

ADDIS ABABA UNIVERSITY  
SCHOOL OF GRADUATE STUDIES  
DEPARTMENT OF BIOLOGY



**Diversity and Uses of Plant Species in Chato Natural Forest, Horro Guduru Wollega Zone,  
Oromia Regional State, West Ethiopia**

**Habtamu Teshome Tefera**

**A Thesis Submitted to the School of Graduate Studies of Addis Ababa University**

**Presented in Partial Fulfillment of the Requirement for Degree of Masters science in**

**Biology**

**August, 2018**

**Addis Ababa, Ethiopia**

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## Approval Sheet I

This is to certify that the thesis prepared by Habtamu Teshome entitled: “*Diversity and Uses of Plant Species in Chato Natural Forest, Horro-Guduru, Wollega Zone, Oromia Regional State, West Ethiopia*” and submitted in partial fulfillment of the Degree of Master of Science (Biology) compiles with the regulation of the University and meets the accepted standards with respect to originality and quality.

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Department head \_\_\_\_\_ signature \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_

## **ABSTRACT**

### **Diversity and Uses of Plant Species in Chato Natural Forest, Horro Guduru Wollega Zone, Oromia Regional State, West Ethiopia**

**Habtamu Teshome Tefera**  
**August, 2018**

The role of plant species in everyday lives of rural communities in Horo-Gudru district (Wellega Zone, West Ethiopia) is highly prominent. However, no scientific documentation has been found to the knowledge of the researcher. The present study aimed at documenting the diversity and uses of plant species in the district. Purposive sampling was done and sampling of plant specimen took place from 40 quadrants, which were established in Chato Forest (a Natural forest located nearby the community and used as plant resource). Sampling of informants for use purpose was undertaken from rural villages around the Chato forest. The total number of informants involved in this study were 45:30 male (age 18-65 years) and 15 female (21-71 years). Semi-structured interview and guided field walk were the methods used to collect Ethnobotanical data. A total of 142 specimens were collected consisting of 103 and 39 woody and herbaceous species, respectively. Three plant community types were identified and named after the species that are dominant in the community. Major uses of local plant species are for traditional medicine, human consumption as food, animal feed, household construction, for detergent and firewood. The result in this study evidenced that the area is rich in plant diversity. These results confirm that “apparent” plants, perennial woody species, are used by the communities living around the forest more than the “non-apparent” short life cycle herbaceous species.

**Key words:** Ethnobotanical, Natural forest, Plant Diversity

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## **List of Acronyms**

CBD; Conservation of Biological diversity

CSA; Central Statistical Authority

EMA: Ethiopia Mapping Agency

EFAP: Ethiopia Forestry Action Plan

FAO: Food and Agriculture Organization

HWAO; Horro Woreda Agricultural Office

HWNRMO: Horo Wereda Natural Resource Management Office

NBSAP: National Biodiversity Strategy and Action Plan

NFPA; National Forest Priority Areas

RBGK: Royal Botanic Garden, Kew

SIV: Species Importance Values

UV; Use value

# CHAPTER ONE

## 1. INTRODUCTION

### 1.1. Background

Forests are mainly composed of plant resources and have been providing humans several uses since their evolution. About 31% of the land's surface is covered by forest and about 240 million people live in and around these forest ecosystems (United Nations Food and Agriculture Organization (FAO), 2010; World Bank, 2003). In Africa, forests contribute 17% of the world's forest land size and they are the source of livelihoods for the adjacent communities (Schippmann *et al.*, 2006). Ethiopia is a country of great geographical diversity with high and rugged mountains, flat-topped plateau and deep gorges, incised river valleys and rolling plains. Over the ages, erosion, volcanic eruptions, tectonic movements and subsidence have occurred and continued through millennia to accentuate the unevenness of the surface (EMA, 1988). Altitude variation ranges from the highest peak at Ras Dejen, 4620 m above sea level; down to the depression of the Kobot Sink, which is 110 m below sea level (Demel Teketay 1999; EFAP, 1994). This gives the country a highly diversified climatic conditions and topography with a wide range of habitats and vegetation types. Because of this, Ethiopia has been regarded as one of the most important countries in Africa with respect to biological resources (EFAP, 1994).

The estimated number of higher plants species (flowering plants, conifers and ferns) growing in Ethiopia is about 6000 (Flora of Ethiopia and Eritrea Volumes 1-8), of which about 10% are endemic to the country (Vivero *et al.*, 2006). This high number of plant species results from the wide variation in climate, geology and terrain established through long periods of time (Sebsebe

Demissew *et al.*, 2003; Mulugeta Lemenih and Demel Teketay, 2004). However, the forest cover of Ethiopia has been diminishing over times due to always increasing demand for uncontrolled farmlands, the increasing livestock population, and an increasing demand for fire wood and charcoal with illegal harvesting of the forest and its products (Feyera Senbeta and Demel Teketay, 2003; Teshome Soromessa *et al.*, 2004). Loss of such forest resources would have great implication for the environment, biological diversity and socio-economic setup of the communities.

Historical sources indicate that about 35-40% of the land surface of the country has been covered with forest and woodlands (EFAP, 1994). The same source has shown that the size has exhibited diminishing trend over years, i.e., about 16% was left by early 1950s, 3.1 % by 1982, 2.6 % by 1989 and less than 2.3 % in 1990 forest cover was remaining before the completion of the study that led to establishment (EFAP, 1994). Most of the remaining forests in Ethiopia are confined to the south and the south-western parts which are less accessible (Kumilachew Yeshitela and Tamrat Bekele, 2002). However, now adays the remnant natural forests in these areas are also continuously threatened by anthropogenic activities and the existing ones are in a secondary state of development (Friis and Mesfin Tadesse, 1990).

Deforestation due to different factors is the cause of forest cover loss in Ethiopia which has its root in a cascade of events. Population growth resulted in rural demand for agricultural lands. This in turn led to expansion of cultivated fields at the expense of the forest. The annual rate of deforestation in Ethiopia was found to be extremely high. The major causes of deforestation were reported elsewhere (Desta Hamilto, 2001; NBSAP, 2005). This unprecedented deforestation rate is considered a major threat to the Ethiopian biodiversity (Tadesse

Woldemariam and Demel Teketay, 2001; IBC, 2009) and the habitats of the 120 threatened endemic plant species of Ethiopia (Vivero *et al*, 2005). This apparent forest resources degradation is alarming and the establishment and reinforcement of stringent forest resources conservation measures should be put in place. The inclusion of local communities in conservation activities is also equally useful for forest resource conservation. In view of this, generation of sound biodiversity and ecological data on the remaining natural forest of Ethiopia is deemed necessary for their subsequent conservation activities.

Chato Natural Forest is part of the Chato Sangi Dangeb National Forest Priority Area (EFAP, 1994). the diversity and uses of plant species in this forest has not been studied scientifically and no compiled documents are found to our knowledge. The location of the forest, which is distant from the main road, might have caused difficulties to conduct such studies. Therefore, assessing the diversity and uses of plants species is required including the the threats for dwindling of the plant species in the forest. The result from this study will contribute to the existing knowledge of forest protection and preservation in Ethiopia.

## **1.2. Statement of the problem**

Chato Natural Forest is one of the few forest patches in Ethiopia where one finds high number of plantspecies diversity and remarkable vegetation stands. This forest is highly valued for its high economic and other ecological services. For instance, in these areas, people treat human and livestock ailments by using their knowledge of medicinal uses of plants. Their knowledge of using plants of their area is also directly related to wild plants of nutritional values and other many uses.

The human pressure on natural resources causes deforestation, forest degradation and loss of many plant species as other parts of the country (HWNRMO, 2017). However, evidence based knowledge on the diversity and uses of the plant resources in the forest is lacking. Unless a scientific document is produced and disseminated to the responsible body, the resource would be neglected which may result in loss of the resource and the associated knowledge. Thus, detailed scientific study is important to draw the awareness of the community as well as policy makers. Assessing the diversity and uses of plants species is required to understand the threats of the plants and also recommend a means of protection and preservation of the biodiversity and the knowledge.

### **1.3. Objectives of the Study**

#### **General objective**

The general objective of this study is to document the diversity and use of plant species in Chato Natural Forest.

#### **Specific objectives**

- To document local knowledge on utilization and relative importance of woody and herbaceous plant species of Chato Natural forest.
- To determine the use value of plants and their contribution to households' livelihoods in the study area.
- To identify the plant community types in terms of: Species richness, evenness and species diversity.
- To recommend conservation measures that enhances future intervention strategies to maintain the remnant forest.

## CHAPTER TWO

### 2. LITERATURE REVIEW

#### 2.1. Biodiversity

"Biological diversity" means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. Biological diversity is subdivided into three levels, namely, genetic diversity, ecological diversity and species diversity.

Genetic diversity refers to the variation in genetic information between species as well as variation between individuals of same species (Veblen and Lorenz, 1987). Genetic diversity determines the extent to which a given population adapts to environmental changes and diseases (Addo-Danso, 2010). Genes play a very important part in the resilience of biodiversity to world changes, such as climate change (Assefa *et al.*, 2007). Genetic diversity is the raw material that allow species to adapt to a changing world whether these changes are caused naturally or by human (Maclaurin and Sterelny, 2008). Ecosystem diversity is a measure of various ecosystem types, diversity of habitats and ecosystem functions within all of them (Addo-Danso, 2010). Ecosystem diversity refers to the conditions and processes which natural ecosystems and the species that make them up, sustain and fulfill human life. Species diversity is a measure of the number of species in a community (species richness) and the evenness of species abundance. Therefore, communities with abundant species are considered to be more diverse and undisturbed than a community with lesser species and can be concluded to be less diverse or

disturbed (Maclaurin and Sterelny, 2008). By considering this, the study concerned with the examining diversity and uses of plant species in chato natural forest.

## **2.2. Plant species diversity**

Arthur (2009) reported that the estimated number of species in the world is about 11 million of which nearly 1,900,000 are accepted published species and about 18,000 new species are being described per year. This author added to his idea that 11% of the new species discovered solely in the year 2007 were vascular plants. His major conclusion was that the estimated number of described flowering plants species in the world range from 300,000 to 400,000 of which 268,600 were described and published. He further summarized that some 92% of the vascular are endemic to their respective geographical regions where they are restrict found.

This idea is also in line with that of Hobohm (2014) about endemism in the vascular plant taxa. He took detailed and in depth survey of the possible number of higher plants globally from various published sources. Moreover, Arthur's estimation of flowering plants is closer to what Crane *et al.*, (1995) had already estimated as 250,000 to 300,000 extant species of angiosperms that dominated the vegetation of most terrestrial ecosystem. However, the most recent data from the Royal Botanic Garden, Kew showed that approximately 391,000 vascular plant species are currently known to science (RBGK, 2016).

The modern Ethiopia flora project was initiated in 1980 and documented thousands of plant specimens in the Ethiopia National Herbarium that grew from 14,000 in 1980 to 80,000 currently (Sebsebe Demissew, 2014) . The flora of Ethiopia and Eritrea documented about 6,027 vascular plant species including subspecies with about 10% endemism (Ensermu Kelbessa and Sebsebe

Demissew, 2014). They further noted that the number of species in Ethiopia is about 5,757 species.

### **Vegetation types in Ethiopia**

Recently the depletion of vegetation resource and environmental degradation have become issue national and global concern. This is due to the fact that the decline of vegetation cover and depletion of natural resources are closely associated with drought and food shortage problem that are becoming great threat to the people of the world (Motuma Didita, 2007)

Ethiopia is regarded as one of the most important countries in Africa with respect to endemic of plant and animal species (EFAP, 1994). The vegetation types of Ethiopia are considered extremely complex, where the complexity is due to the great variation in altitude. The difference in altitude in turn results in great variations of spatial distribution in the country (Zerihun Wolde, 1999).

Ethiopia is gifted with range of vegetation types ranging from afroalpine to desert vegetation. Several scholars have studied and described the vegetation types of country at different times. Those scholars have attempted to classify the vegetation of Ethiopia are (Zerihun Woldu 1999; Friis and Sebsebe Demissew 2001). There are twelve vegetation types in Ethiopia (Friis *et al.*, 2010). This include ;Desert and Semi desert scrub land Forest; Acacia-commiphora wood land and bush land; wooded grass land of the western Gambela region; Combretum-Terminalia wood land and woody grass land; Dry Evergreen arfomontane forest and grass land complex; Moist Evergreen montane forest and bush land; Transitional rain forest; Ericaceous belt; Afro-alpine belt; Riverine vegetation; Fresh-water lakes; and Salt lakes vegetation (Friis *et al.*, 2010).

From these vegetation types, the current study area, Chato Natural Forest, might match with characteristics of the moist evergreen montane forest in the country (NBSAP, 2005; Woldeyohannes Enkossa, 2008) as it has similar climatic and physical features to the southwestern parts of the country.

### **Plant Community Types**

The species compositions of the communities better express their relationships to one another and environment than any other characteristics (Kent and Cooker, 1992). It can be defined as the collection of plant species growing together in a particular location that show a definite association or affinity with each other (Kent and Cooker, 1992). Plant community can be understood as combination of plants that are dependent on their environment, influence one another, and modify their environment (Mueller-Dombois and Ellenberg, 1974). As stated in Mueller-Dombois and Ellen berg (1974), the floristic composition of vegetation includes all species occurring within a plant community. However, most plant communities consist of many different species which are not particular to discover all species within a community. Hence, it is common to use the dominant species in naming plant communities (Kent and Cooker, 1992).

## **Species diversity, species richness and evenness**

The explanation of plant community involves the analysis of species diversity, evenness and similarity. Diversity and equitability of species in a given plant community are used to interpret the relative variation between and within the community and help to explain the underlying reason for such a difference. The two main factors taken into account when measuring diversity are richness and evenness.

Richness is a measure of the number of different species in a given site and can be expressed in a mathematical index to compare diversity between sites (Zerihun Woldu, 1985). Species richness refers to the total number of species in a community whereas evenness is the relative abundance of species within the sample or community making up the richness of an area (Kent and Cooker, 1992). Species richness index is of great importance in assessing taxonomic and ecological values of habitats. Among many species diversity indices, probably the most widely used to calculate the diversity and evenness includes Shannon-Wiener diversity index, which naturally varies between 1.5 and 3.5 and rarely exceeds 4.5 (Kent and Cooker, 1992). It is widely used index that combines richness and evenness (Krebs, 1999).

## **Species important value index and dominance**

Species important value allows comparison of species in a given forest and reflects the dominance, occurrence and abundance of a given species in relation to other associated species in an area (Kent and Coker, 1992). Therefore, for setting priority, it is a good index for summarizing vegetation characteristics and ranking species for management and conservation practices. Whereas species with lower SIV need high conservation efforts, those with higher SIV need monitoring management

## **Vegetation patterns along environmental gradients**

Altitude affects temperature, moisture, radiation and atmospheric pressure thereby influencing the growth and development of plants and the distribution of vegetation ( Zerihun Woldu *et al.* (1989) indicated that altitude is the main factor that orders the tree-shrub layer into respective vegetation types because it is positively correlated with some environmental factors like organic matter and negatively correlated with pH, clay and calcium. Altitude is one of the most important environmental factors that determine species diversity and distribution patterns. Species diversity generally tends to decrease with increasing altitude or elevation (Whittaker, 1975). The interacting influences of climate, topography and soil are primary determinants of plant distribution so that variables such as vegetation structure and productivity also exhibit complex patterns along environmental gradient (Brown, 2001).

### **2.3. The uses of Plants**

Forests cover considerable part of the world's terrestrial land surface and support millions of people living adjacent to them (FAO, 2010; World Bank, 2003). These ecosystems account for

significant roles in sustaining environmental integrity through carbon sequestration and hydrological services (Godoy *et al.*, 2002), as well as providing subsistence needs and economic benefits to communities through direct utilization and sale (Larsen and Smith, 2004; Sunderlin *et al.*, 2005).

In Africa, plants have a central role in the everyday lives of rural people. It provides us with food, fiber, shelter, medicine, and fuel. The basic food for all organisms is produced by green plants. In the process of food production, oxygen is released. This oxygen, which we obtain from the air we breathe, is essential to life. The only source of food and oxygen are plants; no animal alone can supply these. Shelter, in the form of wood for houses; and clothing, in the form of cotton fibers, are obvious uses of plant materials. But we must not forget fuel, furniture, paper products, certain medicines like aspirin, and many other products like perfume and chewing gum. To these tangible aspects of the plant world we must also add the importance of beauty and relaxation derived from plants. Since animals are surrounded by and dependent upon plants, the factors that influence plant growth, structure, and distribution, affects the animal world as well (Hamilton *et al.* 2003).

In addition to using, harvesting and processing of various plant products are undertaken by rural people in Africa to fulfill their various daily needs (Nikiema 2005). Most rural populations in Africa will continue to be heavily reliant on local wild plants Published: April 10, 2009 Ethnobotany Research & Applications [www.ethnobotanyjournal.org/vol7/i1547-3465-07-053.pdf](http://www.ethnobotanyjournal.org/vol7/i1547-3465-07-053.pdf) on the number of uses attributed to a plant by the totality of informants.

## **Measuring Uses of plant species to communities**

Previous studies on ethno-medicinal plants mainly documented botanical knowledge of species, parts used and their mode of preparation (Mesfin *et al.*, 2009; Kipkore *et al.*, 2014; Shiracko *et al.*, 2016). In the recent past, there has been a change towards quantitative ethno botany that determines the relative importance of species to communities (Reyes-Garcia *et al.*, 2006; Benz *et al.*, 2000). Numerous ethnobotanical indices have been developed by different researchers such as informant consensus indices (Phillips and Gentry, 1993a, 1993b; Phillips 1996); informant agreement ratio (Trotter and Logan, 1986); and indices that rely on researcher's subjective allocation of plant importance (Turner 1988). The most utilized indices are those based on informant consensus (Albuquerque *et al.*, 2006) because they tend to eliminate researcher's biasness (Phillips, 1996). The researcher's subjective method is biased because it is influenced by researcher's judgments (Tardio and Pardo-de-Santayana, 2008).

Informant agreement ratio has been used in determining the effective or the mostly used medicinal plants in treatment of certain ailment (Trotter and Logan 1986). Turner (1988) developed a measure of cultural significance as an estimate from quality of use, intensity of use and exclusivity of use. However, modified the index developed by Turner (1988), by developing one that had additional variables such as plant part used; multifunctional food use; taste score; and food-medicinal role among others. Phillip and Gentry (1993a) developed the use value of plant, which is defined as the proportion of the number of uses cited by informant and the number of interviews for that species with the informant.

Albuquerque *et al.* (2006) modified the index developed by Phillip and Gentry (1993a), and defined it as the summation of the number of use mentioned by informant for species divided by

the total number of informants. Other researchers have developed plant value by capturing the actual economic value of plant species by estimating their financial contribution to households' consumption and earnings (Godoy *et al.*, 2002; Reyes-Garcia *et al.*, 2006). However, some of these techniques are positively correlated therefore they can be used interchangeably (Albuquerque *et al.*, 2006; Tardio and Pardo-de-Santayana, 2008). Cultural indices can be used to provide imperative assessment and meaningful values that shows the relative importance of species to a community or region (Turner, 1988).

From the estimation of cultural importance of species, it is possible to identify the most utilized and underutilized families, species and growth forms. According to Ayantunde *et al.* (2009) Uses of Local Plant Species by Agro pastoralists in Southwestern Niger classified the uses of plant species as traditional medicine, as food for human consumption for household construction, for firewood and other uses of local plant species.

## CHAPTER THREE

### 3. MATERIALS AND METHODS

#### 3.1. Description of the Study Area

##### Location

The study was conducted at Chato Natural Forest which is located in the Horo Guduru Wollega Zone of Oromia Regional State, Ethiopia. Chato forest is part of National Forest Priority Areas (NFPA) and has been known by the name Chato Sangi-Dangab Forest in the country (EFAP, 1994). This forest lies approximately between  $9^{\circ} 40'$  -  $9^{\circ} 42'$  N latitudes and  $36^{\circ} 59'$  -  $37^{\circ} 00'$  E longitudes (EMA, 1988) in the Horo District 30 km north west of Shambu the capital of Horo Guduru Wollega Zone which is located at about 314 km west of Addis Ababa ( Figure 1 ). Chato natural forest is located along altitudinal ranges between 1700 m and 2350 m a.s.l and covers an area of about 50,000 hectares, of these 18, 000 ha is the natural forest (HWNRM 2017).

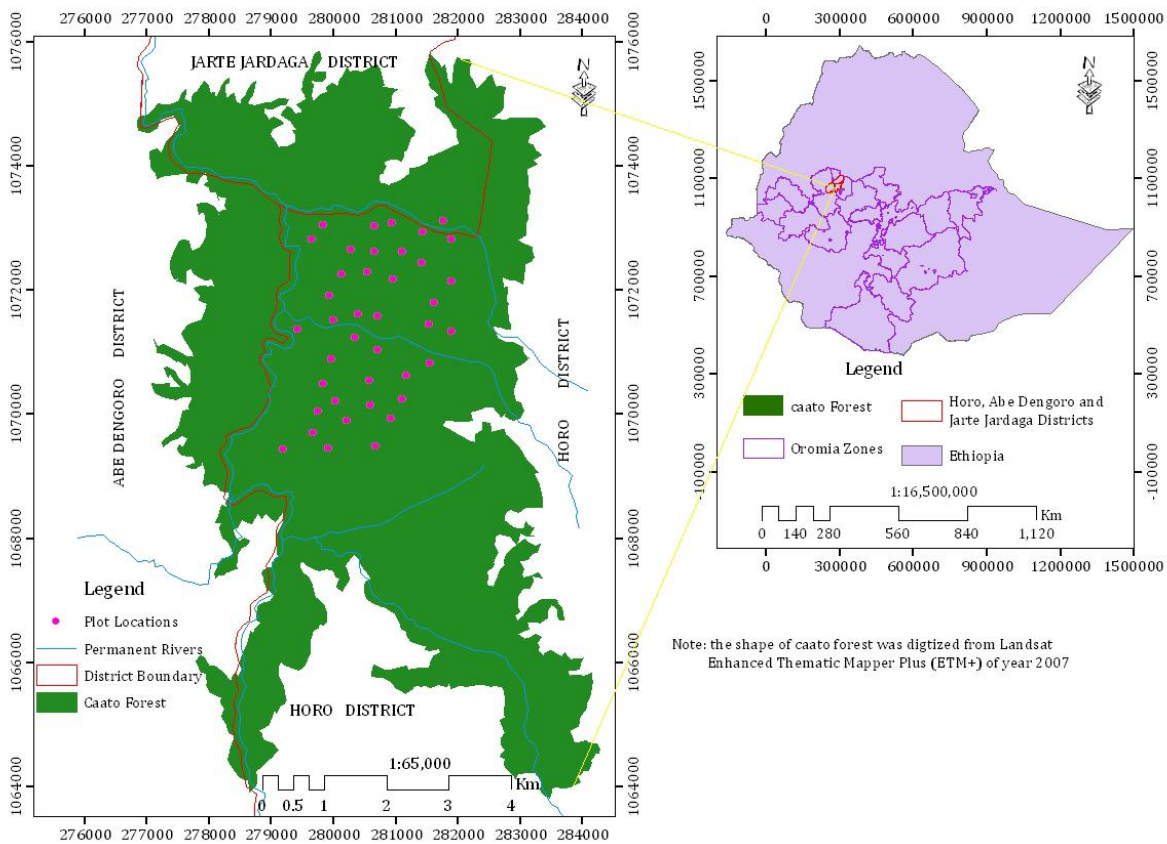


Figure 1 Location map of the study area (Chato Natural Forest)

## Topography

Chato natural forest is characterized by rough topography with undulating plain, hills, slopes, deep valley, gorges (Figure 2). Rivers such as Badessa, Chiracho, Yamalagi and others are flowing by crossing the forest and all them emerging from highland area. Due to geographical locaton (surrounded by hill) Chato natural forest is comparatively less affected by human except the marginal area.



Figure 2 Topography of the forest area

### **Climate**

Depending up on the data from the year 2003- 2017 the mean annual rain fall in study area is about 1566mm rain fall peak between May to October and decrease in November and December and little rain fall in Jaunary.The mean annual temperature is 16.6<sup>o</sup>c.The hottest months are from February to May maximum temperature is about 24.72<sup>o</sup> c and the coldest months are from June to December(EMSA2018).Horro woreda has threeClimatic Zones depending on altitudinal variations Woina Dega, Dega and Kola (Horo Woreda Agricultural Office, 2017).

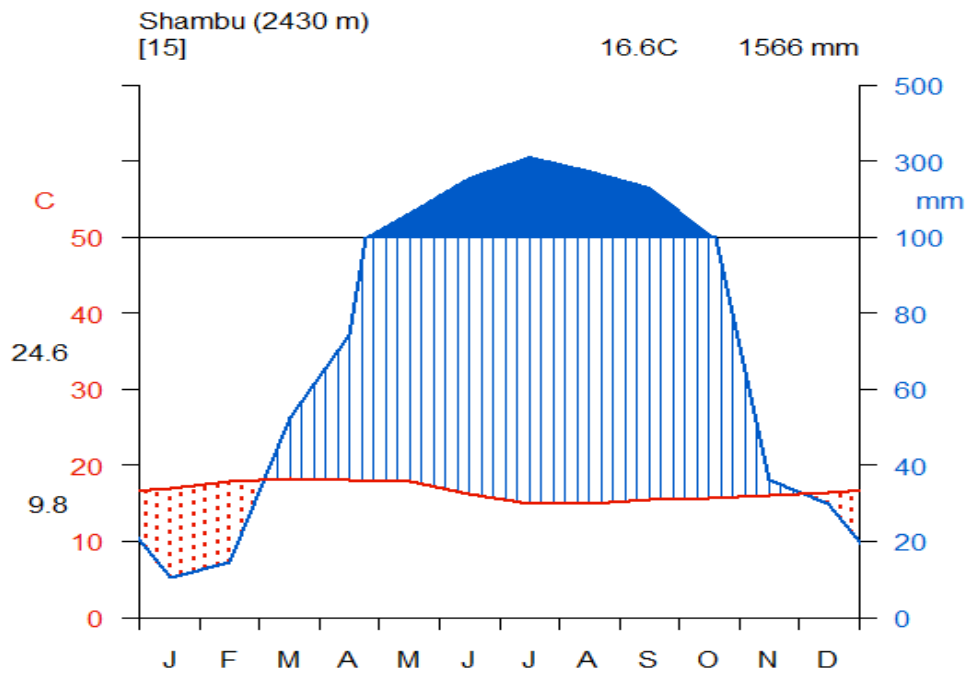


Fig 3 Climate diagram of the study area (temperature variation and rain fall distribution from 2003-2017(EMSA2018)

## Soil

According to (HWAO, 2017) the type of soil in the District is sandy-loam type. The Soils of the forest area are darker reddish in color with concentrated humus.

## Human Population

The total population of Horo District was 76,162; of these 73,983 rural and 2,179 urban, according to population and housing censuses reported by the CSA (2007). Similarly, 37,906 are males and 38,256 are females in the woreda. In each, 36,811 are males and 37,172 are female in rural, whereas 1,095 are males and 1,084 are females in urban area.

## **Land uses and agriculture**

According to the data obtained from the agricultural office of district different types of crops are cultivated by the farmer. The major crops that are cultivated in the district include cereal such as *Zea mays* (maize), *Eragrostis tef* (teff), *Triticum aestivum* (wheat), *Hordeum vulgare* (barley), *Pisum sativum* (Field pea) and *Vicia faba* (Faba bean) and oil crops noug and rape seed. Additionally, Honey and Coffee production is also practiced in the forest area.

## **Livestock population**

Data obtained from Horo district Agricultural and rural office reveals that the district possesses 689432 Livestock population consisting of 383,654 cattle, 120,385 sheep, 31,326 goats, 39,524 horses, 5,412 mules and 21,454 donkeys 87,677 poultry.

## **Vegetation**

The south western forest of Ethiopia is characterized by having moist montane forest ecosystem (Friis, 1992; Kumilachew Yeshitila1998). Chato natural forest contains many plants species including evergreen and broad leaved with important tree species such as *Croton macrostachyus*, *Celtis africana*, *Podocarpous falcatus*, *Mimusops kummel*, *Millettia ferruginea*, *Nuxia congesta*, *Ekebrergia capensis*, *Allophylus abyssinicum*, *Prunus africana*, *Cordia africana*, *Albiza gummifera*.

## **Wild life**

According to the information obtained from Horo District Natural Resource Management Office, Chato Natural Forest vegetation also contains various species of mammals, birds and reptiles. Some of the common wildlife includes Colabus monkey, Verbeit monkey, Anubis baboon, wild pig, Porcupine Common warthog and many others.

### **3.2. Methods of data collection**

#### **3.2.1. Reconnaissance survey**

Reconnaissance survey of the Chato natural forest was made in the first two weeks of October, 2017 in order to obtain an impression of the site conditions, to collect preliminary information and to identify sampling design.

#### **3.2.2. Sampling study site**

Selection of sampling sites was done purposively in Chato forest based on the level of disturbance. The forest is less disturbed in the middle than it is in the marginal areas where people can easily interfere. Once the site was determined, Plots were laid randomly within the sample frame and a total of 40 plots established for the vegetation data collection. Woody species were sampled in 20 m x 20 m sample plot. For the purpose of sampling herbaceous species nested plots were established within each 20 m x 20 m main plot. A total of five 1m x 1m subplot (one at each of the four corners and one at the center) were laid as the nested plots.

### **3.2.3. Sampling informants**

Because Chato forest is surrounded by rural people, for the plant uses purpose, only rural peoples around the Chato forest were interviewed. The informants were selected by using Purposive sampling. Purposive sampling was used because the researcher felt that they were vital informants whose ideas could not be over looked. Gay and Airasian (2000) define purposive sampling as one, which involves selecting a sample based on experiences or knowledge of the group to be sampled. By considering this, the informants were included 30 male (age 18-65 years) and 15 female (21-71 years) were interviewees administered the questionnaire.

### **3.2.4. Vegetation data collection**

Collection of data was conducted in different field work that took place between November 2017 and April 2018. The whole list of woody and herbaceous plants species was made from the plots. Additionally, plants species exist outside the plot were also collected to create a comprehensive list of the plant species diversity and uses of the study area. Specimen of all woody and herbaceous plants were collected, dried and brought to National Herbarium of Ethiopia for identification.

### **3.2.5. Data collection on the uses of plant species**

For the purpose of use diversity analyses, specimen of plant species also collected by a local guide who is highly knowledgeable of local plants in addition to the plant specimen collected from the sample plot. The collected specimens were used for the interviews which were conducted individually. The interview was conducted by using local language of the community which is Afan Oromo (Appendix 1).

Semi-structured interview method was employed to collect ethnobotanical data from the community. In each interview, time an interviewee was shown the specimen of plant species collected and was asked to identify each of them and also to list the different uses that they know. Once they identify the plant and the uses, questions were asked about use and the plant parts being used and the awareness on the present species abundance of the plant species (Appendix 3).

To simplify the interview, six use categories were included in the questions. These were medicine, food, forage, construction, firewood and others. Uses of plants for ritual uses, household utensils, farm tools, detergents, generate income, making house and household utensils good smell were included in the category “other”. A question on the perception of present species abundance of the plant, I asked if the species is abundant, moderately available, and rare or has completely disappeared.

### **3.3. Data Analysis**

#### **3.3.1. Vegetation data**

Classification and ordination are the two main method approaches that in vegetation ecology studies. It is now generally accepted that the choice between the two methods depends on the objectives of the data analysis and the structure of the data set being examined, rather than on preconception about the nature of the vegetation and there is no former reason to accept either a classification or an ordination as an inherently correct technique (Anderson, 1965). Therefore classification technique is working to study the ecology of Chato Natural Forest. Classification by means of cluster analysis is the most common multivariate technique to analysis community data and for mapping ecological community (Kershaw, 1973). Hierarchical cluster analysis in

PC-ORD for windows version 5.0 (McCune and Grace, 2000) was used to classify the vegetation into plant community types.

### **Diversity indices**

Shannon Wiener (1949) of the various indices, Shannon-Wiener diversity index ( $H'$ ) were most applicable index to quantify species diversity and richness. The two main indices of measuring diversity are richness and evenness. Richness is a measure the number of different species in a given site and can be expressed as a mathematical index to compare diversity between the sites.

- i. **Diversity index** was calculated according to Shannon Wiener by using the following

formula: 
$$H' = \sum_{i=1}^s (P_i)(\ln P_i)$$

Where,  $H'$  = Shannon diversity index  $\Sigma$  = Summation symbol;  $S$  = the number of species;  $P_i$  = the proportion of individuals or the abundance of the  $i$ th species expressed as a proportion of the total cover;  $\ln$  = log base<sub>e</sub> (natural logarithm)

- ii. **Shannon's Equitability** ( $E$ ), Evenness is calculated from the ratio of observed diversity to maximum diversity using the equation  $E = H' / H'_{\max}$ , or  $E = H' / \ln s$ , Equitability assumes a value between 0 and 1 with 1 being complete evenness (Kent and Cooker, 1992).

The higher the value of evenness index, the more even the species is in their distribution within the given area.

### **3.3.2. Use value**

The use value ( $UV$ ) was calculated for each species, and use category employing the following equations (Lucena *et al.* 2008):  $UV = \sum U_i / n$  and  $UV_c = \sum UV / nc$

Where:  $U_i$  = number of uses mentioned by each informant;  $n$  = total number of informants;

$UV_c$  = use value of each species in the use category;  $n_c$  = number of species in the use category.

Data analysis was performed by calculating the plant species use value and analyzes use value for different use categories per plant types of woody and herbaceous plant species.

## CHAPTER FOUR

### 4. RESULTS AND DISCUSSIONS

#### 4.1. Vegetation diversity

In this study, a total of 142 species of plants belonging to 65 families and 123 genera were identified from the 40 plots and plant species existing out side of the plots (Appendix 2). Regarding with their growth forms the 103 species were woody while the 39 species were found to be herbaceous. The following table has shown the most dominant families with regards to species number.

**Table 1 the most dominant families regard to species number**

Family Name	Species Number
Acanthaceae	7
Asteraceae	7
Euphorbiaceae	7
Fabaceae	7
Poaceae	7
Lamiaceae	6
Rubiaceae	6
Oleaceae	5

On the other hand, the remaining families of the study area are comprised of 4, 3, 2 and 1 species each. The whole list of scientific name, Local (vernacular) name of the species are given in (Appendix 2).

## **4.2. Vegetation Community Classification**

Based on using hierarchical cluster analysis of pc-ord 5.0 V three plant community types were identified. Based on the present analysis, the three plant community types identified from the study area were *Carissa spinarum-Justicia schimperiana* (Community1), *Matyenus gracilipes Commbretum-pancuiculatum* (Community 2) and *Podocarpus falcatus-Teclea nobilis* (Community 3).

### ***Carissa spinarum - Justicia schimperiana* Community type**

The dominant species in this community types are *Carissa spinarum* and *Justicia schimperiana*. This community exposed to a high level of antropogenic disturbance. It is located at a high altitude range. Altitude is one of the environmental gradients that could affect the species diversity and distribution of the plant communities. This species plot clustered was relatively located along the hill slopes and extends toward the flat bottom with narrow gradients between respective plots.

The common woody plants species to this community included *Croton macrostachyus*, *Clausena anistata*, *Pouteria adolfi-friederici*, *Cordia africana*, *Nuxia congesta*, *Ekebergia capensis*, *Macaranga capensis*, *Vernonia ampygdalina*, *Maesa lanceolata* and *Premna schimperii*.

In this community common herbaceous species covering the ground are *Setaria megaphylla*, *Hypoestes forskaoli*, *Hyparrhenia anthistiriodes*, *Achyrospermum schimperi*, *Kalancheo*

*petitiana* and *Achyranthes aspera*. This community also contains Lianas such as *Jasminum abssinicum* and *Clematis hirusta*.

### ***Matyenus gracilipes* –*Commobretum paniculatum* Community type**

This community is also highly exposed to human impacts such as logging trees for construction purpose and timber products.

This community holds different species of the community lives together and have similar characteristics for specific topographic factors and altitudinal gradients. The related woody plants in this community are: *Acacia brevispica*, *Vernonia auriculifera*, *Prunus africana*, *Ficus thonniigii*, *Matyenus gracilipes*, *Clusia abyssinica*, *Rothmannia urcelliformis*, *Myrsine africana*, *Euclea divinoroum* and *Gardenia ternifolia*. The herbaceous was comprised of *Oplismenus hirtellus*, *Cyperus fischerianus* and *Commelina foliacea*. The Lianas of this community include; *Periploca linearifolia* and *Mikaniopsis clematoides* are recorded.

### ***Podocarpus falcatus*–*Teclea nobilis* community**

This community type located in the inner and wettest part of Chato Natural forest. This community consists of main woody plant such as; *Podocarpus falcatus*, *Teclea nobilis*, *Psychotria orophila*, *Mimusops kumme*, *Olea capensis*, *Pittosporum viridiflorum*, *Ficus vasta*, *Acacia abyssinica*, *Cassipourea malosana*, *Phoenix reclinata*, *Rubus steudneri*, *Calpurnia aurea*, *Bersama abyssinica*. Few *Echinops longisetus* were observed in some sample plots. Except *Echinops longisetus* there is no more species of herbaceous. The lianas such as *Landolphia buchananii*, *Tiliacarpa troupinii*, *Hippocratea goetezia* and *Urera hypelodendron* were found. Few *Carduus schimperi* were observed in some sample plots.

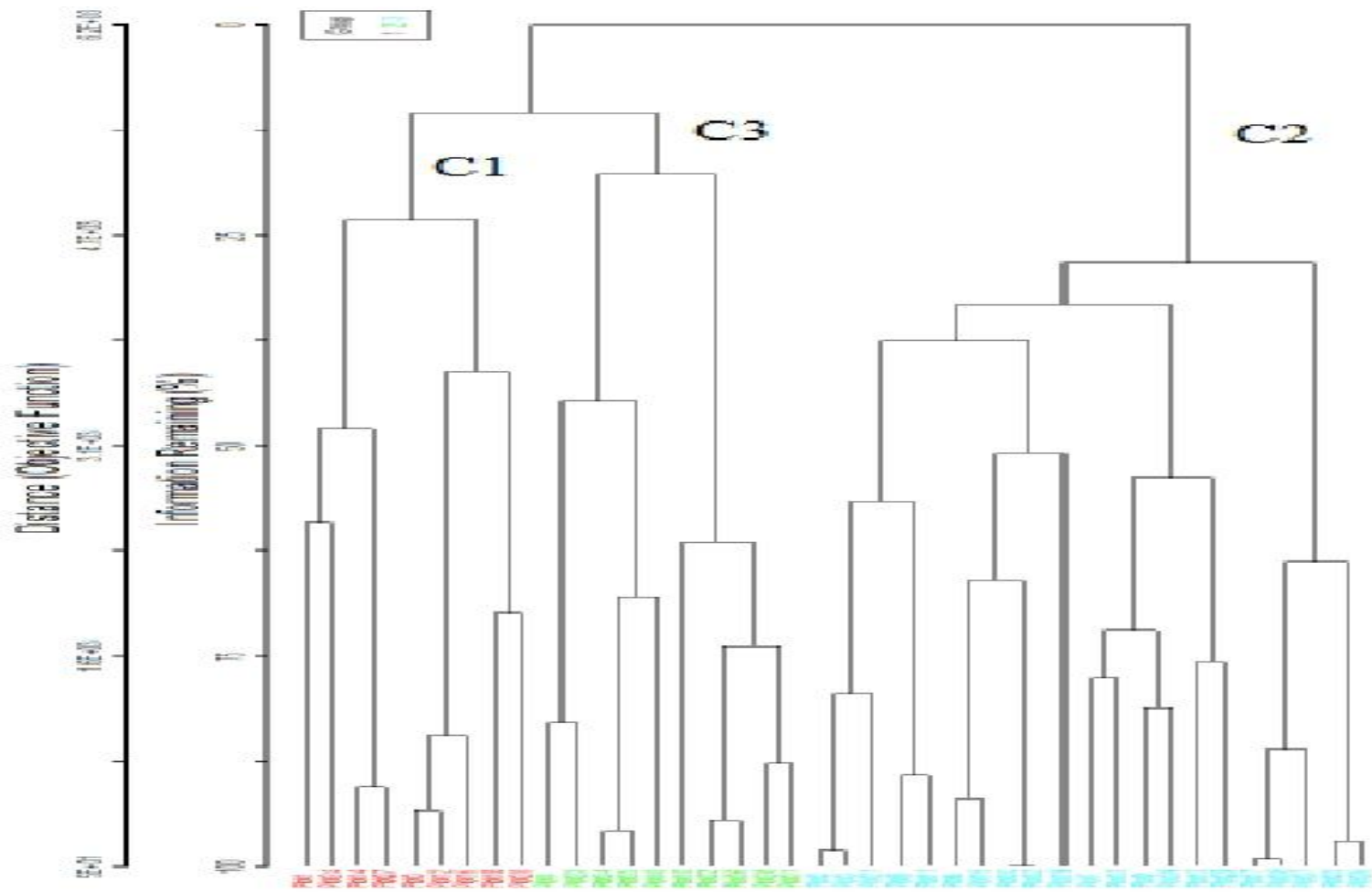


Fig 4 Dendrogram showing the plant community types of the study area (Chato forest)

### 4.3. Species richness, evenness and species diversity of plant community types

Community 3 has the lowest species richness diversity when compared with the remaining community. Community 2 has the highest species richness and diversity index and followed by the community1 (Table2). Among the three community types there was little difference in diversity index. Because of the closeness of diversity among the three communities have relatively similar altitude differences. From this result, one may deduce that Chato natural forest (the study location) is rich in plants richness and diversity showing the forest is more diverse and complex.

In the study location /site the highest Shannon winner diversity indices were recorded in plots 40( $H'=3.12$ ), plot 19( $H'=3.01$ ), plot 20( $H'=2.95$ ) and plot 10( $H'=2.93$ ).And their corresponding numbers of species were 26, 24, 22 and 21.These shows that many species occur/found at these plots site. On the other hand, the lowest diversity index was observed for plot 26 ( $H'=2.21$ ) having 10 species. This low diversity could be the result of biological, topographic and anthropogenic factors.

Table 2 Shannon Wiener Diversity Index

Community	Richness	Diversity index(H)	Evenness
1	67	3.61	0.55
2	86	3.73	0.51
3	60	3.51	0.54

#### **4.4. Relative importance of plants species based on use value**

The floristic structure was studied by using an index namely, Importance Value Index, force following (Curtis and McIntosh's, 1951). The greatest species important value reflects the degree of dominance and abundance of a given species in relation to the other species in the area. It is also used for setting priority or ranking species management and conservation practices and helps to identify their sociological status in a certain plant community as dominant or rare species (Kent and Coker, 1992).

From 103 woody plant species included in the survey, 102 and from 39 herbaceous plant species 30 of them were reported as useful by the informants. The species were grouped in six use categories those are medicine, food, forage, construction, firewood and other. The following figure 5 below shows that the species richness reported for woody and herbaceous plant species. See Figure 5.

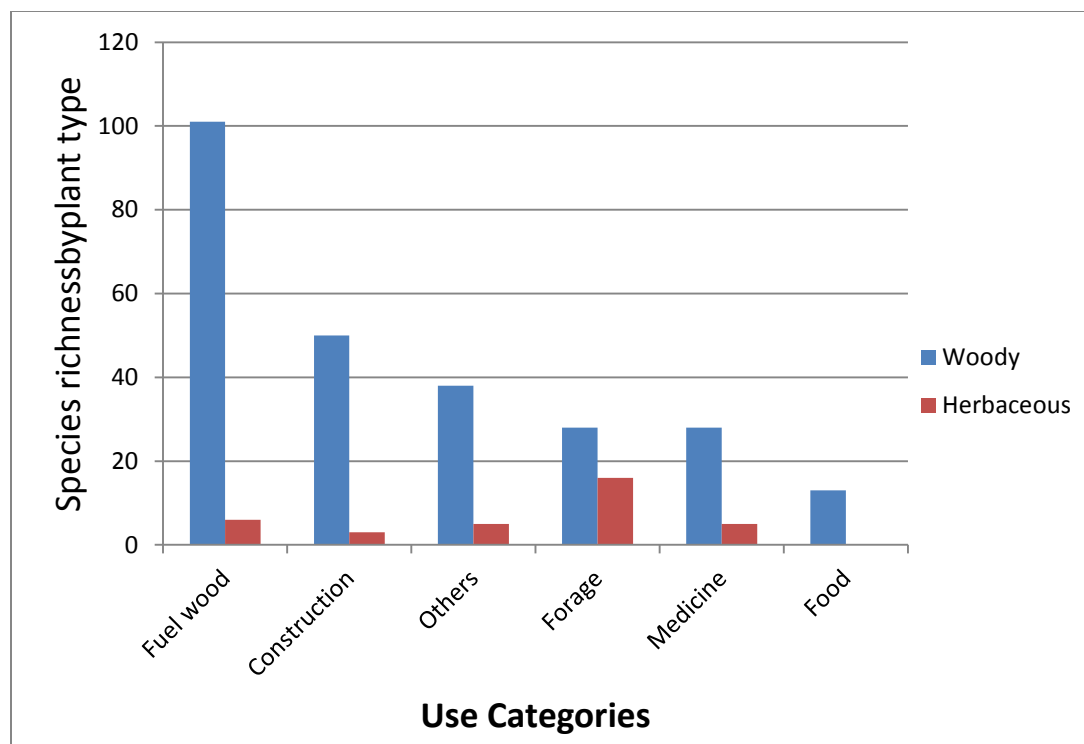


Figure 5 Distribution of species richness by plant type in the different use categories reported by informants

The informants interviewed in this study were highly aware of the value of almost all the woody plant species. However, the knowledge of the actual use of the herbaceous species varied obviously among the six use categories with a strong partiality towards the utilization as animal fodder and for traditional medicine.

#### 4.5. Uses of plants species as traditional medicine

Among the 103 of woody plants species 28 species were reported as important for medicine by local community. Five species out of 39 herbaceous species are also plants having medicinal value. Table 3 show the most common medicinal species in the study area reported by informants were as follows.

Table 3 Common medicinal species in the study area according to informants (n = 45).

Scientific name	Local name	No of mentions	Use value	Part used	Application	Aliment treated	Species abundance
Woody plant species							
<i>Calpurnia aurea</i> (Ait) Benth	Ceekaa	44	4.2	Leaf	Veterinary	Eliminate tick	Moderately Available
<i>Embelia schimperi</i> Vatke	Haanquu	45	2.8	Fruit	Human	Stomach ache	Rare
<i>Ocimumlamifolium</i> <i>Hochst.ex.Benth</i>	Hancabbii	45	2.2	Leaf	Human	Head ache	Rare
<i>Olinia rochetiana</i> A. Juss.	Noolee	45	4.36	Leaf, Bark Stem	Human	Toothache	Moderately available
<i>Stereospermum kunthianum</i> Cham.	Botoroo	37	2.83	Leaf	Veterinary	Problem in breathing system	Rare
<i>Clausena anistata</i> (willd)Benth.	Ulumaayii	19	3.00	Leaf	Human, Veterinary	Diarrhea, Stomach ache	Moderately available

<i>Croton macrostachyus</i> Del.	Bakkanisa	39	3.1	Leaf	Human	Skin disease	Abundant
Herbaceous plant species							
<i>Arisaema schimperiana</i> Schott.	N/ Bofaa	23	1.0	Root	Human Veterinary	Stomachache, snake attack	Rare
<i>Plantago lenceolata</i> L.	Qorxobbii	43	2.13	Leaf	Human	Fresh wound	Abundant
<i>Commelina foliacea</i> Chiov.	G/ Fardaa	19	1.01	Leaf	Human	Diarrhea, Stomach ache	Rare
<i>Cynodon dactylon</i> (L.) pers.	Coqorsa	15	2.11	Leaf	Human	Fresh wound,Stoma ch ache	Abundant
<i>Kalanchoe petitiana</i> A.Rich	Busuqqee	15	1.02	Leaf	Human	Rheumatism	Moderately avail able

The large number of plants used for traditional medicine explains the important role played by local plant species in the health of the rural communities. Supporting this idea, (Lykke *et al.*, 2004) said that the majority of rural people in Africa will continue to rely on traditional medicine in the future for much of their primary health care due to poverty and the high cost of western style medical care. Some population still in this study site relies on traditional medical practitioners.

Four woody species recorded as medicinal are well known by almost all the informants. About 57% of the woody and 80% of herbaceous species in the study area used as medicine to treat human and only about 29% of woody used to treat animal ailments.

One species from each of the woody and herbaceous species is mentioned as important medicine used for both human and animal ailments. The most repeatedly used plants part for treatment of human and animal ailments are leaves. Stomach problem is the most common ailments that was mentioned and treated by a number of medicinal plants (60% of herbaceous medicinal plants species and 29% of woody species). The medicinal plants are usually prepared by elderly men and women by chewing, boiling, squeezing, burning and roasting and always prescribed by them according to the informants.

The widespread use of leaves for traditional medicine in this study is in accordance with the findings of (Ricker, 2002) in northern Nigeria, where leaves are the most widely plant part used for traditional medicine. The widespread use of local plants to treat stomach related problems in this study agrees with the observation made by (Maundu *et al.* 2001) in their study on ethno

botany of Loita Massai in Kenya that gastro intestinal problems is the leading ailment for which local plants are used.

#### **4.6. Uses of plants species as food for human consumption**

Thirteen of the woody species are reported as food plants while none among the herbaceous plant species are known as food for human. All most all the informants had well known five woody species used as food (Table 4).

Table 4 Common food plant species in the study site according to informants (n=45)

Name	Local name	No res	Use Value	Part used	Species abundance
Woody plant species					
<i>Mimusops kummel</i> A. DC.	Qolaadii	45	3.02	Fruit	Rare
<i>Ficus sur</i> Forssk.	Harbuu	45	4.03	Fruit	Moderately available
<i>Syzgium guineense</i> (willd) <i>D.C.subsp.afromontanum</i> F.whit	Baddeessaa	45	4.01	Fruit	Rare
<i>Syzgium guineense</i> subsp. <i>Guineensis</i>	Goosuu	45	3.41	Fruit	Moderately available
<i>Rubus steudneri</i> Schweinf.	Goraa	45	1.56	Fruit	Rare

<i>Cordia africana</i> Lam.	Waddeessa	37	4.40	Fruit	Rare
<i>Phoenix reclinata</i> Jacq.	Meexxii	41	3.63	Fruit	Moderately available
<i>Ximenia amercana</i> L.	Hudhaa	29	2.54	Fruit	Rare
<i>Carissa spinarum</i> L.	Hagamsa	43	4.00	Fruit	Abundant
<i>Rosa abyssinca</i> Lindley	Qaqawwii	19	1.01	Fruit	Abundant

The fruit of woody plants eaten raw and from those the fruit of *Mimusops kummel* and *Syzygium guineense* subsp. *afromontatum* are important for those household with low economic status because the fruit sold in most local market of the study area. The informant report showed that those plant species which have high use value are found rarely and moderately available but those plants species have low use value is occurred in abundant in the study area (Table 4).

None of herbaceous species reported as useful for human food could be partly the characteristics of seasonal availability of most herbaceous species in the study area. Another factor may be that many herbaceous species are consumed mainly when there is crop failure and famine. In the study area the absent of crop failure for many years makes the communities not depend much on wild plants for food. For this, reason relatively no herbaceous plant species are used for human consumption in the study site. This idea confirming with the widely held view that man consumes only few species of the available plant resources (Kiambi & Attah Krah, 2003).

#### **4.7. Uses of plants species as forage**

Twenty eight of the woody and sixteen of the herbaceous plant species are known as animal forage. All the informants had well known around four woody and three herbaceous plant species used as animal forage (Table 5). The following table shows the common woody and herbaceous plant species used for animal forage (Table 5).

Table 5 Common forage plant species in the study location according to informants (n=45) 1=Cattle, 2=Goats, 3=Sheep, 4=donkey/mules 5=Horses

Name	L/name	No inf	Use Value	Part Used	Eaten by	Species Abundance
Woody plant species						
<i>Acaccia abyssinica</i> Hochst.ex Benth.	Laaftoo	45	3.01	Leaf,stem	1,2	Moderately available
<i>Acanthus eminens</i> C.B. Clarke	Kosorruu	45	2.33	Leaf	1,2	Moderately available
<i>Carissa spinarum</i> L.	Hagamsa	45	3.41	Leaf,stem	1,2	Moderately available
<i>Clausena anistata</i> (Willd.) Benth	Ulumaayii	31	3.0	Leaf	2	Moderately available
<i>Clematis hirsuta</i> Perr & Guill.	H/feetii	41	1.9	Leaf,stem	1,2,3	Abundant
<i>Coffea arabica</i> L.	Buna	19	3.37	Leaf	2	Rare
<i>Cordia africana</i> Lam.	Waddeessa	21	4.49	Fruit,Leaf	1,2	Rare
<i>Dombeya torrida</i> (J.F. Gamel.)	Daanisaa	33	1,01	Leaf	1,2	Moderately available

P. Bamps.						
<i>Dracaena afromontana</i> Mildbr	Warqee	27	1.25	Leaf	1	Moderately available
<i>Embelia schimperi</i> Vatke	Haanquu	16	2.80	Fruit,stem	1,2	Abundant
<i>Hibiscus macranthus</i> Hochst. <i>Ex.A.Rich.</i>	Hincinnii	30	1.31	Leaf	1,2	Moderately available
<i>Vernonia amygdalina</i> Del.	Eebicha	44	3.61	Leaf	1,2,3	Moderately available
<i>Ficus sur</i> Forssk.	Harbuu	41	4.03	Fruit	1,2	Rare
<i>Grewia ferruginea</i> Hochst.ex. A.Rich.	Dhoqonuu	35	1.32	Leaf	1,2	Moderately available
<i>Hippocratea goetezi</i> Looes.	H/qolalaafess aa	37	2.32	Leaf,stem	1,2	Moderately available
<i>Jasminum abyssinicum</i> Hochst. ex DC.	H/ilchimmee	23	2.31	Leaf,stem	1,2	Moderately available
<i>Landolphia buchananii</i> <i>(Hall.f.)stapf.</i>	H/geeboo	15	2.36	Leaf,stem	1,2	Moderately available

<i>Achyrospermum schimperi</i> (Hochst.exBriq.)Perkins	Kusaayee	43	3.39	Leaf,stem	1,2	Abundant
<i>Mimusops kummel</i> A. DC.	Qolaadii	44	3.02	Fruit,leaf	2	Moderately available
<i>Myrsine africana</i> L.,	Qacamaa	31	2.27	Leaf	1,2	Moderately available
<i>Nuxia congesta</i> R.Br.ex Fresen	Naffuroo	39	3.02	Leaf	1,2,3	Moderately available
<i>Ocimum lamiifolium</i> Hochst. ex Benth.,	Hancabbii	21	2.21	Leaf,stem	1,2	Rare
<i>Olinia rochetiana</i> A. Juss.	Noolee	29	4.36	Leaf	1	Rare
<i>Maytenus</i> <i>arbutifolia</i> (A.Rich)Wilczek.	Kombolcha	45	3.14	Leaf	1,2	Moderately available
<i>Osyris quadripartita</i> Decn.	Waatoo	24	3.74	Leaf	1,2	Moderately available
Herbaceous plant species						
<i>Acrachne racemosa</i> (Roem. & Schulf.) Ohwi	Marga	45	2.10	Leaf,stem	1,2,3,4,5	Moderately available
<i>Andropogon abyssinicus</i> Frese	M/baalamii	45	1.33	Leaf,stem	1,2,3,4,5	Rare
<i>Cynodon dactylon</i> (L.) Pers.	Coqorsa	45	2.94	Leaf,stem	1,2,3,4,5	Moderately available

<i>Cyperus fischerianus</i> A. Rich.	Daggioo	36	2.7	Leaf,stem	1	Rare
<i>Achyranthes aspera</i> L.	Maxxannee	24	1.00	Leaf,stem	1,2	Abundant
<i>Echinops longisetus</i> A.Rich.	Q/harree	33	1.01	Leaf,stem	2,4,5	Abundant
<i>Hyparrhenia anthistiriodes</i> (Hochst.ex A.Rich.)Stapf	Daggala	36	1.51	Leaf,stem	1	Abundant
<i>Eragrostis superba</i> Peyr	G/xaafii	12	1.02	Leaf,stem	1,2,3	Rare
<i>Commelina foliacea</i> Chiov.	G/fardaa	9	1.00	Leaf,stem	1,3	Rare
<i>Oplismenus hirtellus</i> (L.) P. Beauv.	M/booyee	17	1.12	Leaf,stem	1,3	Moderately available
<i>Plantago lenceolata</i> L	Qorxobbii	44	2,13	Leaf, stem	1,2,3,4,5	Abundant
<i>Pennisetum sphacelatum</i> (Nees) Th. Dur. & Schinz.	Duffaa/migir a	44	3.11	Leaf, stem	1	Moderately available

The report of the informants showed that all leaves, most stem and a few fruit of woody plant part and all leaves and stem of herbaceous plants are chosen by animals to be eaten. Leaves and stem of herbaceous forage plant species mostly consumed by animals are annual grasses such as *Acrachne racemosa* and *Cynodon dactylon* are chosen by Cattle, Sheep, Donkey, Mule and Horses. While all leaves, most stem and fruit woody forage plant species commonly consumed by cattle and goats. These woody plant species are *Acaccia abyssinica*, *Maytenus arbutifolia*, *Carissa spinarum*, *Achyrospermum schimperi* and *Clematis hiruta* (Table 5).

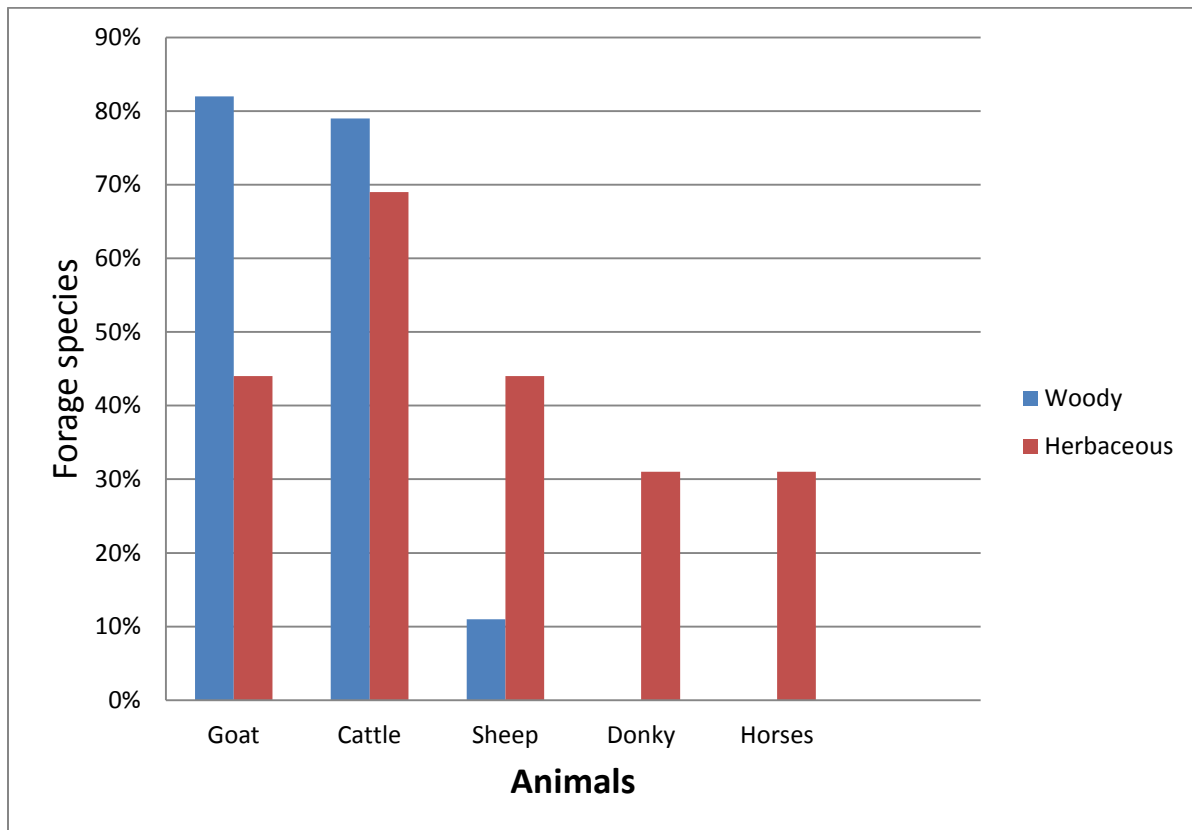


Figure 6 Forage species consumed by different animals according to informants

According to the report of informants different animals consumed different forage species, of these 82% of woody and 44% herbaceous and 79% of woody and 69% of herbaceous plant species consumed by goat and cattle respectively. Donkey and horses have not consumed woody plant species, but sheep consumes few woody plant species (Figure 6)

The response of interviewees as regards the dominance of woody leaves in goat's diets agrees with the report of (Kufmann, 1998) on pastoral goat's husbandry in northern Kenya. Relatively ruminant animals have the most consumed woody and herbaceous plant species than non ruminant animals. And the response of interviewees indicated that almost a similar number of herbaceous species consumed by donkeys and horses in view of similar digestive system. Both are mono gastric herbivores, thus they eat rough ages and utilize cellulose and hemicelluloses efficiently (Aganga & Tsopi 1998).

#### **4.8. Uses of plant species for household construction and fuel wood**

The response of informants/interviewees indicated that fifty (49%) woody plant species and three (10%) herbaceous plant species used for household construction. The common woody and herbaceous plant species used for household construction are listed below in (Table 6).

Among 50 (49%) of woody plant species reported which used for construction five of them had known by all informants and almost all informants well known two common herbaceous species used for household construction . The two common herbaceous plant species reported are *Hyparrhenia anthistiriodes* and *Pennisetum sphacelatum* are used for household construction. They are found in moderately abundant in study site.

The five repeatedly mentioned woody plant species by informants used for construction are *Podocarpus falcatus*, *Justicia schimperiana*, *Prunus africana*, *Olea welwitschii* and *Olea europae*

The woody plant species are used for roofing material, to make door for mud house, and used as pole for hut. As the informant report the main parts of the herbaceous plant used for house hold construction are leave and stem. And stem and branch of woody plant species is the main part plant used for household construction as the informants reported.

From the whole identified plant species 101 (98%) woody species and six (15%) of herbaceous plant species are used for fuel wood in the study area. Among one hundred one woody plant species used for fuel wood three of them are well known and almost two of the herbaceous species plants are commonly known by informants. Stem and branch of woody plant species and leaves and stem of herbaceous plant is the main part used for purpose of fuel wood (Table 7).

Table 6 Common plant species for household construction in the study area according to the informants (n=45)

Name	Local name	No resp	Use value	Part used	Species abundance
Woody plant species					
<i>Podocarpus falcatus</i> (Thunb.) R. B. ex Mirb.	Birbirs	45	4.3	Branch, stem	Moderately available
<i>Olea europaea</i> L. subsp. <i>Cuspidot</i> (wall ex G.Don)cif.	Ejersa	45	4.44	Branch, stem	Rare
<i>Justiciaschimperiana</i> (Hochst ex Nees) T.	Dhummuuggaa	45	2.11	Stem	Abundant
<i>Dodonae angustifolia</i> L. f	Ittacha	45	3.39	Stem	Moderately available
<i>Prunusafricana</i> (Hook.f.) Kalkam.	Hoomii	45	4.14	Brunch, stem	Rare
<i>Clematis hirsuta</i> Perr & Guill.	H/feetii	44	1.9	Stem	Abundant

<i>Olea wewitschii</i>  (knobl.)Gil & Schellenb.	Bahaa	44	4.15	Brunch, stem	Rare
<i>Landolphia buchananii</i> (Hall.f.) Stapf.	H/geeboo	44	2.36	Stem	Moderately available
<i>Syzygium guineense</i> (Willd.) DC.	Baddeessaa	43	4.01	Brunch, stem	Moderately available
<i>Acacciaabyssinica</i> Hochst.ex Benth.	Laaftoo	31	3.01	Stem	Moderately available
<i>Carissa spinarum</i> L.	Hagamsa	24	3.41	Stem	Moderately available
<i>Cordia africana</i> Lam.	Waddeessa	21	4.49	Stem	Rare
<i>Vepris dainelli</i> (Pichi-serm.) Kokwaro.	Hadheessa	27	3.17	Stem	Rare
<i>Ochna holstii</i> Engl.	Lookoo	18	3.00	Stem	Rare
<i>Hippocratea goetzei</i> Looes.	H/qolalaafessaa	37	2.32	Stem	Moderately available
<i>Jasminum abyssinicum</i> Hochst. ex DC.	H/ilchimmee	23	2.31	Stem	Moderately available
<i>Mimusops kummel</i> A. DC.	Qolaadii	32	3.02	Stem	Moderately available

<i>Myrsine africana</i> L.,	Qacamaa	26	2.27	Stem	Moderately available
<i>Nuxia congesta</i> R.Br.ex Fresen	Naffuroo	20	3.02	Stem	Moderately available
<i>Olinia rochetiana</i> A. Juss.	Noolee	23	4.36	Stem	Rare
Herbaceous plant species					
<i>Hyparrhenia anthistiriodes</i> (Hochst.ex A.Rich.) stapf	Daggala	41	1.51	Leaf,stem	Abundant
<i>Oplismeunus hirtellus</i> (L.) P. Beauv.	M/booyee	17	1.12	Leaf,stem	Abundant
<i>Pennisetum sphacelatum</i> (Nees) Th. Dur. & Schinz.	Duffaa/migira	44	3.11	Leaf, stem	Moderatelyavailable

Relatively woody plant species are more important than herbaceous plant species. The woody plant species are important for heat and cooking purpose. But herbaceous plant species are mostly used for initiate (start) the fire for different purpose. *Carissa spinarum* L, *Podocarpusfalcatus* (Thunb.)R.B.exMirb and *Dodonaea angustifolia* L.f are mostly useful woody plant species reported by informants.On the other hand, *Hyparrhenia anthistiriodes* and *Pennisetum sphacelatum* Th. Dur. & Schinzare frequently utilized herbaceous plants reported by informant used as fire.

According to the informants, *Lepidotrichilia volkensisii* (Locally named komogno) tree has no value. It is neither for Medicine, Food, Construction, Firewood, and Forage nor for other purposes in the study area. Informants called it as an evil tree. According to them, if they used it for some purpose, it calls spiritual evil and death to the house hold member and it is never consumed by any animals. Similarly *Clausena anistata* (Locally named ulumaayii) is not used for fire wood because it has great respect from the societies and has ritual values. The respondent believes that, if they used it for fire wood, as a culture, it is not good for cattle raring.

The woody plants species of chato forest found near to the village are the highly exploited as firewood by illegal persons. Not only the rural populations rely on woody plants species as firewood, many urban households around chato forest like Sakala, Jardaga, Dongoro and Shambu also rely on purchased firewood from illegal persons.

Table 7 Common plant species used for fuelwood in the study area according to the informants (n=45)

Name	Local name	No inform	Use value	Part used	Species abundance
Woody plant species					
<i>Podocarpusfalcatus</i> (Thunb.)R.B.exMirb.	Birbirsa	45	4.3	Branch,stem	Moderately available
<i>Dodonaea angustifolia L.f</i>	Ittacha	45	3.39	Stem	Moderately available
<i>Syzygium guineense</i> (Willd.)DC	Baddeessaa	43	4.01	Branch,stem	Moderately available
<i>Acacciaabyssinica Hochst.ex</i> <i>Benth</i>	Laaftoo	31	3.01	Stem	Moderately available
<i>Carissa spinarum L.</i>	Hagamsa	45	3.41	Stem	Moderately available
<i>CordiaafricanaLam</i>	Waddeessa	21	4.49	Stem	Rare
<i>Nuxi acongestaR.Br.ex Fresen</i>	Naffuroo	20	3.02	Stem	Moderately available
<i>Olinia rochetiana A.Juss.</i>	Noolee	23	4.36	Stem	Rare

Herbaceous plant species						
<i>Hyparrhenia anthistiriodes</i> (Hochst.ex A.Rich.) stapf	Daggala	41	1.51	Leaf,stem	Abundant	
<i>Pennisetum sphacelatum</i> (Nees) Th.Dur.&Schinz	Duffaa/migira	44	3.11	Leaf, stem	Moderately available	

#### **4.9. Other uses of plant species**

Thirty eight woody and four herbaceous plant species reported as other use categories by informant. Making farm tools, traditional furniture, detergents, making of household utensils, generate income, ritual uses and making of house and house hold utensils good smell are mentioned by informant as other uses of woody and herbaceous plants species in the study area (Table 8 and Figure 7).

Table 8 Common plant species used for other purposes in the study sites according to informants (n=45)

Name	Local name	No inform	Use Value	Part Used	Species Abundance
Woody Plant Spices					
<i>Olea europaea</i> L.subsp. <i>Cuspidate</i> (wall.ex.G.Don) cif.	Ejersa	45	4.44	Stem	Rare
<i>Olinia rochetiana</i> A.	Noolee	29	4.36	Stem	Rare
<i>Croton macrostachyus</i> Del.	Bakkaniisa	39	3.1	Stem	Moderately available
<i>Ficus sur</i> Forssk.	Harbuu	41	4.03	Stem	Moderately available
<i>Cordia africana</i> Lam.	Waddeessa	21	4.49	Stem	Rare
<i>Teclea nobilis</i> Del.	Hadheessa	24	3.17	Stem	Rare
<i>Olea capensis</i> L...	Gagamaa	21	3.66	Stem	Rare
<i>Maytenus arbutifolia</i> (A.Rich)Wilczek	Kombolcha	45	3.14	Stem	Moderately available
<i>Olea welwitschii</i> (Knobl.) Gilg.	Bahaa	44	4.15	Stem	Rare
<i>Mimusops kummel</i> A.	Qolaadii	32	3.02	Stem	Moderately available
<i>Ochna holstii</i> Engl.	Lookoo	20	3.00	Stem	Rare

<i>Phoenix reclinata</i> Jacq.	Meexxii	31	3.63	Leaf	Moderately available
<i>Acaccia abyssinica</i> Hochst.	Laaftoo	45	3.01	Leaf,stem	Moderately available
<i>Acanthus eminens</i> C.B.	Kosorruu	45	2.33	Stem	Moderately available
<i>Clausena anistata</i> .	Ulumaayii	31	3.0	Leaf	Moderately available
<i>Nuxia congesta</i> R.Br.ex Fresen	Naffuroo	39	3.02	Stem	Moderately available
<i>Vernonia purpurea</i> Sch.	Sooyoma	41	3.01	Stem	Rare
<i>Maesa lanceolata</i> Forssk.	Abbayii	19	2,9	Stem	Abundant
<i>Calpurnia aurea</i> (Ait)Benth.	Ceekaa	40	4.2	Stem, leaf	Abundant
<i>Periploca linearifolia</i> Kurt. Dill.	H/aannannoo	41	2.99	Stem, leaf	Moderately available
<i>Clematis hirsuta</i> P.	H/kalaalaa	41	1.90	Leaf,stem	Abundant
<i>Syzygium guineense</i> (Willd.) DC.	Baddeessaa	19	4.44	Fruit	Moderately available
<i>Rubus steudneri</i> Schweinf.	Goraa	12	2.89	Fruit	Abundant
<i>Vernonia amygdalina</i> Del.	Eebicha	44	3.61	Leaf	Moderately available
<i>Carissa spinarum</i> L.	Hagamsa	10	3.41	Fruit	Moderately available
<i>Landolphiabuchananii</i> (Hall.f.) Stapf.	Handoodee	15	2.36	Leaf,fruit	Moderately available
<i>Achyrospermum schimperi</i> (Hochst.exBriq.)Perkins	Kusaayee	43	3.39	Leaf,	Abundant

<i>Urera hypselodron</i> (A. Rich.) Wedd.	Laanqisaa	9	2.67	Bark	Moderately available
<i>Solanum giganteum</i> Jacq.	Hiddii	21	2.21	Fruit	Moderately available
<i>Osyris quadripartita</i> Decn.	Waatoo	24	3.74	Stem	Moderately available
<i>Ekebergia capensis</i> Sparrm.	Somboo	20	3.00	Bark	Rare
<i>Hymenodictyon floribundum</i> .	Gaarrii	41	2.33	Stem	Rare
<i>Echinops kebericho</i> Mesfin	Qarabichoo	40	2.12	Root	Rare
<i>Dombeya torrida</i> (J.F. Gamel.) P. Bamps.	Daanisaa	19	2.11	Bark	Moderately available
<i>Lagenaria abyssinica</i> C.	B/seexanaa	18	1.00	Fruit	Rare
<i>Grewia ferruginea</i> Hochst.ex. A.Rich.	Dhoqonuu	21	2.11	Bark	Moderately available
<i>Coffea Arabica</i> L.	Buna	45	4.41	Fruit	Rare
<i>Rhamnus prinoides</i> L. Herit	Geeshoo	45	4.44	Leaf	Rare
Herbaceous Plant Species					
<i>Cynodon dactylon</i> L.	Coqorsa	45	2.94	Leaf,stem	Moderately available
<i>Cyperus fischerianus</i> A.	Daggoo	36	2.7	Stem	Rare
<i>Pennisetum sphacelatum</i> (Nees).	Duffaa/migira	44	3.11	Leaf, stem	Moderately available
<i>Girardinia bullosa</i> (Steud.)Wedd.	Doobii	43	1.00	Trunk	Abundant

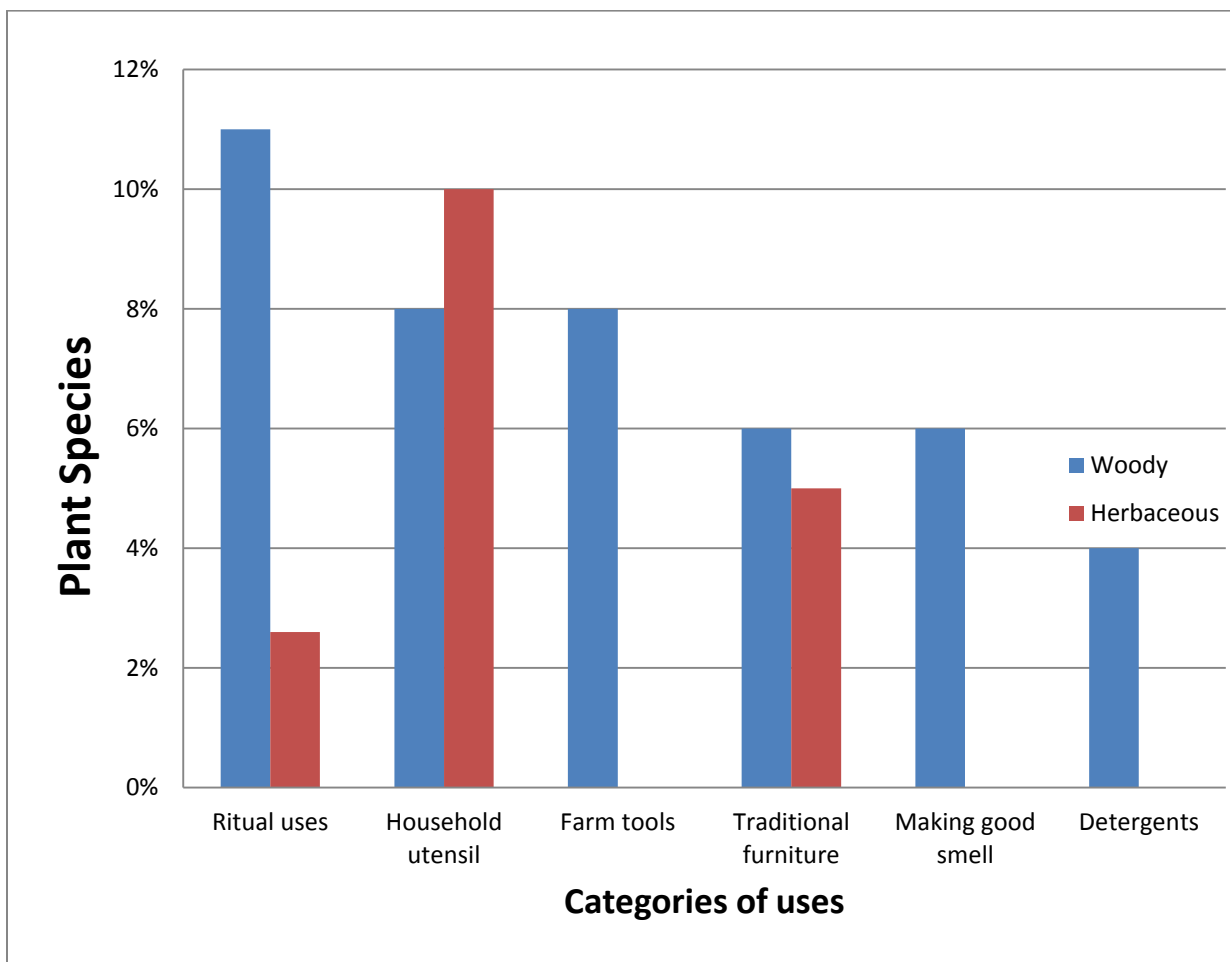


Figure 7 Other uses of woody and herbaceous plant species in the study location

According to the informant report, out of thirty eight mentioned or identified as other uses of woody plants species, eight percent of woody plants are used to make farm tools. Only woody species are used for this purpose such as making handles for hoe, digger, yoke and cutlass. No herbaceous species reported as important for making farm tools.

The common woody plants species used for farm tools are *Croton macrostachyus*, *Ficus sur* and *Olea welwitschii*. From the total identified as other uses plant species by informants six percent woody and five percent herbaceous plant species are used for making traditional furniture. The woody species used for traditional furniture used to make beds, chairs and tables are *Croton macrostachyus*, *Ficus sur*, *Cordia africana*, and *Olea welwitschii* and *Ekebergia capensis*. *Phoenix reclinata*, *Pennisetum sphacelatum* and *Girardinia bullosa* are herbaceous plant species used for traditional furniture such as mats and rope.

Four percent woody species were identified for detergent .The fruit and leafs of *Landolphia buchananii* and *Ocimum lamiifolium*, and the barks of *Grewia ferruginea* and are used as soap for washing clothes. The leaf of *Vernonia amygdalina* is used for washing household utensils like pot and jar, which are useful for the preparation of alcoholic drink like tella and teji as informant mentioned.

Eight percent woody plant species reported by informants useful for making household utensil such as wooden spoons, mortar and pestles. While ten percent herbaceous plant species used for making household utensil like brooms and ropes.

The common woody species plants used household utensils were *Croton macrostachyus*, *Ficus sur*, *Cordia africana*, *Olea welwitschii*, and herbaceous plant species like *Girardinia bullosa*,

*Cyperus fischerianus* and *Pennisetum sphacelatum* are the most commonly used for making household utensil. Two percent woody plant species, the fruit of *Coffea arabica* and the leaf/stem of *Rhamnus prinoides* are important for generating income to the surrounding community and also important for their own personal consumption.

Eleven percent of woody and 2.6% of herbaceous plant species was mentioned for ritual purposes. The common herbaceous plant like *Cynodon dactylon* and woody plant species like *Lagenaria abyssinica*, *Periploca linearifolia*, *Calpurnia aurea*, *Maesa lanceolata*, *Vernonia purpurea*, *Acaccia abyssinica*, *Acanthus eminens*, and *Clausena anistata*. *Nuxia congesta* and *Croton macrostachyus* are used for ritual (for example used to celebrate ceremonies like Atettee, Taboree, Jarihorii, Hirkisaa damaraa) and other purpose.

According to informants reported, in order to making the house and household utensils good smell six percent woody species are used for this purpose. The common woody plant species used for making house and household utensil good smell are *Osyris quadripartita*, *Hymenodictyon floribundum*, *Achyrospermum schimperi*, *Ekebergia capensis*, *Olea europaea* subsp. *cuspidate* and *Echinops kebericho*.

The first woody plant species is used for making the milk churn having good smell for long time and they make the milk attractive for drinking. The stem of the first woody species is caught by fire and smoked to milk churn and after smoking stage is completed, the leaf and the stem of the 3<sup>rd</sup> woody species is used for cleaning it with good smell and the milk churn is ready for use. However the 2<sup>nd</sup>, 4<sup>th</sup> and 5<sup>th</sup> woody plant species respectively are used for making Bee Hive attractive and good smell. The bark and stem of 2<sup>nd</sup> and the stem of the 4<sup>th</sup> and the 5<sup>th</sup> are used for this purpose. The bark and the stem of those mentioned trees are first caught by fire and

smoked to Bee Hive and after smoking is completed, the Bee Hive is ready for use and it attracts Bee.

The results from study show that the woody plant species have diverse uses than the herbaceous species. The higher use values for the woody plant species compared to the herbaceous species support the apparent hypothesis that plants that are visible and dominant in the ecosystems are more likely to be used than those that are non apparent which with short live cycle mainly herbaceous species. These results agree with the past ethno botanical studies in the West African Sahel (Diop *etal.* 2005, Lykke *et al.* 2004, Nikiema 2005) which reported the multipurpose uses of woody plant species. High use value for a plant species may be an indication of high use pressure.

On the other hand high use value for a plant species may be a sign of high use force and this may describe for specific conservation measures to prevent over exploitation of the species. The broad report of the multipurpose uses of woody (tree) species in the study site, conservation measures addressing woody plants may stand a better chance of succeeding than measures that only search for to protect species that are not commonly used by the communities (Albuquerque & Lucena 2005). Therefore some woody species those have high use value such as *Cordia africana*, *Prunus africana*, *Ekebergia capensis* and *Olea welwitschii* are rarely occurring in the study area. Obviously that these species are highly exploited by illegal people for various uses and there is a selective logging of them. During the data collection, I observed many tree stumps in the forest. In addition to this during this survey, I observed that the people used and affect some of important woody species and face difficulty if they continue to exploit them without putting in place. Therefore, unless some appropriate conservation measure and management plan

are put in place, these species become locally extinct from Chato Natural Forest in a short period of time.

There is a long history of local tradition which attached to story from an ancient times felling of trees and uses (household and commercial) of large trees in the Chato natural forest. This tradition promoted effective conservation of the forest resources of this Natural Forest. As a result, it is a common practice to observe old tree species which are naturally dying and fall over the ground.

## CHAPTER FIVE

### 5. CONCLUSION AND RECOMMENDATION

#### 5.1. Conclusion

This study contributes the basic data on diversity and uses of plant species of chato natural forest. One hundred forty two species of plants were identified and assigned to 103 woody and 39 herbaceous plant species. Of which woody plant species are the most dominant. These dominant species might have well developed strategies and adaptations which helped them successfully to survive in the study area.

Classification by means of cluster analysis of the vegetation data of the forest produced three community types each of which have its own dominant species. The distributions of these plant communities in the forest were affected by various environmental factors, a biotic factors and biotic stresses. Due to these factors variations in species richness, and species diversity among communities created. By considering this, one may deduce that the study area is rich in plant diversity and richness indicating the forest is more complex and diverse.

Additionally this survey stated the relative importance or uses of woody and herbaceous plant species of chato natural forest. Major uses of local plant species are for traditional medicine, human consumption as food, animal feed or forage, household construction, firewood, for detergents and making house and house hold utensils having good smell. Results from this study confirm that availability of a plant largely determines its utilization.

## 5.2. Recommendations

Ethnobotanical study provides a means to create awareness of the conservation needs of the plant species. The results of this study show the proper documentation of local ecological knowledge in order to preserve the experience and practices of past generations for present benefit and for future local and global use. Plant species provide for future genetic resources, and would have great implications for the environment, biological diversity and socioeconomic importance. Considerably higher use values for the woody plant species compared to the herbaceous species support the apparent hypothesis that plants that are visible and dominant in the ecosystems are more likely to be used than those that are non apparent which are mainly herbaceous species with short life cycles. High use value for a plant species may be an indication of high use pressure and this may describe for the necessity for targeted community based conservation measures to be taken to protect species with high use pressure. Based on the results of the study, the following recommendations were drawn.

- During this survey, the informants told some of the valuable woody species are seriously exploited. Therefore the result of this study shows most plant species which have high use value rarely occur. Unless exact conservation and management measures should be put in place, these species become extinct from Chato natural forest in a short period of time.
- This study is limited to diversity and use of plant species. Then additional studies on, forest management and conservation system, composition, structure, environmental parameters and regeneration of the woody species is recommended.
- The next management and conservation system should apply multiple use conservation system. This forest (Chato natural forest) consists of large areas that are

unreachable places, so this site used as the area of tourism of biodiversity and it gives different ecosystem importance, so biosphere reserve establishment is recommended.

- The participation of the whole local communities in the forest conservation activities and management is the only way to reduce the forest loss, by giving awareness of multi uses of forest to the community is recommended.
- Further ethnobotanical surveys also needed to explore the wealth of indigenous knowledge on multi uses of plants species is recommended.
- Afforestation of degraded landscape by local community to create a protection for forest is recommended.

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## Appendix

**Appendix 1 List of plant species collected from Chato Natural Forest. Habit: (T= tree, S= shrub, F= FernL=liana, H= herb); Col.code= collection code, Ha= habit & \* : No local name**

No.	Genus and species Name	Family	Local Name	Ha	Coll.No
1	<i>Acaccia abyssinica</i> Hochst.ex Benth	Fabaceae	Laaftoo	T	H003
2	<i>Acaccia brevispica</i> Harms	Fabaceae	Haragamaa	S	H047
3	<i>Acaccia etbaicae</i> schweinf	Fabaceae	Doddota	T	H039
4	<i>Acanthus emines</i> C.B. Clarke	Acanthaceae	Kosoruu	S	H024
5	<i>Achyranthes aspera</i> L.	Amaranthaceae	Maxxannee	H	H094
6	<i>Achyrospermum schimperi</i> (Hochst.exBriq.) perkins	Lamiaceae	Kusaayee	H	H046
7	<i>Acrachne racemosa</i> (Roem.&Schulf.) Ohwi	Poaceae	Marga	H	H099
8	<i>Adiantum poriretti</i> Wikstr.	Adiantaceae	Farnii	H	H075
9	<i>Albiza gummifera</i> (J.F.Gmel.) C.A.S.M	Fabaceae	Birbirraa	T	H085
10	<i>Allophylus abyssinicus</i> (Hochst) Radkofe	Sapindaceae	Malqaqqoo	T	H053
11	<i>Andropogon abyssinicus</i> Fresen.	Poaceae	Margabaalamii	H	H118
12	<i>Argomelera macrophylla</i> Pax.	Euphorbiaceae	Hanbubbuu	S	H126
13	<i>Arisaema schimperiana</i> schott.	Araceae	Nitii bofaa	H	H130

14	<i>Asparagus africanus Lem.</i>	Asparagaceae	Saritii	S	H108
15	<i>Aspilia gilletti willd.</i>	Asteraceae	*	S	H102
16	<i>Bersama abyssinica Fresen.</i>	Melanthaceae	Araarsaa	S	H013
17	<i>Caesalpinia decapetata(Roth.) Alston</i>	Fabaceae	Harangamaa	L	H117
18	<i>Calpurnia aurea(Ait)Benth.</i>	Fabaceae	Ceekaa	S	H010
19	<i>Carissa spinarum L.</i>	Apocyanaceae	Hagamsa	S	H012
20	<i>Cassipourea malosana(Baker) Alston</i>	Rhizophoraceae	Qilxiixuu	T	H042
21	<i>Celtis Africana Burm.f.</i>	Ulmaceae	Cayyii	T	H062
22	<i>Clausena anistat (willd.) Benth</i>	Rutaceae	Ulumaayii	S	H008
23	<i>Clematis hirsuta per&amp;Guill.</i>	Ranunculaceae	Hidda feetii	L	H035
24	<i>Clutia abyssinica Jub. &amp; Spach</i>	Euphorbiaceae	Ulee foonii	S	H082
25	<i>Coffee Arabica L.</i>	Rubiaceae	Buna	S	H005
26	<i>Combretum paniculatum vent.</i>	Combretaceae	Baggii	L	H085
27	<i>Commelina foliacea Chiov.</i>	Commelinaceae	G/ Fardaa	H	H067
28	<i>Cordia africanaLam.</i>	Boraginaceae	Waddeesa	T	H037
29	<i>Croton macrostachyus Del.</i>	Euphorbiaceae	Bakanniisa	T	H021
30	<i>Cynodon dactylon(L) Pers.</i>	Poaceae	Coqorsa	H	H097
31	<i>Cyperus fischerianus A. Rich</i>	Cyperaceae	Daggoo	H	H112
32	<i>Diaphananthe tenuicular summerh.</i>	Orchidaceae	*	S	H120
33	<i>Diospyros abyssinica(Hiern.)F. White</i>	Ebenaceae	Ilkee	T	H118
34	<i>Dissotis senegambiensis(Guill&amp;per.)Triana</i>	Melastomataceae	*	H	H125

35	<i>Dodonaea angustifolia</i> L.f	Sapinadaceae	Ittacha	S	H020
36	<i>Dombeya torrid</i> (J.F.Gamel.)P.Bamps.	Sterculiaceae	Daaniissaa	S	H070
37	<i>Dovyalis abyssinica</i> (A.Rich.)Warb.	Flacourtiaceae	Koshommii	T	H016
38	<i>Dracaena steudneri</i> Engl.	Dracaenaceae	Warqee	T	H116
39	<i>Drynaria volkensii</i> J.Sm.	Polypodiaceae	Sokokee	L	H060
40	<i>Dryopteris anthamantica</i> (Kunze)Kuntze	Dryopteridaceae	Tirimmii	F	H064
41	<i>Dryopteris inaequalis</i> (Schltdl.)kuntze	Dryopteridaceae	Tirimmii	F	HO53
42	<i>Duranta repens</i> L.	Verbenaceae	*	S	H124
43	<i>Echinops kebericho</i> Mesfin*	Asteraceae	Qarabichoo	H	H074
44	<i>Echinops longisetus</i> A.Rich.	Asteraceae	Qoraatii Harree	H	H033
45	<i>Ehretia cymosa</i> Thonn.	Boraginaceae	Ulaagaa	T	H127
46	<i>Ekebergia capensis</i> Sparrm.	Meliaceae	Somboo	T	H129
47	<i>Embelia schimperi</i> Vatke	Myrsinaceae	Hanquu	L	H092
48	<i>Eragrostis superb</i> peyr	Poaceae	G/xaafii	H	H105
49	<i>Erythrococca</i> <i>trichogyne</i> (Muell.Arg.)prain	Euphorbiaceae	Caakkoo	T	H079
50	<i>Euclea divinorum</i> Hiern.	Ebenaceae	Mi'eessaa	S	H076
51	<i>Euphorbia ampliphylla</i> pax.	Euphorbiaceae	Hadaamii	T	H120
52	<i>Ficus sur</i> Forssk.	Moraceae	Harbuu	T	H027
53	<i>Ficus thonningii</i> Blume	Moraceae	MukaDambii	T	H029

54	<i>Ficus vasta</i> Forssk.	Moraceae	Muka Qilxuu	T	H045
55	<i>Flacourtia indica</i> Burm.f.Merr.	Flacourtiaceae	Akuukkuu	T	H109
56	<i>Galiniara saxifrage</i> (Hochst.).Bridson	Rubiaceae	Mixoo	T	H121
57	<i>Gardenia ternifolia</i> schumch&Thon.	Rubiaceae	Gambeelloo	T	H106
58	<i>Grewia ferruginea</i> Hochst.ex.A.Rich.	Tiliaceae	Dhooqonuu	L	H078
59	<i>Giradinia bullosa</i> (steud)wedd.	Utricaceae	Doobbii	H	H031
60	<i>Helinus mystacinus</i> (Ait) E.Mey.exSteud	Rhamnaceae	Kobbituu	L	H110
61	<i>Hibiscus macranthus</i> Hochst.ex.A.Rich	Malvaceae	Hincinnii	S	HO22
62	<i>Hippocratea goetezi</i> Looes.	Celastraceae	H  qolalaafessa	L	H095
63	<i>Hymenodictyon floribundum</i> .	Rubiaceae	Gaarrii	T	H090
64	<i>Hyparrhenia anthistiriodes</i> (Hochst.ex A.Rich.)staps	Poaceae	Daggala	H	H036
65	<i>Hypoestes forskaoli</i> (Vahl)R.Schult	Acanthaceae	Darguu	H	H122
66	<i>Jasminum abyssinicum</i> Hochst.ex.DC.	Oleaceae	Hidda Ilchimmee	L	H004
67	<i>Justicia diclipteroides</i> Lindau subsp.aethiopica Hedren.	Acanthaceae	Darguu	H	H128
68	<i>Justicia ladanoides</i> Lam.	Acanthaceae	G/darguu	H	H108
69	<i>Justiciaschimperiana</i> (Hochst.ex.Nees)T. Ander	Acanthaceae	Dhumuugaa	S	H066
70	<i>Kalanchoe lanciata</i>	Crassulaceae	G/busuqqee	H	H081
71	<i>Kalanchoe petitiana</i> A.Rich.	Crassulaceae	Bsuqqee	H	H123

72	<i>Lagenaria abyssinica</i> (Hook. f.) C. Jeffe	Cucurbitaceae	B  Seexanaa	S	H126
73	<i>Landolphia buchananii</i> (Hall. f.) Staps.	Apocynaceae	Hidda geeboo	L	H054
74	<i>Lepidotrichilia volkensii</i> (Gurke.) Leory.	Meliaceae	Qomonyoo	T	H001
75	<i>Lippia adoensis</i> Hochst. ex. Walp.	Verbenaceae	G kusaayee	S	H011
76	<i>Macaranga capensis</i> (Bail.) Sim.	Euphorbiaceae	Ho'aa	T	H130
77	<i>Maesa lanceolata</i> Forssk.	Myrsinaceae	Abbayyii	T	H028
78	<i>Matyenus gracilipes</i> (Welw. ex. Oliv.) Excell	Celastraceae	Hacaaccii	S	H026
79	<i>Maytenus arbutifolia</i> (A. Rich) Wilczek	Celastraceae	Kombolcha	T	H084
80	<i>Maytenus undata</i> (Thunb.) Blakelock	Celastraceae	Ilka	S	H136
81	<i>Mikaniopsis clematoides</i> (A. Rich) Miln Redh	Asteraceae	H  hantuutaa	L	H100
82	<i>Millettia fruginea</i> (Hochst.) Bak.	Fabaceae	Sootoloo	T	H134
83	<i>Mimulopsis solmsii</i> Schweinf.	Acanthaceae	Darguu	H	H119
84	<i>Mimusops kummel</i> A. DC.	Sapotaceae	Qolaaddii	T	H086
85	<i>Myrsine Africana</i>	Myrsinaceae	*	S	H138
86	<i>Nuxia conesta</i> R. Br. Ex. Fresen	Loganiaceae	Nafuroo	T	H015
87	<i>Ochna holstii</i> Engl.	Ochnaceae	Muka lookoo	T	H133
88	<i>Ocimum lamiifolium</i> Hochst. ex. Benth.	Lamiaceae	Hancabbii	S	H032
89	<i>Ocimum urticifolium</i> Roth	Lamiaceae	*	S	H135
90	<i>Olea capensis</i> L. subsp. <i>macrocarpa</i> (C. H. Wright)	Oleaceae	Gagamaa	T	H103

91	<i>Olea europaea</i> L.subsp. <i>cuspidate</i> (wall.ex.G.Don)cif.	Oleaceae	Eejersa	T	H006
92	<i>Olea wewitschii</i> (knobl.)Gilg&schellenb.	Oleaceae	Bahaa	T	H80
93	<i>Olinia rochetiana</i> A.Juss.	Oliniaceae	Noolee	T	H019
94	<i>Oplismenus hirtellus</i> (L.)P.Beauv.	Poaceae	Marga Booyyee	H	H087
95	<i>Osyris quadripartite</i> Decn.	Santalaceae	Waattoo	S	H023
96	<i>Pavonia urens</i> cav.	Malvaceae	Gosa Hincinnii	S	H056
97	<i>Pennisetum</i> <i>sphacelatum</i> (Nees)Th.Dur.&schinz	Poaceae	Migira	H	H034
98	<i>Peperomia abyssinica</i> Miq.	Piperaceae	*	H	H101
99	<i>Periplocalarifolia</i> Qurt.Dill.&A.Rich	Asclepiadaceae	Aanannoo	L	H030
100	<i>Phaulopsis imbricate</i> (Forssk) sweet.	Acanthaceae	*	H	H063
101	<i>Phoenix reclinata</i> Jacq.	Arecaceae	Meexxii	T	H142
102	<i>Phragmanthera macrosolon</i> (steud.ex.A.Rich)Balle.	Loranthaceae	Eertoo	S	H138
103	<i>Phytolacca dodecandra</i> L. Herit.	Phytolaccaceae	Andoodee	S	H014
104	<i>Pittosporum viridiflorum</i> sims	Pittosporaceae	Qasammee	T	H091
105	<i>Plantago lanceolata</i> l.	Plantaginaceae	Qorxobbii	H	H056
106	<i>Podocarpus falcatus</i> (Thunb)R.B.ex.Mirb.	Podocarpaceae	Birbissa	T	H009
107	<i>Polyscias fulva</i> (Hiern)Harms	Araliaceae	Hobolxoqaa	T	H096
108	<i>Pouteria adolfi</i> (Engl.)Baehni	Sapotaceae	Sooqee	T	H058

109	<i>Premna schimperi</i> Engl.	Lamiaceae	Urgeessaaa	T	H088
110	<i>Protea gagedi</i> J.F.Gamel.	Proteaceae	Yubdoo	T	H114
111	<i>Prunus Africana</i> (Hook.f.) kalkam.	Rosaceae	Hoomii	T	H044
112	<i>Psychotria orophila</i> petit	Rubiaceae	Mukka Gurraacha	T	H132
113	<i>Pteris catoptera</i> kunze.	Pteridaceae	Tirimmii	F	H137
114	<i>Pteris pteridiodes</i> (Hook.)Ballard.	Pteridaceae	Tirimmii	F	H140
115	<i>Pycnostachys abyssinica</i> Fresen.	Lamiaceae	Dorommii	S	H057
116	<i>Rhamnus prinoides</i> L. Herit.	Rhamnaceae	Geshoo	S	H043
117	<i>Rosa abyssinica</i> Lindley	Rosaceae	Qaqawwii	S	H018
118	<i>Rothmannia urcelliformis</i> (Hiern) Robyns	Rubiaceae	Bururii	T	H089
119	<i>Rubus steudneri</i> schweinf.	Rosaceae	Goraa	S	H002
120	<i>Rytigynia neglecta</i> (Hiern)Robyns.	Rubiaceae	Mixoo	T	H075
121	<i>Schefflera</i> <i>abyssinica</i> (Hochst.ex.A.Rich)Harms	Araliaceae	Gatamaa	T	H072
122	<i>Setaria megaphylla</i> (steud)Th.Dur.	Poaceae	Jajjaba	H	H069
123	<i>Solanum giganteum</i> Jacq.	Solanaceae	Hiddii Saree	S	H050
124	<i>Solenstemon autranii</i> (Briq.)J.K.Moore.	Lamiaceae	*	H	H041
125	<i>Stephania abyssinica</i> Dillon&A.Rich waip.	Menispermaceae	Hidda Kalaalaa	L	H007
126	<i>Stereospermum kunthianum</i> cham	Bignoniaceae	Botoroo	T	H104
127	<i>Syzygium guineense</i> (willd)D.C.subsp.	Myrtaceae	Baddeessaa	T	H068

	<i>afromontanum F. white.</i>				
128	<i>Syzygium guineense</i> <i>subsp. guineensis(willd)DC.</i>	Myrtaceae	Goosuu	T	H071
129	<i>Taccazzea apiculata oliv.</i>	Asclepiadaceae	Gura Hantuutaa	L	H115
130	<i>Tactaria gimmifera(Fee)Alston.</i>	Tectariaceae	*	F	H139
131	<i>Teclea nobilis Del.</i>	Rutaceae	Hadheesa	T	H083
132	<i>Terminalia macroptera Giull&amp;per.</i>	Combretaceae	*	T	H061
133	<i>Terminalia schimperiana Hoscht.</i>	Combretaceae	Gaarrii	T	H059
134	<i>Tiliacarpa troupinii Cufod.</i>	Menispremeaceae	Hidda Liqimnee	L	H141
135	<i>Tragia brevipes pax.</i>	Euphorbiaceae	Gurgubbee	H	HO40
136	<i>Ttiumfetta rhomboidea Jacq.</i>	Tiliaceae	*	S	H065
137	<i>Urera hypselodedron</i> <i>(A.Rich)wedd.</i>	Urticaceae	Hidda Lanqisaa	L	H038
138	<i>Veprisdainelli(pichi sserm)kokwaro.</i>	Rutaceae	Hadheessaa	T	H055
139	<i>Verninia amygdalina Del.</i>	Asteraceae	Eebicha	T	H025
140	<i>Vernonia auriculifera</i>	Asteraceae	Reejjii	S	H017
141	<i>Vernonia purpurea sch.bip.ex.walp.</i>	Asteraceae	Sooyoma	S	H052
142	<i>Ximenia amercana L.</i>	Olacaceae	Hudhaa	T	H073

**Appendix 2 Plants families with their genera and species distribution in Chato natural forest**

FAMILY NAME	NUMBER OF GENERA	NUMBER OF SPECIES
ACANTHACEAE	5	7
ADIANTACEAE	1	1
AMARANTHACEAE	1	1
APOCYANCEAE	2	2
ARACEAE	1	1
ARALIACEAE	2	2
ARECACEAE	1	1
ASCLEPIADACEAE	2	2
ASPARAGACEAE	1	1
ASTERACEAE	4	7
BIGNONIACEAE	1	1
BORAGINACEAE	2	2
CELASTACEAE	2	4
COMBRETACEAE	2	4
COMMELINACEAE	1	1
CRASSULACEAE	2	2
CUCURBITACEAE	1	1
CYPERACEAE	1	1
DRACAENACEAE	1	1
DRYOPTERIDACEAE	1	2
EBENACEAE	2	2
EUPHORBIACEAE	7	7

FABACEAE	5	7
FLACOURTACEAE	2	2
LAMIACEAE	5	6
LOGANIACEAE	1	1
LORANTHACEAE	1	1
MALVACEAE	2	3
MELASTOMATACEAE	1	1
MELIACEAE	2	2
MELIANTHACEAE	1	1
MENISPERMACEAE	2	2
MORACEAE	2	3
MYRSINACEAE	3	3
MYRTACEAE	1	2
OCHNACEAE	1	1
OLACACEAE	1	1
OLEACEAE	3	5
OLINIACEAE	1	1
ORCHIDACEAE	1	1
PHYTOLACCACEAE	1	1
PIPERACEAE	1	1
PITTOSPORACEAE	1	1
PLANTAGINACEAE	1	1
POACEAE	7	7
PODOCARPACEAE	1	1
POLYPODIACEAE	1	1
PROTEACEAE	1	1
PTERIDACEAE	1	2

RANUNCULACEAE	1	1
RHAMNACEAE	2	2
RHIZOPHORACEAE	1	1
ROSACEAE	3	3
RUBIACEAE	6	6
RUBTACEAE	3	3
SANTALACEAE	1	1
SAPINDACEAE	2	2
SAPOTACEAE	2	2
SOLANACEAE	1	1
STERCULIACEAE	1	1
TECTARIACEAE	1	1
TILIACEAE	2	2
ULMACEAE	1	1
URTICACEAE	1	1
VERBENACEAE	2	2
65	123	142

### **Appendix 3 Interview question for the informants**

1. Can you tell me the vernacular name of this plant?
2. Do you think that this plant has value for community?
3. If your response on question number two is ‘**NO**’ why?
4. If your responses on question number two is ‘**yes**’ what the uses the Communities are gain from this plant?
5. Which plant parts (leaf, stem, branch, root, bark or the combination of each of the them) is being used by the communities?
6. For what purpose the communities used each part of the plants?
7. What do you know about the plant species abundance (abundant, moderately available or rare or disappear)?
8. Is there (if any) a plant species that are abundantly occurred in chato forest?
9. Is there (if any) a plant species that are moderately occurred in chato forest?
10. Is there (if any) a plant species that are rarely occurred in chato forest?
11. Is there (if any) a plant species that is/are disappear from chato forest?
12. If your response on questions number ten and eleven is <yes> what do you think for the case to happen?
13. Can you mention some of the inclusion of local communities taken (if any) in the forest conservation activities and management to reduce the forest loss and destruction?
14. Do you think that the Potential traditional knowledge of the people is stengethend by government on the diverse uses of plants?
15. Do you think that tree planting by local people has done and encouraged on already degraded landscapes to create a buffer for the forest?

## Appendix 4

### Interview Questions Translated to Afan Oromo for the Informants

1. Mukti kun afaan oromootiin maal jedhama?
2. Mukti kun uummata naannoo kanaaf faayidaa qabaa?
3. Deebiin ati gaafii lammaffaa irratti qabdu <lakki>kan jettu yoo ta'e maalf lakki jettee?
4. Deebiin ati gaafii lammaffaa irratti qabdu <eeyyee>kan jettu yoo ta'e faayidaan inni qaba maalfaati?
5. Mukti ati faayidaa qaba jette kun eessasaatu (baala, damee, jirma, qola, hidda moo walitti makaa isaaniitu) faayidaa qabaa?
6. Mukti Kun faayidaa aakkamiifaaf oolaa?Eesasaatu maaliif oolaa?
7. Haalli jiraanyaa (argama) muka kanaa (bayi'naan jira, giddugaleessaan jira, darbee darbee jira, dur malee amma hinjiru) akkamiin ibsitaa?
8. Bosona kana keessa gosti mukaa bay' inaan jiru maalfaatii?
9. Bosona kana keessa gosti mukaa gidduu galeessaan jiru maalfaatii?
10. Bosona kana keessa gosti mukaa darbee darbee jiru maalfaatii?
11. Bosona kana keessa gosti mukaa dur malee amma hinjirre yoo jiru ta'e maalfaatii?
12. Deebiin ati gaafii 10 if 11 irratti qabdu <eeyyee>kan jettu yoo ta'e sababiin isaa Maalidha jettee yaadda?
13. Tarkaanfiiwwan kunuunsa bosona kanaaf gochuu irratti gama uummata naannoo kanaan kan fudhatame yoo jiraata maalfaatii?
14. Akkataa qabeenya bosona kanaa seeraan fayyadamuu dandeessan irratti gabifannaan beekumsa adaa qaama mootummaan siniif ta'e yoo jiraata maalfaatii?
15. Kana dura naannoo bosona kanaa keessumaayyuu darbee darbee bakka bosonaan hin haguugamne haguuguuf biqiltuu dhaabdani beektuu?

## DECLARATION

I declare that this thesis entitled “Diversity and Uses of Plant Species in Chato Natural Forest, Horro Guduru Wollega Zone, Oromia Regional State, West Ethiopia”, is my original work and all references used are duly acknowledged. It also has never been presented in any university for fulfillment of any degree program.

Name: Habtamu Teshome Tefera

Signature \_\_\_\_\_ Date \_\_\_\_\_

This work has been done under my supervision

Name: Tigist Wondimu (PhD)

Signature \_\_\_\_\_ Date \_\_\_\_\_