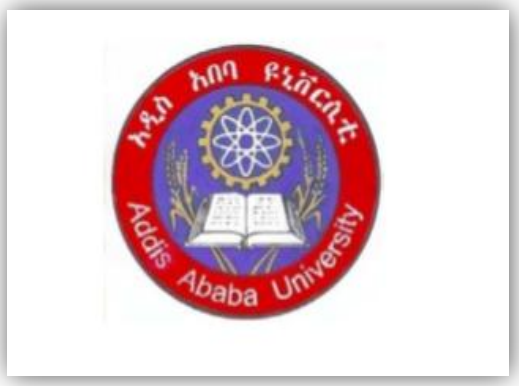

ADDIS ABABA UNIVERSITY, DEPARTMENT OF ZOOLOGICAL SCIENCE

"WOODY PLANT DIVERSITY AND THEIR LOCAL USES IN BORENA DISTRICT, SOUTH WOLLO ZONE OF AMHARA REGION, ETHIOPIA"

MSc Thesis

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Woody Plant Diversity and Local Uses in Borena District, South Wollo Zone of Amhara Region, Ethiopia

A Thesis Submitted to the Graduate Programmes of Addis Ababa University in Partial Fulfilment of the Requirement for the Degree of Master of Science in Biology

Tsehaynew Getnet Aragaw

Addis Ababa, Ethiopia

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ADDIS ABABA UNIVERSITY
GRADUATE PROGRAMMES

This is to certify that the thesis prepared by Tsehaynew Getnet Aragaw entitled: "*Woody Plant Diversity And Their Local uses in Borena District, South Wollo Zone of Amhara Region, Ethiopia"* and submitted in Partial fulfilment of the requirements for the Degree of Master of Science in Biology meets the regulations of the University and the accepted standards with respect to the originality and quality.

Approved by Examining Board

Name Signature DATE

1. Zemede Asfaw (Advisor) _____

2. _____ (Examiner)_____ _____

3. _____(Chairman) _____ _____

Abstract

Woody Plant Diversity and Local Uses in Borena District, South Wollo Zone of Amhara Region, Ethiopia

Tsehaynew Getnet Aragaw, MSc Thesis

Addis Ababa University, 2020

This study tried to explore the status of woody plant diversity, uses, threats and conservation in Borena District, South Wollo Zone of Amhara Region. The main objective of the study was to identify, analyze and document woody plant diversity and their uses, value, threat and conservation status. Data were collected from December 2019 up to March 2020. Interviews were a total of 150 informants and ran free listing, preference ranking and direct matrix ranking exercises to measure diversity, value, threat and conservation of woody plants. Informants were selected from 5 study kebeles and 2-4 key informants were purposively selected per study kebele. Fifty-seven woody plant species that belong to 51 genera and 34 families listed by informants using local names were given corresponding scientific names. Plant community types were classified by visual observation with informants in to four, namely *Eucalyptus globulus-dominated, Juniperus procera-dominated, Acacia abyssinca-dominated* and *Olea europaea subsp. Cuspidata-dominated. Eucalyptus globulus* was the most dominant species and have variety of uses for the peoples of the District. The majority of woody plants were used to fencing followed by fire wood, traditional medicine and house construction. Many threat factors affect woody plants such as farm land expansion, fire wood, house construction, overgrazing, charcoal and drought. *Hagenia abyssinica* was the most commonly mentioned species with reference to high threats. The research concluded that, special attention be directed towards the conservation and sustainable use of woody plant species through collaboration of communities, the relevant government offices and non-governmental organizations.

Keywords: Conservation, Ethnobotany, Borena, *Eucalyptus globulus*, Species diversity, Threats.

LIST OF ACRONYMS

AAU	Addis Ababa University
ANRS	Amhara National Regional State
BWAO	Borena Woreda Agricultural Office
BWAODNRM	Borena Woreda Agricultural Office Department of Natural Resource Management
BWCO	Borena Woreda Communication Office
CSAE	Census Statistical Agency of Ethiopia
DMR	Direct Matrix Ranking
FAO	Food and Agricultural Organization
FDRE	Federal Democratic Republic of Ethiopia
FEE	Flora of Ethiopia and Eritrea
MASL	Meter Above Sea Level
NMSA	National Meteorological Service Agency

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CHAPTER ONE

1. INTRODUCTION

1.1 Background

Diversity of woody plants reflects the number and variety of plant species but as the present study indicates, the abundance of woody plant species in the world varies from time to time. In Africa, the forest cover is estimated to be 650 million ha, constituting 17 percent of the world's forest. Over 50% of African land is covered by Afromontane vegetation (vegetation found on highland of Africa). (Amanual Ayanaw,2016).

Our country Ethiopia is a mountainous country with great geographic diversity. The diversified topographic features made the country to be covered by the richest forest cover in tropical Africa (Tolera et al.,2008). The diversified forests are essential for survival of living organisms by providing foods, oxygen, shelter and recreation. They are the source of pharmaceutical, timber and clothing. Woody plants serve a wide range of economic, sociocultural and ecological functions with in traditional farming system (Wondie Mebrat and Temesgen Gashaw, 2013).

Today, the forest coverage of Ethiopia is less than 3% compared with an average of 20% for Sub-Saharan African. Reduction in forest cover has number of consequences including soil erosion and reduced capacity for watershed protection with possible flooding reduced capacity and loss of biodiversity. Soil water availability is one of the key factors for the generation, survival and growth of seedling community. As many scholars agree, the forest of Ethiopia become decreasing from time to time due to anthropogenic activities (Dikaso and Tesema, 2016).

Ethiopia has fifth largest in Africa and the flora has rich endemic elements owing to the diversity vegetation particularly the forest resource is under server pressure as a consequence of inhabitants, the need for more farm lands and grazing lands. There is a source and increasing fuel wood gap in the country which leads to depletion of the standing stock and further degradation of the remaining forest stands (Dikaso Unbushe and Tesema Takele, 2016). Loss of forest cover and biodiversity due to anthropogenic activities is a growing concern in many part of the world (Hedge and Enters, 2000).

According to the report of FAO 2015, between 1990 and 2005 the extent of Ethiopia's forest decreased by 1.4 million ha. By 2005 the forest cover had further declined and estimated to cover 13.0 million ha. This indicates that Ethiopia has lost over two million ha of forest. As the studies show, the abundance and frequency of woody plant species decline from year to year. Therefore, any state holders should identify the major threats that cause for losing woody plants.

The major threats of the conservation of the Ethiopian vegetation are intensive use of forest lands for agriculture and livestock, need of fuel wood and construction materials, forest fires and human settlement (FAO, 1996). Plant diversity can be affected by biotic and abiotic factors.

According to (Belay Tefera et al., 2014), farmers throughout the world deliberately maintains trees and shrubs that are used for cropping or grazing. Farmers protect and promote woody species within and around their home gardens and fields. Plant regeneration by naturally and artificially is essential for preservation and maintenance of biodiversity. Lack of integration of the local people living around the conservation areas in to the conservation efforts is the major constraint to the overall conservation effort in Ethiopia. Unless the local community is involved in the conservation effort, the sustainability of forests will be under question (Feyera Senbeta and Demel Tektay, 2003). However, our government put the rules of conservation management, managing forest together with local people is essential to reducing forest degradation in Ethiopia (Tsegaye Bekele et al., 2007).

Borena is one of the 24 Weredas in South Wollo Zone which is needs great managing policies. Woody plants serve a wide range of purposes for farming families in the Borena District. The most frequently uses include fencing, fire wood and construction. The woody plants in the study area may be decline by lack of awareness and anthropogenic activities (BWAODNRM, 2009) Therefore, the present study will be aimed to study the factors that affect the diversity of woody plants and which are needed regeneration status.

Ethnobotany is defined as the study of local people's interaction with the natural environment: how they classify, manage and use plant available around them (Martin, 1995). In the study area, saving species, documenting and preserving woody plants are fundamental urgent issue.

1.2 Statement of the problem

Woody plants have a wide range of economic, sociocultural, and ecological functions across the world. Construction materials and farm equipment, fuel wood, food, feed and medicines are the main result of plants to which woody plants contribute the biggest share. However, sustainable use and conservation status of plants is the great impact in most part of the world. In Ethiopia, the diversity of plants has been decreasing from time to time and the climatic change is linked with loss of diversity of plants. Likewise, in Borena District of South Wollo the woody plant cover of the land has been declining.

Thus, there is a great need to provide conservation scientific information on the conservation status and needs for sustainable use of woody plants. For this, ethnobotanical studies should be encouraged since they represent basic studies to help implementing conservation programmes.

Review of different sources and investigations in Ethiopia showed that, many studies have been conducted so far in different parts of the country but, woody plant diversity have not been well studied and documented in Borena District, South Woll Zone. Hence, the current study was conducted on woody plant diversity, value, threat and conservation status in the study kebeles.

1.3 Research Questions, hypotheses, and objectives

This research tried to answer the following questions:

1. What type of vegetation types and plant community types are found in Borena District?
2. How different are the structure and composition of woody plants in different plant community types?
3. What are the roles (use values and ecosystem services) of woody plants for the communities in Borena District?
4. What are the components of woody plant species in the District?
5. What are the most frequently available woody plants in the District?
6. What are the conservation status of woody plant species of Borena District?
7. Are there local conservation practices for woody plants?
8. What is the pattern of distribution of woody plant species along environmental gradients?

1.3.1 Research hypotheses

- Woody plants have high species diversity and they are important for the district.
- People use more income sources from woody plants in the District.

- Woody plants are more distributed in woina dega based on their habitats in the District.
- Woody plants are highly threatened by deforestation for agricultural expansion in the District.
- Most people conserve their woody plants in the District.

1.3.2 Objectives of the Study

1.3.2.1 General objective

To identify, analyze and document woody plant diversity and their values in Borena District, South Wollo Zone, Amhara region, Ethiopia.

1.3.3 Specific Objectives

- To identify woody plant species diversity and community types in Borena District.
- To assess the value of woody plants for the community.
- To classify plant groups according to their habit as tree, shrub, liana.
- To identify the most useful woody plant species in the community in Borena District?
- To identify the major threats and local conservation practices of woody plant species in the study site.

1.4 Significance of the study

Until this time, there is no research on woody diversity, threat, conservation and their value in the Borena District. The findings of this study would be aware people for the uses, mode of sustainable use and give attention for the threatened woody plant species. This study would contribute to raising public awareness on the value of forests to avoiding or minimizing environmental degradation. The documentation on woody plant diversity and value can be the part of information to conduct a further research. In addition, the study serves to record, compile and document about woody plants which are common in Borena District associated with their utilization, management and conservation.

CHAPTER TWO

2. LITRATURE REVIEW

. 2.1 Woody plant diversity and distribution in Ethiopia

Ethiopia has large natural and cultural diversity with a wide range of climate but the dense forest exists in the southern and southwest part of Ethiopia. The differences in altitude and latitude have resulted in a wide variation in climate. The various ecological location and environment have different diversity of plants.

The great plains of Ethiopia occur on top of massive high land plateaus like slopes of the Semien Mountains National Park (SMNP), Bale Mountain National Park (BMNP) and other mountain ranges, where as the lowlands are dividing the highlands and the whole country into two unequal halves by the great rift valley. Many of these mountain ranges reach over 4000 m a.s.l. and are home to numerous endemic species of flora and fauna (Friis, 1992; EPA, 1998; Demel Teketay, 2004; Friis et al.,2010).

The vegetation of our country is heterogeneous and it varies from semi desert to Afro-alpine vegetation type (Dinkissa Beche, 2011). There are more than 6000 higher plant species in Ethiopia, from the total plant species, 428 are endemic and near endemic, 107 are trees and 321 are shrubs (Vivero et al.,2005). The forest and woody vegetation resource of Ethiopia were estimated to cover greater than 11.7% of the land., of this the woodlands cover about 45% of the total land of Ethiopia. The woody plant species in flora of Ethiopia and Eretria was estimated to be 1100; out of these about 300 are tree species (Dinkissa Beche, 2011). The majority of the economic activities and life of most Ethiopian related to the forest resources (Demel Teketay, 2001).

The differences in altitude and latitude have resulted in a wide variation in climate i.e., rainfall, humidity, temperature and exposure to wind, etc. These differences along with edaphic variations form the basis for the wide biodiversity of the country. This geographical and ecological diversity of Ethiopia, with extraordinary range of terrestrial and aquatic ecosystems, contributed to the high rate of endemism and diversity (Demel Teketay et al., 2004; IBCR, 2009).

2.2 Uses of woody plants

The multipurpose role of trees and shrubs as a source of feed for both domestic and game animals, fire wood, implements, source of medicine, mulch and soil conservation in semi-arid regions has long been recognized by scholars in the past (Smit, 2002).

In Ethiopia, rural communities in general and pastoralists in particular depend on woody plants for wider range mainly for medicine, food, forage, local construction, making of household implement, fire wood and shade (Gemedo Dalle et al., 2006).

Woody plants serve a wide range of purposes for farming families. The most frequently mentioned uses including fencing, fuel wood and shade. Woody plants are also used as forage and fodder, construction materials, tools and equipment, source of income, cleaning supplies (branches and leaves for sweeping the home and washing dishes), traditional medicine, improving soil fertility, furniture, bee forage, ornamentals, food, spiritual practices and toothbrushes. Furthermore, most woody plants are used for multiple purposes (Belay Tefera et al., 2014).

2.3 Threats of woody plant diversity in Ethiopia

According to Wondie Mebrat and Temesgen Gashaw (2013), the mountainous land scopes of Ethiopia high lands were characterized by high woody plant species diversity but they have been degraded and fragmented. Degradation is the result of population pressure that increases crop cultivation and livestock grazing in marginal areas.

Agricultural investment, charcoal production and relentless expansion of very aggressive invasive alive species are having a profound and determinant effect on the woody plant resource availability. The above activities contributed to increase deforestation and soil erosion in the high land of the country (Tewolde berhan Gebre egzeabhare, 1988). According to his report, land degradation indicates temporarily or permanent long term decline in ecosystem function and productive capacity and it is the primary cause of species loss at local, regional and global scales through urban development, road building, recreation, forest fires, agriculture and tree logging.

The factors that would suppress woody species diversity accelerate the degradation of natural habitats with many woody plant species at a great extent. Such practice is leading to the extinction of moisture loving species and promoting the hardy and spiny species having least value for the society. Therefore, the loss of biodiversity and changing the pattern of woody

species has necessities the assessment of woody species diversity of the region and prioritize habitats, communities and species for conservation (Wondie Mebrat and Temesgen Gashaw, 2013). Pollutants are the main threats to species diversity specially to water inhabitant species (river, lake, coastal and ocean) that cause the death of flora and also destruction of ecosystems.

Due to these practices woody species diversity is suppressed highly in Ethiopia. These factors accelerate the degradation natural habitats with many woody plant species at great extent. Such practices are leading to the extinction of moisture loving species and promoting the hardy and spiny species having least value for the society. The loss of biodiversity and changing the pattern of woody species has necessitated the assessment of woody species diversity of the region and prioritize habitats, communities and species for conservation (Pant and Samant, 2007; FDRE, 2012).

Deforestation is the conversion of forested area to non-forested land use such as arable land, urban use, logged area or wasteland (Tejaswi, 2007). It is a clearance of large expanse of forest for agriculture and other uses, when a forest is removed, the total amount of water and minerals that flow in to the streams increase drastically (Alemayehu, 2007). Deforestation in Ethiopia was increasing at alarming rate and the rate of afforestation was very negligible in light of the very high rate of clearing for fuel, expanding agricultural land, for construction, urban development purposes, and also lack of awareness creation for the communities have contribution for deforestation (Mohammed, 2011). This intensive logging practice seriously damages the structure and composition natural woody plant species and leading to the declining of forest diversity and agricultural yield in Ethiopia. Such activities pose a serious threat to the conservation and regeneration status biodiversity in general and plant species in particular. Besides to deforestation, livestock- induced disturbance might be among the major factors constraining regeneration and recruitment of woody species. These factors ultimately contribute to the decline of woody species populations in the forests (Alemayehu, 2007).

Invasive alien species are not native to Ethiopia and threaten its native plants and biodiversity. It is a growing environmental and economic threat to the country. Conservation biologists have globally ranked invasive alien species as the second most serious threat to plant species at risk (after habitat destruction and (Chenje and Mohamed- Katerere, 2003; Rankin and MES, 2004; Loeb, 2012).

2.4 Conservation strategies of woody plants

Conservation is the management of human use of biosphere to give the greatest sustainable benefits to current generation. It is also preservation, maintenance, sustainable utilization, restoration and enhancement of the natural environment. Conservation is important for sustainable development in agriculture, livestock, and economic outputs.

The accelerating pace of species extinction is the greatest challenges facing in most part of Ethiopia. This challenge has led to the emergence of the practice of conservation in the country. It seeks to learn how to preserve species, communities, and ecosystems and it studies the cause of declines in species richness. To do these two approaches are being used to protect and conserve vegetation diversity. These are the in-situ and ex-situ conservation approaches. The in-situ approach species within their natural habitat while the ex-situ approach does so outside the habitats of the species by collecting and protecting them in gene bank (FDRE, 2003). As a result, conservation of woody plant species at the levels of ecosystems, landscapes, community, populations, individuals and genes, is essential to sustain the health and vitality of ecosystems. Conservation practice includes the establishment of protected area as well as management strategies based on beneficial balance between resource development and satisfaction of human needs (Uhlig, 1988; Tesfahun, 2000). Therefore, ecological assessment of the existing enclosed forests is the base for meaningful planning to rationally utilize the remaining forest resources (Abate, 2007). These study of woody plant species distribution in response to environmental factors helps to generate information for a better understanding of ecological processes and in managing ecosystems.

CHAPTER THREE

3. MATERIALS AND METHODS

3.1 Description of the study area

This study was conducted in South Wollo Zone of Borena District, Amhara National Regional State. Borena is one of the 24 District in South Wollo Zone of the Amhara national regional state. The District is 580 kms North west of Addis Ababa and 316 kms east of Bahir Dar the capital city of the regional state, and 180 kms from Dessie the administrative capital city of South Wollo zone. Borena District is bordered in the south by Wogid District, North by Mehal Sayint District, East by Legambo District and West by Abay River separated it from east Gojjam (Merto lemariam). Mekane selam is the Town of Borena District (BWAODNRM, 2009).

The total area of Borena district is estimated to be 937 square kilometers. As a result, it is one of the largest district in South Wollo Zone (BWAODNRM, 2009). According to the communication office of the woreda, Borena district in general is composed of 34 kebeles.

Borena district lies between 10^0 34'N to $10^0$53'N latitude and $38^0$28'E to $38^0$54'E longitude (Figure 1). The elevation of the district ranges between 1000 to 3700 meters above sea level.

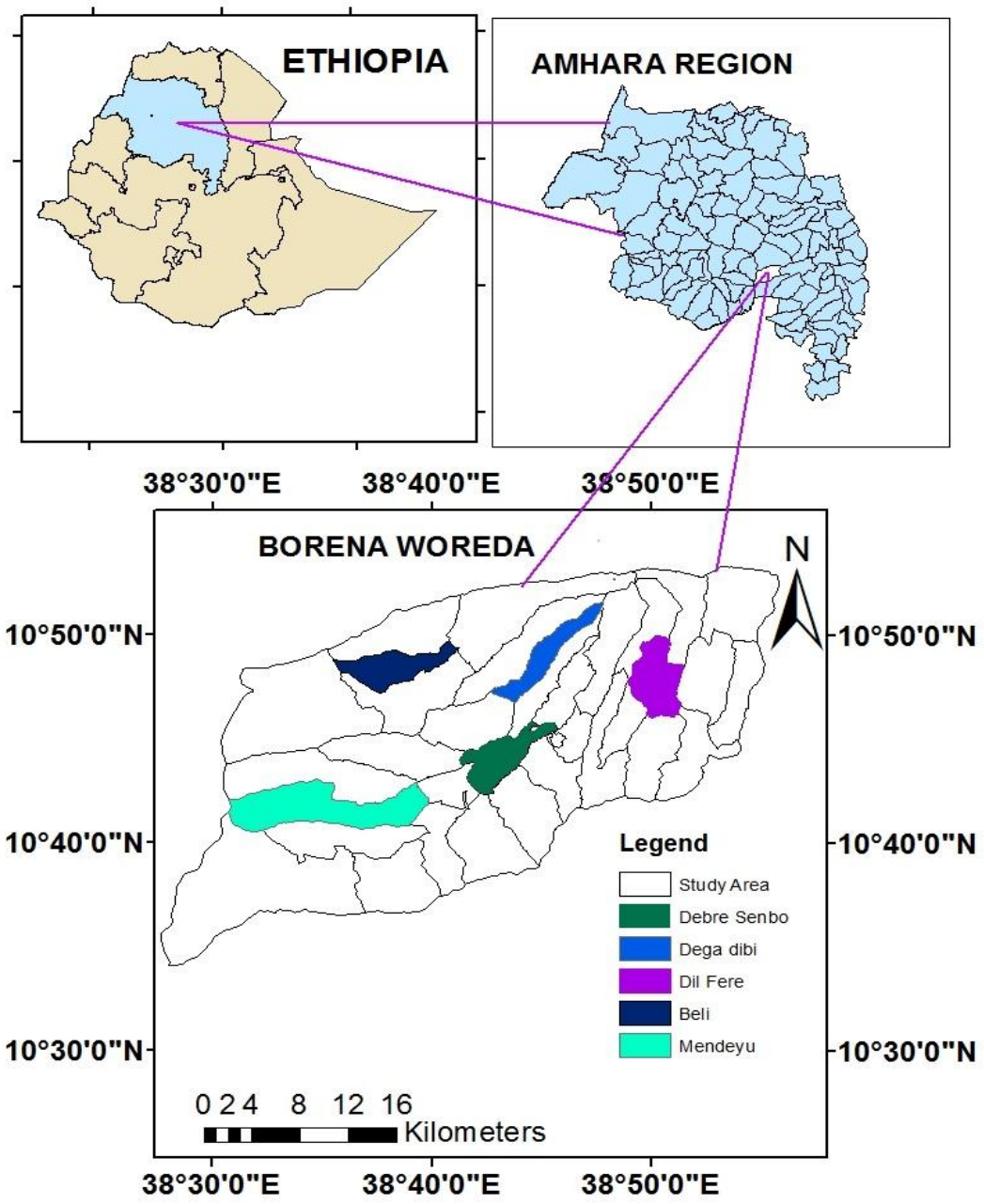

Figure 1: Map of Ethiopia showing kebeles sampled in Borena District of Amhara Region.

3.2 Population and demography

With regard to population, based on the 2007 national census conducted by the Central Statistical Agency of Ethiopia (CSAE**),** the total population of the district was 158,209, of which 149,500(94.5%) were rural people while 8,709(5.5%) were urban dwellers. A total of 37,193 households were counted in the district. Amharic is predominantly spoken language in Borena District. Next to Amharic few Afan Oromo speakers are found in the district (Tewachew Assefa, 2019).

3.3 Topography

The topography of Borena district is dominated with up and downs (40%), valley (30%), plain (20%), mountains (10%). (BWAODNRM, 2009). In Ethiopia the most significant factor which causes differences in climatic conditions is altitude. As a result of the impact of altitude, Borena district has four agro-climatic zones. These are Wurch (Alpine), Dega (high altitude), Woina dega (temperate or moderate altitude) and Kola (low land with hot climate). Each zone accounts for 1%,20%,47%,32% of the total area of the district respectively. The district is, therefore, to a large extent characterized by favorable climatic condition of the Woina dega (BWAODNRM, 2009). Local elevation ranges from about 500 m a.s.l at Abay valley to 3700 m a.s.l at Lemmesk around Borena Sayint Werehimeno National Park, the highest being Lemmesk (3700) meters in Borena. Most parts of the district lie between 1500 and 2300meters above sea level. The difference in temperature is very observable between Abay and Lemmesk. The latter being cold. Dega zone in the district which is cold has elevations ranging from 2300 to 3200 meters above sea level. Areas which are extremely cold in the dega region are called "Wurch'' (Alpine) refers to high lands between 3200 and 3700 meters above sea level. relatively gentile slopes characterized the down streams part of the district. (Tewachew Assefa, 2019).

3.4 Climate and rainfall

The total annual rainfall varies from 889 to 1500 mm per year. The highest rainfall falls during summer, which starts in June and ends in September and short rainy season is in spring which consists of March, April and May. The mean annual temperature of the region is also varying from 14^0c to 19^0c. The absolute maximum temperature occurs from March to May and the absolute minimum temperature occurs in June, July, and August. The upper north western part of the district is known for their minimum temperature which results in the prevalence of wurch type of climate while the south and south western part of the district, has the highest temperature, characterized by kola climate.

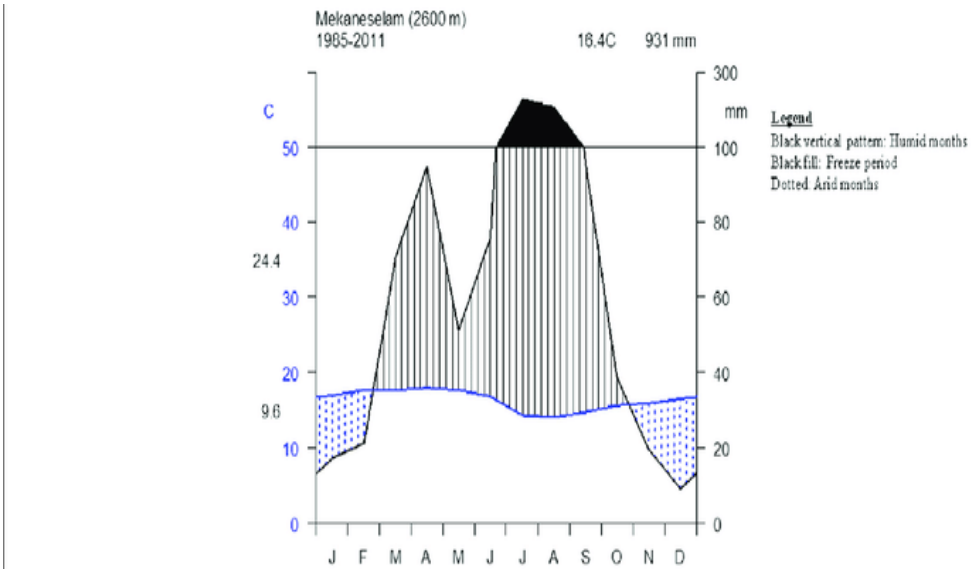

Figure 2: Climatic diagram of Mekane selam (source of climate data: National Metrological Service Agency).

3.5 Survey before main study (Reconnaissance Study)

The survey was conducted from November 24 to 29, 2019 to obtain basic information about the study kebeles and their numbers, the main location of woody plant species and discussed with kebele administrators to have permission in the study kebele. Reconnaissance study also made from November 1 to 15, 2019 to familiarize me with the study kebeles; to get an insight of the vegetation pattern, topography, and other environmental conditions in order to locate sampling kebeles in the district were systematically selected.

A survey of the land cover in Borena District shows that an area of 39,780 hectares is arable or cultivable, 14,089.43-hectare pasture, 14,173.245-hectare forest and the remaining 32,045.745 hectares is considered swampy, mountainous or otherwise un usable. As can be noted from the above cultivable and grazing land together constituted the largest portion of the total land use and land cover of the district. That is why Borena district is considered as one of the major source of grain, cereals and vegetables in the hinter land and even from wollo (Tewachew Assefa, 2019).

3.6 Methods

The following methods were used to carry out the diversity of woody plants and their value.

3.6.1 Vegetation study

3.6.2 Sampling design

Site selection was carried out using visual inspection and general information would be collected during reconnaissance survey. Systematic sampling design use to collected overall vegetation and environmental data of Borena District following the techniques of Evenness Kent and Coker (1992).

3.6.3 Sampling and collection of ethnobotanical data

3.6.4 Informant selection

Representative general informants and knowledgeable people of the District were selected using purposive sampling approach, in the manner described by Martin (1995). The total number of informants involved in the survey from the four agro-ecological zone of the District was 150 (75 male and 75 female). Informants' ages ranged from 20-80 years (50 were between 20-40, whereas 100 where ≥41 years old). Group discussions from community members, elderly people and knowledgeable inhabitants helped in nominating 20 people (10 male and 10 female) who participated as key informants following Davis and Wagnar (2003). Whereas general informants were sampled during random visits made to households in the study kebeles.

The number of kebeles sampled and the corresponding number of informants are shown in Table 1.

Table 1: Number of kebeles with the informants.

No	Name of kebeles	Number of informants		Total
		Male	Female	
1	Debre Senbo	15	15	30
2	Mendeyu	15	15	30
3	Billi	15	15	30
4	Dega Dibi	15	15	30
5	Dil Fire	15	15	30
	Total	75	75	150

3.6.5 Data collection

Ethnobotanical data were collected from December 2019 to March, 2020. Specimens of all woody plant species were collected, pressed and identified by using Flora of Ethiopia and Eritrea (FEE). All woody plants were collected for floristic composition. Trees, shrubs and lianas were collected. In this study, tree refers to single stimmed woody plant or woody plant with single bole; shrubs as multiple stemmed woody plant; and liana refers to woody vines, rooted in the soil, and supported physically by trees (Dinkissa Beche, 2011). This data was collected by closely interacting with informants using semi-structured interview, guided field walk, group discussion, market survey, preference ranking and use direct matrix ranking.

Interviews were based on, around a semi-structured checklist of topics consisting of 10 main questions (Appendix 2) prepared in English, and translated to Amharic. Interviews with informants were mainly conducted in their local language. The language use with the informants is Amharic.

3.7 Ethical consideration

Data collection was conducted after permission was obtained from the District Administrative Office. Special ethical considerations were taken from the beginning to the end of data collection. Approaching of the informants was very systematic and informants were informed the objective of the research as it was for educational purpose, compiling and documenting of woody plants of the study kebeles but not for commercial purposes. Informants accepted the idea and give information freely on woody plants used in the kebeles without command of District Administrative Office.

3.8 Field observation/guided field walk/

Field observations were guided by the help of indigenous knowledgeable people interviewed to obtain the available data in the study kebele. During field observation, land forms, soil type, the nature of human activities, major threats, habit and habitat were recorded to each kebel. Some of informants and plant species were photographed in order to document ethnobotanical information**.** In the study kebele, conserved areas and deforested areas were observed.

3.8.1 Plant specimen collection and identification

The specimen of all encountered woody plant species mentioned by informants were collected, pressed and identification for voucher. Plant specimens were identified both in the field and by using taxonomic keys.

The growth forms of woody plants were listed, voucher specimens collected and recorded by vernacular names. Later, converted to their botanical names by using flora of Ethiopia and Eritrea (Hedberg et al., 2009).

3.8.2 Semi-structured interview

Semi- structured interview was employed by interviewing the informants about information on woody plants (Figure 3), (local name, diversity, value, threats and conservation practice) and also information about informant status. (Appendix 1 & 3).

Figure 3: Systematic data collection from different informants (Photo taken by Tsehaynew Getnet, 2020).

3.8.3 Group discussion

Three brief group discussions were done with selected people and was conducted at each study site with informants (Edir and religious leaders, knowledgeable members) of the local people on Knowledge in diversity, value, threat and biodiversity conservation (Figure 4).

Figure 4: Group discussion in Dil fire kebele (Photo taken by Tsehaynew Getnet 2020).

3.8.4 Market survey

Market surveys were done successfully in six market places by recording the parts available on market, amount per unit price, Measurement and name of markets (Appendix 4**).**

Figure 5: Some woody plant species in Soye market (Photo taken by Tsehaynew Getnet 2020).

3.8.5 Data analysis

Data were analysed following survey and analytical tools for ethnobotanical methods. Informant consensus and scoring methods such as preference and direct matrix ranking were employed to test consistency of responses and to get accurate results**.**

3.8.6 Descriptive statistics

Both qualitative and quantitative analytical tools was used for data analysis following approaches of Martin (1995), Alexiades (1996), Cotton (1996), Heinrich (1998).

The collected data were arranged and then analyzed using text analysis to make table, frequency and simple calculation.

Descriptive statistical methods such as percentage were employed to analyze and summarize the data of woody plants, use and associated knowledge. The most useful information would be gathered. The most frequent uses of woody plants application, parts used and habitat were analyzed through descriptive statistics. The most threatened woody plants and the threatening factors would be described quantitatively in words and the gender roles would be discussed.

Statistics methods like percentage and frequency would be used to analyze and summarize the data on uses of woody plants, method of use of use, conservation and also market survey would be discussed.

3.8.7 Informant consensus

In order to evaluate the reliability of information during the interview, 20 key informants were contacted at least two times for the same ideas and the validity of information was proved and recorded. If the idea of the informants differed from the original information, two key informants was rejected and considered as unreliable. Only the reliable ones were analyzed. This method was adopted from Alexiades (1996).

3.8.8 Preference ranking

Preference ranking was conducted following Martin (1995). This were help to indicate the most useful woody plants used by the community to improve their lives. The key informants were selected to assess the degree of usefulness woody plants. value of each species indicate from (0-5) 5=Best, 4= very well, 3= good, 2=less used, 1= least used and 0 =not used. were summed up and the rank of each species was determined based on the total score (Table 4).

3.8.9 Direct matrix ranking for multipurpose woody plants

Direct matrix ranking was conducted in order to compare multi-purpose woody plants commonly reported by key informants and to assess the relative importance. According to the relative benefits of woody plants, multipurpose tree species were selected and assigned their values by giving different scores. For example; best =5, very well, =4 good =3, less used =2, least used, =1 and not used, =0. Based on the key informant information, average value of each use-diversity for a species was taken and the value of each species summed up and ranked (Table 5).

General research designs of woody plants diversity and their local uses in Borena District shown in (Figure 6).

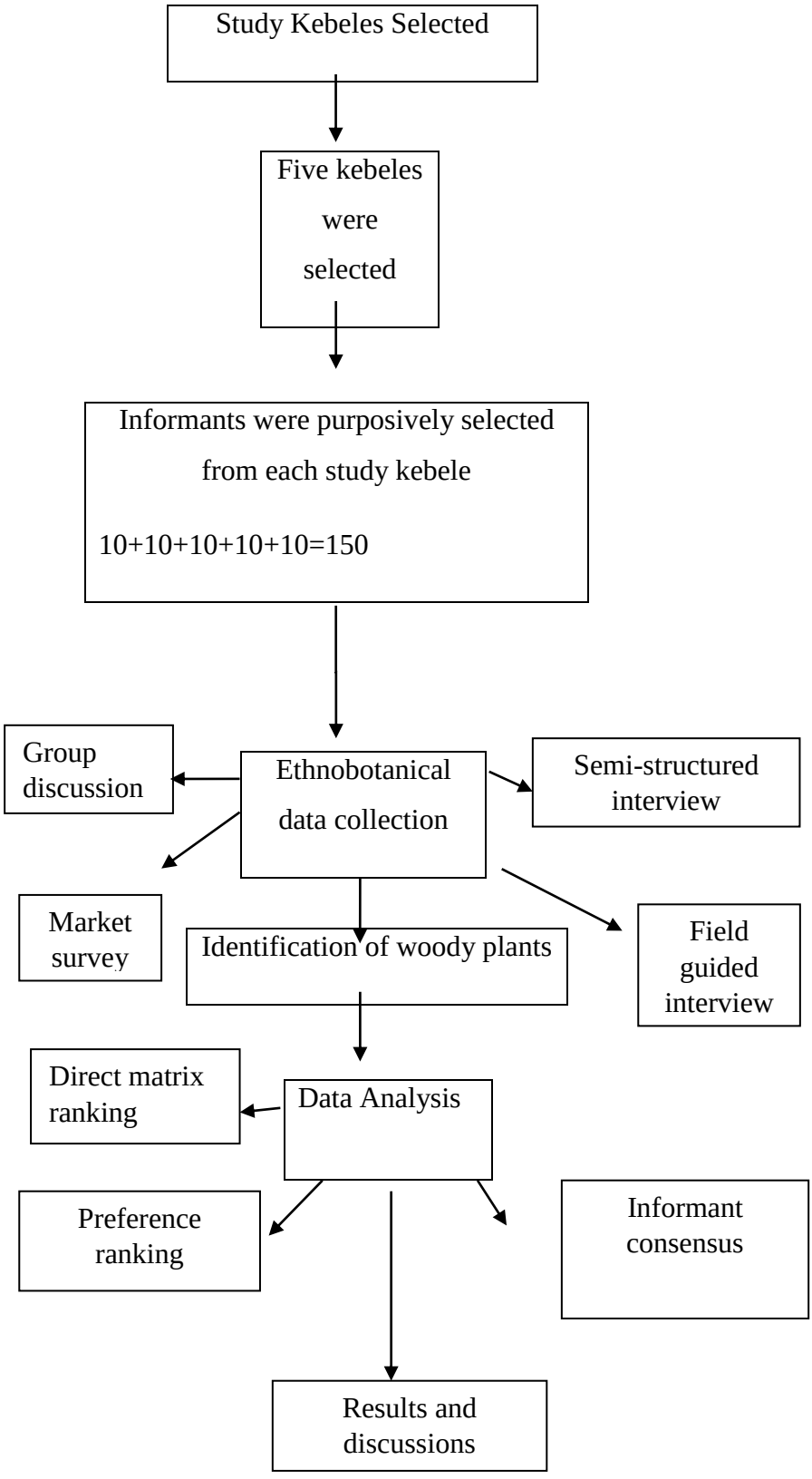

Figure 6: Summary of the research design for ethnobotanical study of woody plants.

CHAPTER FOUR

4. RESULTS

Results of this study brought forth information on different aspects of woody plant resources in Borena District. The findings are presented under the woody plant diversity, value, threat and conservation practice used by people in the District described in in the following sections.

4.1 composition of woody plants

A total of 57 woody plant species in 51 genera and 34 families were listed by informants (Appendix 1). From 57 woody plants, Rosaceae (6 species, 10.5%), had high number of species and was found to be the dominant family followed by Fabiaceae and Rutaceae (4 species, 7%) each, Euphorbaceae, Lamaceae and Solanaceae (3 species, 5.25%) for each, Anacardaceae, Asteraceae, Cucurbitaceae, Loganaceae, Moraceae and Sapindaceae with (2 species,3.5%) for each and The remaining 28 families were represented by a single species (1.75%) each, which were less dominant in the study kebeles (Appendix 3).

Table 2: List of top six most dominant families of with the number of genera, species and percentage recorded in the study kebeles.

No	Family	Genera	No of Species	%
1	Rosaceae	4	6	10.5
2	Fabiaceae	2	4	7
3	Rutaceae	2	4	7
4	Euphorbaceae	2	3	5.25
5	Lamaceae	3	3	5.25
6	Solanaceae	3	3	5.25

There were 34 (59.6%) shrubs, lower number of trees and lianas in the study kebeles. Number, percentage and growth habits of the woody plant species of the study area are shown in Table 3.

Table 3: Growth habits of the woody plants in Borena District with the number of species and percentages.

No	Growth habit	Number	Percentage(%)
1	Shrubs	34	59.6
2	Trees	18	31.6
3	Lianas	5	8.8

4.2 Plant community visual classification

4.2.1 Informants classified woody plant community types

Based on the agro-ecological zone of the District woody plant community types were classified as four groups as follows.

4.2.1.1 *Eucalyptus globulus* plantation dominated plant community type

This plant community type is found almost in all study sites. *Eucalyptus globulus* is the most dominant plantation tree species in the study kebeles. It is one of the good income generating plants for the community in the study kebeles. *Asparagus africanus, Dovyalis abyssinica, Schinus molle* are common woody plants that occur in this community type.

4.2.1.2 *Juniperus procera* dominated plant community type

This community type dominantly found in Billi and Dil fire kebeles and in most school and church. *Cupressus lusitanica, Dombeya torrida, Hagenia abyssinica* were the common woody plants in this community types.

4.2.1.3 *Acacia abyssinica* dominated plant community type

This community type is mainly involved in Debir senbo and Mendeyu kebeles. *Catha edulis, Cordia africana, Coffea arabica* were the common woody plants in this type of community.

4.2.1.4 *Olea europaea subsp. cuspidata* dominated plant community type

This community is found in Mendeyu and Billi kebeles and most churches in the study kebeles. *Calpurnia aurea, Cordia africana, Dodonaea angustifolia* were the common woody plants in this type of community.

4.3 Uses of woody plants

Woody plants serve a wide range of purposes for communities in the Borena District. Based on the response of the informants the most frequently list uses include fence, construction, shade and fire wood (Appendix 5). Woody plants are also used as fuel wood, income, furniture, tooth brush, traditional medicines, agricultural equipment's, bee forage, washing materials, soil fertility (Appendix 4).

Table 4: Preference ranking results for key informants for most frequently listed woody plant.

No	Woody plant Species	Key informants with code																				Total	Rank
		I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	I_9	I_{10}	I_{11}	I_{12}	I_{13}	I_{14}	I_{15}	I_{16}	I_{17}	I_{18}	I_{19}	I_{20}		
1	*Eucalyptus globulus*	5	5	4	5	5	4	4	5	5	5	5	3	5	5	4	4	5	5	5	5	93	1
2	*Acacia abyssinica*	4	4	4	3	5	3	5	4	4	5	3	4	4	3	5	5	5	4	4	5	83	2
3	*Juniperus procera*	3	4	3	3	5	5	3	5	4	5	4	4	3	3	4	4	3	4	5	4	78	3
4	*Rhamnus prinoides*	4	5	3	3	3	2	3	4	4	5	5	3	4	5	3	4	3	5	3	1	72	4
5	*Cordia Africana*	3	2	1	4	5	4	3	1	2	1	2	3	5	4	3	4	3	2	1	3	56	5
6	*Ficus sur*	2	4	1	3	2	1	2	3	4	1	3	2	1	4	2	2	3	2	4	4	50	6
7	*Ocimum urticifolium*	1	3	1	2	1	3	4	1	3	2	1	4	2	1	3	1	1	3	4	4	45	7
8	*Olea europaea*	2	2	1	2	1	2	1	1	2	1	2	1	3	1	2	1	2	1	2	4	34	8

I= informants

Table 5: Direct matrix ranking results from key informants, including six most frequently mentioned woody plants and six most frequently discussed uses.

Major uses		List of woody plants					
		Eucalyptus Globulus	*Rhamnus prenoides*	*Acacia abyssinica*	*Juniperus procera*	*Olea europae*	*Phytolacca dodecandra*
1	Construction	5	0	1	1	0	0
2	Fencing	5	3	3	1	2	2
3	Source of income	4	4	3	3	3	2
4	Fire wood	5	1	5	5	4	1
5	Variety of uses	4	3	1	2	2	1
6	Fodder	2	4	1	1	1	1
	Total	25	15	14	13	12	7
	Rank	1	2	3	4	5	6

Table: 6 Frequency and percentage of parts used in Borena Woreda.

Part used	Frequency (no. of times recorded	%
Stem	35	56.5
Leaf	14	22.6
Fruit	11	17.7
Flower	2	3.2
	62	100

The results show that the use pattern of the community showed that the stem is used more frequently in 57% of the cases. This implies that the use pattern is usually more destructive compared to the other parts.

Table 7: Organized from More frequent to less frequent woody plant uses.

Uses of Woody Plants	Frequency	%
Fence	20	19.0
Fire wood	19	18.1
Medicine	8	7.6
Construction	7	6.7
Farm equipment	6	5.7
Food source	5	4.8
Source of food	5	4.8
Washing (tank, hair, other)	4	3.8
Baking and bread making	3	2.9
Charcoal	3	2.9
Fumigation	3	2.9
Income	3	2.9
Food flavoring	2	1.9
Furniture	2	1.9
Relaxation	2	1.9
Bee forage	1	0.95
Bittering agent	1	0.95
Broom	1	0.95
Chebo	1	0.95
Decoration	1	0.95
Detergent	1	0.95
Home material	1	0.95
Invocation game	1	0.95
Malting	1	0.95
Marjoram	1	0.95
Shovel	1	0.95
Strapping	1	0.95
Winnowing	1	0.95

The information presented in the above Table was analyzed. The above table showed that in 35 (56.5%) of the species recorded in the study area the stem parts of the woody plant species were said to be used in various ways while leaves, fruits and flowers were used in 14, 11 and 2 cases respectively (Table 7).

In the case of the various uses of wood plants were recorded 105 times, the most frequent being use of woody plants as fence (20) followed by firewood (19) and medicine (8). The rest 26 uses were mentioned from 7 times to just once (Figure 7).

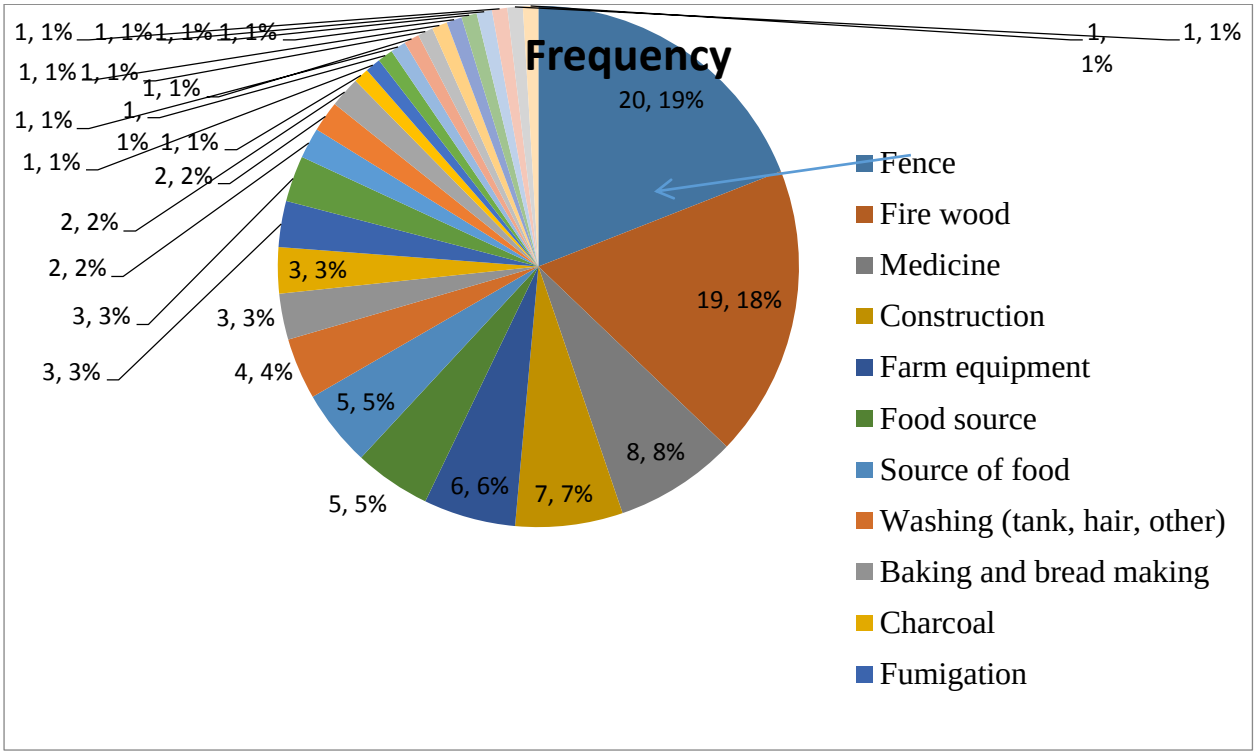

Figure 7: Pie chart showing the various frequencies of use of woody plants reported by informants in Borena Woreda

4.4 Marketability of woody plants

The results from the market survey of woody plants show that top 10(17.5%) have high marketable value for the community and were more available on major market places of the District. At the time of interview informants mentioned the most marketable woody plants (Table 8).

Eucalyptus globulus were the most marketable woody species in the District and almost all the peoples of the District benefit. (1 stem sold up to 1500 birr), followed *by Olea europaea subsp. Cuspidata*, *Citrus medica* and *Citrus simensis* respectively, based on their cost (Table 8). These woody species were mainly gathered and sold for their uses related to traditional

medicine, edibility, firewood, construction and furniture purposes. In my findings many District farmers got marketing income from woody species next to animals including cattles, sheep and goats.

Table :8 Results of most marketable woody plants in Borena District.

List of Marketable woody plants	Parts available on market	Measurement	Unit price	Name of market	Remark
Gesho	Leaf &stem	Estimation	300/kuntal	Soye	
Apil	Fruit	Number	8/ birr	Soye	
Orange	Fruit	Number	5/birr	Segno	
Lomy	Fruit	Number	2/ birr	Hamus	
Duba	Fruit	Number	12/ birr	Soye	
Bahir zaf	Stem	1.mekina	30000/birr	Junior	
Woira	Stem	Number	20/ birr	Soye	
Koso	Stem	Number	1000/birr	Billi	
Tirngo	Fruit	Number	50-80/ birr	Soye	
Kok	Fruit	Number	2/birr	Arib	

4.5 Threats of woody plants mentioned by key informants

Borena District is characterized by high woody plant species diversity. People living in Borena cannot get the value of woody plants if the species are affected by different threats. Threats mentioned by informants that affect the growth of woody plants in Borena District are deforestation for agricultural expansion, overgrazing, land degradation, overexploitation and climate change.

Table 9: threatening factors for the losses of woody plants (values 1-6; 1 is the least destructive threat and 6 is the most destructive one.

No	Threatening factor	Ranks given by key informants								Total	Rank
		I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8		
1	Charcoal	2	2	2	2	2	2	2	2	16	**5th**
2	fire wood	5	5	5	5	5	5	4	4	38	**2nd**
3	Drought	1	2	1	1	1	2	1	2	11	**6th**
4	Free grazing and animal food	3	4	3	4	3	3	3	3	26	**4st**
5	House construction and farm	4	4	4	3	4	4	4	5	32	**3rd**
6	Farm land expansion	6	6	6	6	6	6	6	6	48	**1th**

In the study kebeles, as shown in Table 6, eight knowledgeable key informants were selected to score the threatening factors of woody plants. The scores for threatening factors were summed up and ranked. Accordingly, Farm land expansion were the most serious reasons for the loss of woody plant diversity followed by firewood collection, house construction and farm materials, free grazing and animal food, charcoal making and drought (Table 6). Based on Table 6 the percentage of threatening factors of woody plants showing in (Figure 8).

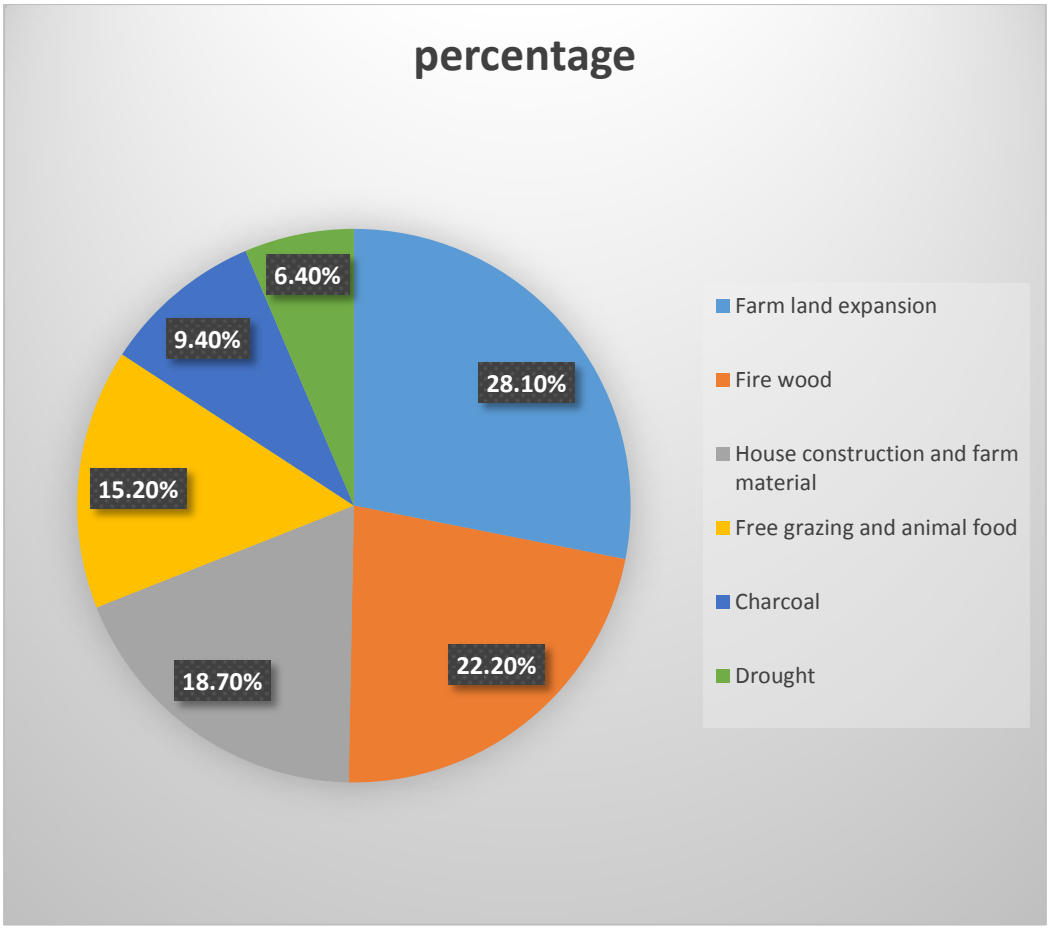

Figure 8: Pie chart showing the major threats percentage of woody plants reported by key informants in Borena Wereda.

4.6 Conservation of woody plant species mentioned by informants

According to the informants were mentioned conservation practice in Borena District were increase from time to time. Most people's conserve woody plant species in Borena District by using management and conservation practices listed by key informants include fencing, preventing illegal cutting, watering for saplings, using fertilizers, weeding and hoeing, example (Figure 8). Most of the time 18 (90%) of key informants said these practices done by males. In the sociological variables on local perception and attitude especially in Borena District males were work more in outdoor and females indoor. The finding is in agreement with (Hussien Adal, 2014) assumption of the impact of a patriarchal society that encourages males to manage outdoor activities as a factor determining the gender-based knowledge difference.

Table 10: Conservation practice reported by informants to promote woody plants.

No	Conservation practice	Ranks given by key informants								Total	Rank
		I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8		
1	Fencing	5	5	5	3	5	4	5	5	37	**1st**
2	Watering	4	5	3	5	4	5	4	3	33	**2nd**
3	Hoeing	5	3	3	4	5	4	3	2	29	**3rd**
4	Fertilizing	3	2	5	4	2	5	3	1	25	**4th**
5	Preventing illegal cutting	4	4	2	2	2	3	2	2	21	**5th**
6	Weeding	2	4	3	1	2	1	2	2	17	**6th**

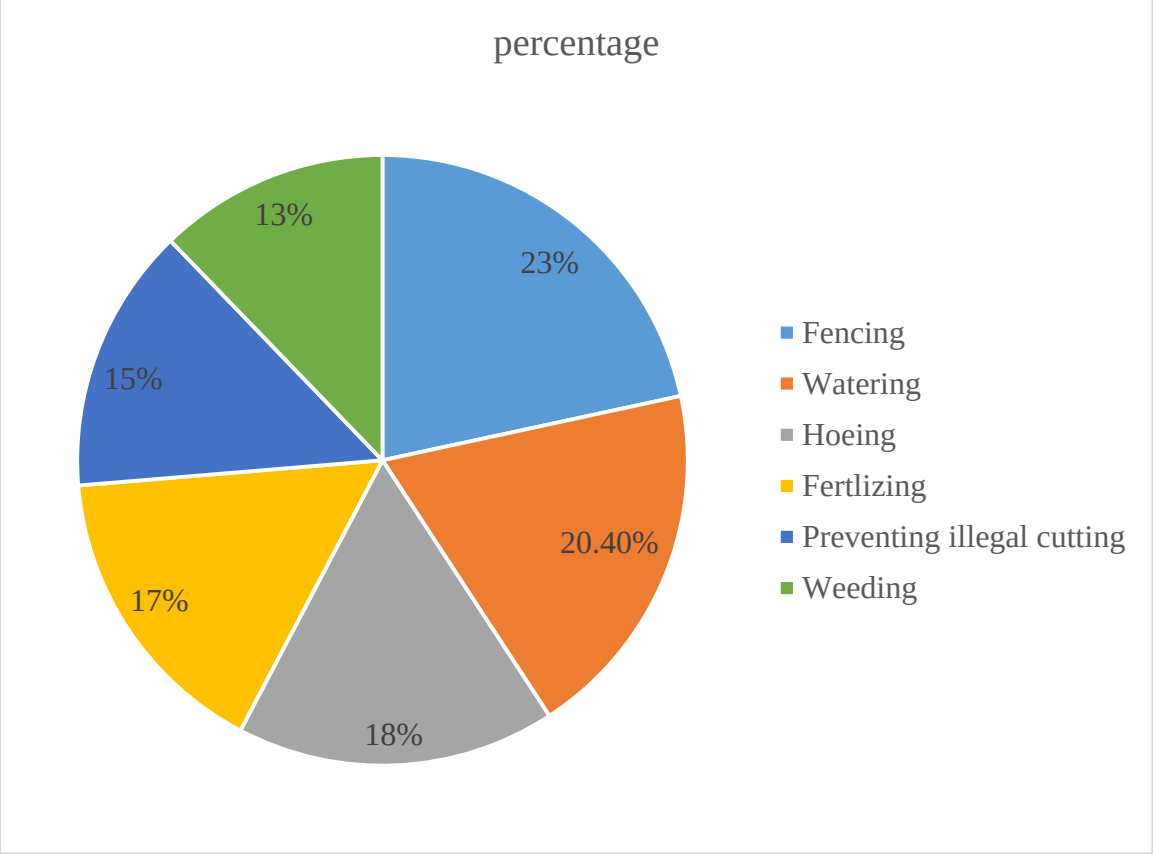

Figure 9: Pie chart showing conservation practices percentage of woody plants reported by informants in Borena Wereda

A. Conservation of *Acacia abyssinica* within a crop field (photo taken by Tsehaynew Getnet 2020).

B. Conservation of *Eucalyptus globulus* on hilltops in Dilifire Kebele (Photo taken by Tsehaynew Getenet).

Figure10: Different conservation of habitats.

CHAPTER FIVE

5. DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

5.1.1 Composition of woody plants

Results show that Borena District is less in woody plant component as shown by the presence of 57 woody plant species (distributed in 51 genera and 34 families. (Appendix 1). Based on informants' information shrubs 34(59.6%), lower number of trees and liana in the Borena District according to their habits.

Results show that the family with the highest number of species were Fabaceae was the same as the earliest studies with Dinkissa Beche (2011). Results show that 49% of the families had only one species are susceptible to extinction either due to anthropogenic activities or due to unsuitable environmental conditions or due to both. Therefore, sound conservation and management must be given for specie susceptible to extinction in in-situ conditions.

The comparison between different collectors at different time shows a difference in number of woody plant species. Some species of woody plants mentioned in this present study were the same and some also different.

Results show that the woody plant species of the District relatively higher in species richness in other some studies. Debark District in Northern Ethiopia (55 species) (Belay Tefera et al., 2014), Yemrehane Kirstos Church Forest (39 species) in North Wollo (Amanual Ayanaw, 2016) and relatively lower than the result of Denkoro forest in South Wollo (64 species) (Abate Ayalew, 2003), Menagesha Amba Mariam Forest with (70 species) in Central Shewa (Abiyou Tilahun, 2009) and Gedo forest with (130 species) in West Shewa (Birhanu Kebede, 2010).

The woody plant habitats described by informants included crop fields, fences, grazing lands, road sides, church compounds, forests, hilltops and home gardens. These type of habitats mentioned in this present study were the same as the earliest studies with (Belay Tefera et al.,2014). According to Borena District agro-ecological zones 12(21%) species in Kola (high temperate), 35(61.4%) species in Woina dega (moderate temperate) and 10(17.54%) species in Dega (low temperate) were distributed. Most woody plants distribute in Woina dega (moderate temp') due to suitable weather conditions and availability of water.

5.1.2 Plant community visual classification

5.1.2.1 Informants Classified plant community

As results shown The differences in woody species composition observed among the four woody plant communities identified in Borena District could be attributed to variations in environmental gradients.

The Four plant community types were identified based on the agro-ecology of the District. The dominant species were those with highest cover- abundance value for a given community. Each community has different in numbers of species. According to Hedberg (1964), altitude effects, atmospheric pressure, moisture and temperature in an area directly influence growth and development of plants and the corresponding patterns of vegetation distribution.

Urban et al (2000). Also explained that plant community distribution is an expression of physical gradients (elevation, soil heterogeneity and microclimate), biotic response to these gradients and human-induced and/or environmental disturbances in a region. So, informants classified the communities including these factors.

5.1.3 Uses of woody plants

As results show in the results, woody plants serve a wide range of purposes for farming families in Borena District. The most frequently mentioned uses include fencing (20 species), firewood (19 species), medicine (8 species) construction (7 species) from most frequent to least frequent contains 17 uses one species for each.

As indicated in the results, the list of uses by informants in the current study as compared with those reported in other studies in Ethiopia (Hussien Adal, 2014; Belay Tefera et al., 2014), have high degree of correspondence. This implies that the cognitive domain for on farm woody plant species are more or less universal in rural communities of different parts of Ethiopia, and elsewhere due to dependence on plants for their livelihood world-wide.

As a result, indicates many multipurpose woody plants were important for the rural areas (Table 4). but by different factors peoples of the District cannot got the whole value of woody plants. These factors were peoples cannot have enough knowledge about the use of all plants, ages, gender, climate and also sociological variables. In earlier studies it was shown that many of indigenous species have been recorded as multipurpose woody plants used as food, medicine and a variety of purposes to the respective communities (Hussien Adal, 2014).

Preference ranking indicated that *Eucalyptus globulus* was the most preferred woody plant by almost farmers, *Acacia abyssinica, Juniperus procera, Rhamnus prinoides, Cordia africana, Ficus sur, Ocimum urticifolium and Olea europaea subsp cuspidata* were ranked second, third, fourth, fifth, sixth, seventh and eighth respectively (Table 4). As in other regions where it has been introduced, *Eucalyptus globulus* is favored for its rapid growth rates, minimal management requirements and coppicing ability (Turnbull & Pryor 1978; FAO 1981).

Direct matrix ranking also indicated that *Eucalptus globulus* is the most highly valued tree based on multiple attributes (Table 5). key informants ranked it highest for its use in fencing and construction, as well as a source of cash income. Also ranked higher than all other trees based on its growth performance, the availability of saplings at local extension offices, and its overall multifunctionality (variety of uses). used by the whole peoples of the District based on the information of informants.

According to the result elder informants' retention of relatively more woody plants in their farm can be attributed to rich experience and deeper environmental knowledge possessed over the younger informants. Based on this finding 100(66.7%) of the informants were (≥41) years old (Appendix 3).

Based on Borena Wereda Agricultural Office, diversity and distribution of woody plant species difference with agro-ecological zones due to gradients of environmental factors that inhibit woody plants growth.

5.1.4 Marketability of woody plants

Local communities in Borena mainly collect and use woody plants for a private use for their own income. However, a limited scale of buying and selling woody plants was observed at Soye, Segno, Hamus, Junior, Billi and Arib local market in the District. Although 17.5%(10 species) of the woody plants were shown to be available on the market.

Eucalyptus globulus was the most marketable tree in the Borena District followed by *Olea europaea subsp cuspida, Citrus medica and Citrus simensis* respectively (Table 8). These woody plants species buy and sell for the purpose of traditional medicine, firewood, edibility, house construction and furniture.

The specific market price of the woody plants mainly depends on the availability of species in the area and the distance travelled to collect the respective plants.

Olea europaea subsp. cuspidata and *Citrus simensis* were reported for scarcity in the area by all the informants and local retailers where by the latter was explained to be due to overharvesting of woody species. This made people travel long distances to gather the woody species.

5.1.5 Threats of woody plants

Plants are basic need for different activities and survival of life. The increasing number of population in an area has highly linked with plant species diversity to fulfill their requirements. An increasing demand for arable land and forest products due to the rapidly growing population and poverty of the rural people have also been maintained as a major threat to the survival of many of the Ethiopian land species (Ensermu Kelbessa *et al.*, 1992). There were major anthropogenic activities carried out in the Borena District. Some of the activities seriously observed in the areas were cattle overgrazing, cutting of trees for firewood, charcoal production and harvesting of grasses for roof cover and setting of fire near the woody plants by owners adjacent to the woody plants to expand their land and protect crops from monkey.

According to the result shown that the major threats of woody plant species appeared in Borena District were farm land expansion, fire wood, overgrazing, house construction and farm material, charcoal and climate change. This results were the same as the earlier study Wondie Mebrat and Temesgen Gashaw (2013).

According to (Hundra 2007). Showed that agricultural expansion is the major threat to woody plants in the Jimma Zone of southwestern Ethiopia. This result was the same as the present study in Borena District (Tsehaynew Getnet, 2020).

5.1.6 Conservation practice of woody plant species listed by informants

The conservation of woody plant species has become high challenge in our District in background of farming, firewood extraction, building and industrial activities due to increasing human population with high deforestation rates. The intensive logging practice has seriously damaged the composition and structure of woody plant species of the study area there by increasing the economic, social and environmental problems include flood, soil erosion, drought, poor soil and health problems.

As results indicated that this problem solved by fencing, watering, hoeing, fertilizing, preventing illegal cutting and weeding were the major conservation practice of woody plant

species in Borena District. This implies that the conservation practices of woody plants were the same as the earlier study (Belay Tefera et al., 2014).

An effort to conserve woody plant diversity in the Ethiopian highlands could be facilitated by spiritual beliefs and religions institutions. Ethiopia is home to a diversity of spiritual systems, religions traditions, and associated cultural taboos, including many that are related to woody plants, particularly large charismatic and emblematic trees. For example, some informants in the study kebeles that croplands can become unproductive due to a curse brought on by the evil eye. As responses of informants Indigenous woody plants such as *Acacia abyssinica, Olea europaea subsp. cuspidata, Hagenia abyssinica and Juniperus procera* should be mainly conserved in Ethiopian orthodox churches in Borena District. Mainly conserved the threatened woody plant species in the District.

5.2 Conclusion

The results and discussion indicated that the findings give useful information on the present condition of woody plant species diversity, uses, threats, and conservation practices in Borena District. as result indicates, that woody plant diversity alarmingly diminishes in the Borena District. As the information obtained from informants showed there are four plant community types. The findings also showed that shrubs were high and lianas had the smallest number of woody plant species in the Borena District. From the four agro-ecological zones of the District, Woina dega (moderate temp') was the most suitable zone for woody plant species.

In the study kebeles, a total of 57 woody plant species were listed by informants that are used by people of the District and were distributed among 51 genera and 34 families as determined scientifically. It indicated that the people of the District got more benefit from woody plant species and give great value for woody plant species. The major uses of woody plants are fencing, fire wood, traditional medicine and construction. As shown by the results, *Eucalyptus globulus* was the most widely planted woody plant largely on account of its fast growth, sapling availability and high market value that offers opportunities for income generation.

As results indicated people of the District mainly used the stem parts of the woody plants followed by leaf, fruit and flower. As responses of some informants' leaf parts of woody plants were mainly used for traditional medicines.

Woody plants are mainly threatened by deforestation for agricultural expansion, fire wood, overgrazing and illegal cutting for building. The decline of woody plant species due to poor conservation practice and huge demand of woody plant species reduce the diversity of woody plants in Borena District. Based on the result, the need for implementing good conservation practice is underlined in order to save the life of woody plant species and their diversity.

The community, the District administration, government offices and other stakeholders need to take care of and conserve the indigenous woody species such as *Hagenia abyssinica, Acacia abyssinica and Olea europaea subsp cuspidata.*

5.3 Recommendations

Based on the results of the study the following recommendations are forwarded.

1. The woody plants of Borena District are disturbed through grazing and browsing by domestic animals and other human uses, These further affect the quality of regeneration process of shrubs, trees and lianas. Recognizing these issues as possible future scenario underlines the need for management intervention to increase quality of regeneration being recruited and to accelerate the growth of the young plants already present.
2. The present study was limited to diversity of woody plants only in five kebeles, therefore further study on all vegetation component's as well as in the rest of the study areas in the District and further studies on soil seed bank, seed physiology, medicinal plants, herbaceous plants and land use management system in the area are recommended for wereda agricultural officers and farmers.
3. Tree growing project should be encouraged by farmers, local communities and agricultural development office and sustainable utilization of the resources should be encouraged;
4. Governmental organization should participate in awareness raising for woody plant users to minimize the loss of indigenous plant species; and
5. Conservation site should be established by community and wereda agricultural offces in the District to effectively conserve the threaten species including *Olea europaea subsp cuspidata, Haginia abyssinica and Acacia abyssinica.*

REFERENCES

Abate Ayalew (2003). A Floristic composition and structural analysis of Denkoro Forest, South Wollo. MSc. Thesis. Addis Ababa University, Ethiopia.

Abate, Z. (2007). Comparative floristic study on Menagesha Suba state forest on years 1980 and 2006, MSc thesis Presented to school of graduate studies, Addis Ababa University.

Abiyou Tilahun (2009). Floristic composition, structure and regeneration status of Menagesha Amba Mariam (Egdu) Forest in central Highland of Shewa, Ethiopia. MSc. Thesis. Addis Ababa University, Ethiopia.

Alemayehu, W. (2007). Ethiopian church forests opportunities and challenges for restoration PhD, Wageningen University, Wageningen, The Netherlands.

Alemneh Dejene (2003). Integrated Natural Resource Management to enhance Food security. The case for Community-Based Approaches in Ethiopia. and Natural Resource Service Sustainable Development Department. FAO, Rome.

Alexiades, M. (1996). Collecting ethnobotanical data. A field manual. USA. The New York Botanical Garden P_P. 53-94.

Amanual Ayanaw (2016). Woody species diversity, structure and regeneration status of Yemeharene Kirstos Church Forest of Lasta Wereda, North Wollo Zone, Amhara Region, Ethiopia. Thesis, Addis Ababa University.

Bartlett, J.E., Kotrlic, J.W. and Higgins, C.C. (2001) Organizational Research: Determining Appropriate Sample Size in Survey Research. Information Technology, Learning, and Performance Journal, 19, 43-50.

Behailu Etana (2010). Ethnobotanical study traditional medicinal plants of Goma Wereda, Jima Zone of Oromia Region, Ethiopia. Thesis, Addis Ababa University, Biology Department Dry land biodiversity stream.

Belay Tefera, Morgan L. Ruelle, Zemede Asfaw, and Berhanu Abraha Tsegay (2014). Woody plant diversity in an Afromontane agricultural landscape (Debark Wereda northern Ethiopia). Forests, Trees and Livelihoods. 23, available onlineathttps://dx.doi.org/10.1080/14728028.2014.942709

Birhanu Kebede (2010). Floristic composition and structural analysis of Gedo Dry Evergreen Montain Forest, West Shewa Zone of Oromia National Regional State, Central Ethiopia. MSc,Thesis, Addis Ababa University, Ethiopia.

BWAODNRM (2009). Borena Wereda Agricultural Office Department of Natural Resource

Management, Borena wereda agricultural office 2009 annual report. Mekane selam, Ethiopia.

Chenje, M. and Mohamed- Katerere J. (2003) "Invasive alien species are emerging as one of the major threats to sustainable development, on a par with global warming and the destruction of life-support system, Preston and Williams, working for water programme/south Africa environment outlook.

Cotton, C. M. (1996). Ethnobotany principles and applications. Chichester, England John Wiley and Sons.

Davis, A. and Wagner, J.R. (2003). Who knows? On the importance of identifying "Experts" when researching local ecological knowledge. *Human Ecology* 31: 463-489.

Demel Teketay (2001). Deforestation, woody famine and environmental degradation in Ethiopia's High land Ecosystem: Urgent Need for action. Northeast African studies, **8**(1): PP. 57-76.

Demel Teketay, Teshome Soromessa and Sebsebe Demessew (2004). Ecological study of the vegetation in Gamo Gofa Zone, Southern Ethiopia, Tropical Ecology 45 (2): 209-221.

Denkissa Beche (2011). Floristic composition, Diversity and structure of woody plant species in Menagesha suba state, Central Ethiopia. MSc. Thesis. Addis Ababa University, Department of Plant Biology and Biodiversity management.

Dikaso Unbushe and Tesema Takele (2016). Floristic composition and diversity of woody plant species. *Journal of Natural resource ecology and management*, **1(3): P**P. 63-70.

Ensermu Kelbessa; Sebsebe Demissew; Zerihun Woldu and Edwards, S (1992). Threatened Endemic plant of Ethiopia. (In: Edwards, S., and Zemede Asfaw (Eds.). The plant used in African traditional medicine as practice in Ethiopia and Uganda, PP. 35-55.

EPA (1998). National Action Programme to combat Desertification. Environmental Protection Authority. Addis Ababa.

FAO (1981). Eucalyptus for planting. FAO Forestry and Forest Products Studies 11. Rome.

FAO (1996). Ethiopia: country report to the FAO. International Technical conference of plant genetic resource. Lepzing, Germany.

FDRE (Federal Democratic Republic of Ethiopia) (2003). State of Environment report for Ethiopia, published by Environmental protection authority, Addis Ababa, Ethiopia.

FDRE (Federal Democratic Republic of Ethiopia) (2012). National strategy and action plan for the implementation of the great wall institute in Ethiopia.

Feyera Senbeta (2006). Biodiversity and Ecology of Afromontane Rainforests with Wild coffee Arabica L. Populations in Ethiopia. Ecology and Development Series No. 38, P_P. 144.

Friis, I., Sebsebe Demissew and van Bruegel, P., (2010). Atlas of the potential vegetationof Ethiopia. The Royal Danish Academy of Science and letters, Biologiske Skrifter 58.

Gemedo Dalle T. Maass BL, Isselstein J (2006). Range land condition and trend in the semi-arid Borena lowlands, Southern Oromia, Ethiopia. Afr. J. R. and Forage Sci., 23, 49-58.

Hedberg I, Friis I, Person E. General part and Index to Vol 1-7. Flora of Ethiopia and Eritrea Volume 8. Ethiopia and Uppsala, Sweden: The National Herbarium, Addis Ababa; 2009.

Hedberg O. (1964). Features of Afro-alpine Plant Ecology. Acta Phytogeographic Suecica 49: 1-144.

Hegde, R. and Enters, T. (2000). Forest products and household economy: a case study from Mudumalai Wildlife Sanctuary, Southern India. Environmental Conservation, 27: P_P. 250-259.

Hundra K. (2007). Traditional forest management practices in Jimma Zone, South west Ethiopia. Ethiop J Educ Sci. 2:2-9.

Hussien Adal and Zemede Asfaw (2018). A Pragmatic Comparison of Smallholder Farmers' **Perceptions and Attitudes Towards Integration of Trees in Farmed Landscapes in North Eastern Ethiopia** Afromontane agricultural landscape (Debark Wereda northern Ethiopia). Forests TreesandLivehoods**.23(4)**:Pp.261279,avalaibleonlineathttp://dx.doi.org/10.1080/14728028.2014.942709

IBCR (2009). Ethiopia's 4th Country Report, Convention on biological Diversity. Institute of Biodiversity Conservation and Research, Addis Ababa.

Ken, M. and Coker, P. (1992). Vegetation Description and analysis. A practical approach. John Wiley and Sons, New York. P_P. 363.

Loeb, R.E. (2012) Arboricultural Introductions and Long-Term changes for invasive woody plants in Remnant Urban Forests, Forests 3, 745-763.

Martin, G.J. (1995). Ethnobotany: A method manual. Chapman and Hall, London. North Eastern Ethiopia. *Abyssinia Jornal of Science and Technology* **3(1)**: Pp.28-38.

Mohammed A. (2011). Perception of Local Community towards Deforestation: the case of Edigetber and Selamber kebele around Wolkite an MSc thesis presented to school of graduate studies of Addis Ababa University.

Motuma Tolera, Zemede Asfaw, Mulugeta Lemenih and Erik, K. (2008). Woody species diversity in a changing Land scape, south-central Ethiopia highlands, Agriculture Ecosystem and Environment. 128: 52-58.

NMSA. (2012). Climate data for Mekane selam, Ethiopia. National meteorological service agency of Ethiopia, Mekane selam branch, Ethiopia.

Pant, S. and Samant, S. S. (2007) Assessment of plant diversity and prioritization of communities for conservation in mornaulareserve forests, G.B. plant institute of Himalaya environment and development, Himalaya unit, himachal Pradesh, India.

Rankin, C. and MES (Madrone Environmental Services), (2004). Invasive alien species for BC: identifying and addressing threats to biodiversity a working document to address issues associated with biodiversity in British Colombia Biodiversity Branch Ministry of Water, land & Air Protection.

Smit GN (2002). The importance of ecosystem dynamics in managing the bush encroachment problem in Southern Africa. Inaugural Lecture. University of the Free State, Bloemfontein, South Africa.

Tejaswi, G. (2007). Strengthening monitoring, assessment and reporting on sustainable forest management in Asia (gcp/int/988/jpn) forestry department manual on deforestation, degradation and fragmentation using remote sensing and gis.

Tewachew Assefa (20.19). History of Borena Wereda, In wollo from (1941- 1991). M.A. Thesis Axum University, Ethiopia.

Tewelde berhan Gebre egzeabhare (1988). Vegetation and environment of the mountain of Ethiopia: Implications for Utilization and Conservation Mountain research development, 8: PP. 211-216.

Tsegaye Bekele, Mulugeta Lemenh, Tsegaye Tadesse and Aklilu Ameha (2007). Determining forest carrying capacity in PFM/JFM sites, The case of Adaba-Dodola Forest. In: Participatory Forest Management (PFM), *Biodiversity and Livelihoods in Africa*, PP. 202-213.

Turnbull JW, Pryor LD. (1978). Choice of species and seed source. In: Hillis WE, Brown AG, editors. Eucalyptus for wood production. London: CSIRO.

Uhlig, K. (1988). Mountain forest and the upper tree limitation on the south eastern plateau of Ethiopia, Mountain Research and Development, Vol.8: 227-234.

Urban, D., Miller, C., Halpin, P. and Stephenson N (2000). Forest gradient response in Sierran landscapes: the physical template. Landscape, 15: 603-620.

Vivero, J. L., Ensermu Kelbessa and Sebsebe Demisew (2005) *The Red list of Endemic Trees and shrubs of Ethiopia and Eritrea.* Fauna and Flora international, Cambridge. Ethiopia. For.Rev.(3/4): PP. 41-68.

Wondie Mebrat and Temesgen Gashaw (2013). Threats of Woody plant species diversity and their conservation technique in Ethiopia. *European Journal Botany, plant science and phytology*, **1:** PP. 10-17.

APPENDICES

Appendix 1: Lists of woody plant species in Borena District.

No	Local name	Sientific name	Family	Growth Habit	Code
1	Agam	*Carissa spinarum* L.	Apocynaceae	Shrub	TG01
2	Ameraro	*Discopodium penninervium* Hochst.	Solanaceae	Shrub	TG02
3	Amja	*Hypericum revolutum*	Hypericaceae	Shrub	TG03
4	Anfar	*Buddleja polystachya* Fresen.	Loganiaceae	Shrub	TG04
5	Apil	*Malus sylvestris* L.[j]	Rosaceae	Tree	TG05
6	Askuar	*Nuxia congesta* R.Br. ex Fresen.	Loganiaceae	Shrub	TG06
7	Azamir	*Bersama abyssinica* Fresen.	Melianthaceae	shrub	TG07
8	Bahir Zaf	*Eucalyptus globulus* Labill.[j]	Myrtaceae	Tree	TG08
9	Birtukan	*Citrus sinensis* (L.)Osb	Rutaceae	Shrub	TG09
10	Bisana	*Croton macrostachyus* Del.	Euphorbiaceae	Tree	TG010
11	Buna	*Coffea arabica* L.	Rubiaceae	Shrub	TG011
12	Chat	*Catha edulis* (Vahl) Forssk Ex eduli.	Celastraceae	Shrub	TG011

13	Damakesi	*Ocimum urticifolium* Roth.	Lamiaceae	Shrub	TG013
14	Digta	*Calpurnia aurea* (Aiton) Benth.	Fabaceae	Shrub	TG014
15	Duba	*Cucurbita pepo* L.	Cucurbitaceae	Liana	TG015
16	Embis	*Allophylus abyssinicus* (Hochst.) Radlkofer	Sapindaceae	Tree	TG016
17	Embuacho	*Rumex nervosus* Vahl.	Polygonaceae	Shrub	TG017
18	Enbuay	*Solanum marginatum* L.f.	Solanaceae	Shrub	TG018
19	Endahule	*Kalanchoe petitiana L.*	Crassulaceae	Shrub	TG019
20	Endod	*Phytolacca dodecandra* L'Herit.	Phytolaccaceae	Liana	TG020
21	Fereszeng	*Leonotis ocymifolia* (Burmf.) iwarsson	Lamiaceae	Shrub	TG021
22	Gesho	*Rhamnus prinoides* L'Her.	Rhamnaceae	Shrub	TG022
23	Girar	*Acacia abyssinica* Benth.	Fabaceae	Tree	TG023
24	Grawa	*Vernonia amygdalina* Delile	Asteraceae	Tree	TG024
25	Hareg eresa	*Zehneria scabra* (Linn.f.) Sond.	Cucurbitaceae	Liana	TG025
26	Kechemo	*Myrsine africana* L.	Myrsinaceae	Tree	TG026
27	Kega	*Rosa abyssinica Lindley*	Rosaceae	Shrub	TG027
28	Kentefa	*Pterolobium stellatum* (Forssk.) Brenan	Fabaceae	Liana	TG028

29	Ketetina	*Verbasicum sinaiticum* Benth	Scrophulariaceae	Shrub	TG029
30	Kinchib	*Euphorbia tirucalii* L.	Euphorbiaceae	Shrub	TG030
31	Kitkita	*Dodonaea angustifolia* L.f	Sapindaceae	Shrub	TG031
32	Kok	*Prunus africana* (Hook. f.)Kalkm.	Rosaceae	Shrub	TG032
33	Koso	*Hagenia abyssinica* (Bruce) J.F. Gmel.	Rosaceae	Tree	TG033
34	Kulkual	*Euphorbia abyssinica* J.F.Gmel.	Euphorbiaceae	Tree	TG034
35	Kundo Berbere	*Schinus molle* L.	Anacardiaceae	Shrub	TG035
36	Lomy	*Citrus aurantifolia* (christm.) swingle.	Rutaceae	Shrub	TG036
37	Sensel	*Justicia schimperiana* (Hochst.ex Nees) T.Anders.	Acanthaceae	Shrub	TG037
38	Shekoko Gomen	*Solanecio gigas* (vatke) C.Jeffrew	Astraceae	Shrub	TG038
39	Shenbeko	*Arundo donax* L.	Poaceae	Shrub	TG039
40	Shinet	*Myrica salicifolia* Hochst. ex. A. Rich.	Myricaceae	Tree	TG040
41	Shola	*Ficus sur* Forssk.	Moraceae	Tree	TG041
42	Tena	*Ruta chalepensis* L.	Rutaceae	Shrub	TG042
43	Tikur inchet	*Prunus africana* (Hook. f.)Kalkm.	Rosaceae	shrub	TG043
44	Tilem	*Rhus natalensis* Krauss	Anacardiaceae	shrub	TG044
45	Tinbaho	*Nicotiana tabacum* L.	Solanaceae	Shrub	TG045
46	Tinjut	*Otostegia integrifolia* Benth.	Lamiaceae	Shrub	TG046
47	Tringo	*Citrus medica* L.	Rutaceae	Shrub	TG047
48	Tsigereda	*Rosa x-ricihardi* Rehd	Rosaceae	Shrub	TG048

49	Wanza	*Cordia africana* Lam.	Boraginaceae	Tree	TG049
50	Warka	*Ficus vasta* Forssk.	Moraceae	Tree	TG050
51	Woira	*Olea europaea* subsp. cuspidata L.	Oleaceae	Tree	TG051
52	Wulkfa	*Dombeya torrida* (J. F. Gmel.) Bamps	Malvaceae	Tree	TG052
53	Yeazo hareg	*Clematis simensis* Fresen.	Ranunculaceae	Liana	TG053
54	Yeferenji girar	*Acacia decurrens* Wild.[j]	Fabaceae	Tree	TG054
55	Yehabesha tsid	*Juniperus procera* L.	Cupressaceae	Tree	TG055
56	Yeset kest	*Asparagus africanus* Lam.	Asparagaceae	Shrub	TG056
57	Zigba	*Podocarpus falactus*	Podocarpaceae	Tree	TG057

TG=Tsehaynew Getnet

Appendix 2: List of families of woody plants with the number of species and genera recorded in the study kebeles.

No	Family	Genera	No. of Species	Percent (%)
1	Acanthaceae	1	1	1.75
2	Anacardiaceae	2	2	3.5
3	Apocynaceae	1	1	1.75
4	Asparagaceae	1	1	1.75
5	Asteraceae	2	2	3.5
6	Boraginaceae	1	1	1.75
7	Celastraceae	1	1	1.75
8	Crassulaceae	1	1	1.75
9	Cucurbitaceae	2	2	3.5
10	Cupressaceae	1	1	1.75

11	Euphorbiaceae	2	3	5.25
12	Fabaceae	3	4	7
13	Hypericaceae	1	1	1.75
14	Lamiaceae	3	3	5.25
15	Loganiaceae	2	2	3.5
16	Malvaceae	1	1	1.75
17	Melianthaceae	1	1	1.75
18	Moraceae	2	2	3.5
19	Myricaceae	1	1	1.75
20	Myrsinaceae	1	1	1.75
21	Myrtaceae	1	1	1.75
22	Oleaceae	1	1	1.75
23	Phytolaccaceae	1	1	1.75
24	Poaceae	1	1	1.75
25	Podocarpaceae	1	1	1.75
26	Polygonaceae	1	1	1.75
27	Ranunculaceae	1	1	1.75
28	Rhamnaceae	1	1	1.75
29	Rosaceae	4	6	10.5
30	Rubiaceae	1	1	1.75
31	Rutaceae	2	4	7
32	Sapindaceae	2	2	3.5
33	Scrophulariaceae	1	1	1.75
34	Solanaceae	3	3	5.25
	Total	51	57	100

Appendix 3: Questionnaires about woody plants.
Date_____

Addis Ababa University

This questionnaire is to collect data about woody plants and their uses for the communities. I like to forward hearty thanks to your time and cooperation.

I. General information:

- ✓ Name_____age_____Sex:M_____F_____
- ✓ Religion_____Marital status_____Ethnicity_____
- ✓ Educational status_____Occupation_____locality(kebele)_____

II. Basic Information (data)

1. What are the most available woody plant species?
2. What is the habit of the woody plants?
3. What are the main roles of woody plants?
4. Are there local conservation practice for woody species?
5. How can use the different woody species?
6. Do you use woody plants as your income generation? a) Yes b) No
7. Are threats to the woody plants? List out the main threats?
8. Are there any woody plants that are found under extinction?
9. Which woody plant is the most useful for the District?
10. Which type of agro-ecology is more suitable for woody plants?

Appendix 4: List of woody plants and their parts used and uses mentioned by key informants.

No	Local name	Scientific name	Parts used	Uses
1	Kundo berbere	*Schinus molle* L.	Leaf	Food flavoring
2	Girar	*Acacia abyssinica* Benth	Stem	Fire wood, Charcoal
3	Koso	*Hagenia abyssinica* J.F.Gmel.	Stem	Medicine and Fire wood
4	Endod	*Phytolacca dodecandra*	Leaf	As detergent and Medicine

		L'Herit.		
5	Tinjut	*Otostegia integrifolia* Benth.	Leaf	For washing materials
6	Agam	*Carissa spinarum* L.	Stem	Fence, Fire wood
7	Digta	*Calpurnia aure(Aiton)* Benth.	Stem	Fire wood, Fence chebo
8	Sensel	*Justicia schimperiana* (Hochst.ex Nees) T.Anders.	Stem	Fire wood, Fence
9	Ameraro	*Discopodium penninervium* Hochst.	Stem	Fire wood, Fumigation
			Leaf	Baking bread
10	Kulkual	*Euphorbia abyssinica* J.F.Gmel.	Stem	Fire wood, Winnowing shovel, Fence
11	Duba	*Cucurbita pepo* L.	Fruit	Source of food
12	Yeset kest	*Asparagus africanus* Lam.	Stem	Broom, Fence
13	Yeazo hareg	*Clematis simensis* Fresen.	Stem	Strapping
14	Kinchib	*Euphorbia tirucalii* L.	Stem	Fence
15	Shola	*Ficus sur* Forssk.	Stem	Charcoal, Fire wood, Farm equipment
			Fruit	Source of food
16	Enbuay	*Solanum marginatum* L.f.	Fruit	For washing hair
17	Yehabesha tsid	*Juniperus procera* L.	Stem	Construction material, Charcoal, Fire wood, Farm equipment
18	Zigba	*Podocarpus falactus*	Stem	Fire wood, Farm equipment, construction material
19	Kok	*Prunus africana* (Hook. f.) Kalkm.	Fruit	Source of food
20	Endahule	*Kanchoe* sp.	Leaf	For bread making
21	Hareg eresa	*Zehneria scabra* (Linn.f.) Sond.	Leaf	Medicine, Fence
22	Dama kesi	*Ocimum urticifolium*	Leaf	Medicine

		Roth.	Stem	Fire wood
23	Tena adam	*Ruta chalepensis* L.	Leaf	Food flavour, Marjoram
24	Bisana	*Croton macrostachyus* Del.	Stem	Fire wood, Fence, Farm material
25	Fereszeng	*Leonotis ocymifolia* (Burmf.) iwarsson.	Stem	Fence
26	Embuacho	*Rumex nervosus* Vahl.	Leaf	Medicine
			Stem	Fire wood
27	Tinbaho	*Nicotiana tabacum* L.	Leaf	For relaxation
28	Yeferenji girar	*Acacia decurrens* Wild.[j]	Stem	Farm equipment, Charcoal, Fire wood
29	Gesho	*Rhamnus prinoides* L'Her.	Leaf	It gives bitter taste for alcoholic drinks
30	Bahir zaf	*Eucalyptus globulus* Labill.[j]	Stem	Construction, Farm and Home materials, Fire wood, Medicine, Income, Fence
31	Warka	*Ficus vasta* Forssk.	Stem	Furniture
32	Tsigereda	*Rosa x-richardii* Rehd	flower	For decoration
33	Amja	*Hypericum revolutum*	Stem	Fire wood
34	Anfar	*Buddleja polystachya* Fresen.	Stem	Fence, Washing for tank
35	Askuar	*Nuxia congesta* R.Br. ex Fresen.	Fruit	Food source
			Stem	Fence, Fire wood
36	Apil	*Malus sylvestris* L.[j]	Fruit	Food source, Income
37	Azamir	*Bersama abyssinica* Fresen.	Stem	Fence
38	Birtukan	*Citrus sinensis* (L.)Osb	Fruit	Food source
39	Buna	*Coffea arabica* L.	Fruit	Food source
40	Chat	*Catha edulis* (Vahl) Forssk Ex eduli.	Leaf	Relaxation, Income
41	Kega	*Rosa abyssinica* R. Br.ex Lindl.[d]	Fruit	Food source
42	Ketetina	*Verbasicum sinaiticum*	Leaf	Medicine

		Benth		
43	Kentefa	*Pterolobium stellatum* (Forssk.) Brenan	Stem	Fence
44	Kechemo	*Myrsine africana* L.	Leaf	Invocation game
45	Kitkita	*Dodonaea angustifolia* L.f	Stem	Fence
46	Lomy	*Citrus aurantifolia* (christm.) swingle.	Fruit	Source of food
47	Shikoko gomen	*Solanecio gigas* (vatke) C.Jeffrew	Stem	Fence
			Leaf	Malt baking
48	Shenbeko	*Arundo donax* L.	Stem	Fence
49	Shinet	*Myrica salicifolia*	Stem	Fumigation
50	Tikur inchet	*Prunus africana* (Hook. f.)Kalkm.	Stem	Fence, Construction
51	Tirngo	*Citrus medca* L.	Fruit	Source of food
52	Wanza	*Cordia 3africana* Lam	Stem	Furniture, Construction
53	Woira	*Olea europaea* L.	Stem	Fumigation, Fire wood
54	Wulkfa	*Dombya torrida* (J. F. Gmel.) .Bamps	Stem	Fire wood, Construction
			Flower	Food source for bee
55	Grawa	*Vernonia amygda* lina	Stem	Washing tanks, Medicine
56	Tilem	*Rhus natalensis* Krauss	Stem	Fence
57	Embis	*Allophylus abyssinicus* (Hochst.) Radlkofer	Stem	Fence, Construction

Appendix 5: Informants personal data.

List of respondents

No	Full Name	Kebele	Sex	Age	Marital Status	Religion	Occupation	Educational Status
1	Gashaw Abate	019	M	38	Marriage	Orthodox	Farmer	Illiterate
2	Dessalew Asen	019	M	39	Marriage	Orthodox	Farmer	Illiterate
3	Asen Geremew	019	M	70	Marriage	Orthodox	Farmer	Illiterate
4	Habtamu Mekonen	019	M	24	Marriage	Muslim	Farmer	Illiterate
5	Demssie Ahmed*	019	M	39	Marriage	Orthodox	Farmer	Agriculture
6	Alemu Kebede	019	M	65	Marriage	Orthodox	Farmer	Illiterate
7	Fetene Jemal	019	M	60	Marriage	Muslim	Farmer	Illiterate
8	Aychesh Enyew	019	F	50	Marriage	Orthodox	Farmer	Illiterate
9	Aynalem Yesuf	019	F	45	Marriage	Muslim	Farmer	Illiterate
10	Belete Getaneh	019	M	70	Marriage	Orthodox	Farmer	Illiterate
11	Fasika Legese	019	F	60	Marriage	Orthodox	Farmer	Illiterate
12	Halimet Ayalew	019	F	59	Marriage	Muslim	Farmer	Illiterate
13	Seada Gebeyehu	019	F	41	Marriage	Muslim	Farmer	Illiterate
14	Jembere Kibret	019	F	56	Marriage	Orthodox	Farmer	Illiterate

15	Fentanesh Demeke	019	F	61	Marriage	Orthodox	Farmer	Illiterate
16	Wudiye Kebede	019	F	60	Marriage	Orthodox	Farmer	Illiterate
17	Tsegaye Nurye*	019	M	75	Marriage	Orthodox	Farmer	Illiterate
18	Yohanis Zeleke	019	M	70	Marriage	Orthodox	Farmer	Illiterate
19	Zeyneba Alebache	019	F	65	Marriage	Muslim	Farmer	Illiterate
20	Abebech Worku	019	F	55	Marriage	Orthodox	Farmer	Illiterate
21	Abel	019	M	50	Marriage	Orthodox	Farmer	Illiterate
22	Abiye Getachew	019	M	60	Marriage	Orthodox	Farmer	Illiterate
23	Anteneh Belay	019	M	45	Marriage	Orthodox	Farmer	Illiterate
24	Ayalew Mekonen	019	M	40	Marriage	Orthodox	Farmer	Illiterate
25	Demssew Adimasu	019	M	49	Marriage	Orthodox	Farmer	Illiterate
26	Feleku Alebache	019	F	55	Marriage	Orthodox	Farmer	Illiterate
27	Shibre Assefa	019	F	45	Marriage	Orthodox	Farmer	Illiterate
28	Zebiba	019	F	65	Marriage	Muslim	Farmer	Illiterate
29	Zinet Zewudu	019	F	60	Marriage	Muslim	Farmer	Illiterate
30	Tesfanesh Kindu*	019	F	70	Marriage	Orthodox	Farmer	Illiterate
31	Demssie Fetene	028	M	65	Marriage	Orthodox	Farmer	Dacon
32	Demssie Ambaw*	028	M	29	Marriage	Orthodox	Farmer	Illiterate

33	Eshetu	028	M	55	Marriage	Muslim	Farmer	Illiterate
34	Beletu Hailu	028	F	40	Marriage	Orthodox	Farmer	Illiterate
35	Shewaye Dessalew	028	F	40	Marriage	Orthodox	F/A/L	10th
36	Abebe Tegegne	028	M	43	Marriage	Orthodox	Farmer	Illiterate
37	Melese Geremew	028	M	27	Single	Orthodox	Farmer	5th
38	Asdesaw Abi	028	M	28	Single	Orthodox	Farmer	6th
39	Fetene Mesele	028	M	42	Marriage	Orthodox	Farmer	Illiterate
40	Mekonen Arage	028	M	48	Marriage	Muslim	Farmer	Illiterate
41	Moges Gedefe	028	M	45	Marriage	Orthodox	Farmer	Illiterate
42	Hasen Workneh	028	M	40	Marriage	Orthodox	Farmer	Illiterate
43	Tsehay Adem	028	F	40	Single	Muslim	Farmer	Illiterate
44	Cheru Mengstu*	028	M	62	Marriage	Orthodox	Priest	Priest
45	Abebaw Geto	028	M	28	Marriage	Muslim	Farmer	Illiterate
46	Aytenew Tesema	028	M	26	Marriage	Orthodox	Farmer	10th
47	Yimer Ahmed	028	M	53	Marriage	Muslim	Farmer	Illiterate
48	Hamid Yimer	028	M	29	Marriage	Muslim	Farmer	Illiterate
49	Fentanesh Tebeje	028	F	24	Single	Orthodox	Farmer	Illiterate
50	Tejitu Adem	028	F	35	Marriage	Muslim	Farmer	Illiterate

51	Abebech Teshome	028	F	40	Marriage	Orthodox	Farmer	Illiterate
52	Birke	028	F	45	Marriage	Orthodox	Farmer	10th
53	Aynalem Assefa	028	F	50	Marriage	Orthodox	Farmer	10th
54	Kokobe Mitku*	028	F	60	Marriage	Orthodox	Farmer	Illiterate
55	Meka Abebe	028	F	60	Marriage	Muslim	Farmer	Illiterate
56	Muluwork	028	F	70	Marriage	Orthodox	Farmer	Teacher
57	Sosna Melese	028	F	40	Marriage	Orthodox	Farmer	Illiterate
58	Zehara Ahmed	028	F	50	Marriage	Muslim	Farmer	Illiterate
59	Bizunesh Yimer	028	F	60	Marriage	Muslim	Farmer	Illiterate
60	Ewawoy Dessalew	028	F	60	Marriage	Orthodox	Farmer	Illiterate
61	Amognesh	013	F	22	Single	Orthodox	Farmer	Illiterate
62	Endalk Habtamu	013	M	30	Single	Orthodox	Farmer	5th
63	Awoke Derese	013	M	44	Single	Orthodox	Farmer	7th
64	Alelign Belete	013	M	30	Marriage	Orthodox	Farmer	Illiterate
65	Fentaw Ayalew	013	M	60	Marriage	Orthodox	Farmer	Illiterate
66	Kokobe Mengstu	013	F	30	Single	Orthodox	Farmer	7th
67	Bosi Temeche	013	F	50	Marriage	Orthodox	Farmer	Illiterate

68	Alimet Wubetu	013	F	25	Marriage	Muslim	Farmer	Illiterate
69	Tigst	013	F	26	Single	Orthodox	Farmer	Illiterate
70	Amare Hailu	013	M	48	Marriage	Orthodox	Farmer	Illiterate
71	Wondiye Alemu*	013	M	32	Marriage	Orthodox	Merchant	10th
72	Stotaw Birhan*	013	M	40	Marriage	Orthodox	Teacher	12th
73	Tewabech Mitku*	013	F	30	Marriage	Orthodox	Merchant	10th
74	Zabsh	013	F	48	Marriage	Orthodox	Farmer	Illiterate
75	Kassanesh Abnew	013	F	28	Marriage	Orthodox	Farmer	Illiterate
76	Abebe Molla	013	M	55	Marriage	Orthodox	Farmer	Illiterate
77	Likye Ayalew	013	F	45	Marriage	Orthodox	Farmer	Illiterate
78	Andualem Abnew	013	M	27	Marriage	Orthodox	Farmer	Illiterate
79	Bosi	013	F	30	Marriage	Orthodox	Farmer	Illiterate
80	Beletu Alemu	013	F	45	Marriage	Orthodox	Farmer	Illiterate
81	Abebe Bayeh	013	M	40	Marriage	Orthodox	Farmer	Illiterate
82	Getachew Amare	013	M	21	Single	Orthodox	Student	10th
83	Mulugeta Andarge	013	M	24	Single	Orthodox	Student	10th
84	Derese Alemu	013	M	50	Marriage	Orthodox	Farmer	Illiterate
85	Nigus Gashaw	013	M	29	Single	Orthodox	Student	6th

86	Tsehay Tareke*	013	F	26	Marriage	Orthodox	Teacher	12th
87	Bashah Wured	013	M	50	Marriage	Orthodox	Farmer	Illiterate
88	Demewoz Gochaw	013	F	25	Single	Orthodox	Farmer	Illiterate
89	Serke Demse	013	F	65	Single	Orthodox	Farmer	Illiterate
90	Alganesh Dejen	013	F	40	Marriage	Orthodox	Farmer	Illiterate
91	Belew Tadesse	09	M	60	Marriage	Orthodox	Farmer	Illiterate
92	Belete Deresse*	09	M	30	Marriage	Orthodox	Farmer	Illiterate
93	Abebaw Tessema	09	M	55	Marriage	Orthodox	Farmer	Illiterate
94	Abera Kibret	09	M	50	Marriage	Orthodox	Farmer	Illiterate
95	Bosena Belete*	09	F	59	Marriage	Orthodox	Farmer	Illiterate
96	Belete Eshetu	09	M	65	Marriage	Orthodox	Farmer	Illiterate
97	Seid Ali	09	M	51	Marriage	Muslim	Farmer	Illiterate
98	Bogale Dege	09	M	75	Marriage	Orthodox	Farmer	Illiterate
99	Habtam assefa	09	F	35	Marriage	Orthodox	Farmer	10th
100	Emebet Dessalew	09	F	45	Marriage	Orthodox	Farmer	Illiterate
101	Toyba	09	F	56	Marriage	Muslim	Farmer	Illiterate
102	Fulhaw Tadesse	09	M	52	Marriage	Orthodox	Farmer	Illiterate
103	Zeleke Andarge	09	M	58	Marriage	Orthodox	Farmer	Illiterate

104	Almaz Andarge	09	F	63	Marriage	Orthodox	Farmer	Illiterate
105	Fate	09	F	60	Marriage	Muslim	Farmer	Illiterate
106	Desalew Abebe	09	M	70	Marriage	Orthodox	Farmer	Illiterate
107	Alemnew Teshome	09	M	65	Marriage	Orthodox	Farmer	Illiterate
108	Melaku Akele*	09	M	32	Marriage	Orthodox	Guard	10^{th}
109	Sindew Kibret	09	M	29	Marriage	Orthodox	Guard	10^{th}
110	Dagne Gebeyehu	09	M	51	Marriage	Orthodox	Farmer	Illiterate
111	Fentaw Mulaw	09	M	71	Marriage	Orthodox	Farmer	Illiterate
112	Tirngo Alemu	09	F	60	Marriage	Orthodox	Farmer	Illiterate
113	Ajebush Darge	09	F	54	Marriage	Orthodox	Farmer	Illiterate
114	Tegada Tefera	09	F	35	Marriage	Orthodox	Farmer	Illiterate
115	Abay Tareke	09	F	50	Marriage	Orthodox	Farmer	Illiterate
116	Askal Bekele	09	F	60	Marriage	Orthodox	Farmer	Illiterate
117	Kemila Geto	09	F	65	Marriage	Muslim	Farmer	Illiterate
118	Maritu Endire	09	F	70	Marriage	Muslim	Farmer	Illiterate
119	Habtam Molla	09	F	60	Marriage	Orthodox	Farmer	Illiterate
120	Ayelech Tefera	09	F	75	Marriage	Orthodox	Farmer	Illiterate
121	Ali Asen	02	M	45	Marriage	Muslim	Farmer	Sheh

122	Abebe Tadesse	02	M	22	Marriage	Orthodox	Farmer	Illiterate
123	Temesgen Belay	02	M	27	Marriage	Orthodox	Student	12th
124	Mechu Shibesh*	02	M	60	Marriage	Orthodox	Teacher	12th
125	Gashaw Muhamed	02	M	40	Marriage	Muslim	Police	10th
126	Dagne Adem	02	M	45	Marriage	Muslim	Farmer	Illiterate
127	Alelign Workneh	02	M	50	Marriage	Orthodox	Farmer	Illiterate
128	Aliy Mekonen	02	M	60	Marriage	Muslim	Farmer	Illiterate
129	Amognesh	02	F	70	Marriage	Orthodox	Farmer	Illiterate
130	Andualem Worku	02	M	80	Marriage	Orthodox	Farmer	Illiterate
131	Worku Aragaw	02	M	75	Marriage	Orthodox	Farmer	Illiterate
132	Truwork Muhe	02	F	60	Marriage	Muslim	Farmer	Illiterate
133	Zemzem Yimer	02	F	67	Marriage	Muslim	Farmer	Illiterate
134	Beletu Kassa	02	F	65	Marriage	Orthodox	Farmer	Illiterate
135	Feleke Legese	02	M	45	Marriage	Orthodox	Farmer	Illiterate
136	Talema Abebe	02	M	60	Marriage	Orthodox	Farmer	Illiterate
137	Mesfin Feleke	02	M	70	Marriage	Orthodox	Farmer	Illiterate
138	Shikur Ali	02	M	75	Marriage	Muslim	Farmer	Illiterate

139	Kindu Ayalew	02	M	78	Marriage	Orthodox	Farmer	Illiterate
140	Geleta	02	M	73	Marriage	Muslim	Farmer	Illiterate
141	Shewaye Melku	02	F	60	Marriage	Orthodox	Farmer	Illiterate
142	Likye Wodajo	02	F	50	Marriage	Orthodox	Farmer	Illiterate
143	Hayat Ali	02	F	35	Marriage	Muslim	Farmer	Illiterate
144	Mulu	02	F	40	Marriage	Orthodox	Farmer	Illiterate
145	Adissie Gedefaw	02	F	50	Marriage	Orthodox	Farmer	Illiterate
146	Fentanesh Gashaw	02	F	28	Marriage	Orthodox	Farmer	8^{th}
147	Genet Alemu	02	F	31	Marriage	Orthodox	Farmer	6^{th}
148	Amsal Mengstu	02	F	34	Marriage	Orthodox	Farmer	Illiterate
149	Serke Lema	02	F	39	Marriage	Orthodox	Farmer	Illiterate
150	Yeshume Yechale	02	F	44	Marriage	Orthodox	Farmer	Illiterate

Key: * = key informants selected from each study kebeles

Declaration

I, the under signed declare that this thesis is my original work and all source of materials used to this thesis have been duly acknowledged.

Name	Signature	Date
Tsehaynew Getnet	_____	_____

Date of submitted_____

This thesis has been submitted for examination with my approval as research advisor.

Name	Signature	Date
Zemede Asfaw (Prof.)	_____	_____

Date of approval _____