



**Plant Diversity and Ethnobotanical Study of Traditional Medicinal and Wild Edible Plants in Yayo and Hurumu Districts, Ilu Abba Bor Zone of Oromia Region, Southwest Ethiopia**

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This is to certify that the dissertation prepared by Garuma Gerbaba Chemedda, entitled: Plant Diversity and Ethnobotanical Study of Traditional Medicinal and Wild Edible Plants in Yayo and Hurumu Districts, Ilu Abba Bor Zone of Oromia Region, Southwest Ethiopia, and submitted in Fulfilment of the requirements for the Degree of Doctor of Philosophy in Plant Biology and Biodiversity Management and complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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## Abstract

### **Plant Diversity and Ethnobotanical Study of Traditional Medicinal and Wild Edible Plants in Yayo and Hurumu Districts, Ilu Abba Bor Zone of Oromia Region, Southwest Ethiopia**

Garuma Gerbaba Chemed, Ph.D. Dissertation

Addis Ababa University, 2020

*This study was conducted in Yayo and Hurumu districts, Oromia Region, Southwest Ethiopia during 2016 to 2019 with the aim of investigating plant diversity and ethnobotanical and wild edible plants. To collect vegetation data, a total of 96 quadrats in which 20 m x 20 m major quadrat, while 5 m x 5 m, and 2 m x 2 m subplots were established for shrubs and herbaceous plant species respectively. Transects were laid at a distance of 500 m apart from each other, the first line transect was established randomly. The successive quadrats were established along altitudinal gradients. Altitude, latitude, longitude were recorded using GPS. Plant species with DBH >2.5 cm, height >2 m were documented. For those plants having a height < 2 m and DBH < 2.5 cm were recorded as seedlings or saplings. For ethnobotanical data collections, 396 informants were interviewed. 52 key informants were purposively selected. FGD, participant observation and market survey were made. For plant diversity analysis, Shannon-Wiener diversity index ( $H'$ ) was used. Community cluster analyses of the forests were performed with the help of R software. Density, frequency, DBH, IVI, and BA were computed. Descriptive techniques were also used for ethnobotanical data analysis. A total of 298 (184 from quadrats and 114 outside) plant species in 235 genera and 93 families were reported. Asteraceae was the most species rich family represented by 27 followed by Fabaceae that contributed 24 species. Six community types: *Antiaris toxicaria* - *Celtis africana*, *Justicia schimperiana* - *Vepris dainellii*, *Carissa spinarum* - *Trichilia dregeana*, *Apodytes dimidiata* - *Croton macrostachyus*, *Rubus apetalus* - *Vernonia amygdalina*, *Clematis simensis* - *Trema orientalis* community types were identified. The study area was characterized by diversified plant species with an average diversity index ( $H'$ ) of 3.4. The local communities possess rich knowledge on the use of plants. A total of 172 plant species were used for the traditional medicine and 22 used as wild edible plants. The highest values of ICF (0.93) were recorded for gastro-intestinal ailments. The highest FL was recorded for *Thalictrum rhynchocarpum* (97%). Anthropogenic pressure including firewood and agricultural expansion were identified as the factors that could be seen as threats of plant species of the study area.*

#### **Keywords/phrases:**

*Ethnobotany, medicinal plants, plant diversity, wild edible plants, Yayo and Hurumu districts*

## **DEDICATION**

This dissertation is dedicated to local communities of Yayo and Hurumu districts who enthusiastically their good willingness, and commitment to share their valuable indigenous knowledge on the use of plants for traditional medicine, wild edible plants, and related essential indigenous knowledge on plant uses which has been practiced for many years.

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## **List of Acronyms**

AAU: Addis Ababa University

CBD: Convention on Biological Diversity

CSMP: Conservation and Sustainable Use of Medicinal Plants

DBH: Diameter at Breast Height

ECFF: Environment and Coffee Forest Forum

ETH: National Herbarium of Ethiopia

FL: Fidelity Level

GPS: Global Positioning System

HDANRMO: Hurumu District Agricultural and Natural Resources Management Offices

IBC: Institute of Biodiversity Conservation (Ethiopia)

ICF: Informant Consensus Factor

IK: Indigenous Knowledge

NFPA: National Forest Priority Area

NTFPs: Non-Timber Forest Products Development Training Manuals Series

TK: Traditional Knowledge

STCP: Sustainable Tree Crops Program

TM: Traditional Medicine

UVs: Use Values

WHO: The World Health Organization

YDRADO: Yayo District Rural and Agricultural Development Office

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# CHAPTER ONE

## 1. INTRODUCTION

### 1.1. Background

Forests are a diverse ecosystem and are often considered as reservoirs of biodiversity (Vajari and Shardami, 2013). Forests provide humanity with many different goods and services that are required to sustain a livelihood (Abreham Assefa *et al.*, 2013). The use of forests and forest products dates back to several centuries in human history. Today, millions of people living in and around forests in the tropics to a large extent depend on forests (NTFPs, 2013). The forests of Ethiopia have served and still serve as a source of food, fuel, construction material, farm equipment, income-generating, and medicine to many people mainly that the rural populations (Tamrat Bekele, 1994).

Ethiopia's forests once covered about 65% of the country but currently forest cover is only about 2.2% of the country (Evangelista *et al.*, 2012). The country has been experienced substantial deforestation, soil degradation and an increase in the area of bare land over the years (Ensermu Kelbessa and Teshome Soromessa, 2008). It is clear that the forest cover in different parts of the country is diminishing because of natural and man-made factors. One of the main challenges facing the Ethiopian's forest today is reconciling the often conflicting priorities of those who depend on them for a whole range of goods and services obtained they offer (Sebsebe Demissew, 1988). The problem is still far from being resolved due to the failure in realizing the value of direct involvement of local communities in planning, monitoring, evaluation and the implementation of forest resource management (Mulugeta Lemenih and Demel Teketay, 2004).

Diversity of species in a given plant community are used to interpret the relative variation between and within the community and helps to explain the underlying reason for such a variation (Zerihun Woldu, 1985). Species diversity exists at different spatial scales, and the most conspicuous pattern of species diversity at large spatial scales is latitudinal diversity gradient. Ecologists have measured diversity either by estimating species richness (number of species) in an area, or by one or more indices combining species richness and relative abundance within an area (Sanderson *et al.*, 2004).

Knowledge of the spatial pattern of biodiversity is crucial to assess the consequences of forest degradation and habitat loss caused by human activities, and to develop systematic conservation strategies (Schmitt *et al.*, 2009). Hence, appropriate measures are required to maintain and restore the remaining natural forests (Getinet Masresha *et al.*, 2015). There is close associations between poverty, population growth, economic development, and the use of the environment. If present trends in population growth continue, deterioration of natural resources will be even more rapid in the future (Feyera Abdena, 2010).

Medicinal plants play a key role in the development and advancement of modern medicine by serving as a starting point for the development of novelty in drugs (Oladele *et al.*, 2011). In many developing countries, a large proportion of the population relies heavily on traditional medicine to meet primary healthcare needs (WHO, 1999). Ethnobotany attempts to find out how people have traditionally used plants, for whatever purposes, and how they are still doing so. Thus, ethnobotany tries to preserve valuable traditional knowledge for future generations (Tesfaye Awas and Sebsebe Demissew, 2009).

The interest and support for the conservation and development of medicinal plants have been growing in different parts of countries (Kunwar and Bussmann, 2008). This is due to a growing recognition given to the role of medicinal plants in the provision of culturally relevant and affordable healthcare, in creating sustainable livelihoods and in the vital conservation of biodiversity (STCP, 2005). Ethnobotanical studies are mainly useful in documenting, analyzing, and disseminating of knowledge on the interaction between biodiversity and human society, and how biodiversity is valued in different societies as well as how it is influenced by human activities (Martin, 1995).

The natural vegetation of western part of Ethiopian escarpment is still nearly intact, but imperfectly recognized (Sebsebe Demissew *et al.*, 2005). Yayo and Hurumu districts are characterized by dense vegetation cover including high abundance of wild coffee populations. However, currently, it is under pressure due to various factors such as human pressure, population growth, and resettlements which contribute to forest diminishing including traditional medicinal and wild edible plant species in the study area. Hence, this study could be also important in many ways by addressing the status of plant resources, to perform essential conservation measures of the plants species in the study area.

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

Previously, southwest part of Ethiopia has one of the largest remnants of natural forest fragments and characterized by high plant species diversity (Tadesse Woldemariam, 2003; Dereje Denu, 2006). The forests of Yayo and Hurumu districts are used by the local communities for various purposes such as traditional medicine mainly to treat human and livestock ailments and as wild edible food. However, currently, from our observation these forests are disappearing at an alarming rate due to over-utilization of forest resources and anthropogenic pressure including agricultural activities, fire wood, charcoal, timber production, the pressure from investors, and some other natural factors such as sudden fire.

Although the local communities of Yayo and Hurumu districts are well known by their indigenous knowledge on utilization of plant resources mainly traditional medicinal and wild edible plants, this important information is not well explored and documented. Beside, the forests including medicinal and wild edible plants are under threats. Thus, the present study was aimed to find solutions for these problems and to fill such gap. The study could be makes available an inclusive documentation of information on plant diversity in the natural forests parallel with an ethnobotanical knowledge of the local communities which is interconnected with sustainable use of traditional medicinal and wild edible plants. It also aimed at the documentation of marketable traditional medicinal plants in the study area. Thus, it could be contributed by giving first-hand information regarding plant species diversity, sustainable utilization and management of traditional medicinal and wild edible plants of the study area that could be supportive in achieving the objectives.

Generally, this study could contributed valuable information that can be used by the local communities, researchers, institutions, policy makers and other concerned bodies at all levels to take conservation measures and as sources of information to facilitate further study on the discovery of new drugs through proper identification. The study also suggests future directions of sustainable use the plant resources, and the phytochemical study of preferred traditional medicinal plants, and nutritional analysis of wild edible plant species. It is also believed that this research will provoked similar studies in different part of the country.

### **1.3. Research questions, hypotheses and study objectives**

#### **1.3.1. Research questions**

The following research questions, hypothesis and objectives were designed for careful assessment.

- Which plant species are found in the Yayo and Hurumu forests?
- Are there any variations in plant species richness, evenness, and diversity in Yayo and Hurumu forests due to the influence of environmental factors?
- Which plants species are used traditionally by local communities in the study area as medicine and food?
- Which plants are frequently used by local communities? And what are their use values?
- How do the indigenous local communities in Yayo and Hurumu districts use medicinal and wild edible plants?
- What is the status of the natural forests and medicinal plants found in Yayo and Hurumu districts?
- How is traditional knowledge on medicinal plants transferred from one generation to another?
- What are the major threats to the conservation of natural forests, medicinal and wild edible plants of Yayo and Hurumu districts?
- Which wild plant species used as medicine and food in the study area are marketable?

#### **1.3.2. Research hypotheses**

- The plant diversity of Yayo and Hurumu forests is high;
- Environmental factors influence plant species richness, evenness and diversity in Yayo and Hurumu forests;
- The regeneration of the natural forests in the study area is good;
- The indigenous communities in Yayo and Hurumu districts have significant understanding of the traditional uses of medicinal and wild edible plants;

- Knowledge on the use of plants for medicinal or other purposes differs among different age and sex classes in the study area and is passed from the old to the younger generation;
- Traditional medicine and wild edible plants are marketable in Yayo and Hurumu districts.

### **1.3.3. Study objectives**

#### **General study objective**

The general objective of this study was to investigate the plant diversity and ethnobotanical study of traditional medicinal and wild edible plants of Yayo and Hurumu districts.

#### **Specific objectives**

The specific objectives of the study were:

- To determine plant species diversity in the forests of Yayo and Hurumu forests;
- To determine species richness, evenness and diversity among different plant community types in Yayo and Hurumu forests;
- To document wild plants used traditionally in the study area as food and remedies for human and livestock ailments;
- To assess variation in indigenous knowledge on medicinal and wild edible plants among social groups in the study area;
- To determine the traditional uses of medicinal and wild edible plants including plant parts used, modes of preparation, routes of application, dosages, efficacy, and relative healing potential;
- To identify the major threats to the forests of Yayo and Hurumu districts;
- To determine the conservation status of medicinal and wild edible plant species;
- To determine whether there is market for wild plants used as traditional medicine and food in the study area.

## **CHAPTER TWO**

### **2. LITERATURE REVIEW**

#### **2.1. Vegetation of Ethiopia**

Vegetation is described as ‘plants collectively’ or ‘plant growth in the mass. Vegetation also defined as an assemblage of plants growing together in a particular location (Kent, 2012). It is the collective plant cover of an area and can be characterized either by its component species or by the combination of structural and functional characters that characterize the appearance of the vegetation. Vegetation could be influenced by several factors including climate, geology, edaphic factors and biotic factors including pressure by humans in ecological succession. Moreover, vegetation is continually altering due to the fact that climatic change, human land use, and other interface (Motuma Didita *et al.*, 2010).

Ethiopia has very diverse climatic condition varied from hot and dry desert in the lowland areas, parts of which as deep as 116 m below sea level, upto cold and humid alpine area habitats in highlands, which rise to over 4000 m above sea level (Tadesse Woldemariam, 2003). Ethiopia has sets of ecosystems, ranging from humid forest and extensive wetlands to deserts, such as Afar depression, supporting a wide variety of life forms. A number of authors reported that Ethiopia has diverse flora and fauna in tropical Africa due to its great geographical diversity, vegetation types, and soil types (Kalkidan Esayas and Afework Bekele, 2011). According to Zerihun Woldu (2008) the topography and diverse climatic conditions of Ethiopia have led to the occurrence of habitats that harbor some unique plant species and animals and their assemblages. As a result, Ethiopia is one of the countries in the world with a high level of biodiversity.

The vegetation in Ethiopia is very heterogeneous and is rich in endemic plant species. In the Flora of Ethiopia and Eritrea about 6,027 vascular plant species (including subspecies), with about 10% endemism have been documented (Ensermu Kelbessa and Sebsebe Demissew, 2014). The identification and documentation of endemic plants is important and contributes for the formulation of national plant conservation target (IUCN, 2010).

Recently, the Ethiopian vegetation has been categorized into twelve (12) major types Desert and semi-desert scrubland (DSS); *Acacia-Commiphora* woodland and bushland (ACB); Wooded grassland of the western Gambela region (WGG); *Combretum-Terminalia* woodland and wooded grassland (CTW); Dry evergreen Afromontane forest and grassland complex (DAF); Moist evergreen Afromontane forest (MAF); Transitional rainforest (TRF); Ericaceous belt (EB); Afroalpine belt (AA); Riverine vegetation (RV); Fresh-water lakes; Lake shores; Marsh and floodplain vegetation (FLV); and Salt-water lakes; Salt-lake shores; Marsh and pan vegetation (SLV) (Friis *et al.*, 2011).

The conversion of natural vegetation is currently one of the leading agenda for a number of world conservation organizations, authorities and interest groups. Vegetation study is particularly urgent in countries such as Ethiopia, since the natural environment has been severely altered and only a few relict patches of natural vegetation remain (Zerihun Woldu *et al.*, 1989). The reduction of forest was also due to climatic changes and various human-induced pressures such as agriculture, overgrazing, firewood, charcoal, timber and settlements have contributed to the reduction of forests. That is human beings are dependent for their subsistence, health, well being and enjoyment on forests. Moreover, clearing for cultivation, burning to create pasture lands, and improper cutting practices have reduced the forest area to a small fraction of the total area of various country including Ethiopia (Feyera Senbeta, 2006).

### **2.1.1. Moist evergreen Afromontane forest (MAF) of Ethiopia**

Of the thirty four (34) global biodiversity hotspots two (2) are found in Ethiopia (IBC, 2005). The Afromontane region contains about 4000 plant species of which about 75% are endemic or near endemic to the region. Very recently, this region was designated as the “Eastern Afromontane Hotspots,” which is one of the 34 regions globally important for biodiversity conservation (Feyera Senbeta, 2006). Moist evergreen Afromontane forest (MAF) vegetation type is in most cases characterized by one or more closed strata of evergreen trees that may reach a height of 30 to 40 m. Sometimes only the lower stratum remains, due to the removal of the tallest trees. Previously, this vegetation type was considered to consist of two subtypes namely *Afromontane rainforests*, where the forests with wild coffee are found, and *Transitional rainforest*, bordering the *Combretum-*

*Terminalia* woodlands on the western escarpment of the Ethiopian highlands in the floristic regions Ilu Abba Bor (IL) and Kefa (KF) (Friis *et al.*, 2011).

Ecological studies have been conducted in Ethiopia on vegetation resources and forest by different scholars. For instance Sebsebe Demissew (1988), Zerihun Woldu *et al.* (1989), Tamrat Bekele (1993), Tamrat Bekele (1994), Tesfaye Awas *et al.* (2001), Abate Ayalew *et al.* (2006), Ensermu Kelbessa and Teshome Soromessa (2008), Feyera Senbeta (2006), Haile Yineger *et al.* (2008c), Abreham Assefa *et al.* (2013), and Fekadu Gurmessa *et al.* (2013) have demonstrated the variation in several attributes of plant communities with variation in environmental variables. These studies were mainly focused on climate, physiognomy, and other ecological attributes and some descriptions of species composition.

The Moist evergreen Afromontane forest occurs mainly in the Western highlands between (1500-) 1800 and 2600 (-3000) meters, with an annual rainfall between 700 and 2000 millimeters (or more). The Harena forest on the southern slopes of the Bale Mountains is the easternmost example of this forest while the northernmost examples of this type of forest are patches in Wollega (WG) floristic region, such as the Wembera forest. The examples of this forest type in the surroundings of the small town of Wendo Genet on the border between the Sumale (SU) and Sidama (SD) floristic regions (Friis *et al.*, 2011). The forests in this floristic region predominantly contain broad-leaved evergreen species in the multilayered canopy. *Podocarpus falcatus* may occur in the eastern and northernmost of these forests, but this plant species is never prominent. The most characteristic type of this forest occurs widely in the upland parts of the southern Wollega, Ilu Abba Bor (excluding the lowlands), and Kefa floristic regions. It is found in areas between 1500 and 2500 m, with an annual rainfall between 1500 mm and 2000 mm, with rain all the year round (Sebsebe Demissew and Nordal, 2010).

Besides, the moist forest ecosystem is the most diverse ecosystem in composition, structure and habitat types; consequently, it is rich in biodiversity with a number of endemic species. The characteristic plant species in this vegetation type include the largest and commercially most important trees which are the most commonly emergent species and also the ones found in the upper canopy. These include *Pouteria adolfi-friederici*, *Podocarpus falcatus*, *Celtis africana*, *Schefflera abyssinica*, *Mimusops kummel*, *Millettia ferruginea*, *Croton macrostachyus*, *Albiza gummifera*, *Ficus ovata*,

*Ficus thonningii*, *Syzygium guineense* subsp. *afromontanum*, *Ekebergia capensis* and *Olea welweitschii* (Feyera Senbeta, 2006; Feyera Abdena, 2010).

### **2.1.2. Vegetation classification and plant community types**

Vegetation classification implies to arrange vegetation patterns into an ecologically meaningful set of types, with clear diagnostic criteria for identifying the types (Langendoen *et al.*, 2007). Hence, it is useful to facilitate communication and information-gathering about ecological resources. Vegetation classifications also important to document the diversity of ecological communities, and provide a framework for addressing scientific inquiries into the patterns of vegetation (Mueller-Dombois and Ellenberg, 1974).

Different scholars have defined plant community types in different ways. For example, Kent and Coker (1992) defined a plant community as a collection of plant species growing together in a particular location that show a definite relationship or affinity with each other. It is a combination of plants that are dependent on their surrounding environment, influence one another, and modify their own surroundings area. Description of a plant community can be expressed by analysis of species diversity, evenness, and similarity (Mueller-Dombois and Ellenberg, 1974; Langendoen *et al.*, 2007).

### **2.1.3. Plant species diversity, richness and similarity**

The term biological diversity refers to variety within the living world or among and between living organisms (Swingland, 2001). Biological diversity or “biodiversity” has been also defined by the Convention on Biological Diversity (CBD) as: “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”. Moreover, biodiversity is simply the variety of life: its ecosystems, species, populations, and genes. In short, biodiversity refers to the variety of life on earth (IBC, 2005; Wilsey and Stirling, 2007).

Plant species diversity is the number of species and their relative abundance in a defined area. Diversity measurements incorporate both species richness (S, the number of plant species in a community) and species evenness (J, an estimate of species distribution within a community). This diversity provides the building blocks to adapt to altering

ecological conditions in the future (Swingland, 2001; IBC, 2005). A number of factors or hypotheses e.g climatic stability, environmental heterogeneity, competitions, history and water-based energy dynamics can be used to explain species diversity along latitude. A community is basically “even” if all the species in the community have an equal number of individuals and are all the same size. Various indices combine these two factors to measure diversity in plant communities (Sanderson *et al.*, 2004).

## **2.2. History of Ethnobotany**

The term ethnobotany was coined by John W. Harshberger in 1896 and was considered as the art of collection of useful plants by a group of people and the description of the uses of plants (Cotton, 1996). The term ethnobotany is derived from "ethno" the study of people and "botany" the study of plants which is a branch of ethnobiology that studies the complex relationships between uses of plants and cultures (Martin, 1995). Ethnobotany is a multidisciplinary science that study of the direct interaction between plants and people or the study of the relationship between plants and people (Balick and Cox, 1996; Stepp, 2005). It is the scientific investigation of plants as used for food, medicine, magic, rituals, building, household utensils and implements, musical instruments, firewood, pesticides, clothing, shelter and other purposes particularly in indigenous cultures (Choudhary *et al.*, 2008).

Knowledge of plants used by humans is based on thousands of years experience. By “trial and error”, communities learnt how to recognize and use plants, including those with a magic-religious function (Rodrigues *et al.*, 2003). This knowledge was widespread in ancient civilizations. By the end of the 19<sup>th</sup> century, ethnobotany had started to develop as a science, providing a new tool for pharmaceutical research. Ethnobotany focuses on how plants have been or are used, managed and perceived in human societies (Choudhary *et al.*, 2008).

Some ethnobotanical inventories emphasising on systematic documentation of medicinal plants have been conducted in parts of Ethiopia such as in the Zay people in Ethiopia (Mirutse Giday *et al.*, 2003); 'Dheeraa' town of Oromia (Tigist Wondimu *et al.*, 2006); in Southern Ethiopia (Zemedede Asfaw, 2009); in Kafficho people of southwestern Ethiopia (Tesfaye Awas and Sebsebe Demissew, 2009); around Alamata of Southern Tigray (Gidey Yirga, 2010); in Wayu district of Oromia (Moa Megersa *et al.*, 2013); in around

Fiche District of central Oromia (Abiyu Enyew *et al.*, 2014); in Amaro Woreda of SNNPR (Fisseha Mesfin *et al.*, 2014); Hadiya Zone of SNNPR (Habtamu Agisho *et al.*, 2014); in Holeta Town of Oromia (Mekonnen Amberber *et al.*, 2013); in Berehet District of Amhara (Getu Alemayeh *et al.*, 2015), and Dega Damot District of Amhara (Yayesh Limenih *et al.*, 2015).

### **2.2.1. Ethnobotanical survey and its significance**

In the past, ethnobotany has been perceived negatively for a number of reasons. For example, since it is intrinsically interdisciplinary, it is susceptible to charges of being vague and imprecise, and ethnobiologists are considered to study and learn from cultures that western science and biomedicine hold to be "primitive" and inferior (Phillips and Gentry, 1993). Indeed, basic quantitative and experimental ethnobotany includes basic documentation, quantitative evaluation of use and management, and experimental assessment (Choudhary *et al.*, 2008).

In cultural anthropology which is highly related to ethnobotany, a quantitative school has long been influential and more recently, there has been interest in integrating quantitative and qualitative types of research (Choudhary, *et al.*, 2008). However, until recently, ethnobotanists had been reluctant to appreciate the potential significance of quantification (Höft *et al.*, 1999). Quantitative ethnobotanies which deals with the application of quantitative techniques to the direct analysis of contemporary plant use data has the potential to contribute to a wide range of important issues at the interface of science and development. Today, ethnobotanical surveys include applied projects that have the potential to reduce poverty level of the communities, allowing them to make decisions about their future directions by giving focus to environmental issues (Phillips and Gentry, 1993).

### **2.2.2. Techniques of ethnobotanical data collection and its significance**

In ethnobotanical data collection, information about medicinal and other uses of plants is collected and recorded with the following target groups: key informants; focus groups or individuals and randomly selected households (Martin, 1995). Interviews and focus normally provide depth of information that might be useful (Harrell and Bradley, 2009). Interviews are a dynamic technique involving spoken interactions between two or more

individuals, and are meant to gather information on a specific set of issue (Alexiades, 1996). It is the principal tool used by ethnobotanists for obtaining ethnobotanical information and is therefore an essential skill for botanists conducting ethnobotanical or ethnomedical field surveys in species rich areas and for conservation planners needing useful information about the subsistence use of species or ecological communities (Alexiades, 1996). Information on plant uses can be gathered much more rapidly through interviews than by direct observation alone (Phillips, 1996).

Depending on the nature and scope of an inquiry, the investigator usually identifies appropriate groups from which the key informants are drawn and then selects a few individuals from each group (Kumar, 1989). In order to develop good interviews, preparation of an interview guide that lists the topics and issues to be covered during an interview is very crucial. Of different interviews, the semi-structured interview is based on the use of an interview guide about uses, management of resources and medicinal plants (Martin, 1995). The best information is obtained over extended periods of time, where mutual trust and understanding can develop, allowing the researcher to cross-check his or her observations repeatedly (Alexiades, 1996).

Interviews are discussions, usually one-on-one between an interviewer and an individual, meant to gather information on a specific set of topics. Interviews differ from surveys by the level of structure placed on the interaction (Harrell and Bradley, 2009). The interview, in its different forms, constitutes the basis of most ethnobotanical data gathering. The value of interview as a tool of inquiry depends on the context in which it takes place and on the interviewer's skills (Hoffman and Gallaher, 2007). Local rules of conversation have to be discovered and adopted, including the use of visual cues such as eye contact, posture, and so on. In reality, the way in which an interview is conducted, how questions are constructed and presented, and the answers recorded, all have significant impact on the quality, quantity, and meaning of the data collected (Alexiades, 1996).

Its value as a tool of inquiry depends on the context in which it takes place and on the interviewer's skills. Local rules of conversation have to be discovered and adopted, including the use of visual cues such as eye contact, posture, and so on (Martin, 1995). In reality, the way in which the interview is conducted, how questions are constructed and presented, and the answers recorded, all have significant impact on the quality, quantity, and meaning of the data collected. It is through the interview that the fieldworker can

record the different epistemological, symbolic, and pragmatic aspects of plant use and situate this information in a meaningful context (Alexiades, 1996).

Direct or participant observation is based on observing human-plant interactions, such as which plants are collected and used. It also refers to living with people and sharing with them many aspects of their life, from subsistence activities such as cooking, farming to ritual occasions such as marriage and other religious celebrations (Martin, 1995). The information collected through participant observation is highly reliable; this technique is particularly valuable for documenting plant use (Alexiades, 1996). It is an additional method that can be used to reduce researcher subjectivity and intrusiveness, and matching statements of research participants with their actions (Hoffman and Gallaher, 2007).

Because of the complexities involved in most ethnobotanical studies, it is common for ethnobotanical researchers to collect observations on many different variables. However, the researcher's presence may have some influence on the participants and the exchanges that take place. Basically, observations have to be tied to the research question(s) (Höft *et al.*, 1999), which would act as a guide during data collection. Focus group discussions are methods that involve dynamic group discussions used to collect crucial information. Like interviews focus groups are also the best technique to resolve seemingly conflicting information, because the researcher has the direct opportunity to ask about the apparent conflict. Audio and video recording are also crucial in recording the needed information in fast and precise manner. Market surveys are also very important tools in ethnobotanical data collection (Harrell and Bradley, 2009).

### **2.2.3. Indigenous knowledge and traditional medicinal plants in Ethiopia**

The term "indigenous communities" refers to communities that follow traditional, non-industrial lifestyles in areas that they have occupied for generations (Balick and Cox, 1996), while Indigenous knowledge refers to the knowledge that is exceptional to a particular culture or society which is different from the knowledge gained at formal institutions (Martin, 1995). Indigenous knowledge systems are the complex array of knowledge, know-how, practices and representations that guide human societies in their innumerable interactions with the natural milieu: agriculture and animal husbandry; hunting, fishing and gathering; struggles against disease, and injury; naming and

explaining natural phenomena; and strategies for coping with changing environments (Nakashima and Rou'e, 2002).

Traditional knowledge (TK) is a difficult concept to define because it encompasses such diversity. TK or indigenous knowledge covers wide-ranging subject areas from art to agriculture, as well as medicinal uses of plants and traditional systems of medical diagnosis (Abbott, 2014). It has been described as a cumulative body of knowledge, practice and belief, evolving through adaptive processes and handed over through generations by cultural transmission (Ketema Tolossa *et al.*, 2013). Traditional knowledge of indigenous people relating to the uses and management of plant resources is extensive. The use of traditional medicine (TM) has expanded globally and mainly used for primary healthcare of in developing countries (Gemedo Dalle *et al.*, 2005).

Indigenous knowledge (IK) is entering into the mainstream of sustainable development and biodiversity conservation discourse. The Convention of Biological Diversity has contributed to this process by requiring signatories to: “respect, preserve and maintain knowledge, innovations, and practices of indigenous and local people embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity” (Nakashima and Rou'e, 2002). Indigenous knowledge (IK) has been recognized in recent decades as making an important contribution to natural resource management systems, particularly in the developing world (Dixon, 2002).

Recognizing, empowering and incorporating IK in participatory rural development projects has been considered a means of ensuring socially, environmentally and economically sustainable natural resource management (Dixon, 2002). Traditional medicine comprises therapeutic practices that have been in existence, for hundreds of years, before the development and spread of modern medicine and are in use today (Moa Megersa *et al.*, 2013). Traditional medicine is used throughout the world as it is dependent on locally available plants, which are easily accessible, and capitalizes on traditional wisdom (Tsfaye Awas and Sebsebe Demissew, 2009). Several populations in Ethiopia use traditional medicine for their healthcare. Hence, using traditional medicinal plants is familiar and forms the backbone of traditional medicine (Gidey Yirga, 2010; Habtamu Agisho *et al.*, 2014). On the other hand, documentation of medicinal plants has been started only very in recent times and it is inadequate. There is also very little effort

that has been made to document medicinal plant uses and any associated information (Gemedo Dalle *et al.*, 2005).

It is estimated that about 70-80% of people worldwide rely essentially on traditional medicine to meet their primary healthcare needs (Hamilton, 2004). To date, growth and development of modern healthcare in Ethiopia has been very small and its coverage is less than 50% of the population (Yayesh Limenih *et al.*, 2015). The majority of the rural populations, therefore, still depend on traditional medicine (Abiyu Enyew *et al.*, 2014), and the knowledge of traditional medicine has been passed by word of mouth orally from one generation to others (Habtamu Agisho *et al.*, 2014).

#### **2.2.4. Biodiversity conservation and sustainable use of medicinal plant**

Biodiversity conservation is the protection, restoration and sustainable management of wildlife and natural resources such as forests and water and the biological diversity within it (Schmitt *et al.*, 2009). Biodiversity is crucial for survival, health and well-being of humans. It gives greater resilience to ecosystems, and organisms (Mekonnen Amberber *et al.*, 2013). People of different countries are dependent on biodiversity and biodiversity products for their subsistence livelihoods. However, there has been a rapid decline due to habitat destruction, overharvesting, and pollution (Feyera Senbeta, 2000). Strategies to overcome such losses should be very important in the larger policy framework of development (Feyera Senbeta, 2006). A challenge for the conservationist is to identify features of local societies favourable towards conservation and then, where needed, find ways to encourage them (Leaman, 2011). Through the conservation of biodiversity not only the survival of many threatened species and habitats can be ensured, but also these valuable resources will be secured for future generations (Schmitt *et al.*, 2009).

Conservation is the care or wise use and appropriate management of the natural environment and its natural resources. The traditional healthcare practice is mainly dependent on medicinal plants collected from the wild. Nevertheless, the medicinal plant is being depleted due to man-made and natural factors (IBC, 2012). In many countries including Ethiopia medicinal plants are threatened by over-harvesting, land conversion, and habitat destruction. This reality demands the development of constructive approaches for medicinal plants collection and the incorporation of integrated principles to ensure the sustainable uses (Leaman, 2005; Kasagana and Karumuri, 2011).

Promotion and revival of traditional management practices is one of such measures. These traditional practices, which are mostly based on cultural norms and religious beliefs, are the basis for the sustainable use and conservation of biodiversity (Msuya and Kideghesho, 2009). The issue of medicinal plant conservation in Ethiopia today calls for study and documentation before the accelerated ecological and cultural transformation distort the physical entities and the associated knowledge base (Fisseha Mesfin *et al.*, 2014).

#### **2.2.4.1. Role of medicinal plants in conservation**

Medicinal plants may offer exceptional opportunities for landscape scale conservation where many people depend on these resources (Leaman, 2011). The primary aim of conservation is to support sustainable development by protecting and using biological resources in ways that do not diminish the world's variety of genes and species or destroy important habitats and ecosystems. It involves activities such as collection, propagation, characterization, evaluation, storage, and distribution. The conservation of plant genetic resources has long been realized as an integral part of biodiversity conservation (Kasagana and Karumuri, 2011).

The special significance of medicinal plants in conservation stems from the major cultural, livelihood or economic roles that they play in the lives of many communities's. Different sets of recommendations have been compiled relating to the conservation of medicinal plants (Leaman, 2011). They include: the need for coordinated conservation action, based on both *in situ* and *ex situ* strategies; inclusion of community and gender perspectives in the development of policies and programmes; the need for more information on the medicinal plant trade; the establishment of systems for inventorying and monitoring the status of medicinal plants; the development of sustainable harvesting practices; encouragement for microenterprise development by indigenous and rural communities; and the protection of traditional resource and intellectual property rights (Hamilton, 2004).

#### **2.2.4.2. Threats and conservation approaches of medicinal plants**

Conservation in the ‘real world’ (outside the confines of strict nature reserves or *ex-situ* collections) is a multi-disciplinary challenge. Every place has its own peculiarities, as do all practical efforts aimed at conservation (Leaman, 2011). Hence, it can be difficult to know why any particular conservation effort has succeeded or failed. From the perspective of scientific methodology, the problem of determining best practice in conservation has a parallel with medicine, which also is a real world, multidisciplinary; challenge (Feyera Senbeta, 2006).

Conserving the areas where populations of species exist naturally is an underlying condition for the conservation of biodiversity. That is why protected areas form a central element of any national strategy to conserve biodiversity. *In-situ* conservation is considered the most appropriate way of conserving biodiversity (Tamene Yohannes *et al.*, 2011). As indicated by Feyera Senbeta (2006), *ex-situ* conservation can never take over the function of *in-situ* conservation as a means of storing the world’s genetic diversity of crop plants or their wild relatives with potential use and vice versa.

In practice, no single conservation technique can effectively conserve the full range of genetic diversity of target species, but the two strategies can be complementary. It has been suggested that an alternative to the two conservation options is the sustainable use of biodiversity, which is hoped may provide balanced utilization and conservation of biodiversity (Feyera Senbeta, 2006). The practices are additional conservation strategies that can complement the contemporary conservation strategies in ensuring conservation and sustainable utilization of natural resources. The reality that the people have regular interactions and are familiar with resources in their environment compared to other potential actors makes them the best managers of these resources (Msuya and Kideghesho, 2009).

### **2.2.5. Ethnobotany of wild edible plants**

Different authors have defined wild plants differently but the concept is more or less similar. For instance, Anywar *et al.* (2014) defined wild plants as those plants that grow spontaneously in self maintaining populations in natural or semi-natural ecosystems and can exist independently of direct human action. These wild plant species have been used for various uses such as: sources of food, medicine, firewood cultural artifacts, trade, and sources of different household. Wild plants continue to play a central role in the livelihood of large proportion of the world's population (Dereje Denu and Desalegn Desissa, 2013). Tigist Wondimu *et al.* (2006) stated that many people in different parts of the globe feed on various types of food with 90% of it being derived from plant materials with high nutritional value. Various sources shown that, globally a considerable number of wild food plants are either neglected or underutilized (Anywar *et al.*, 2014).

Wild food plants are usually incorporated into the normal livelihood strategies for a number of rural communities. Hence, they are typically considered as additional diet for rural communities (Annabe *et al.*, 2013). Wild plants are known to have formed an important part of our ancestors' diet e.g. as vegetables, fruits, spices or beverages (Dénés *et al.*, 2012). Millions of people in many developing countries still cannot meet their daily food requirements due to scarcity of food. This aggravated even further by deficiencies in one or more micronutrients (Uprety *et al.*, 2012; Abbasi *et al.*, 2013). As a result, in most cases rural communities depend on wild resources including wild edible plants to meet their food needs in periods of food crisis (Kebu Balemie and Fassil Kebebew, 2006).

The importance of wild plants in the rural population's diet is widely recognized in the tropics and subtropics areas (Gueye *et al.*, 2014). Tilahun Teklehaymanot and Mirutse Giday (2010) indicated that utilization of wild edible plants as a food source and consume wild edible plants as snacks and at times of food scarcity (Ju *et al.*, 2013). Wild edible plants (WEPs) refer to species that are harvested or collected from their wild natural habitats and used as food for human consumption. They can also be defined as species that are neither cultivated nor domesticated, but are available from their wild natural habitat and used as sources of food (Ermias Lulekal *et al.*, 2011).

Wild edible plants (WEPs) provide staple food for indigenous people, serve as supplementary food for non-indigenous people and are one of the primary sources of cash income for poor communities (Ju *et al.*, 2013). It plays an important role ensuring food security and improves the nutrition in the diets of many people in developing countries (Ermias Lulekal *et al.*, 2011). They are also considered as potential sources of species for domestication and provide valuable genetic traits for developing new crops through breeding and selection. Since the loss of traditional knowledge has been recognized as one of the main factor that has negative effects on the conservation of biological diversity and WEPs, documenting traditional knowledge of WEPs is essential to preserve genetic and cultural diversity. A few studies have been conducted in some parts of Ethiopia which have shown the presence of WEPs and their importance to local people (IBC, 2012).

#### **2.2.5.1. Indigenous knowledge with respect to wild edible plants**

Scholars and development agencies are only beginning to acknowledge their importance and their enduring role as the mainstay of local food production and health care in the developing world cannot be questioned (Nakashima and Roue', 2002). Indigenous communities, from their own experience recognize the role, importance and contribution of wild edible plants (WEPs) to their daily diet, and their significance related to health and environmental hazards (Direess Tsegaye *et al.*, 2007). Indigenous communities are endowed with knowledge of seasonal availability of WEPs with fruits and implications to climate change adaptations. Their seasonal availability and contribution to climate change adaptation has been poorly documented in Ethiopia (Debela Hunde *et al.*, 2011). Wild edible plants are freely available within natural habitats and indigenous people have good knowledge and skills of how to gather and prepare these foods. Such valuable knowledge is more frequently held by elders than youngsters but is rarely recorded and documented. Hence, the death of knowledgeable elders means the loss of indigenous knowledge if it is not transferred to the next generation (Ermias Lulekal *et al.*, 2011).

## CHAPTER THREE

### 3. MATERIALS AND METHODS

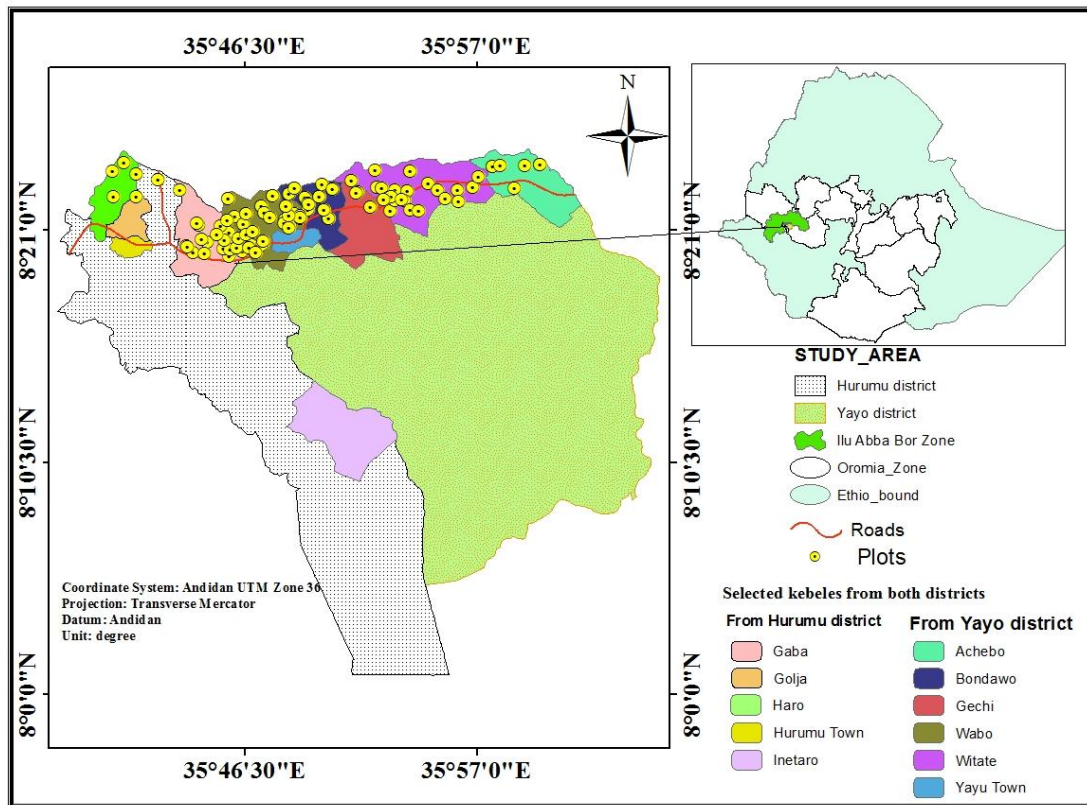
#### 3.1. Description of the study area

##### 3.1.1. Geographic location

The study was conducted at Yayo and Hurumu districts in Ilu Abba Bor Zone of Oromia National Regional State (Figure 1), at about 564 Kms and 582 Kms southwest of Addis Ababa, the capital of Ethiopia respectively. Yayo district is one of the few areas in the country that is endowed with a variety of plant species including endemic ones and it is located between 08°21' and 08°26' N, and 35°45' and 36°03' E (Tadesse Woldemariam, 2003). Hurumu district is, on the other hand, is located between 1400 m to 2580 m above sea level, and between 8°2'42" N and 8°31'17" N between 35°05'18" E and 35°07'12" E (HDANRMO, 2009).

Yayo and Hurumu districts are characterized by a rolling topography with flat areas, river valley slopes, waterlogged valley bottoms which is highly dissected by small streams and two major rivers, Geba and Dogi. The landform changes frequently from flat surfaces on the top of plateaux to very steep slopes and valley bottoms within short distances. It is in the two districts where forest coffee is registered by United Nations, Scientific and Cultural Organization (UNESCO) as one of the country's heritage (Tadesse Woldemariam *et al.*, 2008).

Yayo district is bordered by Dorani and Alge districts in the North, Chora district in the East, Hurumu district in the West and Sigo-seta district (Jimma zone) in the South. It includes eighteen (18) administrative *Kebeles* including an addition *Kebele* of Yayo town. Coffee is an important cash crop in the area with over 50 km<sup>2</sup> plantation (YDRADO, 2008). Hurumu district is found along the main road which leading to Mettu and Gambela towns. This district is bordered by Bilo-Nopha district in the North, Yayo district in the East, Mettu district in the West and Bacho district in the South direction. Hurumu has 14 *Kebeles* peasant associations including one town administration called Hurumu town.



**Figure 1.** Map of Ethiopia showing the study area and sample sites

### 3.1.2. Population and settlement patterns

The total population of Yayo district is 61,439, comprising 31,936 males and 29,503 females while the total numbers of households in the district is 10,870 comprising 9,463 males and 1,407 females. The Oromo are the major ethnic group (85%) followed by followed by the Amhara (8%), Tigrayan (4%) and others (3%). Hurumu district administration official report indicated that the local communities of Hurumu district composed of Oromoo ethnic group (the highest proportion) (90%) followed by Ahmara (6%), Tigrigna, and Guragna 4%. On livelihood, the majority of the population in both Yayo and Hurumu districts engage in agriculture which includes crop production and animal husbandry (Abiyu Zewde, 2011).

The dominant language is “*Afaan Oromoo*” (83.74%) followed by Amharic (13.32%) and Tigringa (2.39%); the remaining (0.55%) speak other languages (YDANRMO, 2009).

Almost all the member of the society in the study area believes in the existence of GOD whom they call ‘Waaqaa’ or Waqaayyoo’. Essentially they are Christians (Orthodox,

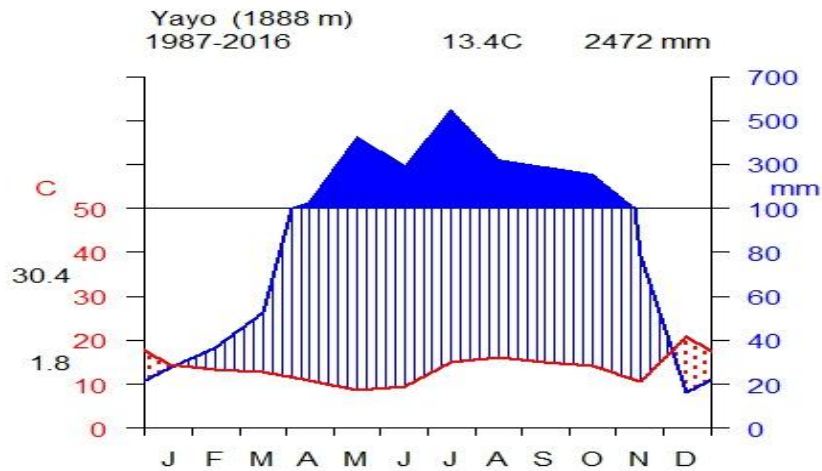
Protestant, and Catholic), Islam and Waaqefata. However, the majority are Muslims (57.21%), 31.73% are followers of Orthodox Church and 10.93% Protestants (YDRADO, 2007).

### **3.1.3. Climate, rainfall and temperature**

Yayo district is characterized by diverse climate patterns, soil and vegetation, all of which are related to the physical conditions and altitude variations in the area. And by hot and humid climatic conditions (Tadesse Woldemariam 2003). According to information from National Meteorological Services Agency of Ethiopia, the mean annual temperature of the district is about 20° C, and temperature throughout the year shows some variation with the hottest months being February to April (29° C) and the coldest July to September (12° C). The mean annual rainfall is 2100 mm year<sup>-1</sup>, with high variation from year to year, ranging from about 1400-3000 mm year<sup>-1</sup>. The annual rainfall patterns in the both districts are more or less uni-modal with variation in different seasons; a dry season between January and February and a slightly similar pattern in November and December and the rainy season follows between May and October (Tadesse Woldemariam *et al.*, 2008). Climate diagram of Yayo district is shown in the Figure 2.

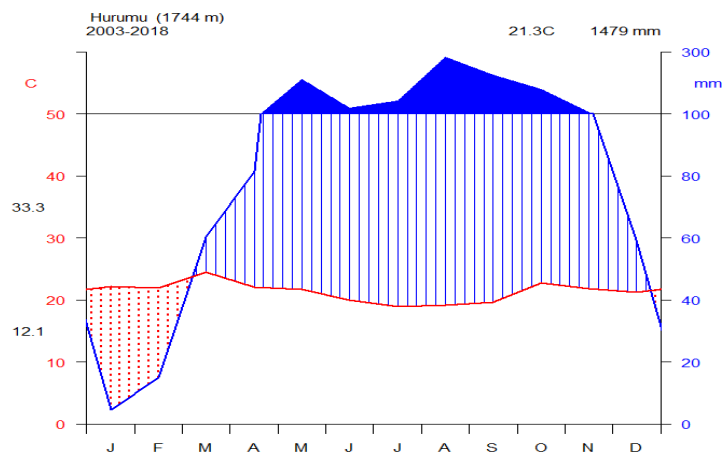
The altitudinal range of Hurumu district is between 1400 m and 2580 m above sea level. The physical conditions and variations in altitude have resulted in a great diversity of climate, soil and vegetation. The climate diagram of Hurumu district is shown in Figure 3. The district has three agro-ecological climate zones: these include 3.5% (5,750.4 hectares) highland (*Baddaa*); 85 % (138,465.85 hectares) midland (*Badda-daree*) and 11.47 % (18,684.75 hectares) lowland (*Gammoojjii*) (HDANRMO, 2009). Such diverse agroecological climatic conditions and habitats partly contributed to the occurrence of high species diversity in plants and animals (Zewdie Jotte, 2009).

According to National Meteorological Services Agency of Ethiopia, Hurumu district is also characterized by an average annual rain fall range of 1191 mm to 1960 mm and an annual average temperature of 23<sup>0</sup> C. The total area of the District is 48,615.14 hectare (486.15 km<sup>2</sup>) of which 86% is midland (*Badda-daree*) type of agroecological climate zone, 9% lowland (*Gammoojjii*) type and the remaining 5% highland (*Baddaa*) type (HDANRMO, 2009).



**Figure 2.** Climate diagram of Yayo district

Source: National Meteorological Services Agency of Ethiopia



**Figure 3.** Climate diagram of Hurumu district

Source: National Meteorological Services Agency of Ethiopia

### 3.1.4. Geology and Soil

The geology and soil types of both Yayo and Hurumu districts are similar. Both districts are characterized by Precambrian Metamorphic rocks consisting of biotite and hornblende gneisses granulate migmatite with minor meta-sedimentary gneisses along the river valleys and by flood basalts overlying the crystalline basements on the plateaus in between the river valleys (Andnet Deresse, 2010; Abiyu Zewde, 2011). The soil types in

Yayo and Hurumu districts are described as red or brownish ferrisols derived from volcanic parent material (Tadesse Woldemariam, 2003). The prevalence of high rainfall has masked other soil forming-factors and hence, very similar soils have developed on a variety of parent materials. The major soil groups in both districts include nitosols, acrisols, vertisols, and cambisols (HDANRMO, 2009; YDANRMO, 2009).

### 3.1.5. Vegetation

Southwest Ethiopia including Yayo and Hurumu districts is well known for their natural resources. The forest in Yayo and Hurumu districts are categorized as Moist evergreen Afromontane rainforest (MAF) with high plant species diversity and an abundance of coffee trees under the forest canopy (Tadesse Woldemariam, 2003). The availability of abundant wild coffee populations makes it a keystone forest ecosystem for the conservation of the genetic resources of coffee in the country (Teklu Tesfaye and Thomas, 2004). Moreover, high diversity of *Coffea arabica* and other plant species makes the forest one of the most important forest areas for the conservation of biodiversity in Ethiopia (HDANRMO, 2009; YDANRMO, 2009). The Yayo and Hurumu districts are characterized by high forest cover with a variety of vegetations, soil types and wild animals (Tadesse Woldemariam, 2008; Zewdie Jotte, 2009).

Yayo and Hurumu districts are primarily known for their vast natural forests that form the major part of “Yayu National Forest Priority Area (NFPA)”. The forest ecosystem is endowed with a variety of plant species (Zewdie Jotte, 2009). Some common plant species that are found in the study area include: *Albizia grandibracteata*, *Antiaris toxicaria*, *Blighia unijugata*, *Bridelia micrantha*, *Celtis africana*, *Cordia africana*, *Diospyros abyssinica*, *Ficus exasperata*, *Ficus lutea*, *Ficus sur*, *Ficus thonningii*, *Millettia ferruginea*, *Mimusops kummel*, *Morus mesosygia*, *Olea capensis* subsp. *welwitschi*, *Sapium ellipticum*, *Trichilia dregeana* and *Trilepisium madagascariense*. The major small trees and shrubs making up the middle strata are *Dracaena steudneri*, *Ehretia cymosa*, *Maesa lanceolata*, *Maytenus gracilipes*, *Pittosporum viridiflorum*, *Ritchiea albersii* and *Vepris dainelli* (Tadesse Woldemariam *et al.*, 2001).

### 3.1.6. Fauna

In addition to floral diversity, both Yayo and Hurumu districts are also rich in wildlife. Some of the wild animals include: *Anubus baboon* (Jaldeessaa), *Colobus guereza* (Black-and White Colobus monkeys), *Colobus monkey* (Weennii), *Vervet monkey* (Qalamee), *Porcupine* sp. (Xaddee), Fox (Waango), *Crocota crocuta* (Waraabessa), *Bush buck* (Bosonuu), *Salvycapra* spp. (Quruphee), *Birazas monkey* (Chanoo), *Felis serval* (Iyyaa), Ant-eater (Awaal-diigessa), *Panther pardus* (Qeeransa) and Bat (Simbirroo-halkanii). Seen but rarely, are small numbers of big wild animals such as *Panther lio* (Leenca), *Syncerus caffer* (Gafarsa), *Potamochoerus porcus* (Booyyee), and *Phacochoerus ethiopicus* (Karkarro) also exist around the river area and in the dense forest of core zone. Some of the wild animals such as *Anubus baboon* (Jaldeessaa), *Vervet monkey* (Qalamee), *Bush pig* (Booyyee) and *Phacochoerus ethiopicus* (Karkarro) share a substantial amount of food crops with the local communities. There are over 50 species of mammals, 30 species of birds, and 20 species of amphibian within the forests of Yayo and Hurumu districts (HDANRMO, 2009; YDANRMO, 2009).

### 3.1.7. Socio-economic status and land use pattern of Yayo and Hurumu districts

The most important source of livelihood for local communities is agriculture in which various crop types are cultivated. Majority of local communities earn their livelihood from crop production, and livestock rearing. The agricultural practices in the two districts essentially are smallholder subsistence farming. For more than 60% of the population, coffee production, processing and marketing are the major sources of employment. The agricultural production is based on rain fed cultivation and some on irrigation. Some of cultivated crops grown by farmers are listed in Table 1.

The area is well known for producing crops like maize (*Zea mays*), Sorghum (*Sorghum bicolor*), Teff (*Eragrostis tef*), Bean (*Phaseolus vulgaris*) and few other cereal plants. Coffee (*Coffea arabica*) and Khat (*Catha edulis*) play a very important role in the economics of the local communities. They also rear animals' such as cattle, sheep, goats, poultry, and also engage in beekeeping (HDANRMO, 2009; YDANRMO, 2009; Abiyu Zewde, 2003).

**Table 1.** Some crops grown in the study area

Scientific name	Local name ( <i>Afaan Oromoo</i> )	Crop category
<i>Eragrostis tef</i> (Zucc.)	Xaafii	Cereals
<i>Zea mays</i> L.	Boqqolloo	
<i>Eleusine coracana</i> (L.) Gaertn.	Daagujjaa	
<i>Sorghum bicolor</i> L.	Bisingaa/Boobee	
<i>Hordeum vulgare</i> L.	Garbuu	
<i>Triticum aestivum</i> L.	Qamadii	
<i>Carica papaya</i> L.	Paapayya	Fruits
<i>Citrus sinensis</i> (L.) Osb.	Burtukaana	
<i>Citrus limon</i> L.	Loomii	
<i>Mangifera indica</i> L.	Maangoo	
<i>Musa paradisiaca</i> L.	Muuzii	
<i>Prunus persica</i> L.	Kookii	
<i>Psidium guajava</i> L.	Zayituunaa	Cash crops
<i>Coffea arabica</i> L.	Buna	
<i>Catha edulis</i> (Vahl) Forssk.ex Endl.	Caatii/Jimaa	
<i>Nicotiana tabacum</i> L.	Tambo	
<i>Saccharum officinarum</i> L.	Shonkoraa	
<i>Phaseolus vulgaris</i> L.	Adengware	Pulses
<i>Pisum sativum</i> L.	Atara	
<i>Vicia faba</i> L.	Baaqelaa	Oil crops
<i>Guizoa abyssinica</i> (L.f.)	Nuugii	
<i>Helianthus annuus</i> L.	Suufii	
<i>Linum usitatissimum</i> L.	Talbaa	Root and tuber crops
<i>Coccinia abyssinica</i> (Lam.) Cogn.	Ancootee	
<i>Ipomoea batatas</i> (L) Lam.	Dammee/Shukkaaree	
<i>Colocasia esculenta</i> (L.) Schott	Goodarree	Vegetables
<i>Allium cepa</i> L.	Qullubbii diimaa	
<i>Allium sativum</i> L.	Qullubbii adii	
<i>Brassica oleracea</i> L.	Raafuu	
<i>Capsicum frutescens</i> L.	Barbarree	
<i>Cucurbita pepo</i> L.	Buqqee nyaataa	
<i>Lycopersicon esculentum</i> Mill.	Timatimii	
<i>Rhamnus prinoides</i> L'Herit	Geeshoo	

## **3.2. Research methods**

### **3.2.1. Reconnaissance survey**

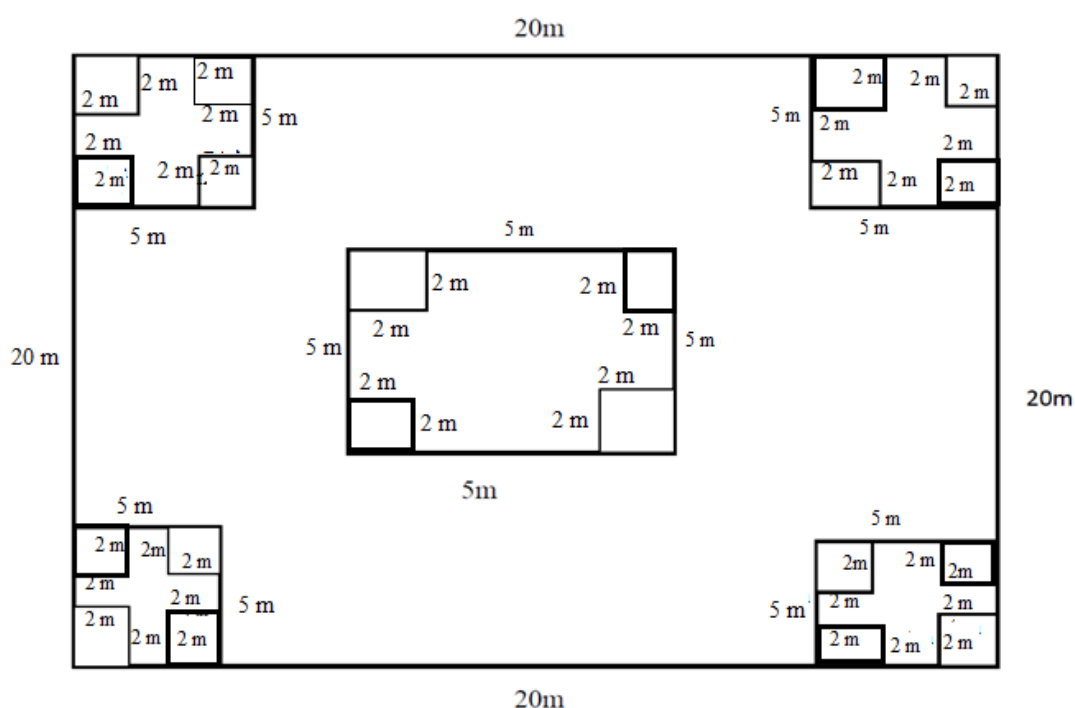
A reconnaissance survey was made in August, 2015, which involved a preliminary field visit of the study area. This was important to design possible approaches to the study which would have includes the possibility of designing different sampling methods, to select the representatives of the study area for data collection, to determine data collection tools, steps and procedures. Depending on the reconnaissance survey various forms of data collection techniques that involve both quantitative and qualitative approaches were used.

### **3.2.2. Vegetation data collection**

A systematic sampling design was adopted and used to collect vegetation and environmental data following Kent and Coker (1992). Transects were systematically laid at a distance of 500 meters apart (the distance between two parallel line transects). The first line transect was established randomly in the forest. Along this transect a 400 m<sup>2</sup> (20 x 20 m) quadrat was laid down with subsequent ones being established along an altitudinal gradient. Nested quadrats were used to sample plants of different sizes and other important environmental variables. Within each 400 m<sup>2</sup> (20 x 20 m) quadrat; subplots of 25 m<sup>2</sup> (5 x 5m) and 4m<sup>2</sup> (2 x 2m) were placed to record shrub and herbaceous plant species respectively following Kent and Coker (1992), as indicated in Figure 4.

Geographical data together with altitude, latitude and longitude were recorded using Global Positioning System (GPS) for each quadrat. In each quadrat woody plant species with a diameter at breast height (DBH) > 2.5 cm were measured using a diameter tape, those with a height > 2 m were measured using a meter tape and those with a height < 2 m and DBH < 2.5 cm were recorded as seedlings and saplings. During field data collection, photos and specimens of all plants encountered were taken when and where necessary. Geographical data including altitude, latitude and longitude were recorded using a Global Positioning System (GPS). Information on plant characteristics e.g. Growth habit etc. was also recorded plant specimens collected were processed for storage in the herbarium following standard methods mainly focusing on the fertile parts of individuals.

They were numbered, pressed, dried and taken to the National Herbarium (ETH) in Addis Ababa University for identification. Identification was done using the keys found in Flora of Ethiopia and Eritrea Volume one to Volume eight (Hedberg and Edwards, 1989; Phillips, 1995; Edwards *et al.*, 1995; 1997 and 2000; Hedberg *et al.*, 2003 and 2006; and Mesfin Tadesse, 2004), by comparing the collected specimens with the already identified specimens found in the in National Herbarium (ETH) of Ethiopia in Addis Ababa University, and consulting experts. The identified voucher specimens with their associated botanical and ethnobotanical information were then mounted, labeled, and deposited in the National Herbarium (ETH) at Addis Ababa University.



**Figure 4.** The designed for lay out of the study

### 3.2.3. Selection of *Kebeles* in the study area

In Yayo district out of eighteen (18) *Kebeles*, seven (7) of them were selected. Out of fourteen (14) *Kebeles*, five (5) of the *Kebeles* were purposively selected from Hurumu district by the help of each *Kebele* managers and agriculture expert. The *Kebeles* selection was on the basis of medicinal plants accessibility, and well-known traditional healers are living and distance from the health center.

### 3.2.4. Informant selection and Sample size determination

An important part of any research effort is determining the sampling and sample size. Accordingly, the sample size determination was done following Bartlett *et al.* (2001). The below formula was used to determine sample size as it was considered a better representative informant for collecting quantitative data for medicinal and wild edible plants of Yayo and Hurumu districts. Thus, considerable numbers of general informants which randomly selected and key informants purposefully selected were used from seven (7) *Kebeles* from Yayo district and five (5) *Kebeles* from Hurumu district (Table 2). The *Kebeles* selections were based on the above mentioned criteria such as *Kebeles*'s managers recommendation and personal observation.

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

n = sample size; N= the population size, in this case total number of households in the particular selected *Kebeles*.

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

1 = the probability of the event occurring

**Table 2.** Sample size for general and key informants for the ethnobotanical data collection in the study area

No	Districts	Number of households									Total
		M	F	Total no of households	Sample size						
					General informants			key informants			
					M	F	Total	M	F	Total	
	Hurumu	8242	1449	10005	125	41	166	15	9	24	190
	Yayo	9463	1407	10870	141	37	178	17	11	28	206
<b>Total</b>		17705	2856	20875	266	78	344	32	20	52	396
<b>Total sample size</b>					344+52= <b>396</b>						

### **3.2.5. Ethical considerations**

It is understandable that in a number of studies including ethnobotanical of medicinal and wild edible plants, it would be carried out with permission, ethically, and diplomatically. Obtaining the appropriate permission from all concerning bodies are important to perform entire research with conducive environment and in order to reduce risk. In the present study, prior permission was obtained from the Oromia Forest and Wildlife Enterprise, and the letter subsequently sent to the Ilu Abba Bor zone Forest and Wildlife Enterprise. Approval was also obtained from each local participant after explaining the objectives, procedures, outcomes and benefits of the study. Moreover, their privacy during data collection and confidentiality of the information or secrets they divulged was also observed.

### **3.2.6. Ethnobotanical data collection**

#### **3.2.6.1. Interviewing**

In ethnobotany data collection, interviews involve interviewing a selected group of individuals who are likely to provide needed information, ideas, and approach on a particular issue. Such key informants are selected because they possess profound knowledge or information or ideas that a researcher could be looking. In our study, interviews were made following (Alexiades, 1996; Harrell and Bradley, 2009) to explore deeply into medicinal and wild edible plants. Discussions with randomly selected general informants, purposefully pre-identified key informants, and elders were made to know the knowledge of the local communities on the traditional medicinal and wild edible plants. During interview and discussion, the vernacular names of plants, diseases treated, parts used, conditions of usage, method of preparation, and application, and how dosage can be determined was asked and documented. Information on conservation status, threats, management practices, habit marketability of the medicinal plants and WEPs were also recorded. In this regard, a total of 396 informants (206 from Yayo district and 190 Hurumu district) were selected. Out of 396 informants, 52 of which were key informants (28 from Yayo and 24 Hurumu district).

### **3.2.6.2. Direct observation and participant observation**

The ethnobotanists accompanies the people with whom he or she is working, often directly participating during such tasks as gathering of fruits or forest products, hunting, farming, or collecting and using medicinal plants (Alexiades, 1996). In this study, a number of activities such recording observations, asking questions about the uses of medicinal plants and wild edible plants and collecting voucher specimens were done with the help of local assistants (Appendex 1). At the same time, discussions and interviews were made with traditional healers and elders about traditional medicinal and wild edible plants with respect to the conservation status, growth habit, habitat and other related information that found in each *kebele* of the study area.

### **3.2.6.3. Focus group and individual discussions**

In focus group discussions (FGD), traditional healers recommended by local communities, *Kebele* managers, and research assistants were chosen depending on their knowledge of medicinal plants and experience on the use of medicinal plants following (Martin, 1995; Cotton, 1996). In this regard, at least one FGD was made with both general and key informants depending on the interest and willingness of the informants. The focus group discussions comprising five to seven individuals together with the local community elders, religious leaders in each *Kebele*. More, audio cassette recorders were also conducted following (Alexiades, 1996) for recording local plant names, other important information with respect to medicinal and wild edible plants which parts used, how prepared and used during interviews. This is done because of taping is faster and more accurate than note taking.

### **3.2.6.4. Market survey**

Markets are often rich sources of ethnobotanical information and the survey was conducted following (Alexiades, 1996). In this study, the market survey was done in an organized manner with the help of data collection format that already prepared, combined in order to record information by means of interview and observation in the open markets found in the Yayo and Hurumu districts. Hence, the market survey was carried out at four open markets purposefully selected as information taken from the research assistants and elders where accessible. Accordingly, two market were surveyed from Yayo District

namely Wixate and Yayo town, and Hurumu town and Gaba from Hurumu district. During this task, different data including the use of medicinal plants, parts used, condition of usage, income generation, their prices and information on the availability of wild edible plants and the products of the plants were observed and recorded.

### **3.2.6.5. Secondary data sources**

Secondary data sources are datasets that are previously recorded and found in various institutions. In this study, secondary data including population data were recorded and used from different data sources such as Yayo and Hurumu District Rural and Agricultural Development Offices, research institutions, health centers of the districts, cultural centers, and administrative office of each district, libraries, published articles, books, and magazines. Besides, 29 years climate data for Yayo and 15 years of data for Hurumu districts were obtained from the National Meteorological Services Agency of Ethiopia.

## **3.3. Data Analysis**

### **3.3.1. Plant diversity analysis**

The Shannon-Wiener diversity index ( $H'$ ) which is commonly used vegetation diversity indices was used in this data analysis. Accordingly, Shannon-Wiener diversity index, species richness and Shannon's evenness were computed to describe species diversity of the plant community types in the vegetation of the study area. The data collected was grouped into clusters with the help of R (Zerihun Woldu, 2012). The value of percent cover-abundance was estimated visually for each species within the quadrats and recorded. This was later converted to the Braun-Blanquet 1-9 scale as modified by van der Maarel (1979) as follows:

- 1: Rare, generally one individual
- 2: Occasional, with less than 5% cover of the total
- 3: Abundant, with less than 5% cover of the total
- 4: Very abundant, with less than 5% cover of the total
- 5: 5-12% cover values of the total area
- 6: 12-25% cover values of the total area

7: 25-50% cover of the total area

8: 50-75% cover of the total area

9: 75-100% cover of the total plot area

Thus, the plant diversity was evaluated using the Shannon-Wiener Diversity Index (H') by using the following formula.

$$H' = - \sum_{i=1}^s p_i(\ln(p_i)) \text{ Whereby,}$$

H' = Shannon diversity index

S = the number of species;

P<sub>i</sub> = the proportion of individuals or the abundance of the i<sup>th</sup> species expressed as a proportion of the total cover in the sample;

ln = natural logarithm to base n (log<sub>n</sub>)

Shannon's evenness index (J) or equitability was calculated by applying the formula:

$$J = \frac{H}{H_{max}} \text{ Whereby,}$$

J = the species evenness

H' = Shannon-Wiener Diversity Index

H<sub>max</sub> = Maximum Diversity Index of species in the sample (Kent and Coker, 1992).

### 3.3.1.1. Similarity coefficient

Similarity coefficients measure the degree to which the species compositions of quadrats or samples are alike. The similarity of this study forests with respect to species composition or floristic similarity between study sites of the community types was computed. In this study, such similarity coefficient was done by the help of Sørensen's coefficients formula as follows (Kent and Coker, 1992):

$$S_s = \frac{2a}{(2a + b + c)} \text{ where,}$$

S<sub>s</sub> = Sørensen's similarity coefficient

a = Number of species common to both study areas

b= Number of species in study area 1; or in forest 1

c= Number of species in study area 2; or in forest 2

Indicator Species Analysis (ISA) was also done to determine indicator species using Rsoftware (Zerihun Woldu, 2012). A species is considered to be an indicator species of a group when its indicator value is significantly high at  $P < 0.05$ . In this study, the identified clusters were designated as plant community types and given names after two or three dominant or characteristic species (Dufrene and Legendrecited in Tadesse Woldemariam, 2003).

### 3.3.1.2. Analysis of the vegetation structure

To determine vegetation structure, parameters such as density which is a count of the number of individuals of a species within a quadrat or the number of plants of a given species per unit area, frequency, height, DBH, and IVI were considered. The importance value index (IVI) is an important tool for forest inventory and normally calculated to describe the ecological importance of given species (Lamprecht, 1989). According to Kent and Coker (1992), it is useful to compare the ecological significance of species and for setting conservation priorities. It is calculated using parameters such as relative density, relative dominance, and relative frequency, as a sum of all of them (Mueller-Dombois and Ellenberg, 1974) as follows:

**IVI = Relative Density (RD) + Relative Dominance (RDO) + Relative Frequency (RF)**

$$RD = \left[ \frac{\text{the number of individuals of a species}}{\text{the total number of all individuals}} \right] (\text{DBH} \geq 2.5\text{cm}) * 100$$

Where 'RD' stands for relative density of a species

$$RF = \left[ \frac{\text{the frequency of a species}}{\text{the total frequency of all species}} \right] * 100$$

Where 'RF' stands for relative frequency

$$RDO = \left[ \frac{\text{the dominance of a species}}{\text{the dominance of all species}} \right] * (\text{DBH} \geq 2.5\text{cm}) * 100$$

Where 'RDO' stands for relative dominance;

The other measure used was the basal area which, for trees and shrubs, is expressed in square meter per hectare (m<sup>2</sup> per hectare) (Mueller-Dombois and Ellenberg, 1974) and can also be used to measure the dominance of a species. In this study, the basal area was computed for woody trees and shrub species with a DBH greater than or equal to 2.5 cm. The following formula was used to calculate it:  $BA = \pi (DBH / 2)^2$ , where BA = basal area,  $\pi = 3.14$ , DBH = diameter at breast height (m).

### **3.3.2. Ethnobotanical data analysis**

Quantitative methods and species use values enable comparisons of use to be made between different vegetation types or ecological zones, between people of different ages, gender or occupation within or between communities (Tesfaye Awas and Sebsebe Demissew, 2009). Quantification helps to generate quality information, which in turn contributes substantially to resource conservation and development. The ethnobotanical data was summarized and entered in an Excel spreadsheet (Microsoft Corporation, 2007). Then the information gathered on medicinal plants regarding their uses, routes of application, methods of preparation, diseases treated and dosage were considered. And also parts used, growth habit, and habitat medicinal and wild edible plants were expressed in form of percentage, frequency, average, table, bar chart, and pie chart.

#### **3.3.2.1. Informant Consensus Factor (ICF)**

The Informant Consensus Factors (ICF) was used to compute the degree of agreement in the informants' knowledge about the different human and livestock ailments. Informant consensus use values reflect the importance of each use or species to each informant (Heinrich *et al.*, 1998), and it was calculated using the below formula.

$$ICF = \frac{n_{ur} - n_t}{n_{ur} - 1}$$

Where ICF stands for Informant Consensus Factor,

$n_{ur}$  is number of use citations in each group, and

$n_t$  is the number of species used by all informants for a particular illness.

### 3.3.2.2. Fidelity Level (FL)

Fidelity level (FL) is designed to quantify the importance of a species for a given purpose (Phillips, 1996). In this study it was employed to determine the most important plant species used for treating certain ailments by local traditional healers in the study area. The Fidelity Level (FL) or the percentage Fidelity of medicinal plants in the study area was computed based on the following formula:

$$FL\% = (I_p/I_u)*100\%$$

Where:

FL = Fidelity Level,

$I_p$  is the number of informants who suggested the use of a species for the same major purpose

$I_u$  is the total number of informants who mentioned the plant for any use

### 3.3.2.3. The preference ranking and direct matrix ranking

The preference ranking and direct matrix ranking methods were employed following Martin (1995), Alexiades (1996) and Cotton (1996), based on the scores given by chosen key informants of preferred medicinal and wild edible plants for the purpose of identifying multi-use plants and those under pressure. The preference ranking and direct matrix ranking are similar in some ways but differ in that preference ranking is based on a single dimension whereas direct matrix ranking is more complex, i.e. It is based on multiple dimensions.

### 3.3.2.4. Use values

The use-values were computed to determine the relative value of a given species that is well-known around an area following Phillips and Gentry (1993) and by using the below formula:

$$UV_{is} = \Sigma U_{is}/n_{is}$$

Where  $UV_{is}$  stands for the use value (UV) of a species  $s$  for informant  $i$ ;

$U_{is}$  is the number of uses mentioned by informant  $i$ ; and

$n_{is}$  is the number of events for species  $s$  with informant  $i$

The use categories employed included:

- i. **Medicine:** both for human and animals (veterinary) medicine.
- ii. **Food:** food for humans including beverages, and food flavourings, and spices.
- iii. **Fodder:** feed for livestock and / or cattles.
- iv. **Materials:** for construction, agricultural tools, furniture, and other important equipment.
- v. **Fuel:** plants used as firewood and/or for making charcoal.
- vi. **Cultural and ritual uses:** which used during different religious ceremony
- vii. **Environmental uses:** including live fence, shade, shelter, ornamental, soil erosion control/ protection, and soil fertility improvement.

**Poison:** toxic for human, livestock and other animals, insecticide and insect repellent.

Use Diversity values - Use Diversity (UD) values of species were also computed to estimate how many use categories a plant species can be placed and how evenly these categories contribute to its total value.

$$UD_s = -\sum P_c * \ln(P_c)$$

Where:  $UD_s$  = use diversity value of species  $s$ ; and

$P_c$  = the contribution of family  $C$  to total utility of a species  $s$  (i.e. the number of times species  $s$  was mentioned by all participants within each category, divided by the total number of use reports of species  $s$  across all use categories). If a species is used in many use categories and its uses are evenly distributed over these categories, then it will have a high use diversity value.

## **CHAPTER FOUR**

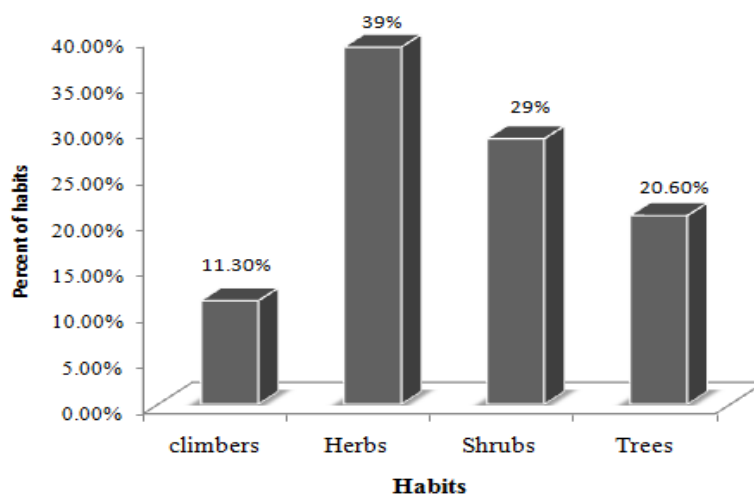
### **4. RESULTS**

#### **4.1. Floristic composition and growth habit**

In this study 298 vascular plant species including 2 sub-species belonging to 235 genera, in 93 families were documented in and around Yayo and Hurumu districts as shown in Appendix 1. Out of these, a total of 184 species were obtained from quadrats sampled in the forest whereas the remaining 114 were collected and identified from homegardens, roadsides, and farmlands. Of the plants documented 3 were ferns, 3 gymnosperms, and two hundred and ninety two (292) were angiosperms.

Among the different plant families, Asteraceae was relatively, the most dominant and most species rich family represented by 27 (9 %) species followed by Fabaceae that contributed 24 (8.1%) species. Lamiaceae and Solanaceae were the third most rich families represented by 16 (5.37 %) species each, followed by Euphorbiaceae and Poaceae with 12 (4%) and 11 (3.7%) species respectively. The list of families and species is shown in Appendix 2.

Other families including Moraceae represented by 9 species (3%), Acanthaceae, Amaranthaceae, Boraginaceae, Malvaceae, and Rubiaceae by 7 species each (2.35%) Celastraceae by 6 species (2%) and Cucurbitaceae, Oleaceae, Rosaceae, and Rutaceae by 5 species each (1.68%) (Appendix 3). Flacourtiaceae and Polygonaceae were represented by 4 species each (1.34%), thirteen families contributed 1% each of the total number of species documented. On the other hand, sixty one (61) families represented less than 1% of the species documented. Figure 5 shows the different growth habits of plant species documented during this study. Herbs were comparatively the most encountered growth habit and climbers the least.



**Figure 5.** Growth habits of species documented in forests in the study area

#### 4.1.1. Endemic plant species of the study area

Out of the identified vascular plant species in the study area, fourteen (5%) were endemic to Ethiopia and some are listed in the IUCN Red Data List as either vulnerable or of least concern (Vivero *et al.*, 2005; IUCN, 2010). Among the plants species recorded as endemic, the family Asteraceae was represented by three (3) species followed by Fabaceae with two (2) species. The remaining nine (9) families had a single species each. A list of endemic plants species identified during this study is shown in Table 3. Among the endemic plants, shrubs followed by herbs, climbers, and trees were the dominant growth habit. Two of the endemics were infraspecific taxa i.e. *Millettia ferruginea* subsp. *ferruginea* and *Lippia adoensis* var. *adoensis*.

**Table 3.** List of endemic plant species in Yayo and Hurumu districts showing their conservation status, growth habit and uses

	Species name	Family name	Habit	IUCN category	Uses				Remark
					M	F	Ma	O	
1.	<i>Coccinia abyssinica</i>	Cucurbitaceae	C	—	√	√	√		
2.	<i>Cynoglossum densefoliatum</i>	Boraginaceae	H	—					
3.	<i>Echinops kebericho</i>	Asteraceae	H	—	√		√		
4.	<i>Erythrina brucei</i>	Fabaceae	T	LC	√				
5.	<i>Impatiens rothii</i>	Balsaminaceae	H					√	

	Species name	Family name	Habit	IUCN category	Uses				Remark
					M	F	Ma	O	
6.	<i>Lippia adoensis</i> var. <i>adoensis</i>	Verbenaceae	S	LC	√				
7.	<i>Millettia ferruginea</i> subsp. <i>ferruginea</i>	Fabaceae	T	LC	√				
8.	<i>Phragmanthera macrosolen</i>	Loranthaceae	H	LC	√				
9.	<i>Pycnostachys abyssinica</i>	Lamiaceae	S	VU	√				
10.	<i>Solanecio gigas</i>	Asteraceae	S	LC	√				
11.	<i>Tiliacora troupinii</i>	Menispermaceae	C	VU	√				
12.	<i>Urtica simensis</i>	Urticaceae	H	—	√				
13.	<i>Vepris dainellii</i>	Rutaceae	S	LC	√				
14.	<i>Vernonia leopoldi</i>	Asteraceae	S	LC	√				New to IL

**Keys:** IL= Ilu Abba Bor, LC = Least concern, VU = Vulnerable, M = Medicinal, F = food, Ma = Marketable, O = Ornamental

#### 4.1.2. New plant records for Ilu Abba Bor (IL) floristic region of Ethiopia

Of the two hundred and ninety eight (298) plant species recorded during the study, fifty three (53) were documented as new records for Ilu Abba Bor (IL) Floristic Region (Table 4). There are distributed in 44 genera and 28 families and 24 were shrubs, 16 herbs, 7 trees, and 5 climbers.

**Table 4.** New plant species recorded for the Ilu Abba Bor Floristic Region of Ethiopia

No	Plant species name	Family name	Habit	Local name (Afaan Oromoo)
1.	<i>Allophylus abyssinicus</i>	Sapindaceae	T	Gur-sadee/Malqaqqoo
2.	<i>Brugmansia suaveolens</i>	Solanaceae	S	Hababoo
3.	<i>Cissus quadrangularis</i>	Vitaceae	C	Mar'immaan Jaartii
4.	<i>Cynoglossum densefoliatum</i>	Boraginaceae	H	Maxxannee Daalattii
5.	<i>Cyphostemma cyphopetalum</i>	Vitaceae	C	Hidda

No	Plant species name	Family name	Habit	Local name ( <i>Afaan Oromoo</i> )
6.	<i>Discopodium penninervum</i>	Solanaceae	S	Coocingaa
7.	<i>Dovyalis abyssinica</i>	Flacourtiaceae	S	Koshmoo
8.	<i>Dovyalis caffra</i>	Flacourtiaceae	S	Koshmoo
9.	<i>Echinops kebericho</i>	Asteraceae	H	Qarabichoo
10.	<i>Hypericum quartinianum</i>	Hypericaceae	S	Hindhee/ ulee foonii
11.	<i>Impatiens rothii</i>	Balsaminaceae	H	***
12.	<i>Indigofera arrecta</i>	Fabaceae	S	Heenna
13.	<i>Ipomoea purpurea</i>	Convolvulaceae	C	***
14.	<i>Leucas martinicensis</i>	Lamiaceae	H	Noobbee
15.	<i>Lippia adoensis</i> var. <i>adoensis</i>	Verbenaceae	S	Kusaayee
16.	<i>Maytenus undata</i>	Celastraceae	T	Goggee(kombolcha)
17.	<i>Medicago polymorpha</i>	Fabaceae	H	Qoricha hadhaaha
18.	<i>Myrsine africana</i>	Myrsinaceae	S	Qacamee
19.	<i>Nicotiana tabacum</i>	Solanaceae	H	Tamboo
20.	<i>Olinia rochetiana</i>	Oliniaceae	T	Soolee
21.	<i>Pellaea calomelanos</i>	Sinopteridaceae	H	***
22.	<i>Pinus patula</i>	Pinaceae	T	'Shuwashuwwee'
23.	<i>Polypogon viridis</i>	Poaceae	H	Marga biraa
24.	<i>Premna schimperii</i>	Lamiaceae	S	Urgeessa
25.	<i>Pteris catoptera</i>	Pteridaceae	H	***
26.	<i>Pterolobium stellatum</i>	Fabaceae	C	Harangamaa
27.	<i>Rhus tenuinervis</i>	Anacardiaceae	T	Xaaxessaa diimaa
28.	<i>Rhynchosia resinosa</i>	Fabaceae	H	Mannoo
29.	<i>Rubus steudneri</i>	Rosaceae	C	Goraa

No	Plant species name	Family name	Habit	Local name ( <i>Afaan Oromoo</i> )
30.	<i>Rumex nervosus</i>	Polygonaceae	S	Dhangaggoo
31.	<i>Salvia merjamie</i>	Lamiaceae	H	Qoricha Michii
32.	<i>Salvia nilotica</i>	Lamiaceae	H	Qoricha Michii, waraansaa
33.	<i>Scolopia theifolia</i>	Flacourtiaceae	T	Rigaa raabaa
34.	<i>Senna didymobotrya</i>	Fabaceae	S	Qoricha keessa fiigaa
35.	<i>Smilax aspera</i>	Smilacaceae	C	Harangamaa
36.	<i>Solanum adoëense</i>	Solanaceae	S	Hiddii waraabessaa
37.	<i>Solanum incanum</i>	Solanaceae	S	Hiddii loonii
38.	<i>Solanum linnaeanum</i>	Solanaceae	S	Hiddii xiqaa
39.	<i>Solanum marginatum</i>	Solanaceae	S	Hiddii Baddaa(Hiddii hongorcaaa)
40.	<i>Solanum nigrum</i>	Solanaceae	S	Hiddii gurracha
41.	<i>Teclea nobilis</i>	Rutaceae	S	Hadheessa Kormaa
42.	<i>Tecoma stans</i>	Bignoniaceae	S	***
43.	<i>Trifolium rueppellianum</i>	Fabaceae	H	Siddisa
44.	<i>Trifolium semipilosum</i>	Fabaceae	H	Siddisa
45.	<i>Trilepisium madagascariense</i>	Moraceae	T	Lookoo gurracha
46.	<i>Urtica simensis</i>	Urticaceae	H	Gurgubbee
47.	<i>Vangueria volkensii</i>	Rubiaceae	S	Bururi adii
48.	<i>Verbena officinalis</i>	Verbenaceae	H	Sanaafica Simbirroo
49.	<i>Vernonia leopoldi</i>	Asteraceae	S	Sooyyoma
50.	<i>Vernonia myriantha</i>	Asteraceae	S	Sooyyoma gurracha
51.	<i>Vernonia rueppellii</i>	Asteraceae	S	Reejjii
52.	<i>Vernonia urticifolia</i>	Asteraceae	S	Reejjii
53.	<i>Withania somnifera</i>	Solanaceae	S	Gizaawwaa

**Key:** H = Herbs, S = Shrubs, T = Trees, C= climbers, \*\*\* = no local name provided

### 4.1.3. Commercially useful tree species

In the natural forests of Yayo and Hurumu districts, there are nine (9) tree species that are common and considered by the local communities to be very important as they are frequently used commercially for income generation (Figure 6). These include *Cordia africana*, *Celtis africana*, *Prunus africana*, *Apodytes dimidiata*, *Albizia gummifera*, *Albizia grandibracteata*, *Croton macrostachyus*, *Ekebergia capensis*, *Olea welweitschii*, and *Syzygium guineense*.



**Figure 6.** Selective cutting of *Cordia africana* for timber production from Yayo district

(Photograph taken by the researcher in August, 2016)

Besides income-generation, some of the plants around homegardens and farmlands such as *Albizia grandibracteata* and *Celtis africana* are very important as shade trees for a number of crops mainly for coffee plantations, for traditional remedies, ornamentation, rituals and other ecological uses.

### 4.1.4. Plant community types

Six plant community types (clusters) were identified from the hierarchical cluster analyses (Figure 7). Sampling quadrats that were close together were found to be similar in species composition and consequently were placed in the same community type.

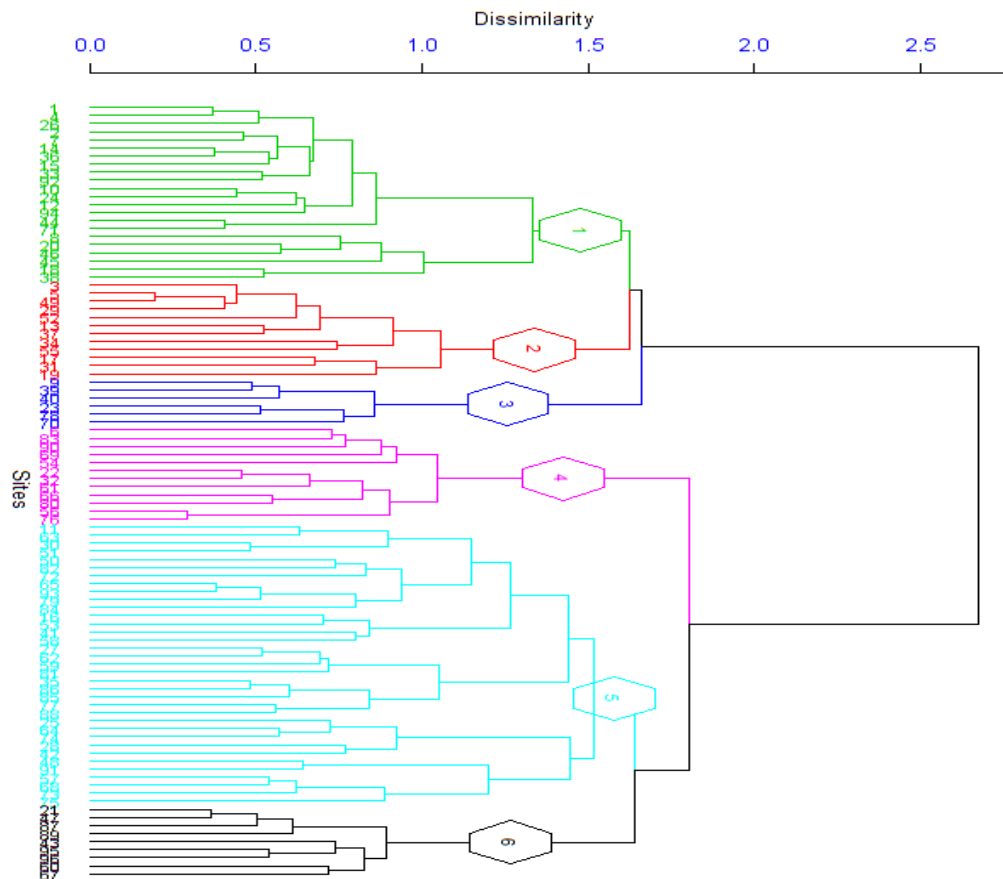
Species that had significant indicator values at  $P^* < 0.05$  were chosen as indicator species for each community (Table 5).

**Table 5.** Indicator values for species in each community and Monte Carlo test ( $p^*$ ) values of significance observed for each species.

<b>Group</b>					
Sequence: 1 2 3 4 5 6					
Identifier: 1 6 9 16 21 25					
Indicator groups					
<b>Column</b>	<b>Maxgrp Value</b>	<b>(IV)</b>	<b>Mean</b>	<b>S.Dev</b>	<b>p *</b>
Anti.tox	1	17.6	8.6	5.45	<b>0.0003</b>
Apod.dim	16	2.9	8.2	5.30	<b>0.0004</b>
Aspa.afr	25	92.1	9.0	5.34	0.0002
Bers.abby	25	24.8	9.1	5.43	0.0198
Cari.spi	9	32.2	10.3	5.46	<b>0.0084</b>
Celt.afr	1	48.9	15.7	5.16	<b>0.0004</b>
Ciss.qua	25	27.4	8.2	5.35	0.0170
Clem.sim	25	28.7	11.5	5.31	<b>0.0020</b>
Crot.mac	16	31.8	11.1	5.52	<b>0.0030</b>
Digi.vel	9	25.0	7.0	4.53	0.0082
Drac.afr	1	39.2	16.7	4.91	0.0020
Ekeb.cap	9	22.2	7.7	4.86	0.0154
Hypo.for	9	70.2	9.2	5.59	0.0002
Just.sch	6	64.9	13.6	5.44	<b>0.0002</b>
Lagg.cri	9	25.0	7.1	4.52	0.0074
Poly.ful	25	20.0	6.1	4.09	0.0480
Pycn.abby	25	27.4	8.1	5.23	0.0162
Rubu.ape	21	35.8	7.7	4.92	<b>0.0018</b>
Trem.ori	25	17.7	7.1	4.44	<b>0.0036</b>
Tric.dre	9	19.9	10.3	5.70	<b>0.0022</b>
Triu.rho	25	27.0	8.4	5.27	0.0182
Vern.amy	21	40.5	12.0	5.58	<b>0.0044</b>
Vepr.dai	6	18.7	6.9	4.42	<b>0.0244</b>
Vern.myr	25	32.5	7.9	4.76	0.0034
Vern.rue	25	14.8	7.8	4.84	0.0648

\*Proportion of randomized trials with indicator value equal to or exceeding the observed indicator value.  $p = (1 + \text{number of runs} \geq \text{observed}) / (1 + \text{number of randomized runs})$   
 Maxgrp = Group identifier for group with maximum observed IV

**Keys:** The bold values denote indicator species used for naming each community.



**Figure 7.** Dendrogram showing six different hierarchical cluster groups (community types 1-6) of Yayo and Hurumu districts.

#### 4.1.4.1 The *Antiaris toxicaria* - *Celtis africana* Community

This community type had ninety eight (98) different plant species sampled in 22 quadrats. This community lies between 1368 m to 1423 m above sea level. It is mainly dominated by many small and some large size plant species showing good indicator values such as *Antiaris toxicaria* and *Celtis africana*. Majority of species which found in this community type such as *Dracaena steudneri*, *Ehretia cymosa*, *Landolphia buchananii*, *Maytenus gracilipes*, *Olea welwitschii*, *Pterolobium stellatum*, and *Vernonia thomsoniana* are useful ecologically and economically.

Forty seven (47) different medicinal plants used for the treatment of different human and livestock ailments also form part of this community. These include *Aframomum corrorima*, *Ehretia cymosa*, *Bersama abyssinica*, *Allophylus abyssinicus*, *Brugmansia suaveolens*, *Abutilon longicuspe*, *Landolphia buchananii*, *Grewia ferruginea*, *Hallea*

*rubrostipulata*, *Ocotea kenyensis*, *Rumex nervosus*, and *Teclea nobilis* (Appendix 4).

#### **4.1.4.2. The *Justicia schimperiana* -*Vepris dainellii* Community**

This community comprises seventy one (71) species sampled from twelve (12) different quadrats. It occurs between altitudes of 1397 m and 1458 m above sea level partly in the transitional zone (which is relatively disturbed zone or area of the forest) and core zone (somewhat undisturbed zone or area of the forest) in which the dominance of *Justicia schimperiana* is clearly visible at the lower strata and *Vepris dainellii* in the upper ones.

The two are also indicator species in this community. The other plant species of this community are *Vernonia urticifolia*, *Cyphostemma cyphopetalum*, and *Clausena anisata*. A total of thirty four (34) different medicinal plants were found in this community type. These include *Cordia africana*, *Pycnostachys abyssinica*, *Hippocratea goetzei*, *Vernonia amygdalina*, *Rhamnus prinoides*, and *Jasminum abyssinicum*.

#### **4.1.4.3 The *Carissa spinarum* - *Trichilia dregeana* Community**

This community comprises seventy one (71) species sampled from six (6) different quadrats. It lies between altitudes 1213 m and 1358 m above sea level. *Carissa spinarum* and *Trichilia dregeana* emerged as the indicator species this community. Comparatively this community is the least species rich and diversified community.

The other important species found in this community include *Acanthus pubescens*, *Blighia unijugata*, *Clematis hirsute*, *Ficus ovate*, *Premna schimperi*, *Ficus sur*, *Ficus vallis-choudae*, *Sapium ellipticum*, and are also. Identified alongside these in the community were about twenty nine medicinal plants e.g. *Carissa spinarum*, *Ocimum lamiifolium*, *Lippia adoensis*, *Maesa lanceolata*, *Ocimum urticifolium*, and *Phytolacca dodecandra* used as traditional remedies for both human and livestock diseases by the local communities.

#### **4.1.4.4 The *Apodytes dimidiata* - *Croton macrostachyus* Community**

This community composed forty (40) species distributed in twelve (12) different quadrats. The altitudinal range within which this community occurs is between 1456 m to 1591 m above sea level. Besides *Apodytes dimidiata* and *Croton macrostachyus*, the indicator species for this community, there were other species which possibly could be considered as indicator species because they also had good indicator values (Table 5). These include *Brucea antidysenterica*, *Hippocratea goetzei*, *Olea capensis*, and *Ekebergia capensis*. Compared to the other communities already mentioned in this one only about fifteen medicinal plant species were identified. Some of the commonly used ones were *Embelia schimperi*, *Digitaria velutina*, *Stephania abyssinica*, and *Millettia ferruginea*.

#### **4.1.4.5. The *Rubus apetalus* - *Vernonia amygdalina* Community**

This was the most species community with one hundred and nine (109) species sampled from thirty five quadrats, which also made it the most taxonomically rich. The community lies altitudes 1518 m and 1722 m above sea level. *Rubus apetalus*, and *Vernonia amygdalina* emerged as the indicator species for the community. Other species found in it include *Phaulopsis imbricata*, *Pittosporum viridiflorum*, *Albizia gummifera*, and *Scolopia theifolia*. The community was also found to have sixty three species medicinal plants that are commonly used by the local communities for self-medication and for the treatment of their livestock. These include *Justicia schimperiana*, *Croton macrostachyus*, *Clematis simensis*, and *Teclea nobilis*.

#### **4.1.4.6. The *Clematis simensis* - *Trema orientalis* Community**

This community had contained 51 species e.g. *Chionanthus mildbraedii*, *Combretum paniculatum*, *Hippocratea africana*, *Rubus steudneri*, *Zehneria scabra*, and *Vernonia rueppellii*, sampled from (9) quadrats. It occurs between altitudes 1645 m and 1750 m above sea level. In this community very large-sized trees especially *Albizia grandibracteata* are very common. This tree plays a great role serving as shade tree in coffee forests but not only in coffee forests. The local farmers also confirmed that it is preferred for coffee plantations around homegardens. Similar to other community types, this one also had twenty six medicinal species which included *Bersama abyssinica*, *Brucea antidysenterica*, *Vangueria volkensii*, *Coffea arabica*, and *Vernonia amygdalina*.

#### 4.1.5. Analysis of Plant diversity in the study area

##### 4.1.5.1. Species diversity, evenness, and richness of the plant communities

As Table 6 shows, the computation of the Shannon-Wiener diversity index, species richness and Shannon's evenness in the six plant community types recognized. Community type 5 was comparatively the most species with 109 species, the most diverse with H' diversity index of 3.95 and had the highest species evenness of 0.84. On the other hand, community 4 was the least species rich with 40 species only and a H' diversity index 2.96. Community 1 had the lowest Shannon Evenness value of 0.76 communities 2 and 3 had equal values of species richness but differed in Shannon-Wiener diversity indices and Shannon Evenness values.

**Table 6.** Shannon - Wiener diversity index, species richness, diversity and evenness values of the plant communities identified in study forests

Community types	Species Richness	Diversity index (H')	Shannon–Evenness
1	98	3.49	0.76
2	71	3.38	0.79
3	71	3.44	0.81
4	40	2.99	0.81
5	109	3.95	0.84
6	51	3.16	0.80

##### 4.1.5.2. Similarity between plant communities

Community type 3 and community type 4 relatively had the highest similarity ratio whereas the least similarity ratio was displayed among communities 2 and 4 (Table 7). That is Community type 3 and community types 4 were almost similar in species composition whereas Community type 2 and community type 2 are less similar.

**Table 7.** Sorensen's Coefficient of similarity index among communities

Community type	1	2	3	4	5	6
1						
2	0.42					
3	0.67	0.49				
4	0.69	0.77	0.533			
5	0.722	0.64	0.76	0.743		
6	0.65	0.58	0.67	0.69	0.71	X

#### 4.1.6. Vegetation structure

##### 4.1.6.1. Density of trees and shrubs

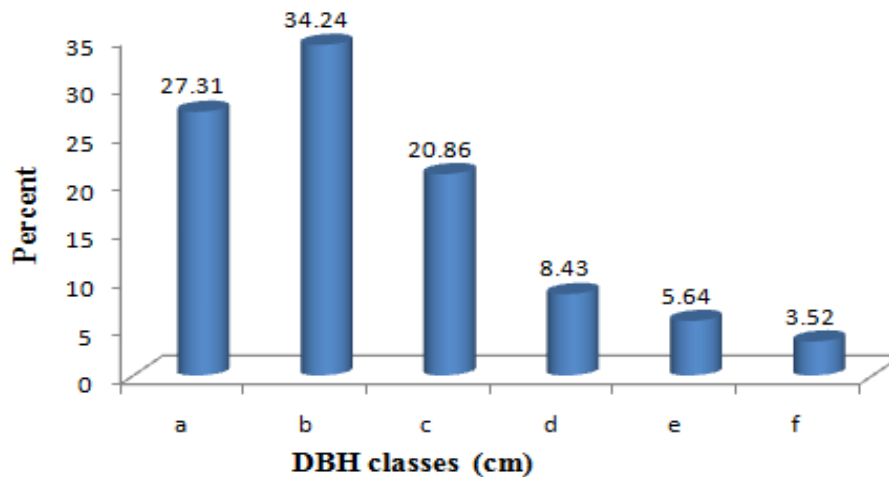
The number of individuals in various DBH category intervals is shown in Table 8. Out of a total of 1627 individuals 967 individuals with DBH greater than 2.5 cm were counted per hectare ( $\text{ha}^{-1}$ ). However, overall, individuals in the lower DBH classes such as *Argomuellera microphylla*, *Albizia grandibracteata*, *Allophylus abyssinicus*, *Celtis africana*, *Carissa spinarum*, *Cassipourea malosana*, *Croton macrostachyus*, *Coffea arabica*, *Dracaena afromontana*, *Maesa lanceolata*, *Millettia ferruginea* subsp. *ferruginia*, *Olea capensis* subsp. *macrocarpa*, and *Vernonia amygdalinahad* the greater proportion of this total .

**Table 8.** The summarized density of tree and shrub species

DBH classes (cm)	Density $\text{ha}^{-1}$	Percent (%)
Greater than 2.5 to 10	967	59.43
10.01 to 20	381	23.42
Greater than 20.01	279	17.15
<b>Total</b>	<b>1627</b>	<b>100</b>

#### 4.1.6.2. Distribution of Diameter at Breast Height (DBH)

The analysis of DBH distribution established six DBH classes (Figure 8). The greatest proportions of individuals were found in the lower diameter classes, and mainly the first two classes i.e. 2.5 –10 cm and 10.01– 20 cm.

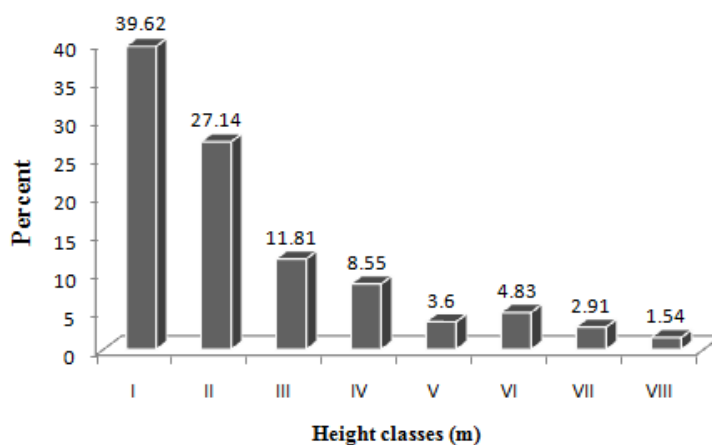


**Figure 8.** DBH classes and the percentage of individuals/ha in each class

a = 2.5 – 10 cm, b = 10.01– 20 cm, c = 20.01–30 cm, d = 30.01 – 40 cm, e = 40.01 – 50cm, f = > 50 cm.

#### 4.1.6.3. Tree height

The woody trees and shrubs in the study area can be conveniently classified into eight height classes (Figure 9). These can be used to indicate the age of a forest.



**Figure 9.** Height class distribution of woody plant species in the forests of the study area

Class I (2 – 6 m), II (6.01 -10 m), III (10.01 -14 m), IV (14.01-18 m), V (18.01- 22 m), VI (22.01-26 m), VII (26.01-30 m), VIII (>30 m)

#### 4.1.6.4. Basal area

The total basal area for woody plant species with DBH greater than 2.5 cm was found to be 75.47 m<sup>2</sup> ha<sup>-1</sup> (Table 9). The greatest proportion of this (i.e. >90%) was contributed by 14 woody plant species. The species with the highest basal areas were *Albizia grandibracteata*, *Albizia gummifera*, and *Celtis africana*.

**Table 9.** Basal area (m<sup>2</sup> ha<sup>-1</sup>) of woody plants in the study area

Plant Species	BA (m <sup>2</sup> ha <sup>-1</sup> )	Relative Abundance (RA)	Growth habit
<i>Albizia grandibracteata</i>	14.06	2.75	T
<i>Albizia gummifera</i>	13.11	3.8	T
<i>Celtis africana</i>	8.12	12	T
<i>Prunus africana</i>	7.94	1.8	S
<i>Olea welwitschii</i>	7.27	8.41	S
<i>Ficus sur</i>	5.83	5.5	T
<i>Sapium ellipticum</i>	4.03	10.3	T
<i>Allophylus abyssinicus</i>	3.02	2.3	T
<i>Millettia ferruginea</i>	2.63	6	T
<i>Cordia africana</i>	2.4	2.1	T
<i>Schefflera abyssinica</i>	2.3	5.8	T
<i>Syzygium guineense</i>	1.7	4.7	T
<i>Vepris dainiellii</i>	1.16	11.4	S
<i>Croton macrostachyus</i>	1.07	13.67	T
<i>Grewia ferruginea</i>	0.54	7	S
<i>Bersama abyssinica</i>	0.15	0.35	S
<i>Maesa lanceolata</i>	0.14	2.1	S
<b>Total</b>	<b>75.47</b>	<b>99.98</b>	

#### 4.1.6.5. Frequency and dominance

*Coffea arabica*, *Dracaena afromontana*, *Argomuelleria microphylla* emerged as the most frequently occurring species. They were reported in 91, 82, and 74 quadrats out of 96 respectively. Other species that also occurred frequently in many quadrats included *Croton macrostachyus*, *Blighia unijugata*, *Carissa spinarum*, *Olea capensis* subsp. *macrocarpa*, and *Vernonia amygdalina*. *Argomuelleria microphylla*, *Clematis simensis*, *Croton macrostachyus*, *Blighia unijugata*, *Carissa spinarum*, *Coffea arabica*, *Maesa lanceolata*, *Dracaena afromontana*, *Justicia schimperiana*, *Millettia ferruginea* subsp. *ferruginia*, *Olea capensis* subsp. *macrocarpa*, *Vernonia amygdalina*, were identified as the most dominant species.

#### 4.1.6.6. The Importance Value Index (IVI)

The Importance Value Index (IVI) was computed for the top fourteen woody species out of all species documented. The results show that out of the fourteen species, ten had an IVI greater than 5 percent (Table 10). Those with IVI greater than ten percent included *Coffea arabica* (13.72%), *Albizia grandibracteata* (12.96%), *Argomuelleria microphylla* (10.21%), and *Celtis africana* (11.98%). Apart from their ecological functions, these species were also important in socio-economic, cultural and spiritual aspects of the local communities, and in different income-generating activities.

**Table 10.** Importance Value Indices (IVI) of woody plant species

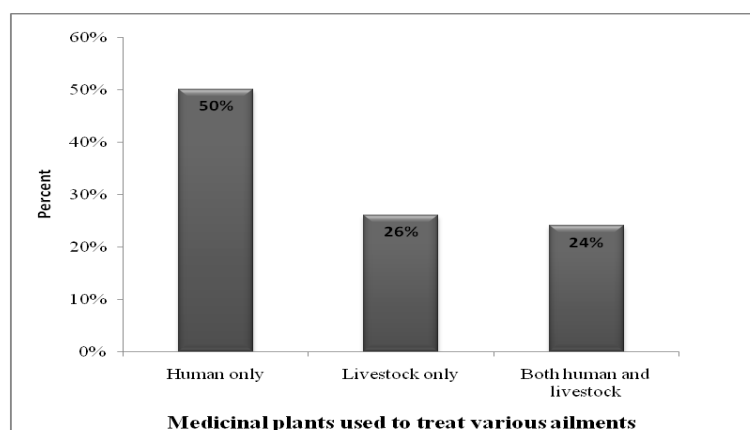
S/N	Species	IVI (%)
1.	<i>Albizia grandibracteata</i>	12.96
2.	<i>Albizia gummifera</i>	4.31
3.	<i>Allophylus abyssinicus</i>	3.46
4.	<i>Apodytes dimidiata</i>	5.33
5.	<i>Argomuelleria microphylla</i>	10.21
6.	<i>Celtis africana</i>	11.98
7.	<i>Coffea arabica</i>	13.72
8.	<i>Cordia africana</i>	5.22

S/N	Species	IVI (%)
9.	<i>Croton macrostachyus</i>	6.04
10.	<i>Dracaena afromontana</i>	9.61
11.	<i>Ekebergia capensis</i>	3.6
12.	<i>Millettia ferruginea</i> subsp. <i>ferruginia</i>	3.23
13.	<i>Olea welwitschii</i>	5.29
14.	<i>Sapium ellipticum</i>	5.03
	<b>Total</b>	<b>99.99</b>

## 4.2. Ethnobotanical study

### 4.2.1. Diversity of medicinal plants

Asteraceae was comparatively the most species family with 20 medicinal species, followed by Fabaceae and Lamiaceae which had 14 species each. The Solanaceae, Rubiaceae, and Euphorbiaceae were next represented by 12, 10, and 6 species each respectively. In the remaining 59 families the number of medicinal species recorded varied between 1 to 5. Of the identified medicinal plants, 86 (50%) were used only for healing human ailments and 45 (26%) only for treating livestock diseases. Forty one species (24%) had multiple uses being employed as traditional remedies for human and livestock ailments (Figure 10). These human ailments treated using medicinal plants were gastro-intestinal diseases and dermatological conditions diseases associated with the sanitation (the degree to which the local communities keeps themselves or their environment clean, mainly to prevent disease) and socioeconomic factors in the local communities.



**Figure 10.** Percentage of medicinal plants used to treat human, livestock, human and livestock ailments

#### **4.2.2. Types of disease, diagnosis, remedy preparation, modes of administration, and dosage**

A total of sixty two (62) different human and livestock disease treated using traditional medicinal plants were documented in Yayo and Hurumu districts (Appendix 6). The highest proportion (12%) of the medicinal plant remedies were reportedly used for the healing of gastro-intestinal ailments, abdominal illness/stomach disorders and internal parasites, gastritis, diarrhea, taeniasis, hepatitis, rabies, fibril illness and evil eye spirit. Different diagnosis methods were used by traditional healers. The commonly practiced diagnosis was done by observation. This is visual inspection of patient and interviewing either the patient or one of his/her family members if the patient is in a chronic condition. Symptoms of the patient such as lack of appetite, body temperature, eye colour, and status of physical strength were considered.

A number of techniques were used to prepare medicinal plant remedies. These included: pounding accounted 35% which prepared from freshly collected plant material whereas 16.86% by crushing and powdering, 12 (11.3%) by chewing of plant parts (Figure 11). Fifty three (31%) of the traditional plant remedies were made using more than three methods such as chopping, decoction, crushing, boiling, burning, chewing, concoction, cooking, homogenizing, infusion, powdering, rubbing, and squeezing. Sometimes cold water and/or hot or warm water, boiled coffee, milk, honey and local drinks were used to increase the curative potential of the remedy minimize its adverse side effects or just flavor it.

The most commonly practiced mode of administration was via oral. The other mode of application that was frequently cited was external, mainly through the skin using different processes e.g. rubbing remedy on part of skin infected. Moreover, the ailments such as some external skin problems, headache and evil eye were applied via fumigation.



**Figure 11.** The preparation and treating activities of remedies carried out by traditional healers in Gechi kebele (Yayo district)

(Photograph taken by Garuma Gerbaba, in December, 2016)

**Keys:** a, b, c, showed preparation methods including pounding and ‘d’ treating the patient.

During the preparation and administration of such traditional medicines, sometimes other ingredients such as salt, sugar, milk and honey are added either as additional remedies or simply to improve the taste. Different units of measurement were used to determine the duration of administration and the dosage to be administered. The dosage was determined by basic criteria for such as the age, physical strength of the patient and the severity of the diseases. It is commonly practical and not advisable by traditional healers that pregnant

women were not allowed to take any traditional remedies. The amount of medicine to be administered was measured or estimated by traditional healers using different techniques such as length of a finger, fork, spoon, and cup of coffee.

The duration of administration of the remedies depended on how long it took one to recover from their ailments. For the determination of duration possibly depends on the recovery of patient from particular ailments. The modes of administration of the tradition remedies included oral intake, external application i.e. applied externally as lotion, nasal via the nose, via the eyes, through the ear canal and anal depending on the type of ailment. Oral administration was the most practical and dominant route of administration followed by dermal application (Table 11).

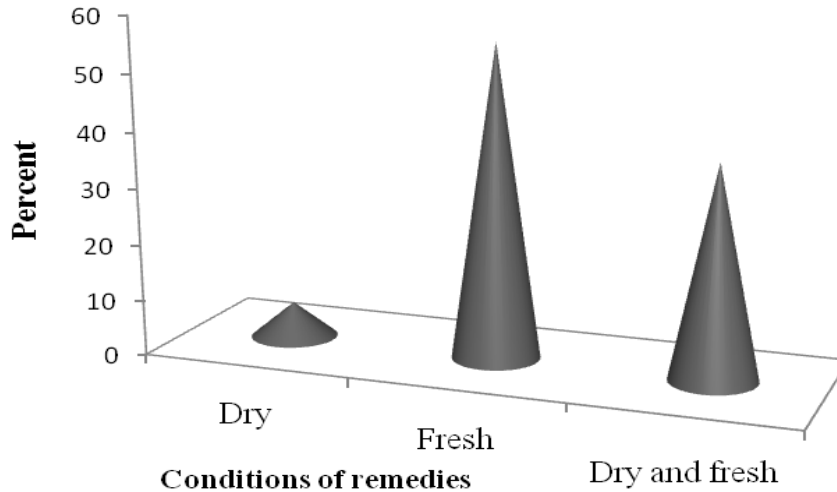
**Table 11.** Modes of administering traditional medicine in the study area

S/N	Mode/Route of administration	Number of species	%
1.	Oral only	64	37.2
2.	Dermal only	52	30.23
3.	Both oral and dermal	19	11.06
4.	Nasal only	17	9.88
5.	Both oral and nasal	14	8.14
6.	Both dermal and nasal	4	2.33
7.	Both nasal and dermal	2	1.16
	<b>Total</b>	<b>172</b>	<b>100</b>

#### **4.2.3. Plant parts used, and conditions of usage of traditional medicinal remedies**

The most commonly used plant parts for remedy preparation were leaves which accounted 48 (27.91%) followed by mixing of different parts (collection of leaves, roots, fruits, barks) 33 (19.2%), root 25 (14.51%). Fruit contributed 19 (11%), whole plant 16 (9.3%), bark 8 (4.7%), latex 6 (3.5%) whereas seeds and tubers contributed 5 (2.91%) each. The other medicinal plant parts used for remedy preparation suchs as stems, bulbs, seed and/or fruits represented by below 2% each. The majority of the remedies were

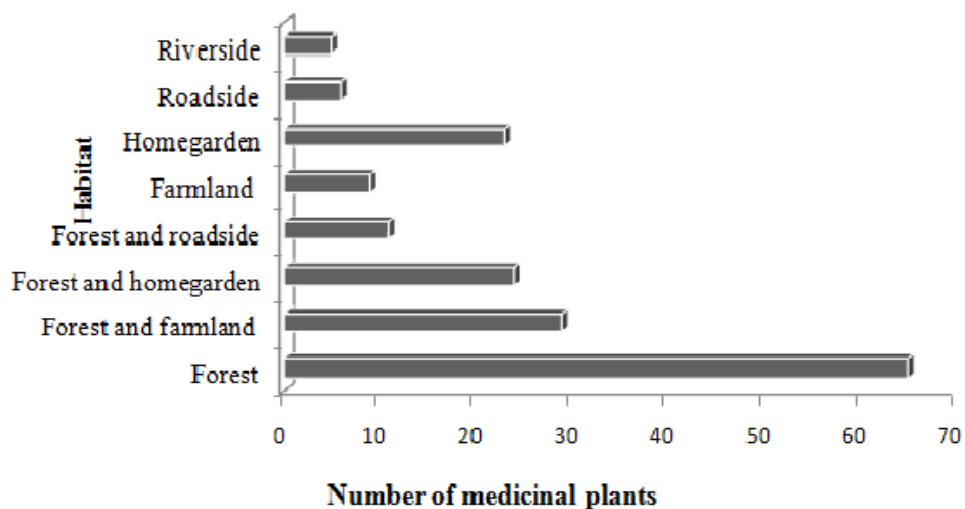
prepared at time of fresh condition (55.81%), that is, the preferred plant parts were used soon after collected (Figure 12). Those medicinal plant remedies prepared from both fresh and dry conditions comprised 37.86% while 6.33% were prepared only from dried plants.



**Figure 12.** The condition of medicinal plants usage for healing different ailments

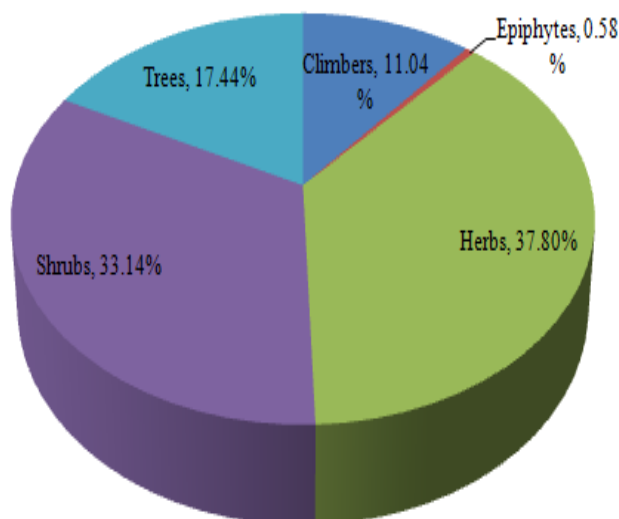
#### 4.2.4. Habitat and growth habit diversity of traditional medicinal plants

Medicinal plants in Yayo and Hurumu districts were collected from different localities or habitat. Medicinal plants collected from wild or natural forests accounted for 65 (38%) followed by forest and farm lands, and forest and homegarden represented by 29 (17%) and 24 (14%) respectively (Figure 13).



**Figure 13.** Diversity of habitats from which medicinal plants were collected

Majority of the medicinal plants collected were herbs (65, 37.8%), followed by shrubs (57, 33.14%), trees (30, 17.44%), and climbers (18, 10.46%). Epiphytes woody climber accounted for less than 1% as indicated in Figure 14.



**Figure 14.** Growth habit diversity of medicinal plants reported from the study area

#### 4.2.5. Marketability of medicinal plants

In a number of *Kebeles* e.g. in Hurumu town and Gaba *Kebele* from Hurumu district, and Yayo town and Wixate *Kebele* from Yayo district some traditional healers sold traditional medicinal plants in the local markets. However, the majority of traditional healers sold the plants from their homesteads. Species like *Allium sativum*, *Glinus lotoides*, *Echinops kebericho*, *Aframomum corrorima*, *Cucurbita pepo*, *Ruta chalepensis*, *Linum usitatissimum*, *Ocimum basilicum*, and *Thalictrum rhynchocarpum* are good examples of plants that were being sold in the open markets (Figure 15). Others like *Allium cepa*, *Capsicum annuum*, *Capsicum frutescens*, *Mentha spicata*, *Piper capense*, *Ruta chalepensis* and *Rosmarinus officinalis* were mainly sold as spices to generate income. *Catha edulis*, and *Coffea arabica* have multiple uses in the local communities including being used as traditional remedies against different ailments such as internal parasites, as stimulants, and for income-generation.



**Figure 15.** Photographs of some of the medicinal plants sold in markets in the study areas  
(Photograph taken by Garuma Gerbaba - in December, 2016)

#### **4.2.6. Preference ranking of medicinal plants used for healing human ailments**

Preference ranking was done to identify the seven most preferred medicinal plants for treating human illnesses and the results are given in Table 12. *Allium sativum*, *Ruta chalepensis*, *Coffea arabica*, and *Carica papaya* emerged as the most preferred being ranked as first, second, third and fourth respectively. The remaining three namely *Rosmarinus officinalis*, *Rumex nervosus*, and *Ajuga integrifolia* had the lowest three rankings against different diseases.

**Table 12.** Preference ranking of seven (7) medicinal plants used for healing human ailments

S/N	Medicinal plant	Respondents (R)															Total score	Rank
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
1.	<i>Allium sativum</i>	6	6	6	7	6	7	5	7	6	5	7	6	6	7	7	<b>94</b>	<b>1<sup>st</sup></b>
2.	<i>Ruta chalepensis</i>	7	6	6	5	6	4	5	6	5	6	7	5	6	7	6	<b>87</b>	<b>2<sup>nd</sup></b>
3.	<i>Coffea arabica</i>	6	5	6	5	5	7	5	4	6	6	5	6	5	4	6	<b>81</b>	<b>3<sup>rd</sup></b>
4.	<i>Carica papaya</i>	5	7	5	6	4	5	4	5	6	6	3	5	5	6	5	<b>77</b>	<b>4<sup>th</sup></b>
5.	<i>Rosmarinus officinalis</i>	4	5	6	4	2	6	7	3	5	5	6	5	4	6	5	<b>73</b>	<b>5<sup>th</sup></b>
6.	<i>Rumex nervosus</i>	3	4	5	6	5	7	4	6	2	0	3	4	3	3	4	<b>59</b>	<b>6<sup>th</sup></b>
7.	<i>Ajuga integrifolia</i>	2	3	6	2	2	5	6	4	3	3	1	4	3	5	2	<b>51</b>	<b>7<sup>th</sup></b>

#### 4.2.7. Direct matrix ranking

Direct matrix ranking was used to determine the relative importance of the different use categories to the local communities and the degree of existing pressure directly or indirectly associated with the use values of these categories. Thus *Cordia africana* and *Apodytes dimidiata* were ranked first and second respectively in the direct matrix ranking (Table 13). These two species preferred by the local communities for their medicinal and other uses were also known to be under the greatest pressure and hence the most threatened. The other plants considered were *Croton macrostachyus*, *Calpurnia aurea*, *Maesa lanceolata*, *Euphorbia ampliphylla*, *Coccinia abyssinica* which also have multiple uses and were ranked third, fourth, fifth, sixth and seventh respectively (Table 13).

**Table 13.** Direct matrix ranking of general use diversity categories of seven plants species

Use diversity	<i>Apodytes dimidiata</i>	<i>Croton macrostachyus</i>	<i>Maesa lanceolata</i>	<i>Calpurnia aurea</i>	<i>Cordia africana</i>	<i>Euphorbia ampliphylla</i>	<i>Coccinia abyssinica</i>	Total	Rank
Medicinal	4	5	2	3	4	4	4	26	2 <sup>nd</sup>
Food	0	0	3	0	4	0	5	12	8 <sup>th</sup>
Commercial	5	3	1	2	5	4	5	25	3 <sup>rd</sup>
Furniture	4	2	1	3	5	3	0	18	6 <sup>th</sup>
Charcoal	4	5	4	2	3	1	0	19	5 <sup>th</sup>
Firewood	5	5	4	5	5	3	0	27	1 <sup>st</sup>
Construction	5	4	2	4	4	4	0	23	4 <sup>th</sup>
Fodder	2	3	4	2	3	0	2	15	7 <sup>th</sup>
	29	27	21	22	33	19	16		
	2 <sup>nd</sup>	3 <sup>rd</sup>	5 <sup>th</sup>	4 <sup>th</sup>	1 <sup>st</sup>	6 <sup>th</sup>	7 <sup>th</sup>		

Based on use values criteria (5 = best; 4 = very good; 3 = good; 2 = less used; 1= least used; and 0 = unknown or not used)

#### 4.2.8. Informant Consensus Factor (ICF) of medicinal plants

Out of different types of health problems/ ailments documented in Yayo and Hurumu districts the following diseases categories were identified as the most common known in the two areas. The highest Informants' Consensus Factor (ICF) value was recorded for gastro-intestinal and internal parasites (0.93) followed by external ailments (dermal/ skin disease) (0.87). Evil spirit, fibril illness, headache, and snake poison followed in that order (Table 14).

**Table 14.** Informant Consensus Factor values for some common disease categories in the study area

S/N	Disease category	$n_t$	$n_{ur}$	$n_{ur}-n_t$	$n_{ur}-1$	ICF
1.	Gastro-intestinal and internal parasites	26	382	356	381	0.93
2.	External (dermal/ skin disease)	41	320	289	319	0.87

S/N	Disease category	$n_t$	$n_{ur}$	$n_{ur}-n_t$	$n_{ur}-1$	ICF
3.	Evil spirit	11	45	34	44	0.77
4.	Fibril illness	16	49	33	48	0.68
5.	Headache	13	32	19	31	0.61
6.	Snake poison	7	16	9	15	0.6
7.	Rabies	13	24	11	23	0.49
8.	Influenza	5	8	3	7	0.42
9.	Gastritis	4	6	2	5	0.4
10.	Teeth infection	12	19	7	18	0.39
11.	Rheumatism	8	13	5	12	0.38
12.	Hemorrhoids	6	9	3	8	0.37
13.	Gonorrhea	3	4	1	3	0.33
14.	Spider and other insects poison	12	16	4	15	0.27

**Keys:**  $n_t$  = number of medicinal plant species used by all informants for a particular illness (number of taxa used);  $n_{ur}$  = number of use citation in each group

#### 4.2.9. Relative healing potential of medicinal plants used for treating human ailments

The healing potential of some medicinal plants to treat diseases as represented by fidelity level values was determined. The highest fidelity level values were recorded for *Thalictrum rhynchocarpum* (97%) followed by *Ocimum lamiifolium* (96%), *Cucurbita pepo* (95%), *Embelia schimperi* (92%) and *Justicia schimperiana* (91%) (Table 15). The least was recorded for *Ehretia cymosa* (71%). Thus, *Thalictrum rhynchocarpum* had the highest potential to treat the greatest number of gastro-intestinal ailments. *Ocimum lamiifolium* was very common and was very popular and effective in treating vaginitis (vaginal inflammation).

**Table 15.** Fidelity level values or relative healing potential of some medicinal plants used to treat different human ailments

S/N	Plants species	Therapeutic categories (Disease treated)	Ip	Iu	FL%	Rank
1.	<i>Thalictrum rhyngocarpum</i>	Gastro-intestinal ailments	33	34	97	1 <sup>st</sup>
2.	<i>Ocimum lamiifolium</i>	Vaginitis	23	24	96	2 <sup>nd</sup>
3.	<i>Cucurbita pepo</i>	Ascariasis, Taeniasis	19	20	95	3 <sup>rd</sup>
4.	<i>Embelia schimperi</i>	Taeniasis	24	26	92	4 <sup>th</sup>
5.	<i>Justicia schimperiana</i>	Rabies	30	33	91	5 <sup>th</sup>
6.	<i>Rumex nepalensis</i>	Tonsillitis	16	19	84	6 <sup>th</sup>
7.	<i>Acmella caulirhiza</i>	Gonorrhea	16	21	76	7 <sup>th</sup>
8.	<i>Verbena officinalis</i>	Stomachache, tonsillitis	16	22	73	8 <sup>th</sup>
9.	<i>Ehretia cymosa</i>	Teeth infection	10	14	71	9 <sup>th</sup>

**Keys:** FL = Fidelity Level,

$I_p$  is the number of informants who suggested the use of a species

$I_u$  is the total number of informants who mentioned the plant for any use

#### 4.2.10. Ethnoveterinary medicinal plants

In addition to the forty one (41) medicinal plants used to treat both human and livestock, forty five (45) other species belonging to thirty seven (37) genera and twenty three (23) families were exclusively used for treating livestock ailments. Among the plant families the most species was the Solanaceae with eight (8) species followed by the Asteraceae and Rubiaceae with six (6) and five (5) species each respectively (Table 16). The Euphorbiaceae and Malvaceae three (3) species each, whereas the Urticaceae and Vitaceae had two (2) species each. The remaining sixteen (16) families were represented by a single species each. Of all these ethnoveterinary medicinal plants, two species namely *Lippia adoensis* var. *adoensis* and *Vepris dainellii* are endemic to Ethiopia.

#### 4.2.11. Growth habit and habitat of plants used in ethnoveterinary medicine

Shrubs constituted the highest proportion (51%) of plants used as ethnoveterinary medicine, followed by herbs (20%), trees (18%), and climbers (11%). Of all the plants used for ethnoveterinary medicine, thirty four (34) were harvested from wild habitats in natural forests while eleven (11) were collected from various habitats e.g. homegardens either as cultivated or living freely on fences, farmland, and in rare cases were found both in the wild and in homegardens.

**Table 16.** Families of plants used for ethnoveterinary medicine and number of species used in each

S/N	Plant family	Number of species
1.	Solanaceae	8
2.	Asteraceae	6
3.	Rubiaceae	5
4.	Euphorbiaceae	3
5.	Malvaceae	3
6.	Urticaceae	2
7.	Vitaceae	2
8.	Amaryllidaceae	1
9.	Apiaceae	1
10.	Araliaceae	1
11.	Arecaceae	1
12.	Celastraceae	1
13.	Cucurbitaceae	1
14.	Fabaceae	1
15.	Hypericaceae	1
16.	Loganiaceae	1
17.	Meliaceae	1
18.	Oleaceae	1
19.	Pittosporaceae	1
20.	Poaceae	1
21.	Sterculiaceae	1
22.	Ulmaceae	1
23.	Verbenaceae	1
	<b>Total</b>	<b>45</b>

#### 4.2.12. Major livestock diseases and traditional methods used to diagnose them in Yayo and Hurumu districts

Thirteen (13) different livestock diseases which treated using medicinal plants were reported. Of these, Blackleg (*Bushoofuu*), and Trypanosomiasis (*Gandii*) were treated using seven (7) different species (Table 17). These two livestock ailments are very common in both districts.

**Table 17.** Common livestock ailments and the number of medicinal plant species used to treat them

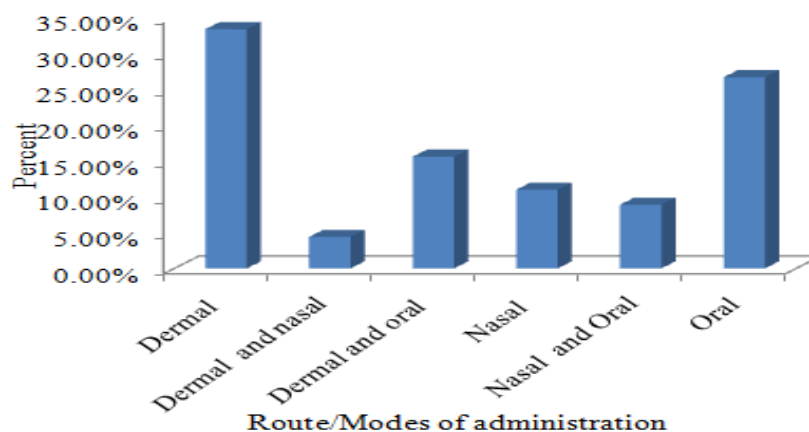
S/N	Types of ailments	Number of ethnoveterinary medicinal plants
1.	Blackleg ( <i>Bushoofuu</i> )	7
2.	Trypanosomiasis ( <i>Gandii</i> )	7
3.	Actinomycosis ( <i>Kurufsisaa</i> )	5
4.	Pasturolosis ( <i>Gororsaa</i> )	5
5.	Avian cholera ( <i>Fingillee</i> )	3
6.	Blotting ( <i>Bokoksaa Horii</i> ).	4
7.	Hyena bite ( <i>Cininna Warabessa</i> )	4
8.	Lumpy skin ( <i>Dhukkuba Gogaa</i> )	4
9.	Synerosis celebralis ( <i>Maramartoo</i> )	4
10.	Erythroblasts ( <i>Gatacha horii</i> )	3
11.	Expelling leeches ( <i>Ulaandhulaa</i> )	3
12.	Retained placenta ( <i>Dil'uu Baasuu Dadhabuu</i> )	3
13.	Epizootic lymphagities ( <i>Biichee Faradaa</i> )	2
	<b>Total</b>	<b>54</b>

#### **4.2.13. Plant parts used, methods of preparation, and modes of administration for ethnoveterinary remedies**

The plant parts commonly used for the treatment of livestock diseases were roots (33.3 %) followed by leaves (26.7 %), fruits (15.6%), and bark (8.9%). Some of the remedies were also made either from a mixture of different parts of different medicinal plants or from different parts of single plants. In this regard, the mixture of bark and leaves accounted for 6.7% of the remedies used while latex and tuber for 4.4%.

The most commonly used remedy preparation methods during treatment of livestock diseases included crushing (21.8%), and powdering (20.53%). Other preparation methods such as pounding, homogenizing, squeezing, and chopping took up 19%, 13.4%, 9.3%, and 5.76% respectively. The remainder such as preparation of concoctions, fumigation, rubbing, and burning contributed accounted for less than five percent (5%). A total of 36% of the remedies used were prepared using both fresh and dried plant parts, while 33% used as fresh parts only and 31% dried parts alone.

Topical application was the most commonly used mode of administering treatment on livestock using traditional remedies made from plants. It accounted for 33.40% of the possible modes of administration followed by oral administration (26.70%). About 11% of the remedies were applied via the nose. However, sometimes depending on the condition being treated, two or more routes could be used at the same time. Thus, for both dermal and oral applications used to treat various health problem accounted 7 (15.6%) whereas about 4 (8.9%) done via both nasal and oral (Figure 16).



**Figure 16.** Modes of administration used to apply ethnoveterinary remedies to livestock ailments

#### 4.2.14. The most preferred medicinal plants for healing livestock diseases

Traditional healers in the study area preferred a number of medicinal plants to others for veterinary use. *Thalictrum rhynchocarpum*, *Periploca linearifolia*, and *Clematis simensis* were the top three species that were popular and commonly used in the communities for the treatment of common livestock ailments (Table 18).

**Table 18.** Preference ranking of six (6) medicinal plants used for treating livestock ailments

S/N	Medicinal plants	Respondents (R)															Total score	Rank
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
1.	<i>Thalictrum rhynchocarpum</i>	7	5	6	6	7	5	6	5	5	7	6	6	7	6	7	<b>91</b>	<b>1<sup>st</sup></b>
2.	<i>Periploca linearifolia</i>	6	6	5	4	5	5	6	7	4	6	7	6	6	6	5	<b>84</b>	<b>2<sup>nd</sup></b>
3.	<i>Clematis simensis</i>	6	6	3	5	7	6	6	5	5	4	6	5	5	6	6	<b>81</b>	<b>3<sup>rd</sup></b>
4.	<i>Solanum incanum</i>	5	4	6	5	5	6	5	4	5	4	5	6	5	7	4	<b>76</b>	<b>4<sup>th</sup></b>
5.	<i>Jasminum abyssinicum</i>	5	3	7	6	4	4	5	3	2	4	5	4	5	3	4	<b>64</b>	<b>5<sup>th</sup></b>
6.	<i>Dombeya torrida</i>	4	5	5	2	2	3	4	5	4	4	3	4	2	4	5	<b>56</b>	<b>6<sup>th</sup></b>

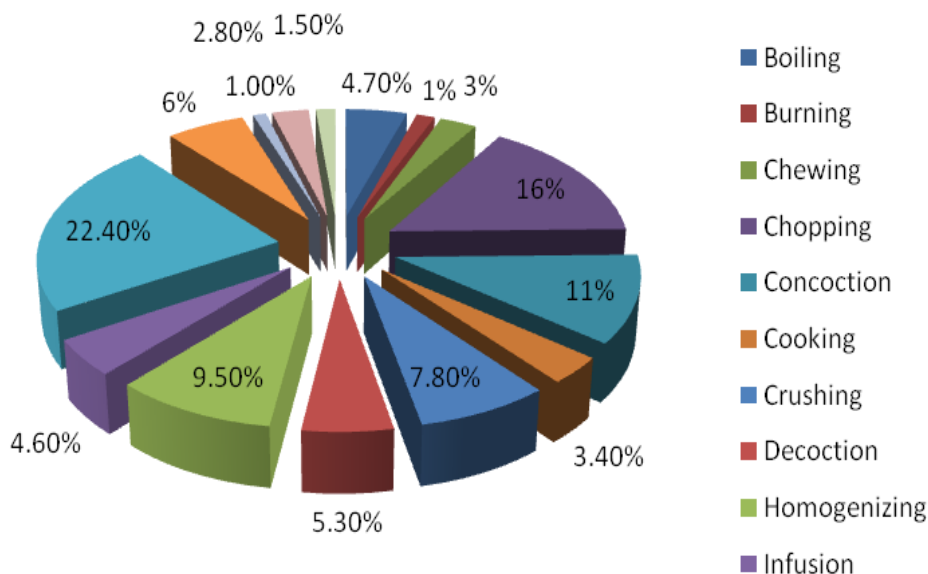
#### **4.2.15. Medicinal plants used to treat only human ailment**

A total of eighty six (86) species occurring in 74 genera and 43 families were used traditionally for treating human ailments only. Among the families identified, Lamiaceae was the most species rich with 14 species. It was followed by Asteraceae with 10 species, Fabaceae 9 and Amaranthaceae 4 species. Other families including Cucurbitaceae, Polygonaceae, and Rutaceae had 3 species each while Boraginaceae, Crassulaceae, Musaceae, and Oleaceae 2 each. The remaining 31 families had 1 species each.

The biggest proportion of medicinal plants used for treating human ailments were herbs (46, 54%) followed by shrubs (20, 23%) and trees (13, 15%). Climbers accounted for less than ten percent. A considerable number of these medicinal plants were harvested from wild whereas some from home garden as cultivated and other habitats. Of different parts used during the remedy preparations, the most frequently used part was leaf which accounted thirty six (36) species followed by whole plant accounted fourteen (14) species, roots eleven (11), fruits ten (10) species. The remaining parts such as bark, bulb, latex, rhizome and seed totally accounted about fifteen (15) species.

#### **4.2.16. Methods of preparation and modes of administration**

In this study, traditional healers have employed several processing during the time of preparation for the suitability before administration of the remedy made depending on the type of ailments. Out of different methods of the remedy preparations during the treatment of human ailments, the most commonly experienced by traditional healers were pounding accounted. Other preparation techniques frequently practiced also confirmed such as chopping, concoction, homogenizing, crushing, powdering, and decoction (Figure 17).



**Figure 17.** Methods of remedy preparations to treat only human ailments

During the time of remedy preparations of medicinal plants used to treat only human ailments, the traditional healers as they employed different methods and choosing condition of medicinal plants also practical. In this regard, a total of 53 (61.6%) remedies were prepared from fresh plant parts soon harvest from different area whereas about 19 (22.1%) were from dried and /or fresh condition. Preferring freshly or newly medicinal plants possibly related with the traditional healers prefer mostly the leaf part and herbs. Fourteen (16.28%) were prepared only from dried part of plant body typically from different parts such as root, bark, stem, whole plants, and sometimes from different parts.

According to traditional healers, the appropriately prepared medicinal plants were administered through various parts. Hence, the highest proportions of these remedy application was done through oral 40 (46.5%) followed by dermal application 25 (29.07%), and nasal 11 (12.79%). The other routes of administrations were applied by combinations of either two or more modes at the same time. Normally, such application is done depending on the types of the diseases. Thus, about 7 (8.14%) was applied both oral and/or dermal, 2 (2.33%) oral and /or nasal, 1 (1.16) dermal and/or nasal applications.

#### **4.2.17. Medicinal plants used to treat both human and livestock ailments**

A total of forty one (41) medicinal plants distributed in thirty seven (37) genera and twenty six (26) families were documented as being used for treating both human and livestock ailments. Asteraceae was the most dominant in terms of species richness with five (5) species followed by Euphorbiaceae, Fabaceae, Ranunculaceae, and Solanaceae with three (3) species each. Twenty one (21) families had one (1) species each.

Shrubs were the biggest proportion (34.15%) of plants used for treating both human and animal ailments, followed by herbs (26.83%), trees (24.39%), and climbers comprised 14.63%. Similarly, the biggest proportion (41.5%) of these plants were harvested from wild or natural forests, followed homegardens (31.7%). About 14.6% were found in both forests and homegardens while 12.2% were gathered from other different habitats e.g. farm lands, river and road sides.

The leaves formed the biggest proportion (29.3%) of plant parts that were used to prepare remedies used for treating both human and livestock diseases. This was followed by the roots (24.4%), fruits (9.77%), barks (7.3%) and seeds (4.88%). Bulbs, tubers, and whole plant accounted for 2.4% each. The remedies were prepared by mixing different parts of either the same individual plant or from different plants. Hence, 17.12% of the remedies were prepared that way and the biggest proportion (46%) using fresh parts. Twenty nine percent (29%) were made from dried parts and twenty five (25%) from either fresh or dried parts depending on the availability of plants.

#### **4.2.18. Methods of preparation and modes of administration of remedies used to treat both human and animal ailments**

Crushing was used to the greatest extent (22.50%) in the preparation of remedies used for treating human and animal ailments. The second most used method for making these remedies was pounding (16.78%), followed by powdering (15.70%) and homogenization (13.50%). Other methods such as making of concoctions, chopping, squeezing, rubbing and fumigation all combined accounted for 31.50%. The correct mode of administering these remedies was determined by experienced traditional healers depending on the type of ailment and part infected. The most commonly used method was external application on the skin. This accounted for 34.15% of the number of times these remedies were

administered while oral application accounted for 29.3%, dermal and oral methods together accounted 14.6% (Table 19).

**Table 19.** Modes of administration for medicinal remedies used to treat both human and livestock ailments

S/N	Modes application	Number of plants	Percent (%)
1.	Dermal	14	34.15%
2.	Oral	12	29.3%
3.	Dermal and oral	6	14.6%
4.	Dermal, nasal and oral	4	9.75%
5.	Nasal	3	7.3%
6.	Dermal and nasal	2	4.9%
	<b>Total</b>	<b>41</b>	<b>100</b>

#### **4.2.19. Use diversity, threats, and conservation of medicinal plants in Yayo and Hurumu districts**

According to local informants and from personal observation some of the medicinal plants found in Yayo and Hurumu districts were harvested for other uses such as firewood, charcoal production, construction, timber and as forage. Beside, the other threat to the medicinal plants in the study area was mainly related with agricultural expansion, overharvesting, overgrazing, urban expansion, pesticide application. In this result the anthropogenic pressure was considered as major causes for the forest general and medicinal plants in particular which accounted 89% while the natural onces (which possibly happened either suddenly or man-made fire) consists of 11%.

#### **4.2.20. Main sources, acquisition and transference of traditional knowledge of the medicinal plants**

In this study, the practical observation and interview results revealed that the majority of local communities of both Yayo and Hurumu districts have good indigenous knowledge. But, such knowledge was not equally practiced and transferred to local communities and in the family members. In this regard, 92% knowledge was transferred from traditional healers to the son whereas 8% transferred to any family members and relatives. With regard to the sources of traditional knowledge on medicinal remedy of present study, different house hold survey also made. In view of that, the main sources traditional knowledge is frequently reported as parents mainly fathers and/or their elders 95% while 5% of the informants confirmed that they gained the knowledge by observation.

#### **4.2.21. Ethnobotany wild edible plants (WEP) in the study area**

##### **4.2.21.1. Taxonomic and growth habit diversity of wild edible plants**

A total of twenty two (22) wild edible plants species distributed in 15 genera and belonging to fourteen families were identified. The family Moraceae had the highest number of species followed by Cucurbitaceae, Flacourtiaceae, Polygonaceae, Rosaceae, and Solanaceae each with 2 species (Table 20). All the remaining families had 1 species each. Trees were the dominant growth habit with 45% followed by shrubs and climbers 23% each whereas the herbs were the least used at 9%.

**Table 20.** Plant families and number of wild edible species found in the study area

<b>SN</b>	<b>Family</b>	<b>Total number of species</b>	<b>%</b>
1.	Moraceae	4	18.2
2.	Cucurbitaceae	2	9
3.	Flacourtiaceae	2	9
4.	Polygonaceae	2	9
5.	Rosaceae	2	9
6.	Solanaceae	2	9

SN	Family	Total number of species	%
7.	Apocynaceae	1	4.6
8.	Areaceae	1	4.6
9.	Boraginaceae	1	4.6
10.	Myrsinaceae	1	4.6
11.	Myrtaceae	1	4.6
12.	Rubiaceae	1	4.6
13.	Sapindaceae	1	4.6
14.	Sapotaceae	1	4.6
	<b>Total</b>	<b>22</b>	<b>100</b>

#### 4.2.21.2. Plant parts used and modes of consumption of wild edible plants

Fruits constituted the highest proportion (82%) of parts eaten from wild plants. The leaves, leaves combined with stem, tubers and the stem alone each accounted for 4.5% of the parts of wild plants eaten. More than ninety percent (90%) of the wild edible plants were taken raw without any processing while about ten percent (10%) were used after being processed e.g. by cooking and/ or roasting.

#### 4.2.21.3. Preferences ranking of wild edible plants

Using eight key informants selected randomly, preference ranking was done for wild edible plants commonly used as food in different season. *Syzygium guineense* subsp. *afromontanum*, *Ficus sur*, and *Embelia schimperi* were identified as the top three most preferred species for food while *Carissa spinarum*, *Cordia africana*, and *Rubus steudneri* were comparatively the less preferred wild edible plant.

**Table 21.** Preference ranking of wild edible plants

S/N	Wild edible species preferred for food	Informants								Total score	Rank
		A	B	C	D	E	F	G	H		
1	<i>Syzygium guineense</i> subsp. <i>afromontanum</i>	5	4	5	3	5	4	5	4	35	1 <sup>st</sup>
2	<i>Ficus sur</i>	4	3	5	4	4	5	4	4	33	2 <sup>nd</sup>
3	<i>Embelia schimperi</i>	4	3	3	5	5	4	3	3	30	3 <sup>rd</sup>
4	<i>Carissa spinarum</i>	3	3	2	4	5	4	3	3	27	4 <sup>th</sup>
5	<i>Cordia africana</i>	4	2	3	4	3	4	2	4	26	5 <sup>th</sup>
6	<i>Rubus steudneri</i>	3	2	3	4	3	2	3	4	24	6 <sup>th</sup>

#### 4.2.22. Other uses of medicinal and wild edible plants of the study area

##### 4.2.22.1. Plants used as fodder

A total of 90 species representing 74 genera and 45 families were documented as sources of fodder and/ or forage. The family Asteraceae had the highest number of species (12) followed by Fabaceae (7) and Amaranthaceae and Lamiaceae (4) each. The remaining families had 3 species or less (Appendix 5). Herbs made up the highest proportion (38%) of plants used as animal fodder. They were followed by shrubs (33%) trees (19%) and climbers (10%).

##### 4.2.22.2. Plants used for construction and other related functions

A range of plants were found to be important in the construction of houses, timber production making of house furniture, beehives, farm tools, and other useful local materials used in different seasons and situations. Seventy nine (79) species, belonging to forty two (42) families and seventy one (71) genera were found to be important for such uses. Family Fabaceae had the highest number of species (7) in this category followed by Moraceae and Oleaceae with 5 species each.

The Euphorbiaceae and Lamiaceae had 4 species each while the Flacourtiaceae, Myrsinaceae, Rubiaceae and Rutaceae had 3 each. The remaining families had either one or two species each falling in this category. The highest proportion of plants that were used for construction and other related functions were largely trees (57%) followed by shrubs (27.8%), climbers (including woody climbers) (12.70%) and herbs (2.5%). The parts of these plants that were commonly put to use were the stems and occasionally the roots.

#### 4.2.23. The Use value of plants most cited for use in construction and other related function

Twelve (12) species were the most cited for use in construction and other related uses (Table 22). *Cordia africana*, *Apodytes dimidiata*, *Celtis africana*, *Albizia grandibracteata*, and *Olea capensis* subsp. *macrocarpa* had the highest use values ( $UV_{mat}$ ).

##### 4.2.23.1. Plants used as fuel

A total of 75 species representing 40 families and 62 genera were reported as sources of fuelwood. The most dominant family in terms of species richness was Fabaceae with 8 species followed by Asteraceae with 7 and Euphorbiaceae, Flacourtiaceae, Moraceae, and Oleaceae with 4 species each. Rubiaceae and Rutaceae had 3 species each.

**Table 22.** Use values of species used for construction and other related functions

Species	No. of informants citing the species	Total citations	Total number of construction uses	$UV_{mat}$
<i>Cordia africana</i>	193	1895	7	9.8
<i>Apodytes dimidiata</i>	205	1873	5	9.1
<i>Celtis africana</i>	198	1724	5	8.7
<i>Albizia grandibracteata</i>	202	1680	4	8.3
<i>Olea capensis</i>	206	1693	5	8.2

Species	No. of informants citing the species	Total citations	Total number of construction uses	U V <sub>mat</sub>
subsp. <i>macrocarpa</i>				
<i>Allophylus abyssinicus</i>	192	1504	4	7.8
<i>Prunus africana</i>	186	1382	5	7.4
<i>Dombeya torrida</i>	129	867	4	6.7
<i>Croton macrostachyus</i>	148	981	4	6.6
<i>Olea welwitschii</i>	178	1120	4	6.2
<i>Ekebergia capensis</i>	127	779	4	6.1
<i>Chionanthus mildbraedii</i>	103	608	3	5.9

**Keys:** UV<sub>mat</sub> = use value

Majority of the woody plants species were used as fuelwood with their stems followed by roots being the most frequently used part. Trees comprised the highest proportion (51%) of these followed by shrubs (45%) woody climbers (3%) and herbs (1%).

#### 4.2.23.2. Plants employed in Social-cultural practices

There are some plants that were used in various cultural practices and spiritual ceremonies in different seasons. Hence, 105 species belonging to 57 families and 90 genera were documented in this use category.

The families Euphorbiaceae and Fabaceae had the highest number of species in this use category, each with 8 species. The Asteraceae and Moraceae followed with six (6) and four (4) species respectively and the Apocynaceae, Bignoniaceae, Celastraceae, Lamiaceae, Oleaceae, and Solanaceae were next, each with three (3) species. Forty seven (47) families had either one (1) or two (2) species in this category. Trees were the most frequently used in this category, comprising 36% of the total number of plants used. They were followed by shrubs (30 %), herbs (19 %) and climbers (15%).

#### **4.2.23.4. Plants used for various environmental functions**

Fifty eight 58 species distributed in 37 families and 51 genera were found to have various uses or functions in the environment. This included use as ornamentals and/or for beautification, soil erosion control, improvement of soil fertility, and as shade for coffee agroforestry. The most diverse family in terms of number of species was the Fabaceae with 10 species followed by the Moraceae, Amaranthaceae, Asteraceae and Euphorbiaceae with three (3) species each. Bignoniaceae, Lamiaceae, and Solanaceae had two (2) species each. Nearly more than half of the species in this use category were used as organic fertilizers purposely for the improvement of soil fertility and also to protect the soil from being eroded. Trees were the most frequently used with 25 species being recorded in this category. They were followed by shrubs (17), herbs (12) with and climbers (4).

#### **4.2.23.5. Plants used as poison**

A number of plants were used as poisons either for humans, livestock or both humans and livestock. The same plants were also sometimes used as insecticides and repellents. These included *Abutilon longicuspe* (Malvaceae), *Datura stramonium* (Solanaceae), *Euphorbia ampliphylla* (Euphorbiaceae), *Millettia ferruginea* subs. *ferruginia* (Fabaceae), *Periploca linearifolia* (Asclepiadaceae), *Tagetes minuta* (Asteraceae), *Trifolium semipilosum* (Fabaceae). The latex (milky exudate) of *Euphorbia ampliphylla* and *Periploca linearifolia* were used as human poison while *Millettia ferruginea* subs. *ferruginia* played a significant role as fish poison and repellent against rats. *Tagetes minuta* was used as a repellent for insects such as ants, lice, and fleas.

#### **4.2.23.6. Plants with most diverse uses**

A number of plants were reported to have multiple uses e.g. as medicinal remedies, food, construction materials, fuel, fodder, forage for bees, and for environmental services. Accordingly fifteen (15) species were reported for such multiple uses (Table 23).

**Table 23.** Plant species with the most diverse uses

S/N	Plant species	Number of uses	Use diversity
1.	<i>Albizia grandibracteata</i>	6	Medicinal, fodder, bee forage, for construction, environmental services.
2.	<i>Apodytes dimidiata.</i>	7	Medicinal, fodder, bee forage, cultural uses, for construction, income-generating, environmental services.
3.	<i>Carissa spinarum</i>	6	Medicinal, edible, fodder, bee forage, for construction, environmental services.
4.	<i>Celtis africana</i>	4	Medicinal, construction, for material making, environmental services
5.	<i>Clematis simensis</i>	5	Medicinal, fodder, bee forage, cultural uses, for construction
6.	<i>Cordia africana</i>	7	Medicinal, edible, fodder, bee forage, construction, material making, environmental services
7.	<i>Croton macrostachyus</i>	5	Medicinal, bee forage, for construction, material making, environmental services
8.	<i>Embelia schimperi</i>	6	Medicinal, edible, fodder, cultural uses, for material making, environmental services
9.	<i>Millettia ferruginea</i> subsp. <i>ferruginia</i> (Hochst.)	5	Medicinal, bee forage, cultural uses, for construction, environmental services
10.	<i>Olea capensis</i> subsp. <i>macrocarpa</i>	4	Medicinal, for construction, for material making, environmental services
11.	<i>Phoenix reclinata</i>	5	Medicinal, edible, cultural uses, material making, environmental services
12.	<i>Prunus africana</i>	4	Medicinal, fodder, for construction, environmental services
13.	<i>Sapium ellipticum</i>	4	Medicinal, fodder, for construction, environmental services
14.	<i>Schefflera abyssinica</i>	5	Medicinal, fodder, bee forage, for construction, environmental services
15.	<i>Syzygium guineense</i> subsp. <i>afromontanum</i>	5	Medicinal, edible, fodder, construction, income-generating, environmental services

## CHAPTER FIVE

### 5. DISCUSSION, CONCLUSION AND RECOMMENDATIONS

#### 5.1. Discussion

##### 5.1.1. Plant diversity of the study area

In this study the findings have shown that Yayo and Hurumu districts are rich in floristic composition and plant diversity with a total of 298 different species identified. This might be attributed due to favorable climate conditions, and soil characteristics. The species richness in the study area is relatively higher than what has been recorded in other related forests in different parts of Ethiopia such as Belete forest (157 species) (Kflay Gebrehiwot and Kitessa Hundera, 2014), Komto forest (180 species) (Fekadu Gurmessa *et al.*, 2013), Masha forest (130 species) (Abreham Assefa *et al.*, 2013), Chato forest (154 species) (Feyera Abdena, 2010), Mana Angetu (212 species) (Ermias Lulekal *et al.*, 2008b), Yayu forest (220 species) (Tadesse Woldemariam Gole *et al.*, 2008), Bibita forest (192 species) (Dereje Denu, 2006), Jibat Forest (131 species) (Tamrat Bekele, 1993); but lower than that of Sheka forest (555 species) (Zewdie Kassa, 2017). This is possibly due to the fact that the study area included not only forests, but also other habitats, and also has relatively minor anthropogenic influences.

The emergence of the family Asteraceae as the most species family with 27 species followed by the Fabaceae with 24 species is not a unique occurrence. Other studies e.g. Ermias Lulekal *et al.* (2008b), Fekadu Gurmessa *et al.* (2013), Mathewos Agize *et al.* (2013a), Birhanu Kebede *et al.* (2014), Kflay Gebrehiwot and Kitessa Hundera (2014), Zewdie Kassa (2017), and Abiyot Berhanu *et al.* (2018) carried out in similar vegetation types have shown similar results. The Asteraceae is considered to be the most species family in Ethiopia (Mesfin Tadesse, 2004), and globally as well (Mac'ia *et al.*, 2005; Scherrer *et al.*, 2005).

Whereas in this study the Fabaceae emerged second to the Asteraceae in species richness, other studies carried out in other vegetation types in different parts of Ethiopia (e.g. Teshome Soromessa *et al.* 2004; Getachew Tesfaye *et al.* 2008; Tamene Yohannes, 2009; Samson Shimelse *et al.*, 2010; Motuma Didita *et al.*, 2010; Moa Megersa *et al.*, 2013; Abyot Dibaba *et al.*, 2014; Fikadu Erenso and Melesse Maryo, 2014; Amanuel

Ayanaw,2016, and Garuma Gerbaba and Wendawek Abebe 2016) have reported the dominance of family Fabaceae. Such differences with regard to the richness and dominance of specific plant families possibly suggest the interplay of different factors including ecological characteristics of the particular environment.

Just as in studies conducted elsewhere in Ethiopia in similar vegetation types (e.g. Dereje Denu, 2006; Samson Shimelse *et al.*, 2010; Fekadu Gurmessa *et al.*, 2013; and Fikadu Erenso and Melesse Maryo, 2014), herbs were relatively the most abundant represented by 39% of the species documented. However, findings in other studies e.g. by Fikadu Erenso *et al.* (2014), Mirutse Giday and Gobena Ameni (2003) have contrasted with these results, with shrubs representing the biggest proportion of the habit of species documented. From our practical observation, the relatively larger proportions of herbs perhaps suggest that selective logging of economically very important trees for various uses such as for timber production, and other construction uses.

### **5.1.2. Endemic plant species**

Out of the two hundred and ninety eight (298) species documented in Yayo and Hurumu districts, 5% were endemic to Ethiopia. The family Asteraceae had the highest number (3) followed by Fabaceae (2). A finding similar to this was reported by Ensermu Kelbessa and Sebsebe Demissew (2014) who indicated that the Asteraceae had the highest number of endemic taxa in the Flora of Ethiopia. The results in this study thus reveal that the forests in Yayo and Hurumu districts contain a relatively higher number of endemic taxa compared to related forests in Ethiopia such as Chato forest with 12 species (Feyera Abdena, 2010) and Bibita forest with 13 species (Dereje Denu, 2007). However, the numbers were lower than found in Komto forest which has been reported to have 18 species (Fekadu Gurmessa *et al.*, 2013).

Among the identified endemics *Lippia adoensis* var. *adoensis* is known to occur both in the Flora of Ethiopia and that of Eritrea flora while *Vernonia leopoldi* is a new record for the Ilu Abba Bor floristic region. Following the IUCN criteria level of threat, two(2) species including *Pycnostachys abyssinica*, and *Tiliacora troupinii* have been categorized as vulnerable (VU), and seven (7) species *Erythrina brucei*, *Lippia adoensis* var. *adoensis*, *Millettia ferruginea* subsp. *ferruginea*, *Phragmanthera macrosolen*, *Solanecio gigas*, *Vepris dainellii*, *Vernonia leopoldi* as of least concern (LC). The remaining 5

species were not found in the Red Data List of the IUCN (Vivero *et al.*, 2005; IUCN, 2010). Thus, identification of such species at the national level is thus important for conservation.

### **5.1.3. Plant communities of the forests in the study districts**

In this study, six (6) plant communities were recognized. Although there were noticeable similarities in species composition across the six communities due to overlaps in altitudinal ranges, distinctions were also observed. These could have been due to variations in environmental parameters, anthropogenic disturbances arising from the multiple uses of the forest by the local communities and natural ones as well.

Among the communities, community five (5) had a relatively higher diversity, species richness and evenness values compared to the rest. The reason for this might be the fact that it is found almost in the core zone of the forest far from human encroachment where there is low anthropogenic activity. This relatively high richness could result from its wide range of altitude and also the majority of the quadrats fall in the core zone which is relatively the protected part. Thus, the high species richness and evenness contributed to the high diversity index of this community type. Zerihun Woldu (2012) stated that a high species diversity index is generally thought to indicate a more complex and healthier community because a greater variety of species allows for more species interactions, and hence, a greater system stability which in turn indicates good environmental conditions.

Community type four (4) on the other hand was the poorest in species composition as it occurs in the buffer zone of the forest which is directly or indirectly exposed to human interference such as human settlement and high dependence of the surrounding local communities on the forest for socio-economic activities. Selective cutting of economically important larger trees including *Apodytes dimidiata* and useful medicinal plants such as *Embelia schimperi* also practical. Generally, the occurrence of a high or low species diversity index in a community can be attributed to different factors including anthropogenic activities, and other environmental variables e.g. aspect, altitudinal variations, slope and soil types (Kent, 2012).

#### **5.1.4. Vegetation structure**

The vegetation structure of the study forests is here explained under different parameters such as density, frequency, height, DBH (Diameter at Breast Height) and the importance value index (IVI) of trees and shrubs.

##### **5.1.4.1. Density of trees and shrubs**

The density of trees and/or shrubs in different DBH classes was recorded per for a total of 1627 individuals. The results show that the highest number of individuals (57.77%) were in the lower DBH classes (between 2.5 to 10 cm) and the least (12.78%) in the higher classes (greater than 20.01 cm). The results also show that there was a comparatively higher woody species density (493 individuals ha<sup>-1</sup>) compared to what has been obtained in other related vegetation studies. For example, in Masha-Andaracha Moist Afromontane forest a density of 385.7 individuals ha<sup>-1</sup> was obtained (Kumelachew Yeshitela and Taye Bekele, 2003). However, it was lower than the 500 individuals ha<sup>-1</sup> obtained in Bibita (Gura Ferda) forest (Dereje Denu, 2006) and 638 individuals ha<sup>-1</sup> in Chilimo forest (Tamrat Bekele, 1993).

In general, when the three zones of the study forest (i.e. the transitional zone, buffer zone, and core zone) are compared, the core zone has the highest density. Feyera Senbeta (2006) reported that due to the continuous management of the wild coffee in the semi-forest (which is mainly found in the transitional and buffer zones in this case); the coffee system suppresses woody plant regeneration and reduces tree density. The results in this study confirm this.

##### **5.1.4.2. Diameter at Breast Height (DBH) distribution**

The results in this study shown that as the DBH class size increases, the number of individuals gradually decreases though with slight differences, and vice-versa. Most individuals were found to be distributed in the first two lower diameter classes i.e. 2.5 to 10 cm and 10.01 to 20 cm. These two classes accounted for about 61.55% of individuals recorded. However, with increase of DBH class, there was a considerable decrease in the number of individuals recorded.

Since it is apparent that the majority of species in the two study areas had most of their individuals in the lower DBH classes, this is an indication that the forest has a good regeneration potential, though mainly in the core zone where disturbance was relatively less when compared to the buffer and transitional zones. The reason for this could be the selective cutting down of various species of a specific size class as commonly practiced. Similar findings were also reported by Tamrat Bekele (1993), Feyera Senbeta and Demel Teketay (2003), Feyera Senbeta (2006) and Birhanu Kebede *et al.* (2014) for the most moist montane and other dry forests in Ethiopia.

#### **5.1.4.3. Height-class distribution**

The results in this study have shown that, the lower height classes i.e. Class I (2- 6 m) and Class II (6.01 – 10 m) accounted for about 66.67% of height-class distribution in the studied forests while the higher classes, i.e. Classes VII (26.01 – 30 m) and VIII (>30 m) accounted for less than 5%. The high proportion of small-sized woody plants may be attributed to over exploitation of the higher class size trees in the forest. This agrees with findings reported by Feyera Senbeta (2006) on the predominance of small sized woody plant in the forest.

#### **5.1.4.4. Basal area (BA)**

The total basal area of plants with DBH greater than 2.5 cm in forests of the study area was 75.47 m<sup>2</sup> ha<sup>-1</sup>. Despite some woody plants being the dominant species with high frequency, density, and cover abundance their contribution to the basal area was very low. This can be attributed to them having extremely thin stems. *Albizia grandibracteata*, *Albizia gummifera*, and *Celtis africana* together with 8 other species (Table 9) were responsible for the biggest proportion of the total basal area in this study.

What is apparent is that most woody individuals in the lower DBH classes contributed the least to the total basal area in the study area whereas those in the higher DBH classes made the highest contribution. When the total basal area in this study is compared with what has been reported for other studies carried out in more or less related vegetation types, it was found to be either lower or higher. Hence, it was lower than that of Masha-Andaracha (Kumelachew Yeshitela and Taye Bekele, 2003), and Menna Angetu (Ermias

Lulekal *et al.*, 2008b) forests but relatively higher than that of the Bibita (Gura Ferda) (Dereje Denu, 2006), and Chato (Feyera Abdena, 2010) forests.

#### **5.1.4.5. Importance value index (IVI)**

The results on IVI in the study area showed that, the top ten woody plant species contributed about 85.39% of the total present of the importance value index. These species include *Albizia grandibracteata*, *Apodytes dimidiata*, *Argomuelleria microphylla*, *Celtis africana*, *Coffea arabica*, *Cordia africana*, *Croton macrostachyus*, *Dracaena afromontana*, *Olea welwitschii*, and *Sapium ellipticum* had the highest importance value index (IVI). This might be due to the high contribution of these plants for economic, environmental and cultural values including demand for timber productions and shade. Mueller-Dombois and Ellenberg (1974) pointed out that the high IVI shows their importance.

#### **5.1.5. Ethnobotany of plants used in traditional medicine to treat humans ailments**

##### **5.1.5.1. Taxonomic diversity of plants used in human ethnomedicine**

A good number of plants reported in this study were used for the preparation of different remedies used in traditional medicine. In many countries, especially what are often referred to as Least Developed Countries (LDC), it is widely known that local communities recognize and accept traditional medicine as one way of in treating human and livestock ailments. Even though the study area face many challenges in the form of cultural crises, socio-political instability and environmental changes resulting mainly from deforestation, there is still a rich body of indigenous knowledge on the use of medicinal plants, in the local communities. Much of this knowledge has been passed verbally from generation to generation.

The presence of a total of 172 species of medicinal plants spread in 139 genera and 66 families attests to the widespread use of traditional medicine in the local communities of the study area. The taxonomic diversity of medicinal plants in the two districts of the study area is almost the same since they share a similar type of ecology. Other studies done in Ethiopia (e.g. Haile Yineger *et al.*, 2008a; Fisseha Mesfin *et al.*, 2009; Tesfaye Hailemariam Bekalo *et al.*, 2009; Anteneh Belayneh *et al.*, 2012; Samuel Zeraburk and

Gidey Yirga, 2012; Getachew Addis *et al.*, 2013a; Ketema Tolossa *et al.*, 2013; Mohammed Adefa and Seyoum Getaneh, 2013; Getnet Chekole, 2017; Gemedi Abdela and Mustefa Sultan, 2018) have also registered an equally high diversity of medicinal plants.

The high abundance and species richness of the Asteraceae could be attributed to the fact that the wide range of distribution in Ethiopia (Mesfin Tadesse, 2004). Some studies (e.g. Haile Yineger *et al.*, 2007; Fisseha Mesfin *et al.*, 2009; Tesfaye Awas and Sebsebe Demissew 2009; Tesfaye Hailemariam Bekalo *et al.*, 2009; Mirutse Giday *et al.*, 2010; Mathewos Agize *et al.*, 2013a; Mohammed Adefa and Seyoum Getaneh 2013; Anteneh Belayneh and Negussie Bussa 2014; Ermias Lulekal *et al.*, 2014) and Engedasew Andarge *et al.*, 2015) have reported similar findings, though others (e.g. Mirutse Giday and Gobena Ameni, 2003; Debela Hunde *et al.*, 2006; Haile Yineger *et al.*, 2008b; Teferi Flatie *et al.*, 2009; Tesfaye Hailemariam *et al.*, 2009; Habtamu Hailu and Zemedede Asfaw, 2011; Anteneh Belayneh *et al.*, 2012; Maroyi, 2013; Balcha Abera, 2014; Tugume *et al.*, 2016; Tilahun Teklehaymanot, 2017; Gemedi Abdela and Mustefa Sultan, 2018) have reported the family Fabaceae to have the highest number of medicinal plants species.

From the documented medicinal plants which used for the treatment of human ailments only, family Lamiaceae had the highest number of species with 14 (16%) species followed by Asteraceae with 10 species. Similar results were reported in Ethiopia (e.g. Abraha Teklay *et al.*, 2013; Ketema Tolossa *et al.*, 2013; Abiyu Enyew *et al.*, 2014) on the dominance of family Lamiaceae. The first choice of family Lamiaceae by traditional healers could be an indication of their high abundance and/or availability, familiarity and other socio-cultural reasons. According to Stepp and Moerman (2002) as cited in Abiyu Enyew *et al.* (2014), family Lamiaceae are typically characterized by having aromatic secondary metabolites, which could be effective in curing different ailments.

Although there were other most commonly used growth habit such as shrubs and trees mentioned by some other researchers, the present result in agreement with other ethnomedicinal survey carried out in various parts of Ethiopia (Fisseha Mesfin *et al.*, 2009; Tesfaye Awas and Sebsebe Demissew, 2009; Mirutse Giday *et al.*, 2010; Abraha Teklay *et al.*, 2013; Abiyu Enyew *et al.*, 2014; Engedasew Andarge *et al.*, 2015) which indicated that the herbs as the most frequently used. In the present study, the majority of remedies were prepared from leaf parts soon the targeted medicinal remedy harvested in

the form of fresh material of plant parts. Such activity probably done due to the traditional healers was commonly adapted to the preparation of medicinal remedy undertake automatically when the disease happened

#### **5.1.5.2. Methods of preparation and modes of administration**

With regard to remedy preparations, a considerable number of the medicinal plants were prepared by helping different techniques in which some remedy were prepared from various medicinal plants whereas others from single species. Moreover, majority of remedy preparation was done in the form of pounding 22.4% followed by chopping 16% and concoction 11%. Of different modes of applications of remedy for the treatment of only human ailments, the highest proportions of these remedy application was done internally through oral 46.5% followed by external through dermal application 29.07% and nasal 12.79%.

In fact, sources revealed that the most frequently used mode of remedy administration is oral which could be associated with high contribution in rapid physiological reaction with the causative agents and enhance the therapeutic potential of traditional medicinal plants remedies. Besides, occasionally, combinations of either two or more modes such as both oral and/or dermal, oral and /or nasal, and dermal and/or nasal of administrations at the same time also applied. Our result in agreement with other ethnomedicinal studies carried out in different parts of Ethiopia (Mirutse Giday *et al.*, 2009; Samuel Zeraburk and Gidey Yirga, 2012; Kalayu Mesfin *et al.*, 2013; Ketema Tolossa *et al.*, 2013; Mohammed Adefa and Seyoum Getaneh, 2013).

#### **5.1.5.3. Types of human diseases treated, their diagnosis and how remedies are prepared and used**

Different disease types including gastro-intestinal ailments, abdominal/stomach disorders, diarrhea, taeniasis, hepatitis, fibril illness and other dermatological diseases were frequently reported. Many of these can be linked to sanitation problems mainly hygiene and lack of pure water. While carrying out diagnosis of ailments, the local traditional healers looked out for various symptoms like change of body temperature, and appetite. The present result in line with other findings reported in various parts of Ethiopia done by Mirutse Giday *et al.*, 2003; Ermias Lulekal *et al.*, 2008b; Fisseha Mesfin *et al.*, 2009;

Tesfaye Hailemariam (2009); Seyoum Getaneh and Zerihun Girma (2014) on diagnosis of human ailments.

This result also showed that pounding, chopping, concoction, chewing and homogenizing as the most frequently reported. This could be related with cultural adaptation of the local communities of the Yayo and Hurumu districts. The additives were important for increasing the efficacy (increasing curing potential of the remedy), reducing a negative or harmful effect or for giving good odor and taste. Teferi Gedif and Hahn (2003) showed that the use of honey in traditional formulations might have a direct therapeutic effect on various diseases. The most frequently cited mode of application was oral followed by external (e.g. rubbing on the infected parts), and nasal were commonly practical in the study area which also direct or indirect relation with that of types of the diseases. Sometimes the dosage determination was not consistent rather it depends on the judgment of traditional healer, but they have been used some common units of measurement cup of coffee and tea in order to determine the dosage at the time administrations which also cultural adaptation of the communities.

It is very common and the traditional healers confirmed that giving the traditional medicine for a pregnant woman is forbidden. Similar results were also reported in Ethiopia (e.g. Mirutse Giday *et al.*, 2003; Ermias Lulekal *et al.*, 2008b) on giving traditional medicine is not allowed for a pregnant woman, but other study in Mali (Nordeng *et al.*, 2013) indicated that giving traditional medicine for pregnant woman is possible for some diseases such as common cold, nausea, and skin problem which might be due to cultural differences of the traditional healers.

#### **5.1.5.4. Habitats of medicinal plants in the study area used for treating human diseases**

The medicinal plants used by traditional healers in the study area were harvested from different habitats in different localities. The biggest proportion (38%) was harvested only from the wild particularly in the natural forests, and comparatively, the tended to be used more than those growing in homegardens and/or cultivated. The abundance of medicinal plants in the wild than in other habitats e.g. home gardens, farmlands and roadsides can be explained by the fact that, generally, the proportion of human activities within forests compared to that experienced in the other habitats is normally lower and hence, its impact

far much less. This agrees with the results from other studies conducted in Ethiopia e.g. Yalew Addisie *et al.* (2012), Abraha Teklay *et al.* (2013), Kalayu Mesfin *et al.* (2013), Mathewos Agize *et al.* (2013a), Moa Megersa *et al.* (2013), Abiyu Enyew *et al.* (2014) and Engedasew Andarge *et al.* (2015), in La Paz and El Alto in Bolivia (Mac'ia *et al.*, 2005) and Southern Italy (Scherrer *et al.*, 2005). Like already indicated medicinal plants were also obtained by the traditional healers from homegardens, from plants growing in and around their houses and also sometimes as plants intercropped with other crops in the field.

Belachew Wassihun *et al.* (2003) and Tefera Mekonen *et al.* (2015) observed that homegardens provide a number of services to local communities including quick and easy access to foodstuffs and as sources of remedies to treat various illnesses while Yang *et al.* (2014) suggested that homegardens are also ecologically and culturally important systems for cultivating medicinal plants, and thus, communities worldwide should manage medicinal plants in homegardens to support their wellbeing and livelihoods. Interestingly other studies conducted in Loma and Gena Bosa districts of Dawro zone (Mathewos Agize *et al.*, 2013b) and Sabata town (Habtamu Hailu and Zemedede Asfaw, 2011) in Ethiopia showed that home gardens tended to have a higher taxonomic diversity and richness of plants used for various purposes contrary to the findings of this study. They are considered as ecosystems that cater for the immediate needs of household members primarily with respect to food, health, fuel, spiritual requirements and other socio-economical needs (Bajpai *et al.* 2013). Generally, their significance arises from the fact that they help communities manage, utilize and transmit ecological and ethnomedical knowledge to support the well being of households (Yang *et al.*, 2014).

#### **5.1.5.5. Growth habit diversity of plants used in traditional medicine**

Herbs accounted for about 37.8% of the medicinal plants used followed by shrubs (33.14%) and trees (17.44%). It appears like most traditional healers preferred using material obtained from herbs than shrubs or trees to formulate their medicines. The high usage of herbs by traditional healers is probably an indication of their abundance especially in the moist environment where the study area is located. It is also practical and confirmed from the traditional healers harvesting of more herbs that used for traditional medicine is due to easy accessibility, and cultural adaptation of the local communities.

Other studies (e.g. Haile Yineger *et al.*,2007; Tigist Wondimu *et al.*,2007; Fisseha Mesfin *et al.*, 2009; Tesfaye Awas and Sebsebe Demissew,2009; Mirutse Giday *et al.*,2010; Yalew Addisie *et al.*,2012; Abraha Teklay *et al.*,2013; Bajpai *et al.*,2013; Abiyu Enyew *et al.*,014; Engedasew Andarge *et al.*,2015; Melesse Maryo *et al.*,2015 and Tefera Mekonen *et al.*, 2015) have also shown a preference for herbs by traditional healers in making their remedies.

However, other studies (e.g. Kebu Balemie *et al.*, 2004; Debela Hunde *et al.*, 2006; Ermias Lulekal *et al.*, 2008a; Fisseha Mesfin *et al.*, 2009; Anteneh Belayneh *et al.*, 2012; Ermias Lulekal *et al.*, 2014; Alemayehu Kefalew *et al.*, 2015; Mersha Ashagre *et al.*, 2016a; Getnet Chekole, 2017; Tilahun Teklehaymanot, 2017) have also reported a dominance of shrubs in the formulation of medicinal remedies largely due to the fact that they are not affected by seasonal variations in climate and hence are available all year round apart from being drought resistant.

#### **5.1.5.6. Plant parts used in the formulation of traditional remedies**

Different parts of medicinal plants are normally used by traditional healers and local communities to prepare herbal remedies. In this study, the parts of medicinal plants that were most commonly used by the traditional healers in the preparation of remedies were the leaves. This can be attributed to their easy accessibility, harvesting (Voeks and Robert, 2004) and processing, besides the fact that leaves are known to accumulate pharmacologically active agents (Ocvirk *et al.*, 2013).

This agrees with other findings conducted in Ethiopia e.g. Balcha Abera (2003), Mesfin Tadesse *et al.* (2005), Tigist Wondimu *et al.* (2007), Tesfaye Awas and Sebsebe Demissew (2009), Tesfaye Hailemariam Bekalo *et al.* (2009), Abraha Teklay *et al.* (2013), Moa Megersa *et al.* (2013), Mohammed Adefa and Seyoum Getaneh (2013) as leaves were the frequently plant parts used in the traditional remedies preparations. The use of leaves in the formulation of herbal remedies is also common in many other countries (Fitsum Dulo and Amere Mekonnen, 2017). In general, the harvesting and processing of leaves is considered easy and does not do much damage to a plant compared to the harvesting of roots or the whole plant.

However, other studies conducted in different parts of Ethiopia (e.g. Debela Hunde *et al.*, 2006; Ermias Lulekal *et al.*, 2008; Fisseha Mesfin *et al.*, 2009; Teferi Flatie *et al.*, 2009; Tilahun Teklehaymanot and Mirutse Giday, 2010; Ketema Tolossa *et al.*, 2013; Abiyu Enyew *et al.*, 2014 and Ermias Lulekal *et al.*, 2014) have shown that the roots are sometimes the most frequently harvested and used plant part for remedy preparation. The possible explanation could be that apart from remaining in the soil even during long dry seasons, especially in shrubs, roots are also easily accessible, (Ketema Tolossa *et al.*, 2013).

The drawback to the roots being preferred to other parts in the preparation of herbal remedies is that the harvesting of roots usually puts great pressure on and threatens the very survival of the plants targeted. Fresh plant parts were mostly preferred in the preparation of herbal remedies even though some proportion (37.86%) was also prepared using a combination of both fresh and dry material or using dried material alone (6.33%). Studies done in Ethiopia (e.g. Debela Hunde *et al.*, 2006; Haile Yineger *et al.*, 2007; Tesfaye Hailemariam *et al.*, 2009 and Yalew Addisie *et al.*, 2012) have also come up with similar findings. .

#### **5.1.5.7. Methods used to prepare and administer herbal remedies**

Out of all methods used for preparing herbal remedies, pounding was the most used method accounted 35%. In most cases it involved pounding of fresh leaves. Crushing (16.86%) and powdering (11.3%) ranked second and third respectively. After being pounded or prepared using any of the other methods like crushing, the plant materials were often mixed in either cold or hot water. These results agree with the findings of Tilahun Teklehaymanot and Mirutse Giday (2010) indicated that pounding was predominant methods of remedy preparation.

The prepared remedies were often administered either through internal or external routes. Internal modes of administration mostly involved the remedies being taken orally or through the nose such as internal parasite and stomachache. Administration through the mouth was the most commonly used route, accounting for about 37.2% of the cases. On certain occasions two or more routes of administering a remedy are normally used for a single ailment for example hemorrhoids and skin rash. This agrees with the results from other studies conducted in Ethiopia e.g. Mesfin Tadesse *et al.* (2005), Fisseha Mesfin *et*

*al.* (2009), Mirutse Giday *et al.* (2009), Mirutse Giday *et al.* (2010), Samuel Zeraburk and Gidey Yirga (2012), Kalayu Mesfin *et al.* (2013) Ketema Tolossa *et al.* (2013), Moa Megersa *et al.* (2013), and in Mabira Central Forest Reserve of Uganda Tugume *et al.* (2016) indicated oral application is most frequently practiced.

#### **5.1.5.8. How dosages of traditional herbal remedies are administered**

The local communities of Yayo and Hurumu districts use a number of techniques and unit measurements to make decisions on the quantity of herbal remedy that can be administered. The determination of dosage and the length of time the medicine would be taken seemed to depend on the age and physical strength of the patient, type of ailment and severity of the disease. It is worthy to note that despite the traditional healers having good knowledge and the means to decide on the dosage to be given to their patients, there were differences and inconsistencies in the dosages given for similar ailments by different healers. This can be considered to be a serious drawback to the use of traditional medicines. Studies conducted in Ethiopia (Abiyot Berhanu *et al.*, 2006; Ermias Lulekal *et al.*, 2008a; Haile Yineger *et al.*, 2008a; Mirutse Giday *et al.*, 2010; Melesse Maryo *et al.*, 2015) reported similar results on the dosage determination.

#### **5.1.5.9. Marketing of medicinal plants**

From the market survey conducted, it was apparent that traditional medicines were being sold in the markets within the study area. However, many respondents indicated that despite the herbal remedies being sold in the markets, the traditional healers preferred selling them in their homes instead of the open markets. A good example is seen in the Zay community where medicinal plants are hardly found in the local markets, except for *Hagenia abyssinica*, which is sold because it is not found around that area (Mirutse Giday *et al.*, 2003). The way the local traditional healers conduct their treatment is that they prepare the remedies at home soon after the occurrence of an ailment is reported to them.

However, that notwithstanding, there are certain medicinal plants, for example, *Echinops kebericho* and *Glinus lotoides* that were very common and were found in many markets within the study area. Tigist Wondimu *et al.* (2007) reported that the local communities living around “Dheera” town brought some medicinal plants to the local market for sale. In this study other plants such as *Allium sativum*, *Aframomum corrorima*, *Cucurbita*

*pepo*, *Ruta chalepensis*, *Lippia adoensis*, *Linum usitatissimum* and *Ocimum basilicum* besides their medicinal importance, were also sold in the markets for other use as stimulants or food flavourings. Other studies conducted in Ethiopia have also revealed that medicinal plants sold in the markets do also have other multiple uses (Dessaegn Dessisa, 2001; Kebu Balemie and Fassil Kebebew, 2006; Debela Hunde Feyssa *et al.*, 2011). *Catha edulis* is often sold in the markets as a stimulant and also as medicinal and is the most valued for income-generation (Tefera Mekonen *et al.*, 2015).

#### **5.1.5.10. Preference ranking**

In this study some medicinal plant species were reported as the most preferred by the traditional healers, for example *Allium sativum* and *Ruta chalepensis* for their better healing potential mainly in order to treat human disease. Other study conducted in Ethiopia (e.g. Abiyot Berhanu *et al.*, 2006) has revealed that a preference of *Allium sativum* is very common for the treatment of both human and livestock diseases. The preference of particular plant species could be due to healing potential of that medicinal plant and multiple uses of the species (Thomas, 2008).

#### **5.1.5.11. Direct matrix ranking**

From the Direct matrix ranking analysis eight (8) different use-categories for plants in the study area viz., medicinal use, food, commercial, animal fodder, furniture making, firewood, charcoal production, and construction were identified. *Cordia africana* and *Apodytes dimidiata* were the top two species recorded for the highest number of uses. Observations made during the study showed that the two species, and especially *C. africana* has high quality wood that can be put to various use e.g. timber production, furniture making, construction etc. However, the ongoing pressure on the species, due to overharvesting, is likely to threaten their existence in the wild. A study conducted in the Tigray Region of Ethiopia among different cultural groups also found that *C. africana* was the most preferred multipurpose species (Abraha Teklay *et al.*, 2013).

This study has revealed that there are a number of medicinal plants which are over-exploited for non-medicinal uses e.g. firewood, construction and others. The harvesting of firewood for local consumption or to process into charcoal and the harvesting of timber construction have been identified as the major threats for to various species. Thomas

(2008) observed that an existence of species is often threatened not only by number of use-categories it falls into but also by the method of harvesting and/or harvesting preferences. This further point to the need of appropriate conservation measures being taken to conserve and manage the use of such species whose existence is threatened by unsustainable use.

#### **5.1.5.12. Informant consensus factor (ICF)**

The Informants' Consensus Factor (ICF) values in this study ranged between 0.27 and 0.93. Gastro-intestinal ailments had the highest informant consensus value followed by external ailments (skin diseases) and evil spirits (Table 14). The highest value of ICF indicates that there was relatively strong agreement among the participants' perception of gastro-intestinal disease with the medicinal plants (Anteneh Belayneh *et al.*, 2012). Tilahun Teklehaymanot and Mirutse Giday (2007) also found a higher ICF value for gastrointestinal disorders. However, other studies have recorded higher ICF values for other diseases. For example Fiseha Mesfin (2007) in his study recorded the highest ICF values for malaria and headaches. The lowest ICF values in this study were 0.38 and 0.37 recorded for rheumatism and hemorrhoids respectively. The low figures are an indication that there was lack of agreement among the informants on their perception of the ailments (Andrade-Cetto and Heinrich, 2011). Thomas (2008) pointed out that the perception of a plants efficacy as an herbal remedy was strongly correlated with the distribution of knowledge about that species, in that some plants are more known because they are more effective therapeutically than others.

#### **5.1.5.13. The relative healing potential of medicinal plants used for treating human ailments**

With regard to the relative therapeutic potential of traditional medicinal plants in this study, the highest fidelity level value was recorded for *Thalictrum rhynchocarpum* about 97% against gastro-intestinal diseases; which also indicated that the medicinal plants that are highly accepted and widely used by the local communities. As the knowledgeable local participants confirmed the local name of the plant is “*Miil-kumee* or *sira bizu*” which indicated that the plant has multiple uses and known by its effective therapeutic potential. *Ocimum lamiifolium* recorded by its efficient healing potential of against

vaginitis and had 96%, whereas *Cucurbita pepo* well-known against ascariasis and taeniasis accounted 95% in particular.

### **5.1.6. Ethnobotany of plants used in traditional medicine to treat animals ailments**

#### **5.1.6.1. Taxonomic diversity of medicinal plants used in animal ethnomedicine**

The traditional healers of Yayo and Hurumu districts have rich knowledge on the use of traditional herbal remedies for the treatment of livestock diseases. However, the number of plants they use for treating animal compared to human diseases, was less. Nevertheless, the findings in this study show that the local communities were highly dependent on traditional medicines for veterinary services a fact that points to the lack of sufficient formal veterinary health services confirming the finding by Fekadu Fullas (2010) that modern veterinary services are not well developed in Ethiopia. In many instances one individual species was used to treat one type of livestock disease but occasionally mixing of two or more plant parts from the same species or a different one against a single disease was also practiced. A good example of this was in the treatment of rabies where different parts belonging to different plants were used.

About forty five (45) species belonging to thirty seven (37) genera distributed in twenty three (23) families were identified as being used to treat livestock diseases only. The species diversity and richness recorded in this study seems to be higher than that recorded in other similar previous studies e.g. Girmay Zenebe *et al.* (2012), Gidey Yirga *et al.* (2012), Gebremedhin Gebrezgabiher *et al.* (2013) and Yibrah Tekle (2014). However, it is also lower when compared to finding by Mirutse Giday and Gobena Ameni (2003), Haile Yineger *et al.* (2007) and Mirutse Giday and Tilahun Teklehaymanot (2013). The Solanaceae had the highest number of species followed by the Asteraceae and Rubiaceae (Table 16). The dominance of the Solanaceae was also reported by Yibrah Tekle (2014) from Gedeo Zone though Mirutse Giday and Gobena Ameni (2003).

### **5.1.6.2. Growth habit diversity and habitat of medicinal plants used in ethnoveterinary practice**

Shrubs accounted for more than half (51%) of the plants used in ethnoveterinary practice. Herbs came second followed by trees and climbers in that order. Other studies (e.g. Debela Hunde *et al.*, 2006; Ermias Lulekal *et al.*, 2008a; Fisseha Mesfin *et al.*, 2009; Mirutse Giday and Tilahun Teklehaymanot, 2013; Ermias Lulekal *et al.*, 2014 and Kebede Tirfessa *et al.*, 2017) have also reported the dominance of shrubs, but others e.g. Haile Yineger *et al.* (2007) have shown the dominance of herbs. Most of the herbal remedies used for treating livestock traditionally were harvested from the wild, in their natural habitats though others were also harvested from other habitats like homegardens, farmlands and roadsides. Getachew Addis *et al.* (2001), Kebu Balemie *et al.* (2004), Haile Yineger *et al.* (2007) and Yibrah Tekle (2014) reported harvesting plants for similar purposes from the wild as well.

### **5.1.6.3. Types of livestock diseases treated and diagnosis methods**

Traditional healers in the study area commonly treated cattle, sheep, goats, poultry, horse, mule, donkey, dogs, and cats using herbal remedies. During diagnosis of livestock ailments, the traditional healers carry out different activities to check for symptoms. They commonly do their diagnosis prior to identifying the species to be used for treatment, the method of preparing the remedies, every aspect of remedy application and dosage determination. The method the traditional healers use for diagnosis is use of visual inspection in which they look for symptoms like whether the animal grazes or not its drinking pattern, checking the condition of parts such as the tongue, neck, skin for abnormalities Teferi Flatie *et al.* (2009) reported comparable results. The commonly reported animals' ailments from both Yayo and Hurumu districts were Blackleg (*Bushoofuu*) and Trypanosomiasis (*Gandii*). These diseases cause various effects on livestock including decreasing their productivity of milk and meat.

#### **5.1.6.4. Plant parts used for preparing herbal medicines used in ethnoveterinary**

In many of cases, the traditional healers frequently harvested roots which comprised about 33.3 % of all plant parts used in ethnoveterinary. This was followed by leaves which could either be fresh and/or dry. Other similar studies have also found the roots to be the predominant plant part used by traditional healers (Getachew Addis *et al.*, 2001; Mirutse Giday and Gobena Ameni, 2003; Haile Yineger *et al.*, 2007; Ermias Lulekal *et al.*, 2014; Feyisa Kuma *et al.*, 2015). This could be related to the ready availability of roots during both the dry and wet seasons.

However, the harvesting of roots and tree bark other than leaves is known to be destructive and has a negative impact on medicinal plants and consequently on their future accessibility if not replaced. Leaves have also emerged in other studies as the major plant part used for the preparation of traditional veterinary healthcare remedies (Gebremedhin Gebrezgabiher *et al.*, 2013; Mirutse Giday and Tilahun Teklehaymanot 2013 and Yibrah Tekle, 2014).

#### **5.1.6.5. Methods used to prepare ethnoveterinary remedies, their modes of administration and dosage**

The traditional healers used various methods to prepare herbal remedies for the treatment of livestock diseases. Crushing and powdering took the biggest proportion of methods used at 21.8% and 20.53% respectively. Other methods used included pounding, homogenization, squeezing, chopping, preparation of concoctions, fumigation, rubbing and burning. For instance, to prepare the remedy for treating leech infestation, most of the time, fresh leaf parts of *N. tabacum* are crushed, pounded, then homogenized with salt while adding water as solvent. This is normally administered to cattle once or twice either via the mouth or nose or both. Gidey Yirga *et al.* (2012), Melesse Maryo *et al.* (2015) and Hana Tadesse and Ashebir Balcha (2018) in their studies found crushing was the most common method used for preparing ethnoveterinary remedies which agrees with the findings in this study.

There are occasions when some ethnoveterinary remedies are prepared from a mixture of different parts of the same plant. For instance, about 6.7% were prepared from mixing bark and leaf and 4.4% using latex and tuber. The use of dried and fresh plant parts in preparing the remedies was the most prevalent among the healers followed by the use of fresh parts only. The use of dried parts alone was the least preferred. The choice of whether to use fresh or dried plant parts to prepare the herbal ethnoveterinary remedies depended on the availability of the plant species to be used and socio-cultural beliefs of the traditional healer and local communities.

Once prepared the herbal remedies were administered through different routes. The most frequently reported route of administration was topical, in which the medication was applied directly on the surface of the part of the body being treated. This comprised 33.40% of all methods used. Oral and nasal routes were the other routes of administration that were commonly used. There were occasions when the healers needed to use more than one route of application depending on the types of disease for effective treatment. Hence, 15.6% of ethnoveterinary remedy administration done by the traditional healers used both the dermal and oral routes whereas 8.9% were made via the nose and mouth for given diseases. In other studies conducted in Ethiopia (e.g. Gidey Yirga *et al.*, 2012; Ermias Lulekal *et al.*, 2008a; Mirutse Giday and Tilahun Teklehaymanot, 2013) the oral route of application had the highest proportion of cases. The healers determined the dosage of the herbal remedies to be given to livestock using different techniques and instruments depending on the type and seriousness of the disease being treated. For example glasses with different size. However, there was no consensus or standard among the healers on how dosage determination was to be done.

#### **5.1.6.6. Medicinal plants preferred for treating some livestock diseases**

In the preference ranking *T. rhynchocarpum* emerged first an indication that among the traditional healers it was considered the one with the highest potential to be effective in treating livestock diseases such as blackleg. Other medicinal plants that were preferred by the healers against the blackleg disease were *P. linearifoli*, *C. simensis*, *S. incanum*, and *J. abyssinicum* in that order. *D. torrid* was ranked as the least preferred which indicated that a particular traditional medicinal plant may be mentioned by informants for any use other than for remedy compared to with those highly preferred (Andrade-Cetto and Heinrich, 2011).

### **5.1.7. Acquisition and transfer of traditional knowledge on medicinal plants**

The local traditional healers indicated that they acquired their knowledge from various sources but most often from their parents, mainly the father. Hence, a lots of time the healers transfer their indigenous knowledge to their sons when they are old enough. This approach of knowledge acquisition and transfer is widespread and accepted in the culture of the local community. Through this approach precious indigenous traditional knowledge is transferred from generation to generation orally though without any written records. How such knowledge is transfer is influenced by factors such as age, sex, modernization and education background/level. In most cases, this kind of knowledge is normally held by the older and knowledgeable traditional healers. However, the young people in the communities did not seem to give much attention and/or interest to it.

Like indicated earlier the other factors that influence the acquisition and transfer of indigenous knowledge in the study area lack of interest of the young generation and the traditional healers want to keep it secret due to their fear of societal recognition which also related with incomes obstacle (Fisseha Mesfin *et al.*, 2009). The transfer of indigenous knowledge by traditional healers to their daughters was also in most cases considered impractical except in rare cases. This was possibly due to the fact that the healers feared women would not keep the secrets of their indigenous knowledge. That notwithstanding some there were women in the local communities who were still found to be rich in knowledge including knowledge of traditional medicine. This was considered to have been acquired from their daily experiences and activities. Other studies carried out in Ethiopia (e.g. Hareya Fassil, 2005; Ermias Lulekal, 2014; Fisseha Mesfin *et al.*, 2014; Engedasew Andarge *et al.*, 2015) have also indicated similar results.

## **5.1.8. Ethnobotany of wild edible plants occurring in the study area**

### **5.1.8.1. Taxonomic diversity of wild edible plants in the study area**

The rural populations in Ethiopia consume and have a rich knowledge of wild edible plants which still an integral part of the different cultures in the country. In the southern part of the country, wild edible plants are used as dietary supplements and a means of survival during times of food shortage (Tilahun Teklehaymanot and Mirutse Giday, 2010). Utilization of wild plants for food is essential in time of food shortage and also other times. Hence, the use of edible wild plants is part and parcel of the lives of local people in different parts of Ethiopia (Getachew Addis *et al.*, 2005).

In Yayo and Hurumu districts the local people used local plant resources for various purposes including as food during normal times and also times of seasonal food shortages. A total of 22 wild or semi-wild species were documented as edible. The Moraceae had the highest number of species followed by the Cucurbitaceae, Flacourtiaceae, Polygonaceae, Rosaceae, and Solanaceae in that order. Tena Regassa *et al.* (2014) and Uprety *et al.* (2012) also reported the dominance of family Moraceae among wild edible plants in their studies. However, Ermias Lulekal *et al.* (2011) and Tinsae Bahru *et al.* (2013) found the Fabaceae had the highest number of edible wild species.

### **5.1.8.2. Growth habit diversity of wild edible plants in the study area**

The biggest proportions of wild edible plants were trees followed by shrubs, climbers contributed and herbaceous in that order. The local communities seem to prefer trees to shrubs, climbers and herbs as sources wild edible food. This could be attributed to the fact that trees are more accessible and often have food that can be consumed at different periods of the year, for example *Ficus sur* and *Syzygium guineense* subsp. *afromontanum*. Uprety *et al.* (2012) also found that trees dominated as sources of wild edible food in their study. However, other studies (e.g. Kebu Balemie and Fassil Kebebew, 2006; Ermias Lulekal *et al.*, 2011; Tinsae Bahru *et al.*, 2013; Tena Regassa *et al.*, 2014; Getu Alemayehu *et al.*, 2015; Mersha Ashagre *et al.*, 2016b) have also established shrubs as the dominant source of wild edible food indicated that.

### **5.1.8.3. Parts of wild plants used as food**

The local communities use different parts of from wild plants as foods. In this study the wild plant parts that were used the most as food were the fruits accounting for about (82%) of the parts used. The remaining parts contributed below five percent. Other inventories of wild edible plants (e.g. Campbell 1987; Fentahun Mengistu and Hager, 2008; Ermias Lulekal *et al.*, 2011; Uprety *et al.*,2012; Tinsae Bahru *et al.*,2013; Tena Regassa *et al.*,2014 and Mersha Ashagre *et al.*,2016b) have also found that the fruit is the part of wild edible plants that is most harvested and consumed.

Campbell (1987) observed that the importance of wild fruits in the diet depends to a large extent on their availability though harvesting and consuming them excessively has also been shown to have negative effects on the regeneration and sustainability of plants as fruits comprise a major step in the reproductive process (Uprety *et al.*, 2012). Nevertheless, as indicated by Debela Hunde Feyssa *et al.* (2011) wild edible plants still provide a significant amount of nutrients and energy to supplement household diets and can also be a good source of income. Thus, wild edible plants and specifically fruits collected from the wild, apart from being nutritionally superior to cultivated fruits, play a significant role in the food and nutrient security of different communities, especially rural poor communities (Ajesh *et al.*, 2012).

The inventories carried out in various parts of the world have shown that the contribution made by wild edible plants during times of food scarcity is enormous and of cultural significance (Motlhanka *et al.*, 2008). Almost all the fruits of wild plants (90%) documented in this study were consumed raw without any processing. However, other edible parts such as leaves, the stem, and tubers were taken after being processed mainly by cooking and/ or roasting.

### **5.1.8.4. Preference ranking of wild edible plants**

*S. guineense*, *F. sur*, and *E. schimperi* emerged as the most well-known and preferred wild edible plants by the local communities. Other wild edible plants whose fruits were consumed during different seasons include *C. spinarum*, *C. africana*, and *R. steudneri* Belachew Wassihun *et al.* (2003) also found that the edible fruits of *C. spinarum*, and *C. africana* provided supplementary food in different seasons including during times of

drought in Southern Ethiopia.

### **5.1.9. Medicinal and wild edible Plants used as fodder and for construction**

Fifty two (52) of plant species were reported to be important as fodder for livestock in the study area. *Asparagus africanus*, *Abutilon longicuspe*, and *Buddleja polystachya*, *Combretum paniculatum* were some examples reported plant species used as fodder. The Asteraceae had the highest percentage of species followed by Fabaceae. Of these, the majority were herbs at 38% of the total which can be attributed to their high abundance in the study area. The use of plants as construction material is a very important use category in the local communities since in one way or the other it relates to their daily livelihoods.

The Fabaceae, Moraceae and Oleaceae were the top three families with the highest number of species that were being used as construction material by the local communities of Yayo and Hurumu districts. In many plants, the stem was the part that was most prevalently being used as material for construction. The use of the stem especially from trees which represent about 57% of all the plants that are being used for construction poses a challenge for the survival of trees in the study area. Virtually almost all the species (96%) that are used as construction material in the study area were being harvested from the wild in the natural forests. This kind of exploitation that primarily focuses on the stem is destructive and could be a serious threat to the sustainability of the forests in the area.

### **5.1.10. Use value of plants most cited for use as construction material**

Members of the local communities mostly cited twelve species they preferred to use in construction. These are the species that made high contribution in use value particularly as construction material. Hence, the top five  $UV_{mat}$  were documented for *C. africana*, *A. dimidiata*, *C. africana*, *A. grandibracteata* and *O. capensis* subsp. *macrocarpa*. *Cordia africana* (Waddeessa in Afaan Oromoo) is one of the most preferred and highly valued species because of its multiple uses which include timber production and use as construction material. It also plays a significant role in socio-economic and environmental uses e.g. income-generation, shade provision, coffee agroforestry and improving soil

fertility and erosion. It is all these uses that make *C. africana* that lead to the popularity of such species.

#### **5.1.11. Plants used as fuel**

This use category relates to those plants that are mainly used for charcoal production and as firewood. Trees were the most preferred for fuelwood taking up more than fifty percent (50%) of all plants species documented in this use category. The stems followed by roots and leaves, in that order, were the most preferred plant parts for use as fuel. Thomas (2008) also indicated that stems are the most preferred plant parts and great influence on the sustainability of plants.

#### **5.1.12. Plants used for Social and environmental purposes**

The local communities of Yayo and Hurumu districts have rich knowledge of using plants for social purposes such as rituals, religious and spiritual functions, and other known societal ceremonies. Amare Getahun (1974) has shown that the use of plants in religious ceremonies has been practiced in different parts of Ethiopia. One hundred and five (105) species were identified for such uses with the Euphorbiaceae and Fabaceae being dominant in terms of species richness. Among these, trees dominated followed by shrubs, herbs and climbers.

Thus, there were specific species that were used for specific social functions whereas others had multiple uses. For example, the seed and leaves of *P. dodecandra* are used for producing soap for washing clothes while *E. schimperi*, *V. bipontini* and *V. leopoldi* are used for making beehives. The bark of *E. capensis* and the leaves of *O. europea* subsp. *cuspidata* are used for fumigation. Although *C. arabica* and *N. tabacum* are used as stimulants, the one that is very popular is *C. edulis* which also has other multiple uses. Thus, *C. edulis* is grown in homegardens, farmlands and even around forests in the study area. Even coffee plantations have been cut and replaced with this species.

Of the families identified for environmental use, the Fabaceae had the highest number of species. A number of species in this family are used in the improvement of soil fertility through nitrogen fixation. For instance, *A. grandibracteata* in the Fabaceae is preferred for its multiple uses e.g. in agroforestry as shade for coffee plants and improvement of

soil fertility through the production of leaf litter in homegardens and in farmlands. Other species such as *E. brucei*, *P. abyssinica*, and *E. tirucalli* play a significant role in fence making besides its medicinal and other social uses. The use of *E. tirucalli* for fence also reported by Belachew Wassihun *et al.* (2003).

### **5.1.13. Poison plants**

The local communities also categorized some plants as poison. These can be poison to human beings (mainly children), livestock, and/ or to both. For example, the latex (milky exudates) in *E. ampliphylla*, and *P. linearifolia* were found to be very toxic to humans and livestock. *Datura stramonium* was also found to be toxic to both humans and cattle if not properly handled. Ermias Lulekal (2014) also found that *D. stramonium* was likely to cause death because of its toxicity. *Tagetes minuta* is used as a repellent against various insects such as ants, lice, and fleas while *M. ferruginea* subsp. *ferruginia* is useful as a repellent against rats and also important in traditional fishing techniques. *Trifolium semipilosum* is also known as a poison to livestock and mainly cattle if eaten before birth takes place and/or when a newborn is not well matured.

## 5.2. Conclusion

Yayo and Hurumu districts are characterized by rich plant diversity and traditional medicinal and wild edible plants. A total of 298 different plant species were documented in this study 5% are endemic to Ethiopia and 53 are new records for the Ilu Abba Bor (IL) Floristic Region. More than half (57.7%) of these are used as traditional medicine for human and livestock ailments while 22(7.5%) used as wild edible plants. The Asteraceae is the most species rich family followed by the Fabaceae. Six plant community types were identified and community 5 (*Rubus apetalus* - *Vernonia amygdalina*) was the richest diversity implying relatively low pressure while community 4 (*Apodytes dimidiata* - *Croton macrostachyus*) the poorest in diversity indicating under high pressure. The analysis of the vegetation structure shows majority of the species are in the lower DBH classes implying good regeneration of the forests. Four species viz., *C. africana*, *A. grandibracteata*, *A. dimidiata* and *C. africana* were found to have high importance value indices (IVI) due to high economic and environmental contribution and a good implication of these species under threat and needs to give prior attention to conserve. Herbs were comparatively the most abundant (39%) of the species documented and implying selective logging trees for various uses such as for timber production.

The local communities of Yayo and Hurumu districts have rich knowledge on the traditional uses of medicinal plants to treat different human and livestock ailments and wild plants for food. The majority of medicinal plants (96%) were harvested from wild implying high human pressure around homegarden compared to the forest. Marketability of some medicinal and other useful plants was reported in this study indicating the traditional healers preferred selling traditional medicine around their homes which could be associated with cultural background of the communities. *Allium sativum*, *R. chalepensis*, and *C. arabica* were reported for their better healing potential mainly in order to treat human diseases. Blackleg and Trypanosomiasis were the most common livestock ailments and *T. rhynchocarpum* was the preferred species against gastrointestinal and also had the highest informant consensus values. The extensive use of plants not just as traditional medicine but for various other uses such as firewood and timber production is likely to be a threat to the forests of the study area. Some wild edible plants of the study area play significant roles including *S. guineense*, *F. sur*, and *E. schimperi* which also emerged as the most preferred by the local communities as a result

these plants are under pressure. The traditional healers acquired and transferred their knowledge most often from their parents, mainly from father to son orally without any written records but influenced by factors such as age, sex, modernization, and education background. The connotation is the transfer of such indigenous knowledge is diminishing time to time.

### **5.3. Recommendations**

The following recommendations are forwarded from the results of this study:

- Integrated conservation measures; sustainable uses of plants (medicinal and wild edible) should be applied by all stakeholders including local communities, government and non-government institutions.
- Establishing botanical gardens, applying *in-situ* and *ex-situ* conservation strategies are suggested.
- Conservation priority could be applied mainly for community 4, multipurpose used plant species e.g. *Cordia africana*, *C. africana*, *P. africana*, and *A. dimidiata*.
- Raising awareness and providing necessary professional support for the local communities on cultivation, management, sustainable use medicinal and wild edible plants were suggested.
- Further phytochemical study of primarily chosen medicinal plant species such *Th. rhyncho carpum*, *C. pepo* and nutrition analysis of highly preferred WEPs such as *S. guineense*, *F. sur*, and *E. schimperi* were recommended.
- Acknowledging the traditional healers; licensing and giving recognitions for their indigenous knowledge; supplying professional supports and encouraging their knowledge to do with together modern health care of the study area for wider use were recommended.

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## Appendices

**Appendix 1.** The semi-structured interview prepared and used in our study

The aim of this questionnaire is to investigate ethnobotanical study of traditional medicinal plants in Yayo and Hurumu districts.

Instruction: Read the questions carefully and answer the correct one and encircle it from the given alternative and write the necessary information where required.

1. Full name of the respondent: \_\_\_\_\_

2. Sex: A. Male B. Female Age \_\_\_\_\_

3. Marital status of the respondent:

A. Married B. Unmarried C. Divorce D. Widowed

4. Religion of the respondent:

A. Muslims B. Waqefata C. Catholic D. Protestant E. Orthodox

5. Educational level/back ground of the respondent:

A. Not formally educated B. 1 to 4th grade educated C. 5 to 8th grade educated  
D. 9 to 12th grade educated E. Certificate F. Diploma G. Degree and above

6. Occupation/main job/: \_\_\_\_\_

7. Date \_\_\_\_\_ Residence Area/village/ \_\_\_\_\_

8. Locality: district \_\_\_\_\_, kebele \_\_\_\_\_, Village \_\_\_\_\_

9. Number of families /households members \_\_\_\_\_

10. What are the main useful plants in your local area? Write in the table below accordingly.

S/N	Local/vernacular name of the plants	Growth habit (Habit)	Habitat/collected from	Use

11. Please mention the major human and livestock ailments at your area?

13. What are the most common diseases for both humans and livestock in your surroundings?
14. Mention the symptom/ indication of particular ailment in your area when happened
15. Explain the way that the local communities control, prevent, and treat a given disease around your area
16. How do you treat human and livestock diseases or both?
17. List which plant(s) do you utilizes for treating the given ailment/disease; mention the plant(s), vernacular name, Disease treated by the plant and other uses if any.

S/N	Local name(s) of the plant(s)	Botanical name(s)	Family	Habit	Disease treated by the plants	Other uses	Description

18. From where the plants grow and obtained (habitat/locality)? Wild, cultivated, or both
19. Which plant parts used frequently for remedy preparations?
20. The condition of remedy preparation frequently used was/were: Fresh only, dried only, either fresh or dried, there is possibility to be used both fresh and dried
21. Which preparation technique is commonly practiced in the study area for various diseases types? concoction, Boiling, crushing, pounding, decoction, homogenizing, infusion, powdering, rubbing, burning, chewing, chopping, squeezing (Underline)
22. How the dosage of remedy is determined/ decided? Is it consistant among different healers? How does it work among different age groups, sex, and patient status?
23. What are the conservation statuses of medicinal plants? What are main causes for such problems? Is there any conservation practices carried out/ planned in the future?
24. What are the additional uses of these medicinal plants? Edible, Food, firewood, charcoal, construction, cultural, ritual, forage, and others (Underline)
25. How they play role in the economic activities of the local communities? What about the marketability of the medicinal plants?

26. How the indigenous knowledge transfer from generation to generation? What are hindering factors in this case?

**Appendix 2.** List of all plant species in the study areas with their respective family, growth habit, local name and collection number

S/N	Species name	Family name	Habit	Local name ( <i>Afaan Oromoo</i> )	Co. No
1.	<i>Abutilon longicuspe</i> Hochst. ex A. Rich.	Malvaceae	S	Qoricha buutii	GG.9
2.	<i>Acacia abyssinica</i> Hochst.	Fabaceae	T	Sondii	GG.248
3.	<i>Acacia lahai</i> Steud. and Hochst. ex Benth.	Fabaceae	S	Sondii gurraacha	GG.76
4.	<i>Acalypha ornata</i> A. Rich.	Euphorbiaceae	C	Gurgubbee	GG.200
5.	<i>Acanthus eminens</i> C. B. Clarke	Acanthaceae	S	Kosorruu	GG.224
6.	<i>Acanthus polystachius</i> Delile	Acanthaceae	S	Kosorruu	GG.304
7.	<i>Acanthus pubescens</i> (Oliv.) Engl.	Acanthaceae	S	Kosorruu	GG.73
8.	<i>Achyranthes aspera</i> L.	Amaranthaceae	H	Caaggoo	GG.13
9.	<i>Achyrospermum schimperi</i> (Hochst. ex Briq.) Perkins.	Lamiaceae	H	Qoricha michii	GG.245
10.	<i>Acmella caulirhiza</i> Del.	Asteraceae	H	Gororsaa Fardaa	GG.121
11.	<i>Acmella caulirhiza</i> Del.	Asteraceae	H	Gutichaa	GG.72
12.	<i>Aframomum corrorima</i> (Braun) Jansen	Zingiberaceae	H	Ogeyyoo	GG.192
13.	<i>Agave sisalana</i> Perrine ex Engl.	Agavaceae	H	Argeessa	GG.314
14.	<i>Ajuga integrifolia</i> Buch.- Ham. ex D. Don	Lamiaceae	S	Harma guusa	GG.114
15.	<i>Albizia grandibracteata</i> Taub.	Fabaceae	T	Alalee	GG.46
16.	<i>Albizia gummifera</i> (J.F. Gmel.) C. A. Sim.	Fabaceae	T	Hambabbeessa	GG.85

S/N	Species name	Family name	Habit	Local name ( <i>Afaan Oromoo</i> )	Co. No
17.	<i>Allium cepa</i> L.	Alliaceae	H	Qullubbii adii	GG.67
18.	<i>Allium sativum</i> L.	Alliaceae	H	Qullubbii diimaa	GG.69
19.	<i>Allophylus abyssinicus</i> (Hochst.) Radlkofer	Sapindaceae	T	Gur-sadee/Malqaqqoo	GG.187
20.	<i>Amaranthus caudatus</i> L.	Amaranthaceae	H	Aramaa	GG.78
21.	<i>Amaranthus hybridus</i> L.	Amaranthaceae	H	***	GG.227
22.	<i>Amaranthus spinosus</i> L.	Amaranthaceae	H	Aramaa1	GG.163
23.	<i>Andropogon abyssinicus</i> Fresen.	Poaceae	H	Baallammii	GG.86
24.	<i>Annona squamosa</i> L.	Annonaceae	S	Giishxaa	GG.277
25.	<i>Antiaris toxicaria</i> Lesch.	Moraceae	T	Dangii	GG.42
26.	<i>Apodytes dimidiata</i> E. Mey. ex Arn.	Icacinaceae	T	Wandabiyoo	GG.171
27.	<i>Argemone mexicana</i> L.	Papaveraceae	H	***	GG.310
28.	<i>Argomuelleria microphylla</i> Pax	Euphorbiaceae	S	Abraangoo	GG.55
29.	<i>Asparagus africanus</i> Lam.	Asparagaceae	C	Sariitii	GG.284
30.	<i>Artemisia abyssinica</i> Sch. Bip. ex A. Rich.	Asteraceae	H	Qooddoo	GG.249
31.	<i>Azadirachta indica</i> A. Juss.	Meliaceae	T	Bayi bayi	GG.104
32.	<i>Berkheya spekeana</i> Oliv.	Asteraceae	H	***	GG.316
33.	<i>Bersama abyssinica</i> Fresen.	Melanthaceae	S	Lolchiisaa	GG.44
34.	<i>Bidens pilosa</i> L.	Asteraceae	H	Maxxaannee	GG.239
35.	<i>Bidens prestinaria</i> (Sch.-Bip.) Cuf.	Asteraceae	H	Maxxaannee	GG.89
36.	<i>Blighia unijugata</i> Bak.	Sapindaceae	T	Cuucuu	GG.64
37.	<i>Bougainvillea spectabilis</i>	Nyctaginaceae	C	Habaaboo	GG.299

S/N	Species name	Family name	Habit	Local name (Afaan Oromoo)	Co. No
	Witld.				
38.	<i>Brassica carinata</i> A. Br.	Brassicaceae	H	Goomanaa	GG.151
39.	<i>Brassica oleracea</i> L.	Brassicaceae	H	Goomanaa	
40.	<i>Brucea antidysenterica</i> J. F. Mill.	Simaroubaceae	S	Qomonyoo	GG.272
41.	<i>Brugmansia suaveolens</i> (Humb. & Bonpl. ex Willd.) Bercht. & Presl	Solanaceae	S	Hababoo	GG.297
42.	<i>Buddleja polystachya</i> Fresen.	Loganiaceae	S	Qawwisa (Nafaaree adii)	GG.31
43.	<i>Caesalpinia decapetala</i> (Roth) Alston	Fabaceae	C	Qonxir	GG.283
44.	<i>Calpurnia aurea</i> (Ait.) Benth.	Fabaceae	S	Ceekaa	GG.35
45.	<i>Canna indica</i> L.	Cannaceae	H	Biqiltuu Callee	GG.218
46.	<i>Capsicum annum</i> L.	Solanaceae	H	Darraa	GG.92
47.	<i>Capsicum frutescens</i> L.	Solanaceae	H	Daabbusee	GG.169
48.	<i>Carduus nyassanus</i> (S. Moore) R. E. Fries	Asteraceae	H	Luudee	GG.259
49.	<i>Carduus schimperi</i> Sch. Bip. ex A. Rich.	Asteraceae	H	Baala waraantii	GG.246
50.	<i>Carica papaya</i> L.	Caricaceae	T	Pappayyaa	GG.93
51.	<i>Carissa spinarum</i> L.	Apocynaceae	S	Hagamsa	GG.269
52.	<i>Cassipourea malosana</i> (Baker) Alston.	Rhizophoraceae	T	Lookoo adii	GG.57
53.	<i>Catha edulis</i> (Vahl) Forssk. ex Endl.	Celastraceae	S	Jimaa/Caatii	GG.266
54.	<i>Caylusea abyssinica</i> (Fresen.) Fisch. & Mey.	Resedaceae	H	Qoricha garaa ciniinna (Lootuu)	GG.27
55.	<i>Celosia anthelminthica</i> Asch. in Schweinf.	Amaranthaceae	H	Amaasilloo	GG.216

S/N	Species name	Family name	Habit	Local name ( <i>Afaan Oromoo</i> )	Co. No
56.	<i>Celtis africana</i> Burm.	Ulmaceae	T	Cayii	GG.63
57.	<i>Chionanthus mildbraedii</i> (Gilg. & Schellenb.) Stearn	Oleaceae	T	Karra waayyuu	GG.62
58.	<i>Cissus quadrangularis</i> L.	Vitaceae	C	Mar'immaan Jaartii	GG.183
59.	<i>Citrus limon</i> (L.) Burm.f.	Rutaceae	S	Loomii	GG.94
60.	<i>Citrus sinensis</i> (L.) Osb.	Rutaceae	S	Burtukaana	GG.290
61.	<i>Clausena anisata</i> (Willd.) Benth.	Rutaceae	S	Ulmaayyaa	GG.48
62.	<i>Clematis hirsuta</i> Perr. & Guill.	Ranunculaceae	C	Hidda-Fiitii	GG.8
63.	<i>Clematis simensis</i> Fresen.	Ranunculaceae	C	Hidda-Fiitii	GG.203
64.	<i>Clerodendrum myricoides</i> (Hochst.) Vatke	Lamiaceae	S	Maraasisaa	GG.14
65.	<i>Coccinia abyssinica</i> (Lam.) Cogn.	Cucurbitaceae	C	Ancootee	GG.202
66.	<i>Coffea arabica</i> L.	Rubiaceae	S	Buna	GG.155
67.	<i>Colocasia esculenta</i> (L.) Schott	Araceae	H	Godarree	GG.94
68.	<i>Combretum paniculatum</i> Vent.	Combretaceae	WC	Baggee	GG.136
69.	<i>Commelina benghalensis</i> L.	Commelinaceae	H	Laaluuncaa	GG.36
70.	<i>Conyza bonariensis</i> (L.) Cronq.	Asteraceae	H	Gororsa	GG.18
71.	<i>Corchorus olitorius</i> L.	Tiliaceae	H	Oopxii	GG.213
72.	<i>Cordia africana</i> Lam.	Boraginaceae	T	Waddeessa	GG.159
73.	<i>Cotula anthemoides</i> L.	Asteraceae	H	Gutichaa fakkaatuu	GG.91
74.	<i>Crassocephalum rubens</i> (Juss. ex Jacq.) S. Moore	Asteraceae	H	***	GG.255

S/N	Species name	Family name	Habit	Local name (Afaan Oromoo)	Co. No
75.	<i>Crinum abyssanicum</i> Hochst ex A. Rich.	Amaryllidaceae	H	Shunkurtii waraabessaa	GG.98
76.	<i>Crotalaria incana</i> L.	Fabaceaea	H	Atarii waraabessaa	GG.236
77.	<i>Croton macrostachyus</i> Del.	Euphorbiaceae	T	Bakkannisa	GG.282
78.	<i>Cucurbita pepo</i> L.	Cucurbitaceae	C	Buqqee Seexanaa	GG.95
79.	<i>Cyathula uncinulata</i> (Schrad.) Schinz.	Amaranthaceae	H	Maxxannee	GG.243
80.	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	H	Marga	GG.232
81.	<i>Cynoglossum amplifolium</i> Hochst. ex A. DC. in DC.	Boraginaceae	H	Abbaa giddii	GG.211
82.	<i>Cynoglossum densefoliatum</i> Chiov.	Boraginaceae	H	Maxxannee Daalattii	GG.34
83.	<i>Cynoglossum geometricum</i> Bak. and Wright	Boraginaceae	H	Maxxaannee	GG.162
84.	<i>Cynoglossum lanceolatum</i> Forssk.	Boraginaceae	H	Abbaa giddii	GG.186
85.	<i>Cyperus digitatus</i> Roxb.	Cyperaceae	H	Qunnii	GG.75
86.	<i>Cyphostemma adenocaula</i> (Steud .ex A.Rich.) Descoings ex Wild & Drummond	Vitaceae	C	Hidda	GG.96
87.	<i>Cyphostemma cyphopetalum</i> (Fresen.) Descoings ex Wild & Drummond	Vitaceae	C	Hidda	GG.138
88.	<i>Dalbergia lactea</i> Vatke	Fabaceae	S	Seexxoo	GG.141
89.	<i>Datura stramonium</i> L.	Solanaceae	H	Asaangira	GG.100
90.	<i>Daucus carota</i> L.	Apiaceae	H	Kaarootii	GG.108
91.	<i>Desmodium repandum</i> (Vahl) DC.	Fabaceaea	H	***	GG.261
92.	<i>Dicrocephala integrifolia</i> (L. f.) O. Kuntze	Asteraceae	H	***	GG.257

S/N	Species name	Family name	Habit	Local name (Afaan Oromoo)	Co. No
93.	<i>Digitaria velutina</i> (Forssk.) P. Beauv.	Poaceae	H	***	GG. 180
94.	<i>Diospyros abyssinica</i> (Hiern) F. White	Ebenaceae	T	***	GG. 216
95.	<i>Discopodium penninervum</i> Hochst.	Solanaceae	S	Ajooftuu	GG. 102
96.	<i>Dombeya torrida</i> (G.F. Gmel.) P. Bamps	Sterculiaceae	S	Daannisaa	GG.251
97.	<i>Dovyalis abyssinica</i> (A. Rich.) Warb.	Flacourtiaceae	S	Koshmoo	GG. 115
98.	<i>Dovyalis caffra</i> (Hook. f. & Harv.) Hook. f.	Flacourtiaceae	S	Koshmoo	GG.303
99.	<i>Dracaena afromontana</i> Mildbr.	Dracaenaceae	S	Sarxee xiqqoo	GG.106
100.	<i>Dracaena steudneri</i> Engl.	Dracaenaceae	T	Sarxee guddaa	GG.65
101.	<i>Dregea schimperi</i> (Decne) Bullock	Asclepiadaceae	S	Hidda goorri'saa	GG.160
102.	<i>Drymaria cordata</i> (L.) Schultes	Caryophyllaceae	H	Qoricha hadhaaha/Hanc abbi	GG.116
103.	<i>Dryopteris lewalleana</i> Pic.Serm	Dryopteridaceae	H	Baala balleessaa	GG.80
104.	<i>Echinops kebericho</i> Mesfin	Asteraceae	H	Qarabichoo	GG. 152
105.	<i>Ehretia cymosa</i> Thonn.	Boraginaceae	T	Ulaagaa	GG.50
106.	<i>Ekebergia capensis</i> Sparrm.	Meliaceae	T	Somboo	GG.264
107.	<i>Embelia schimperi</i> Vatke	Myrsinaceae	WC	Haanquu	GG.296
108.	<i>Ensete ventricosum</i> (Welw.) Cheesman	Musaceae	H	Warqee	GG.107
109.	<i>Eriosema scioanum</i> Avetta	Fabaceae	H	Gurra Hantuutaa	GG.230
110.	<i>Erythrina brucei</i> Schweinf.	Fabaceae	T	Waleensuu	GG.260

S/N	Species name	Family name	Habit	Local name (Afaan Oromoo)	Co. No
111.	<i>Erythrococca trichogyne</i> (Muel.Arg.) Prain	Euphorbiaceae	S	Ceekaa biroo	GG.194
112.	<i>Eucalyptus camaldulensis</i> Dehnh.	Myrtaceae	T	Bargamoo diimaa	GG.238
113.	<i>Euphorbia abyssinica</i> Gmel.	Euphorbiaceae	T	Hadaamii fakkaata	GG.109
114.	<i>Euphorbia ampliphylla</i> Pax	Euphorbiaceae	T	Adaamii	GG.289
115.	<i>Euphorbia pulcherrima</i> Klotzsch.	Euphorbiaceae	S	Habaaboo	GG.305
116.	<i>Euphorbia tirucalli</i> L.	Euphorbiaceae	S	Cadaa	GG.288
117.	<i>Ficus mucuso</i> Ficalho	Moraceae	T	Harbuu biraa	GG.317
118.	<i>Ficus ovata</i> Vahl	Moraceae	T	Doqoo	GG.68
119.	<i>Ficus sur</i> Forssk.	Moraceae	T	Harbuu	GG.110
120.	<i>Ficus thonningii</i> Blume	Moraceae	T	Dambii	GG.82
121.	<i>Ficus vallis-choudae</i> Del.	Moraceae	T	Harbuu fakkaattii	GG.308
122.	<i>Ficus vasta</i> Forssk.	Moraceae	T	Qilimxoo	GG.321
123.	<i>Flacourtia indica</i> (Burm.f) Merr.	Flacourtiaceae	T	Akuukkuu	GG.201
124.	<i>Foeniculum vulgare</i> Mill	Apiaceae	H	Dimbilala (Insiilaa)	GG.105
125.	<i>Galiniere saxifraga</i> (Hochst.) Bridson	Rubiaceae	S	Buniitii	GG.111
126.	<i>Galinsoga parviflora</i> Cav.	Asteraceae	H	***	GG.250
127.	<i>Galium spurium</i> L.	Rubiaceae	C	Saam'ee	GG.164
128.	<i>Geranium arabicum</i> Forssk.	Geraniaceae	H	Damakasee lafaa(Qoricha arrabduu)	GG.127
129.	<i>Geranium</i> spp.	Geraniaceae	S	Qoricha arrabduu	GG.233

S/N	Species name	Family name	Habit	Local name (Afaan Oromoo)	Co. No
130.	<i>Girardinia bullosa</i> (Steudel) Wedd.	Urticaceae	S	Doobbii	GG.112
131.	<i>Glinus lotoides</i> L.	Molluginaceae	H	Waggartii	GG.177
132.	<i>Glycine max</i> (L.) Merr.	Fabaceae	H	Akuwaaatarii	GG.208
133.	<i>Grevillea robusta</i> R. BR.	Proteaceae	T	Giraavilliyaa	GG.263
134.	<i>Grewia ferruginea</i> Hochst. ex A. Rich.	Tiliaceae	S	Laanqessaa	GG.83
135.	<i>Guizotia scabra</i> (Vis.) Chiov.	Asteraceae	H	Hadaa/keelloo	GG.309
136.	<i>Guizotia schimperi</i> Sch.Bip.ex Walp.	Asteraceae	H	Hadaa/Tuufoo	GG.306
137.	<i>Hallea rubrostipulata</i> (K. Schum.) J.-F. Leroy	Rubiaceae	T	Hoboo	GG.139
138.	<i>Helianthus annuus</i> L.	Asteraceae	H	Suufii	GG.113
139.	<i>Hibiscus rosa-sinensis</i> L.	Malvaceae	S	Habaaboo	GG.190
140.	<i>Hippocratea africana</i> (Willd.) Loes.	Celastraceae	C	Geebboo qalamee	GG.146
141.	<i>Hippocratea goetzei</i> Loes.	Celastraceae	C	Hidda gafarsaa	GG.70
142.	<i>Hygrophila schulli</i> (Hamilt.) M.R. & S.M. Almeida	Acanthaceae	H	Araba dubartii	GG.237
143.	<i>Hypericum quartinianum</i> A. Rich.	Hypericaceae	S	Solee	GG.117
144.	<i>Hypoestes forskaolii</i> (Vahl) R. Br.	Acanthaceae	H	Darguu	GG.247
145.	<i>Hypoestes triflora</i> (Forssk.) Roem. & Schult.	Acanthaceae	H	Darguu	GG.118
146.	<i>Ilex mitis</i> (L.) Radlk.	Aquifoliaceae	T	Mi'eessaa	GG.204
147.	<i>Impatiens rothii</i> Hook. f.	Balsaminaceae	H	***	GG.178
148.	<i>Indigofera arrecta</i> Hochst. ex A. Rich.	Fabaceae	S	Heennaa	GG.30
149.	<i>Ipomoea batatas</i> (L.) Lam.	Convolvulacea	H	Dammee	GG.300

S/N	Species name	Family name	Habit	Local name ( <i>Afaan Oromoo</i> )	Co. No
		e			
150.	<i>Ipomoea purpurea</i> (L.) Roth.	Convolvulaceae	C	***	GG.298
151.	<i>Iresine herbstii</i> Lindl.	Amaranthaceae	H	Habaaboo	GG.154
152.	<i>Jacaranda mimosifolia</i> D. Don	Bignoniaceae	T	Jakaraandaa	GG.129
153.	<i>Jasminum abyssinicum</i> Hochst. ex DC.	Oleaceae	C	Hidda Ichilbee (Michilbee)	GG.285
154.	<i>Juniperus procera</i> L.	Cupressaceae	H	Gaattiraa	GG.120
155.	<i>Justicia schimperiana</i> (Hochst. ex Nees) T. Anders.	Acanthaceae	S	Dhummuugaa	GG.87
156.	<i>Kalanchoe densiflora</i> Rolfe	Crassulaceae	H	Bosoqqee	GG.172
157.	<i>Kalanchoe petitiiana</i> A. Rich.	Crassulaceae	H	Bosoqqee	GG.166
158.	<i>Kosteletzkya adoensis</i> (Hochst. ex A. Rich.) Mast.	Malvaceae	H	Hincinnii	GG.168
159.	<i>Lagenaria siceraria</i> (Molina) Standl.	Cucurbitaceae	C	Buqqee seexanaa	GG.181
160.	<i>Laggera crispata</i> (Vahl) Hepper & Wood	Asteraceae	H	***	GG.271
161.	<i>Landolphia buchananii</i> (Hall.f.) Stapf.	Apocynaceae	C	Hidda geeboo	GG.140
162.	<i>Lantana camara</i> L.	Verbenaceae	S	Miidhaan dubartii	GG.281
163.	<i>Leucas martinicensis</i> (Jacq.) R. Br.	Lamiaceae	H	Noobbee	GG.132
164.	<i>Leucas martinicensis</i> (Jacq.) R. Br.	Lamiaceae	H	Luuddee	GG.241
165.	<i>Linum usitatissimum</i> L.	Linaceae	H	Talbaa	GG.274
166.	<i>Lippia adoensis</i> Hochst. ex Walp.	Verbenaceae	S	Kusaayee	GG.206
167.	<i>Lycopersicon esculentum</i> Mill.	Solanaceae	H	Timaatimii	GG.229

S/N	Species name	Family name	Habit	Local name ( <i>Afaan Oromoo</i> )	Co. No
168.	<i>Maesa lanceolata</i> Forssk.	Myrsinaceae	S	Abbayyii	GG.270
169.	<i>Malva verticillata</i> L.	Malvaceae	H	Qoricha hoola	GG.173
170.	<i>Mangifera indica</i> L.	Anacardiaceae	T	Maangoo	GG.205
171.	<i>Maytenus addat</i> (Loes.) Sebsebe	Celastraceae	T	Kombosha	GG.56
172.	<i>Maytenus arbutifolia</i> (A.Rich.) Wilczek	Celastraceae	S	Hacaacii	GG.179
173.	<i>Maytenus gracilipes</i> (Welw. ex Oliv.) Exell subsp. <i>arguta</i> (Les.) Sebsebe	Celastraceae	S	Kombolcha (Hacaacii)	GG.262
174.	<i>Maytenus undata</i> (Thunb.) Blakelock	Celastraceae	T	Goggee (kombolcha)	GG.40
175.	<i>Medicago polymorpha</i> L.	Fabaceae	H	Qoricha hadhaaha biraa	GG.10
176.	<i>Mentha spicata</i> L.	Lamiaceae	H	Nanaa	GG.97
177.	<i>Millettia ferruginea</i> subsp. <i>ferruginia</i> (Hochst.) Bak.	Fabaceae	T	Sootaloo	GG.125
178.	<i>Mimusops kummel</i> A. DC.	Sapotaceae	T	Qolati	GG.43
179.	<i>Momordica foetida</i> Schumach.	Cucurbitaceae	C	Hinbayee	GG.279
180.	<i>Morus alba</i> L.	Moraceae	T	Goraa faranjii	GG.291
181.	<i>Musa x paradisiaca</i> L.	Musaceae	H	Muzii	GG.315
182.	<i>Myrsine africana</i> L.	Myrsinaceae	S	Qacamee	GG.220
183.	<i>Nerium oleander</i> L.	Apocynaceae	S	***	GG.119
184.	<i>Nicotiana tabacum</i> L.	Solanaceae	H	Tamboos	GG.302
185.	<i>Nuxia congesta</i> KBr. ex Fresen.	Loganiaceae	S	Qawwisa (Nafaaree gurracha)	GG.292
186.	<i>Ochna holstii</i> Engl.	Ochnaceae	T	Lookoo wasoo	GG.51

S/N	Species name	Family name	Habit	Local name ( <i>Afaan Oromoo</i> )	Co. No
187.	<i>Ocimum basilicum</i> L.	Lamiaceae	H	Bossobilaa	GG.153
188.	<i>Ocimum lamiifolium</i> Hochst. ex. Benth.	Lamiaceae	S	Damakasee	GG.219
189.	<i>Ocimum urticifolium</i> Roth	Lamiaceae	S	Hancabbii	GG.235
190.	<i>Ocotea kenyensis</i> (Chiov.) Robyns & Wilczek	Lauraceae	T	Goggee	GG.189
191.	<i>Olea capensis</i> L. subsp. <i>macrocarpa</i> (C.A.Wright) Verdc.	Oleaceae	T	Gagamaa	GG.60
192.	<i>Olea europea</i> L. subsp. <i>cuspidata</i> (Wall. ex G.Don) Cif.	Oleaceae	T	Ejersa	GG.287
193.	<i>Olea welwitschii</i> (Knohl.) Gilg & Schellenb.	Oleaceae	T	Bahaa	GG.71
194.	<i>Olinia rochetiana</i> A. Juss.	Oliniaceae	T	Soolee	GG.176
195.	<i>Oplismenus hirtellus</i> (L.) P. Beauv.	Poaceae	H	Qacaa	GG.49
196.	<i>Oxalis radicata</i> A. Rich.	Oxalidaceae	H	Lootuu lafaa	GG.128
197.	<i>Paullinia pinnata</i> L.	Sapindaceae	C	Hidda gafarsaa	GG.137
198.	<i>Passiflora incarnata</i> L.	Passifloraceae	C	Lo'a	GG.88
199.	<i>Pavonia urens</i> Cav.	Malvaceae	S	Hincinnii	GG.256
200.	<i>Pelargonium zonale</i>	Geraniaceae	H	Habaaboo	GG.252
201.	<i>Pellaea calomelanos</i> (Sw.) Link	Sinopteridacea e	H	***	GG.311
202.	<i>Periploca linearifolia</i> Quart.- Dillon and A.Rich.	Asclepiadaceae	C	Aannannoo	GG.254
203.	<i>Persea americana</i> Mill.	Lauraceae	T	Abokaadoo	GG.276
204.	<i>Phaseolus vulgaris</i> L.	Fabaceae	H	Dafee/lojoo	GG.275
205.	<i>Phaulopsis imbricata</i> (Forssk.) Sweet	Acanthaceae	H	Darguu	GG.320

S/N	Species name	Family name	Habit	Local name (Afaan Oromoo)	Co. No
206.	<i>Phoenix reclinata</i> Jacq.	Arecaceae	T	Meexxii	GG.79
207.	<i>Phragmenthera macrosolen</i> (A.Rich.) M. Gilbert	Loranthaceae	H	Dheertuu	GG.253
208.	<i>Physalis peruviana</i> L.	Solanaceae	H	Awuxii	GG.150
209.	<i>Phytolacca dodecandra</i> L'Herit	Phytolaccaceae	C	Handoodee	GG.301
210.	<i>Pinus patula</i> Schiede ex Schltdl. & Cham.	Pinaceae	T	'Shuwashuwwe e'	GG.121
211.	<i>Piper capense</i> L. f.	Piperaceae	H	Tunjoo	GG.143
212.	<i>Pittosporum viridiflorum</i> Sims	Pittosporaceae	T	Qassammee	GG.182
213.	<i>Plantago lanceolata</i> L.	Plantaginaceae	H	Qorii simbiraal/Qorx obbii	GG.126
214.	<i>Podocarpus falcatus</i> (Thunb.) Mirb.	Podocarpaceae	T	Birbirsaa	GG.318
215.	<i>Polyopogon viridis</i> (Gouan) Breeistr.	Poaceae	H	Marga biraa	GG.133
216.	<i>Polyscias fulva</i> (Hiern) Harms	Araliaceae	T	Karisoo	GG.122
217.	<i>Pouteria adolfi-friederici</i> Rob. & Gilg	Sapotaceae	T	Qararoo	GG.191
218.	<i>Premna schimperi</i> Engl.	Lamiaceae	S	Urgeessa	GG.5
219.	<i>Prunus africana</i> (Hook.f.) Kalkm.	Rosaceae	T	Hoomii	GG.156
220.	<i>Prunus persica</i> L.	Rosaceae	S	Kookii	GG.286
221.	<i>Psidium guajava</i> L.	Myrtaceae	S	Zayituunaa	GG.101
222.	<i>Psychotria orophila</i> Petit	Rubiaceae	S	Hudduu fardaa	GG.50
223.	<i>Pteridium aquilinum</i> (L.) Kuhn	Dennstaedtiaceae	H	Giixoo	GG.148
224.	<i>Pteris catoptera</i> Kunze	Pteridaceae	H	***	GG.313

S/N	Species name	Family name	Habit	Local name ( <i>Afaan Oromoo</i> )	Co. No
225.	<i>Pterolobium stellatum</i> (Forssk.) Brenan	Fabaceae	C	Harangamaa	GG.312
226.	<i>Pycnostachys abyssinica</i> Fresen.	Lamiaceae	S	Yeroo	GG.74
227.	<i>Pycnostachys meyeri</i> Gurke	Lamiaceae	S	Mata bokkee	GG.207
228.	<i>Rhamnus prinoides</i> L'Herit	Rhamnaceae	S	Geeshoo	GG.197
229.	<i>Rhus natalensis</i> Krauss	Anacardiaceae	T	Xaaxessaa	GG.81
230.	<i>Rhus tenuinervis</i> Engl.	Anacardiaceae	T	Xaaxessaa diimaa	GG.265
231.	<i>Rhynchosia resinosa</i> (Hochst. ex A. Rich.) Bak.	Fabaceae	H	Mannoo	GG.215
232.	<i>Ricinus communis</i> L.	Euphorbiaceae	S	Qobboo	GG.223
233.	<i>Rosa x richardii</i> Rehd.	Rosaceae	S	Tsigeradaa	GG.267
234.	<i>Rosmarinus officinalis</i> L.	Lamiaceae	H	Yesiga metibesha	GG.278
235.	<i>Rubus apetalus</i> Poir.	Rosaceae	C	Goraa	GG.198
236.	<i>Rubus steudneri</i> Schweinf.	Rosaceae	C	Goraa	GG.268
237.	<i>Rumex abyssinicus</i> Jacq.	Polygonaceae	S	Qoricha sabata waaqayyoo	GG.28
238.	<i>Rumex nepalensis</i> Spreng.	Polygonaceae	H	Timijjii	GG.12
239.	<i>Rumex nervosus</i> Vahl	Polygonaceae	S	Dhangaggoo	GG.294
240.	<i>Ruta chalepensis</i> L.	Rutaceae	H	Cilaadama	GG.149
241.	<i>Rytigynia neglecta</i> (Heirn) Robyns.	Rubiaceae	S	Mixoo	GG. 242
242.	<i>Saccharum officinarum</i> L.	Poaceae	H	Shonkoraa	GG.123
243.	<i>Salix subserrata</i> Willd.	Salicaceae	S	Alaltuu	GG.195
244.	<i>Salvia merjamie</i> Forssk.	Lamiaceae	H	Qoricha Michii	GG.131
245.	<i>Salvia nilotica</i> Jacq.	Lamiaceae	H	Qoricha waraansaa	GG.1

S/N	Species name	Family name	Habit	Local name (Afaan Oromoo)	Co. No
246.	<i>Sapium ellipticum</i> (Krauss) Pax	Euphorbiaceae	T	Boossuu	GG.134
247.	<i>Satureja paradoxa</i> (Vatke) Engl.	Lamiaceae	H	Baadu Furdis (Kefoo sa'aa)	GG.209
248.	<i>Scadoxus multiflorus</i> (Martyn) Raf.	Amaryllidaceae	S	Ija Dhukkubsituu	GG.124
249.	<i>Schefflera abyssinica</i> (Hochst. ex A. Rich.) Harms	Araliaceae	T	Gatamaa	GG.295
250.	<i>Scolopia theifolia</i> Gilg	Flacourtiaceae	T	Rigaa raabaa	GG.170
251.	<i>Senna didymobotrya</i> (Fresen.) Irwin & Barneby	Fabaceae	S	Qoricha keessa fiigaa	GG.33
252.	<i>Senna petersiana</i> (Bolle) Lock	Fabaceae	S	Raamsoo/Qoric ha Capxoo	GG.25
253.	<i>Senna septemtrionalis</i> (Viv.) Irwin & Barneby	Fabaceae	S	Kishkish	GG.165
254.	<i>Sesbania sesban</i> (L.) Merr.	Fabaceae	S	Saspaanaa	GG.161
255.	<i>Setaria megaphylla</i> (Steud.) Th. Dur. & Schinz.	Poaceae	H	Jajjaba/Baballii	GG.210
256.	<i>Sida rhombifolia</i> L.	Malvaceae	H	Karaabaa leencaa	GG.103
257.	<i>Smilax aspera</i> L.	Smilacaceae	Wc	Harangamaa	GG.217
258.	<i>Solanecio gigas</i> (Vatke) C. Jeffrey	Asteraceae	S	Xoongii	GG.130
259.	<i>Solanum adoense</i> Hochst. ex A. Rich.	Solanaceae	S	Hiddii waraabessaa	GG.199
260.	<i>Solanum anguivi</i> Lam.	Solanaceae	S	Hiddii saree	GG.158
261.	<i>Solanum incanum</i> L.	Solanaceae	S	Hiddii loonii	GG.163
262.	<i>Solanum linnaeanum</i> Hepper & Jaeger	Solanaceae	S	Hiddii xiqaa	GG.307
263.	<i>Solanum marginatum</i> L.f.	Solanaceae	S	Hiddii baddaa	GG.163
264.	<i>Solanum nigrum</i> L.	Solanaceae	S	Hiddii gurracha	GG.221

S/N	Species name	Family name	Habit	Local name (Afaan Oromoo)	Co. No
265.	<i>Solanum tuberosum</i> L.	Solanaceae	H	Dinicha	GG.234
266.	<i>Sorghum bicolor</i> L.	Poaceae	H	Bisingaa	GG.225
267.	<i>Spathodea campanulata</i> P. Beauv. subsp. <i>Nilotica</i>	Bignoniaceae	T	Muka habaa	GG.228
268.	<i>Stephania abyssinica</i> Dillin and A. Rich.) Warp.	Menispermaceae	C	Hidda-Kalaalaa	GG.222
269.	<i>Synadenium compactum</i> N. E. Br.	Euphorbiaceae	S	***	GG.66
270.	<i>Syzygium guineense</i> (Willd.) DC. subsp. <i>afromontanum</i>	Myrtaceae	T	Baddeessaa	GG.293
271.	<i>Tagetes minuta</i> L.	Asteraceae	H	Kan ajaawu	GG.226
272.	<i>Teclea nobilis</i> Del.	Rutaceae	S	Hadheessa Kormaa	GG.188
273.	<i>Tecoma stans</i> (L.) Juss.	Bignoniaceae	S	***	GG.61
274.	<i>Thalictrum rhynchocarpum</i> Dill. & A. Rich.	Ranunculaceae	H	Miil-kumee (Serebezu)	GG.3
275.	<i>Tiliacora troupinii</i> Cufod.	Menispermaceae	WC	Hidda Liqixii	GG.77
276.	<i>Tragia uncinata</i> M. Gilbert	Euphorbiaceae	C	Gurgubbee Qamalee	GG.212
277.	<i>Trema orientalis</i> (L.) Bl.	Ulmaceae	S	Saccoo	GG.175
278.	<i>Trichilia dregeana</i> Sond.	Meliaceae	T	Luyyaa	GG.45
279.	<i>Trifolium rueppellianum</i> Fresen.	Fabaceae	H	Siddisa	GG.240
280.	<i>Trifolium semipilosum</i> Fresen.	Fabaceae	H	Siddisa	GG.58
281.	<i>Trilepisium madagascariense</i> DC.	Moraceae	T	Lookoo gurracha	GG.59
282.	<i>Triumfetta rhomboidea</i> Jacq.	Malvaceae	S	Karaabaa	GG.214
283.	<i>Urera hypselodendron</i> (A. Rich.) Wedd.	Urticaceae	S	Laanqisaa	GG.83

S/N	Species name	Family name	Habit	Local name (Afaan Oromoo)	Co. No
284.	<i>Urtica simensis</i> Steudel	Urticaceae	H	Gurgubbee	GG.280
285.	<i>Vangueria volkensii</i> K. Schum.	Rubiaceae	S	Bururi adii	GG.193
286.	<i>Vepris dainellii</i> (Pic-Serm.) Kokwaro	Rutaceae	S	Hadheessa dhaltuu	GG.185
287.	<i>Verbena officinalis</i> L.	Verbenaceae	H	Sanaafica Simbirroo	GG.24
288.	<i>Vernonia amygdalina</i> Del.	Asteraceae	S	Eebicha	GG.273
289.	<i>Vernonia bipontini</i> Vatke	Asteraceae	S	Sooyyoma	GG.144
290.	<i>Vernonia hochstetteri</i> Sch. Bip. ex Walp.	Asteraceae	S	Sooyyoma	GG.135
291.	<i>Vernonia leopoldi</i> (Sch.Bip.) Vatke	Asteraceae	S	Sooyyoma	GG.26
292.	<i>Vernonia myriantha</i> Hook.f.	Asteraceae	S	Sooyyoma gurracha	GG.145
293.	<i>Vernonia rueppellii</i> Sch.Bip. ex Walp.	Asteraceae	S	Reejjii	GG.54
294.	<i>Vernonia thomsoniana</i> Oliv. & Hiern ex Oliv.	Asteraceae	S	Sooyyoma daalattii	GG.231
295.	<i>Vernonia urticifolia</i> A. Rich.	Asteraceae	S	Reejjii	GG.258
296.	<i>Withania somnifera</i> (L.) Dunal	Solanaceae	S	Gizaawwaa	GG.90
297.	<i>Zehneria scabra</i> (Linn.f.) Sond.	Cucurbitaceae	C	Hidda reeffaa	GG.196
298.	<i>Zingiber officinale</i> Roscoe	Zingiberaceae	H	Jinjibila	GG.184

**Keys:** H =Herbs, S =Shrubs, T =Trees, C=climbers, WC=woody climber, \*\*\*= no local name

**Appendix 3.** The number of reported families with respect to their total number of species

<b>No</b>	<b>Family name</b>	<b>Number of species</b>
1.	Asteraceae	27
2.	Fabaceae	24
3.	Solanaceae	16
4.	Lamiaceae	15
5.	Euphorbiaceae	12
6.	Poaceae	11
7.	Moraceae	9
8.	Acanthaceae	7
9.	Amaranthaceae	7
10.	Boraginaceae	7
11.	Malvaceae	7
12.	Rubiaceae	7
13.	Celastraceae	6
14.	Cucurbitaceae	5
15.	Oleaceae	5
16.	Rosaceae	5
17.	Rutaceae	5
18.	Flacourtiaceae	4
19.	Polygonaceae	4
20.	Anacardiaceae	3
21.	Apocynaceae	3
22.	Bignoniaceae	3
23.	Geraniaceae	3
24.	Meliaceae	3
25.	Myrsinaceae	3
26.	Myrtaceae	3
27.	Ranunculaceae	3
28.	Sapindaceae	3
29.	Tiliaceae	3
30.	Urticaceae	3
31.	Verbenaceae	3
32.	Vitaceae	3
33.	Alliaceae	2
34.	Amaryllidaceae	2
35.	Apiaceae	2
36.	Araliaceae	2
37.	Asclepiadaceae	2
38.	Brassicaceae	2
39.	Convolvulaceae	2
40.	Crassulaceae	2
41.	Dracaenaceae	2
42.	Lauraceae	2

<b>No</b>	<b>Family name</b>	<b>Number of species</b>
43.	Loganiaceae	2
44.	Menispermaceae	2
45.	Musaceae	2
46.	Sapotaceae	2
47.	Ulmaceae	2
48.	Zingiberaceae	2
49.	Agavaceae	1
50.	Annonaceae	1
51.	Aquifoliaceae	1
52.	Araceae	1
53.	Arecaceae	1
54.	Asparagaceae	1
55.	Balsaminaceae	1
56.	Cannaceae	1
57.	Caricaceae	1
58.	Caryophyllaceae	1
59.	Combretaceae	1
60.	Commelinaceae	1
61.	Cupressaceae	1
62.	Cyperaceae	1
63.	Dennstaedtiaceae	1
64.	Dryopteridaceae	1
65.	Ebenaceae	1
66.	Hypericaceae/Guttiferae	1
67.	Icacinaceae	1
68.	Linaceae	1
69.	Loranthaceae	1
70.	Melianthaceae	1
71.	Molluginaceae	1
72.	Nyctaginaceae	1
73.	Ochnaceae	1
74.	Oliniaceae	1
75.	Oxalidaceae	1
76.	Papaveraceae	1
77.	Passifloraceae	1
78.	Phytolaccaceae	1
79.	Pinaceae	1
80.	Piperaceae	1
81.	Pittosporaceae	1
82.	Plantaginaceae	1
83.	Podocarpaceae	1
84.	Proteaceae	1
85.	Pteridaceae	1

No	Family name	Number of species
86.	Resedaceae	1
87.	Rhamnaceae	1
88.	Rhizophoraceae	1
89.	Salicaceae	1
90.	Simaroubaceae	1
91.	Sinopteridaceae	1
92.	Smilacaceae	1
93.	Sterculiaceae	1

**Appendix 4.** Medicinal plants documented from the study area, their uses, preparation, and application methods.

Scientific name	Family	Ht	Local name (Afaan)	Pu (Parts)	Cp(Condition)	Ra (Route of application)	Used for	Disease treated	Preparation & Application	Other uses
<i>Abutilon longicuspe</i>	Malvaceae	S	Qoricha buutii	Rt & L	F/D	O/Dm	Hu	Poisoning (Buutii)	Either the fresh and or dried roots and leaves are crushed, pounded and powdered then dissolved in 1Jar of water or 1-2 cup of coffee is taken orally twice per day in the morning and night for 7 consecutive days. At the same time it also used as body lotion or creamed the body focusing around the infected part.	
				Rt & L	F/D	O/Dm	Ls	Poisoning (Buutii)	For livestock all the ways of preparation and the application system is similar the only difference is the dosage in which 1-3 glass is given to cattle daily in the morning and night for 7 days.	
<i>Acacia abyssinica</i>	Fabaceae	T	Sondii	Ba & Rt	F/D	Na	Hu	Evil Spirit (Jinnii)	Both the bark and root crushed the put in the fire fumigated and or inhaled.	
<i>Achyranthes aspera</i>	Amaranthaceae	H	Qoricha Shaan qilaa	Rt	F	O	Hu	Teeth Infection (Dhukkub bii Ilkaanii)	The root part chewed and taken orally for three consecutive days.	
<i>Achyrospermum schimperi</i>	Lamiaceae	H	Qoricha Michi	Wp	F	O / Dm	Hu	Fibril Illness (Dhukkub oota Qaama Ho'isan )	By squeezing and concoction with butter	

Scientific name	Family	Ht	Local name (Afaan)	Pu (Parts)	Cp(Condition)	Ra (Route of application)	Used for	Disease treated	Preparation & Application	Other uses
<i>Acmella caulirhiza</i>	Asteraceae	H	Gororaa Fardaa	Wp	F	O	Hu	Gonorrhoea ( <i>Cophxoo</i> )	By chopping then pounding and decoction. It is taken one cup of coffee for three successive days for the patient and perhaps continued till cured.	
<i>Aframomum corrorima</i>	Zingiberaceae	H	Ogeyyoo	S	F/D	O	Hu	Internal Parasite ( <i>Raamoo Garaa Keessaa</i> ), Stomachache ( <i>Dhukkuba Garaa</i> )	By pounding and powdering then homogenizing with hot red pepper then taken orally.	Marketable, also used to condiment which results to flavor foods.
<i>Ajuga integrifolia</i>	Lamiaceae	S	Harmagusa	L	F	O	Hu	Stomachache ( <i>Dhukkuba Garaa Cininna</i> )	After pounded then dissolved in 4 glasses of water and mixed with <i>Zingiber officinale</i> similarly prepared taken orally one cup of coffee for five consecutive days.	
							Ls	Stomachache ( <i>Dhukkuba Garaa Cininna</i> )	For cattle, the preparation is similar but the difference is the dosage in which 1-2 glass is given can to cattle for 3 to 7 days.	
<i>Albizia grandibracteata</i>	Fabaceae	T	Alalee	Ba	F/D	NA	Hu	Headache ( <i>Mata Bowwuu</i> )	By crushing the inner part of the bark putting on fire fumigated.	Best for shading of coffee, bee forage.
<i>Albizia gummifera</i>	Fabaceae	T	Hamba beesaa	Ba & Rt	F/D	O/Dm	Ls	Trypanosomiasis ( <i>Gandii</i> )	The bark in most case the inner soft part crushed, pounded and mixed with similarly prepared of <i>Zingiber officinale</i> & <i>Allium sativum</i> dissolved in 4 glass of water then homogenized with butter and 1-2 glass given to cattle or sometimes creamed on the body.	Used for fire wood and charcoal production
<i>Allium cepa</i>	Alliaceae	H	Qullubbiidiimaa	Bu	F/D	O/Dm	Hu	Rheumatoid Arthritis ( <i>Dhaqna Nyaataa</i> )	The bulb chopped and mixed with lemon small drops given to patient via mouth &/ also creamed on the infected body.	It is also marketable.

Scientific name	Family	Ht	Local name (Afaan)	Pu (Parts)	Cp(Condition)	Ra (Route of application)	Used for	Disease treated	Preparation & Application	Other uses
<i>Allium sativum</i>	Alliaceae	H	Qullubii adii	Bu	F/D	O, Na /Dm	Hu	Internal Parasites (Raammo o Garaa), Malaria(Bu saa), Cough(Qa kee), Mental Illnesses (Dhukkub a Mataa), Toothache (Dhukkub a Ilkaanii)	Chopping, pounding and/or without any process that can be taken orally either with INJERA &/ alone.	Income generation.
							Ls	Scabies (Citto), Lice (Injiraan), Blackleg (Bushoofuu), Blotting (Bokoksaa Horii).	Chopped then pounding then concocted & homogenized with fresh butter and salt then could be taken orally &/ put in the noise, & also used as lotions.	
<i>Allophylus abyssinicus</i>	Sapindaceae	T	Gur-sadee	FR	F	O	Hu	Stomachache (Dhukkub a Garaa Cininna)	Just eating the fresh fruit after clearly matured.	Used for fire wood, for house building & furniture
<i>Amaranthus graecizans</i>	Amaranthaceae	H	***	Wp	F	O/ Dm	Hu	Tonsillitis (Harsasee)	By pounding the plants and squeezing it then taken by half cup of coffee for three consecutive days.	
<i>Amaranthus spinosus</i>	Amaranthaceae	H	Aramaa	Wp	F/D	O	Hu	??? (Dhukkub a Qorsaa)	The whole plant chapped and then exhaustively pounded taken orally one cup of coffee for three days daily in the morning.	
<i>Apodytes dimidiata</i>	Icacinaceae	T	Wanda biyyoo	L &Ba	F/D	O	Hu	Rabies (Dhukkub a Saree Maraatu)	The leaves and barks were pounded homogenized with <i>Justicia schimperiana</i> , <i>Teclea nobilis</i> given 1 cup of tea every morning for 1 week for the patient then checked the change keep on if there no much change up to cure.	For timber production, house construction.

Scientific name	Family	Ht	Local name (Afaan)	Pu (Parts)	Cp(Condition)	Ra (Route of application)	Used for	Disease treated	Preparation & Application	Other uses
							Ls	Rabies Actinomycosis (Kurufsisa)	For the 1glass is given to cattle with the disease for 14 successive days in the morning and night time.	
<i>Bersama abyssinica</i>	Melianthaceae	S	Lolchii saa	L	F	O	Hu	Ascariasis (Maagaa Garaa)	By crushing the leaves then squeezed and homogenizing with sugar then taken one spoon in the morning for two days.	
				Rt & L	F	O	Hu & Ls	Rabies (Dhukkuba Saree Maraatu)	Crushing, pounding then homogenizing with similarly prepared some plants such as <i>Justicia schimperiana</i> , <i>Vernonia amygdalina</i> , <i>Teclea nobilis</i> , <i>Bersama abyssinica</i> then sometimes mixing honey orally taken one cup of coffee for two weeks.	
<i>Bidens pilosa</i>	Asteraceae	H	Maxxa annee	L	F	Dm	Hu	Scabies (Cittoo)	The pounded leaves would be creamed on the infected body part for 5 days.	
<i>Brassica carinata</i>	Brassicaceae	H	Goomanaa	L&/S	F	O	Hu	Stomach Problem (Dhukkuba Garaa)	The leaves cooked or sometimes without any processing and mixed with <i>Allium sativum</i> then taken orally with bread or INJERA. Normally, the leaves are eaten after cooked as vegetable.	Seeds used as oil, for baking material such as plate and others.
				L	F	Dm	Hu	Skin Diseases (Shifee).	Pounding either the leaves then concoction with fresh butter then used as lotion &/ creamed around the infected part in the morning and night time for one week.	

Scientific name	Family	Ht	Local name (Afaan)	Pu (Parts)	Cp (Condition)	Ra (Route of application)	Used for	Disease treated	Preparation & Application	Other uses
<i>Brucea antidysenterica</i>	Simaroubaceae	S	Qomonyoo	R	F	O	Hu	Rabies (Dhukkuba Saree Maraatu).	By Crushing, pounding then homogenizing with similarly prepared plants species such as <i>Justicia schimperiana</i> , <i>Vernonia amygdalina</i> , <i>Teclea nobilis</i> , <i>Bersama abyssinica</i> then orally taken a half to one cup of coffee twice per day in the morning and night for 14 days.	
				R	F	O	Ls	Rabies (Dhukkuba Saree Maraatu).	Here the process of preparation and the application is similar but the difference is only the dosage. In this case 1-2 glass is given to cattles for 14 days.	
				L	F	Dm	Hu	Skin Diseases (Shiffee).	The leaves pounded and concocted with fresh butter then used as lotion or creamed on the infected part in the morning and night time for 7 days.	
<i>Brugmansia suaveolens</i>	Solanaceae	S	Habaaboo	Rt	F/D	O	Ls	Anti-Inflammatory (Riifensa Kaasaa)	The root crushed and powdered and mixed with <i>Allium sativum</i> homogenized with salt & butter 1-2 spoon given to cattles via mouth.	For fencing.
<i>Buddleja polystachya</i>	Loganiaceae	S	Qawwisa (Nafaree adii)	L	F	Dm	Ls	Eye Infection (Dhukkuba Moora Ijaa)	Pounding the leaf then homogenizing with water then used as lotion around infected eye.	
				Rt/Ba	F/D	O	Ls	Internal Parasites (Maxxantoota Keessaa)	The root and inter part of the plant crushed and pounded, then mixed with similarly prepared root of <i>Justicia schimperiana</i> , and <i>Carissa spinarum</i> and dissolve in 1 Jar and 2-3 glass is given to the cattle.	For animal fodder, house fencing and others.

Scientific name	Family	Ht	Local name (Afaan)	Pu (Parts)	Cp(Condition)	Ra (Route of application)	Used for	Disease treated	Preparation & Application	Other uses
<i>Calpurnia aurea</i>	Fabaceae	S	Ceekaa	L	F	Dm	Hu & Ls	External Parasites (Cinii Horii) & Scabies (Cittoo)	The leaves pounding and mixed with similarly prepared leaves of <i>Croton macrostachyus</i> , <i>Bersama abyssinica</i> and then creamed on the infected body in the morning and night time.	
<i>Capsicum frutescens</i>	Solanaceae	H	Daabb usee	Fr	F	O	Hu	Malaria (Busaa), Headache.	Just the fresh fruit can be eaten by INJERA after clearly matured either mixed with <i>Allium sativum</i> or alone.	
<i>Carduus nyassanus</i>	Asteraceae	H	Luudee	Rt	F/D	Dm	Ls	Hyena Bite (Cinna Warabessa)	The root crushed, pounded and mixed with pounded leaf of <i>Croton macrostachyus</i> and creamed on the infected body.	
<i>Carduus schimperii</i>	Asteraceae	H	Baalawaraantii	Rt	F	Dm	Hu	Swelling (Dhitoo)	Pounding the root then decocted with butter and used as lotion for 1 week.	
<i>Carica papaya</i>	Caricaceae	T	Pappayyaa	Fr	F	O	Hu	Gastritis (Dhukkuba Garaachaa) Intestinal Parasites, Worms.	Eaten without any processing and can be taken possibly up to cure.	Also used as sources of food.
<i>Carissa spinarum</i>	Apocynaceae	S	Hagamsa	Fr. & L	F	O	Hu	For Toothache & Stomachache	The fruits are taken orally without processing while the leaves are used after pounded then homogenized with honey.	Usually the plant also used for fencing.
<i>Catha edulis</i>	Celastraceae	S	Jimaa/ Caatii	L	F	O	Hu	Intestinal Parasites	The young shoot parts would be taken orally in form of chewing.	Serve as cash crops by generating incomes.
<i>Caylusea abyssinica</i>	Resedaceae	H	Qoricha garaaciniinna daa'immaniiif (Lootuu)	Wp	F/D	O/D	Hu	Skin Rash (Limxii), Spider Poisons (Sibijjii).	Pounding either leaves &/ whole plant then take orally and also as lotion until cured.	

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<i>Celosia anthelminthica</i>	Amaranthaceae	H	Amaasilloo	L	F	O	Hu	Stomachache (Dhukkuba Garaa)	The leave part cooked and taken either with INJERA &/ bread usually in the morning.	The leaves are edible as cabbage
<i>Celtis africana</i>	Ulmaceae	T	Cayii	Ba	F/D	O/Dm	Ls	Trypanosomiasis (Gandii)	The inner bark crushed mixed with pounded leaves of <i>Vernonia amygdalina</i> and homogenized with butter given to the cattle by leaf of <i>Croton macrostachyus</i> for 3-7 twice per days in the morning and night time.	For coffee shading, house building and for furniture.
<i>Chionanthus mildbraedii</i>	Oleaceae	T	Karra waay yuu	L & Ba	F/D	Dm	Hu	Rheumatoid Arthritis (Dhaqna Nyaataa)	The leaves and internal part of the bark crushed and fumigated to the infected part.	
<i>Citrus sinensis</i>	Rutaceae	S	Burtuk aana	Fr	F	O/ Na	Hu	Internal Parasites (Raamoo Garaa), Motion Sickness (Balaqqama Konkolaataa Keessaa).	Either taken orally when matured or mixed with other foods. Also used in the form of smell during journey by transportation that is Motion sickness.	used as food, generating income, & ornamental
<i>Clausena anisata</i>	Rutaceae	S	Ulmayyaa	L	F	Dm	Hu	Scabies (Cittoo), External Parasite (Maxantoota Alaa)	The leaves pounded then homogenized with honey and creamed on the infected body and it cured.	For smell, teeth brush and other ritual purposes.
<i>Clematis hirsuta</i>	Ranunculaceae	C	Hidda-Fiitii	L	F	Dm	Hu	Rheumatism (Dhaqna Nyaataa), Skin Diseases.	Crushing the leaves then squeezed it and applying to the harmed body part.	Used for house building & fencing as tiding
							Ls	Most Cases For External Parasites.		
<i>Clematis simensis</i>	Ranunculaceae	C	Hidda-Fiitii				Hu	Swelling (Dhullaa)	Pounding the leaves then homogenizing with	Used for house

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							LS	Blotting (Bokoksaa Horiif)	<i>Allium sativum</i> & fresh butter then applied to both human and to animals automatically when and where the problems happened.	building and fencing us tiding
<i>Clerodendrum myricoides</i>	Lamiaceae	S	Maraas isaa	L	F/D	O / Dm	Hu	Hemorrhoids (Kintaarot ii)	Crushing the leaves then pounding and squeezing it and applying to the infected part/& sometimes taken orally.	For firewood.
<i>Coccinia abyssinica</i>	Cucurbitaceae	C	Ancoot ee	Tu	F	O	Hu	Injure (Caba Qaamaa), Swelling (Dhitoo), Wound (Madaa), Rheumatism (Dhaqna Nyaataa), Back Pain (Waransa)	Either cooking the tuber without any producing /& after chopped & pounded then cooked in the form of WAT or soup then used.	Used as sources of food.
<i>Coffea arabica</i>	Rubiaceae	S	Buna	Fr	F/D	O	Hu	Diarrhea (Garaa Kaasaa), Headache (Mata Bowwuu), & Prevention Of Stroke.	Roasting the matured fruits then pounding and powdering it, finally after boiled & then drunk it either without adding anything or adding salt or sugar or some butter if interested. The powdered form also concocted and homogenized with honey and utilized to treat diarrhea problem.	It also used for ritual purpose during festivity and also the leading economy exchange for the country.
<i>Colocasia esculenta</i>	Araceae	H	Godarree	Tu	F	O	Hu	Internal Parasite (Rammoo Garaa Keeessaf), Stomach Problem (Garaa Cininna)	After the tuber cooked and then eaten with well prepared hot <i>Capsicum frutescens</i> .	Used as sources of food after the tuber cooked.
<i>Combretum paniculatum</i>	Combretaceae	C	Baggee	L, & La	F	Dm	Hu	Scabies (Cittoo), Furuncle (Dhullaa).	The latex from the crushed leaves and other parts are used as crime on the skin.	

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							Ls	External Parasite (Maxxant oota Alaa)	The leaves were pounded, at the same time the plant sap also used for the body of infected cattles.	
<i>Commelina benghalensis</i>	Commelinaceae	H	Laalunnaa	Wp	F	Dm	Hu	Common Wart (Kormammu).	After well crushed then pounded and creamed for 3 successive days.	Used for cattle as fodder.
<i>Conyza bonariensis</i>	Asteraceae	H	Gororsa	Wp	F	O	Hu	Diarrhoea (Garaa Kaasaa)	Pounding it and homogenizing with honey and powder of coffee taken one small spoon for two day after breakfast	
<i>Conyza</i> spp	Asteraceae	H	Gororsa	L	F	O	Ls	Erythroblasts (Gatacha Horiif)	The leaves pounded and homogenized with salt given to cattle.	
<i>Corchorus olerarius</i>	Tiliaceae	H	Oopxii	L	F	O	Hu	Teeth Infection (Dhukkubbii Ilkaanii)	The leave part cooked and taken with <i>Allium sativum</i> and salt.	Used as vegetables
<i>Cordia africana</i>	Boraginaceae	T	Waddeessa	Br, R & Fr	F/D	O	Hu	Internal Parasites (Raamoo Garaa), Spider Poison (Sibijjii/D hukuba Simbiraa)	The mature fruits are usually eaten. Part of barks and roots are crushed and pounded then concocted with honey and taken one spoon or fork for three days in the morning after breakfast.	The most important for timber production, the fruits are edible as a forage
<i>Cotula anthemoideis</i>	Asteraceae	H	Gutichaa fakkaatu	L	F/D	Dm	Hu & Ls	Scabies (Cittoo), External Parasite (Maxxant oota Alaa)	The leaves are infused and squeezed then finally creamed on the infected body both for human and cattle daily at night time up to cure.	
<i>Crassocephalum rubens</i>	Asteraceae	H	***	L	F	Dm	Hu	Subhoerric Dermatitis (Foroforii)	Leaves pounded and mixed with white onion and creamed on the infected body	
<i>Crinum abyssanicum</i>	Amaryllidaceae	H	Shunkurti waraabessa	L & Bu	F	Na	Hu	Sinusitis (Dhukkubaa Saayinasii)	After chopping & pounding both leaves and bulb and diluted by water was made it is taken two drops via nasal for one week.	

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				L & R	F/D	Na/Dm	Ls	Actinomycosis (Kurufsisa a)	Leaves and roots are pounded and then mixed with <i>Allium sativum</i> then given to infected sheep and goats for three days.			
<i>Crotalaria incana</i>	Fabaceae	H	Atarii waraa bessa a	L	F	Dm	Hu	Fibril Illness (Michii), Spider Poison (Sibijjii).	The fresh leaves, crushed, pounded and then squeezed finally use as cream.			
<i>Croton macrostachyus</i>	Euphorbiaceae	T	Bakkan nisa	La	F	Dm	Hu & Ls	Pitriasis Versicolor (Barollee), Scabies, External Parasite, Clotting Blood, Fire Burn (Gubaa Abidda)	The watery latex extracted from the tip shoot parts and leaves, creamed the infected skin.			
								Na	Hu		Evil Spirit (Jinnii)	The fresh leaves burnt and fumigated.
								Na	Hu		Headache	The leaves and root chopped and dissolved in water then 1-2 drops given to patient.
								L/& La	F		Dm	Ls
<i>Cucurbita pepo</i>	Cucurbitaceae	C	Dabaaq ula/Buqqee nyaataa	Fr	F	O	Hu	Taeniasis (Koosoo), Ascariasis (Maagaa Garaa), Internal Parasites (Raamoo Garaa), Kidney Problem (Dhukkuba Kalee),	The fruits cooked eaten either alone or in the form of WAT with INJERA. The dried seed also roasted and eaten.	Serve as source of food and income.		
<i>Cyphostemma adenocaula</i>	Vitaceae	C	Hidda	L	F	Dm	Ls	External Parasites (Maxxanta Alaa)	The leaves pounded & homogenized with salt then creamed on the infected part at night up to cure.	Used for tied materials especially during house building & for fencing		

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<i>Cyphostemma cyphopetalum</i>	Vitaceae	C	Hidda	L & Rt	Fr	Dm	Ls	Trypanosomiasis (Gandii)	Both tip part of the root & leaf pounded and dissolved in one glass of water then given to cattle one cup of coffee both via nose and mouth daily in the morning for one week.	Used for tied also sold in the market.
<i>Datura stramonium</i>	Solanaceae	H	Asaangiraa	L & Fr	F/D	O	Hu	Teeth Infection (Dhukkubbi Ilkaanii)	In most cases the fruits & sometimes leaves crushed, pounded & mixed with honey then taken one spoon in the morning & at night 2-5 days.	
				L & Fr	F/D	O & Dm	Hu & Ls	External Parasites (Maxantoota Keessaa), Skin Rash (Shiffie), Scabies, Snake Poison (Bofaan Iddamuu).	The pounded leaves & fruits wounded be mixed with fresh butter and creamed the infected parts.	
<i>Daucus carota</i>	Apiaceae	H	Kaarotii	Rt	F	O	Ls	Headache (Mata Bowwuu), Stomach Problem (Garaa Dhukkubbi)	The root can be eaten either as raw & or cooked.	As food & income generation.
<i>Desmodium repandum</i>	Fabaceae	H	***	Rt	F/Dm	O	Hu	Stomachache (Dhukkuba Garaa Keessaa)	The tip root chopped and squeezed and homogenized with zinger and taken small amount when feel pain.	
<i>Discopodium penninervum</i>	Solanaceae	S	Coocin gaa	Fr	F/D	Na	Ls	Anti-Inflammatory (Riifensa Kaasaa).	The fresh/ dried crushed fruits then pounded & decocted & homogenizing with <i>Allium sativum</i> finally given to cattle through nose.	For firewood, & fence.

Scientific name	Family	Ht	Local name (Afaan)	Pu (Parts)	Cp(Condition)	Ra (Route of application)	Used for	Disease treated	Preparation & Application	Other uses
<i>Dombeya torrida</i>	Sterculiaceae	S	Daannisaa	L	F	Dm	Ls	Blackleg (Bushoofuu), Blotting (Bokoksaa Horii)	Pounded fresh leaves mixed <i>Allium sativum</i> & salt then given to cattle when symptom appeared.	Bark fiber has multi uses including rope, farm tools, for cattle & bee forage.
<i>Drymaria cordata</i>	Caryophyllaceae	H	Hancabbii	Wp	F	Dm	Hu	Tetanus (Hadhaa), Furuncle (Dhullaa).	Fresh collected plant pounded then tied to the infected body part for 12 hours.	
<i>Echinops kebericho</i>	Asteraceae	H	Qarabichoo	Rt	F/D	Na	Hu	Evil Spirit (Jinnii)	The root chopped and then fumigated.	It also marketable
<i>Ehretia cymosa</i>	Boraginaceae	T	Ulaagaa	L	F	O	Hu	Teeth Infection (Dhukkubbii Ilkaanii)	Leaves pounded and homogenized with similarly prepared <i>Croton macrostachyus</i> and <i>Premna schimperi</i> then used one spoon once or twice per day.	For firewood, house construction & farm tools.
<i>Ekebergia capensis</i>	Meliaceae	T	Somboo	Ba	F/D	D	Ls	Lumpy Skin (Dhukkuba Gogaa)	The inner bark crushed and mixed with butter then creamed for a week.	For firewood, timber & used for smell.
<i>Embelia schimperi</i>	Myrsinaceae	WC	Haanquuu	Se/Fr	F/D	O	Hu	Taeniasis (Koosoo)	The seed of the plant pounded and powdered the mixed with water then taken 1 cup of coffee/tea for 3-5 days.	Fruit is edible & for the formation of traditional beehives.
<i>Ensete ventricosum</i>	Musaceae	H	Warqee	Rt	F	O	Hu	Erythroblasts (Irraa Ba'uu Dubartiif).	The root chopped, pounded and decocted then mixed with salt then a half of cup of coffee given to the patient for 3 consecutive days.	
<i>Erythrina brucei</i>	Fabaceae	T	Waleensuu	Ba	F/D	O	Hu & Ls	Snake Poison (Bofaan Iddamuu)	The bark pounded and powdered then mixed with fresh butter and creamed on the infected body automatically.	For fencing, bee forage.
<i>Erythrococca trichogyne</i>	Euphorbiaceae	S	Ceekeabiroo	L	F	O/Dm	Ls	Hyena Bite (Cinna Warabessa)	The leaves pounded & mixed with <i>Allium sativum</i> then homogenized. And it would be creamed & given orally.	

Scientific name	Family	Ht	Local name (Afaan)	Pu (Parts)	Cp(Conditio)	Ra (Route of application)	Used for	Disease treated	Preparation & Application	Other uses
<i>Eucalyptus camaldulensis</i>	Myrtaceae	T	Bargamoodiima	L	F			Used For Repelling Lice And Tick.	Simply putting the leaves in the material/close with lice problem.	For construction, timber, firewood, charcoal.
<i>Euphorbia abyssinica</i>	Euphorbiaceae	T	Hadaamii fakkaata	La	F	Dm	Hu	Hemorrhoids (Kintaarotii Kormaa)	After the body washed by hot water then the milk latex creamed on the infected part in the morning and night time for 14 days.	For construction, timber.
<i>Euphorbia ampliphylla</i>	Euphorbiaceae	T	Adaamii	La	F	Dm	Hu	Hemorrhoids (Kintaarotii Dhalaa), Common Wart (Kormam muu)	The body washed by hot water then the milk latex creamed on the infected part in the morning and night time for 7 days. Here sometimes the <i>Allium sativum</i> may be added.	For construction, timber, fencing.
<i>Euphorbia tirucalli</i>	Euphorbiaceae	S	Cadaa	La	F	Dm	Hu & Ls	Common Wart (Kormam muu).	The milky latex creamed on affected part.	For fencing.
<i>Ficus sur</i>	Moraceae	T	Harbuu	La	F/D	Dr, O	Hu & Ls	External Parasites (Cinii), Scabies (Citto).	The milky latex of the plant is creamed the infected body.	The fruit is edible after matured, also used as food (fruit), timber.
<i>Ficus thonningii</i>	Moraceae	T	Dambii	La	F	Dm	Hu	Hemorrhoids (Kintaarotii), Common Wart (Kormam muu)	The milky latex taken from the tip of shoot part is creamed the infected body in the morning.	Sometimes used for firewood.
<i>Ficus vallis-choudae</i>	Moraceae	T	Harbuu fakkaatii	Fr	F/D	O	Hu & Ls	Internal Parasites (Raamoo Garaa)	The fruit is taken orally when get problem. Used to treat both human and livestock diseases.	For food (fruit), timber.
<i>Flacourtia indica</i>	Flacourtiaceae	T	Akuukuu	Fr	F	O	Hu & Ls	Stomach Problem (Garaa Cininna).	The fruits are taken in the morning for 3-5 days.	The fruit is edible and serve as food.
<i>Foeniculum vulgare</i>	Apiaceae	H	Dimbila (Insiilaa)	Fr	F/D	O	Hu	Stomach Problem (Garaa Cininna).	The fruits are taken at the time of pain.	Very important for spices & condiment.

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<i>Galiniera saxifraga</i>	Rubiaceae	S	Mixoo fakka attii	Fr/l	F/D	O	Ls	Internal Parasites (Raamoo Garaa)	Either pounded or powdered and dissolved in glass of water then given to livestock via mouth.	Firewood, contribution.
<i>Galinsoga parviflora</i>	Asteraceae	H	***	L	F	Na/ O	Hu	Fibril Illness (Michii).	The leaves pounded and squeezed then used 1 spoon for 3 days.	
<i>Geranium arabicum</i>	Geraniaceae	H	Damakasee lafaa (Qorich arrabduu)	Wp	F/D	Dm	Hu	Skin Problem (Dhukkuba Gogaa), Scabies (Cittoo)	The plant pounded and creamed on the infected body part.	
<i>Geranium</i>	Geraniaceae	H	Qorich arrabduu	Wp	F/D	Dm	Hu	Swelling (Dhitoo)	The whole plant pounded, squeezed, & homogenized with butter and salt then creamed on infected two times per day.	
<i>Glinus lotoides</i>	Molluginaceae	H	Waggarthii	Wp	F/D	Na	Hu	Evil Spirit (Jinnii)	The patient treated simply by smelling.	
<i>Guizotia abyssinica</i>	Asteraceae	H	Nugii	Se	D	O	Hu & Ls	Injure (Caba Qaamaa) & Swelling (Dhitoo).	The dry seed roasted & then homogenized with salt take one cup coffee for human for 2-5 days whereas 1 glass for animals 2-7 days.	Very important for income generation.
<i>Guizotia scabra</i> (Vis.) Chiov.	Asteraceae	H	Hadaa/keelloo	L	F	O	Ls	Anthrax (Abba Sangaa)	The leaves pounded and homogenized with hot water given to cattle 1 glass for 2 days.	
<i>Guizotia schimperi</i>	Asteraceae	H	Hadaa/Tuufoo	R/Wp	F/D	O/Na	Ls	Erythroblasts (Gatacha)	The whole plant or the root pounded & homogenized with fresh butter then taken either orally/via nose.	
<i>Hallea rubrostipulata</i>	Rubiaceae	T	Hoboo	Ba	F/D	O/Dm	Ls	Trypanosomiasis (Gandii)	The bark would be pounded and powdered then homogenized with salt and butter given to the cattle for seven days.	

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<i>Hippocratea africana</i>	Celastraceae	C	Geebb oo qalamee	L	F/D	O/Na	Ls	Pasturolosis (Gororsaa)	The leaves crushed & salt would added & homogenized in water and one glass is given via mouth & nose.	Bee-hives & fence.
<i>Hippocratea goetzei</i>	Celastraceae	C	Hidda gafarsaa	L	F	Dm	Hu	Common Wart (Kormam muu)	The leaves pounded and tied on the infected body at night time and washed in the morning.	
<i>Hypericum quartinianum</i>	Hypericaceae	S	Hindhe/ulee foonii	L & Ba	F & D	Dm	Ls	Trypanosomiasis (Gandii)	The leaves & barks pounded then homogenized with fresh butter then creamed on the infected part until cured.	firewood
<i>Indigofera arrecta</i>	Fabaceae	C	Heenna	L	F	Dm	Hu	Skin Rash (Shiffee), Spider Poisons (Dhukuba Simbiraa).	Fresh leaves pounded and homogenized with butter and applied on the affected part at night time until cure.	
<i>Ipomoea batatas</i>	Convolvulaceae	H	Dammee	Tu	F	O	Hu	Stomach Problem	After cooked taken oral mixed with honey at problem.	Edible (tubers) and sold
<i>Jasminum abyssinicum</i>	Oleaceae	C	Hidda Ichilbee (Michilbee)	Wp	F	Na	Ls	Blackleg (Bushoofuu)	It would be pounded and squeezed then given via nose.	Also used for farm tools, & as rope.
<i>Justicia schimperiana</i>	Acanthaceae	S	Dhummuugaa	Rt	F	O	Hu & Ls	Rabies (Dhukkuba Saree Maraatu)	Roots are crushed, pounded & Squeezed then homogenizing with similarly prepared some plants such as <i>Vernonia amygdalina</i> , <i>Teclea nobilis</i> , <i>Bersama abyssinica</i> then sometimes mixing honey orally taken one cup of coffee for two weeks.	Firewood & fence.
<i>Kalanchoe densiflora</i>	Crassulaceae	H	Bosoqqee	L	F	Dm	Hu	Common Wart (Kormam muu)	The leaves pounded and creamed on the infected.	
<i>Kalanchoe petitiana</i>	Crassulaceae	H	Bosoqqee	L & Rt	F	O	Hu	Evil Spirit (Jinnii)	It crushed, squeezed then smelled.	

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<i>Lagenaria siceraria</i>	Cucurbitaceae	C	Buqqee seexanaa/hadhaa haa	L	F	Na	Ls	Sudden Sickness (Dingetegnaa)	The leaves are pounded then homogenized with water and given to cattles via nose.	For drinking material serve as drinking glasses.
<i>Linum usitatissimum</i>	Linaceae	H	Talbaa	Se	D	O	Hu	Stomachache (Dhukkuba Garaa), Gastritis (Dhukkuba Garaachaa).	Infusion is made the homogenized with sugar then taken in the morning before breakfast.	Marketable & generate income.
<i>Lippia adoensis</i>	Verbenaceae	S	Kusaayee	L	D/F	Dm	Ls	Epizootic Lymphagities (Biichee Faradaa)	The leaves pounded & then creamed the infected body.	The leaves are aromatic & used for washing material.
<i>Maesa lanceolata</i>	Myrsinaceae	S	Abbayyii	L & Se	F	Dm	Hu & Ls	For Treating Skin Rash (Shifee).	The leaves and seed pounded and homogenized with butter then creamed on the infected part.	Also used to make local TELA.
<i>Malva verticillata</i>	Malvaceae	H	Qorich a rammoo ballee ssu	L	F & D	Dm	Ls	Used For Treating External Parasite.	Leaves are crushed, dried & powdered rubbed on the infected part.	
<i>Mangifera indica</i>	Anacardiaceae	T	Maangoo	Fr	F	O	Hu	Used For Healing Stomachache Problem.	Just after matured it would be taken before breakfast either lonely or with one spoon of honey.	Fruits are edible & also marketable.
<i>Medicago polymorpha</i>	Fabaceae	H	Qorich a hadhaaha biraa	Wp	F	Dm	Hu	Tetanus (Hadhaha)	Pounding the whole plant then creaming it on the infected part for five days in the morning and night time daily after clearly washed by hot water.	
<i>Mentha spicata</i>	Lamiaceae	H	Nanaa	L	F/D	O	Hu	Headache (Mataa Bowuu), Stomachache (Dhukkuba Garaa), Common Cold (Utaalloo)	Just put the leaves in the hot water take one cup of tea when get the problem after breakfast or meal.	Also used as spices and marketable.

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<i>Millettia ferruginea</i>	Fabaceae	T	Sootalloo	L	F/D	Dm	Hu & Ls	Scabies (Cittoo), External Parasite.	The leaves pounded and then creamed on the infected part in the morning and night daily for five days.	For shade, timber, household utensils, catching fish.
<i>Momordica foetida</i>	Cucurbitaceae	C	Hinbaayee	Fr	F/D	Dm	Hu	Rheumatism (Dhaqna Nyaataa)	The matured fruits crushed & creamed on the infected part for one week.	
<i>Musa x paradisiaca</i>	Musaceae	H	Muzii	Peel	F	Dm	Hu	Common Wart (Kormammu)	Simply creaming on the infected body at night time up to cure.	Edible (fruits) & marketable
<i>Nicotiana tabacum</i>	Solanaceae	H	Tambo	L	F	O/Na	Ls	For Expelling Leeches (Ulaandhula)	The leaves pounded & squeezed then one cup of coffee given to cattle by either via their nose or mouth during night time.	
<i>Nuxia congesta</i>	Loganiaceae	S	Qawwisa (Nafaree gurracha)	L	F	D/Na	Ls	Hyena Bite (Cinna Warabessa)	The leaves and inner bark crushed, and pounded and then mixed with salt and creamed on the infected part & some amount given via nose.	Firewood, cattle & bee forage, & fence.
<i>Ocimum basilicum</i>	Lamiaceae	H	Bossobila	L	F/D	O	Hu	Headache (Mataa Bowuu), Evil Spirit (Jinnii)	The leaves put in hot water take one cup of tea when get the problem after breakfast or meal.	Used as spice & marketable
<i>Ocimum lamiifolium</i>	Lamiaceae	S	Damakasee	L	F	Dm	Hu	Vaginitis (Dhukkuba Qaama Hormaata Dubartootaa)	The fresh leaves decocted those female faced vaginal infection mainly after gave birth then sit down on the hot water three times per day up to cured.	
								Fibril Illness (Michii)	The fresh leaves crushed & pounded then finally creamed to the infected part of the body or squeezed given to the patient in small amount via nose.	
<i>Ocimum urticifolium</i>	Lamiaceae	S	Hancabii	L	F	Dm/Na	Hu	Fibril Illness (Michii)	The leaves pounded & squeezed then either creamed or sniffed.	

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<i>Olea europaea</i> subsp. <i>cuspidata</i>	Oleaceae	T	Ejersa	L & Br	F	Na	Hu	Evil Spirit (Jinnii)	Leaves and the inner side bark burn and fumigated to the patient.	For furniture, to fumigate material including pots & other materials for milk flavoring, buttermilk, and for the local beverages such as TELLA, BIRZI and TEJ. Toothbrushes.
<i>Olinia rochetiana</i>	Oliniaceae	S	Soolee	L	F	O	Hu	Teeth Infection (Dhukkub bii Ilkaanii)	The tip fresh leaves chewed on the affected teeth.	Farm tools, Ornamental, furniture & fencing material.
<i>Oxalis radicata</i>	Oxalidaceae	H	Lootuu lafaa	Wp	F	Dm	Hu	Spider Poison (Dhukuba Sharariitii)	The all parts strongly pounded then creamed the infected body part for five days daily in the morning.	
<i>Pavonia urens</i>	Malvaceae	S	Hincinii	L & Rt	F/D	O	Ls	Retained Placenta (Dil'uu Baasuu Dadhabuu)	The leaves and roots chopped and homogenized with butter and salt then given to cattle after gave birth.	
<i>Periploca linearifolia</i>	Asclepiadaceae	C	Aannoo	Wp	F	Dm	Hu	Swelling (Dhitoo), Hemorrhoids (Kintaarotii)	The fresh plat decocted & mixed with <i>Allium sativum</i> & pounded then homogenized with butter then creamed in the morning & at night time after washed by hot water.	Also important as ritual uses during Christmas.
				Rt & L	F/D	O	Ls	Anti-Inflammatory (Riifensa Kaasaa), Blackleg (Bushoofuu).	The pounded leaf & root homogenized with butter & salt then dissolved in hot water & 1 glass twice per day given to cattle.	

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<i>Persea americana</i>	Lauraceae	T	Abokadoo	Fr	F	O & Dm	Hu	Gastritis (Dhukkuba Garaachaa), Acne (Finnisa), Subhoerri c Dermatitis (Foroforii)	The fresh fruits eaten in the morning before breakfast. It also creamed to face & hairs then washed with cold water after 1-2 hours.	For food (fruit), shade, & cosmetics
<i>Phoenix reclinata</i>	Arecaceae	T	Meexxi	Fr	F/D	O	Ls	Synerosis Celebralis (Maramartoo)	Usually the fruit & sometimes the root parts crushed and pounded then water added, one cup coffee given to cattle particularly for sheep and goats via nose or mouth for 3 days.	The fruits are edible, for ornamental.
<i>Phragmetheria macrosolen</i>	Loranthaceae	Ep	Dheertuu	Ba	F	Dm	Hu & Ls	External Parasite (Maxantoota Alaa).	The bark like is pounded and homogenized with <i>Allium sativum</i> then creamed the infected part.	
<i>Phytolacca dodecandra</i>	Phytolaccaceae	C	Handodee	L, Fr, & Rt	F & D	O	Hu & Ls	Rabies (Dhukkuba Saree Maraatu)	Crushing, pounding then homogenizing with equally prepared some plants such as <i>Justicia schimperiana</i> , <i>Vernonia amygdalina</i> , then mixing honey orally taken one cup of tea for three weeks.	Used as a soap
								Hemorrhoids (Kintaarotii)	The roots crushed and pounded then squeezed and creamed after cleaned on the infected part in the morning and night for seven days.	
<i>Piper capense</i>	Piperaceae	H	Tunjoo	Rt	F/D	Dm	Hu	Rheumatism (Dhaqna Nyaataa)	The root part crashed, pounded & homogenized with fresh butter then creamed on the infected part in the morning & night time for 1 week.	It has been used as spices & marketable.
<i>Pittosporum viridiflorum</i>	Pittosporaceae	T	Qassammee	L	F/D	Na	Ls	Pasturolosis (Gororsaa)	Leaves pounded and squeezed and some drops given to cattles via nose.	Firewood, construction, & farm tools.

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<i>Plantago lanceolata</i>	Plantaginaceae	H	Qorii simbir aal/Qorxob bii	L	F	Dm	Hu	Eye Infection (Dhukkuba Ijaa)	The fresh leaves pounded & squeezed then put 1-2 drop in the morning and night time.	
<i>Premna schimperi</i>	Lamiaceae	S	Urgeessa	L	F	O	Hu	Teeth Infection (Dhukkub bii Ilkaanii).	The leaves crushed, pounded then homogenized with <i>Croton macrostachyus</i> , & <i>Ehretia cymosa</i> which prepared in similar manner then squeezed then taken once or twice per day drop after dinner & breakfast depending on the cases.	
<i>Prunus africana</i>	Rosaceae	T	Hoomii	Ba	F/D		LS	Trypanosomiasis (Gandii),	The bark crushed and pounded then concocted with pounded leaves of the <i>Calpurnia aurea</i> and also squeezed, butter and salt added then 1-2 cup of coffee given to the cattle either via nose or mouth.	For construction, timber, firewood, charcoal,
				Ba	F/D	Dm	Hu	Wound (Madaa)	The bark crushed and powdered then homogenized and creamed on the infected part in the morning and night time.	Shades, Usually the leaves are toxic to cattles.
<i>Pycnostachys abyssinica</i>	Lamiaceae	S	Yeroo	L	F	Na	Hu	Influenza (Qufaa)	The leaves rubbed then used via nose.	
<i>Pycnostachys meyeri</i>	Lamiaceae	S	Yeroo fakkaatii	L	F/D	Na	Hu	Headache (Mataa Dhukkub bii)	The leave part squeezed then used in the form of smelling.	
<i>Rhamnus prinoides</i>	Rhamnaceae	S	Geesho	L, Br & Fr	F / D	Dm	Hu	Rheumatism (Dhaqna Nyaataa)	It is pounded & squeezed then finally creamed at night & morning.	For the preparation of alcoholic beverages (TELA & TEJ).
<i>Ricinus communis</i>	Euphorbiaceae	S	Qobbo	Se	F / D	Dm	Hu	Furuncle (Dhullaa)	The seed pounded then creamed on the infected in the evening for three consecutive days.	Also used as oilseed

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							Ls	Trypanosomiasis (Gandii)	The pounded seed homogenized with <i>Allium sativum</i> then creamed to the infected at night & morning up to cure.	
<i>Rosmarinus officinalis</i>	Lamiaceae	H	Yesigametib esha	L	F/D	O	Hu	Stomachache (Dhukkuba Garaa)	The leaves can be taken orally after cooked either alone or with other ingredient.	Used as food, spice & medicinal.
<i>Rumex abyssinicus</i>	Polygonaceae	S	Dhang aggoo fakkatii/Q. sabata waaqayyoo	Rt	F/D	O	Hu	Hepatitis (Dhukuba Sabata Waaqayyoo)	Pounding the root part & then homogenized honey taken one cup of coffee before breakfast on Monday, Wednesday and Friday. At that moment it is impossible to move anywhere before the completion of the medicine.	Edible (young shoot part)
<i>Rumex nepalensis</i>	Polygonaceae	H	Timijjii (Timijjii)	L, & Rt	F/D	O	Hu	Internal Parasites, Tonsillitis (Huuba Qooqoo)	The leaves and roots Chopped & pounded then squeezed homogenized with salt then taken orally for 2-5 days.	
<i>Rumex nervosus</i>	Polygonaceae	S	Dhang aggoo	Rt	F/D	O	Hu	Stomachache (Dhukkuba Garaa)	The tip leaves chewed and swallowed when the pain happened.	Edible (shoot part)
<i>Ruta chalepensis</i>	Rutaceae	H	Cilaadama	L	F/D	O/Na	Hu	Stomach Problem (Dhukkuba Garaa), Common Cold (Utaalloo), Stomachache (Garaa Cininnaa)	The leaves can be chewed alone, mixed with tea, coffee, milk etc. It also used by smelling via our nose.	It also marketable
<i>Rytigynia neglecta</i>	Rubiaceae	S	Mixoo	L	F	Dm	Ls	External Parasites (Maxxantu Alaa)	After leaves pounded & squeezed then creamed on the infected.	
<i>Saccharum officinarum</i>	Poaceae	H	Shonkora	S	St	O	Hu	Gastritis (Dhukkuba Garaachaa)	It chewed & then swallowed specially before breakfast.	

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<i>Salvia merjamie</i>	Lamiaceae	H	Qoricha Michi	L	F	O	Hu	Fibril Illness (Dhukkuboota Qaama Ho'isan)	The leaves pounded and squeezed then half cup of coffee given to the patient after meal.	
<i>Salvia nilotica</i>	Lamiaceae	H	Qoricha waraansaa	L/R	F	O	Hu	Headache (Mata Bowwuu)	The leave crushed and pounded then squeezed the finally 2 to 3 drop is given to patient when get the problem.	
<i>Satureja paradoxa</i>	Lamiaceae	H	Kefoosa'aa	L	F	Dm	Hu	Common Wart (Kormammu), Hemorrhoids (Kintaarotii)	The leaves pounded and homogenized with fresh butter and creamed daily in the morning and night for five successive days.	
<i>Scadoxus multiflorus</i>	Amaryllidaceae	S	Ija Dhukubsituu	Tu	F/D	O	Ls	Epizootic Lymphagities (Biichee Faradaa)	The tubers chopped and mixed with pounded leaves of <i>Vernonia amygdalina</i> and <i>Allium sativum</i> given to horse twice per days at night and morning usually 1 glass for five days.	
<i>Schefflera abyssinica</i>	Araliaceae	T	Gatamaa	L & Ba	F/D	O/Na	Ls	Pasturolosis (Gorosa)	Leaves and inner part of the barks are pounded mixed with water 1-3 drops once per day is given to cattle for 3 days via nose/ orally.	For furniture, farm tools, & bee forage.
<i>Senna didymobotrya</i>	Fabaceae	S	Qoricha keessa fiigaa	L	F/D	Dm	Hu	Spider Poison (Dhukuba Sharariitii)	The young part of the pounded and creamed on the infected body for five days.	
<i>Senna petersiana</i>	Fabaceae	S	Raamsoo/Qoricha Capxoo	L/Fr	F	Na	Hu	Evil Spirit (Jinnii)	Leaves with together fruits pounded and burnt sniffed it.	
<i>Senna septemtrionalis</i>	Fabaceae	S	kishkish	L/Rt	F	Na & Dm	Hu & Ls	Snake Poison (Bofaan Iddamuu)	The leaves pounded mixed with <i>Rumex abyssinicus</i> , homogenized and butter squeezed then either creamed, the drops given via nose or 1-2 cup given via mouth.	

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<i>Setaria megaphylla</i>	Poaceae	H	Jajjaba/Babalii	L & Rt	F/D	O	Ls	Blackleg (Bushoofuu)	The leaves pounded and homogenized with salt and given to cattle via mouth.	
<i>Solanecio gigas</i>	Asteraceae	S	Xoongi	Rt	D	Na	Hu	Fibril Illness (Dhukkuboota Qaama Ho'isan)	The root chopped and burnt used by fumigation.	
<i>Solanum adoense</i>	Solanaceae	S	Hiddii waraabessa	Fr	F	Na	Ls	Pasturolosis (Gororsaa)	It is pounded and squeezed then given to sheep and goat 1-3 drops for five days.	
<i>Solanum anguivi</i>	Solanaceae	S	Hiddii saree	Fr	F	Na/O	Ls	Anthrax (Abba Sangaa)	The fruit pounded then half cup of coffee given via either nose or mouth.	
<i>Solanum incanum</i>	Solanaceae	S	Hiddii loonii	Fr	F/D	Na/O	Ls	Blackleg (Bushoofuu)	The fruit pounded or powdered and homogenized with salt then one spoon given to effected cattle three times per day for five days.	
<i>Solanum linnaeanum</i>	Solanaceae	S	Hiddii xiqaa	Fr/Se	F	Na	Ls	Sudden Sickness (Dhukkubaa Tasaa).	Either fruit or seed rubbed and squeezed and given one cup of coffee per day.	
<i>Solanum marginatum</i>	Solanaceae	S	Hiddii Baddaa (Hiddii hongo rcaa)	Fr	F	Dm	Hu & Ls	External Parasite (Maxantoota Alaa)	After crushed then creamed on the infected body.	
<i>Solanum nigrum</i>	Solanaceae	S	Hiddii gurrac ha	Fr	F	Dm	Ls	Synerosis Cerebralis (Maramartoo)	The two drops given two times per day in the morning & night to cattles in most cases for sheep.	
<i>Stephania abyssinica</i>	Menispermaceae	C	Hidda-Kalaa laa	L	F	Dm	Hu	Skin Rash (Shiffee)	The leaves pounded and homogenized with fresh butter then creamed on the infected part up to care.	
							Ls	External Parasites (Cinii)	The leaves rubbed and creamed on the affected part up to care.	

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<i>Syzygium guineense</i> subsp. <i>afro montanum</i>	Myrtaceae	T	Baddeessaa	Fr	F/D	O	Hu	Ascariasis (Maagaa Garaa), Cough (Qakee)	Either the fresh/ sometimes dried matured fruits should be taken orally when the problem happened or at any normal time.	Edible (fruit), for firewood, charcoal, construction.
							Ls	Internal Parasites (Raamoo Garaa)	The fruit pounded and mixed with <i>Allium sativum</i> then given to cattles orally.	
<i>Tagetes minuta</i>	Asteraceae	H	Kanajaawu	L	F	Dm	Hu	Scabies (Cittoo)	The leaves part smashed	For annoy (irritate) ants because of unpleasant smell
<i>Teclea nobilis</i>	Rutaceae	S	Hadheessa Kormaa	L & Rt	F	O	Hu & Ls	Rabies (Dhukkuba Saree Maraatu)	The leaves and barks pounded homogenized with similarly prepared <i>Justicia schimperiana</i> , <i>Apodytes dimidiata</i> given 1 cup of tea every morning for 1 week for the patient then checked the change keep on if there no much change up to cure.  Whereas 1 glass for cattle for two week.	Firewood, charcoal, timber, & sticks.
<i>Thalictrum rhynchocarpum</i>	Ranunculaceae	H	Miilkume (Serebezu)	L & Rt	F	O	Hu	Stomachache (Dhukkuba Garaa Ciniinnaa), Spider Poison (Dhukuba Sharariitii), Ascariasis (Maagaa Garaa)	The leaves and root are chopped and pounded then homogenized with butter then 1 cup of coffee is given to the patient on Monday, Tuesday and Friday.	
							Ls	Blackleg (Bushoofuu), Blotting (Bokoksaa Horii).	The leaves and root are pounded and homogenized with <i>Allium sativum</i> and salt then given to cattle.	
<i>Tiliacora troupinii</i>	Menispermaceae	L	Hidda Liqixii	L	F	Dm	Hu	Swelling (Dhitoo)	The leaves smashed and mixed with the pounded leaves of <i>Croton macrostachyus</i> then tie on the infected body part.	Used for house construction, farm tools, and fencing.

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<i>Trifolium semipilosum</i>	Fabaceae	H	Siddisa	Wp	F/D	Dm	Hu	Spider Poison (Dhukuba Sharariitii)	The whole plant pounded and homogenized with fresh butter and creamed on the infected body.	
<i>Triumfetta rhomboidea</i>	Malvaceae	S	Karaabaa	Rt & L	F/D	O	Ls	Retained Placenta (Dil'uu Baasuuf)	Leaves and roots crushed and pounded mixed with similarly prepared the leaves of <i>Grewia ferruginea</i> and homogenized with salt and given to cattles after gave birth.	
<i>Urera hypselodendron</i>	Urticaceae	S	Laanqisaa	Rt	F/D	Na/O	Ls	Sudden Sickness (Dingetegnaa)	The roots crushed, pounded and squeezed then mixed with <i>Allium sativum</i> and 1-2 glasses given to the cattle at any time.	
<i>Urtica simensis</i>	Urticaceae	H	Gurgubee	L	F	Dm/Na	Ls	Anti-Inflammatory (Riifensa Kaasaa)	The leaves, upper shoot part pounded then creamed or sometimes squeezed and given to cattle via nose.	House construction.
<i>Vangueria volkensii</i>	Rubiaceae	S	Bururiadii	R	F	O	Ls	Hyena Bite (Cininna Warabessa)	Roots crushed and pounded homogenized with salt and 1 glass of water added then 1-3 glass given to cattles via oral.	
<i>Vepris dainellii</i>	Rutaceae	S	Hadheessa dhaltuu	R	F/D	O	Ls	Retained Faces (Dhooqqee Goge)	Roots crushed and mixed with pounded leaves of <i>Vernonia amygdalina</i> , <i>Grewia ferruginea</i> then homogenized with salt and butter and given to cattle.	For firewood, farm tools.
<i>Verbena officinalis</i>	Verbenaceae	H	Sanaafica Simbirroo	L	F	O	Hu	Stomachache (Dhukkuba Garaa)	Leaves cooked and mixed with pounded <i>Zingiber officinale</i> salt added then taken orally at any time.	
<i>Vernonia amygdalina</i>	Asteraceae	S	Eebicha	L	F/D	Na,	Hu	Evil Spirit (Jinnii)	The leaves smashed and mixed with root of <i>Echinops kebericho</i> sniffed/inhaled	The leaves are used to clean materials that are used for brewing local drinks (FARSOO or TELA, BOOKA or TEJ The leaves are used to clean materials that are
						Dm	Hu	Subhoerric Dermatitis (Foroforii)	Leaves rubbed and squeezed then creamed at night time on the infected head after washed by hot water.	

Scientific name	Family	Ht	Local name (Afaan)	Pu (Parts)	Cp(Condition)	Ra (Route of application)	Used for	Disease treated	Preparation & Application	Other uses
						O	Hu	Hepatitis (Dhukuba Sabata Waaqayyoo)	The leaves pounded and mixed with <i>Allium sativum</i> , and the root of <i>Rumex nervosus</i> then squeezed and 1-2 cup of coffee is given to patient on Monday, Wednesday for two weeks.	used for brewing local drinks (FARSOO or TELA, BOOKA or TEJ)
						O	Hu	Fibril Illness (Dhukkuboota Qaama Ho'isan)	The leaves pounded and mixed with <i>Ruta chalepensis</i> and 1-2 cup of coffee is given to the patient at any time.	
				L	F/D	O	Ls	Blackleg (Bushoofuu)	The leaves smashed and squeezed and small amount of water added 1-2 is given to cattles.	
								Blotting (Bokoksaa Horii).	The leaves pounded and homogenized with butter given to cattle via mouth.	
<i>Vernonia bipontini</i>	Asteraceae	S	Sooyyoma	Rt	F/D	O/Na	Ls	Anthrax (Abba Sangaa)	Tip part of the rot crushed, pounded and mixed with similarly prepared form leave part of <i>Rhamnus prinoides</i> and homogenized with local TELLA, then 1-2 given to the cattle for 3 days.	
<i>Vernonia myriantha</i>	Asteraceae	S	Sooyyomagurracha	Br	F/D	O	Hu	Teeth Infection (Dhukkubbi Ilkaanii)	The branch crushed put for 1 hour in the morning and afternoon.	for the formation of traditional beehives
<i>Vernonia thomsoniana</i>	Asteraceae	S	Sooyyomadaaltii	L	F	Na	Hu	Epilepsy (Gaggabdo)	The leaves smashed and sniffed at the moment problem happened.	For firewood
<i>Vernonia urticifolia</i>	Asteraceae	S	Reejjii	Rt	F/D	Na/O	Ls	Actinomycosis (Kurufsisa)	Roots chopped and pounded 2 glass of water added and homogenized with similarly prepared root part of <i>Brucea antidysenterica</i> , <i>Desmodium repandum</i> and 1-2 cup of coffee is given to cattle in most cases for goats and sheep.	

Scientific name	Family	Ht	Local name (Afaan)	Pu (Parts)	Cp(Condition)	Ra (Route of application)	Used for	Disease treated	Preparation & Application	Other uses
<i>Withania somnifera</i>	Solanaceae	S	Gizaaw waa	Rt	F/D	Na	Hu	Evil Spirit (Jinnii)	The roots crushed dried mixed with <i>Echinops kebericho</i> fumigated.	
				L	F	Na/O	Ls	Anti-Inflammatory (Riifensa Kaasaa)	The leaves pounded dissolved in water and squeezed then homogenized with <i>Allium sativum</i> , salt and butter. Then given to cattle either via orally or nose both 1-2 glass for 3 days.	
<i>Zehneria scabra</i>	Cucurbitaceae	C	Hidda reeffaa	Rt	F	O	Hu	Cough (Qufaa)	The roots rubbed, and dissolved in water the squeezed then mixed with <i>Allium sativum</i> small amount is taken orally after mealtime.	
				Rt	F	O	Hu	Ascariasis (Dhukkub oota Qaama Ho'isan)	Root crushed and homogenized with honey and half of cup of coffee is taken orally in the morning for three days	
				L	F/D	O/Na	Ls	Pasturolosis (Gororsaa)	The leaves pounded and mixed with similarly prepared of leaves of <i>Nicotiana tabacum</i> and salt homogenized small amount of KATIKALA (AREKE) then half to two cup of coffee is given to cattle five days.	
<i>Zingiber officinale</i>	Zingiberaceae	H	Jinjibila	Tu	F/D	O/Na	Hu	Motion Sickness (Balaqqa ma Konkolaataa Keessaa), Common Cold (Utaalloo), Influenza (Qufaa), Teeth Infection (Dhukkub bii Ilkaanii), Headache (Mata Bowwuu)	The tubers pounded and taken either with INJERA or tea, even taken alone.	Used as species to condiment that flavor foods, hot beverages including tea.

Scientific name	Family	Ht	Local name (Afaan)	Pu (Parts)	Cp(Condition of preparation)	Ra (Route of application)	Used for	Disease treated	Preparation & Application	Other uses
							Ls	Avian cholera (FINGILLE E), Blotting (BOKOKS AA HORII), Sudden sickness (DINGETE GNAA), Epilepsy (GAGGAB SAA).	Tubers pounded and mixed with <i>Allium sativum</i> and sometimes homogenized with salt and local drink such as FARSO/TELA	

**Keys:** H =Herbs, S =Shrubs, T =Trees, C=Climber, Wc= woody climber, Pu=Parts used, Cp=Condition of preparation, Ra= Route of application, Hu= Human, Ls= Livestock, F=Fresh, D=Dried, F/D=Fresh/Dried, O=Oral, Dm=Dermal, Na=Nasal, Er=Ear, L=Leaf, Rt=Root, St=Stem, Ba=Bark, Fr=Fruit, S=Seed, Bu=Bulb, Rh= Rhizome, La=Latex, \*\*\*= no local name for the plant species

**Appendix 5.** Plant families showing number of genera and species used as fodder

S/N	Family name	Number genera	Number of species
1.	Acanthaceae	1	1
2.	Alliaceae	1	2
3.	Amaranthaceae	4	4
4.	Apiaceae	1	1
5.	Apocynaceae	1	1
6.	Araliaceae	1	1
7.	Asteraceae	7	12
8.	Boraginaceae	2	2
9.	Brassicaceae	1	1
10.	Caryophyllaceae	1	1
11.	Celastraceae	1	1
12.	Combretaceae	1	1
13.	Cucurbitaceae	2	2
14.	Euphorbiaceae	2	2
15.	Fabaceae	3	7
16.	Flacourtiaceae	2	2
17.	Geraniaceae	1	2
18.	Icacinaceae	1	1
19.	Lamiaceae	4	4
20.	Loganiaceae	2	2
21.	Malvaceae	1	1
22.	Meliaceae	1	1
23.	Melanthaceae	1	1

S/N	Family name	Number genera	Number of species
24.	Moraceae	2	3
25.	Musaceae	2	2
26.	Myrsinaceae	2	2
27.	Myrtaceae	1	1
28.	Oleaceae	1	1
29.	Passifloraceae	1	1
30.	Phytolaccaceae	1	1
31.	Poaceae	2	2
32.	Polygonaceae	1	3
33.	Ranunculaceae	1	2
34.	Resedaceae	1	1
35.	Rhamnaceae	1	1
36.	Rosaceae	2	3
37.	Rubiaceae	1	1
38.	Rutaceae	3	3
39.	Sapindaceae	1	1
40.	Solanaceae	2	2
41.	Sterculiaceae	1	1
42.	Tiliaceae	1	1
43.	Ulmaceae	1	1
44.	Urticaceae	2	2
45.	Verbenaceae	2	2
	<b>Total</b>	74	90

**Appendix 6.** Human and livestock disease types reported in the study

S/N	Disease types	Human (Hu)	Livestock (Ls)	Both Hu and Ls
1.	Actinomycosis ( <i>Kurufsisaa</i> )		√	
2.	Acne (Finnisa)	√		
3.	Avian Cholera ( <i>Fingillee</i> )		√	
4.	Back Pain (Waraansa)	√		
5.	Blackleg ( <i>Bushooftuu</i> )		√	
6.	Blood Clotting (Gubaa ibiddaa)	√		
7.	Blotting ( <i>Bokoksaa Horii</i> ).		√	
8.	Common Cold ( <i>Utaalloo</i> )	√		
9.	Common Wart ( <i>Kormammuu</i> )	√		
10.	Cough ( <i>Qufaa</i> )	√		
11.	Diarrhea ( <i>Garaa kaasaa</i> )	√		
12.	Epilepsy ( <i>Gaggabdo</i> )	√		
13.	Epizootic Lymphagities ( <i>Biichee Faradaa</i> )		√	

S/N	Disease types	Human (Hu)	Livestock (Ls)	Both Hu and Ls
14.	Erythroblasts ( <i>Gatacha horii</i> )		√	
15.	Evil spirit ( <i>Jinnii</i> )	√		
16.	Expelling leeches ( <i>Ulaandhulaa</i> )		√	
17.	External Parasite (Maxantoota Alaa)			√
18.	Eye Infection ( <i>Dhukkuba Ijaa</i> )		√	
19.	Fibril illness ( <i>Dhukkuboota Qaama Ho'isan</i> )		√	
20.	Fire Burn (Gubaa Abidda)			√
21.	Skin Rash ( <i>Shifee</i> ).	√		
22.	Furuncle ( <i>Dhullaa</i> )	√		
23.	Gastritis ( <i>Dhukkuba Garaachaa</i> )	√		
24.	Gonorrhea ( <i>Cophxoo</i> )	√		
25.	Headache ( <i>Mata Bowwu</i> )	√		
26.	Hemorrhoids ( <i>Kintaarotii Dhalaa</i> )	√		
27.	Hepatitis ( <i>Dhukuba Sabata Waaqayyoo</i> )	√		
28.	Hyena Bite ( <i>Cininna Warabessa</i> )	√		
29.	Influenza ( <i>Qufaa</i> )	√		
30.	Injure ( <i>Caba Qaamaa</i> )	√		
31.	Internal Parasites ( <i>Maxxantoota Keessaa</i> )	√		
32.	Kidney Problem ( <i>Dhukkuba Kalee</i> )	√		
33.	Lice ( <i>Injiraan</i> )	√		
34.	Lumpy Skin ( <i>Dhukkuba Gogaa</i> )	√		
35.	Malaria ( <i>Busaa</i> )	√		
36.	Motion Sickness ( <i>Balaqqama Konkolaataa Keessaa</i> )	√		
37.	Pasturolosis ( <i>Gororsaa</i> )	√		
38.	Pitriasis Versicolor ( <i>Barollee</i> )	√		
39.	Poisoning ( <i>Buutii</i> )	√		
40.	Rabies ( <i>Dhukkuba Saree Maraatu</i> )	√		
41.	Retained Placenta ( <i>Dil'uu</i> )	√		

S/N	Disease types	Human (Hu)	Livestock (Ls)	Both Hu and Ls
	<i>Baasuu Dadhabuu</i> )			
42.	Rheumatism ( <i>Dhaqna Nyaataa</i> )	√		
43.	Scabies ( <i>Citto</i> )	√		
44.	Sinusitis ( <i>Dhukkuba Saayinasii</i> )	√		
45.	Skin Diseases ( <i>Shifee</i> ).	√		
46.	Skin Rash ( <i>Shiffee</i> )	√		
47.	Snake Poison ( <i>Bofaan Iddamuu</i> )	√		
48.	Spider Poisons ( <i>Sibijjii</i> ).	√		
49.	Stomach Problem ( <i>Dhukkuba Garaa</i> )	√		
50.	Subhoerric Dermatitis ( <i>Foroforii</i> )	√		
51.	Sudden Sickness ( <i>Dhukkuba tasaa</i> ).	√		
52.	Swelling ( <i>Dhitoo</i> )	√		
53.	Synerosis Celebralis ( <i>Maramartoo</i> )	√		
54.	Taeniasis ( <i>Koosoo</i> )	√		
55.	Taeniasis ( <i>Koosoo</i> );	√		
56.	Teeth infection ( <i>Dhukkubbii Ilkaanii</i> )	√		
57.	Tetanus (Hadhaa); Furuncle (Dhullaa).	√		
58.	Tonsillitis ( <i>Harsasee</i> )	√		
59.	Trypanosomiasis ( <i>Gandii</i> )		√	
60.	Repelling lice and tick.			√
61.	Vaginitis ( <i>Dhukkuba Qaama Hormaata Dubartootaa</i> )	√		
62.	Wound ( <i>Madaa</i> )			√