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ASSESSING WOODY SPECIES COMPOSTION AND COMMUNITY PERCEPTION ON HUNASE PROTECTED NATURA FOREST, GIBE WOREDA, HADIYA ZONE, SOTHERN ETHIOPIA

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Abbreviations and Acronyms

FAO	Food and Agricultural Organization
GPS	Global position system
GWARDO	Gibe Woreda Agricultural and Rural Development Office
IPCC	Intergovernmental Panel for Climate Change
MEA	Millennium Ecosystem Assessment
SNNRS	Southern Nation Nationalities and regional state
TEEB	The Economics of Ecosystems and Biodiversity
UNFCCC	United Nations Framework Convention on Climate Change
USNF	United State National Forests

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Abstract

The study aimed at identifying and documenting woody species composition on the sites far from the settlement and near to the settlement. . Data were gathered through semi-structured interviews, field observation and group discussion. The number of plants from an area of 20m ×20m (400 $m^{2)}$ from each of the 18 systematically selected plots along transects were counted in both sites. A total of 72 informants between the ages of 19and 80 provided their perception on the woody species. Shannon, alpha and beta diversity indices were used to determine woody species diversity. The results of comparative assessment of woody plants showed that the plant density and species diversity in area where far from settlement were significantly higher by 196 density and species diversity was 134.5% than in adjacent area, near to the settlement. The apparent higher diversity was confirmed by higher Shannon diversity index of 2.89 in the site where far from the settlement than index of 2.21 in the site where near to the settlement. Furthermore, community developed positive attitude to protecting forest because of multiple benefits they are getting from forest. It is concluded that protecting forest significantly improved soil fertility; and species diversity and plant density relative to adjacent exposed site. Thus, forest protecting is easy to practice and cost effective means of rehabilitating degraded biodiversity, it should be promoted further in areas of Ethiopia where the problem of forest degradation occurs.

Keywords: - Anthropogenic Impact Protecting Forest, Soil Fertility, Woody Species Diversity.

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the study

The basic human life-support systems- of the biological environment have always been characterized by change and inevitable consequence of all human land use throughout history *(*Mather, 1986*).* Seemingly natural ecosystems have been altered significantly by humans at some point in the past (Turner *et al*., 1990*).* The Millennium Ecosystem Assessment (2005) found that over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber, fiber, and fuel.

In recent times, biodiversity has become easy targets for human over-exploitation due to burgeoning human populations and the quest for a better life through improvements in science and technology. Biodiversity, therefore, is being exploited at much faster rates than ever before with negative implications for sustainable human livelihood (Turner *et al*., 1990*).* Wilson (1992) has stated that biodiversity is facing a decline of crisis proportions which could ultimately lead to mass extinctions in the very near future. Evidence indicates that the rate of environmental degradation has increased (*Gyasi et al., 1995*). Previously rich forests being converted to savanna woodland and existing savanna woodlands converted into near desert (Hawthorne & Abu-Juam, 1995).

Activities such as: tree harvesting, which includes cutting plant parts for various human utilizations such as thatching, constructions of animal traps, firewood collection, logging and charcoal burning are main causes for forest lost. At the same time the other activities such as charcoal making and hunting were found at low rates. Still such activities can have a wide negative impact such as deforestation and loss of habitat or even local extinction of wild animals. This is because such activities directly involve cutting of trees and burning which can destroy large forests and lead to desertification (Muyungi, 2007).

Land use practices that resulted to partial or complete removal of forest canopy cover, were identified as cultivation entailed the complete or partial clearances of areas of forest for agriculture through slash and burn techniques, which affected all species and cause fragmentation of the affected forest patches.

The causes of biodiversity loss can be: habitat loss or fragmentation, overexploitation of species, pollution, the spread of invasive alien species, and climate change; all of which have their origins in human demands placed on the biosphere. The resulting erosion of ecosystem services has direct consequences on human well-being since it affects security such as access to resources and basic material needs such as food, shelter, health and clean water (MEA, 2005).

Species are the building blocks of ecosystems, and the health of ecosystems depends on species diversity as well as the abundance of individual plants and animals and the relationships between these. Loss of forest causes ecosystems to become stressed or degraded and ultimately to collapse with loss of the benefits provided to humans and other species. Conversely, more diverse systems are more resilient and better able to recover from natural shocks and anthropogenic pressures (MEA, 2005).

The Economics of Ecosystems and Biodiversity (EEB) study referred to the nature's capacity highlighted that ecosystem conservation and restoration support a range of policy goals including food security, urban development, water treatment, regional development, and climate change mitigation and adaption (EEB, 2010).

In recent years ecologists have turned their attention towards the loss of forest, particularly in tropical forests around the equator where these hotspots are concentrated (*Beck et al., 2002).* Deforestation of tropical forests not only jeopardizes biological diversity but also climate systems of the world (*Schwartzman et al.,2000*).In addition to high species diversity and endemism, tropical forests are also home to rural communities in need of economic sustainability.

Conservation of tropical forest is thus one of the greatest human challenges involving delicate balance between complex-fragile ecosystems, and impoverished populations. Consequently,

shifting cultivation remains the biggest threat to tropical forests (Myers, 1994). In Ethiopia deforestation and subsequent unsustainable agricultural management reduced primary productivity and biological diversity (Mulugeta *et al.*, 2005). Hunase forest is highly valued for its economic and other ecological services. Despite all these services, forest removal will apparently continue for some time to come for the simple reason that forest is still the principal source of construction materials and firewood for the rural and urban population. It is also under extreme pressure from settlement, land- use conversion for farming and grazing, excessive extraction and neglect in terms of forest management and protection.

1.1. Statement of the problem

The Hadiya people, in Gibe District are highly dependent on various woody species for multifarious requirements. The existence of various plant resources are however, currently in danger due to environmental degradation, deforestation, cutting and cultural shifts. This study has, therefore, been initiated to assess woody species composition natural forest in Gibe district Hunase forest.

There is high dependence of society on that forest for their better life. Activities which negatively affect the protected areas are agricultural and other commercial activities such as timber production, charcoal production, fire wood collection and others. The study was designed to address the following research questions.

1.2. Research Questions

1. What woody species differences are observed in the parts of the forest when it is far from the settlement and exposed to the human impact?
2. What is the density and frequency of woody species in the site which is far from the settlement and the site near to the settlement?
3 What are the perceptions of the society toward protecting forest on the study area?

1.3. Objectives

1.3.1. General Objective

The general objective of the study was to assess the woody species composition of Hunase protected natural forest and community perception in Gibe Woreda, Hadiya Zone.

1.3.2. Specific Objectives

1. To compare Composition of woody species in the site far from settlement and the site near to settlement.
2. To calculate density and frequency of woody species and compare with the site which is far from the settlement and the sites which are near to the settlement.
3. To assess the perception of the community toward protecting forest.

1.4. Significance of the study

This research gives some information that helps decision makers on the area about forest conservation and related problem. The study also helps for the studying point of anyone to conduct farther and detailed research around this topic or for direct intervention of the problem. It is also used as a literature review for future research which would be conduct around this topic. It is expected to strength the relationship between the environment and the surrounding society regarding to woody species conservation and using the resource in sustainable way.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Anthropogenic Impacts on Forests

2.1.1. Deforestation

Deforestation is the conversion of forest to an alternative permanent non-forested land use such as agriculture, grazing or urban development (van Kooten and Bulte, 2000). It is primarily a concern for the developing countries of the tropics (Myers, 1994). As it is shrinking areas of the tropical forests it contains only few numbers of species (Barraclough and Ghimire, 2000). Causing loss of biodiversity and enhancing the greenhouse effect (Angelsen *et al*., 1999).

According to Myers (1992) the annual destruction rate seems set to accelerate further and could well double in another decade. Mostly deforestation has occurred in the temperate and sub-tropical areas. Deforestation is no longer significant in the developed temperate countries now and in fact many temperate countries now are recording increases in forest area (FAO, 2010).

Forests cover almost a third of the earth's land surface providing many environmental benefits including a major role in the hydrologic cycle, soil conservation, and prevention of climate change and preservation of biodiversity (Sheram, 1993). Forest resources can provide long-term national economic benefits. For example, at least 145 countries of the world are currently involved in wood production (Anon, 1994a). Sufficient evidence is available that the whole world is facing an environmental crisis on account of heavy deforestation.

2.1.2. Conversion of Forests to commercial and residential use

The worldwide conversion of forest land to commercial and residential use is increasingly affecting the ability of ecosystems to provide basic services to humankind (Foley *et al.*, 2005). Conversion of forest land affects both private and public forest ownerships; for example, Stein *et al*. (2005) documented pressures on United State National Forests (U.S.N.F) from development on neighboring private forest lands, especially in counties that have experienced significant population increases in recent years (Garber-Yonts, 2004).

Predicted increases in population growth over the coming decades are expected to result in steadily increasing fragmentation of currently cohesive forest lands (Plantinga *et al.*, 2007). This development can potentially reduce the goods and services derived from both public and privately owned forests. However, the extent to which the goods and services produced by forests are compromised by development is difficult to predict because human impacts on natural systems are not fully understood and are rarely straightforward (Plantinga *et al.*, 2007).

The effects of forest conversion on wildlife arise from the reduction and fragmentation of formerly contiguous habitat. In many circumstances, the areas bordering large sections of public and private forest lands serve as buffers, increasing the amount of core habitat available within the forest. These buffers act as the forest edge and shelter core areas from edge effects that can arise from predators and nest parasites associated with non forest habitat (Riitters *et al*., 2002).

A major concern is that the conversion of forests to residential and commercial use brings more roads and utilities, which effectively shrink or eliminate forest buffers. Consequently, forest conversion increases the proportion of edge and decreases the amount of core habitat within forested landscapes (Butler *et al.*, 2004). As with timber, much research has shown that an increased proportion of edge to core habitat can promote edge species and introduce non-native wildlife, often at the expense of native species (Danielson *et al., 1997).*

2.1.3. Reduction of species numbers

Many species are negatively affected by the loss and fragmentation of forest habitat, including large mammals (Costa *et al.*, 2005) and Neo tropical migratory songbirds (Askins, 2002). Songbirds have received particular interest in ecological science and are often considered indicators of ecosystem quality. Edge effects arise in conjunction with the boundary between natural environments and are particularly important for many songbird species (Askins, 2002).

For many birds, breeding success is higher in core forest, defined as the interior area of a forest patch beyond the reach of edge effects (Askins, 2002). The breeding success of many bird species is affected by edge because of the increased proximity of nesting habitat to predators (e.g., house cats) and nest parasites (e.g., the brown-headed cowbird (*Molothrus ate*). The ecological literature has shown that edge effects can extend from 50 m (160 ft) to 300 m (984 ft) into forest patches for forest-nesting birds (Van Horn *et al.*, 1995).

In addition to terrestrial species, forest conversion along lake shorelines can yield numerous effects on aquatic species associated with lakes. Converting forested shoreline to development can result in new residents clearing sunken logs along their shoreline property. Such sunken logs serve as habitat for a variety of aquatic species (Christensen *et al*., 1996).

Shoreline forest conversion has also been shown to lead to a reduction in the growth rates of sport fish such as bluegills (*Lepomis macrochirus*) (Schindler *et al*., 2000). And potentially result in localized extinctions of amphibian species such as green frogs [*Rana clamitans melanota*], other amphibians have also been shown to be affected by non-shoreline forest conversion (Kolozsvary, 1999).

Last, forested shoreline that is converted to development has been shown to coincide with an increase in aquatic species invasions arising from increased recreational use of lakes; unlike plants, many animals are highly mobile and often rely on much larger areas of habitat, which can be broken up or eliminated by the construction of buildings and roads (Hrabik, 1999).

Requiring contiguous areas of habitat across both private and national forest land, many species populations are directly impacted by the conversion of forest to residential or commercial development. The research in this area is very extensive, showing that, in addition to nest paras ties and increased predation by edge species, forest conversion can lead to potential population reductions through the direct loss of forage and breeding areas and increased roadside mortality (Spellerberg, 1998).

2.1.4. Climate Change

Climate change is a reality; it has changed in the past, it is changing at the present, and it will change in the future (Burroughs, 2007). The change of climate could be slow and gradual, rapid and catastrophic, short-term or long term could be at local, regional and global scales; and it could be due to natural factors or anthropogenic factors. The overwhelming majority of climate change researchers have reached the understanding-based on decades of evidence, modeling, and debate that it is extremely likely that human activities are responsible for the rising temperatures

on Earth. Human behavior will continue to be a major factor in climate change (UNFCCC, 2009).

Moreover other evidences showed that the atmospheric concentration of carbon dioxide and troposphere ozone have each increased by 35% during the last 50 years, the concentration of methane risen by about 0.6 ^{o}c. Observed decreases in snow and ice extent are also consistent with warming. Satellite data since 1978 shows that annual average arctic sea ice extent has shrunk by 2.7 (2.1 to 3.3) % per decade, with larger decreases in summer of 7.4 (5.0 to 9.8) % per decade. Mountain glaciers and snow cover on average have declined in both hemispheres; such changes have an effect on different aspects in the whole world (IPCC, 2007).

2.1.5. Agriculture expansion

The economic development of most developing countries depends on the performance of the agricultural sector; rain fed agriculture is the backbone of their economy in these developing countries and the contribution of this sector depends on how the natural resources are managed (World Bank, 2003). The growing human population and demand for agricultural products and the consequent expansion of both commercial and subsistence farming play a large role in causing forest loss (Kissinger *et al*., 2012)**.**

About 60 per cent of the clearing of tropical moist forests is for agricultural settlement (Anon, 1991). With logging and other reasons like roads, urbanization and Fuel wood accounting for the rest (Anon, 1994b). Millions of people live on the tropical forest with less than a dollar a day where a third of a billion are estimated to be foreign settlers. However, as the land degrades people are forced to migrate, exploring new forest frontiers increasing deforestation (Wilkie *et al.*, 2000).

Deforestation is peroxide by the expansion of agricultural land. This is because agricultural land expansion is generally viewed as the main source of deforestation contribution. Shifting agriculture also called slash and burn agriculture is the clearing of forested land for raising or growing the crops until the soil is exhausted of nutrients and/or the site is overtaken by weeds and then moving on to clear more forest. It is been often reported as the main agent of deforestation. Smallholder production in deforestation and the growing number of such producers notably shifting cultivators were the main cause of deforestation (Anon, 1994b).

2.1.6. Illegal Logging and Fuel wood collection

Logging does not necessarily cause deforestation. However, logging can seriously degrade forests (Putz *et al*., 2001). It provides access roads to follow-on settlers and log scales can help finance the cost of clearing remaining trees and preparing land for planting of crops or pasture thus, logging catalyzes deforestation (Chomitz *et al*., 2007).

Fuel wood gathering is often concentrated in tropical dry forests and degraded forest areas (Repetto, 1988). Fuel wood is not usually the major cause of deforestation in the humid tropics although it can be in some populated regions with reduced forest area such as in the Philippines, Thailand and parts of Central America. Fuel wood gathering was considered to be the main cause of deforestation and forest degradation in El Salvador. In the drier areas of tropics, Fuel wood gathering can be a major cause of deforestation and degradation (Repetto, 1990).

2.1.7. Overgrazing

Overgrazing is more common in drier areas of the tropics where pastures degraded by overgrazing are subject to soil erosion. Stripping trees to provide fodder for grazing animals can also be a problem in some dry areas of the tropics; even it is probably not a major cause of deforestation but clear cutting and overgrazing can turn large areas into desert. Animals remove the vegetation and winds finished the job by blowing away the top soil, transforming grasslands into desert. The lands are too infertile to grow crops herding is the only way for us to survive." (Hays, 2008 web page).

CHAPTER THREE

3. MATERIALS AND METHODS

3.1. Study area description

3.1.1. Geographical location

The study was conducted in Hunase forest. it was protected for the several years by the societies of area fearing the cultural believes up to 1987 e,c. The cultural believed ordered if any one who deforest the home of wild animals specially Hyenas if all his cutlets eaten by it . it is protected in 1987e,c. after the protection of the forest by Government it is not kept as much as like the cultural believed ways .the total area of the protected land were 208 hectare .it is protected to making national park. Hunase forest which is located in Gibe Woreda, Hadiya zone, Southern Nation Nationalities and people regional state (SNNRS). It is situated at about 260 km south of Addis Ababa and 30 Km South West from Hossana town. Geographically it lies at 7^0 37'53" -7^0 42'43''N Latitude and $37^0$37'07''-37^0 44'25'' E Longitudes. The altitude of the Gibe Woreda ranged from 1391 to 2500 meters above sea level (m.a.s.l). The altitude of the study sites ranged from 1994 to 2028 meters above sea level. The people of the study area speak Hadiyisa language which belongs to the Cushitic language family. The total area of Gibe Woreda is 41,039 ha (fig 1). (GWARDO, 2013)

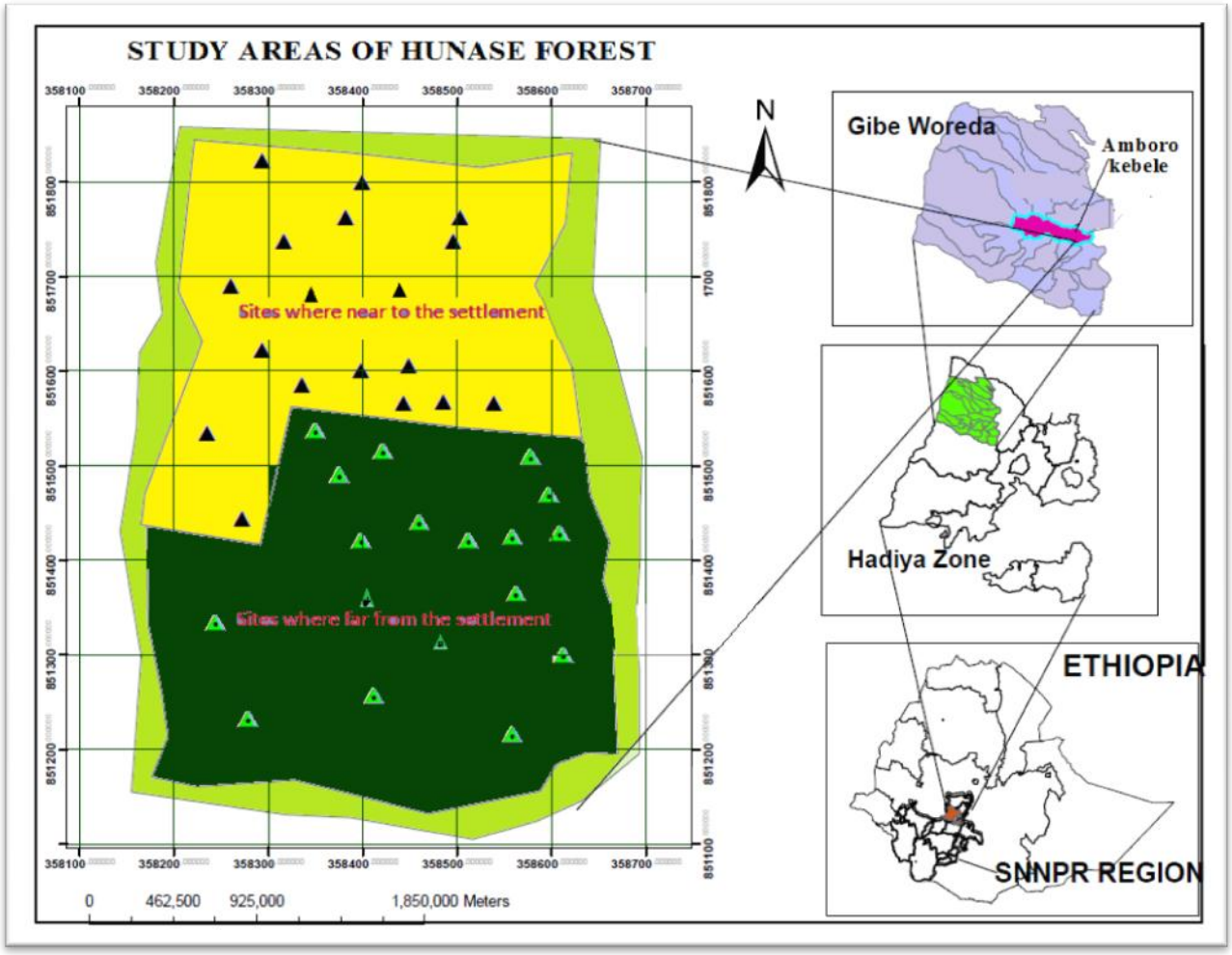

Figure 1: The map of study area

3.1.2. Climate

Based on 1999- 2009 metrological data taken from national metrological service Agency the average maximum temperature in the study area was observed in February (27.8^0C) while the average minimum temperature observed was in December (15.1).

According to the local agro-climatic classifications (GWARDO, 2013), the Woreda has Kola, Woynedega and Dega climatic characteristics with the mean annual rainfall range from 600 to 1200mm. The rainfall in the Woreda is bimodal, which is locally called belg and meher.

3.1.3. Soil **type**

The dominant soil type in the Woreda is Litosoil. Litosoils are deep, well-drained, red, tropical soils. They are generally considered fertile soils. Besides, they are stable soils with favorable physical properties. The deep porous and stable soil structure permits deep rooting and make the soil quite resistant to erosion. Thus, they are the most productive soils to produce the commonly grown food and plantation crops (FAO, 2001).

3.1.4. Vegetation and wild life

The land cover in the woreda is dominated by scattered naturally grown and planted trees and shrubs which are found around settlements, in farmlands, in the forests where far from the settlement. The vegetation in the area has been categorized under the Semi-humid woodland with a mixture of broad and coniferous species like *Podocarpus* (Aalbaek, 1993). These vegetation types are characterized by several species of *Acacia seyal, Acacia saligna, Acacia abyssinica, Croton macrostachyus, Dodonae angustifolia, Euclea schimperi, Phoenix reclinata, Rosa abyssinica, Carissa spinarum, Syzygium guineense, Olea europaena* sub spp (Aalbaek, 1993).. Common wild lives are located such as:-Wild cat, hyena, ape, monke, tighter, deer, fox cheetah and pig.

3.1.5. Population

Based on figures published by the Central Statistical Agency in 2007, the Woreda has an estimated total population of 122,470 of whom 60,912 are men and 61,558 are women (CSA, 2007). According to data obtained from the Gibe Woreda Agriculture and Amiboro Kebele administration office, the communities are settlers around the forest; there are about 150 households from this 143 male house headed and 7 female house headed and the total population of the area are 932 that means total population of the community settler from this 458 male and 474 female (GWARDO, 2013).

3.1.6. Livelihood and economic activities

The people of the area practice various livelihood and income-generating activities mainly crop production and animal husbandry and daily labor. Crop production such as chat, coffee, teff and wheat plays a major role in income generation in the study area. Cereals such as teff, wheat,

maize, barley and sorghum are the major crops grown. Pulses crops, such as, beans and pea are grown to a lesser extent in the area. Enset is the main stable food. A survey of the land in this Woredashows that 68%, is arable or cultivable, 5.3% grazing land, 3.6% degraded land, 8.2% natural and plantation forests, 5.7% cash crops and 9.2% is assigned for settlements. The farmers also keep cattle, equine, but small numbers of sheep and goats are kept by few farmers (GWARDO, 2013).

3.2. Methods of Data Collection

3.2.1. Reconnaissance survey and selection of study site

To achieve the intended objectives, reconnaissance field survey was made to obtain an overview of the study area, before the actual field work.

3.2.2. Plant sampling techniques.

To determine the plant species diversity, species density and plant regeneration status samples were collected from the forest with an area of 24 ha from the total area 208 ha of the forest. A systematic sampling plots design with size of 20 m x 20 m, from the sites which are near to settlement and from the sites which are far from the settlement were established. The distance between consecutive plots along and across the transect line was 100 m. Within each four sided sample plot; the number of individual's seedling, sapling, coppicing and trees/shrubs of different woody species data are collected small sub plots each with 2mx2m. A total of 36 plots (18 with in sites far from the settlement and 18 with in adjacent sites which are near to the settlement) were established.

The specimens of woody species were collected from the two sites are brought to the Jimma University Herbarium. The identification work was performed by using the volumes of Ethiopia and Eretria and other taxonomic literature. Finally the identified specimens were deposited at the Jimma University Herbarium for further reference.

Figure 2 Site where near to settlement.

Figure 3 Site where far to settlement

3.2.3. Sampling of informants

The perception of local community about the forest was collected by the help of house hold surveying, focus group discussion, interview of key informants. A total of 72 key informants were selected purposefully, comprising 47 male and 25 females. The age of the informant are 19-80. They were selected based on age and personal interest. Out of the total key informants, 3 were selected from Woreda experts and 3 were selected from the Kebele administers, development agents, knowledgeable people from the community and development agents. Semi-

structured questionnaire was provided to key informants for collecting qualitative information towards the perception of local communities on the human impact on the forest.

Figure 4 Interview with some of the selected key informants

3.2.5. Field observations

During the study, field observations were performed with the help of key informants (guides selected from among the local people) who were also interviewed. Full notes on the prevailing information about the history of woody species, and how the communities use species for medicinal values, fodder, cultural values and as flues were taken. Field data collection for plant diversity determination was conducted.

3.2.6. Group discussion

The focus group discussions were used for cross check of the reliability of the finding. The participants expressed their own feelings (perceptions), and offered their experiences regarding the human impact on the forest and the problems. A one focus group discussion was conducted. in a group discussion there were 8 participants. The participants of group discussions were selected purposefully taking gender and age into account

3.2.7. Plant species diversity analysis

In species diversity study two components are important: richness and evenness. The species richness refers to the number of species per plot while evenness refers to their distribution within and between the different populations. Species diversity of the woody species in the sites far from settlement and the site near to the settlement were calculated using Shannon diversity index.

Shannon diversity index accounts for both species diversity and evenness in a community (Shannon & Wiener, 1949) Shannon diversity index was computed from the following formula (Kent, 1992).

$$H' = -\Sigma Pi \ln Pi$$

Where: H' = Shannon species diversity index

Σ = Summation symbol

S = the number of species

ln = log base n (natural logarithm)

Pi = the proportion of individuals or the abundance of the i^{th} species (range from 0 to 1).

H is taking to account the number of individuals as well as the number of species. Shannon diversity varies from 0 for a community with only a single species to a high value for a community with many species. For biological communities H does not exceed 5 (Krebs, 1999).

The results are summed across the species and multiply by -1. H is high when it is above 3.0 , medium when it is between 2.0 to 3.0, low when it is between 1.0 to 2.0 , very low when it is smaller than 1.0 (Cavalcanti and Larrazabal, 2004). Evenness (Shannon equitability) index (E) was calculated as follows to estimate the homogeneous distribution of species in plots.

Evenness compares the similarity of the population size of each of the species present; that means it is a measure of the relative abundance of the different species making up the richness of an area. Its value is zero if and only if there is one species in the samples. A high value of evenness indicates that all species in the community have rather similar abundance (Cavalcanti and Larrazabal, 2004*).* A low equitability value means that there is dominance of one or more species in the community. While high equitability means there is a uniform distribution among the species in samples, demonstrating that individuals are well-distributed (Cavalcanti and Larrazabal, 2004)

3.2.8. Plant species density and regeneration analysis

Sapling trees on the forest floor are important determinant of forest regeneration.
The quantitative structural analysis was made using data from density, abundances, frequency of distribution of each species in the study sites. The population structure sometimes called plant species regeneration status was analyzed using data from plant number distribution (regeneration distribution). The purpose of using counting plant number was enabling to investigate the regeneration status of the plant species (Pagiola, 2002). Population structure of all woody species in the entire sample plot was analyzed by counting plant number. The frequency tabular was constructed for each number of woody species taken to the plot into consideration. count into hectare basis; Species density; was determined by counting the number of individuals in the sample plots and converting the

$$\textbf{Density of a species} = \frac{total\ number\ of\ individuals\ of\ a\ specie}{sample\ size\ in\ hectare}$$

$$\textbf{Frequency} = \frac{number\ of\ sample\ plot\ in\ which\ a\ tree\ occur}{total\ sample\ plots\ survey}$$

Coefficient of Jaccard (Sj); to measure the similarity of site where far from the settlement and site where near to the settlement in species composition, the binary similarity coefficient employs presence and absence of species data in a community was used. The Sj gave the percentage of similarity of plant species between two communities. In this study coefficient of Jaccard, which was one of the most commonly used binary similarity coefficient was employed by the formula (Krebs, 1999).

$$S_j = \frac{[\quad c \quad]}{a+b+c} \times 100$$

Where; a = total number of species in the site where far from settlement.

B = total number of species in adjacent degraded site where near to the settlement.

C = the number of species common in both sites.

Height

Height is the straight forwards parameters use for direct measurement of woody species. It is the way that the distance from the observer to the tree was measured. The angle that found between the viewer and the tip of a tree was measured and recorded.

3.2.9. Data Analysis

The collected data was compiled, entered and analyzed using Microsoft excel. Compare the woody species diversity in the site far from the settlement and in the site near to the settlement. The tree species richness (the number of species) was determined by summing up the number of species identified within each site. Shannon-Weiner diversity index was used to quantify woody species diversity and evenness index. Shannon-wiener diversity index accounts both for species richness and evenness and it is not affected by sample size (Kent and Coker1992). Data on the perception of local commonly were entered into Excel spread sheet and analyzed using descriptive statistics such as percentage and frequency to analyze and summarize the data on the woody species plants.

3.2.10. Socio-economic survey

Socio-economic survey was carried to assess perception of local community toward impacts on the forest.

Respondents were selected purposely with the help of woreda agricultural experts, who have extensive experience and knowledge of the study area. We used sampling techniques to select respondents from the population of 300. The sample size was determined by using Yamane's simplified formula.

As result to determined sample size for this study, I used simplified Yamane's formula to get sample size.

$$n=N/1+N(e)^2$$

Where: - n = the sample size

N = population size

E = the degree of error

Then n = $\frac{300}{1+300(0.05)^2}$: 172

N = 172 (sample size).

The interview was conducted either at home or farmland. In this survey a total of172 sample households were selected by taking 14% of the total households. The interview was carried out using both structured and semi-structured questionnaires. The study was used both key informants and focus group discussion.

CHAPTER FOUR

4. Result and Discussion

4.1. Composition of woody species

A total of 31 woody species within 22 families were recorded in site far away from the settlement and 13 woody species in site near to the settlement and also 617 and 208 individuals plants were recorded from plots of both sites. In the site where far from the settlement, the growth stage of plant species recorded includes 65.5% seedling, 19.1 % sapling, and 15.4% trees/shrubs (table 1 and appendix 1) and the number of species recorded per plot varies from zero to sixteen. Whereas, in the site near to the settlement, 21.6% seedling, 0% sapling, 72.6% coppicing and 5.8% trees/Shrubs and the number of species recorded per plot varies from zero species to six.

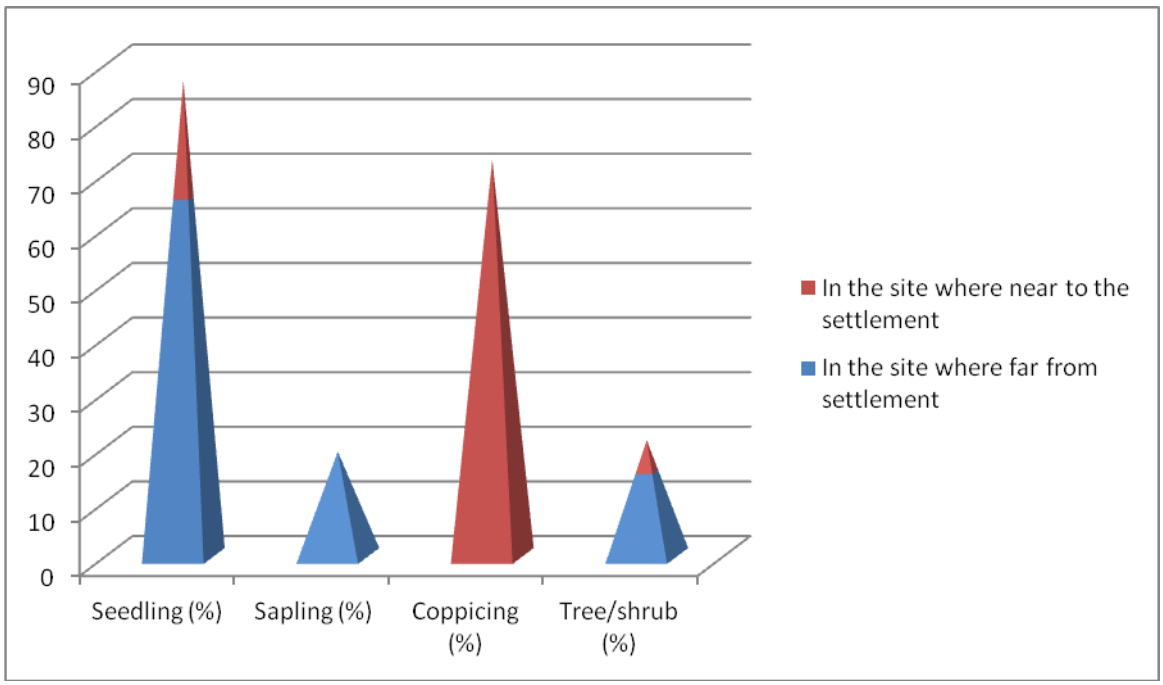

Figure 5 Total number of plants species and their proportions of plants growth stage

The sites far from the settlement, 17.5% of the species recorded belongs to Fabaceae family that includes *Acacia Saligna, Albizia schimperiana, Entada abyssinica, Erythrina abyssinica and Millettia ferruginea* while the *Boraginaceae, Celastraceae, Euphorbiaceae, Flacourtiaceae* and

Myrtaceae families each have different species which covered 2.8%, 9.4%, 9.7%, 15.4% and 3% respectively.

Whereas the remaining each of the 16 families comprised one species. In the site where near to the settlement, the plant families recorded were poorly represented (appendix 3).

The total number of individual plants was 617 in the site far from the settlement and 208 in the adjacent site near to the settlement. This indicates that more species might be affected by disturbances of human and animal interference and seedling removal by erosion and soil compaction in the site near to the settlement but it can be restored when disturbance reduced. This finding is in agreement with that reported by Kidane (2002) that species richness in area enclosures which is not exposed to the human impact was higher than adjacent degraded site which is exposed to impact. This higher proportion of plant species in the site where far from settlement suggests the existence of an active succession of plant species in the sites as a result of restriction from anthropogenic impact.

Dovyalis caffra, Grevellia robusta, Entada abyssinica and Croton macrostachyus, which account high number when compared with other woody plants in the site far from the settlement throughout the sample plots are highly influenced on the richness on the site where near to the settlement (appendix, 2). The more richness in the given area means the more species, apart from the number of individuals in a given species. This indicates that these plants are focused species for different activities of the society.

4.1.1. Diversity of plant species

Shannon diversity index result revealed that the plant species in the sites far from the settlement and adjacent sites near to the settlement were 2.98 and 2.21. The diversity of plant species in the site far from the settlement was higher than in site near to the settlement. The species richness (total number of individual species in a community) in the sites far from the settlement and adjacent sites near to the settlement were 31 and 13 respectively.

The diversity indices Shannon for plant species are higher in the sites far from the settlement (2.98 and 31) than in the sites near to the settlement (2.21 and 13). A higher diversity index (Shannon) indicates that there was better species diversity in the sites far from the settlement than in the sites where near to the settlement. The higher value of Shannon and Alpha index indicates that the sites where far from the settlement are a good implement to the management of all parts of the forest.

The finding of this study is in agreement with that reported by Cavalcanti and Larrazabal, (2004). Plant species in terms of Shannon index in both area enclosures and adjacent degraded site was medium (H ranges from 2 to 3).

Table 1: Comparison of diversity indices of plant species in the sites far from the settlement and sites where near to the settlement.

Diversity indices	**The sites far from the settlement**	**The sites near to the settlement**
Shannon diversity(H)	2.98	2.21
Evenness (J)	0.87	0.85
Species Richness(S)	31	13

Higher species abundance was observed in the sites far from the settlement than the adjacent sites where near to the settlement. This was due to many individual plant species present in the sites where far from the settlements than the sites where near to the settlements. This result is agreed with the findings of Lecointre and Guyader, (2001) and Harrison *et al*. (2004) argued that an ecosystem where some species are represented by many individuals and other species are represented by very few individuals have high and low species evenness, respectively.

Species evenness in the site far from the settlement (0.87) was higher than in the sites near to the settlement (0.85). The sites far from the settlements are not exposed to anthropogenic impact; therefore, the environment of each species resulted in their better abundance (table 2). Conversely, sites near to the settlement are exposed to human impact; therefore some species are represented by many individuals, and other more species are represented by very few individuals had low species evenness.

As evenness compare the similarity of the population size for each of the species present. A low value of evenness indicates that the one or few species are highly dominant, while others were present with few individuals (Cavalcanti and Larrazabal, 2004). Hence dominance inversely related to evenness and richness. The finding of this research indicates that the sites where near to the settlement are less diverse than sites where far from the settlement.

4.1.2. Density, frequency and similarity of woody species

The total numbers of families and their corresponding species, their densities and frequencies recorded in the study sites are presented in table 3. The density of plant species in the site which is far from the settlement and site which is near to the settlement were 856.9 and 288.89 individuals/ ha respectively. The density of plants in site which is far from the settlement was higher by 196 % than in adjacent site where near to the settlement.

On the other hand, in sites which is near to the settlement, *Dovyalis caffra* is the most dominant plant species with 65.35% followed by *Croton Macrostachyus* 58.33%, *Eucalyptus globulus* 34.72%, *Dovyalisa abyssinica* 26.38%, *Clausena anisata* 22.22%, *Dodonaea viscosa* 19.44%, *Acacia abyssinica* 23.61% *Albizia gummifera* 9.72%, *Etada abyssinica* 11.11%, *Maesa lanceolata* 6.94%, *podocarpus falcatus* 5.56%, *Ehretia cymosa* 2.78% and *Rhamnus prinoides* with 2.78% individuals.

Frequency is defined as the probability or chance of finding a species in a given sample area or plot (Kent and Coker, 1992). The frequencies of occurrence plant species at the site where far from the settlement and the sites where near to the settlement were variable. Most frequently occurred plant species in the sites where far from the settlement was Dovyalis caffra, with the

frequency of 83.3%. The second highly distributed species in sites where far from the settlement was Croton Macrostachyus 72.2%, followed by Albizia gummifera, Apodytes didimiata and Dodonae Viscosa each were 44.4% and frequency of the remaining species is less than 38.9%.

On the other hand, the most frequently occured plant species in the sites where near to the settlement were *Dovyalis caffra* and *Croton macrostachyus* with the frequency 66.67% and the second highly distributed species were *Clausena anisata* and *Eucalyptus globules* 33.3% (table 3). A total of 31 species and 22 families were recorded in the site far from the settlement. However the families recorded in the site near to the settlement does not include: *Lamiaceae, Anocardiaceae Araliaceae, Leguminosae, Oleaceae, Rhamnaceae, Rosaceae, Rutaceae, Moraceae, Myrtaceae, Proteaceae and Ulmaceae* (table 3).

The similarly index indicates that there was similarity between the two sites. The coefficient of Jacarrada (Sj) indicates the two sites species similarity. It shows that the sites far from the settlement and sites near to the settlement are similar by 22.25% of the species.

Table 2: shows that the density, frequency and similarity of woody species recorded in the far from the settlement and adjacent sites.

S/N	Plant species	Family name	Sites where far from settlement		Sites where near to the settlement	
			Density/ha	Frequency (%)	Density/ha	Frequency (%)
1	*Acacia abyssinica*	Fabaceae	41.7	33.3	23.61	22.22
2	*Acacia Saligna*	Fabaceae	29.2	27.8	-	-
3	*Acacia Seyal*	Fabaceae	16.7	11.1	-	-
4	*Albizia gummifera*	Fabaceae	38.9	44.4	9.72	27.78
5	*Albizia schimperiana*	Fabaceae	12.5	38.9	-	-
6	*Apodytes dimidiate*	Icacinaceae	26.4	44.4	-	-
7	*Byrsonima crassifolia*	Malpighiaceae,	30.6	11.1	-	-
8	*Celtis africana*	Cannabaceae	5.6	16.7		
9	*Clausena anisata*	Rutaceae	30.6	27.8	22.22	33.33

10	*Cordia africana*	Boraginaceae	15.3	33.3	-	-
11	*Croton Macrostachyus*	Euphorbiaceae	77.8	72.2	58.33	66.67
12	*Dodonaae angustifolia*	Sapindaceae	31.9	44.4	19.44	22.22
13	*Dovyalis abyssinica*	Salicaceae	9.7	27.8	26.38	27.78
14	*Dovyalis caffra*	Salicaceae	108.3	83.3	65.28	66.67
15	*Ehretia cymosa*	Boraginaceae	8.3	22.2	2.78	11.11
16	*Entada abyssinica*	Fabaceae	91.7	33.3	11.11	5.55
17	*Eucalyptus globules*	Myrtaceae	12.5	16.7	34.72	33.33
18	*Erythrina abyssinica*	Fabaceae	9.7	11.1	-	-
19	*Ficus sur*	Moraceae	8.3	27.8	-	-
20	*Grevillea robusta*	Proteaceae	100	27.8	-	-
21	*Maesa lanceolata*	Myrsinaceae	18.1	38.9	6.94	22.22
22	*Millettia ferruginea*	Fabaceae	4.2	11.1	-	-
23	*Podocarpus falcatus*	Podocarpaceae	22.2	38.9	5.56	22.22
24	*Polyscias fulva*	Araliaceae	2.8	11.1	-	-
25	*Prunus africana*	Rosaceae	5.6	16.7	-	-
26	*Ocimum gratissimum*	Lamiaceae	12.5	27.8	-	-
27	*Olea* **europaena**	Oleaceae	15.3	5.6	-	-
28	*Rhamnus prinoides*	Rhamnaceae	8.3	5.6	2.78	11.11
29	*Rhus vulgaris*	Anocardiaceae	5.6	16.7	-	-
30	*Syzygium guineense*	Myrtaceae	9.7	22.2	-	-
31	*Vernonia amygdalina*	Asteraceae	5.6	16.7	-	-

4.1.3. Population structure of plant species

Density and abundance of plant species were higher in the sites far from the settlement and less in the adjacent sites near to the settlement, because it was found at the stamp or coppicing stage (table 4). The difference observed in seedling, sapling and tree/shrubs size stages at sites where far from the settlement showed the positive effects on plant species restoration when it is free from the anthropogenic impact.

The few seedlings, absence of sapling and few tree/shrubs individuals in the site near to the settlement are indication of increased exposure or susceptibility of seedling damage by animal and/or human at their early stage. Those individuals in the sites near to the settlement are either cut at their early age for various purposes by the local community or grazed by their domestic animals, unable to resist water shortage during dry season and sun burn unavailability of shade from mother trees. Most plant species from the *Fabaceae* family are commonly the favored fuel wood sources because of their high calorific values, and also used as sources of fodder for cattle and other domestic animals especially during dry seasons.

There was no disturbance in the sites where far from the settlement; proportions of individuals at seedling and sapling stage in these sites were higher than the sites where near to the settlement. The proportions of trees/shrubs individuals were few in number in the sites where far from the settlement, but still better than adjacent sites where near to the settlement, there was very few tree individuals recorded in the adjacent degraded site.

Structure and composition differences of the two sites appear from human and /or livestock disturbances (sites where near to the settlement) and absences (sites where far from the settlement). The result showed that protecting of the degraded sites from human and animal disturbances (anthropogenic impact) promotes plant species regenerations and productivity.

Table 3: proportion of seedling, saplings, and stamp and trees all plot in the sites where far from the settlement and adjacent sites where near to the settlement.

Species name	**The sites where far from the settlement**				**The sites where near to the settlement**			
	Seedling	*sapling*	*coppicing*	*trees/ shrubs*	*Seedling*	*sapling*	*coppicing*	*trees/ shrubs*
Acacia abyssinica	16	6	0	8	2	0	13	2
Acacia saligna,	14	2	0	5	0	0	0	0
Acacia seyal	8	0	0	4	0	0	0	0
Albizia gummifera	17	6	0	5	2	0	5	0
Albizia schimperiana	6	2	0	1	0	0	0	0

Apodytes didimiata	11	6	0	2	0	0	0	0
Byrsonima crassifolia	17	3	0	2	0	0	0	0
Celtis africana	3	0	0	1	0	0	0	0
Clausena anisata	17	3	0	2	7	0	9	0
Cordia africana	7	2	0	2	0	0	0	0
Croton macrostachyus	41	12	0	5	16	0	23	3
Dovyalis abyssinica	5	0	0	2	5	0	19	0
Dovyalis caffra	62	11	0	5	11	0	36	0
Ehretia cymosa	4	0	0	2	0	0	2	0
Entada abyssinica	52	14	0	0	0	0	8	0
Erythrina abyssinica	5	3	0	1	0	0	0	0
Eucalyptus. camaldulensis	0	4	0	8	0	0	19	6
Ficus sur	0	0	0	4	0	0	0	0
Grevillea robusta	50	18	0	14	0	0	0	0
Maesa lanceolata	7	4	0	2	0	0	5	0
Millettia ferruginea	2	0	0	1	0	0	0	0
Podocarpus falcatus	8	4	0	4	0	0	2	2

Polyscias fulva	0	1	0	1	0	0	0	0
Prunus africana	2	0	0	0	0	0	0	0
Ocimum gratissimum	7	2	0	0	0	0	0	0
Olea europaena	7	4	0	0	0	0	2	0
Rhamnus prinoides	3	3	0	0	0	0	0	0
Rhus vulgaris	2	1	0	1	0	0	0	0
Syzygium guineense	4	2	0	1	0	0	0	0
Vernonia amygdalina	2	1	0	1	0	0	0	0
Total	402	118	0	97	45	0	150	13

4.1.4. Socio-Demographic Background of Respondents

Among the total number of respondents as the data shown in Table 4.1, about 62.2 % of the respondents were male and 37.8 % were female. The age of the respondents were categorized in four, i.e. 15 – 35 years, 36 – 45 years, 46 – 65 years and 65-90. As indicated in table 4, majority of the respondents, (about 64.5%) were found between ages 45-65 years; whereas about 17.4 % in age category of 65-90, 11.6 in age 36-45 and the rest (about 6.4 %) were in the age category of 15–35 years.

Table 4.1: Distribution of Sex and Age of the respondents

Variables	**Frequency**	**Percentage**
Sex		
Male	107	62.2%
Female	65	37.8%

Total	**172**	**100%**
Age		
15-35	11	6.4%
36-45	20	11.6%
46-65	111	64.5%
65-90	30	17.4%
Total	**172**	**100%**

As far as marital status is concerned, about 76.2 % respondent were married, and the rest 20.9 % are single and 2.9 are widowed (Table, 4.2). Out of the total respondents, 87.2 % were unable to read and write, 2.9 % attended primary school, 5.8 % attended secondary school and 4.1 % were diploma holders and above.

4.1.5. The perception of local community on protecting the forest

The study results revealed that 87% of the respondents have a positive attitude towards the forest to be protected. Whereas 12.2 % have negative attitudes in the forest protecting in their locality due to lack of access for livestock grazing and the government policy restricts their free access to this forest if it is enclosed.

The Majority (65.7%) of respondents said that the forest was selected and protected from interference of humans and livestock by both government and local community, 10.5% of the respondents said that selected and protected by government and 23.8 % of respondents said that selected and protected by local communities.

The majority of respondents (90%) of the households have perceived a positive attitude on the establishment of forest protecting for their lives and livelihoods improvement and agreed in protecting the interference of human and livestock while only 10 % of them have no understand on the benefits of the forest protecting but they didn't have negative attitudes. This implies that

most of the local communities have participated in planning and implementation of the program and they were observed the changes of protected forest.

The majority of the respondents (90%) and all the key informants perceived that there is a difference in plant vegetation coverage located in the sites far from the settlement and adjacent sites near to the settlement. However, 10% of the respondents perceived that there was no understanding the difference in the sites where far from the settlement and adjacent sites where near to the settlement.

The respondents agreed that 90% deforestation of forest resources and soil erosion higher in the part of forest near to the settlement. The decline of forest resources that mentioned was occurred because of poor land management, deforestation, population growth and expansion of agricultural lands. Participants also agreed that decline of forest resources cause soil erosion and declines the soil fertility and land productivity while few of them 10% didn't understand causes and effects of decline of forest resources. They concluded that, protecting the forest increases plant diversity and vegetation converges and improved soil fertility; reduces soil erosion in their locality.

4.1.6. The contribution of protecting forest to livelihood income generation

The local communities have access of the main forest products such as dead plant branches, grass and medicinal plants. The majority of participants (85%) agreed that the grasses for house construction and fodder for livestock through cut and carry systems had increased if the forest is protected while few of them 15% argued that they don't get access because the forest is protected.

Table 5: Access of local community to benefits from the Hunase forest

Resources/benefits	**Can get access**		**Cannot get access**	
	Frequencies	(%)	Frequencies	(%)
Forage	17	85	3	15
Fuel wood	12	60	8	40

Medicinal access	3	15	17	85
Demonstration site for training DA and model farmers	20	100	0	0

4.1.7. The management methods of protected forest

The majority of respondents (70 %) agreed that the owners (responsible) of the forest concerned the local community and government but few of respondents (15%) agreed that, responsible of government and (15%)agreed that it concerned local communities. Regarding the management 88.4% of the respondents said kebele administration managed, 5.8% agreed the Committee of forest and 5.8 % of the respondents agreed that the forest is managed by government bodies from Woreda experts.

The majority of respondents said that 90% of local communities involved into the management of forest whereas (10%) of they didn't participated. In addition, respondents said that 95% understand the law and (5%) don't understand the law. Woreda experts, the Committee and Kebele administer meet once in two months. During meeting, the Woreda experts, Committee and Kebele administration bodies discuss on the problems of managements and solves the problems, to sale the grasses if the grasses reach for harvesting, auditing the income from punishment of illegal users and from the sale of grasses. They also discuss for the future activities and arrange plan. The punishment of the illegal users is accepted by all local communities.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusions

The study was conducted Amiboro kebele, Gibe woreda Hadiya zone for Assessing woody species compostion and community perception. Forty four woody species belong to the 51genera and 25 families were collected and identified from both site of settlement. From far site to the settlement *Acacia saligna, Albizia Schimperiana* and *Erythrina Abyssinica* are most dominant. From near to settlement *Dovyalis Caffra, Croton, Macrostachyus, Eucalyptus globules* and *Dovyalisa Abyssinica* are the most dominant. There are 825 individual trees recorded in the study sites out of these 617 individual woody plants in the site far from settlement and 208 individual plants in the site near to the settlement. Different floristic composition and species diversity observed in the forest where far from the settlement

The comparison made between in the forest where far from the settlement and adjacent site where near to the settlement showed that composition, density, richness, diversity of plant species and structure difference were improved in the forest if it is protected from anthropogenic impact. This shows that the vast degraded areas in the study area can quickly and cheaply be restored if the degrading agents such as human and animal disturbances are managed. Although there is recorded data on original floristic composition of the degraded site, all are under the stamp/coppicing stage. So this study provides evidence that the degraded site has resilience to maintain plant species of diversified floristic composition and could use as conservation sites if they are protected well and managed in a sustainable way.

Due to protection and establishment large gullies around the protected forest have stabilized. From management point of view, the protection require much attention from all concerned bodies: the fragmented farm and degraded land size, population size increment, lack of concern from the government, and other similar factors might force the communities not to keep the forest sustainably in the future. Ecological restorations through natural regenerations may need interventions in the management to maintain and diversify the outcomes from the interaction of environmental components.

5.2. Recommendations

Based on the major findings of the study the following recommendations are forwarded. For addressing the problem successfully, conserving the forest and enrichment planting should be implemented by the concerned bodies: namely government, non-governmental organizations, researchers, extension workers, administrative bodies, and local people.

- Protecting management will only succeed if all stakeholders are fully aware of own impact on it and are held accountable for their actions.
- Building the communities capacity through provision of adequate training and experience sharing by visiting similar areas in the country could be better way of promoting forest protecting as an option of improving the overall ecological conditions of degraded lands.
- Protecting forest is a natural/passive rehabilitation conservation measure, it takes a long period of time before it starts giving returns, so based on further scientific study and community interest; integration of productive species in the form of enrichment planting is helpful to diversify income sources of local communities.
- Awareness should be made among the user of woody useful plant species in order to avoid the loss of or erosion of the indigenous knowledge and ensure the documentation and sustainable use of the species
- The local people should develop the habit of using plants wisely for other miscellaneous purposes in addition to food, fodder and traditional medicine to save the useful plant species from extinction.
- Educate through raising awareness of the young generation so that they avoid negative impacts on the woody plants and the associated knowledge in the study area, and hence, documentation of the food, fodder and traditional medicinal plant species of the area to continue.
- Modern agro biodiversity conservation activates should be linked to local knowledge.

  Local authorities' serious attempts for conserving woody plants by both insitu and ex situ Conservation methods using modern technologies,

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APPENDICES

Appendix 1: Plant species recorded per sample plots in the site where far from the settlement

Species name	***Plots***																		***Total***
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	
Acacia abyssinica	*0*	*0*	*0*	*4*	*11*	*7*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*3*	*0*	*0*	*3*	*30*
Acacia Saligna,	*0*	*0*	*2*	*2*	*12*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*3*	*21*
Acacia Seyal	*0*	*0*	*0*	*5*	*7*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*12*
Albizia gummifera	*0*	*0*	*2*	*0*	*0*	*0*	*4*	*5*	*7*	*2*	*2*	*0*	*0*	*0*	*4*	*0*	*0*	*2*	*28*
Albizia schimperiana	*2*	*0*	*3*	*0*	*2*	*0*	*0*	*1*	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*9*
Apodytes dimidiata	*0*	*2*	*1*	*0*	*0*	*3*	*2*	*3*	*4*	*3*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*19*
Byrsonima crassifolia	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*14*	*8*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*22*
Celtis africana	*0*	*0*	*0*	*0*	*1*	*0*	*1*	*0*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*4*

Clausena anisata	*0*	*2*	*0*	*4*	*0*	*4*	*0*	*0*	*8*	*0*	*0*	*0*	*4*	*0*	*0*	*0*	*0*	*0*	*22*
Cordia Africana	*0*	*0*	*0*	*1*	*1*	*0*	*2*	*2*	*4*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*11*
Corton macrostachyus	*4*	*7*	*2*	*0*	*5*	*7*	*5*	*1*	*14*	*0*	*0*	*2*	*1*	*0*	*0*	*3*	*4*	*1*	*56*
Dodonae Viscosa	*0*	*0*	*2*	*0*	*0*	*3*	*0*	*0*	*0*	*0*	*3*	*2*	*0*	*0*	*2*	*5*	*3*	*3*	*23*
Dovyalisa Abyssinica	*0*	*0*	*0*	*0*	*1*	*2*	*0*	*0*	*1*	*2*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*7*
Dovyalis caffra	*3*	*5*	*0*	*4*	*6*	*12*	*9*	*4*	*7*	*13*	*6*	*3*	*1*	*0*	*9*	*0*	*5*	*1*	*88*
Ehretia cymosa	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*1*	*1*	*0*	*3*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*6*
Etada abyssinica	*0*	*0*	*0*	*21*	*18*	*12*	*6*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*16*	*3*	*0*	*0*	*76*
Erythrina abyssinica	*0*	*3*	*0*	*0*	*2*	*4*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*9*

Eucalyptus gubaldulensus	*4*	*3*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*7*
Ficus sur	*0*	*0*	*0*	*1*	*0*	*1*	*1*	*0*	*0*	*2*	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*6*
Grevillea robusta	*0*	*12*	*16*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*32*	*13*	*9*	*82*
Maesa lanceolata	*0*	*0*	*0*	*2*	*0*	*1*	*0*	*1*	*0*	*2*	*4*	*2*	*0*	*0*	*0*	*1*	*0*	*0*	*13*
Millettia ferruginea	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*3*
podocarpus falcatus	*0*	*4*	*0*	*0*	*0*	*0*	*0*	*2*	*0*	*1*	*2*	*3*	*0*	*0*	*0*	*2*	*1*	*0*	*16*
Poyscias fulva	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*2*
Prunus Africana	*0*	*0*	*0*	*0*	*0*	*0*	*2*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*4*
Olea europaena	*0*	*0*	*1*	*0*	*3*	*0*	*0*	*0*	*1*	*3*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*9*
Ocimum gratissimum	*0*	*0*	*11*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*11*

Rhamnus prinoides	*0*	*0*	*6*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*6*
Rhus vulgaris	*0*	*0*	*0*	*2*	*0*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*0*	*4*
Syzygium guineense	*0*	*0*	*0*	*0*	*1*	*1*	*0*	*0*	*0*	*2*	*0*	*0*	*0*	*0*	*0*	*0*	*3*	*0*	*7*
Vernonia amygdalina	*0*	*0*	*0*	*0*	*1*	*0*	*2*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*4*
Species per plots	*4*	*8*	*10*	*10*	*16*	*13*	*12*	*12*	*13*	*9*	*8*	*6*	*4*	*0*	*8*	*8*	*6*	*7*	*617*

(Source: field survey)

Appendix 2: Plant species recorded per sample plots in the adjacent site, where near to the settlement

Species name	*Plots*																		*Total*
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Acacia abyssinica	4	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4	2	3	17
Albizia gummifera	2	0	0	0	0	0	0	0	0	1	1	0	2	0	0	0	0	1	7
Clausena anisata	0	0	0	0	1	0	2	0	0	4	2	1	1	0	2	0	4	0	17
Corton macrostachyus	2	0	4	0	4	0	7	0	4	4	2	5	0	0	2	2	4	2	42
Dodonae Viscosa	0	0	0	0	3	0	0	0	5	0	4	0	2	0	0	0	0	0	14
Dovyalisa Abyssinica	0	0	2	0	0	0	4	0	0	7	0	0	1	0	3	0	0	2	19
Dovyalis caffra	4	0	3	2	6	0	2	0	0	4	5	3	0	0	8	6	1	3	47
Ehretia cymosa	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2
Etada Abyssinica	0	0	0	0	0	0	4	0	0	0	2	0	0	0	0	0	0	2	8
Eucalyptus glubilasus	3	0	0	7	0	0	0	0	4	0	0	0	0	5	0	0	3	3	25
Maesa lanceolata	1	0	0	0	0	0	0	0	0	1	0	1	0	0	1	1	0	0	5
podocarpus falcatus	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	1	0	4
Olea europaena	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	2
Species per plot	6	0	3	2	5	0	6	0	5	6	6	5	6	1	5	5	6	7	209

Appendix 3: List of plant species and families in the site where far from the settlement and adjacent site where near to the settlement

	Species name	*Family name*	*Nominal name*		*Sites, far from the settlement*	*site, near to the settlement*	*F*N*
			Vernacular name	*Amharic name*			
1	*Acacia abyssinica*	*Fabaceae*	*Girara*	*Bazira-girar*	✓	✓	✓
2	*Acacia Saligna,*	*Fabaceae*	*Gua'a*	-	✓	*0*	*0*
3	*Acacia Seyal*	*Leguminosae*	*Uutam haqaa*	*Wach'u*	✓	*0*	*0*
4	*Albizia gummifera*	*fabaceae*	*Mande*	*Sesa*	✓	✓	✓
5	*Albizia schimperiana*	*Fabaceae*	*Mande lop*	*Sesa*	✓	*0*	*0*
6	*Apodytes didimiata*	*Metteniusaceae*	*Mewwa*	-	✓	*0*	*0*
7	*Byrsonima crassifolia*	*Malpighiaceae*	*Tummunga*	*sanisan*	✓	*0*	*0*
8	*Celtis Africana*	*Cannabaceae*	*Qamali-haqqa*	*Kawoot*	✓	*0*	*0*

9	*Clausena anisata*	*Retaceae*	*Bahiti-haqqa*	*Limich*	✓	✓	✓
10	*Cordia africana*	*Boraginaceae*	*Wedesha*	*Wanza*	✓	*0*	*0*
11	*Cortonmacrostachyus*	*Euphorbiaceae*	*Messena*	*Bisana*	✓	✓	✓
12	*Dodonae Viscosa*	*Sapindaceae*	*Kitikita*	*Kitikita*	✓	✓	✓
13	*Dovyalisa Abyssinica*	*Salicaceae*	*Koshimmi*	*Koshimmi*	✓	✓	✓
14	*Dovyalis Caffra*	*Salicaceae*	*Barawa*	*Barawa*	✓	✓	✓
15	*Ehretia Cymosa*	*Boraginaceae*	*Huallaga*	*Huallaga*	✓	✓	✓
16	*Etada abyssinica*	*Fabaceae*	*Koronitee*	*Konitir*	✓	*0*	*0*
17	*Eucalyptus globulus*	*Myrtaceae*	*Kashar barizafa*	*K. Bahirzaf*	✓	✓	✓
18	*Erythrina abyssinica*	*Fabaceae*	*Wora'a*	*Korch*	✓	*0*	*0*
19	*Ficus sycomorus*	*Moraceae*	*Odda*	*shola*	✓	*0*	*0*

20	*Grevillea robusta*	*Proteaceae*	*Giravilli'a*	*Giravilli'a*	✓	*0*	*0*
21	*Maesa lanceolata*	*Myrsinaceae*	*Kowada*	*K'elewa*	✓	√	√
22	*Millettia ferruginea*	*Fabaceae*	*Hanigada*	*Birbira*	✓	*0*	*0*
23	*podocarpusfalcatus*	*Podocarpaceae*	*Digiba*	*zigiba*	✓	✓	✓
24	*Poyscias fulva*	*Araliaceae*	*Bolife'e*	*Yezinijoro woniber*	✓	*0*	*0*
25	*Prunus Africana*	*Rosaceae*	*Aarrara*	*Tikuri-enicheti*	✓	*0*	*0*
26	*Ocimum gratissimum*	*Amiaceae*	*Damakesse'e*	*Damakesse*	✓	*0*	*0*
27	*Olea europea*	*Oleaceae*	*Weira*	*weira*	✓	✓	✓
28	*Rhamnus prinoides*	*Rhamnaceae*	*Gesho'o*	*Gesho*	✓	*0*	*0*
29	*Rhus vulgaris*	*Anacardiaceae*	*Qammo*	*Qmmo*	✓	*0*	*0*

30	*Syzygium guineense*	*Myrtaceae*	*Dubanna*	*Dokima*	✓	✓	✓
31	*Vernonia amygdalina*	*Asteraceae*	*Hebba*	*Grawa*	✓	*0*	*0*

✓ *=present* *0=absent* *F=far from settlement* *N=near to the settlment*

Appendix 4: Questionnaire for local community on the background of forest in English

***JIMMA* University School of Graduate Studies**

Department of biology

Questionnaire of socio-economic data collection on the background of *Hunase* forest.

Households interviewed, Focus Group Discussions and Key informants interviewed of precipitation of local community and benefits:

Region: _____ Zone: _____ *Woreda*: ____*Kebele* _____ gotti _____

Name of interviewer _____ Date: _____

Number of participants: men _____ women: ____ total _____

1 ,sex(1) male(2)female

2,age(1) 15-35(2)36-45(3)46-65(4)66-90

3,what is your marital status? 1 (single) (2) married(3) widowed(4) divorced

4, Educational level (1) unable to read and write (2) primary school (3) secondary school(4) college and above

5,When the forest was protected? _____Yea

6, Who protects the forest? 1) Government 2) Community 3) both 4) other

7. Who is the beneficiary from the forest? 1) Government 2) Community 3) both 4) other

8. What were the major purposes/objectives of the protecting of forest? 1) to restoration of degraded land 2) to protected local community from access of land 3) other

9. What were your feelings during the protection of forest? 1) Positive 2) negative 3) neither

10. Is there societal attitude change after protecting the forest? 1) Yes 2) no if yes/no, specify_____

11. Are you involved in process of forest protecting? 1) Yes 2) no

12. Who own the forest? 1) Government 2) local communities related with the forest 3) both

13. What are the major uses of the forest? 1) Restoration of degraded lands 2) income generated for local community 3) to regulate environmental pollution 4) for all purposes

14. What are the major benefits of the forest for local communities? 1) Fodder 2) fuel wood 3) medicinal plants 4) house constriction materials (grass) 5) all

15. How do you share benefits from the forest? 1) Commonly 2) in group 3) individually

16. What the current condition on plant species diversity and animal disturbances in the forest after its protection? 1) Increased 2) decreased 3) no change 4) I don't know

17. Who is primary responsible for the forest? 1) Community 2) government 3) both

18. How the forest is managed? 1) Committee 2) administrators 3) community 4) others

19. Are all community members involved in the management of the forest? 1) Yes 2) No, why_____

20. Do you have law to manage forest? 1) Yes 2) No

21. Does the law punish the illegal users of forest? 1) Yes 2) No, if yes, how they manage the inputs collected from the illegal users? _____

22. Can you list some of the major management problems in the forest _____

23. What the other mechanisms you think to solve when the problem is happened? _____

24. What do think about the attitude of the society to the conservation of forest?

_____

Appendix 5: Questionnaire for local community on the background of forest in Amharic

JIMMA ዩንቨርሲቲ ድህረ-ምረቃ ትምህርት ቤት የባዮሎጂ ትምህርት ክፍል

ስለ ሁነሴ ደን መረጃ ለመሰብሰብ ለአባ ወረዎች፣ለቡድን ዉይይት እንድሁም ስለ ደኑ ያውቃሉ ተብለው ወደ ምገመቱ ባለሙያወችና ለሚመለከታቸው አካላት የቀረበ፤ በደኑ አጠባበቅ እና ከተከለከለው ወይም ከተከለለ ደን ልገኙ የሚቻሉ ጥቅሞች ላይ የተበተነ መጠይቅ

ክልለ------ዞን-------ወረዳ--------ከበሌ---------ጎጥ----------

የጠያቂው ሥም----------ቀን----------

የተሳታፊዎች ቁጥር፡ ወነድ----------ሴት----------ድምር----------

1. ደኑ የተከለለው መቼ ነው?----------ዓመት
2. ደኑን የከለለው ማን ነው? 1. መንግስት 2. የአካባቢው ህዝብ 3. ሁለቱም 4. ሌለ አካል
3. የደኑ ተጠቃሚው ማን ነው? 1. መንግስት 2. የአካባቢው ህዝብ 3. ሁለቱም 4. ሌለ አካል
4. ደኑ ሲከለል ዋና ዋና አለማዎቹ ምን ነበራ? 1. የተሸረሸረውን አፈር መልሰው ማልማት 2.የአካባቢውን ህዝብ መሬቱን እንዳይጠቀም ለማድረግ 3. ለሌለ ነው
5. ደኑ ስከለል የንተ/ቺ ስሜት ምን ይመስል ነበረ ? 1. አወንታዊ 2. አሉታዊ 3. ከሁለቱም ውጪ
6. ደኑ ከተከለለ በኋለ የህበረተሰቡ የአመለካከት ለውጥ ነበራ? 1.አዎ 2. አይደለም አዎም/አይደለም ከሆነ አበራረው
7. በደኑ ከለለ ሥርዓት ውስጥ አንተ/ቺ ነበርክ/ሽ? 1. አዎ 2. አልነበርኩም
8. የደኑ ባለቤት ማን ነው? 1. መንግስት 2. ደኑ የሚያዋስናቸው ህበረተሰብ 3. ሁለቱም
9. የደኑ ዋና ጠቀሜታው ምንድነው? 1. የተሸረሸረውን አፈር መመለስ 2. ለአካባቢው ህዝብ ለገቢ ምንጭ ሀነው ያገለግላል 3. የአካባቢውን ብክለት ይቆጣጠራል 4. ለሁሉም
10. ደኑ ለአካባቢው ህብረተሰብ የሚሰጣቸው ጥቅም ምንድነው? 1. ለከብቶች መኖ ለመሰብሰብ 2. የማገዶ እንጨት ለመሰብሰብ 3. የበህል መዳኒቶችን ለመልቀም 4. ቤት መስሪያ መሳሪያዎችን ለመቁረጥ/ዱፋ ለማጨድ/ 5. ለሁሉም
11. ከደኑ የሚታገኙትን ጥቅማጥቅም በምን አይነት ሁኔታ ነው የሚታገኙት? 1. በጋራ 2. በቡድን 3. በግል
12. ደኑ ከተከለለ ወድህ የእጽዋት እና የእንስሳት ሁነታ ምን ይመስላል? 1. ጨምሯል 2. ቀንሷል 3. ምንም አልሆነም 4. አለውቅም
13. ለደኑ የመጀመሪያው ተጠሪ ማን ነው? 1. የአካባቢው ህብረተሰብ 2. መንግስት 3. ሀለቱም
14. ደኑ እንዴት ነው ቁጥጥር የሚደረግበት? 1. በኮሚቴ 2. በአስተዳዳሪዎች 3. በአከባቢው ማህበረሰብ 4. በሌለ
15. ሁሉም የአካባቢው ህብረተሰብ አባላት በደኑ ቁጥጥር ሥርዓት ላይ ይሳተፋሉ ዎይ? 1. አዎ 2. አይደለም ፡ ለምን----------
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16. ደኑን ለመቆጣጠር ህግ/ደምብ አላችሁ? 1. አዎ 2. የለም

17. ህጉ/ደምቡ ህጋ ወጥ የደን ተጠቀሚዎችን የሚያስቀጣ ነው? 1. አዎ 2. አይደለም አዎ ከሆነ ከቅጣቱ የሚገኘውን ገነዘብ ምን ታደርጉታላችሁ? ----------

18. በደኑ ቁጥጥር ዙሪያ ላይ የሚታዩ ችግሮችን ዘርዝር/ሪ ----------

19. በቁጥጥር ዙሪያ ላይ ችግር ስገጥም ሌለ ደኑን ለመቆጣጠር የሚታደርጉት ዘዴ ምንድን ናቸው?

ደኑን በቁጥጥርና በአገባቡ በመጠቀም ዙሪያ የህብረተሰብ አመለካከት ምን ይመስልሃል/ሻል?

አመሰገናለሁ!!!

Appendix 6: Altitudes and coordinates of sample plots in the sites where far from the settlement adjacent sites where near to the settlement

	Vegetation sample plots in the sites where far from settlement			**Vegetation sample plots in sites where near to the settlement**		
	Altitude(m)	Coordinates		Altitude(m)	Coordinates	
		X	y		x	Y
1	1995	358559	851216	2022	358443	851571
2	1994	358609	851297	2023	358422	851551
3	2002	358413	851255	2026	358339	851570
4	2004	358593	855144	2021	358446	851607
5	2007	358562	851368	2022	358399	851602
6	2009	358449	851315	2016	358293	851624
7	2016	358600	851427	2016	358469	851661
8	2014	358557	851427	2016	358423	851671
9	2011	358406	851340	2012	358319	851740
10	2016	358588	851437	2012	358488	851409
11	2016	358510	851421	2013	358319	851740
12	2019	358394	851420	2010	358273	851445
13	2019	358596	851464	2019	358497	851739
14	2011	358463	851445	2019	358382	851766
15	2026	358373	851488	2015	358229	851205
16	2021	358574	851506	2023	358503	851763
17	2024	358422	851515	2022	358399	851800
18	2028	358353	851541	2017	358294	851825

APPENDEX 7: List of the informants contacted /consulate during the woody species assessingstudy.

No	Full name	Sex	Age	Marital Status	Edu	Kebele
1.	Dasta Moloro	M	46	Married	IL	Amiboro
2.	Fito Kabamo	F	44	Married	IL	Amiboro
3.	Hbisse Woloro	F	53	Married	IL	Amiboro
4.	Dase Hocheso	M	60	Married	IL	Amiboro
5.	Getebo Ayano	M	67	Married	IL	Amiboro
6.	Arase michye	F	48	Married	IL	Amiboro
7.	Fyissa Waluwa	M	50	Married	IL	Amiboro
8.	Gatise Baba	F	56	Married	IL	Amiboro
9.	Chakko Melese	F	46	Married	IL	Amiboro
10.	Fikre Fokore	M	55	Married	IL	Amiboro
11.	SHawa Jawore	F	50	Married	IL	Gfee
12.	Achamo Lire	M	77	Married	IL	Gfee
13	SHamisu Moaba	M	80	Married	IL	Hadara
14.	Gamachu wole	M	88	Married	12	Haraga
15.	Kajo toto	F	65	Married	IL	Harga
16.	Afana lafebo	M	46	Married	IL	Gfee
17.	Gatebe Amane	F	36	Married	IL	Akoyra

18.	Abute Makoro	M	65	Married	IL	Akoyra
19.	Dolo Abebe	F	38	Married	IL	Hadara
20.	Moloro Dawo	M	66	Married	IL	Amiboro
21.	chala Wome	M	67	Married	IL	Guduro
22.	Temirte woile	M	52	Married	12	Odaboya
23.	Ayelech Mano	F	46	Married	5	Amiboro
24.	Ababa Dagne	M	40	Married	6	Gefee
25	Shobiso Abera	M	51	Married	IL	Odaboy
26	Chakebo Sera	M	50	Married	IL	Amiboro
27.	Fito Shanqo	F	48	Married	IL	Guduro
28.	Lamibebo kassa	M	51	Married	IL	Gfee
29.	Darilo Dakesso	M	74	Married	3	Gonama
30.	Hbame Dnamo	M	44	Married	4	Akoyara
31.	Abute Wane	M	36	Married	IL	Amiboro
32.	Lamando Anishebo	M	76	Married	IL	Hdara
33.	Alemu Sugato	M	40	Married	5	Gonama
34.	Hasiso Awono	M	80	Married	IL	Akoyara
35.	Makuriya Dabaro	M	56	Married	8	Amibe

36. Elifenash Melese	F	60	Married	IL	Guduro
37. Wolao lemma	M	70	Married	IL	Amiboro
38. Fitamo Manne	M	65	Married	IL	Geffe
39 .Taye Megebo	M	60	Married	IL	Gfee
40. Dagne Worqu	M	79	Married	IL	Amiboro
41. Herego Abo	M	48	Married	6	goyinana
42. Herego Tesfaye	M	38	Married	7	Goyinana
43. Ergano Erebo	M	69	Married	5	Gonama
44. Makebo Lisso	M	39	Single	8	Amiboro
45. Latame Bura	F	38	Married	8	Akoyara
46. Dakeso Dafare	M	40	Married	5	Odaboya
47. Lemma Etebo	M	38	Single	7	Odaboya
48. Biletech Tirago	F	37	Married	4	Guduro
49. Mnamo Tuisso	M	74	Married	IL	Odaboya
50. Wosoro Biltibo	M	56	Married	3	Amiboro
51. Watoro Dabebo	M	45	Married	IL	Guduro

52. Latiche Anishebo	F	38	Married	IL	Gfee
53. Hailu Dafare	M	58	Married	4	Geffe
54. Osaye Abebe	F	50	Married	IL	Amiboro
55. Tedele Demeke	M	53	Married	6	Gonama
56. Sara sulito	F	65	Married	IL	Amiboro
57. Dinbore Erisabo	F	75	Married	IL	Gonama
58. Abebe Temirte	M	38	Married	8	Guduro
59. Lero Fyissa	F	70	Married	IL	Gfee
60. Dubala Demeke	M	60	Married	IL	Gefee
61. Tadesse Desta	M	77	Married	8	Gefee
62. Takile Gintamo	M	48	Married	4	Guguro
63. Almaz Anoro	F	77	Married	6	Gefee
64. Lamo Aniye	F	41	Married	7	Amiboro
65 .Gagne Malore	M	60	Married	5	Gefee
66. Wondimu Gaye	M	50	Married	5	Geffe
67. Hailu Hogoro	M	78	Married	5	Gffe

68. Anaqo Hagayo	M	42	Married	5	Odab
69. Liranse Tumisso	F	68	Married	4	Hdara
70. Abo Alemu	M	49	Marred	5	Guduro
71. Libona Tadesse	M	45	Married	IL	Gfee
72. Hailu Hogoro	M	54	Married	IL	Amiboro

Key ; key informant with (*);marital Status; M –married S –single or not married ;Levele of education IL-illiterate (could not read and write),1,2,3,4,5,6,7,8 are indicates the grade levele.