Vascular Plant Diversity and Ethnobotany of Medicinal and Wild Edible Plants in Baso Liben and Debre Elias Districts, East Gojjam Zone of Amhara Region, Northwestern Ethiopia

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This is to certify that the dissertation prepared by Nigussie Amsalu Akele, entitled: Vascular Plant Diversity and Ethnobotany of Medicinal and Wild Edible Plants in Baso Liben and Debre Elias Districts, East Gojjam Zone of Amhara Region, Northwestern Ethiopia, and submitted in fulfillment of the requirements for the Degree of Doctor of Philosophy (Biology: Botanical Sciences) complies with the regulations of the University (AAU) and meets the accepted standards regarding its originality and quality.

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ABSTRACT

Vascular Plant Diversity and Ethnobotany of Medicinal and Wild Edible Plants in Baso Liben and Debre Elias Districts, East Gojjam Zone of Amhara Region, Northwestern Ethiopia

Nigussie Amsalu Akele, Ph.D. Dissertation
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The natural vegetation of the remnant patches are suffering from anthropogenic factors resulting in declining and loss of useful plants, and linked knowledge. Thus, the study was undertaken with the objective of providing documentation and analysis of vascular plant diversity in forest patches along with ethnobotanical study of traditional medicinal and wild edible plants (WEPs), used by the people inhabiting Baso Liben (BL) and Debre Elias (DE) districts, northwestern Ethiopia. Ninety-two (92) plots (20 m × 20 m each) were laid along preferentially established transect lines for trees at every 100 m elevational drop and 5 m × 5 m and 1 m × 1 m subplots for shrubs and herbs, respectively. Each plant species encountered in each plot was recorded and identified. Woody plant species with a diameter at breast height (DBH) ≥2.5 cm were counted. A total of 394 (272 males and 122 females) respondents of which 310 general informants and 84 key informants participated in answering the semi-structured questions. Primary ethnobotanical data were collected using a guided field walk, semi-structured interviews, 10 focus group discussions (FGDs) comprising seven to 12 informants, free listing, photograph recordings and market surveys. Frequency, density and structure of the forest patches were computed using descriptive statistical tools. Furthermore, Shannon diversity index was used to compute species richness and evenness between the plant communities. Likewise, the ethnobotanical data were assessed quantitatively using various measures like informant consensus factor (ICF), fidelity level (FL), use-value (UV), Jaccard's coefficient of similarity (JCS), Relative frequency of citation (RFC), pair-wise comparisons, direct matrix and preference rankings. One-way ANOVA and t-test were also employed. The results revealed that 317 plant species under 234 genera in 95 families were documented from the six patches. Of these, 256 and 275 species were collected from the BL and DE districts, respectively. Of all species encountered in the patches, 137 (43%) were cited for use in traditional herbal medicine. The most commonly represented family was Asteraceae with 37 (12%) species. The hierarchical classification resulted in five plant community types, namely *Croton macrostachyus-Accia abyssinica*, *Vernonia auriculifera-Maytenus arbutifolia*, *Juniperus procera-Albizia schimperiana*, *Acacia seyal-Hyparrhenia rufa* and *Anogeissus leiocarpa-Tamarindus indica*. The overall Shannon-Wiener diversity index and evenness of the patches were 3.13 and 0.98, respectively. The density and basal area were found to have 1,952 stems ha^{-1} and 75 m^2 ha^{-1}, respectively. The highest IVI value was recorded for Croton macrostachyus (16). The results of ethnobotanical study revealed that altogether 172 species belonging to 157 genera and 82 families were recorded in the category of human and livestock medicines. Of these, 153 (53%) (133 from BL; 126 from DE) are merely ethnomedicinal plants, 81 (37%) (65 from BL; 57 from DE) ethnoveterinary plants. The most commonly represented families in the medicinal flora were Asteraceae with 13 (8%) species followed by Fabaceae and Solanaceae with 9 (5%) species each. Herbs were the most widely used growth forms, which accounted for 42 (45%) species. The most frequently used plant parts were the leaves (livestock, 43%; human, 38%) in both districts. Most of the remedies were prepared from fresh materials in the form of infusion (livestock, 39%) and decoction (human, 20%). The highest ICF score for external and internal parasites (livestock ailments) was 0.85 in BL followed by dermatological diseases (human) (ICF = 0.84) in DE District. The highest FL values were recorded for *Senna singueana* (96%) against snakebite and acute febrile illness. Overall, 52 WEPs belonging to 44 genera and 35 families were recorded in the entire study area. Trees accounted for the highest growth forms with 22 spp. followed by shrubs (16 spp.). Of the families, Moraceae was represented by 5 (10%) species followed by Rosaceae with 4 (8%) species. Fruits were the most dominant edible parts, accounted for 38 (73%) species and eaten mainly raw. The local community has preferences for a few WEPs over the others. This study revealed that 58 and 49 of the useful species have been cited as multiple uses and nutraceuticals, respectively. *Croton macrostachyus* had the highest UV (5), followed by *Vernonia amygdalina* and *Cordia africana* with UV 5 each. These species with other high recorded use-values including *Tamarindus indica*, *Juniperus procera* and *Ficus sur* should be given priority for conservation. Based on group discussions and pair-wise ranking, the major threats to medicinal and WEPs in the study area were agricultural expansion (42 citations, 19%) followed by overgrazing (39 citations, 17%). Due to these human-induced factors, forest patches comprising *Croton macrostachyus-Acacia abyssinica* community type (holds 213 spp.) that harbour many medicinal (102 spp.) and WEPs (35 spp.) were under huge threats. Hence, there is an urgent call for encouraging and supporting sustainable use, conservation and management of the vascular plants together with the medicinal and WEPs, and the ethnobotanical knowledge and practices.

Keywords: ethnobotany, fidelity level, floristic composition, medicinal plants, threats, wild edible plants

DEDICATION

I dedicate this Ph.D. thesis to my late and beloved father, Amsalu Akele who was my source of inspiration and encouragement throughout my life.

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LIST OF ACRONYMS

AAU	Addis Ababa University
ANOVA	Analysis of Variance
BA	Basal Area
BL	Baso Liben
BLDFPEDO	Baso Liben District Finance Planning and Economic Development Office
CBD	Convention on Biological Diversity
CSA	Central Statistical Agency
DBH	Diameter at Breast Height
DE	Debre Elias
DEDFPEDO	Debre Elias District Finance Planning and Economic Development Office
DMU	Debre Markos University
EBI	Ethiopian Biodiversity Institute
EEPFE	Environmental Economics Policy Forum for Ethiopia
EFAP	Ethiopian Forestry Action Plan
EGAO	East Gojjam zone Agricultural Office
EMA	Ethiopian Mapping Authority
EOTC	Ethiopian Orthodox Tewahido Churches
ETH	National Herbarium
FAO	Food and Agriculture Organization of the United Nations
FEE	Flora of Ethiopian and Eritrea
FGDs	Focus group discussions
FL	Fidelity Level
GJ	Gojjam Florstic Region
ICF	Informant Consensus Factor
IK	Indigenous Knowledge
IUCN	International Union for the Conservation of Nature and Natural Resources
IVI	Important Value Index
JCS	Jaccard's Coefficient of Similarity
LC	Least Concern

MEFCC	Ministry of Environment, Forest and Climate Change
MoA	Ministry of Agriculture
MoARD	Ministry of Agriculture and Rural Development
MoFED	Ministry of Finance and Economic Development
MPs	Medicinal Plants
NBSAP	National Biodiversity Strategy and Action Plan
NMSA	National Meteorological Service Agency
NT	Near Threatened
RBA	Relative Basal Area
RDe	Relative Density
RDo	Relative Dominance
RFr	Relative Frequency
RFC	Relative Frequency of Citation
TM	Traditional Medicine
TMPs	Traditional Medicinal Plants
USAID	United States Agency for International Development
UV	Use-value
VU	Vulnerable
WCMC	World Conservation Monitoring Centre
WEPs	Wild Edible Plants
WHO	World Health Organization

CHAPTER ONE

1. INTRODUCTION

1.1. Background

The report by the Convention on Biological Diversity (CBD, 1992) has shown that biodiversity is the variety and variability of living organisms and the ecological complexes in which they occur, comprising diversity within species, between species and of ecosystems. Linked to this, diversity is sporadically distributed over the surface of the globe. The most noticeable spatial pattern of species diversity is an elevational gradient of the declining richness of species from the equator to poles (Gaston, 2000; Willig *et al.*, 2003). This pattern of variation is consistent for many groups of organisms including terrestrial plants (Mutke and Barthlott, 2005; Barthlott *et al.*, 2007). However, some taxonomic groups like vascular plant richness in Africa increase towards temperate latitudes (Heywood, 1995); hotspots of gymnosperm diversity are located in Southeast Asia mainly in China, whereas tropical Africa is found to be a cold spot of Gymnosperm species diversity (Mutke and Barthlott, 2005).

Ethiopia is a country endowed with diverse ecosystems that are inhabited by diverse animal, plant and microbial species. This is because of the combined effects of varied topography, the wide spectrum of habitats and climatic factors (Dawit Abebe and Ahadu Ayehu, 1993; EFAP, 1994; Zerihun Woldu, 1999; EBI, 2014). It is reported that the country is one of the top 25 biodiversity-rich countries in the world, and has host two of the world's 34 biodiversity hotspots, namely, the Eastern Afromontane Biodiversity and the Horn of Africa hotspots (WCMC, 1994). It is also anticipated that among the countries in the Horn of Africa, Ethiopia is regarded as a major centre

of diversity and endemism for many plant species. Due to the long history of agriculture and diversity of the ecosystems, Ethiopia is again one of the 12 Vavilovian centres of origin and diversity for many cultivated crops such as *Eragrostis tef* and *Coffea arabica* in the world (NBSAP, 2005; EBI, 2015).

A review by Ensermu Kelbessa and Sebsebe Demissew (2014) showed the presence of 243 families of vascular plants in the Flora of Ethiopia and Eritrea (FEE). The same review further elaborates that 175 of these families are found in both Ethiopia and Eritrea, 63 only in Ethiopia and five only in Eritrea. In terms of plant diversity, there are about 6,027 taxa (species and subspecies) with 647 (10.74%) endemism in the FEE of which 3,875 taxa in Ethiopia only, 270 in Eritrea only and 1,882 common both countries. Regarding plant family representation, they showed that the Fabaceae, Poaceae and Asteraceae are the top three families comprising 678, 609, and 472, taxa respectively further underlining that there are 5,757 species (including subspecies) with the overall endemism of 544 (9.4%) and 238 families in the Ethiopian flora.

Pappoe *et al.* (2010) stated that botanical and ecological assessments include floristic composition; species diversity and structural analysis are indispensable to providing information on species richness of the forests, useful for forest management purposes and help in understanding forest ecology and ecosystem functions. Moreover, knowledge of the floristic composition and structure of forests is also useful in identifying ecologically and economically important plants and their diversities, protecting threatened and economically, important plant species (Addo-Fordjour *et al*., 2009). Likewise, botanical assessment furnishes essential information that can help in optimizing and maximizing plants that are valued socially, culturally and ecologically.

Literature shows that various authors in the past have studied and described vegetation types and vascular plant diversity in Ethiopia. Among which, the early studies such as Pichi-Sermolli (1957), Friis *et al*. (1982), and White (1983) have made substantial contributions towards understanding the Ethiopian vegetation. Studies emphasizing on forests and/or vegetation of specific regions in Ethiopia comprised Friis *et al*. (1982), Sebsebe Demissew (1988), Zerihun Woldu and Mesfin Tadesse (1990), and Tamrat Bekele (1993). These authors suggested that information on these studies constitutes some of the most important vegetation surveys undertaken in different parts of the country aimed at describing plant community types and their association with several natural and anthropogenic features.

Publications on detailed studies of floristic composition, diversity, structure, community analysis and regeneration status of different forests have been reported in (Haileab Zegeye *et al*., 2011; Abreham Assefa *et al*., 2013; Fekadu Gurmessa *et al*., 2013; Ermias Aynekulu *et al*., 2016). Furthermore, Tewolde Berhan Gebre Egziabher (1986), Friis (1986, 1992) and EFAP (1994) have studied the vegetation resources of Ethiopia comprising forests, woodlands and bushlands. These authors employed various methods of vegetation classifications.

Ethiopia is one of the countries in tropical Africa that has been covered with broad forest resources. However, the country's forest resources have been declining at an alarming rate in size (deforestation) and quality (degradation) (Demel Teketay, 2001). Various human-induced impacts such as that of agriculture, overgrazing, fire and settlements have contributed to the reduction of forest covers (EFAP, 1994; McCann, 1997). In Amhara Region, the scenario is the same as that of

the country. The situation shows centuries of deforestation driven by the need for fuelwood, agricultural and grazing lands has resulted in a radical alteration of the natural landscape (McCann, 1997).

Local people have developed their own local knowledge on plant use, management and conservation (Cotton, 1996). They use plants for food, medicines, building, fiber, fuel and shelter. Thus, ethnobotanical investigations are very useful in documenting, analyzing and communicating knowledge and interaction between plant species and human cultures (Martin, 1995; Balick and Cox, 1996; Cotton, 1996).

Humans have utilized wild resources of medicinal plants (MPs) for centuries in traditional therapeutic systems. As stated by Adnan *et al*. (2014), the local people adopted different modes of application and explore natural resources. Millions of people in many developing countries use wild plant resources to meet their food requirements, especially during the food crisis (Kebu Balemie and Fasil Kebebew, 2006). It has been reported that beyond nutritional and medicinal values, plants have a ritual or magical values to the given people (Abbink, 1995). Moreover, wild edible plants (WEPs) play an important role in ensuring food and livelihood security for countless families and communities around the world (Ermias Lulekal *et al*., 2011).

Plants are used in Ethiopia for various purposes in which treatment and prevention of health-related problems of humans and domestic animals make up a major share (Mander *et al*., 2006). It has been reported that nearly 80% of the human population and 90% of livestock rely on traditional herbal medicine and that over 95% of traditional medicinal preparations in Ethiopia are of plant

origin (Dawit Abebe, 1986; Dawit Abebe, 2001). Mander *et al*. (2006) further reported that for millions of rural Ethiopians, and millions of their livestock populations, MPs are the major or the sole providers of healthcare; and for many others, they play supplementary roles to the limited modern healthcare available.

In addition, herbal medicines remain to be the most important and sometimes the only source of therapeutic (Dawit Abebe, 2001). This is mainly because of the cultural acceptability of healers and local pharmacopeias, low cost of TM and limited access to modern health facilities (Jin-Ming *et al*., 2003; Kebede Deribe *et al*., 2006) and other biomedical benefits (Dawit Abebe, 2001; Getachew Addis *et al*., 2001). In short, it is worth noting that MPs in Ethiopia provide vital contributions to human and livestock healthcare needs throughout the country (Dawit Abebe, 1986; Mirutse Giday *et al*., 2003; Mirutse Giday *et al*., 2010).

Several early and general studies have been conducted for example on common medicinal and poisonous plants used in Ethiopian folk medicine (Amare Getahun, 1976), and traditional medicine (TM) in Ethiopia and the attempts being made to promote it for effective and better utilization (Dawit Abebe, 1986). An introduction to medicinal history of Ethiopia (Pankhurst, 1990), and MPs and enigmatic health practices of northern Ethiopia (Dawit Abebe and Ahadu Ayehu, 1993) were few of the early studies. Apart from this, medicinal and ritual plants of the Ethiopian southwest (Abbink, 1995), and the role of home-gardens in the production and conservation of MPs in Ethiopia (Zemede Asfaw, 2001) were found to give some general information on human medicine.

Ethnobotanical studies of medicinal plants have also been carried out on several ethnic groups of Ethiopia. For example, ethnobotanical study of MPs in Wonago District, southern nations, nationalities, peoples and Region (Fisseha Mesfin *et al*., 2009), Meinit ethnic group (Mirutse Giday *et al*., 2009) and Sheko ethnic group (Mirutse Giday *et al*., 2010) were a few of the studies in southern Ethiopia. Ethnobotanical studies of MPs used in Asgede Tsimbila (Girmay Zenebe *et al*., 2012) and Kilte Awulaelo (Abraha Teklay *et al*., 2013) districts were two of the huge studies in Tigray communities. Some of the many ethnobotanical studies of MPs in Oromo ethnic group included by Getachew Addis *et al*. (2001), Tigist Wondimu *et al*. (2007), Ermias Lulekal *et al*. (2008), Moa Megersa *et al*. (2013), and Alemayehu Kefalew *et al*. (2015).

Available data on ethonveterinary studies are insufficient as compared to the data accessible on human medicinal plants. However, studies in Sekoru District (Haile Yineger *et al*., 2007), Ada'ar District (Mirutse Giday and Tilahun Teklehaymanot, 2013), Ankober District (Ermias Lulekal *et al*., 2014) and Kochore District (Yibrah Tekle, 2014) were few of them undertaken in Ethiopia. The scarcity of veterinary drugs and poor accessibility of modern veterinary healthcare facilities on the rural farmers and pastoralists make the case for the use of medicinal plants stronger (Fekadu Fullas, 2010). Thus, considering the fact that the country has a huge resource of medicinal plants, the present research attention focuses on this potential.

On the other hand, some of the most appreciated ethnobotanical studies of WEPs conducted elsewhere in Ethiopia were Zemede Asfaw and Mesfin Tadesse (2001), Getachew Addis *et al*. (2005), Kebu Balemie and Fassil Kebebew (2006), Zemede Asfaw (2009), Tilahun

Teklehaymanot and Mirutse Giday (2010), Debela Hunde *et al*. (2011), Tinsae Bahiru *et al*. (2013), and Mekuanent Tebkew (2015).

In Amhara Region, some limited ethnobotanical studies in Zegie Peninsula (Tilahun Teklehaymanot and Mirutse Giday, 2007), Ankober (Ermias Lulekal *et al*., 2013), Libo Kemkem (Getnet Chekole *et al*., 2015) and Minjar-Shenkora (Getu Alemayehu *et al*., 2015) districts have been conducted in Amhara ethnic group in central and northwestern Ethiopia. On the other hand, very few ethnobotanical investigations on WEPs were documented in the Region (for example, Fentahun Mengistu and Herbert, 2008; Mekuanent Tebkew, 2015). Though the various information confirmed medicinal and WEPs are widely distributed in the country, still there is a scarcity of information at the district, zonal and regional levels. Because of this reason, this study was initiated to study and document ethnobotanical knowledge of medicinal and WEPs in the two districts.

1.2. Statement of the Problem

One of the most critical issues on the national and global agenda is the need to conserve biodiversity for future generations while trying to investigate and document the IK of plant species. This is because the standard approach to conservation has often failed to protect biodiversity in developing countries, for example, in conservation sites such as that of national parks or reserves (Gardner *et al*., 2009). Balick and Cox (1996) further claimed that just as shamanistic teachings or techniques of herbal healing have been refined over many generations of experimentations, so too have technologies for managing resources in environments where conventional Western methods fail. The same authors indicated that ethnobotanical studies of the ways forest resources have

traditionally been managed can offer practical alternatives for regions where unsuitable land is increasingly being employed for conventional agriculture.

Some authors argued that the high rate of deforestation has continued and the country's remnant forests are suffering from more drastic deforestation and degradation, resulting in declining and loss of many plant and animal species, and ecosystems (Ensermu Kelbessa *et al*., 1992; Demel Teketay, 2001; Ermias Lulekal *et al*., 2013; EBI, 2015). In addition, deforestation, overexploitation (Zemede Asfaw, 2001; EBI, 2014; Kipkore *et al*., 2014), overgrazing, habitat loss and degradation, agricultural land expansion, and acculturation constantly threaten Ethiopian traditional MPs and linked knowledge (Zemede Asfaw, 2001).

The local communities and the country have lost the direct and indirect values, which could be obtained from the forest resources. Hence, these local and national issues could also be global issues. This indicates the outcomes of this study could have fundamental importance in identifying locally threatened and endemic species for management and conservation actions.

On the other hand, the research on Ethiopian herbal medicines (ethnobotanical studies) has mostly been more of producing inventories and checklists and, therefore application of comprehensive ethnobotanical research method is just taking shape with more bias to the qualitative approach (Mander *et al*., 2006). Quantitative ethnobotanical methods are complementary to the more traditional forms of the inventories; however, they are not alternatives to them (Alexiades, 1996). Thus, quantification helps for assessing the relative cultural significance of plant species

(Friedman *et al.*, 1986; Alexiades, 1996), and for comparing the use of vegetation types, floras, plant families and species by various communities (Zemede Asfaw and Tigist Wondimu, 2007).

In general, plant species use-values, indigenous ethnobotanical knowledge, economic contribution of medicinal and WEPs to the community's health and food security have not been documented. The absence of previous ecological (and/or ethnobotanical study) in the study area was the main reason for the need of attention and timely scientific investigations. Thus, it is very important to get data about the uses of medicinal and WEPs before the IK disappears. Additionally, this study will contribute to the development of plant species and forest databases for the management of remnant forest patches. In these perspectives, therefore, the present study helps to fill the gaps by documenting the ethnobotanical and ecological information on vascular plant diversity, and ethnobotany of medicinal and WEPs in Baso Liben and Debre Elias districts, northwestern Ethiopia.

1.3. Research Questions, Hypotheses and Objectives

1.3.1. Research questions

The main research questions are:

- What are the plant community types, floristic composition, diversity and structures of forest patches in the study area?
- Which traditional medicinal plants are used to treat human and livestock diseases?
- Which wild edible plants are used by the people of the districts?
- How are herbal remedies prepared, measured and administered?

- Which of the medicinal and wild edible plants used in the study area are available in the local markets?
- Are medicinal and wild edible plants gathered for uses other than their medicinal and food values?
- What are the major threats to the forest patches, and medicinal and wild edible plants in the study area? What are the conservation practices in the study forest patches?

1.3.2. Research hypotheses

This study was intended to investigate the following research hypotheses:

- The natural vegetation of the remnant forest patches of the study area have different plant community types, high species diversity, and the source of herbal medicine and other useful plants for the community in the districts;
- There are a large number of medicinal and wild edible plants in the study areas;
- There is a significant relationship between local knowledge on the use of medicinal and wild edible plants, and socio-demographic characteristics (age, gender and educational level of the local community members); and
- Traditional practices and cultures have the contribution to the management and/or conservation of medicinal and wild edible plants, and forest patches.

1.3.3. Research objectives

General objective

The general objective of this dissertation was to document and analyze vascular plant diversity of remnant forest patches, and the ethnobotany of traditional medicinal and wild edible plants, used by the people of Baso Liben and Debre Elias districts, northwestern Ethiopia.

Specific objectives

The focuses of the specific objectives were to:

- produce checklists of vascular plants in the patches of forests, and the traditional medicinal and wild edible plants of the two study districts;
- analyze species richness, evenness, and diversity and describe the population structure among different forest patches and plant community types of the study districts;
- record, analyze and assess the indigenous botanical knowledge (plant parts used, modes of preparation, routes of administration and dosages) of the local community on medicinal plants used to treat different human and livestock ailments;
- document and analyze ethnobotanical knowledge (related to overlapping, charcoal/firewood, materials, forage, social and environmental uses) of wild edible, nutraceutical and other useful plant species of the study area;
- compare the diversity of medicinal and wild edible plants of the two districts and their distribution in major vegetation formation and plant community types; and
- identify main threats and local needs about conservation of medicinal and wild edible plants.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Vegetation of Ethiopia

Biodiversity comprises more than the diversity of animal and plant species, habitats, ecosystems and landscapes by which we describe and view, or understand our biosphere; it also provides the basis for all ecological processes that sustain life on earth and human livelihoods (Imboden *et al*., 2010). The same authors have clearly shown that the variation within species also provides the basis for evolution through the adaptation of species to new and changing habitats. Vegetation (parts of biodiversity) comprises the largest biotic component of terrestrial ecosystems and directly or indirectly determines or influences the distribution and abundance of all other taxa and lifeforms. The vascular plant diversity is unevenly distributed across the globe. Most of the global centres are located in mountainous Regions within the humid tropics, where suitable climatic conditions and high levels of geodiversity (the diversity of abiotic conditions) concur (Barthlott *et al*., 2005).

The plant diversity shows a general increase in species richness towards the Equator. Most global cores of species richness are located within the humid tropics. In this case, not all tropical Regions show high species richness. The patterns of species richness on a continental to global scales are statistically correlated with different climatic factors related to ambient energy, water availability, or productivity (Francis and Currie, 2003; Mutke and Barthlott, 2005; Barthlott *et al*., 2005). Yet, the predictive value of different factors varies between continents, and among climatic and

vegetation zones (Mutke and Barthlott, 2005). Among various factors, human disturbances evidently affect plant species diversity (Ermias Aynekulu *et al*., 2016).

Ethiopia is described as an important regional centre for biodiversity because of its extensive elevational ranges, great topographical diversity of high rugged mountains, deep gorges, incised river valleys, flat-topped plateaus and rolling plains (Ensermu Kelbessa *et al*., 1992; Dawit Abebe and Ahadu Ayehu, 1993; EFAP, 1994; Zerihun Woldu, 1999; EBI, 2014). These topographic and elevational variations helped the emergence of wide ranges of habitats suitable for the evolution and survival of various plant and animal species (Zerihun Woldu, 1999; Friis *et al*., 2011) that make up the country one of the biodiversity hotspots of the world (EBI, 2015).

The vegetation of Ethiopia is very heterogeneous and has rich endemic elements. Endemism is high in high mountains and Ogaden areas, in both Borana and Bale lowlands (Zerihun Woldu, 1999; Vivero *et al*., 2006). In addition, the authors have reported that the floristic regions of Shewa and Gonder have high numbers of endemic taxa, whereas Sidamo and Harerge have high number of narrow-endemics. Arsi and Shewa are found the most endemic-rich areas in the country.

In Amhara Region, forest patches of the highland areas are known to have high plant species diversity with many being endemic. For example, somewhat more than 10% of the flowering plants growing in the Simen Mountains are Ethiopian endemics (Puff and Sileshi Nemomissa, 2005). As mentioned above, Vivero *et al.* (2006) assert that the floristic regions of Shewa and Gonder have the highest numbers of endemic taxa. However, Welo remains a poor floristic Region

with only one narrow-endemic i.e., the lowest species richness, and with the lowest Afroalpine endemic-richness.

Various authors had previously described the vegetation types of Ethiopia that include Pichi-Sermolli (1957), Tewolde Berhan Gebre Egziabher (1986), Friis (1986, 1992), Zerihun Woldu (1999), Sebsebe Demissew and Friis (2009). The most recent one is by Friis *et al*. (2011) that described major vegetation types primarily based on altitude and climatic variables. According to the authors, the vegetation types in Ethiopia are divided into 12: desert and semi-desert scrubland (DSS); *Acacia-Commiphora* woodland and wooded grassland (ACB); wooded grassland of western Gambella 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); freshwater lakes, lakeshores marshes and floodplain vegetation) (FLV); and salt-water lakes, lakeshores, salt marshes and pan vegetation (SLV).

Based on Friis *et al*. (2011), forest patches in Baso Liben and Debre Elias districts have been classified as DAF. The main vegetation type (DAF) has been divided into four distinct subtypes based on the characteristic species in each subtype. These four subtypes comprise (1) Undifferentiated Afromontane forest, (2) Dry single-dominant Afromontane forest of the Ethiopian highlands, (3) Afromontane woodland, wooded grassland and grassland, and (4) Transition between Afromontane vegetation and *Acacia-Commiphora* bushland on the Eastern escarpment. In general, the DAF represents a complex system of successions including extensive grasslands rich in legumes, shrubs, and small to large-sized trees to a closed forest (Zerihun Woldu,

1999; Sebsebe Demissew and Friis, 2009). It is also multistoried forest vegetation (Zerihun Woldu, 1999).

2.2. Forest Status in Ethiopia

As home to 70 % of all terrestrial plants and animals, forests are critical to conserving biodiversity on a global scale. However, the greatest threat to biodiversity, especially in tropical regions, is the loss of forest cover as forest lands are converted to other land uses, mainly due to agricultural expansion and forest degradation (USAD, 2005). Studies showed that most of the vegetation cover of Ethiopia has been degraded and the few remnant high forests are found in southwestern and western parts and as patches in conservation sites, churches and sacred areas in the country (Friis, 1992; Sebsebe Demissew and Friis, 2009; Friis *et al*., 2011). Many of the high forests in the highlands have been depleted for settlement, agricultural expansion and fuelwood (Friis, 1986; 2005; Friis *et al*., 2011). However, the presence of several isolated large-sized trees, even on farmlands, or forest patches around churchyards and religious burial grounds show the occurrence of vast expanses of earlier forests (Tamrat Bekele, 1993).

It has been estimated that about 35% of the land cover of Ethiopia comprised high forests before human settlement took place, and if the savannah woodlands are included, it can be magnified that about 66% of the country's total area was covered with forests (EFAP, 1994). The report by Environmental Economics and Policy Forum for Ethiopia (EEPFE, 2008) has shown that by the early 1950s, high forests had been reduced to 16% of the total land area of Ethiopia since then. Based on the same report, forest in the country was on a decline at a faster rate and had dwindled to 3.6% by 1980, and 2.6% by 1987.

The environmental data on forest resources of Ethiopia reported in FAO (2010) put Ethiopia among countries with a forest cover of 10-30%. However, the recent information was given by the Ministry of Environment, Forest and Climate Change (MEFCC, 2018), states the country has close to 17.35 million *ha* (15.7%) of forest resources including bamboo, dense woodland, natural forests, and plantations. The various definitions of forests are emanated from different sources. This is because there is a lack of consistent and/or reliable data on areal coverage, standing stock, growth rate, production and productivity of forest resources in Ethiopia (MEFCC, 2018).

2.3. Species Diversity and Diversity Indices

Diversity simply reflects the variety that exists in a certain place and refers to the number of categories that can be differentiated, and the proportions (or relative abundance) of the objects in each category (Martin, 1995). Species diversity and abundance are among the most considerable themes in ecology and plant biodiversity conservation (Watanabe and Suzuki, 2008). Nevertheless, there is a lack of an appropriate connotation of species diversity and its ecological elucidation at different habitats (Kent and Coker 1992), making the concept hard to apply (Magurran, 2004).

A diversity index is a single statistic that is intended to integrate information on both richness and evenness (Magurran, 2004). Here, species richness and evenness are the two main factors that must take into account when measuring diversity. It is asserted that species richness, a count of the number of species (Martin, 1995) is the most commonly adopted diversity index to describe community and diversity (Magurran, 1988; Kent, 2012). However, only obtaining the number of species present in a community does not provide information regarding species abundance, or rather, which species are rare and which are common (Martin, 1995).

The second important component in diversity is the evenness (sometimes known as equitability) (Magurran, 1988). To ensure that diversity measurements discuss different weights to rare and common species, it is necessary to consider the abundance among species in the sample (Martin, 1995). In any case, diversity is measured by recording the number of species and their relative abundances. In general, species diversity (heterogeneity) measures are the traditional way of quantifying biological diversity (Magurran, 2004).

2.4. Plant Community Types

The plant community could be described as the group of plant species growing together in a particular location that shows a definite association or affinity with each other (Kent, 2012). The concept of plant communities is based on the continuum and/or individualistic theories. According to Clements (1916), there is a high degree of integration in a plant community, and the community viewed as an organic entity (organismal view) composed of various species repeat itself with uniformity over a particular region. On the other hand, Gleason (1926) claimed that species composition at any particular site could be unique due to chance dispersal and the independent distribution of each species. This shows that the individualistic concept of the plant community can be based on the environmental factors which act as a filter so that only certain species can survive at particular sites and, the sites vary over time.

Various views still exist among different ecologists, however, the hierarchical continuum theory emphasized as a modern synthesis that recognizes the validity and incorporation of both thoughts and their complementarities in their application for various aspects of community analysis (Collins *et al*., 1993).

The major distinction among plant communities was because of physiognomy, or general appearance of the vegetation (Martin, 1995; Kent, 2012). Species compositions of plant communities had better express their close relationships to one another and the environment than any other characteristic (Kent and Coker, 1992; Kent, 2012). Generally, the plant species that grow together to form a community have also shown that they can coexist with each other (Kent, 2012).

2.5. Ethnobotany and its Scope

In the development of the field of ethnobotany, ongoing change from a narrow scope to a broader scope is obviously evident. In this regard, like any other academic area, the term ethnobotany went through a series of definitions by researchers of different periods. The term was coined by J. W. Harshberger, who defined it as *"...the use of plants by aboriginal peoples"* (Harshberger, 1895; cited in Cotton, 1996; Balick and Cox, 1996). Ethnobotany is the study of the relationship between plant world and local people (Balick and Cox, 1996). One of the other broadest definitions of ethnobotany that is provided by Martin, who elucidated it as the sub-discipline of ethnoecology that is concerned with local people's interaction with plants (Martin, 1995). The plant-human interactions that exist in the different socio-cultural groups express a state of dynamic processes (Zemede Asfaw and Tigist Wondimu, 2007).

In fact, ethnobotany comprises the study of all human societies, past and present, and all types of interrelations including ecological, evolutionary, and symbolic (Alexiades, 1996). Furthermore, ethnobotany encompasses studies concerning plants describe local people's interaction with the natural environment, uses and other relations that exist between humans and plants (Martin, 1995; Cotton, 1996). Hence, the way local people integrate plant species into their cultures, traditions,

religions and cosmologies reveals much about the people themselves (Balick and Cox, 1996). These authors explained that people use plants in so many different ways, which are few arenas of human endeavor in which plants do not play an important role. Indeed, plants have determined the very course of civilization.

Over the past many years, with recognition of its role in traditional knowledge, biodiversity conservation, natural resource management and rural development, ethnobotany has gained significant attention and experienced a period of growth (Alexiades, 2003). The same author further explains that scholars in ethnobotany and related fields have played a key role in validating IK through suggesting its potential for biodiversity conservation, and economic and social development. Generally, the scope of ethnobotany expanded to include studies of modern cultures and has become interdisciplinary and more recently, greater attention is given to its application, conservation and sustainable development.

2.6. Traditional Medicinal Plants

According to World Health Organization (WHO, 2002), traditional medicine is the sum of all knowledge and practices, prevention/inhibition, and elimination of ailments relying on practical experience and observation handed down from one generation to the next, whether orally or in writing. However, ultimately resulting in irretrievable loss and distortion of the original information if the transmission is by word of mouth (Dawit Abebe and Ahadu Ayhu, 1993). Furthermore, Farnsworth (1994) defined ethnomedicine as the use of plants by humans for medicines and traditional medicine as the sum total of all non-mainstream medicinal practices.

The vast majority (about 70-80%) of the people in Africa consult traditional medicinal practitioners for healthcare (Cunningham, 1993).

2.6.1. History of traditional herbal medicine

Using plants by humans dates back millennia because of their multiple useful properties for societies, hence all ancient civilizations (Chinese, Persian, Roman, Egyptian, Arabic, Mayan, Aztec, Inca, etc.), developed important surgical and healing techniques using only plants and their derivative (Gómez, 2000). In Europe for example, a highlight in this matter is the great work of "De Materia Medica" or medicine materials, the forerunner of modern pharmacopeia and written by the physician and botanist Dioscorides. The author further explained that the text describes 600 MPs, 90 minerals and about 30 substances of animal origin.

On the other hand, Good (1987) clarified that African TM is an all-embracing system of healing that is deeply embedded in religious and socio-cultural institutions and reflecting values and practices, both local and foreign which have been integrated and adapted over the centuries. It is also worth noting that TM is an integral part of local culture (like beliefs, lifestyles and attitudes) and therefore people resort to it even when modern medicine is accessible (Dawit Abebe and Ahadu Ayehu, 1993).

2.6.2. The Ethiopian scenario

The literature sources affirm that the use of TMPs has a significant role in primary healthcare delivery system in Ethiopia (Mander *et al.,* 2006; d`Avigdor *et al*., 14; EBI, 2015), yet they are in danger of losing both their ethnobotanical knowledge and the plants they have used as medicine

for millennia (d`Avigdor *et al*., 2014). However, many of the earliest local knowledge was not documented due to secrets kept by the priest and other knowledgeable healers, as a source of power since the early times (Mirutse Giday *et al*., 2003).

In Ethiopia, about 80% of the human and 90% of livestock populations depend on traditional herbal medicines and plant remedies selected over centuries (Amare Getahun, 1976; Dawit Abebe, 1986; Dawit Abebe, 2001; EBI, 2014; EBI, 2015). As mentioned, this shows that the country has a long history of using traditional medicines from medicinal plants (Dawit Abebe and Ahadu Ayehu, 1993; Mander *et al.*, 2006).

The healing methods and associated practices of the Ethiopian people are as diverse as their culture. Often, knowledge of the traditional healing system is either based on oral tradition or on information that is codified in the early various medico-religious manuscripts (Pankhurst, 1990; Dawit Abebe and Ahadu Ayehu, 1993; Kebede Deribe *et al*., 2006). The information found in the antique traditional pharmacopeias is the result of prolonged observations that involve man himself as the subject of experiments while trying to establish the effectiveness and safety of the various agents before they added to the list of the therapies (Dawit Abebe and Ahadu Ayehu, 1993).

Some authors associate the medico-religious healing practices with close interaction of Christian, Islamic, and indigenous religions in the country, which sometimes shows features related to magic, beliefs, and faith in some areas. In this perspective, Ethiopian herbal medicine is concerned with not only the healing of ailments but the defense and promotion of human physical, spiritual, social, psychological and material welfare (Kebede Deribe *et al.*, 2006). On the other hand, the local

knowledge still continues to be transferred through the oral tradition and by application (d'Avigdor *et al*., 2014).

2.6.3. Role of traditional medicinal plants to healthcare and livelihoods

An increasing number of nations, comprising China, Mexica, Nigeria, and Thailand, have decided to integrate TM into their primary healthcare systems. In these systems, ethnobotanical research plays a crucial role in documenting the traditional healthcare practices of the country (Balick and Cox, 1996). The authors further indicated that most developing countries depend on traditional MPs for their healthcare.

Moreover, the role of traditional herbal medicine in healthcare and livelihoods of the developing world is estimated to be substantial and Ethiopia has to see itself in this mirror (Mander *et al*., 2006). However, the dependence on traditional herbal medicines in developing countries may relate to the failure of governments to confirm the delivery of 'modern' health services at an affordable price to everyone, particularly to the most vulnerable groups in the community (Dawit Abebe, 2001). As stated by Mander *et al*. (2006), MPs are also seen as an economic commodity for some members of the society that make their livelihood on their collection, trade and medicinal practices by traditional practitioners or healers. It is, therefore, has a considerable potential to contribute to the economic growth and alleviation of poverty in the country (Dawit Abebe, 1986).

Nowadays, the use of ethnobotanical knowledge regarding medicinal plant usage and research has gained substantial consideration among the scientific communities. As elsewhere in Africa, indigenous people in Ethiopia, by large used plant-based traditional medicine to be cured of

diseases arising from worms, fungi, viruses, and protozoa (Dawit Abebe, 2001). In the country, plants have been used as a source of TM from time immemorial to combat different ailments and human sufferings, and/or to prevent and cure various health problems (Dawit Abebe and Ahadu Ayehu, 1993). For its long period of practice and existence, TM has become an integral part of the culture of Ethiopian people (Pankhurst, 1990). Some MPs also have additional use-values such as food, spices, condiments, construction and cultural values (Zemede Asfaw, 2001).

2.7. Traditional Veterinary Medicine and Domestic Animal Diversity in Ethiopia

The dependency on TM can be interrelated to its low cost, availability, efficacy, cultural acceptability and inaccessibility of modern healthcare facilities (Dawit Abebe and Ahadu Ayehu, 1993; WHO, 2002; Ermias Lulekal *et al*., 2013). Cheaper and more accessible traditionally utilized MPs can verify feasible therapeutic options or substitutes if they are appropriately investigated and standardized (Fekadu Fullas, 2010). According to the same author, several field studies on the use of plants in veterinary medicine have been conducted in many developing countries. Therefore, using traditional medicinal plants for handling animal disease has been a well-recognized practice all over the world and documented in the past.

EBI (2015) indicates that Ethiopia has served as a gateway for domestic animals from Asia to Africa and the country's diverse ecology favored the diversification of these resources. In terms of livestock population, Ethiopia stands first in Africa and the 10th in the world. The same report further elaborates the most common farm animals of the country are classified into mammals, avain and honeybees. Cattle, sheep, goats, camels, donkeys, horses and mules are the dominant

farm animals that are grouped under the mammalian category. The avian category includes chicken, ostrich and turkey, however, the latter two species are not extensively used in the country.

According to the estimates available from CSA (2013), Ethiopia is the home of around 52.13 million cattle, 24.2 million sheep, 22.6 million goats, 0.99 million camels, and over 44.89 million poultry (excluding those of which are being reared in the agropastoral and pastoral areas). The country is also the hub of a good deal of indigenous livestock genetic resources, as observed by Daniel Tesfaye (2008) the total numbers of cattle being reared in the country, majority of them are of native breeds, most of these cattle are reared under the traditional management system.

Livestock plays substantial roles in providing food, household income, and/or cash, manure and fuel, ecological and social functions. Besides, livestock serves as sources of commodities for export like live animals, meat and meat products, hides and skins, and beeswax to earn foreign exchange (EBI, 2015). Nevertheless, their economic benefits remain to be low because of prevailing ailments that are among the principal bottlenecks of livestock performance and cause of high economic losses of the resource-poor farmers (Tigist Wondimu *et al*., 2007). As a result, Ethiopian farmers and pastoralists depend on traditional knowledge, practices and plants to control livestock ailments (Mirutse Giday and Gobena Ameni, 2003).

2.8. Nutraceutical and Other Uses of Plants

2.8.1. Nutraceutical plants

Nutraceuticals are commonly defined as any substance that is considered a food, part of a food, a vitamin, a mineral, or a herb that provides health benefits, including disease prevention and

handling, and they were first identified in 1989 (Kalra, 2003). Combining two words (*nutrition* and *pharmaceutical*), created the name '*nutraceutical.*' Nutraceuticals (sometimes called functional foods) are natural bioactive and/or chemical compounds that have health-promoting, ailment preventing or medicinal properties. The secondary metabolites present in them provide a specific healing benefit other than a purely nutritional effect (Elizabeth, 2002; Dureja *et al*., 2003; Chanda and Kaneria, 2011).

The herbal medicines were found crucial resources of nutraceuticals, which could provide a variety of beneficial effects on human health (Chanda and Kaneria, 2011). Gunther *et al.* (2004) claimed that people get more than basic nutritional needs from nutraceuticals. These nutraceuticals are also used to treat and/or handle many ailments including cancer, cold, cough, metabolic complications, depression, heart disease and many more health problems (Saika *et al*., 2011). Dureja *et al*. (2003) further claimed that nutraceuticals might range from single isolated nutrients, dietary supplements or secondary metabolites to genetically engineered designer foods.

2.8.2. Wild edible plants as sources of food and medicine

Wild edible plants (WEPs), many of which have nutritional, or food (Weinberger and Msuya, 2004) and medicinal benefits (human and veterinary) (Johns and Chapman, 1995; Zemede Asfaw and Tigist Wondimu, 2007) are frequently underutilized as local solutions to food insecurity and associated health concerns. The investigation has revealed that certain WEPs are still used because of their assumed health benefits, thus they can be classified as medicinal foods (Etkin, 1994). Moreover, a study in the Middle East indicated that wild edible fruits are supposed to be essential and open the likelihood for their use as a source of nutritional and pharmaceutical materials

(Hegazy *et al*., 2013). Even though wild food plants represent a minor contribution to family meals, they are potentially important nutrient and cultural resources for local people around the world.

Studies showed that the rural inhabitants of Ethiopia have wider local knowledge, practice, tradition and opportunity of using WEPs (Amare Getahun, 1974; Getachew Addis *et al*., 2005; Getachew Addis *et al*., 2013). However, the extent of utilization of these plants varied with respect to age, sex, time and season (Getachew Addis *et al*., 2005). Many WEPs have supplementary, seasonal and the only source of food for many rural communities during times of critical food shortage. For example, in Benshangul Gumuz Region, WEPs contribute 30-40% to food security in normal and at times of food shortage (EBI, 2015). This shows that they are an essential part of the diet and have diverse contributions in various ways.

2.8.3. Local use of plants

Studies made in various parts of Ethiopia have shown that the people use large number of plant species for other uses (Zemede Asfaw and Tigist Wondimu, 2007). Many of the plants have more than one local use. In this case, Zemede Asfaw (2001) confirms that the local people use many wild plant species for food, medicines, clothing, shelter, fuelwood, fiber, income generation, and for fulfilling cultural and spiritual needs throughout the world. Bussman and Sharon (2006) also confer that local plant resources are widely used in construction, tool-making, fuelwood for cooking, nutritional supplementation and cultural adornment.

Many studies on the utilization of wild plants in Ethiopia showed that they are mainly used for house building and household utensils, clothing, food, soap, medicine, and magic and ritual

purposes (Amare Getahun, 1976; Pankhurst, 1990; Dawit Abebe and Ahadu Ayehu, 1993). Following this, the ethnobotanical information revealed that various studies have made to document the different uses of plants in indigenous communities of Ethiopia (Getachew Addis *et al*., 2005; Tigist Wondimu *et al*., 2006; Ermias Lulekal *et al*., 2013; Getachew Addis *et al*., 13; Moa Megersa *et al*., 2013; Tinsae Bahru *et al*., 2013).

2.9. Diversity of Medicinal and Wild Edible Plants in Ethiopia

2.9.1. Diversity of medicinal plants in Ethiopia

Ethiopia has diverse medicinal flora, which is distributed in different vegetation types. In the country, about 1,000 MPs have been identified and documented (Zemede Asfaw and Tigist Wondimu, 2007). This accounts for 17% of the total taxa in the Ethiopian Flora area. The country is also ethnobotanically rich as there are diverse ethnic groups with diverse cultures (Dawit Abebe and Ahadu Ayehu, 1993).

2.9.2. Wild edible plants in Ethiopia

Several studies recorded the occurrence of wild edibles at different spots of the country although this information is found scattered in botanical monographs, glossaries, and informal notes in the rich oral tradition of the different communities (Zemede Asfaw and Mesfin Tadesse, 2001). Reports from NBSAP (2005) showed that there are about 170 wild edible plant species that are consumed in different parts of the country. About 300 and 400 species of WEPs have been documented from different parts of the country (Zemede Asfaw and Tigist Wondimu, 2007).

Research has also shown that hundreds of edibles including many vegetables of wild/semi-wild origin are known to be sporadically consumed by rural communities in Ethiopia (Getachew Addis *et al*., 2013). A review documented by Ermias Lulekal *et al*. (2011) has shown that 413 species of WEPs belonging to 224 genera in 77 families have been identified so far. However, the actual number of wild edible plants in Ethiopia is expected to be more than the cited number given a large flora of about 5,757 species and sub-species, many cultures and localities that yet remain ethnobotanically unexplored.

2.10. Indigenous Knowledge (IK) and its Transfer

Literature has shown that indigenous knowledge (IK) results from many generations of long years of experience, careful observations, and trial-and-error experiments. This knowledge helps people to adapt and survive challenges from their environment (Martin, 1995). The IK is one of the unique experiences applied to traditional knowledge that is transferred to the younger generation and is still developed by rural indigenous communities in specific geographical areas.

The local knowledge about medicinal plants obviously contributes to the scientific investigations in the modern healthcare system (Zemede Asfaw and Tigist Wondimu, 2007). In fact, the knowledge of MPs in Ethiopia is unevenly distributed amongst the community members. However, all share the local knowledge, and only a few hold specialized knowledge. The knowledge and social structure is thus intertwined (Zemede Asfaw, 2001). On the other hand, those knowledgeable people do not easily transfer their knowledge to the local community where they live. As an alternative, they want their ethnobotanical information to be hidden and the knowledge of plant therapies stayed at their hands (Mirutse Giday *et al*., 2003).

2.11. Threats and Conservation of Medicinal, WEPs and IK

2.11.1. Threats to medicinal, WEPs and associated IK in Ethiopia

In Ethiopia, the knowledge on traditional MPs, which was developed for millennia, is now subjected to loss since it has mainly been stored in the memories of elderly persons and handed down mostly by word of mouth, which is prone to lose at each point of transfer (Dawit Abebe, 2001). In addition, TM as elsewhere in other developing countries faces a problem of sustainability and continuity mainly for loss of taxa of MPs, loss of habitats of medicinal and other categories of plants and cultures (Zemede Asfaw, 2001). Others reported that losing the ethnomedicinal knowledge is because of mainly acculturation, declined the interest in traditional medicinal practice among the younger generation and loss of medicinal species (Abbink, 1995; Miruste Giday *et al*., 2003; Miruste Giday *et al*., 2009).

It has been stressed repeatedly that deforestation, overexploitation (Zemede Asfaw, 2001; EBI, 2014; EBI, 2015) environmental degradation, agricultural expansion and population growth are the principal threats to MPs in Ethiopia (Zemede Asfaw, 2001; Ermias Lulekal *et al*., 2013; EBI, 2015). Similarly, the major threats for the WEPs species are overstocking/overgrazing, selective cutting for construction and technology, agricultural land expansion, fuelwood collection and uncontrolled fire setting, firewood and charcoal production, and fencing materials (Kebu Balemie and Fasil Kibebew, 2006; Tigist Wondimu *et al*., 2006; Tinsae Bahru *et al*., 2013). The vanishing of wild edible species could result in the loss of local knowledge associated with their use (Getachew Addis *et al*., 2005).

2.11.2. Conservation of traditional medicinal plants and associated IK in Ethiopia

Conservation areas around the globe provide environmental services and harbour biological organisms important to local communities and to the world as a whole (Martin, 1995). Over the centuries, indigenous people have developed their own local specific knowledge on plant resource use, management and conservation (Cotton, 1996; Balick and Cox, 1996). In these cultures, such information resides within individuals, families or villages (Ballick and Cox, 1996). Thus, ethnobotanical studies are useful in documenting, analyzing and disseminating the knowledge on the interaction between plant biodiversity, and human society and how it is valued in different societies (Martin, 1995).

Local people in many parts of the world have also favoured certain useful species through traditional conservation practices, dispersal and planting (Cunningham, 2001). Studies emphasize that there are conservation actions that have been undertaken around the world designed to protect threatened MPs from further damage (Cunningham, 1996). *In-situ* and *ex-situ* conservation efforts are implemented to capture medicinal plant resources. In this case, Zemede Asfaw (2001) asserts that home-gardens are important targets for *in-situ* and *ex-situ* conservation of traditional medicinal plants in Ethiopia. Furthermore, some traditional practitioners in Ethiopia have conserved MPs by cultivating at home-gardens though the effort was minimal (Ermias Lulekal *et al*., 2008). The local communities in Ethiopia are owners of a well-developed tradition of preserving and utilizing diverse species of wild and cultivated plants (Zemede Asfaw and Tigist Wondimu, 2007). The close relationship can make indigenous groups a powerful force for conservation (Balick *et al*., 1996).

CHAPTER THREE

3. MATERIALS AND METHODS

3.1. Description of the Study Area

3.1.1. Geographical setting and land use

This study has been conducted in Baso Liben and Debre Elias districts, northwestern Ethiopia (Figure 1). Baso Liben District is bordered on the south by a bend of the Abay River, which separates it from the Oromia Region, on the northwest by Gozamin District, and on the northeast by Aneded District; the Chemoaga River defines part of its western border. The major town in the district is Yejube, which is located around 318 km northwest of the capital of Ethiopia, Addis Ababa (BLDFPEDO, 2018).

The area is located between latitudes and longitudes of 9^0 51' 00" N-10^0 18' 00" N and 37^0 29' 00" E-37^0 53' 00" E coordinates, respectively with a total area of 1,133.95 km^2. The land use pattern in the district covers cultivated land (56, 959.7 ha; 50.19%), natural grazing land (28, 958 ha; 25.52%), natural forest (19, 065 ha; 16.80%), plantation (492.6 ha; 0.43%), water bodies (115.2 ha; 0.10%), and building and settlement (7, 893.3 ha; 0.96%) (BLDFPEDO, 2018).

Debre Elias is also one of the districts in East Gojjam Zone in the Amhara Regional State of Ethiopia (Figure 1). The District is bordered on the south and west by the Abay (Blue Nile) River, which separates it from the Oromia Region, on the northwest by the West Gojjam Zone, on the north by Machakel, and on the east by Gozamin. The town in this District is Elias.

Debre Elias District is located around 335 km northwest from the capital city of Ethiopia, Addis Ababa, with its coordinates are 10^0 1' 00" N-10^0 23' 00" and 37^0 3' 00" E-37^0 32' 00" E. The total land area of the District is 1,165.8 km^2. The land use pattern of the District is known to be cultivated land (40, 454.75 ha; 29.21%), natural grazing land (11, 125.75 ha; 8.03%), natural forest (54, 988 ha; 39.70%), plantation (25,747 ha; 18.60%), water bodies (768.59 ha; 0.55%), building and settlement (1, 940.9 ha; 1.40) and other uses cover 3, 483.1 ha (2.51%) (DEDFPEDO, 2018).

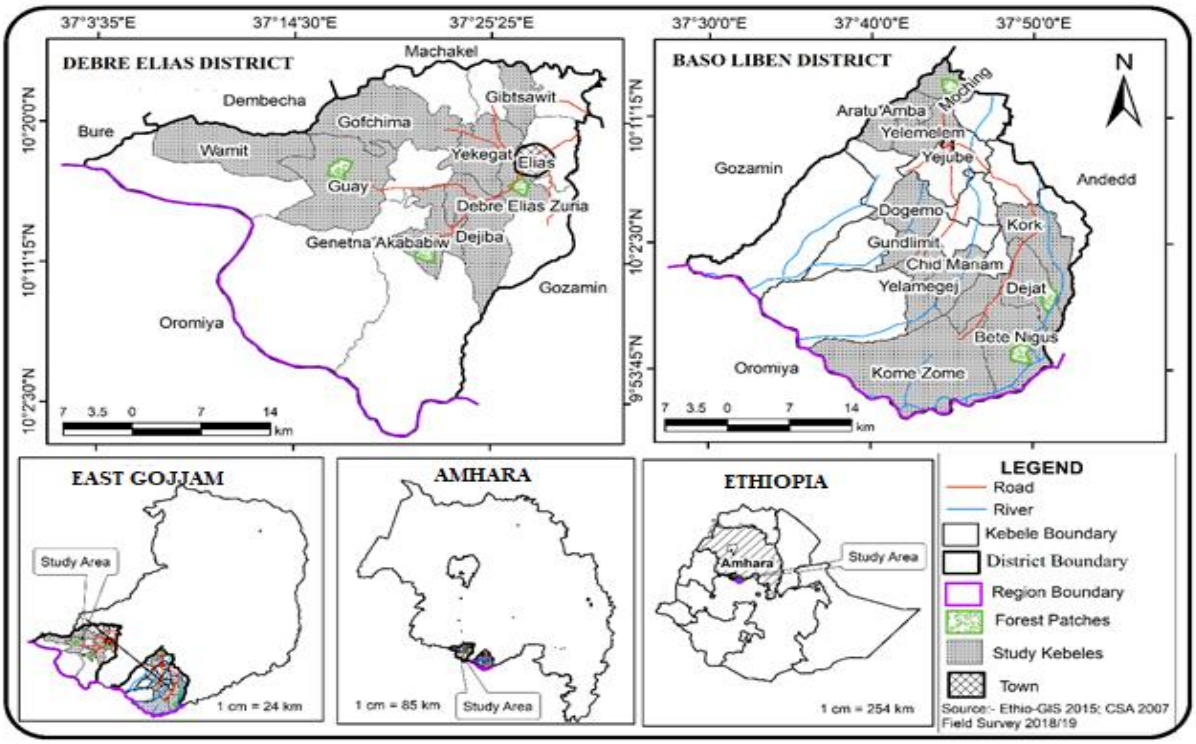


Figure 1. Map of Ethiopia showing the location of the study districts in East Gojjam Zone of Amhara Region

3.1.2. Demography, socio-economic and health status

Demography: According to the Central Statistical Agency of Ethiopia (CSA, 2007), Baso Liben District has a total population of 138, 332, with an increase of 22.74% over the 1994 census, of whom 68, 034 are men and 70, 298 women; 6,439 or 4.65% are urban inhabitants, with an area of

1,118.56 km^2. The population density of the District is 123.67 individuals/km^2, which is less than the Zone average of 153.8 individuals/km^2. Most of the inhabitants practiced Ethiopian Orthodox Christianity, with 99.09% reporting that as their religion, whereas 0.91% of the population was Muslims.

On the other hand, Debre Elias District has a moderately dense population that ranges from 100 to 120 people per km^2 (DEDFPEDO, 2018). As reported by CSA (2007), this District has a total population of 82,150 (of which 41,109 were men and 41,041 were women); 7,928 or 10% were urban inhabitants. The majority of the inhabitants practice Ethiopian Orthodox Christianity (99%), while 1% of the population was Muslims (DEDFPEDO, 2018).

Socio-economy: The Amhara people are chiefly agrarian and dependent on agricultural farming. Livestock rearing in homestead is considered a means of subsistence and supplementary income-generating activity. Petty trade is also an extra source of income in small towns. Thus, in Baso Liben District, the socio-economic activity of the local community is mainly dependent on mixed farming system that involves both in cultivation of crops and rearing of livestock.

The study District has great potential for agricultural production. Wheat (*Triticum* spp.), Tef (*Eragrostis tef*) and maize (*Zea mays*) are dominant crops. Other important crops (agricultural products) include barley (*Hordeum vulgare*), field pea (*Pisum sativum*), linseed (*Linum usitatissimum*), faba bean (*Vicia fava*), NOUG (*Guizotia abyssinica*) and chickpea (*Cicer arietinum)* in their order of importance. Other less common crops include haricot bean (*Phaseolus* spp.), lentil (*Lens culinaries)*, sesame (*Sesamum angustifolium)* and GOMENZER (*Brassica*

carinata). As far as land allotment is concerned, tef has the largest share (34%), followed by maize (16%), bread wheat (14%) and sorghum (*Sorghum bicolor*) (10%). Among the oil crops, linseed is largely produced covering 4% of the cultivated area followed by NOUG (*G. abyssinica*) which covers 2.5%. The report also showed that domestic animals raised include cattle, goats, sheep, donkeys, horses, mules and poultry (DEDFPEDO, 2018).

In Debre Elias District, a small-scale mixed agriculture is also the dominant source of livelihood to the local people. The most important crops grown in the district include wheat (*Triticum* spp.), Tef (*Eragrostis tef*) and maize (*Zea mays*). Other important crops include barley (*Hordeum vulgare*), field pea (*Pisum sativum*), potato (*Solanum tuberosum*), linseed (*Linum usitatissimum*), fava bean (*Vicia fava*), NOUG (*G. abyssinica*) and chickpea (*Cicer arietinum)* in their order of importance. The wheat holds the largest share, and it is the main cash source of the local community in the District. Other less common crops include haricot bean (*Phaseolus* spp.), lupines (*Lupinus albus*) lentil (*Lens culinaries),* sesame (*Sesamum angustifolium*) and GOMENZER (*Brassica carinata*), and from the livestock cattle, sheep and goats are the dominant animals (DEDFPEDO, 2018).

Health: The ten top causes of morbidity for Baso Liben District included diarrhea (none-bloody dysentery), pneumonia, diarrhea with blood (dysentery), infections of the skin and subcutaneous tissues, other or unspecified diseases of the eye and adnexa, malaria, acute upper respiratory infections, acute febrile illness, and other or unspecified diseases of the digestive system (EGZAO, 2018). Likewise, in Debre Elias, the ten top causes of morbidity were dyspepsia, pneumonia, acute febrile illness, trauma (injury, fracture etc.), malaria, disease of the musculoskeletal system and

conductive tissues, acute upper respiratory infections, helminthiasis, infections of the skin and subcutaneous tissue, and other or unspecified infectious and parasitic diseases (EGZAO, 2018).

It was also reported that the most common animal diseases in the two study districts include bacterial infections (blackleg, pastureolosis, anthrax, mastitis, fowl typhoid and avian salmonellosis), endoparasites (fascioliasis, paramphitomiasis, and strongyliasis), ecto-parasites (ticks, mites, lice and insect flies), viral infections (rabies, African horse sickness/AHS, and foot and mouth disease) and protozoal infections (trypanosomiasis, babesiasis and coccidiosis) (EGZAO, 2018).

3.1.3. The study area in historical perspective

There are diverse geographical conditions in East Gojjam Zone, which resulted in varied agroclimatic condition. These varying agroclimatic conditions shaped the settlement patterns, mode of life and the socio-cultural patterns of rural dwellers in the study area (EGZAO, 2018).

Yejube, the main town of the Baso Liben District served as a notable historical centre of slave trade during the 13th century (BLDFPEDO, 2018). Yejube was a large commercial town close to the market of Baso. The name “Baso Liben” is encapsulating from two Oromo words (Baso and Liben). Beke had traveled through this area in 1842 explains that groups of Oromo communities had settled in this part of Gojjam (Baso Liben), thus, the names of their tribes becoming the names of the District (Beke, 1842). Yeda River served as a demarcation of the sub-districts, western part of Baso and eastern part of Liben. The District is a rich source of culture, IK, plant and animal life.

On the other hand, Debre Elias is one of the most known and oldest historical areas in Ethiopian history. Elias (town of Debre Elias) is one of the oldest Ethiopian Orthodox Tewahido Churches (EOTC) that is full of history, indigenous knowledge and cultural arts (DEDFPEDO, 2018). EOTC is an indigenous Christian Church of Ethiopia, being one of the most ancient churches in the country and in Africa.

In the area, the historic religious churches and monasteries have many important and historic religious written documents and materials or church relics. The known Monastery named, Selassie in the District is 38 km away from Elias town and 76 km from Debre Markos, which has a long history of planting, protecting and conserving various plant species. The churches are also the home of IK, belief, art, morals, law, custom and many other capacities.

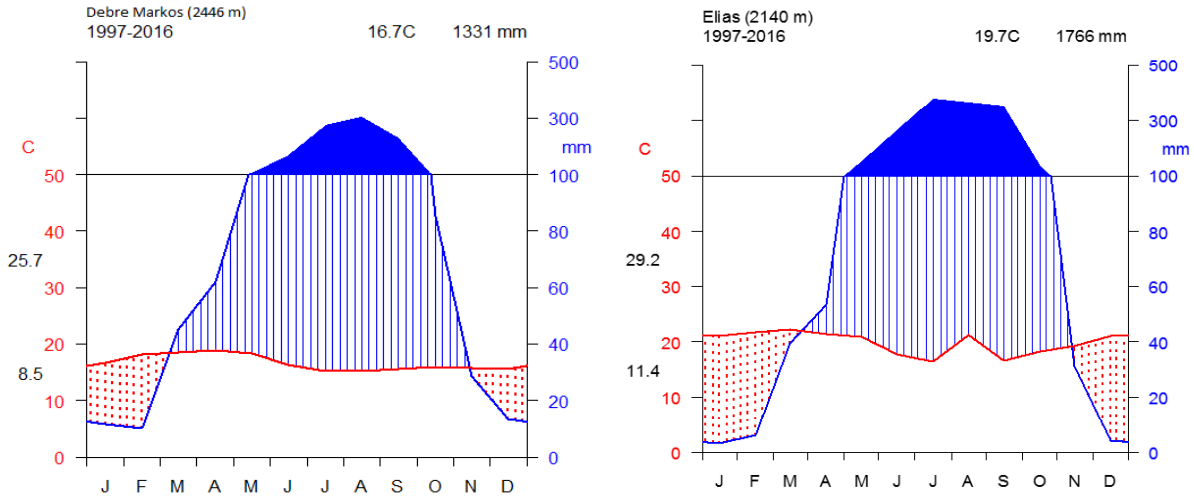
3.1.4. Climate, soil and vegetation types

In Baso Liben, the climate data from Debre Markos Weather Station (that is about 27 km away from the district's town) was recorded. The climate data from (1997-2016; 20 years) indicated that the area received 1331 mm mean annual rainfall, with peaks in July and August. The rainfall pattern is uni-modal that lasts from June-September. The mean annual, maximum and minimum temperature records were 16.7℃ , 25.27℃ and 8.5℃, respectively (Figure 2A).

The climate data recorded from Elias Weather Station was from 1997 to 2016 (20 years). The area received a mean annual rainfall of 1766 mm. Here, the rainfall pattern is also unimodal, stretching from May to September. The mean annual, maximum and minimum temperature records of the study site were 19.7℃, 29.2℃ and 11.4℃, respectively. Rainy months are blackened and dry

months are dotted as indicated in Figure 2B (Elias Station). The mean annual temperature of the District ranges from 18℃ to 27℃ and receives the mean annual rainfall of 1150 mm.

According to the agroecological zonation of Ethiopia (MoA, 1998; MoARD, 2005), the study area can be classified into the following major agroclimatic divisions. These include warm sub-moist lowlands (below 1400 m a.s.l.), cool sub-moist mid highlands (ranges from 1400 to 2200 m a.s.l.), tepid moist mid highlands and cool moist mid highlands where the elevation varies between 1000 and 2000 m a.s.l. (MoA, 1998; MoARD, 2005). Similarly, the dominant soil types are leptosols, cambisols, nitosols, and vertisols (FAO, 1986; MoARD, 2005). In general, the two districts are thought to be good potential agricultural areas with sufficient rainfall and fertile soils.



A) Debre Markos B) Elias

Figure (A-B) 2. Climadiagram of the study area as recorded at Debre Markos (for Baso Liben) and Elias (for Debre Elias) Stations [Data source: National Meteorological Service Agency (NMSA, 2018)].

Vegetation types: As indicated by Friis *et al*. (2011), dry evergreen Afromontane forest and grassland complex (DAF) is the second richest vegetation type after *Acacia-Commiphora* woodland and bushland (ACB). DAF occurs in areas (including the study area) between 1800 and 3000-meter altitude and with rainfall < 1700 mm. Dry evergreen montane forests are characterized by canopies usually dominated by *Juniperus procera* with *Podocarpus falcatus* as co-dominant species, followed by *Olea europaea* subsp. *cuspidata*. Thus, remnant forest patches of the two districts belonging to DAF (Friis, 1992; Friis *et al*., 2011).



A = Hawariat Church-Monastery-*Juniperus procera*, *Albizia schimperiana*



B = Abragit/Dejat-*Anogeisus leiocarpa*, *Tamarindus indica*, *Ficus sycomorus*



C. Elias Zuria-*Syzygium guineense* subsp. D. Bete Nigus- *Croton macrostachyu*, *A. abyssinica guineense*, *Maytenus arbutifolia*



E = Genet - *Acacia seyal*; *Dichrostachys cinerea*; *Hyparrhenia rufa*

Figure (A-E) 3. Forest patches partial view in Baso Liben and Debre Elias districts (Photo taken by Nigussie Amsalu, 2017)

3.2. Sources of Data

The data in this study were gathered from both primary and secondary sources. The primary data were found to be both quantitative and qualitative in nature. These data were collected using interview questions, observations, focused group discussions (FGDs) and field visits. The qualitative and quantitative tools were prepared, pre-tested, or pilot-tested before the actual survey. The research questions were designed in English and translated in Amharic (the local dialect). On

the other hand, secondary data or supplementary data were found from documented references such as books, articles, journals, other published and unpublished materials, manuscripts (from church and monasteries), conference proceedings, and zonal and district documents.

3.3. Reconnaissance Survey

A reconnaissance survey was conducted to have prior information on medicinal, wild edible plants and the general physiognomy of forest patches in both districts from September 4-28, 2015. During the survey, general information about the study districts in various 'kebeles' (sub-districts, the least administrative chain of Ethiopia) was acquired. The surveys have been following the protocols for ethnobotanical data documentation (Alexiades, 1996). Next to the reconnaissance survey, the following appropriate methodologies were developed for in-depth data collection.

3.4. Methods of Data Collection

3.4.1. Vegetation study

3.4.1.1. Data collection in forest patches

Comprehensive floristic data have been collected from May 2016 to March 2018. The collections were conducted both in dry and wet seasons (to consider short-lived annual which merely grow in wet seasons) of the year. Ninety-two (92) sampling plots of each 400 m^2 (20 m × 20 m) were taken from all remnant forest patches. Of which, 41 from Baso Liben (Bete Nigus, Hawariat Church-Monastery and Abragit) and 51 from Debre Elias (Genetna Akababiw, Elias Zuria and Guay) forest patches were sampled.

The number of sampling plots varied from one forest patch to another patch based on forest cover, altitudinal differences (elevation gradients), and habitat unevenness of the remnant forest patches. The selection of stands was preferentially done following standard methods (Barbour *et al*., 1987). This kind of sampling technique could represent the study area well. The plots were established for tree inventory in the manner described by Kent and Coker (1992) at every 100 m elevational drop (interval). However, for shrub and herbaceous layers, 5×5 m^2 and 1×1 m^2 subplots were established, respectively, within the main plots following Kent and Coker (1992). Twenty transects, 200 meters apart from each other were established. Transects were laid against altitudinal gradients to capture representative samples of the forest patches. Thus, the first line transect was aligned purposively at one side of the forest by escaping the forest edge. A list of trees, shrubs, climbers and herbs was made from the preferentially selected plots along each transect.

The scientific and local names, abundance and percentage canopy cover for each woody species were recorded in each plot. The diameter of each woody species having a diameter of ≥ 2.5 cm at breast height (DBH) was measured using a tree caliper. The percentage cover/abundance values were transformed to a scale of ordinal transformed values 1-9 according to the modified Braun-Blanquet approach (van der Maarel, 1979; Kent and Coker, 1992).

3.4.1.2. Specimen collection, identification and preservation

Voucher specimens have been collected from forest patches, cultivated fields and home-gardens at the spot during guided field walk, numbered, pressed, dried and deep-frozen for identification following the standard procedures of herbarium specimen preparations and preservation. The growth forms of the plant species were identified based on the convention in the Flora of Ethiopia

and Eritrea (FEE). Identification of specimens has been carried out both in the field and later at National Herbarium (ETH) using taxonomic keys, descriptions and illustrations in the FEE by comparing with authenticated herbarium specimens and consulting with the professionals (plant systematists). Photographic images of collected plant species were also used to facilitate identification. Finally, the voucher specimens were kept at the ETH and Debre Markos University.

3.4.2. Ethnobotanical data collection

3.4.2.1. Sample site selection, sample size determination and selection of informants

Sample site selection: Nineteen (19) kebeles (sub-districts) were selected (11 from Baso Liben and 8 from Debre Elias districts. Dejat, Dogem, Moching, Yelemelem, Aratu Amba, Kork, Gundlimit, Yelamgej, Chid Mariam, Bete Nigus and Kome Zome were selected from Baso Liben District while Dejiba, Wamit, Guay, Gofchima, Gibtsawit, Genetna Akababiw, Debre Elias Zuria and Yekegat were from Debre Elias District. The selection of the study sub-districts were based on altitude, topography, population density, availability of traditional healers, distance from the main road, modern healthcare facilities and forest patch cover.

Sample size determination: The sample size for quantitative data was determined using Cochran's (1977) formula, as shown via Bartlett *et al*. (2001) as follows:

$$n = \frac{N}{1+N(e)^2}$$, where:

n = sample size for the research, N = total number of households in all 19 kebeles (sub-districts)

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

1 = probability of the event occurring

In this study, the total number of households in 11 sub-districts of Baso Liben District was 15, 675, whereas the total number of households in eight sub-districts of Debre Elias District was 9, 395 (Table 1). Thus, the sample size was determined based on the total number of 25, 070 households (the sum of the two districts).

$$n = \frac{N}{1+N(e)^2} = \frac{25{,}070}{63.675} = 394$$

The required sample size was 394 (number of respondents). The sample size for each sub-district was calculated using a proportion of the number of households (each household is represented by one informant) of the two districts. Thus, the sample size of one of the sub-districts (Aratu Amba) in Baso Liben with households 25, 070 was 19 ($\frac{1{,}204 \times 394}{25{,}070}$). The same way of calculation was used for the other study sub-districts.

Table 1: List of sub-districts along with number of households and informants in the study area

Districts	Sub-districts	TSs	Key informants			General informants			Total no. of informants		
			Ms	**Fs**	**T**	**Ms**	**Fs**	**T**	**Ms**	**Fs**	**T**
Baso Liben	Aratu Amba	1, 204	3	1	4	9	6	15	12	7	19
	Bete Nigus	1, 649	4	2	6	13	7	20	17	9	26
	Chid Mariam	1, 295	3	2	5	9	6	15	12	8	20
	Dogem	1, 675	3	3	6	14	6	20	17	9	26
	Dejat	1, 395	2	1	3	13	6	19	15	7	22
	Gundlimit	647	1	-	1	7	2	9	8	2	10
	Kome Zome	1, 926	5	2	7	18	5	23	23	7	30
	Kork	2, 555	5	2	7	17	16	33	22	18	40
	Moching	924	2	1	3	7	5	12	9	6	15
	Yelamgej	1, 215	3	1	4	9	6	15	12	7	19
	Yelemelem	1, 190	2	-	2	12	5	17	14	5	19
	Sub-total	**15, 675**	33	15	**48**	128	70	**198**	161	85	**246**
Debre Elias	Dejiba	1, 150	2	1	3	9	6	15	11	7	18
	D/ Elias Zuria	549	2	1	3	4	2	6	6	3	9
	Genetna Akababiw	1, 211	4	3	7	8	4	12	12	7	19
	Gibtsawit	767	3	1	4	6	2	8	9	3	12
	Gofchima	1, 929	4	1	5	20	5	25	24	6	30
	Guay	2,010	5	1	6	20	6	26	25	7	32
	Yekegat	1, 222	5	-	5	11	3	14	16	3	19
	Wamit	557	3	-	3	5	1	6	8	1	9
	Sub-total	**9, 395**	28	8	**36**	83	29	**112**	111	37	**148**
Total		**25, 070**	61	23	**84**	212	99	**310**	**272**	**122**	**394**

TSs = total households; Ms = males; Fs = females; T = total

Selection of informants: Random and purposive sampling methods were employed to select a representative of general informants and knowledgeable traditional herbalists (key informants) respectively. The selection of informants was also performed following Martin (1995) who showed that when recording local knowledge held by knowledgeably traditional healers or by certain social groups, the choice of the key informant is crucial. Random selection is appropriate to get information on the distribution of knowledge in communities, while a purposive selection is better at getting specialist information, as exactly local specialists are under target. The latter one was adopted because it is the most flexible sampling scheme that allows for experience and decision making competence of the researcher.

The ethnobotanical information on the various uses of plants has been collected with an overall of 394 (272 males and 122 females) informants including 84 key informants from 19 kebeles of the two districts (Weredas). Out of 84 key informants, based on the number of kebeles and households in each District, 48 key informants for Baso Liben and 36 for Debre Elias were selected. From 19 sampled sub-districts, informants from aged 18-85 were selected to collect information on medicinal and WEPs knowledge of the community (Table 1). Eventually, key informants were identified, later interviewed and followed for further details. Throughout this study, each informant was visited three times to verify the reliability of the data obtained. Repeated visits also help to get some additional information that is not mentioned during the early interviews.

3.4.2.2. Methods of ethnobotanical data collection

Ethnobotanical data were collected during three different field visits within nineteen ‘kebeles’ in the study districts between 5 January 2016 to 20 April 2018. I recorded plant diversity along with

the ethnobotanical knowledge, associated with the MPs used by the local people. The methods used for ethnobotanical data collections were semi-structured interviews following Martin (1995) and Cotton (1996). The data were also collected by closely interacting with informants using guided field walk, focus group discussions, participant and direct observations, and free listing.

Semi-structured interview: Alexiades (1996) discussed the use of semi-structured interviews for collecting local information on plant utilization and thus, addressed a number of questions. In most cases, such interview is conducted with a single informant and allows expressing a personal viewpoint freely without being interrupted (Martin, 1995). The semi-structured interview guides were prepared and indicated in Appendix 1. The interview questions and discussions were conducted in the Amharic language. Since the communities are native Amharic speakers.

In semi-structured interviews, open questions about wild food consumption were required to determine knowledge about past and present-use, mode of consumption and preparation, collection time and collection sites for each species. The ethnobotanical information comprising the various data like local names, habitats, ailments treated, therapeutic effects, parts of plants used, conditions of plant parts used (fresh or dried), methods of preparation, routes of remedy administration, doses and side effects were obtained from local people through individual interviews (Appendices 5 and 6). The questions were also focused on how to get plants, the most important threats facing these plants and knowledge on conservation (Martin, 1995). Besides, the informants were asked to mention useful plant species (medicinal and WEPs) according to each of the use-categories (environmental, fodder, forage, firewood, social, poisonous and material uses), and use diversities of species following the methods by Martin (1995), Alexiades (1996) and Cotton (1996).

Guided field walk: following the semi-structured interview questions, field walk together with guides and traditional healer (s) were made during the trip. During this time, all relevant data including the vernacular name and scientific name of plants (but not everyone), the parts used, the preparation methods and modes of administration, and disease to be treated as well as their cultural knowledge for the conservation and preservation of medicinal and WEPs were gathered. In some study sites, only the researcher and an informant made the field observation without the guide, as the practitioner may not be willing to go with the guide to keep the secret of the IK.



Figure 4. Guided field walk in Debre Elias District



Figure 5. Guided field walk in Baso Liben District

Focus group discussion: As designated by Martin (1995) and Cotton (1996), focus group discussions (FGDs) were used for collecting, crosschecking and verifying the information that has been gathered by semi-structured interviews. Ten FGDs (one group discussion per two nearby 'kebeles' in the districts), comprising seven to 12 informants were used to prove the consistency of the data collected through semi-structured interviews following Alexiades (1996). The FGDs

were made with key informants to encourage and discuss authentically by honestly telling that their knowledge on their traditional practices would be kept top secret by the researcher. The places and time for discussion were arranged based on the interest of the informants.

Participant and direct observations: these are complementary ethnobotanical methods for decreasing researchers' subjectivity and intrusiveness, forming rapport (harmonious relation) and matching the statements of the research participants with their actions (Kremen *et al*., 1998; Reyes-García *et al*., 2006). Participant observation commonly takes place over a comparatively long period, enabling in-depth observations to be made and informal discussions held on the topic of the research (Cunningham, 2001). Many of the collected data in participant observation were qualitative, namely, field notes connecting to situations, photographs or conversation records (Albuquerque *et al*., 2014). Direct observation emphasized observing and recording actual events in the field.

Free listing: This method seeks to identify specific information on a given cultural domain of the studied community (Albuquerque *et al*., 2014). The method used to elicit information concerning WEPs is through free listing, a technique widely employed in ethnobotanical studies to determine the "domain" that one is researching (Castaneda and Stepp, 2008). Using this method, the informants were also requested to list MPs that they know in the area.

Market survey: Marketplaces were recognized by researches as readily accessible and cost-effective places for fieldwork, providing qualitative and quantitative data concerning cultural, social and economic aspects of a plant's usage (Cunningham, 2001). A mmarket survey has been

conducted in four towns (Yejube, Kork, Elias and Genet) to view and collect data on the marketability of medicinal and WEPs, and other uses of plants (Figure 6). The local markets have been visited three to four times, and the medicinal and WEPs sellers were interviewed.



a. *Otostegia integrifolia* b. *Schinus molle* c. *Allium sativum* and *Ruta chalepensis*



d. *Olea europaea* subsp. *cuspidata* e. *Impatiens tinctoria* f. *Rosa abyssinica*



g. Rosmarinus officinalis h. *Lippia adoensis* var. *adoensis*

Figure (a-h) 6. Market surveyed for some medicinal and wild edible plants in the study area (Photo taken by Nigussie Amsalu, 2018)

3.4.2.3. Ethical considerations

Prior to the collection of data, permission was secured from the East Gojjam Zone of Amhara Region. The researcher explained the purpose and nature of the study to the local participants in

order for them to make informed decisions on whether to participate in the study or not. Special ethical considerations were taken based on the cultural view of the local communities in the two study districts. They were also informed that the objective of the research is not for commercial purposes but for academic reasons. In so doing, the local informants, field assistants and other concerned bodies in the study area were well informed about the objectives of the research before the starting of data collection.

3.5. Data Analysis

3.5.1. Vegetation data analysis

Plant diversity analysis (H´): Shannon-Wiener's (1949) index was applied to quantify species diversity by running R Version 3.0.2, 2013 using a library vegan. This method is one of the most widely used approaches in measuring the diversity of species in community ecology (Kent and Coker, 1992) and is calculated as:

$H' = -\sum_{i=1}^{s} pilnpi,$ Where, H´ = Diversity Index; s = number of species; Pi = is the proportion of each species in the sample; lnPi = natural logarithm of this proportion.

Species evenness: Species evenness (equitability) is used to quantify the distinctive depiction of a species against a hypothetical community wherein all species are equally common. One of the simplest means of analyzing floristic vegetation data is to look at the association between species and the level of similarity between plots or samples (Kent and Coker, 1992). The evenness index is calculated using the following formula:

J = $\frac{H\prime}{H'max}$ where, J = evenness, H' = Shannon-Wiener Diversity Index, H'max = lnS where S is the number of species in the sample, and ln = natural logarithm. The value of the evenness index falls

(varies) between 0 and 1, and with 1 showing that a condition where all species are equally abundant or complete evenness (Magurran, 2004). The index was also used to measure the pattern of species similarities among the remnant forest patches and communities in the study area.

Floristic similarity analysis: Similarity indices were used to measure the degree to which the species composition of different systems is alike. Sorensen`s similarity (Ss) coefficient was applied to qualitative data and is widely used because it gives more weight to the species that are common to the samples than those that occur in either sample (Kent and Coker, 1992). In this study, it was used to describe the design of species turnover among successive communities and to compare the forest with other similar forests in the country. It ranges from 0 (complete dissimilarity) to 1 (total similarity) is described using the subsequent formula (Kent and Coker, 1992).

$Ss = \frac{2a}{(2a+b+c)}$, where Ss = Sorensen`s Similarity Coefficient

a = number of spp. common to both samples (communities 1 and 2),

b = number of spp. in sample 1 (community 1), and

c = number of spp. in sample 2 (community 2).

Structural analysis: The structure of the vegetation was described and analyzed using frequency, relative frequency, density, relative density, basal area and Importance Value Index (IVI). Tree or shrub density and basal area (BA) values were computed on a hectare basis. Frequency, density and basal cover of the woody species were calculated following the method described by (Kent and Coker, 1992); Zobel (1987) with some modifications:

Frequency is the percentage of sampling units containing the species.

$$\text{Frequency (\%)} = \left[\frac{\text{Number of plots where an individual species occurred}}{\text{Total number of plots sampled } (m^2)}\right] \times 100$$

Relative frequency: This can be considered by comparing the frequency of occurrences of all the species present.

$$\text{Relative Frequency} = \left[\frac{\text{Frequency of individual species}}{\text{Sum of the frequencies of all species in all of the plots}}\right] \times 100$$

Density is the no. of individuals of each spp. per unit area.

$$\text{Density (Stem/ha)} = \left[\frac{\text{Total number of individuals of a species in all plots}}{\text{Total number of plots studied} \times \text{Size of the plot } (m^2)}\right] \times 100 \text{ (DBH} \geq 2.5 \text{ cm)}$$

Relative density (RD): RD of each species can be computed with the following equation:

$$\textit{R}\text{elative Density (RD, \%)} = \left[\frac{\text{Density of individual species}}{\text{Total density of all species}}\right] \times 100 \text{ (DBH} \geq 2.5 \text{ cm)}$$

Basal Area (m^2/ha)**:** The basal area is measured as the cross-sectional area of tree stems at breast height (1.33 m). It can be computed from the measurement of DBH as follows in Microsoft Excel spreadsheet programme:

BA = $\frac{\pi d^2}{4}$, where π = 3.14; Ba = basal area; d = DBH (diameter at breast height) (m). Nevertheless, given that DBH was measured in centimeters, the formula was modified in such a way that the Ba would be in square meters. Hence, Ba = $\frac{\pi d^2}{40{,}000}$ or 0.0000785 d^2, where d is DBH in centimeters. Following Zobel (1987), the basal area of each species in the sample, plots were also calculated as:

$$\text{Basal area of a species } (m^2/ha) = \left[\frac{\text{Total basal area of a species}}{\text{No.of plots} \times \text{size of the plot } (m^2)}\right] \times 10,000$$

Dominance and relative dominance were computed using the following formula:

$Do = Bi \times Ni$, where Do is the dominance of a species, Bi = mean basal area per species and

Ni = no. of individuals in the i^{th} spp.

$$\text{Relative Dominance} = \left[\frac{\text{Dominance of a species}}{\text{Dominance of all species in the study area}}\right] \times 100 \text{ (DBH} \geq 2.5 \text{ cm)}$$

Importance Value Index (IVI): IVI is the sum of the percentage values of three parameters, namely relative frequency, relative density and relative dominance (basal area). It is used to calculate the woody plant species of forest patches. IVI confirms the share of species importance in the forest patches community.

IVI = RDo + RFr + RDe. Where, RDo (RBA) = relative dominance/relative basal area; RFr = relative frequency and RDe = relative density, as adopted by Kent and Coker (1992).

3.5.2. Ethnobotanical data analysis

The collected ethnobotanical data were analyzed following survey and analytical tools for ethnobotanical methods, which is recommended by Martin (1995). Local knowledge can be quantitatively assessed using various measures like Informant Consensus Factor (ICF), Fidelity level (FL) Relative Frequency of Citation (RFC), Use-Value (UV) and Jaccard's Coefficient of Similarity (JCS). Apart from the above measures, appropriate software and descriptive statistics were also computed in pair-wise comparisons, preference and direct matrix rankings.

Descriptive statistics: Descriptive data analysis method were used to summarize some ethnobotanical information obtained from the interviews on the reported medicinal and WEPs, and related local knowledge. Data were entered in an Excel spreadsheet and analyzed using descriptive statistics to identify the number and percentage of plant species, genera and families of medicinal and WEPs, their growth forms, consumption patterns, mode of remedy preparations, routes of administration, frequency and percentage of frequently utilized plant parts. Independent variables (gender, age group, informant category, marital status and educational background) were used to

assess the ethnobotanical knowledge of local people by using t-test and one-way analysis of variance (ANOVA) at 95% confidence level between means.

Informant consensus factor (*ICF*) - ICF was computed to determine the most important human and livestock disease categories in Baso Liben and Debre Elias districts and identify potentially effective medicinal plant species in the respective disease categories. Thus, ICF was calculated using the succeeding formula (Heinrich *et al*., 1998).

$ICF = \frac{\text{Nur}-\text{Ns}}{\text{Nur}-1}$, Where ICF = informant consensus factor

Nur = no. of use-citations in each ailment category

Ns = the no. of species used.

The value ranges 0 to 1, where a high value shows the greater informant consensus and a lower value implies disparity among the respondents.

Fidelity level (*FL*): The relative healing potential of each reported medicinal plant used against human and livestock ailments were evaluated using an index of fidelity level (*FL*) (Friedman *et al*.,1986; Alexiades, 1996) given by:

$FL = \frac{Ip}{Iu} \times 100$, where *Ip* is no. of informants who mentioned and or/ claimed the importance of a species for the treatment of a particular ailment and *Iu* is the total no. of informants who reported the plant species for any given ailment. The *FL* was used to quantify the importance of the species for a given use.

Preference ranking and direct matrix rankings: Values or scores given by key (main) informants on use-preference and use-diversity of useful plants were ranked to get the outcomes

of the preference ranking (Martin, 1995) and direct matrix ranking exercises following Alexiades (1996). Each key informant was asked to arrange the items based on personal preference and or perceived importance in the community. Thus, the ranking of key threats was computed on useful plants (both medicinal and WEPs) (1 = the least destructive and 5 = the most destructive).

Direct matrix ranking (a more complex version of preference ranking) (Martin, 1995) of multi-purpose plant species was listed for selected key informants from the two study districts each to assess their relative importance in their respective localities. The key informants were asked to allot use-values (5 = best; 4 = very good; 3 = good; 2 = less; 1 = least used, and 0 = not used). The values computed were ranked for each plant species.

Paired comparisons: Paired comparisons of highly cited MPs used to treat highly cited human and livestock ailments were done using selected key (main) informants. The total number of pairs required was determined by the formula $n\,(\frac{n-1}{2})$, where 'n' stands for number of items to be compared (Martin, 1995).

Relative frequency of citation: Relative frequency of citation (RFC) is used to determine the probability between the number of people who give the citation to each species and number of all informants. This index was intended to determine the consensus between the informants on the use of WEPs in the districts without considering use categories. RFC was calculated using the formula or the standard method of (Tardio *et al.*, 2008), which is:

$RFC = \frac{\mathrm{NF}}{N}$ (0 < RFC < 1). Where NF = the number of informants who gave citation at each species, N = total number of informants. Here, N = 394 (246, Baso Liben + 148, Debre Elias).

Use-value (UV): Use-value was used to determine the cultural significance of multi-purpose plant species in the study districts using the following formula:

$UV = \frac{\sum Ui}{N}$, where UV = use-value;

Ui = is the no. of uses mentioned by each informant (respondent) for a given species, and

N = is the total no. of informants as it is described in Albuquerque *et al.* (2006).

Use-value was also calculated using standard protocols (Savikin *et al*., 2013). $UV = \frac{U}{N}$ where 'N' is the number of informants mentioning various uses of a species. The method helps to identify the most important species to the local people, and it is used to infer the use of pressure on these culturally important plant species.

Jaccard's Coefficient of Similarity (JCS) in the study area: JCS was calculated to observe edible plant similarity between Baso Liben and Debre Elias districts. The JCS was estimated for comparing wild edible species composition in four randomly selected studies in Ethiopia following the formula given by Kent and Coker (1992).

$JCS = \frac{\boldsymbol{c}}{(\boldsymbol{a}+\boldsymbol{b}+\boldsymbol{c})}$, In view of that:

a = Number of species found only in Baso Liben District

b = Number of species found only in Debre Elias District

c = Number of common species found in both districts

Finally, to achieve the percentage similarity in species composition between the two study districts JCS must be multiplied by 100. Values close to one indicated that most of the plant species are found in common, while values close to zero assigned dissimilar plant assemblages.

CHAPTER FOUR

4. RESULTS

4.1. Vascular Plant Diversity

The floristic composition of the study area was belonged to three vascular plant groups, namely flowering plants (angiosperms), gymnosperms (conifers) and pteridophytes (ferns). Of the total species (Table 2), 317 (89%) originated from the six forest patches (Figure 7). Among the vascular plant groups, angiosperms were represented by high number of taxa. The least number of taxa were grouped under gymnosperms.

Table 2: Vascular plant group and taxa diversity in the study area

No.	Group name	No. of families	No. of genera	No. of species	No. of endemic species
1	Pteridophytes	6	7	8	0
2	Gymnosperms	2	2	2	0
3	Angiosperms	95	256	345	0
	Monocotyledons	14	34	43	1
	Dicotyledons	81	222	302	22
Total		**103**	**265**	**355**	**23**

4.1.1. Floristic composition

Overall, 317 species belonging to 234 genera and 95 families of plants were recorded from the six forest patches. Of these, 137 (43%) of the plant species recorded from the forest patches have been mentioned to have remedial properties for various ailments (Appendix 2). Fifty (16%) of them were wild edible plants. Of the total species documented, 256 species were found in Baso Liben District forest patches and 275 were from Debre Elias District (Figure 7). Among them, 51 species were considered as new records for Gojjam Floristic Region (Appendix 2).

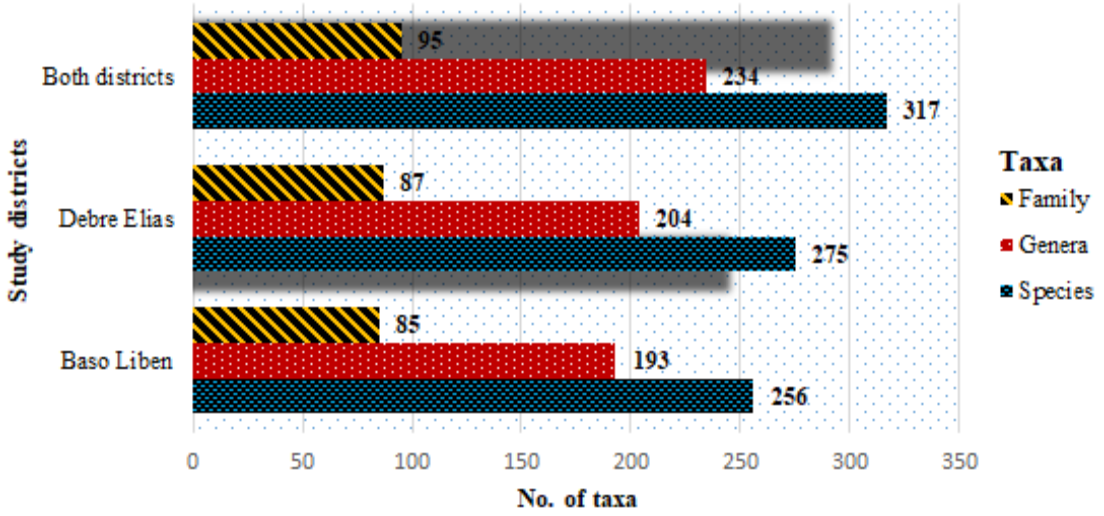


Figure 7. Total number of species, genera and families recorded in forest patches for the two districts

In the six forest patches (the two districts), among all the families were recorded, Asteraceae was the dominant family followed by Fabaceae and Poaceae. In Baso Liben District, the most recorded family with the highest number of species was also Asteraceae, followed by Fabaceae and Poaceae. Similarly, the three families were the most dominant ones in Debre Elias District (Table 3).

Table 3: Top seven families with seven and above species in the study area

No.	Family	Districts, no. of species and their percentage (%)		
		Baso Liben	Debre Elias	Combined districts
		N = 256	**N = 275**	**N = 317**
1	Asteraceae	28 (11%)	34 (12%)	37 (12%)
2	Fabaceae	27 (11%)	27 (10%)	29 (9%)
3	Poaceae	16 (6%)	14 (5%)	19 (6%)
4	Acanthaceae	9 (4%)	11 (4%)	11 (4%)
5	Lamiaceae	8 (3%)	8 (3%)	11 (4%)
6	Solanaceae	8 (3%)	8 (3%)	10 (3%)
7	Euphorbiaceae	7 (3%)	7 (3%)	9 (2%)

N = no. of species

Analysis of growth forms of the flora shows comparatively higher representation of herbs with 142 (45%) species were predominant followed by shrubs with 91 (29%) species (Figure 8).

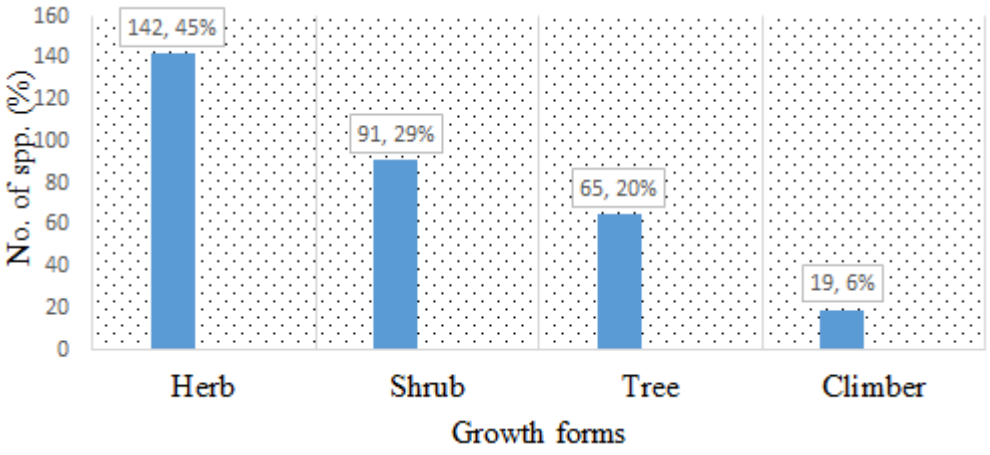


Figure 8. Growth forms of plants in the study area (forest patches)

4.1.2. Floristic diversity of forest patches

In the study area, the overall diversity and evenness were 3.13 and 0.98, respectively. The highest Shannon index was observed in Genetna Akababiw forest patch. In comparison, less alpha diversity indices were recorded for Guay and Abragit in Debre Elias and Baso Liben districts respectively (Table 4). Evenness values were also in comparable order with little variations, however, the highest is being for Genetna Akababiw followed by Elias Zuria Forest patches in Debre Elias District.

Table 4: Indices of diversity and evenness of the forest patches in the study area

Districts	Forest patches	Species richness	Evenness index (J)	Alpha Diversity index (H')
Debre Elias	Elias Zuria	132	0.95	2.90
	Genetna Akababiw	195	0.96	2.96
	Guay	72	0.90	2.82
Baso Liben	Hawaria Church-Monastery	127	0.94	2.90
	Bete Nigus	73	0.91	2.86
	Abragit	49	0.89	2.75
	Total (study area)	**317**	**0.98**	**3.13**

4.1.3. Endemic plant species in the study area

Out of the 317 plant species identified in the present study, 22 (7%) endemic species under 22 genera and 13 families to the Flora area were recorded (Table 5). Of these, 15 and 21 plant species were documented in the forest patches of Baso Liben and Debre Elias districts, respectively. Four taxa, namely *Rhus glutinosa* subsp. *glutinosa*, *Lippia adoensis* var. *adoensis, Vernonia leopoldii* and *Guizotia abyssinica* were shared with Eritrea. Among the total endemic species, herbs were represented by 10 spp. Asteraceae was the first family with seven endemic species.

Table 5: Endemic species and their IUCN categories in the study of forest patches**:** CN = Least Concern; NT = Near-threatened and VU = Vulnerable; BL= Baso Liben, DE = Debre Elias; A = Absent, P = Present; Ha = habit

No.	Endemic species	Family	Ha	BL	DE	IUCN category
1	*Acacia negrii*	Fabaceae	T	P	P	VU
2	*Acanthus sennii*	Acanthaceae	S	P	P	NT
3	*Boswellia pirottae*	Burseraceae	T	A	P	VU
4	*Brassica carinata*	Brassicaceae	H	A	P	LC
5	*Crotalaria rosenii* ***a**	Fabaceae	H	P	P	NT
6	*Crassocephalum macropappum*	Asteraceae	H	P	A	LC
7	*Cynoglossum coeruleum*	Boraginaceae	H	P	P	LC
8	*Echinops kebericho*	Asteraceae	H	A	P	VU
9	*Eragrostis tef*	Poaceae	H	P	P	LC
10	*Erythrina brucei*	Fabaceae	T	P	P	LC
11	*Gomphocarpus purpurascens*	Asclepiadaceae	S	A	P	NT
12	*Guizotia abyssinica*	Asteraceae	H	P	P	LC
13	*Jasminum grandiflorum*	Oleaceae	Cl	P	P	LC
14	*Laggera tomentosa*	Asteraceae	H	P	P	NT
15	*Lippia adoensis* var. *adoensis*	Verbenaceae	S	P	P	LC
16	*Mikaniopsis clematoides*	Asteraceae	H	A	P	LC
17	*Millettia ferruginea* subsp. *ferruginea*	Fabaceae	T	P	P	LC
18	*Rhus glutinosa* subsp. *glutinosa*	Anacardiaceae	T	P	P	VU
19	*Solanecio gigas*	Asteraceae	S	P	P	LC
20	*Urtica simensis*	Urticaceae	H	P	P	LC
21	*Vepris dainellii*	Rutaceae	T	A	P	LC
22	*Vernonia leopoldi*	Asteraceae	S	A	P	LC

4.1.4. Plant community types in forest patches

Five plant community types were identified using a hierarchical cluster analysis (Figure 9). The community types were *Croton macrostachyus-Accia abyssinica* community (C_1), *Vernonia auriculifera-Maytenus arbutifolia* (C_2), *Juniperus procera* (C_3), *Acacia seyal-Hyparrhenia rufa* (C_4) and *Anogeissus leiocarpa-Tamarindus indica* (C_5). The number of plots varied among the community types and ranged from nine to 28 plots. Species with the highest synoptic values in the group were used to name the corresponding communities (Table 6).

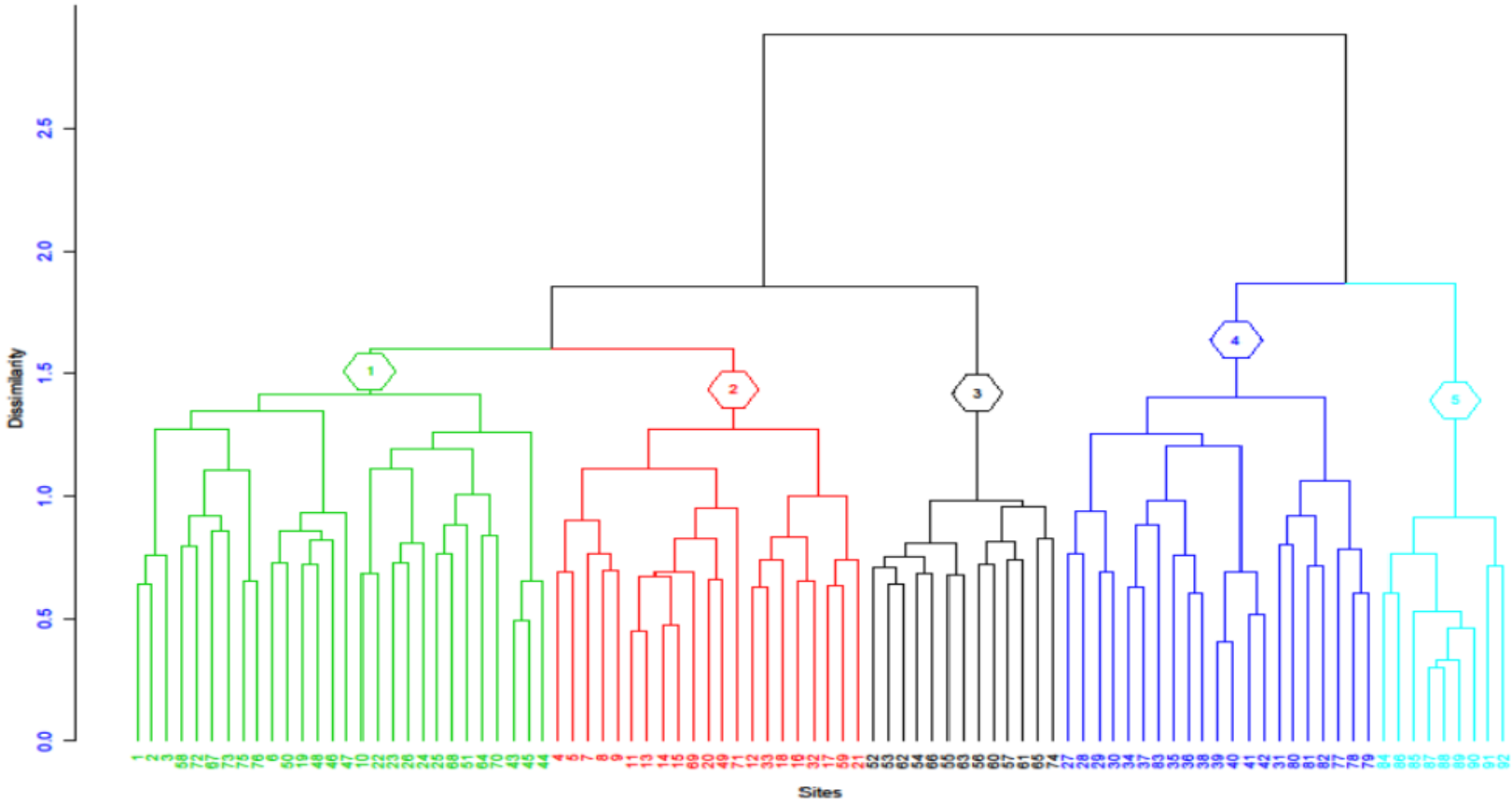


Figure 9. Dendrogram illustrating the five-plant community types in forest patches
The level of grouping was at a dissimilarity of 1.5 [1 = community type 1 (C_1); 2 = community type 2 (C_2); 3 = community type 3 (C_3); 4 = community type 4 (C_4); and 5 = community type 5 (C_5)]

Table 6: High synoptic cover abundance values of plant species in the study area

Species name	Community				
	C_1	C_2	C_3	C_4	C_5
Croton macrostachyus	**4.14**	2.89	1.54	0.48	0.00
Acacia abyssinica	**3.00**	2.46	2.23	0.52	0.00
Acanthus pubescens	**1.82**	0.62	0.46	1.00	0.00
Ficus sur	**1.71**	1.29	0.69	0.00	0.00
Urera hypselodendron	**1.62**	1.14	0.31	0.19	0.00
Syzygium guineense subsp. *guineense*	**1.25**	0.00	0.00	0.00	0.00
Albizia gummifera	1.07	0.24	0.00	0.24	0.00
Milletia ferruginea	0.57	0.00	0.00	0.10	0.00
Crepis rueppellii	0.57	0.48	0.31	0.00	0.00
Rhus retinorrhoea	0.57	0.00	0.00	0.29	0.00
Pavetta abyssinica	0.57	0.76	0.31	0.19	0.00
Allophylus abyssinicus	0.54	0.24	0.38	0.00	0.00
Acacia negrii	0.54	0.00	0.00	0.43	0.00
Vernonia auriculifera	0.75	**6.33**	1.15	0.00	0.00
Maytenus arbutifolia	0.50	**5.10**	2.31	0.19	0.00
Carissa spinarum	0.56	**4.46**	1.92	0.00	0.00
Pterolobium stellatum	0.14	**3.00**	1.00	0.24	0.00
Girardinia diversifolia	0.82	**2.90**	0.77	0.29	0.00
Acacia lahai	0.93	**2.76**	0.31	0.00	0.00
Cynodon dactylon	0.79	**2.52**	0.92	0.00	0.00
Brucea antidysenterica	0.50	1.33	0.31	0.00	0.00
Sida schimperiana	0.75	1.29	0.23	0.00	0.00
Erythrina brucei	0.00	1.29	0.00	0.14	0.00
Oplismenus hirtellus	0.46	1.19	0.85	0.00	0.00
Rubus apetalus	0.32	0.95	0.54	0.00	0.00
Bersama abyssinica	0.25	0.86	0.00	0.00	0.00
Kalanchoe petitiana	0.25	0.76	0.00	0.00	0.00
Juniperus procera	0.14	0.62	**7.62**	0.00	0.00
Albizia schimperiana	0.46	0.19	**3.54**	0.00	0.00
Euphorbia abyssinica	0.75	1.48	**3.00**	0.00	0.00
Achyranthes aspera	1.32	0.71	**2.85**	1.48	1.33
Prunus africana	0.93	0.71	**2.69**	0.24	0.00
Dracaena steudneri	0.50	0.00	1.92	0.00	0.00
Commelina benghalensis	0.36	0.24	1.31	0.10	0.00
Maesa lanceolata	0.18	0.24	1.31	0.00	0.00
Justicia.schimperiana	0.50	0.00	1.23	0.62	0.00
Hypoestes triflora	0.32	0.90	1.08	0.57	0.00
Leucas deflexa	0.43	0.29	1.08	0.00	0.00
Plectocephalus varians	0.07	0.00	1.08	0.00	0.00
Vernonia amygdalina	0.36	0.33	1.00	0.29	0.00
Acacia seyal	0.00	0.00	0.00	**7.00**	3.90
Hyparrhenia rufa	0.00	0.00	0.00	**5.00**	0.44
Combretum molle	0.57	0.00	0.00	**3.14**	0.00
Ficus vasta	0.54	0.43	0.00	**2.81**	0.44

Boswellia pirottae	0.00	0.00	0.00	**2.38**	0.00
Senna singueana	1.68	0.24	0.00	**2.19**	0.22
Cordia africana	0.79	0.86	0.31	1.67	0.00
Entada abyssinica	0.14	0.00	0.00	1.71	0.00
Terminalia brownie	0.00	0.00	0.00	1.33	1.00
Oxytenanthera abyssinica	0.00	0.00	0.00	1.24	0.00
Acokanthera schimperi	0.00	0.00	0.00	1.24	1.22
Anogeissus leiocarpa	0.00	0.00	0.00	0.90	**6.67**
Tamarindus indica	0.00	0.00	0.00	0.67	**5.78**
Dichrostachys cinerea	0.00	0.00	0.00	2.19	**5.67**
Lepisanthes senegalensis	0.18	0.00	0.00	0.38	**5.67**
Ficus sycomorus	0.46	0.00	0.00	1.24	**3.67**
Ziziphus spina-christi	0.00	0.00	0.00	1.05	**3.11**
Xanthium strumarium	0.00	0.00	0.00	1.33	**3.11**
Ocimum urticifolium	0.93	0.00	0.00	0.29	**3.11**
Acacia senegal	0.89	0.00	0.00	2.05	2.56
Abutilon longicuspe	0.00	0.00	0.00	0.52	2.44
Grewia mollis	0.29	0.00	0.00	0.19	2.22
Triumfetta flavescens	0.11	0.19	0.00	0.00	2.22
Ximenia americana	0.00	0.00	0.00	0.48	2.22
Euclea recemosa subsp. *schimperi*	0.36	0.33	0.15	1.76	2.11
Balanites aegyptiaca	0.00	0.00	0.00	0.00	1.78
Ziziphus mucronata	0.00	0.19	0.00	0.76	1.67

Community 1*: Croton macrostachyus-Accia abyssinica* community type

This is the largest community type comprising 28 plots (9 and 19 from Baso Liben and Debre Elias districts respectively) and 213 species at altitudinal ranges from 2,129-2,326 m a.s.l. *C. macrostachyus* and *A. abyssinica* were dominant species in the tree layer. This community had indicator species such as *Acanthus pubescens, Ficus sur, Syzygium guineense* subsp. *guineense, Achyranthes aspera*, *Urera hypselodendron* and *Senna singueana*. Associated woody species in this community type included *Albizia gummifera*, *Vernonia auriculifera*, *Milletia ferruginea*, *Crepis rueppellii*, *Rhus retinorrhoea* and *Pavetta abyssinica*. This community type is associated with disturbances. Most of the medicinal and WEPs are found in this community type (Table 7). The species commonly found in DAF vegetation types.

Community 2: *Vernonia auriculifera-Maytenus arbutifolia* community type

The distribution of this community type ranges from 2,300-2,443 m a.s.l. The community comprises 156 species distributed under 21 (3 from Baso Liben and 18 from Debre Elias District) plots. *Vernonia auriculifera* and *Maytenus arbutifolia* were the dominant species under the shrub layers. Plant species such as *Carissa spinarum, Pterolobium stellatum, Girardinia diversifolia, Cynodon dactylon, Croton macrostachyus* and *Acacia abyssinica* were found character species. Other species such as *Brucea antidysenterica, Erythrina brucei, Acanthus pubescens, Urera hypselodendron, Ficus sur, Sida schimperiana, Apodytes dimidiata, Xanthium spinosum, Cassipourea malosana, Rhus retinorrhoea, Rubus apetalus, Albizia schimperiana, Cordia africana, Calpurnia aurea, Pavetta abyssinica, Maytenus gracilipes* subsp. *gracilipes, Maesa lanceolata, Dodonaea angustifolia* and *Combretum molle* were also represented in this community type. Most of these species are representative of DAF vegetation type.

Community 3: *Juniperus procera-Albizia schimperiana* community type

This community type comprises 13 plots (all from Baso Liben District) and 127 species. This community is found at an altitudinal range from 2,298 to 2,403. *Juniperus procera* and *Albizia schimperiana* were found to be the most dominant species, which dominates the tree layer. *Euphorbia abyssinica* and *Achyranthes* were the indicator species. The associated species were *Prunus africana* and *Maesa lanceolata*. *Justicia schimperiana, Vernonia auriculifera, Vernonia amygdalina* and *Pterolobium stellatum* were also common in the shrub layer within this community. Dominant species in the ground stratum were *Commelina benghalensis, Plectocephalus varians, Hypoestes triflora* and *Leucas deflexa*. The community mostly found in

the undulating and rocky terrains with gentle slopes of Hawariat Church-Monastery in Moching 'kebele' (Baso Liben District). This community belonged to the DAF vegetation type.

Community 4: *Acacia seyal-Hyparrhenia rufa* community type

This community is the second largest community type comprises 21 plots (7 from Baso Liben, 14 from Debre Elias) and 160 species. This community is found within the altitude of 1,490-2,129 m a.s.l. *Acacia seyal* and *Hyparrhenia rufa* were the most dominant species. *Combretum molle*, *Ficus vasta* and *Boswellia pirottae* were the character species. Other associated species in the community included *Senna singueana*, *Dichrostachys cinerea*, *Acacia senegal*, *Euclea racemosa* subsp. *schimperi*, *Entada abyssinica*, *Cordia africana*, *Achyranthes aspera*, *Terminalia brownii*, *Xanthium strumarium*, *Ficus sycomorus*, *Oxytenanthera abyssinica*, *Combretum collinum*, *Ficus glumosa*, *Anogeissus leiocarpa* and *Acokanthera schimperi* were also commonly found in different layers.

The community was found mainly at the rise and fall area of Genet Zuria following Abay (Blue Nile) Gorge and in some cases in the rugged landscape with gentle slopes of Debre Elias Zuria and Bete Nigus. This vegetation could be classified as mainly CTW and DAF vegetation types. The species in CTW vegetation type included *Hyparrhenia rufa*, *Anogeissus leiocarpa*, *Stereospermum kunthianum*, *Oxytennantera abysinica*, *Terminalia* and *Combretum* spp., whereas the species in DAF are *Prunus africana*, *Carissa spinarum* and *Rosa abyssinca*.

Community 5: *Anogeissus leiocarpa-Tamarindus indica* community type

This community type was composed of 49 species distributed in nine plots (all from Baso Liben District) stretching from 1,096 to 1,122 m a.s.l. *Anogeissus leiocarpa* and *Tamarindus indica* were the dominant species. The least species richness found in this community type. The upper and the middle canopies were dominated by characteristic species namely, *Dichrostachys cinerea, Acacia seyal* and *Lepisanthes senegalensis*. Associated species in this community type were *Ficus sycomorus, Ziziphus spina-christi, Xanthium strumarium* and *Ocimum urticifolium*.

The understory was dominated by *Chenopodium ambrosioides, Achyranthes aspera, Amaranthus caudatus,* and *Ageratum conyzoides.* The community also bears *Abutilon longicuspe, Ximenia americana, Grewia mollis, Grewia trichocarpa, Calotropis procera, Withania somnifera, Acacia senegal, A. hecatophylla* and many other species. This community was mostly found in the disturbed, encroachment, agricultural expansion and over-grazing areas on the side of Baso Liben District (Abragit Forest patch) in the Abay Gorge. The community type showed mainly RV (for example the species including *T. indica, A. leiocarpa, Abutilon longicuspe, D. cinerea, Acacia seyal, A. senegal,* and *Lepisanthes senegalensis*), and CTW (species such as *A. leiocarpa, Acokanthera schimperi A. seyal, A. senegal, D. cinerea, X. americana, G. mollis* and *A. hecatophylla*) vegetation types. The commonly found species are indicators of RV and CTW vegetation types.

4.1.5. Number of plant species including medicinal and WEPs in each community type

The highest number of species was recorded in community type 1. The number of medicinal and wild edible plants increases with increasing the number of species in community 1. In community

type-4 and community type 2, the total number of medicinal species decreases and increases, respectively. The least number of species with the least number of medicinal and WEPs are found in community type 5 (Table 7).

Table 7: Number (overall, medicinal and wild edible) of species in each plant community

Community types	Number of plots			Number of species in each community								
	BL	DE	Total	Number of species			Number of MPs			Number of WEPs		
				BL	DE	Total	BL	DE	Total	BL	DE	Total
C1	9	19	28	113	170	213	62	76	102	16	31	35
C2	3	18	21	50	148	156	30	74	80	9	18	21
C3	13	-	13	127	-	127	78	-	78	24	-	24
C4	7	14	21	82	119	160	38	39	62	14	21	26
C5	9	-	9	49	-	49	21	-	21	9	-	9
Overall	**41**	**51**	**92**	**256**	**275**	**317**	**121**	**116**	**137**	**41**	**40**	**50**

BL = Baso Liben; DE = Debre Elias; MPs = medicinal plants; WEPs = wild edible plants

4.1.6. Species diversity, evenness and similarity of plant communities in forest patches

In this study, the diversity and evenness indices of plant communities were more or less similar (Table 8). The highest diversity index and evenness were observed in community 1, which had the highest species richness. Community 4 had also the highest alpha diversity index and evenness. Community-5 had the least alpha diversity and evenness amongst the plant communities (Table 8)

Table 8: Species diversity and evenness of communities

Community	Altitudinal range (m.a.s.l.)	Shannon-Wiener Diversity (H')	Shannon_Evenness (J)
1	2129-2326	4.92	0.91
2	2300-2443	4.34	0.89
3	2298-2403	4.30	0.88
4	1490-2129	4.91	0.90
5	1096-1122	3.51	0.80

The Sorensen's similarity coefficient of the five communities' shows that, community 1 and 2 have the highest similarity, followed by community 1 and 3, and community 1 and 4 which have similarity ratios of 0.65 and 0.57 respectively (Table 9).

Table 9: Sorensen's similarity analysis of plant communities in forest patches

Community types	1	2	3	4	5
1					
2	0.66				
3	0.65	0.60			
4	0.57	0.29	0.28		
5	0.11	0.07	0.04	0.36	

4.1.7. Vegetation structure of forest patches

4.1.7.1. Density and relative density of woody species

In the study area, the overall number of individual woody species with DBH ≥ 2.5 cm was 7,197 stems, whereas the total density was 1,952 stems ha^{-1} (Appendix 4). The top thirteen leading abundant species with abundance value of above 130 individuals included *Carissa spinarum*, *Croton macrostachyus*, *Acacia abyssinica*, *A. seyal*, *Maytenus arbutifolia*, *Senna singueana*, *Vernonia auriculifera*, *Dichrostachys cinerea*, *Teclea nobilis*, *Euclea racemose* subsp. *schimperi*, *Pterolobium stellatum*, *Acacia pilispina* and *Anogeissus leiocarpa*. Of these, *C. spinarum* was the most abundant species with 483 individuals and a density of 131 stems ha-^{1}. Following this, *Croton macrostachyus* and *A. abyssinica* were the second and third abundant species with 365 and 360 individuals, respectively. Their respective densities were 99 and 98 stems ha^{-1} (Appendix 4).

In general, 25% of the species have densities of one stem ha^{-1}. Patches in Debre Elias District had the highest number of tree and shrub individuals, while those in Baso Liben had the lowest number of individuals. On the other hand, the range of relative density was between 0.01 and 6.70%. The

highest was recorded for *C. spinarum*. *Croton macrostachyus (*5.06%) and *Acacia abyssinica* (5.00%) were also the second and third highest relative densities, respectively.

4.1.7.2. Basal area (BA)

The total basal area of woody species in forest patches was 75 m^2/ha (Table 10; Appendix 4). In the study area, 63% of the total basal area was contributed by twelve (12) woody species. The highest BA was recorded in *Croton macrostach* followed by, *Juniperus procera* and *Acacia abyssinica*. *Ficus sycomorous* and *Tamarindus indica* had the largest basal area in Abragit. *J. procera* followed by *Dracaena steudneri* and *A. abyssinica* had large BA in the Church-Monastery. *Croton macrostachyus* and *A. abyssinica* were dominant in all patches except Abragit. *Syzygium guineense* subsp. *guineense* in Elias Zuria and *Anogeissus leiocarpa* in Genet had also large basal areas. Species with the largest contribution in the basal area could be considered the most important woody species in the forest patches.

Table 10: Basal area (m^2/ha) and percentage (%) contributions of 12 most dominant wood species in the forest patches

No.	Name of species	BA (m^2/ha)	Percentage (%)
1	*Croton macrostachyus*	6	8
2	*Juniperus procera*	5	7
3	*Acacia abyssinica*	5	6
4	*Ficus sur*	5	6
5	*Ficus sycomorus*	4	6
6	*Syzygium guineense* subsp. *guineense*	4	5
7	*Tamarindus indica*	4	5
8	*Anogeissus leiocarpa*	3	4
9	*Acacia seyal*	3	4
10	*Dracaena steudneri*	3	4
11	*Albizia schimperiana*	3	4
12	*Ficus vast*	3	4
	Sub-total	**48**	**63**
	All others	27	37
	Total	**75**	**100**

4.1.7.3. Frequency and relative frequency

In terms of frequency, *Croton macrostachyus* was the most frequent species (55%) in the forest patches occurring in 55% (51) of all plots sampled (Appendix 4). The other most frequently distributed woody species in the sample plots were *Acacia abyssinica* (50%); *Carissa spinarum* (41%); *Senna singueana* (40%); *Maytenus arbutifolia* (39%); *Teclea nobilis* (37%); *Dichrostachys cinerea* (37%); *Acacia pilispina* (35%); *Euclea racemosa* subsp. *schimperi* (34%) and *Tamarindus indica* (33%) were also common across 46, 38, 36, 34, 34, 33, 32, 31 and 30 plots respectively. The relative frequency of the woody species was between 0.06 and 3% with comparable orders as their frequencies.

Although the frequency value varies from one patch to another patch, *C. macrostachyus*, *C. spinarum*, *A. abyssinica* and *M. arbutifolia* were the most frequent woody species in the forest patches. *Acacia seyal* was the most frequent species in the three patches, i.e. Bete Nigus, Genet Zuria and Abragit. In Abragit forest patch, the three most frequent woody species in order of their frequency were *Anogeissus leiocarpa*, *Tamarindus indica* and *Ficus sycomorus.* In Church-Monastery patch, *Juniperus procera* was the most frequent species followed by *Albizia scimperiana*, *Euphorbia abyssinica*, *Justicia schimperiana*, *Dracaena steudneri* and *Albizia gummifera. Senna singueana*, *Teclea nobilis*, *Vernonia auriculifera*, *Pterolobium stellatum* and *Prunus africana* had also high frequencies in the three patches of Debre Elias District (Elias Zuria, Genet and Guay). Similar information was observed concerning their relative frequencies. The frequency and relative frequency of all species documented from forest patches with DBH $\geq$ 2.5 cm were given in Appendix 4.

4.1.7.4. Importance value index (IVI)

The importance value index (IVI) of the woody species ranged from 0.07 to 16 (Appendix 4). Based on IVI, the top 19 dominant species in the forest patches are indicated in Table 11. The highest IVI value was recorded for *Croton macrostachyus* (16), followed by *Acacia abyssinica* (14) (Table 11). Following these, *Acacia seyal*, *Carissa spinarum* and *Ficus sur* were the important woody species in the study area. *Acacia seyal*, *Tamarindus indica* and *Anogeissus leiocarpa* were the most dominant tree species in Abragit, Bete Nigus, and Genet Zuria patches. Other important species included *Juniperus procera*, *Dracaena steudneri* (in Hawariat Church-Monastery), *Senna singueana* and *Teclea nobili* in all patches.

Most of the species except for *Acacia seyal*, *Ficus vasta*, *Dichrostachys cinerea* and *Juniperus procera* with the highest IVI values were cited for one or more traditional remedial uses in the area. Species such as *Carissa spinarum*, *Syzygium guineense* subsp. *guineense*, *Euclea racemosa* subsp. *schimperi*, *F. sur*, *F. sycomorus* and *F. vasta* used as sources of food. Most of them have different uses in the community. In the two districts, IVI was also poor for many species such as *Acacia etbaica*, *Cussonia arborea*, *Debregeasia saeneb*, *Ficus glumosa*, *Hymenodictyon floribundum*, *Psydrax schimperiana*, *Ziziphus mauritiana* and many others. In general, the total important values of 130 woody species were low (301) (Appendix 4).

Table 11: IVI of dominant species in the study area

No.	Name of species	RFr	Rde	RBA	IVI	R
1	*Croton macrostachyus*	3	5	8	**16**	1
2	*Acacia abyssinica*	3	5	6	**14**	2
3	*Acacia seyal*	2	4	4	**10**	3
4	*Carissa spinarum*	2	7	1	**10**	3
5	*Ficus sur*	2	1	6	**9**	5
6	*Tamarindus indica*	2	1	5	**8**	6
7	*Juniperus procera*	2	1	5	**8**	6
8	*Ficus sycomorus*	1	1	6	**8**	6
9	*Anogeissus leiocarpa*	1	2	4	**7**	9
10	*Maytenus arbutifolia*	2	4	1	**7**	9
11	*Dichrostachys cinerea*	2	3	2	**7**	9
12	*Senna singueana*	2	4	1	**7**	9
13	*Syzygium guineense* subsp. *guineense*	1	1	4	**6**	13
14	*Vernonia auriculifera*	2	3	0.1	**5**	14
15	*Euclea racemose* subsp. *schimperi*	2	2	1	**5**	14
16	*Ficus vasta*	0.4	1	4	**5**	14
17	*Dracaena steudneri*	1	1	3	**5**	14
18	*Teclea nobilis*	2	2	0.4	**5**	14
19	*Prunus africana*	2	1	2	**5**	14

RFr = Relative frequency; RDe = Relative density; RBA = Relative basal area; IVI = Important value index; R = rank

4.1.7.5. Population structures of representative tree species

The population structures of the 27 most common tree species in forest patches were analyzed and four representative patterns were identified (Figure 10). These population structure patterns were computed and illustrated as a bell-shaped (*Tamarindus indica*), inverted J-shaped (*Anogeissus leiocarpa*), J-shaped (*Juniperus procera*) and broken reverse-J-shaped (*Acacia abyssinica*).

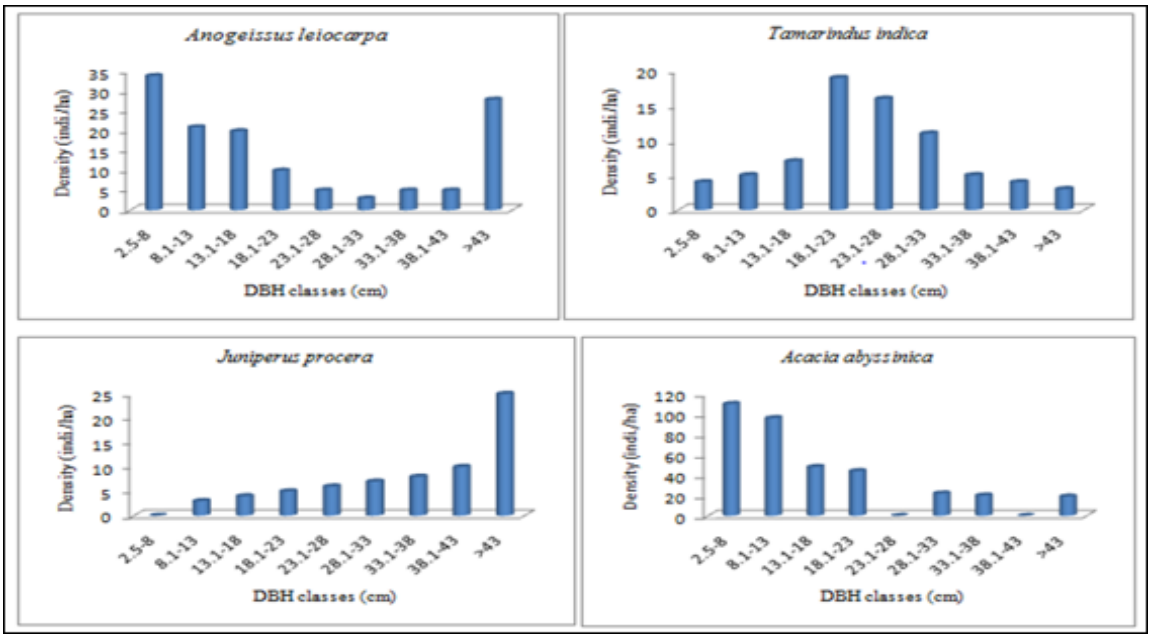


Figure 10. Population structure patterns of tree species in the study forest patches

4.2. Ethnobotany of Medicinal Plants in the Study Area

Overall, 172 medicinal plant species belonged to 157 genera and 82 families were recorded and documented in the study area. Of these species, 153 (89%) species were cited for their uses to treat human ailments, whereas 81 (47%) species were reported for treating livestock ailments and 62 (36%) species for their remedial uses were reported against both humans and livestock diseases. Nineteen (11%) species were used exclusively as ethnoveterinary medicinal plants (Figure 11).

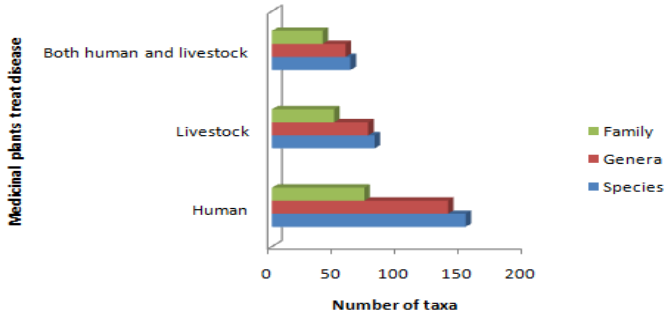


Figure 11. Number of families, genera and species of MPs used to treat human, livestock or both human and livestock ailments in the study area

Thirteen (9%) of the medicinal plants of the study districts were found to be endemic to Ethiopia. Twelve (12) of the species were said to be used to treat human ailments, five of them for livestock and four were claimed for common use for both human and livestock ailments. All species except *Impatiens tinctoria* were collected from the forest patches. Families with the uppermost number of MPs depiction greater than five species were Asteraceae with 13 (8%) species, followed by Fabaceae and Solanaceae with nine (5%) species each, and Lamiaceae and Poaceae with six (4%) species each.

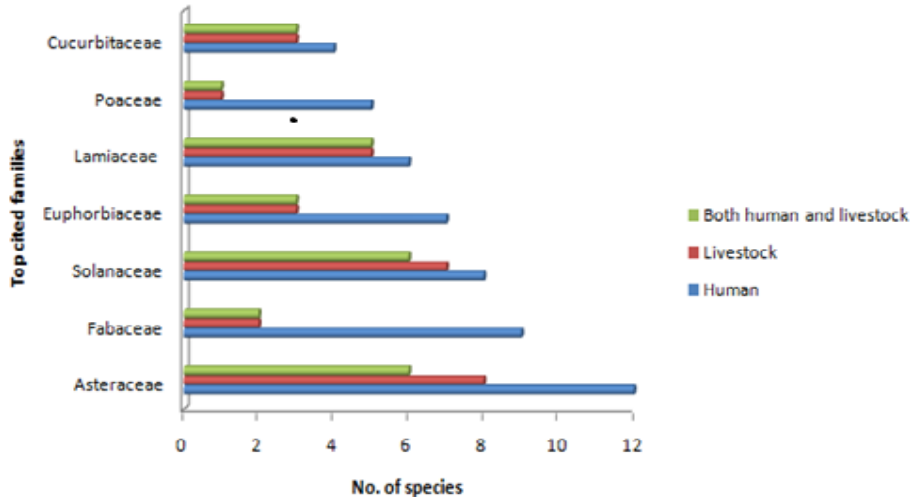


Figure 12. Top cited families with a high number of species in the study area with medicinal values for humans and livestock

4.2.1. Ethnomedicinal plants used to treat human ailments

4.2.1.1. Diversity of the reported ethnomedicinal plants

In the study area, 153 medicinal plants representing 139 genera under 73 families were recorded to treat a wide variety of human ailments. Of these species, 133 species belonging to 122 genera and 72 families were collected from Baso Liben, whereas 126 species under 118 genera and 66 families were from Debre Elias District.

In terms of family, Asteraceae and Fabaceae are two of the best-represented families in the Flora of Ethiopia. Asteraceae was represented by the highest number of species, followed by Fabaceae and Solanaceae in both of the study districts. Similarly, the families including Asteraceae, Fabaceae, Solanaceae and Euphorbiceae were also dominant with their respective number and percentage of species in Baso Liben and Debre Elias districts (Table 12).

Table 12: Plant families and their number of species in the study area

Family	**Number of species belonging to each family**								
	Baso Liben District			**Debre Elias District**			**Both districts**		
	No spp.	%	R	No spp.	%	R	No spp.	%	R
Asteraceae	11	8	1	10	8	1	12	8	1
Fabaceae	9	7	2	7	6	2	9	6	2
Solanaceae	7	5	3	5	4	4	8	5	3
Euphorbiaceae	7	5	3	6	5	3	7	5	4
Poaceae	5	4	5	3	2	5	5	3	6
Lamiaceae	5	4	5	4	3	4	6	4	5
Cucurbitaceae	4	3	7	3	2	5	4	3	7
Rosaceae	3	2	8	3	2	5	3	2	8
Polygonaceae	3	2	8	3	2	5	3	2	8
Myrtaceae	3	2	8	3	2	5	3	2	8
Boraginaceae	2	1.5	11	3	2	5	3	2	8
Asclepiadaceae	2	1.5	11	3	2	5	3	2	8
All other families	72	55	-	73	60	-	87	56	-
Total	**133**	**100**	-	**126**	**100**	-	**153**	**100**	-

R = rank

4.2.1.2. Medicinal plants in natural habitat and home-gardens

The local community collected medicinal plant species to treat human ailments from different environments including home-gardens, cultivated field and the wild (forest patches and any other natural habitats). Of the total human MPs, 125 (81%) were collected from the natural forest patches (floristic patches) and the remaining 28 (18%) of the MPs were from home-gardens and elsewhere in the study area (out of plots) (Appendix 2; Appendix 5).

4.2.1.3. Growth forms of ethnomedicinal plant species

Herbs were the dominant growth form among the reported MPs that make up (55 spp.) in Baso Liben District and (53 spp.) in Debre Elias District followed by shrubs (42 spp.) in BL and (37 species) in DE district used for traditional medicinal purpose. Sixty-four herbs were reported from both districts followed by 46 and 34 species of shrubs and trees respectively (Figure 13).

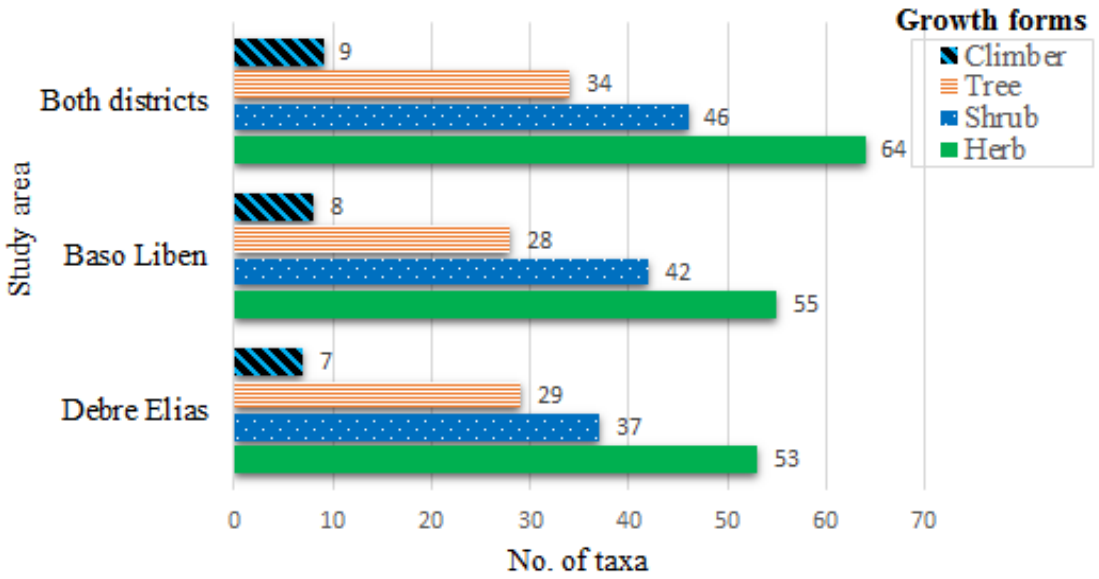


Figure 13. Growth forms of ethnomedicinal plants in the study area

4.2.1.4. Plant parts used in remedy preparation in the study area

Each part of different plant species was used to treat 97 human ailments. As per the informants' responses, the most commonly used part is the leaf, followed by root, fruit and seed. In some cases, two or more parts of the same plant species, particularly a combination of parts, were used in preparing different therapies. The pattern of plant parts used in remedy preparation was comparable in the two districts (Table 13).

Table 13: Plant parts used by the local community in the study area

No.	Plant parts used	Baso Liben		Debre Elias		Both districts	
		Citation	%	Citation	%	Citation	%
1	Leaf	128	39	121	37	137	38
2	Root	074	22	078	24	085	24
3	Fruit	025	08	021	07	025	07
4	Seed	022	07	019	06	022	06
5	Bark	012	04	014	04	015	04
6	Stem	014	04	013	04	015	04
7	Latex/sap	011	03	009	03	012	03
8	Bulb	009	03	009	03	009	03
9	Whole plant	007	02	007	02	007	02
10	Shoot	005	1.5	005	02	006	02
11	Leaf /bark	005	1.5	005	02	005	01
12	Leaf/stem	004	01	004	01	005	01
13	Leaf/root	004	01	005	02	005	01
14	Flower	004	01	004	01	004	01
15	Stem bark/bark	000	00	002	0.6	002	0.6
16	Leaf/fruit	002	0.6	002	0.6	002	0.6
17	Rhizome	002	0.6	002	0.6	002	0.6
18	Others	004	01	003	0.9	004	01
Total		**332**	**100**	**323**	**100**	**362**	**100**

4.2.1.5. Different human ailments treated by each plant species

In total, 97 (90 from Baso Liben; 95 from Debre Elias districts) ailments were treated by various ethnomedicinal plant species (Appendix 9). These diseases can be categorized as dermatological, digestive, respiratory and gastro-intestinal and more. The number of ailments treated by each plant species varies from ailment to ailment and plant species to species. In this study, wounds under dermatological disease categories were treated by 19 (5%) plant species followed by abdominal colic under gastro-intestinal diseases by 18 (5%) species. In each district, abdominal colic, wounds and acute febrile illness were treated nearly similar number of species. Comparable numbers of species were also used for the treatment of common cold, dysentery and sudden diseases in both districts (Table 14).

Table 14: Top 14 human ailments treated by each plant species in the study area

No.	Ailments treated	BL dist.		DE dist.		Both dist.	
		No spp.	%	No spp.	%	No spp.	%
1	Wound	16	5	17	5	19	5
2	Abdominal colic	18	5	16	5	18	5
3	Acute febrile illness	16	5	14	4	16	4
4	Snakebite	14	4	15	5	16	4
5	Toothache	14	4	14	4	14	4
6	Coughing	09	3	09	3	10	3
7	Fever ("Mich")	09	3	09	3	09	3
8	Evil eye	08	2	08	3	08	2
9	Gastritis	08	2	06	2	08	2
10	Malaria	08	2	08	3	09	3
11	Ascariasis	07	2	06	2	07	2
12	Common cold	07	2	07	2	07	2
13	Dysentery	07	2	08	3	08	2
14	Sudden disease ("Qurba")	07	2	05	2	07	2

BL dist. = Baso Liben District; DE dist. = Debre Elias District

In terms of plant species, there were also cases where a specific plant species can be used to treat many ailments. For instance, *Allium sativum* was used to treat over ten ailments (Table 15; Appendices 5 and 9). *Vernonia amygdalina* was the second most important species that treated different types of ailments. Nearly a similar number of ailments were treated by the individual plant species of each district as indicated in Table 15.

Table 15: The most common MPs used to treat human ailments in the study area

Scientific name	Baso Liben		Debre Elias		Both districts	
	NAs	%	NAs	%	Total	%
Allium sativum	10	11	10	10	10	10
Vernonia amygdalina	8	9	8	8	8	8
Rumex abyssinicus	7	8	7	7	7	7
Cucumis ficifolius	7	8	7	7	7	7
Clausena anisata	7	8	7	7	7	7
Tamarindus indica	7	8	7	7	7	7
Zehneria scabra	6	7	6	6	6	6
Otostegia integrifolia	6	7	6	6	6	6
Datura stramonium	6	7	6	6	6	6
Verbascum sinaiticum	5	6	5	5	5	5
Stephania abyssinica	5	6	5	5	5	5
Silene macrosolen	5	6	5	5	5	5
Ruta chalepensis	5	6	5	5	5	5
Plumbago zeylanica	5	6	5	5	5	5
Plantago lanceolata	5	6	5	5	5	5
Catha edulis	5	6	5	5	5	5

NAs = number of ailments treated

4.2.1.6. Traditional methods and conditions in remedy preparations

Traditional herbal medicines were prepared in various modes of preparation to treat human ailments (Table 16). Most of the collected MPs were prepared in the form of boil and drink the decoction after cooling followed by in crush/squeeze, soak the part with cold water and drink the infusion in the combined study districts. The least mode of remedy preparation was observed in the crush and sniffs the fresh part. Nearly similar results were indicated in each district. The data from both districts showed the popular method of herbal medicines prepared in the form of decoction followed by infusion (Table 16).

Table 16: Modes of human herbal medicine preparation in the study area

Mode of remedy preparation	Baso Liben		Debre Elias		Both districts	
	FC	%	FC	%	FC	%
Boil and drink the decoction after cooling	68	20	69	21	74	20
Crush/squeeze, soak the part with cold water and drink the infusion	55	17	54	17	60	17
Grind/crush and paint the powder or crushed parts to the affected body	39	12	42	13	46	13
Extract/remove the latex/juice/sap/and pour into or paint it	33	10	29	9	38	11
Chew the fresh part and take the fluid only	25	8	23	7	27	8
Crush, soak with water and then bathe	19	6	17	5	19	5
Chew and/or hold the part with teeth	15	5	16	5	16	4
Eat/ingest the part (raw/cooked/roasted)	15	5	12	4	15	4
Grind and paste the crushed part and tie	18	5	18	6	19	5
Drink the concoction	16	5	13	4	16	4
Boil and take a steam bathe/wash	8	2	9	3	10	3
Sniff/inhale the heated of powdered parts	14	4	13	4	14	4
Crush and sniff the fresh part	7	2	8	2	8	2
Total citations	**332**	**100**	**323**	**100**	**362**	**100**

FC = Frequency of citation

The result in the conditions of plant part used indicated that most medicines of traditional MPs were prepared from fresh plant materials in the study site, whereas few medicinal plants were reported to be used in dry and both in dry or fresh form respectively. The pattern of conditions of plant parts used in remedy preparation was comparable in the respective districts (Figure 14).

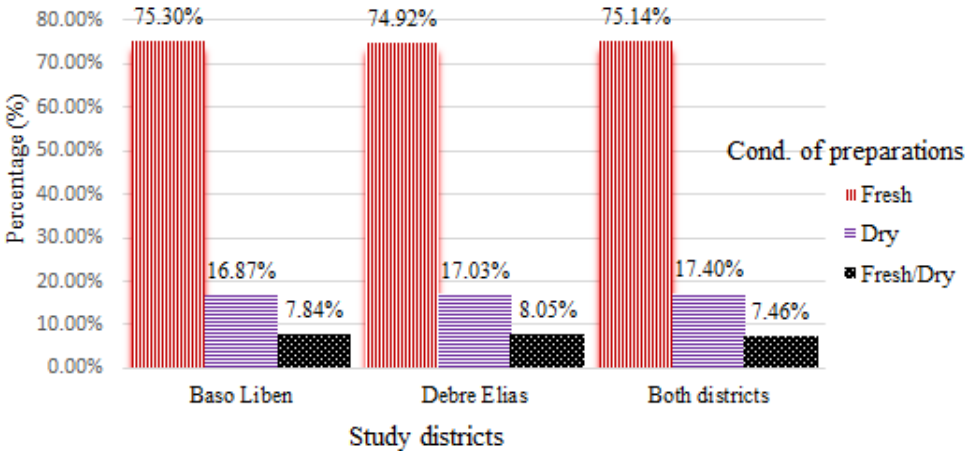


Figure 14. Condition of preparations of traditional medicine in the study area

4.2.1.7. Routes of administration, dosage determination and antidotes

Routes of administration: Oral application was the most commonly used route of administration followed by dermal. Similar routes of administration were practiced in the respective districts (Table 17).

Table 17: Routes of administration of human medicine in the study area

		Baso Liben		Debre Elias		Both districts	
No.	**Routes of adm.**	Citation	%	Citation	%	Citation	%
1	Oral	206	62	202	63	224	62
2	Dermal	97	29	97	30	108	30
3	Nasal/nostril	18	5	16	5	19	5
4	Oral/dermal	1	0.3	1	0.3	1	0.3
5	Ocular	2	0.6	2	0.6	2	0.6
6	Auricular	6	2	3	1	6	2
8	Anal	2	0.6	2	0.6	2	0.6
Total		**332**	**100**	**323**	**100**	**362**	**100**

Dosages: The local informants reported estimating dosages using lid spoons, handfuls (for powder preparations) cups, can and glasses (for liquid mixtures to be administered). In addition, some other informants reported that numbers or occasionally handfuls (for leaf, seed and fruits) and fingertip (for roots, stems and/or barks) were used. The measurements used to determine dosages are not standardized and depend on the age, physical appearance of the patient, degree of the illness, diagnosis and experience of individual herbalists/or knowledgeable individuals. More or less, the key informants took attention of dosage determination.

Side effects and antidotes: According to the informants, 19 (12%) herbal preparations were known to have side effects. Herbal medicines such as *Hagenia abyssinica*, *Ricinus communis*, *Phytolacca dodecandra*, *Verbasicum siniaticum*, *Withania sommnifera*, *Euphorbia abyssinica*, *E.*

tirucalli, *E. schimperiana*, *Ranunculus oligocarpus* and *Clematis simensis* were supposed to have some side effects (Appendix 5). However, some of these medicinal plant preparations were linked to various types of side effects that needed antidotes. Milk, milk products, coffee, local beer (TELLA) and honey were prescribed as antidotes for those adverse side effects.

4.2.1.8. Composition of ethnomedicinal plant preparation in the study area

Most of the therapies were prepared from a single medicinal plant species alone. Nevertheless, forty-two (28%) of the overall (153) human MPs were prepared from over one herbal medicine. Herbal medicines prepared from over one species were very important for the treatments of one and over one ailment (Table 18). For instance, *Acokanthera schimperi* and *Capparis tomentosa* were prepared together against snakebite. *Acokanthera schimperi* mixed with *Brucea antidysenterica* and *Rumex nervosus* and applied for the treatment of leprosy (Table 18).

Allium sativum, *Asparagus africanus*, *Catha edulis*, *Clausena anisata*, *Rumex abyssinicus*, *Ruta chalepensis* and *Zehneria scabra were* mixed and prepared, with one and/ or more than one species for the treatment of one and over one ailment (Table 18). On the other side, *A. sativum* was the most important species used in combination with seven other species followed by *Rumex nervosus*, *Brucea antidysenterica* and *C. anisata* 4 species each; *Ruta chalepensis*, *Sesamum angustifolium* and *Solanum incanum* 3 species each in the curing of various ailments.

Uses of some species are associated with curious traditional beliefs. For example, to treat health problems associated with an evil eye, bulb of the garlic (*A. sativum*) and *R. chalepensis* were mixed and applied around their noses and neck while they were sleeping during night. The healers believe

that garlic is a powerful ward against evil spirits, particularly evil in the form of mysterious and terrifying entities, and related problems.

Table 18: Composition of herbal medicine preparation for the treatment of certain ailments

No.	Name of species	Disease treated	Species combined with
		Leprosy	*Brucea antidysenterica, Rumex nervosus*
1	*Acokanthera schimperi*	Snakebite	*Capparis tomentosa*
		Coughing	*Ruta chalepensis, Schinus molle, Sesamum angustifolium*
		Indigestion	*Zingiber officinale*
2	*Allium sativum*	Evil eye	*Ruta chalepensis*
		Gastritis	*Ocimum lamiifolium*
		Abdominal worms	*Foeniculum vulgare*
3	*Artemisia abyssinica*	Evil eye	*Allium sativum, Ruta chalepensis, Solanum marginatum*
4	*Asparagus africanus*	Impotency	*Psidium guajava, Acokanthera schimperi*
		Leprosy	*Anogeissus leiocarpa*
5	*Catha edulis*	Heart failure	*Anogeissus leiocarpa*
		Hypertension	*Allium sativum*
		Common cold	*Withania somnifera*
6	*Clausena anisata*	Fever	*Buddleja polystachya*
		Itching	*Tamarindus indica*
7	*Cucumis ficifolius*	Rabies	*Solanum incanum, Stephania abyssinica*
8	*Datura stramonium*	Toothache	*Cynoglossum lanceolata, Zehneria scabra*
9	*Lepidium sativum*	Malaria	*Allium sativum*
		Indigestion	*Sesamum angustifolium*
10	*Lippia adoensis* var. *adoensis*	Coughing	*Schinus molle, Saccharum officinarum*
		Common cold	*Ruta chalepensis*
11	*Plumbago zeylanica*	Swelling	*Achyranthes aspera*
		Snakebite	*Carissa spinarum*
		Skin rush	*Cucumis ficifolius, Tamarindus indica*
12	*Rumex abyssinicus*	Pneumonia	*Allium sativum*
		Heart failure	*Ageratum conyzoides*
		Common cold	*Allium sativum*
		Influenza	*Coffea arabica*
13	*Ruta chalepensis*	Abdominal colic	*Coffea arabica*
		Evil eye	*Allium sativum*
		Gastritis	*Allium sativum, Solanum marginatum*
		Dandruff	*Datura stramonium*
14	*Sesamum angustifolium*	Coughing	*Guizotia scabra*
		Abdominal colic	*Lepidium sativum*
15	*Zehneria scabra*	Fever	*Clausena anisata, Cynoglossum lanceolata, Leonotis ocymifolia, Ocimum lamiifolium*

4.2.1.9. High ranking and comparisons of ethnomedicinal plants

Preference ranking: In a pooled data, preference rankings for eight ethnomedicinal plants were used to treat wound of human in the study area confirmed that *Withania somnifera* ranked first followed by *Euphorbia abyssinica*, *Malva verticillata* and *Acokanthera schimperi* (Table 19).

Table 19: Preference rankings of ethnomedicinal plants against the wound in the two districts

Scientific name	Informants (A-H)									
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**Ts**	**R**
Withania somnifera	7	8	5	6	7	4	5	4	**46**	1
Euphorbia abyssinica	5	6	5	5	7	5	6	5	**44**	2
Malva verticillata	4	5	6	4	3	7	6	4	**39**	3
Acokanthera schimperi	5	5	5	2	1	5	2	3	**28**	4
Justicia schimperiana	3	4	3	2	3	4	1	2	**22**	5
Brucea antidysenterica	1	1	2	1	1	2	1	1	**10**	6
Kalanchoe petitiana	1	0	2	0	1	1	2	1	**8**	7
Aloe macrocarpa	2	1	0	1	1	1	1	0	**7**	8

Informants from A to H; Ts = total score; R = rank

Pair-wise comparison: In this study, 10 key informants (6 from BL and 4 from DE) made the pair-wise comparisons of seven MPs and the values were summarized in Table 20. *Laggera tomentosa* stood first followed by *Acmella caulirhiza* for the treatment of toothache. *Datura stramonium* and *Tragia brevipes Momordica foetida* were placed 3rd and 4th, respectively. *Capparis tomentosa* and *Cucumis ficifolius* were the lowest ranked species.

Table 20: Paired comparison of ethnomedicinal plants used to treat toothache in the two districts

Scientific name	Key informants (A-J)											
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**Ts**	**R**
Laggera tomentosa	8	7	9	8	6	6	8	7	3	8	70	1
Acmella caulirhiza	4	5	4	7	6	8	6	9	6	6	61	2
Datura stramonium	5	5	5	2	3	5	2	3	8	2	40	3
Tragia brevipes	2	4	3	5	6	3	4	3	1	2	33	4
Momordica foetida	1	1	1	1	2	2	1	1	0	3	13	5
Capparis tomentosa	1	0	1	1	1	0	1	1	1	1	8	6
Cucumis ficifolius	0	1	0	1	0	1	1	0	0	1	5	7

A-J = key informants; Ts = total score; R = rank

Pair-wise comparisons of seven most cited ethnomedicinal plants were also used to treat abdominal colic, which was the second most cited human ailment was made using 10 key informants (6 from BL and 4 from DE). *Verbena officinalis* was the most preferable plant species against abdominal colic, followed by *Cucumis ficifolius* and *Hypericum quartinianum* in the study area. However, the least preferred plant species was *Croton macrostachyus* (Table 21).

Table 21: Pair-wise comparison on seven MPs against abdominal colic in the two districts

Scientific name	Respondents (A-J)											
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**Ts**	**R**
Verbena officinalis	8	7	6	8	3	6	9	5	3	8	63	1
Cucumis ficifolius	4	3	2	5	6	8	6	8	6	6	54	2
Hypericum quartinianum	5	1	7	6	5	3	1	4	3	2	45	3
Schinus molle	5	6	5	2	1	6	2	3	9	2	41	4
Otostegia integrifolia	5	4	3	5	10	1	1	0	1	0	30	5
Clausena anisata	2	4	3	1	10	1	1	0	1	0	23	6
Croton macrostachyus	0	2	0	1	0	2	0	1	0	2	8	7

A-J = key informants; Ts = total score; R = rank

Direct matrix ranking: Eleven commonly reported multi-purpose medicinal plant species were involved in direct matrix ranking exercise in order to evaluate their relative importance to the local communities and the degree of threats related to their multiple uses. The major uses included firewood, medicine, furniture, forage, charcoal and edible. In view of that, *Tamarindus indica* was found to be the most multi-purpose plant species indicating the most threatened species, followed by *Cordia africana* and *Mimusops kummel*. The least one was *Schefflera abyssinica* having least score (Table 22).

Table 22: Average direct matrix ranking score for the multi-purpose of eleven medicinal plants

Medicinal plants	Use categories						**Total**	**Rank**
	Med	Fiw	Fur	Fora	Socn	Edib		
Tamarindus indica	30	26	20	4	9	16	105	1
Cordia Africana	24	20	24	5	10	10	93	2
Mimusops kummel	27	17	14	0	12	18	88	3
Prunus Africana	21	22	20	5	8	8	84	4
Ficus sur	15	18	14	6	13	17	83	5
Olea europaea subsp. *cuspidata*	20	19	18	9	12	0	78	6
Vernonia amygdalina	28	20	15	6	8	0	77	7
Podocarpus falcatus	12	14	25	0	14	10	75	8
Croton macrostachyus	26	18	17	0	13	0	74	9
Eucalyptus globulus	17	26	21	0	7	0	71	10
Schefflera abyssinica	14	19	18	5	11	0	67	11

Med = medicine; Firewood = Fiw; Fur = furniture; Fora = forage; Socn = soil conservation; Edib = edible

4.2.1.10. Important ethnomedicinal plants

Informant consensus factors (ICF) for human ailments

In the study area, the informant consensus of human medicinal plant usage resulted in ICF varies from 0.29 to 0.84 per disease category (Table 23). Eleven (11) disease categories were identified from the overall of 90 human ailments reported in Baso Liben District. Of which, the categories with the highest ICF values were related to digestive/gastro-intestinal disorders and intestinal parasites, followed by dermatological diseases. On the other hand, the lowest ICF value was recorded for the category of diseases, which belong to diabetes and hypertension.

In Debre Elias District, 11 disease categories were also identified from 95 different human ailments. Plants used against dermatological diseases had the highest ICF values, followed by plants used against digestive/gastro-intestinal disorders and intestinal parasites. The lowest ICF in the District scored for the same disease categories was mentioned in Baso Liben.

Table 23: Results of informants' consensus factor (ICF) for human ailments in the study area

	Baso Liben District				Debre Elias District			
Disease categories	**Ns**	**Nuc**	**ICF**	**R**	**Ns**	**Nuc**	**ICF**	**R**
Dermatological diseases	47	250	0.82	2	43	258	0.84	1
Digestive/gastro-intestinal disorders and intestinal parasites	77	450	0.83	1	72	360	0.80	2
Malaria, febrile illness and/or fever	20	77	0.75	3	19	78	0.77	3
Evil spirit and evil eye	14	45	0.70	4	14	38	0.65	4
Musculoskeletal	6	13	0.58	6	5	12	0.63	5
Respiratory and cardiovascular	26	70	0.64	5	23	57	0.61	6
Biting and poisoning	18	38	0.54	7	21	44	0.53	7
Reproductive and venereal diseases	14	28	0.52	8	12	22	0.48	8
Dental, sensorial and nervous system	35	60	0.42	9	34	56	0.40	10
Diabetes and hypertension	6	8	0.29	11	5	7	0.33	11
Others	13	21	0.40	10	10	18	0.47	9

Fidelity level (FL) of ethnomedicinal plants

The Fidelity level (FL) was used to determine the most significant species used for the treatment of a wide variety of ailments by the local community. In the study area, FL values of all human medicinal plants (153 species) were calculated and presented in Appendix 7. The FL values for twelve (12) commonly employed ethnomedicinal plants against human ailments were calculated and presented in Table 24. In Baso Liben District, the most commonly employed MPs were *Senna singueana* against snakebite and acute febrile illness, followed by *Ruta chalepensis* for respiratory and gastro-intestinal diseases.

In Debre Elias District, the most important species (*S. singueana*) also illustrated the highest fidelity level value for the treatment of snakebite and acute febrile illness followed by *V. officinalis* against gastro-intestinal disorder (Table 24).

Table 24: Fidelity level (FL) values of top-cited ethnomedicinal plants against ailments

		Baso Liben Dist.			Debre Elias Dist.		
Medicinal plants	**Ailment treated**	**Ip**	**Iu**	**FL %**	**Ip**	**Iu**	**FL %**
Senna singueana	Bite and acute febrile illness	26	27	96	28	30	93
Verbena officinalis	Gastro-intestinal	18	20	90	12	13	92
Laggera tomentosa	Toothache/dental	10	11	90	11	12	92
Withania somnifera	Dermatological and nervous	11	12	92	10	11	91
Ocimum lamiifolium	Fever	11	12	92	9	10	90
Croton macrostachyus	Malaria, hepatitis, dermal and gastro-intestinal	20	25	80	25	28	89
Ruta chalepensis	Respiratory and gastro-intestinal	27	29	93	22	25	88
Acmella caulirhiza	Dental and tonsillitis	17	20	90	14	16	88
Datura stramonium	Dermatological, dental and gastro-intestinal	15	17	88	21	24	88
Capparis tomentosa	Evil spirit and dental	25	32	78	20	23	87
Embelia schimperi	Tapeworm and trachoma	11	13	85	13	15	87
Asparagus africanus	Impotency and colic	14	16	88	12	15	80

4.2.2. Ethnoveterinary medicinal plants in the study area

4.2.2.1. Ethnoveterinary medicinal plant diversity

In total, 81 ethnoveterinary medicinal plant species representing 76 genera and 49 families used to manage 53 ailments were identified in the study area (Appendix 12). Of the total collected plants, sixty-five (65) of ethnoveterinary plant species that belonging to 60 genera and 42 families were recorded from Baso Liben District (Appendix 12), which are used to treat 48 ailments (Appendix 11). Similarly, 57 (78%) species belonging to 51 genera under 36 families were collected from Debre Elias District to treat 50 livestock ailments (Appendix 10). Sixty-six (81%) of the ethnoveterinary plants were collected from the wild, and merely a few 15 (19%) were cultivated mainly for purposes other than their medicinal uses (Appendix 6).

The highest number of species was recorded for the family Asteraceae (8 genera, 10%; 8 spp., 10%), followed by Solanaceae (5 genera, 7%; 7 spp., 9%); Lamiaceae (5 genera, 7%; 5 spp., 6%); Cucrbitaceae, Euphorbiaceae and Asclepiadaceae were represented by three species each (Table 25). Seven of the reported families (i.e., Fabaceae, Lamiaceae, Menispermaceae, Myrsinaceae, Plantaginaceae, Rubiaceae and Solanaceae) were represented by two (3%) species each. The remaining families had a single-species representation. Similarly, the highest number of genera and species were also recorded from the previously cited families of the respective districts (Table 25; Appendix 12).

Table 25: Plant families with species and genera in the study area

Family	Number of genera belonging to each family											
	Baso Liben District				Debre Elias District				Both districts			
	NoG	%	NoS	%	NoG	%	NoS	%	NoG	%	NoS	%
Asteraceae	6	10	6	9	6	12	6	11	8	10	8	10
Solanaceae	4	7	6	9	4	8	6	11	5	7	7	9
Lamiaceae	4	7	4	6	4	8	4	7	5	7	5	6
Cucurbitaceae	3	5	3	5	3	6	3	5	3	4	3	4
Euphorbiaceae	2	3	3	5	2	4	3	5	2	3	3	4
Asclepiadaceae	2	3	2	3	2	4	2	4	3	4	3	4
Myrsinaceae	2	3	2	3	2	4	2	4	2	3	2	3
Rutaceae	2	3	2	3	1	2	1	2	2	3	2	3
All others (41)	35	59	-	-	27	52	-	-	46	59	-	-
Total	**60**	**100**	**65**	**100**	**51**	**100**	**57**	**100**	**76**	**100**	**81**	**100**

NoG = no. of genera; NoS = no. of species

In the present study, the most prominent growth forms were herbs with (33) species followed by shrubs (24), trees (20) and climbers (4). The numbers of the growth forms of plant species were comparable in each district (Figure 15).

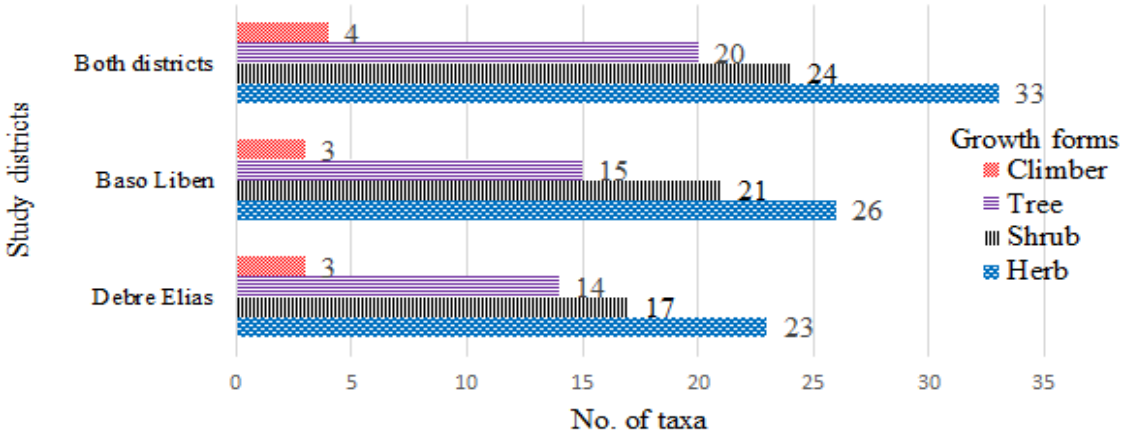


Figure 15. Growth forms of ethnoveterinary medicinal plants documented from the study area

4.2.2.2. Plant parts used for livestock remedy preparation

Each part of various plant species was used against 53 ailments. Most of the plant parts used as sources of medicines were leaves 74 (43%); followed by the roots 34 (21%) (Table 26). The pattern of plant parts used in remedy preparation was more or less similar in each district. Thus, the most

commonly used plant part is the leaf, followed by root and fruit. Sometimes, over two parts of the same plant species, particularly a combination of parts, were used in preparing different therapies (Table 26).

Table 26: Plant parts used by the local community

		Baso Liben		**Debre Elias**		**Both districts**	
No.	**Plant parts used**	Citation	%	Citation	%	Citation	%
1	Leaf	65	24	63	45.65	74	43
2	Root	32	22	30	21.74	34	21
3	Fruit	12	8	11	7.97	12	7
4	Seed	6	4	5	3.62	6	4
5	Bark	4	3	2	1.45	4	2
6	Bulb	4	3	4	3	4	2
7	Latex	4	3	7	5	8	5
8	Whole plant	3	2	2	1.50	4	2
9	Stem	3	2	5	3.60	6	4
10	Fruit/seed	2	1.4	1	0.70	1	0.60
12	Leaf/stem	2	1.4	1	0.70	2	1
13	Leaf/root	1	0.70	1	0.70	1	0.60
14	Stem bark	1	0.70	3	2	3	2
	Leaf/whole plant	1	0.70	0	0	1	0.60
15	Root/whole plant	1	0.70	0	0	1	0.60
16	Rhizome	1	0.70	1	0.70	1	0.60
17	Latex/leaf	1	0.70	0	0	1	0.60
18	Root/fruit	1	0.70	2	1.50	1	0.60
Total		**144**	**100**	**138**	**100**	**164**	**100**

4.2.2.3. Different livestock ailments treated by each plant species

In this study, 53 (48 from BL; 50 from DE) livestock diseases were treated by different plant species. Some of these ethnoveterinary plants appeared to provide multi-use remedies, treating large number ailments. For example, leech infestation was treated by 14 (9%) species followed by bloat 12 (7%) species (Table 27). In each district, a large number of species treated leech infestation. According to the respondents, the community depended on modern veterinary services for the treatments of certain ailments like anthrax, blackleg, pastureolosis and mastitis; however, the services were inadequate.

Table 27: Top 14 livestock ailments treated by each plant species in the study area

		Baso Liben dist.		Debre Elias dist.		Both districts	
No.	**Ailments treated**	**No spp.**	**%**	**No spp.**	**%**	**No spp.**	**%**
1	Leech infestation	11	8	13	9	14	9
2	Bloat	10	7	10	7	12	7
3	Eye infection	9	6	8	6	11	7
4	Emaciation	9	6	9	7	10	6
5	Rabies	9	6	8	6	9	6
6	Coccidiosis	7	5	6	4	7	4
7	Diarrhoea	5	4	4	3	5	3
8	External parasite	5	4	4	3	5	3
9	Wound	5	4	3	2	5	3
10	Epidemic	4	3	4	3	5	3
11	Colic	3	3	5	4	5	3
12	Anthrax	4	5	3	2	4	2
13	Mouth infection	4	3	3	2	4	2
14	Coughing	3	2	3	2	4	2

Dwelling close to the plant world, the local communities have developed vast information about the use of ethnoveterinary plants. The local inhabitants clearly recognize specific features of each species. Some remarkable ethnoveterinary MPs used by most of the interviewed informants from the study area community were *Echinops kebericho* and *Lepidium sativum* treated six (11% each) different ailments followed by *Vernonia amygdalina* and *Zehneria scabra* five (9% each) ailments. Twelve of the following ethnoveterinary plants treated four (8% each) ailments (Table 28). Each of the above mentioned and all of the plant species listed were used to treat nearly similar numbers of ailments in the respective districts.

Table 28: The most common MPs used to treat livestock ailments in the study area

		Baso Liben		Debre Elias		Both districts	
No.	**Scientific name**	NAs	%	NAs	%	Total	%
1	*Echinops kebericho*	6	13	6	12	6	11
2	*Lepidium sativum*	6	13	6	12	6	11
3	*Vernonia amygdalina*	5	10	5	10	5	9
4	*Zehneria scabra*	5	10	5	10	5	9
5	*Allium sativum*	4	8	4	8	4	8
6	*Cucumis ficifolius*	4	8	4	8	4	8
7	*Aloe macrocarpa*	-	-	4	8	4	8
8	*Calotropis procera*	4	8	4	8	4	8
9	*Dracaena steudneri*	4	8	4	8	4	8
10	*Embelia schimperi*	4	8	4	8	4	8
11	*Justicia schimperiana*	4	8	4	8	4	8
12	*Lageneria siceraria*	4	8	4	8	4	8
13	*Nicotiana tabacum*	4	8.	4	8	4	8
14	*Phytolacca dodecandra*	4	8	4	8	4	8
15	*Schinus molle*	4	8	4	8	4	8
16	*Ricinus communis*	4	8	4	8	4	8

NAs = number of ailments treated

4.2.2.4. Types of livestock species treated in the study area

The therapeutic indication of medicinal plant-based remedies in the study area covered all livestock species (Figure 16). The Amhara communities are known to be great farmers. Thus, they use various herbal medicines against livestock ailments. Medicinal plant therapies were more commonly used for treating various ailments affecting cattle (93 citations, 55%), followed by all animals (cattle, pack animals, sheep and goat) (35, 21%), sheep and goat (20, 12%), pack animals (mule, donkey and equine) (13, 8%), and poultry (7, 4%) (Figure 16).

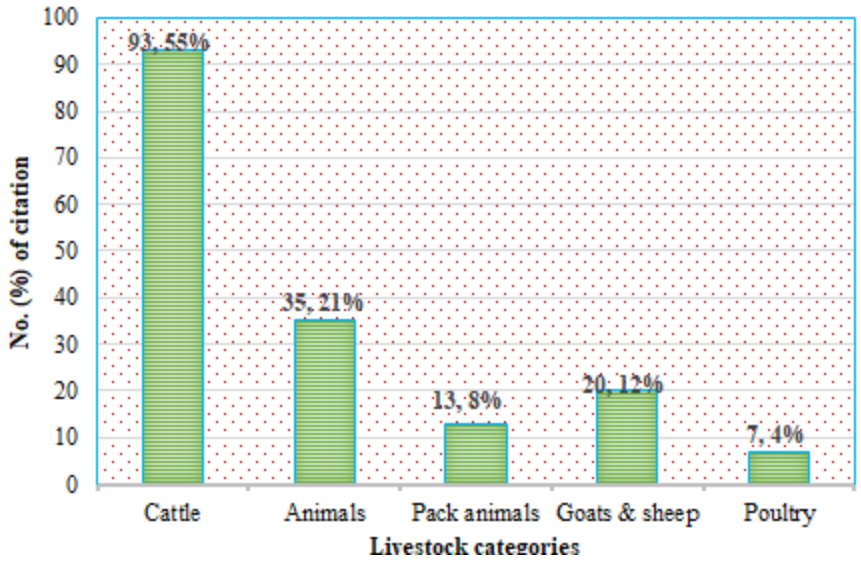


Figure 16. Percentage of MPs used in the treatment of various livestock categories in the study area

4.2.2.5. Traditional methods and conditions in remedy preparations

Traditional herbal medicines were prepared in different modes of preparation by the local people of the study area to treat livestock ailments (Table 29). Based on the data, most of the collected ethnoveterinary plants were prepared in the form of crush/squeeze and soak the part in cold water and give the infusion to the animal that accounted for (64 citations, 39%), followed by extract/remove the latex/juice/sap/ and pour into or paint it (28 citations, 17%). The third-largest form of preparations was boiling, and giving the decoction after cooling scored with 21 citations (13%) in the combined study districts. The least common mode of remedy preparation was grinding/pulverize, and pastes the crushed part and tie with 3 (2.44%) citations. More or less similar results were found in each district (Table 29).

Table 29: Modes of livestock herbal medicine preparation in the study area

	Baso Liben		Debre Elias		Both dists.	
Mode of remedy preparation	FC	%	FC	%	FC	%
Crush/squeeze and soak the part in cold water and give the infusion to animal	60	42	56	41	64	39
Extract/remove the latex/juice/sap/and pour into or paint it	24	17	22	16	28	17
Boil and drink the decoction when cool	18	13	18	13	21	13
Grind/crush and paste the powder or the crushed parts to the affected body	12	8	14	10	15	9
Eat the plant part (raw/cooked/roasted);	12	8	9	7	12	7
Sniff/inhale the fumigated/smoked/burnt/heated of powdered parts	7	5	9	7	11	7
Crush, soak with water and wash	8	6	7	5	9	6
Grind/pulverize and paste the crushed part and tie)	3	2	3	2	4	2
Total citations	**144**	**100**	**138**	**100**	**164**	**100**

FC= Frequency of citation

4.2.2.6. Conditions of preparations, routes of administration and dosages

In this study, the freshly collected plant parts were the leading ones (79%) used in therapy preparation, while dried parts were used subsequently (14%); the remaining 7% of remedies preparation was reported from fresh/dry parts of the plant species. The pattern of conditions of plant parts used in remedy preparation was relatively similar in the two districts (Figure 17).

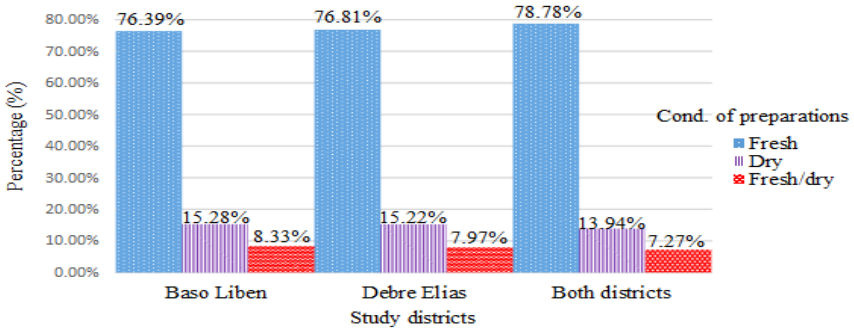


Figure 17. Conditions of preparations of herbal medicine in the study area

Routes of administration: Oral application was the most commonly used route of administration accounting for 101 (61%) preparations, followed by dermal (29 preparations, 18%). Likewise, the oral was the most widely used route of administration, followed by dermal and nasal in each district.

Table 30: Ethnoveterinary routes of administration in the study area

	Route of	Baso Liben		Debre Elias		Both districts	
No.	administration	Citation	%	Citation	%	Citation	%
1	Oral	92	64	86	62	101	61
2	Dermal	25	17	24	17	029	18
3	Nasal	09	06	13	09	013	08
4	Nasal/Oral	08	06	06	04	008	06
5	Ocular	07	05	06	04	009	05
6	Auricular	02	01	02	02	002	01
7	Oral/Ocular	01	0.70	00	00	001	0.60
8	Anal	00	00	01	01	001	0.60
Total		**144**	**100**	**138**	**100**	**164**	**100**

Dosage: The dosage varied between age and kind of livestock treated as decided by local healers. The traditional healers reported different materials such as cans, glasses, bottles and cups for dosage determination during herbal medicine preparations. To treat livestock ailments, a handful of preparations were reported by some other healers. Still, there are no fixed and/or standardized doses of herbal preparations. Species such as *Argemone mexicana*, *Calotropis procera*, *Nicotiana tabacum*, *Euphorbia abyssinica* and *Phytolacca dodecandra* were mentioned to have side effects. However, most of these herbal preparations were applied for dermatological ailments externally.

The commonly used medium for the preparation of traditional herbal medicine was water. Various additives like sugar, milk, flour and table salt were used in the study districts for the preparation for ethnoveterinary medicines. These additives help in reducing the bitter taste of the herbal remedy and the intake of a complete dosage of medication.

4.2.2.7. Composition of ethnoveterinary plant preparations in the study area

In the study area, most of the therapies were prepared from a single medicinal plant species. However, twenty (25%) of the overall (81) livestock remedies were prepared from more than one medicinal plant. Herbal medicines prepared from more than one species were very important for the treatments of one and more than one ailment. *Aloe macrocarpa, Clausena anisata, Cucumis ficifolius, Nicotiana tabacum, Hypoestes forskaolii* and *Schinus molle* were mixed with two or more herbal medicines for the management of different ailments (Appendix 6).

4.2.2.8. Preferences and high ranking of ethnoveterinary plants

Preference ranking: In the study area, 14 MPs were reported against leech infestation. Of these, the preference ranking of seven ethnoveterinary plants was conducted after selecting 10 key informants. *Lageneria siceraria* was the most preferred species followed by *Nicotiana tabacum, Allium sativum* and *Schinus molle* (Table 31). The least preferred plant species was *Dracaena steudneri*.

Table 31: Preference ranking of seven top ethnoveterinary plants against leech infestation

	Respondents (A-J)											
Scientific name	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**Ts**	**R**
Lageneria siceraria	4	5	4	5	4	5	4	5	4	3	**43**	**1**
Nicotiana tabacum	3	4	5	2	5	4	5	3	4	4	**39**	**2**
Allium sativum	5	4	5	2	5	3	1	4	5	4	**38**	**3**
Schinus molle	5	4	2	3	3	4	3	4	**2**	4	**34**	**4**
Lycopersicum esculentum	3	2	3	3	5	4	4	2	1	3	**30**	**5**
Rhamnus prinoides	2	3	3	1	2	3	2	4	2	3	**25**	**6**
Dracaena steudneri	1	2	2	1	2	2	1	1	2	1	**15**	**7**

R = Respondents; Ts = total score; R = rank

Preference ranking: The preference ranking for medicinal plants to treat eye infection (livestock disease) revealed *Buddleja polystachya* (30 scores) was the most preferred one followed by *Aloe*

macrocarpa, *Lepidium sativum* and *Phoenix reclinata*. *Premna schimperii* and *Pavetta abyssinica* were less preferable (Table 32).

Table 32: Preference rankings of six medicinal plants treating eye infection (pooled)

Scientific name	Key informants (A-J)									
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**Ts**	**R**
Aloe macrocarpa	5	4	4	3	2	5	4	3	**28**	**2**
Buddleja polystachya	2	3	4	4	4	4	5	4	**30**	**1**
Lepidium sativum	3	3	2	3	2	4	4	1	**22**	**3**
Pavetta abyssinica	1	2	1	1	0	0	2	1	**8**	**6**
Phoenix reclinata	2	2	2	0	3	5	3	2	**19**	**4**
Premna schimperii	1	2	1	0	1	2	1	2	**10**	**5**

Respondents from A to H; Ts = total score; R = rank

Paired comparison

Using pair-wise ranking, comparisons were made between seven species to treat bloat. Following the scores, *Lepidium sativum* with the highest score (44) was ranked the most preferred species, followed by *Arisaema schimperianum*. The least rank was related to *Croton macrostachyus* (Table 33).

Table 33: Pair-wise rankings of seven ethnoveterinary plants against bloat in the study area

Scientific name	Key informants (A-J)									
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**Ts**	**R**
Lepidium sativum	6	6	5	6	5	5	6	5	**44**	**1**
Arisaema schimperianum	5	6	5	6	5	5	3	6	**41**	**2**
Vernonia amygdalina	6	5	5	4	3	6	5	4	**38**	**3**
Echinops kebericho	5	4	3	4	3	4	5	1	**29**	**4**
Embelia schimperi	3	3	3	0	4	6	3	2	**24**	**5**
Ocimum lamiifolium	3	4	3	1	4	5	2	2	**24**	**5**
Croton macrostachyus	2	2	2	1	0	0	2	1	**10**	**7**

Respondents from A to H; Ts = total score; R = rank

4.2.2.9. Important ethnoveterinary plants in the study area

Fidelity level (FL): Fidelity level values of all ethnoveterinary plants were calculated and presented under (Appendix 8). In Baso Liben, the highest values were recorded for *Phytolacca*

dodecandra and *Justicia schimperiana* against rabies, emaciation and parasites, and for coccidiosis, epidemic, anthrax and endo-parasitic, respectively. On the other hand, *Schinus molle* had the highest FL values, followed by *N. tabacum* for the treatment of corresponding diseases in Debre Elias District (Table 34).

Table 34: Fidelity level (FL) of the top 10 cited ethnoveterinary plants in the districts

Medicinal plants	Ailment treated	Baso Liben			Debre Elias		
		Ip	Iu	FL (%)	Ip	Iu	FL (%)
Schinus molle	Epidemic, leech and rabies	13	14	93	18	19	95
Nicotiana tabacum	Dermatological and parasitic	22	24	92	17	18	94
Lagenaria siceraria	Colic, leech, rabies and retained placenta	9	11	82	12	13	92
Rhamnus prinoides	Colic and leech infestation	11	13	85	10	11	91
Lycopersicum esculentum	Leech and indigestion	11	13	85	9	10	90
Stephania abyssinica	Anthrax, rabies and thick infestation	7	8	88	8	9	89
Justicia schimperiana	Coccidiosis, epidemic, anthrax and endo-parasitic	15	16	94	14	16	88
Euphorbia abyssinica	Nasal affliction	14	15	93	15	17	88
Phytolacca dodecandra	Rabies, emaciation and parasitic	16	17	94	17	20	85
Cucumis ficifolius	Diarrhoea, emaciation, rabies and cough	7	8	88	11	13	85

Informant consensus factors (ICF)

The treatment for different ethonveterinary diseases was classified into 12 categories and the ICF values for each category are given (Table 35). The ICF values calculated for the reported categories show the level of shared knowledge for the management of each category of ailment. In Baso Liben, the highest ICF score for external and internal parasites is 0.85. Twenty-three MPs with 152 citations were recorded to treat the parasites. The disease category, namely dermatological and sensorial scored the second highest value (ICF = 0.77), followed by gastro-intestinal (ICF = 0.76) and fever, evil eye and epidemic ICF value with 0.71. The least was recorded in respiratory and reproductive (ICF = 0.42) disease categories.

Similarly, the category with the highest ICF value was related to external and internal parasites, which scored the highest value (0.82) was recorded in Debre Elias District. Twenty-four MPs with 120 citations were recorded to treat the problem. Following this category, dermatological and sensorial, and gastro-intestinal diseases were in second and third places, respectively. Nearly comparable scores were recorded across each disease category in each district.

Table 35: Results of informants consensus factor (ICF) for livestock ailments in the study area

Disease categories	Baso Liben				Debre Elias			
	Ns	Nur	ICF	R	Ns	Nur	ICF	R
External and internal parasites	23	152	0.85	1	24	120	0.82	1
Dermatological and sensorial	30	128	0.77	2	28	132	0.79	2
Gastro-intestinal diseases	21	83	0.76	3	24	71	0.67	3
Coccidiosis	7	17	0.63	4	6	15	0.64	4
Injuries, bleeding, biting and poisoning	6	14	0.62	5	4	12	0.73	5
Rabies	9	19	0.56	8	8	17	0.56	6
Emaciation	9	22	0.62	5	9	19	0.56	6
Trypanosomiasis	3	6	0.60	7	3	5	0.50	8
Respiratory and reproductive	8	13	0.42	10	9	16	0.47	10
Epidemic	4	5	0.22	12	4	6	0.40	11
Anthrax	4	8	0.40	11	3	4	0.33	12
Others	18	38	0.54	9	11	24	0.48	9

4.3. Ethnobotany of WEPs in the Study Area

4.3.1. Taxonomic diversity

Fifty-two wild edible plant species belonging to 44 genera in 35 families were recorded in the entire study area. Thirty-four (65%) of the recorded species were also reported as human and ethnoveternary medicines (Appendix 14). Of these, two of them (*Acanthus sennii* and *Rhus glutinosa* subsp. *glutinosa*) were found endemic to Ethiopia. Forty-four species under 38 genera and 32 families were collected in Baso Liben, whereas 41 species belonging to 34 genera and 27 families were recorded in Debre Elias District.

Twenty-two (22) of the collected WEPs were trees followed by shrubs with 16 spp., herbs with 11 spp. and climbers with three spp. In Baso Liben District, trees accounted for the highest growth forms with (18 spp.), followed by shrubs with 12 spp., herbs with 11 spp. and climbers with three spp. Likewise, in Debre Elias District, 19 of the reported species were trees followed by shrubs with 14 spp., herbs with six spp. and climbers with two species (Figure 18).

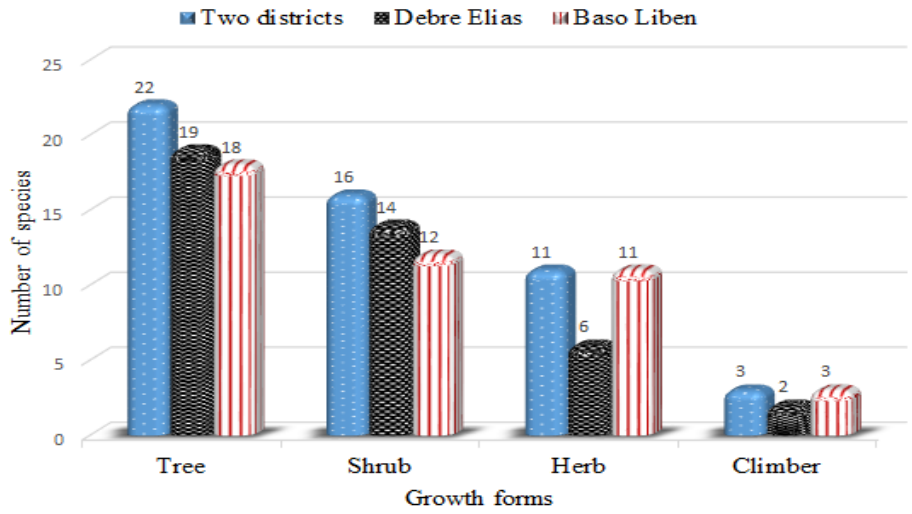


Figure 18. Growth forms of WEPs in the study area

Of all families, Moraceae was represented by five (10% species) which had the highest proportion of WEPs followed by Rosaceae with four (8% species), Acanthaceae, Flacourtaceae and Solanaceae with three (6%) species each. Four of the reported families, namely Anacardiaceae, Boraginaceae, Polygonaceae and Rutaceae were represented by two (4%) species each. The remaining 26 (50%) families had only one species representation in both districts (Appendix 15).

Similarly, the highest represented family in Baso Liben District was Moraceae with four (9% species); followed by Acanthaceae and Solanaceae with three (6%) species each; Polygonaceae and Rutaceae had two (3%) species each. In this district, a single species represented the remaining 26 families. On the other hand, in Debre Elias, the family Moraceae was represented by five (12%)

species, followed by Acanthaceae and Rosaceae with three (7%) species each, Boraginaceae, Flacourtaceae, Polygonaceae, Rutaceae and Solanaceae with two (4.88% species) each. The rest of the families had single-species representation (Appendix 15).

4.3.2. Status, habitats and distribution of WEPs

Most of the WEPs are common and easily accessible. However, some listed plant species i.e., *Balanites aegyptiaca*, *Dioscorea abyssinica*, *Dovyalis abyssinica*, *Celtis africana*, *Rosa abyssinica*, *Ficus palmata*, *Mimusops kummel*, *Podocarpus falcatus*, *Prunus africana* and *Tamarindus indica* are becoming locally rare (Appendix 14). They are hard to find and collect them elsewhere in the study area except in forest patches.

Edible plants were appeared to occupy various habitats and ecological niches. From those tree species listed by the respondents namely: *Ficus sur*, *Syzygium guineese* subsp. *guineense*, *Rosa abyssinica* and many others are some major edible fruit trees found in the patches. Some species such as *Carissa spinarum*, *Rubus* spp., and *Dovyalis abyssinica* occupied open forests and scrubs. *Ziziphus spina-christi*, *Opuntia ficus-indica*, *Ximenia americana*, *Tamarindus indica* and *C. spinarum* commonly inhabiting degraded areas. Other species like *Syzygium guineense* subsp. *guineense*, *Mimusops kummel*, *T. indica* and *Ficus* spp. are typically riparian. Some other species inhabited riverine, roadsides, farmlands, home-gardens, grazing lands, churchyards and monasteries.

Furthermore, this study has documented species such as *Arundinaria alpina*, *Ensete ventricosum*, *Phoenix reclinata* and *Schinus molle*, which their fruits are edible. The first three plant species

were commonly cultivated in and around the home-gardens as well as found in the patches. *L. molle* last species becoming naturalized. The herbaceous stem of the *E. ventricosum* is a staple food for millions of people in Southern Ethiopia, whereas only its fruits are known edible in the study area.

4.3.3. Plant parts consumed and modes of consumption

Relating to the parts used, fruits of the WEPs are the most commonly consumed part, whereas shoot, gume, root, bark, sees and stem are used less frequently. Fruits with 38 (72%) are the most dominant edible parts followed by nectars with four (8%) consumed by people of the study area. More or less proportional numbers of edible parts were also reported in each district (Table 36).

Table 36: Wild edible plant parts consumed in the study area

Number of plant parts and their percentage (%)						
	Baso Liben		**Debre Elias**		**Both districts**	
Parts used	**No.**	**%**	**No.**	**%**	**No.**	**%**
Fruit	31	71	31	77	38	72
Nectar	04	9	04	10	04	08
Shoot	02	05	02	05	02	04
Bulb/tuber	02	05	01	02	02	04
Stem	01	02	01	02	01	02
Root	01	02	-	-	01	02
Leaf	01	02	-	-	01	02
Gum	01	02	-	-	01	02
Fruit/stem	01	02	01	02	01	02
Flower/inf.	-	-	01	02	01	02
Total	**44**	100	**41**	100`	**52**	100

In case of mode of consumption, only two of the WEPs were served after cooking (boiling), one as powdering and all the rest (49) were eaten raw without any processing (Figure 19; Appendix 14). The ripe fruits were collected from various plant species and were consumed as raw. Most of

these plants were also eaten as fresh, directly after they were collected. In the family Moraceae (*Ficus* spp.), the figs are gathered when ripe, cut open seeds discarded and the pulps are eaten. In some cases, the figs were collected and chewed to drain out the juice. Similarly, *Rubus apetalus*, *R. steudneri* and *Mimusops kummel* the wild ripe fruits were collected and eaten as raw. The species *Opuntia ficus-indica* is edible when ripens if the prickly spines are removed by peaking of the outer skin of the fruits.

On the other hand, the young stems/shoots of *Rumex abyssinicus*, *R. nervosus*, *Arundinaria alpina* and *Phoenix reclinata* were collected and eaten fresh. The edible roots of *Arisaema schimperianum* were dug up, peeled and eaten. Tuber of *Dioscorea abyssinica* was boiled and eaten. Children and shepherds ate most plant species. In particular, a mature flower from the species was picked and the nectar was sucked. The inflorescence of *Justicia schimperiana* and *Datura stramonium* were picked and eaten by the children. However, all age groups of the community consumed the WEPs.

Very few species like *Ocimum urticifolium* and *Schinus molle*, so as to utilize some form of home processing like drying, roasting and then mixing with butter and/or made into Ethiopian spice blend (BERBERE).

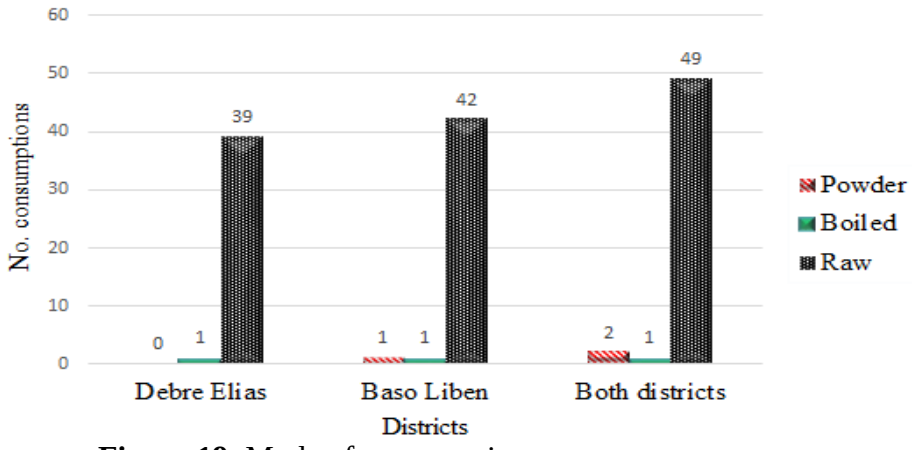


Figure 19. Mode of consumption

4.3.4. Relative frequency of citation (RFC) of wild edible plants

The plant species with highest RFC in the two districts are indicated in table 37. The following WEPs were most widely cited: *Ficus sur*, *Rubus apetalus*, *Cordia africana*, *Rosa abyssinica* and sixteen others. Relative frequency was calculated based on the number of informants who mentioned the WEPs consumed by the local people. The most common plants in the study area were those that got the highest RFC.

The RFC results indicate the order of wild edible species significance. The highest RFC value belonged to *Ficus sur* (0.91 from Baso Liben and 0.88 from Debre Elias), cited by a large number of informants. After *F. su*r, *Embelia schimperi* was found to be the important species. In Baso Liben, the lowest value of RFC was recorded for *Phoenix reclinata*, whereas the lowest value was recorded to *Ritchiea albersii* in the Debre Elias. *Rhus glutinosa* subsp. *glutinosa* and *Ritchiea albersii* were only cited in Debre Elias District (Table 37). *F. sur*, *Rubus apetalus*, *C. africana* and *R. abyssinica* were reported for the treatment of different ailments. Species such as *F. sur*, *R. apetalus* and *C. africana* were also found to be under-exploited edible fruits.

Table 37: Relative frequency of citation for top 20 WEPs in the study area

No.	Scientific name	Family	Baso Liben (BL)			Debre Elias (DE)		
			NF	RFC	R	NF	RFC	R
1	*Ficus sur*	Moraceae	224	0.91	1	130	0.88	1
2	*Embelia schimperi*	Myrsinaceae	180	0.73	7	126	0.85	2
3	*Rubus apetalus*	Rosaceae	208	0.84	2	123	0.84	3
4	*Cordia africana*	Boraginaceae	195	0.80	4	121	0.82	4
5	*Rosa abyssinica*	Rosaceae	202	0.82	3	120	0.81	5
6	*Ficus vasta*	Moraceae	190	0.77	5	117	0.79	6
7	*Ximenia americana*	Olacaceae	177	0.72	8	115	0.78	7
8	*Syzygium guineense* subsp. *guineense*	Myrtaceae	160	0.65	11	110	0.74	8
9	*Dovyalis abyssinica*	Flacourtiaceae	150	0.61	13	100	0.68	9
10	*Ficus sycomorus*	Moraceae	165	0.67	10	98	0.66	10
11	*Tamarindus indica*	Fabaceae	184	0.75	6	96	0.64	11
12	*Carissa spinarum*	Apocynaceae	170	0.69	9	90	0.60	12
13	*Teclea nobilis*	Rutaceae	155	0.63	12	84	0.57	13
14	*Mimusops kummel*	Sapotaceae	141	0.57	14	77	0.52	14
15	*Opuntia ficus-indica*	Cactaceae	110	0.45	16	70	0.47	15
16	*Momordica foetida*	Cucurbitaceae	130	0.53	15	68	0.46	16
17	*Rhus glutinosa* subsp. *glutinosa*	Anacardiaceae	-	-	-	65	0.44	17
18	*Prunus africana*	Rosaceae	94	0.38	17	63	0.43	18
19	*Phoenix reclinata*	Arecaceae	90	0.37	18	56	0.38	19
20	*Ritchiea albersii*	Capparidaceae	-	-	-	50	0.34	20

4.3.5. Preference ranking of wild edible plants in the study area

Ten key informants (5 from each district) were asked to rank six species of WEPs for their good taste according to their personal preferences. Based on FGDs and high number of citations, the following six species were selected. The scores given to each plant species were added and the highest score was ranked first. As a result, *Rosa abyssinica* (56 scores), followed by *Ficus sur* (51 scores) *Mimusopis kumel* (49 scores) and *Syzygium guineense* subsp. *guineense* (48 scores) were species of high preferences. However, *Rhus glutinosa* subsp. *glutinosa* and *Tamarindus indica* were less preferred species (Table 38).

Table 38: Preference ranking of the six most preferred WEPs in terms of taste in the study area

Scores given by key informants (R_1-R_{10})	**Most preferred wild edible plant species**					
	Ficus sur	*Syzygium guineense* subsp. *guineense*	*Mimusopis kummel*	*Rhus glutinosa* subsp. *glutinosa*	*Rosa abyssinica*	*Tamarindus indica*
R1	6	4	4	2	6	4
R2	5	5	5	3	6	5
R3	5	6	6	4	5	3
R4	4	5	5	3	5	4
R5	5	4	4	4	6	2
R6	6	5	5	2	5	4
R7	4	5	5	5	6	5
R8	5	4	4	4	6	4
R9	5	5	5	3	5	5
R10	6	5	6	4	6	3
Total score	**51**	**48**	**49**	**34**	**56**	**39**
Rank	2	4	3	6	1	5

4.3.6. Similarity of species composition (WEPs) in the study area

Jaccard's Coefficient of Similarity (JCS) was used for assessing wild edible plant species composition. The JCS was calculated for comparing wild edible species composition within the two study districts (i.e., the no. of spp., found only in BL was 44, where as 41 spp. in DE, and 33 spp. in common). Thus, the JCS of Baso Liben and Debre Elias districts for the reported WEPs were 0.28 (28%).

4.3.7. Seasonal availability, fruiting and/or flowering patterns

The seasons of fruiting and ripening of WEPs were site and species specific. WEPs mark in a specific season of the year and most of the local communities know accurately at which time the ripening of the plant species in their localities offer their gift. As a result, there is considerable overlap in ripening among the different species both within and between localities (Appendix 14).

According to the informants, few species stayed nearly year round in fruiting or have a wider time range (for example *Cordia africana*). Plants such as *Rosa abyssinica*, *Carissa spinarum* and *Ficus* spp. ripe twice or thrice per year in various seasons; usually, the major fruiting season yielding a plentiful harvest. Fruits of WEPs (especially trees) are available almost throughout the year and most of them ripening from the month of October onwards (Appendix 14). Furthermore, some of the most frequently used edible fruits accessible during dry season were *Balanites aegyptica*, *Ficus* spp., *R. abyssinica*, *Ximenia americana* and *Ziziphus spina-christi*.

Plant parts eaten for their leaves, young shoots or stems were usually collected before the flowering stage, as the edible parts were more or less gentle. Such types of plant species were *Arundinaria alpina*, *Oxalis corniculata*, *Phoenix reclinata*, *Rumex abyssinicus* and *R. nervosus.* Some plants eaten for their root and bulb such as *Dioscorea abyssinica*, *Arisaema schimperianum* and *Cyperus bulbosus* were collected in late autumn and/or beginning of winter, (they were also collected just after rainy seasons). Edible nectars of *Datura stramonium*, *Acanthus* spp. and *Justicia schimperiana* were collected during their respective flowering seasons. The gum from *Sansevieria erythraeae* was collected and consumed just after a rainy season. However, all plant parts are not available during the whole year, availability defines not only the time but also the frequency of collecting plant parts.



a. *Tamarindus indica* **b.** *Rubus apetalus* **c**. *Balanites aegyptica* **d.** *Cordia africana*



e. *Carissa spinarum* **f.** *Phoenix reclinata* **g.** *Ocimum urticifolium* **h.** *Ficus sur*

Figure (a-h) 20. Some WEPs in the study area (both districts)

4.4. Marketability of Medicinal and Wild Edible Plants in the Study Area

Apart from medicinal and food values to the local community, some documented plant species are marketable and can generate income for rural people with limited financial opportunities. Niteen (10%) species were recorded from four local markets (Yejube, Kork, Elias and Genet) (Table 39). In the surveyed markets, species such as, *Mimusops kummel*, *Ocimum urticifolium*, *Rosa abyssinica*, *Schinus molle* and *Syzygium guineense* subsp. *guineense* were the only marketed WEPs. *Acokanthera schimperi*, *Allium sativum*, *Catha edulis*, *Echinops kebericho*, *Lepidium sativum*, *Lippia adoensis* var. *adoensis*, *Ruta chalepensis*, *Securidaca longepedunculata* and *Zingiber officinale* were also few of the marketed MPs. The species *S. longepedunculata*, *E. kebericho* and *L. adoensis* var. *adoensis* were highly marketed, and demanded at the first day of Ethiopian New Year (ENQUTATASH). In particular, S. *longepedunculata* has been widely used in every individual's home during New Year celebration.

Table 39: Medicinal and WEPs recorded from local markets in the study area (pooled data)

Markets surveyed	Date of survey	No of spp. recorded		List of the species recorded
		MPs	WEPs	
Yejube	Aug. 20, 2017 to Jan. 2018	15	3	*Acokanthera schimperi, Allium sativum, Catha edulis, Echinops kebericho, Impatiens rothii, Lepidium sativum, Lippia adoensis* var. *adoensis, Ocimum urticifolium, Olea europaea* subsp. *cuspidata, Otostegia integrifolia, Rosmarinus officinalis, Ruta chalepensis, Schinus molle, Securidaca longepedunculata*, Silene macrosolen, Syzygium guineense* subsp. *guineense* and *Zingiber officinale*
Kork	Sept. 6, 2017 to Dec. 2017	11	4	*A. sativum, E. kebericho, I. rothii, L. sativum, L. adoensis* var. *adoensis, Mimusops kummel, O. europaea* subsp. *cuspidata, O. integrifolia, Rosa abyssinica, R. officinalis, S. molle, S. longepedunculata*, S. guineense* subsp. *guineense* and *Z. officinale*
Elias	Apr. 10, 2017 to Oct. 2017	14	3	*A. schimperi, A. sativum, C. edulis, E. kebericho, L. sativum, L. adoensis* var. *adoensis, O. urticifolium, O. europaea* subsp. *cuspidata, O. integrifolia, R. abyssinica, R. officinalis, Ruta chalepensis, S. molle, Securidaca longepedunculata*, Silene macrosolen* and *Z. officinale*
Genet	Oct. 2, 2017 to Feb. 2018	10	4	*A. sativum, E. kebericho, L. sativum, L. adoensis* var. *adoensis, O.* subsp. *cuspidata, O. integrifolia, O. urticifolium, R. abyssinica, S. molle, S. longepedunculata*, S. macrosolen, S. guineense* subsp. *guineense* and *Z. officinale*
Total		**15**	**4**	**19**

MPs = medicinal plants; WEPs = Wild edible plants; * = highly sold during Ethiopian New Year

In present work, the trend has increased owing to the demand of certain plants, which find diverse uses in the local markets. In this context, many plant species were collected for sale. Medicinal plants such as *Allium stivum, Brassica carinata, Carica papaya, Coffea arabica, Cymbopogon citratus, Foeniculum vulgare, Guizotia abyssinica, Lageneria siceraria, Linum usitatissimum, Nicotiana tabacum, Olea europaea* subsp. *cuspidata, Otostegia integrifolia, Prunus persica, Ricinus communis, Rhamnus prinoides* and *Ruta chalepensis* were also sold for other purposes. However, the healers sold their remedial preparations in their home.

The Saturday markets in the four towns were a pull for different villagers from the neighboring areas. In the markets, ethnographic objects made from plant (*Cordia africana*, *Eucalyptus globulus*, *Grewia bicolor*, *Juniperus procera* etc.) materials such as baskets, brooms, spoons, farm and hand tools were collected and documented.

4.5. Nutraceutical Plants

Out of the total MPs, 49 (29%) of them distributed under 47 genera and 36 families were reported to have overlapping uses i.e., as both a source of food and medicine (nutraceutical). The families comprising Fabaceae, Poaceae and Brassicaceae had the highest nutraceuticals with three species each in the two districts (Table 40).

Table 40: List of families and the number of species in each family in the study area

No.	Family	Number of species in the districts		
		Baso Liben District	Debre Elias District	Both districts
		No of spp. (N = 47)	No of spp. (N = 42)	No of spp. (N = 49)
1	Fabaceae	3	3	3
2	Poaceae	3	2	3
3	Brassicaceae	2	3	3
4	Asteraceae	2	2	2
5	Moraceae	2	1	2
6	Polygonaceae	2	2	2
7	Myrtaceae	2	2	2
8	Rhaminaceae	2	2	2
9	Rosaceae	2	2	2
10	Solanaceae	2	1	2
11	Other families (N = 26)	**25 spp.**	**22 spp.**	**26 spp.**

Considering to the growth forms, herbs (19; 39%) were the most dominant ones followed by trees, shrubs and climbers (Figure 21).

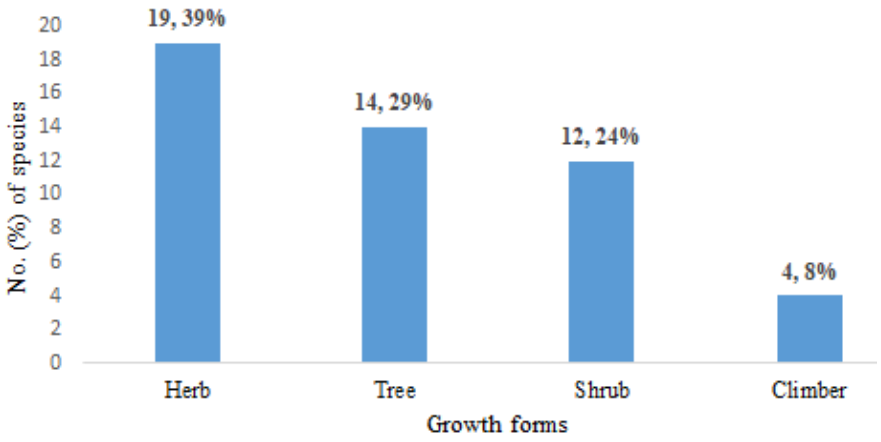


Figure 21. Growth forms of nutraceuticals in the study area

In this work, nutraceutical used in the management of various ailments included abdominal worms, colic, anthrax, coughing, leech infestations, malaria, wound, common cold, febrile illness, gastritis, diarrhoea, an evil spirit and more. Based on local people use-citation, various uses and accessiblity of the plants, species like *Allium sativum*, *Lipidium sativum*, *Ruta chalepensis* and eight others were the most commonly used nutraceuticals reported for their wider use in the study area (Table 41).

The information for two nutraceutical namely, *Rosmarinus officinalis* and *Brassica carinata* was restricted to DE, whereas the information for seven species including *Phoenix reclinata*, *Solanum nigrum*, *Ficus sycomorus*, *Ekebergia capensis*, *Coffea arabica*, *Balanites aegyptiaca* and *Hordeum vulgare* was limited only to BL District (Appendix 16).

Table 41: List of common MPs (human and livestock) used as nutraceuticals

No.	Name of species	Ha	PU	Ailment treated (health benefits)
1	*Allium sativum* (Alliaceae)	H	Bu L	Abdominal worms, anthrax, coughing, dermatophilosis, evil eye, asthma, gastritis, indigestion, ringworm, snakebite, trypanosomiasis, wart
2	*Lipidium sativum* (Brassicaceae)	H	Se	Bloat, diarrhea, eczema, eye infection, indigestion, gastritis, gingivitis, fever, malaria, rabies
3	*Ruta chalepensis* (Rutaceae)	H	L/St	Abdominal colic, common cold, evil eye, influenza, gastritis
4	*Sesamum angustifolium* (Pedaliaceae)	H	Se	Coughing, epidemic, dandruff, abdominal colic, "mognbagegn"
5	*Datura stramonium* (Solanaceae)	H	Ne	Abdominal colic, bloat, dandruff, eczema, rheumatic pain, toothache, wound
6	*Justicia schimperiana* (Acanthaceae)	S	Ne	Anthrax, coccidiosis, constipation, epidemic, external parasite, jaundice, wound
7	*Schinus molle* (Anacardiaceae)	T	Se	Acute fibril illness, stomach trouble, leech, abirq, epidemic, rabies
8	*Rumex abyssinicus* (Polygonaceae)	H	St	Skin rush, burn, hypertension, Tinea nigra, pneumonia, heart failure, acute febrile illness
9	*Tamarindus indica* (Fabaceae)	T	Se	Cancer, malaria, diarrhoea, ascaris, joint ache, snakebite, megangna (colic)
10	*Zingiber officinale* (Zingiberaceae)	H	Rh	Abdominal pain, indigestion
11	*Rhamnus prinoides* (Rhaminaceae)	S	Fr/L	Colic, leech infestation, tonsillitis, skin infection, fibrile illness

Habit = Ha, T = tree, S = shrub, H = herb, Cl = climber, Pu = parts used, Bu = bulb, Fr = fruit, L = leaf, Ne = Nectar, R = root, St = stem, Se = seed

4.6. Other Uses of Medicinal and WEPs

Apart from their food and medicinal values, the reported medicinal and wild edible plants were used for various purposes. In the present study, an overall of 58 (31%) species distributed under 46 genera and 40 families were cited as multiple uses. The ethnobotanical data collected were pooled and presented in figure 22. Trees shared with the highest number of species followed by shrubs (Appendix 17). The reported plant species within the vascular plant biodiversity offer various uses for the benefit of the local people. Among the various use-categories of most cited medicinal and WEPs, charcoal and firewood, and environmental uses (25% each) shared the highest reported uses followed by material uses (Figure 22).

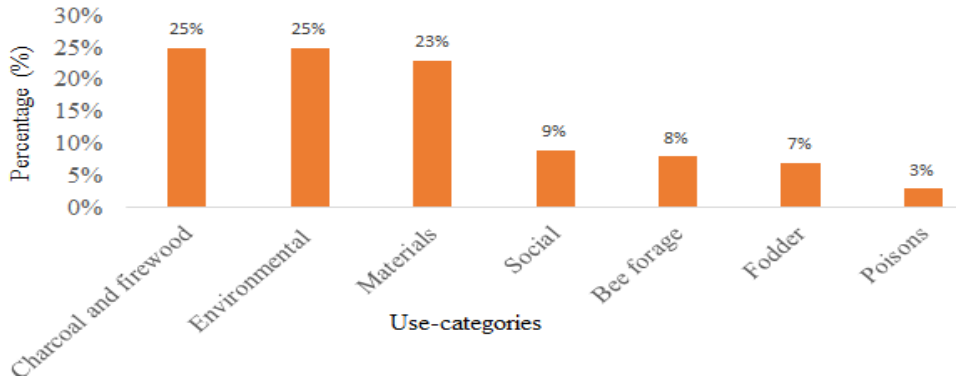


Figure 22. Percentage of various use-categories of reported medicinal and WEPs

Environmental uses: Twenty-five percent (25%) of the use-categories were reported as environmental uses. Ornamental and hedge plant species are very important to the local community who expressed distinguished appreciation to the aesthetic and recreational values. Plant uses as a shade, mulch, live fence, demarcation, and conservation of soils were also reported. The most important plant species under these categories included *Acacia abyssinica*, *A. lahai*, *Acokanthera schimperi* and *Aloe macrocarpa* (for soil conservation/mulch); *Croton macrostachus* (shade, dry fence and soil conservation); *Solanecio gigas* (ornamental, shade and live fence) and *Dracaena steudneri* (ornamental, shade and dry fence) (Appendix 17).

Charcoal and firewood: *Anogeissus leiocarpa*, *Combretum molle*, *Croton macrostachyus*, *Eucalyptus globulus*, *Syzygium guineense* subsp. *guineense*, *Tamarindus indica* and *Vernonia amygdalina* were some of the most important species cited as charcoal and firewood use-categories, which shared with the highest reports (25%).

Material uses: The extraction of wild plant materials (like timber, tannin, dyes), uses as ropes, farm and hand tools, walking sticks, local utensils and toothbrush were appeared to represent a significant share of respondent's reports (23%). Few of the reported species used under these

categories were *Eucalyptus globulus*, *Cordia africana*, *Dichrostachys cinerea*, *Croton macrostachyus*, *Grewia bicolor*, *G. ferruginea*, *Juniperus procera*, *Schefflera abyssinica* and *Olea europaea* subsp. *cuspidata*. These species were important sources of furniture/timber, utensil, building, walking stick, hand and farm tools. *Girardinia bullosa* and *G. ferruginea* were used for making ropes, whereas *Clausena anisata* and *Olea europaea* subsp. *cuspidata* for toothbrush. Species such as *Ricinus communis*, *Stereospermum kunthianum* and *Euclea racemosa* subsp. *schimperi* were used as tannin work and dyes.

Cultural uses: Nine percent (9%) of the plant species were cited as cultural and religious/social uses. Some reported species used in cultural ceremonies included *Boswellia pirottae* (fumigation of home during coffee ceremony) *Ficus sur* and *Prunus africana* (washing body during wedding); *Cymbopogon citratus* and *Lippia adoensis* var. *adoensis* (scenting and ritual ceremonies); *Phoenix reclinata* (religious/spiritual & funeral ceremonies); *Laggera tomentosa* and *Vernonia amygdalina* (washing and fumigation of pots) (Appendix 17).

Bee forage: Eight percent (8%) of the species were reported as important sources of nectar. *Carissa spinarum*, *Clausena anisata*, *Croton macrostachyus*, *Euclea racemose* subsp. *schimperi*, *Laggera tomentosa*, *Lippia adoensis* var. *adoensis*, *Maesa lanceolata*, *Rosa abyssinica*, *Solanecio gigas* and *Vernonia amygdalina* were mentioned as some of the bee forage plants.

Fodder: According to the informants, 7% of the plant species were categorized under the fodder category. Plant species including *Ekebergia capensis*, *Cordia africana*, *Vernonia amygdalina*,

Acacia abyssinica, *Phoenix reclinata*, *Rumex nervosus* and *Solanecio gigas* were the most commonly cited ones used as fodder for domestic animals.

Poisons: The least share of use-categories constituted with 3%. Plants like *Acokanthera schimperi*, *Eucalyptus globulus*, *Euphorbia abyssinica*, *Balanites aegyptiaca* and *Laggera tomentosa* were reported as insect repellent and/or poison plants.

4.7. Use Diversity of Selected Medicinal and Wild Edible Plants in the Study Area

Use-values reflect the significance of each plant species to the respondents. Twelve (12) most cited medicinal and WEPs are indicated in Table 42. In Baso Liben District, the use-value (UV) was reported as high for *Vernonia amygdalina* followed by *Croton macrostachyus* and *Tamarindus indica*. On the other hand, *C. macrostachyus* had the highest UV, followed by *V. amygdalina* and *Cordia africana in* Debre Elias District. However, the least number of score was recorded for *Eucalyptus globulus* in the latter district.

Table 42: Top twelve reported useful plant species using use-value data

			Baso Liben District				Debre Elias District			
No.	**Scientific name**	**Family**	**∑Ui**	**N**	**UV**	**R**	**∑Ui**	**N**	**UV**	**R**
1	*Croton macrostachyus*	Euphorbiaceae	165	35	4.71	2	170	33	5.15	1
2	*Vernonia amygdalina*	Asteraceae	190	37	5.12	1	124	26	4.77	2
3	*Cordia africana*	Boraginaceae	120	30	4.00	7	172	36	4.77	2
4	*Tamarindus indica*	*Fabaceae*	110	25	4.40	3	94	23	4.09	4
5	*Juniperus procera*	Cupressaceae	90	21	4.30	4	92	25	3.68	5
6	*Ficus sur*	*Moraceae*	115	27	4.26	5	88	24	3.67	6
7	*Prunus africana*	*Rosaceae*	78	22	3.55	8	65	21	3.10	7
8	*Acacia abyssinica*	*Fabaceae*	111	40	2.78	10	76	26	2.96	8
9	*Boswellia pirottae*	Burseraceae	-	-	-	-	108	42	2.57	12
10	*Lippia adoensis* var. *adoensis*	Verbenaceae	85	28	3.04	9	69	29	2.38	9
11	*Syzygium guineense* subsp. *guineense*	Myrtaceae	98	37	2.65	11	102	45	2.27	10
12	*Eucalyptus globulus*	Myrtaceae	75	18	4.20	6	66	31	2.13	11

4.8. Ethnodemographic Characteristics of the Informants and IK Transfer

4.8.1. Ethnographic characteristics of the informants

In the study area, with the knowledge difference between the two sexes, females mentioned a few medicinal and WEPs compared to males. The ethnodemographic variables of the informants in the study area have shown in Tables 43 and 44. Regarding to age, each informant varied between 18 and 85 years in 4 age groups (age 18-29, 30-39, 40-60, and 61 and above). The patterns of age categories were similar in both districts (Appendix 19). In each district, the numbers of medicinal plants reported by the age groups (≥ 30) were more than that of the second (18-29 age groups), and there was a significant difference ($P < 0.05$) (Table 43).

More number of plants were reported by illiterate informants as compared to the literate ones. As a result, there was a significant difference ($P < 0.05$) for the average number of MPs reported by illiterate and literate informants (Table 43). There was also a significant difference ($P < 0.05$) in the average of reported medicinal plants reported by the key and general informants. On average, couples have reported a greater number of plants than the single (unmarried /divorced) ones, but there was no significant difference ($P > 0.05$). Similarly, there was no significant difference detected in the number of plants listed by informants inhabiting at a distance of 7 km or less from health centres and those living relatively far away (> 7 km) from the health centres (Table 43).

Table 43: Statistical test of significance on the reported number of medicinal plants among informant groups in the study area

Districts	Parameters	Informant groups	N	Mean ± SD	t-value**	p-value
Baso Liben	Gender	Male	161	4.80 ± 1.20	6.13	0.0001*
		Female	85	2.91 ± 1.12		
	Age	18-29	62	2.89 ± 1.14	11.15	0.0001*
		≥ 30	184	5.32 ± 1.31		
	Literacy level	Literate	145	4.12 ± 1.68	1.74	0.0002*
		Non-educated	101	4.13 ± 1.75		
	Marital status	Single	74	3.85 ± 1.22	0.65	0.452
		Married	172	4.56 ± 1.31		
	Distance from the health centres	Near to health centres (≤ 7 km)	70	4.46 ± 0.23	0.56	0.5583
		Far from health centres (> 7 km)	176	4.24 ± 0.33		
	Informant category	Key informants	48	5.24 ± 1.33	-0.45	0.012*
		General informants	198	5.26 ± 1.42		
Debre Elias	Gender	Male	111	3.91 ± 1.50	5.45	0.0002*
		Female	37	2.10 ± 1.10		
	Age	18-29	47	2.56 ± 1.18	10.57	0.0001*
		≥ 30	101	4.59 ± 1.34		
	Literacy level	Literate	89	3.54 ± 1.17	1.72	0.0003*
		Non- educated	59	3.56 ± 1.52		
	Marital status	Single	51	3.23 ± 0.67	0.64	0.321
		Married	97	3.84 ± 0.85		
	Distance from health centres	Near to health centres (≤ 7 km)	41	4.25 ± 0.27	0.57	0.5672
		Far from health centres (> 7 km)	107	4.14 ± 0.42		
	Informant category	Key informant	36	5.14 ± 0.81	0.54	0.0001*
		General informants	112	5.15 ± 0.68		

*Significant difference ($p < 0.05$); ** t (0.05) (two-tailed); df = 246, 148 and 394 (Baso Liben, Debre Elias and both districts respectively); N = number of informants

Relating to WEPs, male informants reported more on average (4.60 ± 1.21; BL; 2.92 ± 1.40, DE) than females (3.90 ± 1.11; BL; 1.90 ± 1.10, DE) and hence there was a significant difference ($P < 0.05$) on the citation of edible plants. Similarly, the other significant difference ($p < 0.05$) was observed between key and general, and literate and illiterate (non-educated) informants. A greater number of WEPs were reported by senior (≥ 30 years) and key informants than the young (18-29 years) and any other (general informants) in the two districts (Table 44).

Table 44: Statistical test of significance on the reported average number of WEPs among informant groups in the study area

Districts	Parameters	Informant groups	N	Mean ± SD	t-value**	p-value
Baso Liben	Gender	Male	161	4.60 ± 1.21	5.17	0.001*
		Female	85	3.90 ± 1.11		
	Age	18-29	62	3.80 ± 1.14	9.10	0.045*
		≥ 30	184	4.86 ± 1.31		
	Literacy level	Literate	145	3.09 ± 1.42	1.35	0.0002*
		Non-educated	101	4.52 ± 1.65		
	Marital status	Single	74	3.60 ± 1.20	0.75	0.463
		Married	172	3.86 ± 1.21		
	Informant category	Key informants	48	4.90 ± 1.13	-0.25	0.013*
		General informants	198	4.26 ± 1.43		
Debre Elias	Gender	Male	111	2.92 ± 1.40	4.43	0.0003*
		Female	37	1.90 ± 1.10		
	Age	18-29	47	3.56 ± 1.12	9.42	0.007*
		≥ 30	101	3.90 ± 1.37		
	Literacy level	Literate	89	2.66 ± 1.22	1.62	0.002*
		Non- educated	59	2.56 ± 1.71		
	Marital status	Single	51	2.28 ± 0.60	0.44	0.230
		Married	97	2.82 ± 0.95		
	Informant category	Key informant	36	4.54 ± 0.91	0.40	0.001*
		General informants	112	4.15 ± 0. 80		

4.8.2. Knowledge acquires, transfers, and tools used for collection and collection time

4.8.2.1. Knowledge acquired and transfer

Concerning how IK in traditional herbal medicine was obtained, most of the informants acquired knowledge either from their parents, ancestors, intimate friends and partners (husbands and/or wives), whereas few of them (especially few key informants) gained their knowledge from reading Geez related manuscripts such as “Etse-debdabe”. Furthermore, few of the key informants reported that they move from one place to another place in Ethiopia and elsewhere, such as Sudan to search for herbal knowledge and in the meantime attend their informal education.

Some traditional healers are popularly recognized as ‘debtera’. Here, there is no sharing of medicinal plant knowledge to the local community only restricted to the traditional education attendants (‘debtera’). The healers are good enough to bring about healing if they are attached to the spiritual aspects of the healers in the form of ‘digam’ (spiritual healing), using plants and/or their parts.

The healers kept the information more and more top-secret for many reasons. One reason was to prevent information from theft. The second was fear of insult emanating from the community. Still, others assumed that many individuals know the information, then the curative power of the plant will be reduced. In some other cases, the healers' livelihood depends on the income generated from the selling of the remedies. Thus, knowledgeable individuals run their own business by hiding the information. However, the most important way of transfer of IK on types of use of MPs, mode of preparations, the way of administration, traditional idea of disorders, methods of diagnosis and handling among local herbal practitioners of the community was by word of mouth to family members.

The result further revealed the present local knowledge transfer system followed the inheritance-based transfer system where most traditional healers pass their knowledge to the elder (son/ daughter), particularly for the male ones. The selection of the individual for the passing of information was based upon his/her good conduct and competence to keep the secret relating to the ethnobotanical plant use knowledge.

4.8.2.2. Tools used for collection and collection time

Selected tools were used for the collections of plant species. Cutting the plant parts with a horn-handled knife and, digging and/or cutting the plant materials with olive-handled axe, hoe and other sharp apparatus were the most commonly used ones. Neatness is a very important issue during collection. For example, the individual should avoid having sex before gathering the herbal medicines.

The highly traditional knowledgeable informants indicated that Wednesday and Friday were the most preferred days of the week for the collection of remedies. They collected the herbal medicines in the early morning or at evening by hiding themselves. Before and after gathering the plant species, local healers will not speak to anyone until they have finished their activity. Some informants informed that plants lose their healing power if the parts of the collected materials were stayed and stored for a long period. Thus, they collected plant materials just after the end of PAGUME (at the beginning of the new academic year, September). Thus, new and fresh plant materials were found essential for the treatment of ailments jus in the New Year.

4.9. Threats and Conservation of Medicinal and WEPs, and Associated IK

The data collected through focus group and individual discussions with 10 key informants indicated that the most mentioned threats to useful plants of the study area were agricultural expansions (Table 45). Overgrazing, firewood collection and material culture had also effects in threatening the medicinal, wild edible plants and associated IK of the ethnobotanical community [Table 45; Figure (A-D) 23]. Following Abay gorge, patches have been converted into agricultural lands due to sesame cultivation and gum-resins production. Many grazing fields and forest patches

were also converted into cultivated land for crop productions. Though deforestation for material uses was one of the anthropogenic threats, the diverse plant resources (like spoons, brooms, and various hand and farm tools) and linked knowledge are important for the survival and livelihoods of the people (Figure, 23-D).

Table 45: Ranking of key threats on useful plants (values 1-5: 1 = the least destructive and 5 = the most destructive)

	Respondents (A-J)												
Threats	A	B	C	D	E	F	G	H	I	J	**Total**	%	**Rank**
Agricultural expansion	5	4	4	3	4	4	5	4	5	4	42	19	1st
Overgrazing	4	4	5	4	3	3	5	3	4	4	39	17	2nd
Firewood collection	3	3	4	3	4	5	4	4	2	4	36	16	3rd
Material culture/Tools	4	4	3	4	2	3	4	3	3	2	32	14	4th
Construction/building	3	3	2	4	4	3	4	3	1	1	28	12	5th
Furniture	4	2	3	2	2	3	3	2	3	2	26	12	6th
Charcoal making	3	2	3	3	3	3	2	2	1	2	24	11	7th
Total											**227**	**100**%	

In this study, threats that erode IK were caused by secrecy, oral-based knowledge transfer and unwillingness of young to gain the knowledge, influence of modern education and awareness factors. The focus group discussions showed the medicinal knowledge of the local community, especially the young age group, has diminished from time to time. They had also agreed modernization affects the young generation is not to be interested in herbal remedies and mostly, knowledgeable individuals passed away before they transfer their knowledge to the young.

In the study area, irregular remnants of aged dry Afromontane evergreen forests mainly around the Ethiopian Orthodox Tewahido Churches (for example, Hawariat), monasteries (like Saint Selassie, Michael and Tekile Haimanot), Mosques (in Yejube town), gorges, and inaccessible areas are contributing much a lot to the conservation of medicinal and other useful plants. Most important

species such as *Juniperus procera*, *Vernonia amygdalina*, *Draceana steudneri and* and Ficus spp. were preserved in and around various places of worship.

The indigenous people have carried out very few management practices in the home-gardens in and around the forest patches. Few traditional healers in the study area have brought the different curative plants and other cultivated plants from different corners and started to conserve the plants in the home-gardens. The plants under this category were *Allium sativum*, *Artemisia abyssinica*, *Foeniculum, vulgare*, *Lippia adoensis* var. *adoensis*, *Nicotiana tabaccum*, *Ocimum lamiifolium*, *Ruta chalepensis*, *Rhamnus prinoides* and *Verbena officinalis*. Management practices like inter-cropping and crop rotation were also observed among few farmers in the study area. In so doing, herbal remedies continue to exist because of the existence of other plant species. Therefore, the local people have incredible contributions for the conservation of useful plants. However, the attempts regarding to the conservation was weak.

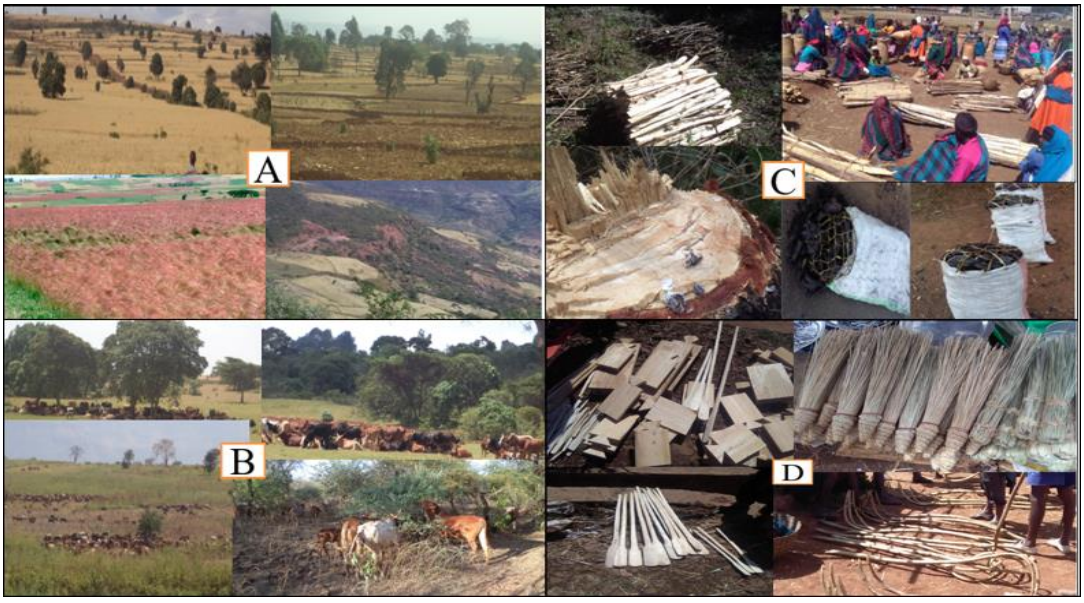


Figure (A-D) 23. Anthropogenic view of disturbances (Photo taken by Nigussie Amsalu, 2017) (A = Agricultural activity; B = Overgrazing; C = Charcoal and firewood production; D = Material use).

CHAPTER FIVE

5. DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1. Discussion

5.1.1. Vegetation of the study area

5.1.1.1. Vascular plant species composition and species level diversity in forest patches

In the present study, 355 plant species have been collected and identified from the entire two districts. Furthermore, results confirmed that forest patches were composed of rich species level plant diversity with 317 vascular plant species. This is because the remnant forest patches were found to be within the Eastern Afromontane hotspots (Mittermeier et *al*., 2011). The observed rich plant species of the patches could also be related to topographic heterogeneity. One hundred thirty-seven of the total recorded species have been mentioned to have remedial properties for various ailments. This further shows that forest patches are the living 'pharmacies' of indigenous societies. The finding shows the pattern reported for most tropical forests in serving as sources of vital traditional MPs and as the basis for at least 25% of modern drugs (Jin-Ming *et al*., 2003).

Results also verify that the forest patches had higher species richness (130 woody species) than some other forests in DAF like Amba Mariam Forest (81 species) (Abyou Tilahun *et al*., 2011), Tara Gedam (111 species) and Abebaye (88 species) (Haileab Zegeye *et al*., 2011), Sesa Mariam Monastery (113 species) (Birhanu Wolde *et al*., 2015); Awi Forest patches (122 species) (Abiyot Berhanu, 2017), and /or Kuandisha Afromontane Forest (66 species) (Abiyot Berhanu *et al*., 2017).

In fact, it is very difficult to compare the species richness of an area with many others. This is because there could be a difference in forest size, sampling size, data collection methods and objectives of the given studies. Thus, the species richness of the forest patches is not poor even though the number of species is less than and/ or greater other Ethiopian forests. In this perspective, Tamrat Bekele (1993) has shown that the forests in southwest Ethiopia are species rich and start to decrease in the north.

In the floristic composition, the most dominant family was Asteraceae followed by Fabaceae and Poaceae. The families' top-dominant position is due to their efficient pollination and successful seed dispersal mechanisms that might have adapted them to a wide range of ecological conditions in the past. The dominance of the families is in line with the assessment results of their dominance in the Flora of Ethiopia. For example, Fabaceae, Poaceae and Asteraceae were the top three taxa (Ensermu Kelbesssa and Sebsebe Demissew, 2014). Asteraceae and Fabaceae were also reported as the most important dominant families conducted in (Haile Yineger *et al*., 2008; Mesfin Tadesse *et al*., 2008) from different floristic studies of the country.

Results show herbs were the dominant growth forms in the forest patches. The dominance of herbs was an expected concurrence as the survival strategy and thus habitat occupancy of the study area. The high number of herbaceous species richness could also be attributed to the opened canopy cover of the forest patches. This concurs with similar patterns of the dominance of herbaceous species in other Ethiopian Montane forests (Ermias Lulekal *et al*., 2008; Fekadu Gurmessa *et al*., 2013).

In the study area, the overall Shannon diversity index and evenness were 3.13 and 0.98, respectively. The highest Shannon index was observed in Genetna Akababiw Forest patch followed by Elias Zuria (Debre Elias District), and Hawariat Church-Monastery in Baso Liben District. In comparison, the least alpha diversity index was recorded for Abragit in the latter District. The disparity in diversity is possible because of heterogeneous edaphic characteristics and climatic differences that exist among the remnant forest patches.

The value was found to be higher than that of the overall diversity index of other Ethiopian dry evergreen Afromontane forests such as Abebaye, Tara Gedam (Haileab Zegeye *et al.*, 2011), Zengena (Desalegn Tadele *et al*., 2014), and Kuandisha (Abiot Berhanu *et al*., 2017). The Shannon diversity index value was lower than Zegie (Alemnew Alelign *et al*., 2007), and forest patches in Awi (Abiot Berhanu, 2017). The Shannon index values above 2 is an indication of medium to high diversity (Barbour *et al.*, 1987). Nevertheless, a lower diversity index is commonly related to high disturbance (Maguran, 1988).

Shannon evenness values were also comparable order with little variations, however, the highest is being for Genetna Akababiw followed by Debre Elias Zuria Forest patches in Debre Elias District. This finding demonstrated better species evenness in the remnant forest patches than the overall evenness in Chilimo (Tadesse Woldemariam *et al*., 2000), Tara Gedam and Abebaye forests (Haileab Zegeye *et al*., 2011), showing a relatively much more fair distribution of individuals among various species in the study areas. The variation could be associated with anthropogenic determinants.

5.1.1.2. Conservation status of endemic species in forest patches

The present study reveals that twenty-two endemic species were found in the forest patches of the study districts. High endemism in this study area may be because of the forest patches of the area are located in different agroecological zones and undulate areas of Abay Gorge. The study area harboured high number of endemic species as compared to other DAF Forests such as Amba Mariam, Tara Gedam and Kuandisha forests (Abiyou Tilahun *et al*., 2011; Haileab Zegeye *et al*., 2011; Birhanu Wolde *et al*., 2015; Abiyot Berhanu *et al*., 2017). This documentation clarifies that endemicity is high in the dry Afromontane forests. Endemic taxa and their status to the Flora area were identified following the FEE volumes (Vol. 1-8) and Vivero *et al*. (2005). Taking into account the facts, a forest patch with high richness and a high level of endemic, rare, or threatened species has priority attention for conservation.

5.1.1.3. Plant community types and species diversity

Cluster analysis of the data on floristic composition of the forest patches resulted in five different plant community types. Diversity indices provided important information in relation to rarity and commonness of species in a community and it is the most important aspect of plant distribution. Based on the outcome of the Shannon-Wiener diversity index analysis, the highest species richness (including medicinal and WEPs), and diversity index and evenness were found in community 1 as compared to the other four communities. On the other hand, community 5 had the least alpha diversity and evenness amongst the plant communities. In general, results of the Shannon-Wiener diversity index (H') of each community type in Baso Liben and Debre Elias remnant forest patches confirmed high species diversity. Kent and Coker (1992) have shown that the values of Shannon diversity index differ between 1.5 and 3.5, and occasionally exceed 4.5.

The number of plots and/or size could affect the species richness and diversity of each community type. The mixed community type (large number of plots from both districts) may partly be attributed to high rainfall pattern that would have resulted in a large number of species. The other expected reason why community 1 had the highest species richness and a diversity index is less to disturbances, grazing and firewood collection in the patches. High diversity of species in less disturbed areas could also be attributed to open canopies created by anthropogenic interference, which promotes the establishment and growth of forest floor species especially the herbaceous ones. This finding confirms the study has been conducted those by Shrestha *et al.* (2012) in Nepal that plant species diversity increases with human-induced disturbance but up to a certain level of disturbances.

In comparison, the least number of species was relatively associated with high disturbances including over-grazing, exhaustive agricultural practices, cutting of woody species for different material uses and roads crossing the plots in community 5 (Baso Liben District). The number of plots are small (all are from Abragit) that could result in low number of species. Therefore, the species richness of the forest patches depends on the number of species per unit area. In addition, this community is found near Abay River (lower altitude) which is characterized by low precipitation that in turn results in low number of species. The lower Shannon evenness indicates the dominance of few plant species in the area (Feyera Senbeta, 2006).

5.1.1.4. Vegetation Structure

Frequency and relative frequency

Results of this study indicated that the largest proportions of species were distributed in the lower frequency class in all community types. Hence, *Croton macrostachyus* was found to be the most frequent species in the forest patches. Although the frequency value varies from patch to patch, *C. macrostachyus* followed by *Carissa spinarum*, *Acacia abyssinica* and *Maytenus arbutifolia* were the most frequent woody species in the six forest patches. According to Tamrat Bekele (1993) and Friis *et al*. (2011), *C. macrostachyus* and *Bersama abyssinica* were the most frequent pioneer species in disturbed parts and forest edges of DAF elsewhere. On the other hand, the least frequent species were *Albizia grandibracteata*, *Debregeasia saeneb*, *Ficus ingens* and *Psydrax schimperiana*. This suggests that the species encountered in a few sample plots. The relative frequencies of the woody species were also comparable orders as their frequencies. In fact, frequency provides an estimated indication of the homogeneity of the stand under consideration (Kent and Coker, 1992).

Density and Relative Density

There were 13 most abundant species with abundance value of above 130 individuals were documented. *Carissa spinarum* with 483 individuals and a density of 131 stems ha^{-1} was the most abundant species followed by *C. macrostachyus* the second abundant species with 365 individuals with 99.18 stems ha^{-1} density. The density of individuals per species varied from species to species. This variation could be associated with the highest anthropogenic influences because of the highest human population in the later district. The variation could also be dependent on the age of the forest patches, habitat preferences of the species and environmental factors.

In this work, the total density of woody species was substantially lower than other forests like Zege Peninsula, Tara Gedam, Sesa Mariam Monastery, Awi and Kuandisha Forests in DAF (Alemnew Alelign *et al*., 2007; Haileab Zegeye *et al*., 2011; Birhanu Wolde *et al*., 2015; Abiyot Berhanu, 2017; Abiyot Berhanu *et al*., 2017). The composition of the leading abundant species was also different from such forest patches with the exception of *Croton macrostachyus*, *Maytenus arbutifolia* and *Bersama abyssinica*, which are pioneer woody species in disturbed sites, secondary forests and forest edges (Tamrat Bekele, 1993; Abiyot Berhanu, 2017; Abiyot Berhanu *et al*., 2017).

Basal Area (BA)

The total BA of woody species in forest patches was high (75 m^2/ha) as compared to BA 15 $m^2 ha^{-1}$ found in Kuandisha forest of northwestern Ethiopia (Abiyot Berhanu *et al*., 2017). On the other hand, the BA of the present study was low as compared to BA 102 $m^2 ha^{-1}$ in Wof-Washa forest of Shewa in central Ethiopia (Tamrat Bekele, 1993); 115 $m^2 ha^{-1}$ in Tara Gedam forest (Haileab Zegeye *et al*., 2011); and 95 $m^2 ha^{-1}$ in Sesa Mariam Monastery (Birhanu Wolde *et al*., 2015) DAF forests in northwestern Ethiopia. The BA indicated that the forest patches were dominated by comparatively few species. Floristic researches conducted on DAF Forests elsewhere in Ethiopia recorded a similar observation with the most common species dominating the forests.

The highest BA of *Croton macrostachyus* followed by *Juniperus procera* and *Acacia abyssinica* could be due to higher density and suitable microclimatic and other related edaphic conditions in the area. Plant species with the high BA could be considered as the most important woody species

in the forest patches. Related to this, Tamrat Bekele (1993) enumerated that BA provides a better measure of the relative importance of tree species than simple stem counts. Furthermore, the variation in BA of various species may be due to the presence or absence of high number of individuals having bigger girth which contributes to the higher BA (Bharali *et al*., 2011).

Important value index of the forest patches

In view of the important value index (IVI), many woody species were reported as the most important ones in the study area. The most important species with the highest IVI indices recorded were *Croton macrostachyus* followed by *Acacia abyssinica*. This is because the species had a high relative dominance and abundance of a given species in comparison to other species in the study area. The IVI is a good indication of woody species that are very important in the floristic composition of a given forest (Aigbe *et al*., 2017). Yet, the total important values of 130 woody species were low as compared to other remnant forests in the DAF (Haileab Zegeye *et al*., 2011; Birhanu Wolde *et al*., 2015; Abiyot Berhanu, 2017; Abiyot Berhanu *et al*., 2017). This might be the area is under high threats due to anthropogenic factors.

5.1.1.5. Population structures of representative woody species

Results from population structure analysis of the most common woody species revealed that four representative patterns of density distributions were found under the forest patches. The first pattern was illustrated by a bell-shaped (such as *Tamarindus indica*). Most species under this pattern were removed for different purposes such as firewood, charcoal, animal fodder, live fences, walking stick and hand tools. This shows that selective elimination of individual trees with lower and higher DBH classes was observed, whereas populations in the middle classes were well

represented. Such kind of pattern has been rarely reported in the DAF (Desalegn Tadele *et al.*, 2014) and MAF (Feyerea, 2006) vegetation types.

The second pattern was Inverted J-shaped (for example, *Anogeissus leiocarpa*), which is usually a marker of the healthy population status of a species as reported by Feyerea (2006) and Abiyot Berhanu *et al*. (2017). In this distribution pattern, most of the individuals are in the lower diameter class, the number is sequentially declining, and thus, the higher classes have few individuals.

The third J-shaped pattern was exemplified by *Juniperus procera* with the distribution of a highly disturbed forest in the forest scrap of Church-Monastery in Baso Liben District. This pattern lacked individuals at lower and intermediate DBH classes but the number steadily increases to the upper classes (highest DBH classes). This J-shaped population distribution is an indicator of a highly disturbed forest with poor reproduction and selective removal of individuals with lower DBH classes was reported in (Tamrat Bekele, 1993; Feyera Senbeta, 2006). The fourth pattern is broken reverse-J-shaped as in *Acacia abyssinica* that was recorded in most of the forest patches.

Most of the species had high number of individuals at lower DBH classes with a gradual decline towards the upper DBH classes. Such type of population pattern suggests good regeneration status. This could also be due to selective removal of mature individual trees for building and other purposes (firewood, charcoal, live fence and timber). The analysis structure of each woody species gives a piece of information that can be used for conservation measures.

5.1.2. Ethnobotany of medicinal plants

5.1.2.1. Taxonomic diversity of medicinal plants

The Ethiopian flora is believed to contain about 1,000 identified and documented medicinal plant species (Mander *et al*., 2006; Zemede Asfaw and Tigist Wondimu, 2007). In this study, 172 medicinal plant species were documented as being used for the treatment of various human and livestock ailments. These huge numbers of MPs and their uses in the local community revealed the depth of the IK of traditional MPs and their wide applications. The high number of species recorded from the two study districts, which is comparatively high and will provide further support for the documentation made by Mander *et al*. (2006), Zemede Asfaw and Tigist Wondimu (2007).

Of the plant families, Asteraceae had the highest medicinal plant species followed by Fabaceae and Solanaceae, for the treatment of various health conditions. Asteraceae and Fabaceae are also the top two endemic-rich families in FEE (Vivero *et al*., 2006). However, there is no endemic family in the Flora area (Ensermu Kelbessa and Sebsebe Demissew, 2014). On the other side, herbs were found the leading growth forms for remedy preparations in the study districts. The frequent use of the herbs among the local communities might be because these growth forms are better available in nearly all rainy seasons. Studies somewhere in Ethiopia also showed that most medicinal plants are herbs, followed by shrubs and trees (EBI, 2014).

5.1.2.2. Diversity of human medicinal plants

The local people in the study area use diverse plant species for the treatment of various human ailments. This shows that many plant species were claimed to be used for the traditional medicinal

purposes by the local community. Comparatively, the local community in Baso Liben used many MPs than the community in Debre Elias. This might be because the larger number of informants mentioned a fairly greater number of MPs in Baso Liben.

Most of the MPs used to treat human ailments were collected from the wild (mainly from the six-remnant forest patches) by the local people of Baso Liben and Debre Elias districts where they are at risk of overharvesting. Thus, forest patches were reported to have traditional herbal medicinal uses. This is because the remnant patches harbour many plant species. Similarly, various studies conducted in Ethiopia and elsewhere reported as the majority of MPs harvested from wild (Ermias Lulekal *et al*., 2008; Fisseha Mesfin *et al*., 2009; Amri and Kisangau, 2012; Ermias Lulekal *et al*., 2013; Moa Megersa *et al*., 2013; Beltran *et al*., 2014; EBI, 2015). On the other side, the findings revealed that relatively many MPs were also obtained from home-gardens. It reflected that home-gardens are important sources of MPs. This in turn indicated that the people and the local healers have started cultivating MPs in their home-gardens. Similar results were reported in (Zemede Asfaw, 2001).

In this study, most of the ethnomedicinal plant species were belonging to Asteraceae. After Asteraceae, Fabaceae, Solanaceae, Lamiaceae, Cucurbitaceae, Euphorbiaceae and Poaceae were known to contain a high number of medicinal species. This is also further confirmed by regular recording of ethnomedicinal uses of species from the above-mentioned families in various other Ethiopian ethnobotanical studies (Haile Yineger *et al*., 2007; Fisseha Mesfin *et al*., 2009; Mirutse Giday *et al*., 2010; Ermias Lulekal *et al*., 2013; Alemayehu Kefalew *et al*., 2015). In Arab countries like Jordan, the families Asteraceae and Lamiaceae were represented by a large number of

medicinal plant species (Oran and Al-Eisawi, 2015). Most of the dominant families were also mentioned in other ethnomedicinal studies in Tanzania, Africa (Amri and Kisangau, 2012), and in Peru, South America (Bussmann and Sharon, 2006; Polesna *et al*., 2011).

The presence of various growth forms of plants indicated that the use and access to herbal medicines were likely to be high among the Amhara people. Of the different growth forms of the reported MPs used to treat human ailments, herbaceous forms were dominant in both districts. This study confirmed that herbs were the largest species in number. As already stated, this is because the herbs exhibit a high level of abundance, distribution and easy access to the healers. The results agreed with the findings of other local researchers including that of Mirutse Giday *et al*. (2003), Tilahun Teklehaymanot and Mirutse Giday (2007) and Ermias Lulekal *et al*. (2013). In contrast, the findings of Mirutse Giday and Gobena Ameni (2003), Ermias Lulekal *et al*. (2008) and Fisseha Mesfin *et al*. (2009) revealed that shrubs are the most commonly used growth forms in their respective different study sites of Ethiopia. However, in another study, trees were found the most widely used growth forms followed by herbs (Kipkore *et al*., 2014).

5.1.2.3. Different human ailments treated by each plant species in the study area

Based on my personal observation, the informants were more serious when they collected ethnomedicinal plants for the treatment of ailments. The ethnobotanical study of MPs in the study areas indicated that many herbal medicines were used to treat various human ailments. For example, wound, abdominal colic, acute febrile illness, snakebite, toothache and coughing were the most commonly reported human health disorders treated by a large number of MPs. Likewise,

the various cultural communities in the coastal areas, Kenya have been reported to use many ethnomedicinal plant resources to handle various health complications (Wekesa *et al*., 2015).

The results further indicated that the number of ailments treated by each plant species differs from plant species to plant species. For instance, *Allium sativum* was the most frequent and/or important species that is used to treated 10 various ailments. This in turn shows a specific plant species was used to treat a large number of ailments. This diversity of action of a given plant species could be explained based on the site of action, dose of the constituent and the various constituents it may embody (Dawit Abebe *et al*., 2003). In other studies, 67 plant species for the handling of 52 human ailments in Zegie Peninsula, Northwestern Ethiopia (Tilahun Teklehaymanot and Mirutse Giday, 2007); 114 plant species for 47 human ailments in Kilte Awulaelo District, Tigray, Northern Ethiopia (Abraha Teklay *et al*., 2013) were reported.

5.1.2.4. Plant parts used, modes and conditions in remedy preparations

The most commonly harvested plant parts were leaves followed by roots in the study area. This shows that leaves were reported to be the topmost used part of the plant species for herbal preparations. The choice of leaf as herbal medicine by the study community was also because of its availability and easier for collecting, storing, processing and handling. Similar results were reported in different ethnobotanical studies in Ethiopia (Mirutse Giday *et al*., 2003; Mirutse Giday and Gobena Ameni, 2003; Haile Yineger and Delnesaw Yehuwalaw, 2007; Moa Megersa *et al*., 2013; Nigussie Amsalu *et al*., 2018) and elsewhere (Macía *et al*., 2005; Togola *et al*., 2005; Amri and Kisangau, 2012).

In India, it was also reported that the ease of access to leaves clarifies their frequent inclusion in most of the preparations (Singh and Lal, 2008). In European countries, it was reported as: if the leaves were a key factor in the identification of plants, and of frequent and easy access, it would be more used than other plant organs (Akerreta *et al*., 2007). In contrast, roots were found to be the most important plant parts reported elsewhere in Ethiopia (Dawit Abebe and Ahadu Ayehu, 1993; Getachew Addis *et al*., 2001; Ermias Lulekal *et al*., 2008; Fisseha Mesfin *et al*., 2009 and Alemayehu Kefalew *et al*., 2015).

Luckily, the plant parts, which are mostly used for the preparations of the remedies in the study area, were leaves, and harvesting of leaves has less influence on the plant than the gathering of roots. However, gathering roots possess a higher risk to the existence of a given species as compared to the use of fruits/seeds or any other parts. In general, the use of the plant parts for remedial purposes also varies from one country to another; for example, in Peru (South America), the bark of the trunk was the most frequently used materials, followed by the entire plant (Polesna *et al*., 2011).

The results showed that most of the herbal remedies have been prepared from fresh parts about traditional MPs in the study community to treat human ailments. This is because the ingredients may be lost or reduced when the plant species become dry. The common use of fresh materials was also noted in other parts of Ethiopia (Mirutse Giday and Gobena Ameni, 2003; Tilahun Teklehaymanot and Mirutse Giday, 2007; Haile Yineger *et al*., 2008; Mirutse Giday *et al*., 2009; Moa Megersa *et al*., 2013; Nigussie Amsalu *et al*., 2018).

Based on the informants' information, most of the collected MPs were prepared in the form of decoction followed by cold infusion. These two forms of preparations were assumed to be the best of human traditional herbal preparations. The most common medium for the preparations of herbal medicine was water. As to the local healers, the harder plant parts must be decocted and /or boiled in water, whereas the softer prepared in the form of cold infusion.

It also was reported that decoction is one of the leading techniques of remedy preparation in the ethnobotanical study of some ethnic groups in Ethiopia (Haile Yineger *et al*., 2007; Ermias Lulekal *et al*., 2013; Getu Alemayehu *et al*., 2015). It was asserted that the decoction is generalized and less carefully selected plant parts are used, which are normally boiled for a long time for human ailment treatments (Benítez *et al*., 2012). However, Dawit Abebe (1986), Haile Yineger and Delenasaw Yewhalaw (2007), and Ermias Lulekal *et al*. (2008) have reported the common use of concoctions in the respective study areas. In Tanzania, the majority of the plant remedies were prepared by boiling, followed by crushing or pounding (Amri and Kisangau, 2012).

5.1.2.5. Routes of administration, dosage determination, side effects and antidotes

It was found that the local community of the study area reported using various ways of remedy administration with different occurrences to treat human ailments. This could be related to the location, condition and types of ailments to be treated. The most significant prescriptions were mainly through oral routes, followed by dermal. A similar route of administration was practiced in each district. This oral route of administration is in agreement with the findings of (Moa Megersa *et al*., 2013; Getnet Chekole *et al*., 2015; Alemayehu Kefalew *et al*., 2015; Nigussie Amsalu *et al.*,

2015) who reported that the leading route of administration used by the specified local community in their own study areas of remedies was taken orally.

In this study, many herbal medicines were reported as safe and many of them were used as nutraceutical plants. Even if some reported medicinal plants have side effects, they are effective for the treatment of various human ailments. To avoid such side effects, antidotes such as milk, milk products, honey, coffee or local beers were commonly used in the study area. This shows that local communities are becoming aware of the use and side effects of herbal medicines. However, the medicinal properties of many traditional plants have been scientifically confirmed in nearly two decades of years. For example, *Hagenia abyssinica* and *Glinus lotoides* were used for the treatment of tapeworm, whereas *Phytolacca dodecandra* was employed as a molluscicide in the handling of schistosomiasis are plant species from Ethiopia which have been verified as effective and safe (Russo, 2000).

Furthermore, many herbal materials that are used in Ethiopian TM are also used as ingredients and spices in Ethiopian food. Related to doses, other studies confirmed that children are given less than adults, such as one-fourth of a coffee cup, whereas an adult is given up to one glass depending on the illness and treatment (Amare Getahun, 1976). Correspondingly, Dawit Abebe (1986), and Mirutse Giday and Gobena Ameni (2003) reported a lack of precision and standardization drawbacks to recognize the traditional healthcare system. It was further noted depending on the dose and to some degree on the age of the patient; a range of drugs could have various effects, including those that are completely opposite (Dawit Abebe and Ahadu Ayehu, 1993). The dose of herbal medicine is also measured in many ways including tea, or coffee cups (i.e., small for

children, and large-sized for young people) (Alemayehu Kefalew *et al*., 2015). In contrast to this, in Jordan, nothing is documented in an appropriate way (Oran and Al-Eisawi, 2015). If you just ask about the use of certain plants, the community in the central mountains of Jordan will say take a little and boil in water and drink.

On the other hand, it was stated that a large human population in developing countries remain highly dependent on plant resources for healthcare because conventional medicine can cure a variety of ailments, but its high prices and occasional side-effects are causing many people to return to herbal medicines which have fewer side effects (Kala, 2005). Furthermore, Agrawal (2005) noted that the use of herbal remedies is becoming increasingly popular because of the toxicity and side effects of allopathic medicines and that this has led to an unexpected intensification in the number of herbal drug manufacturers. In contrast to the previous authors, Ullah *et al*. (2019) described people living in Pakistan using herbal medicines without looking at their potential toxicological effects. The same authors have shown that the scientific validation of MPs mainly based on their traditional use is a very promising approach.

In the study community, additives such as sugar, honey, coffee and garlic help to reduce the bitter taste of the herbal remedy and ensure the intake of a complete dosage of medication. Haile Yineger and Delenasaw Yewhalaw (2007) in Sekoru District, Jimma Zone of southwestern Ethiopia, also reported the different additives in remedy preparation. In Kenya, the different plant parts are boiled or merely soaked in water and the decoction taken alone, or in some occasions combined with honey, soup, or milk if the decoction is from a bitter plant (Kipkore *et al*., 2014).

5.1.2.6. Compositions of ethnomedicinal plant preparations in the study area

A wide category of plant parts was used for remedial purposes and reports of the dominant parts were mixed. The findings showed that some remedies were prepared from over one species, which were used to treat above one ailment. The informants believed that these mixed remedies were effective for the treatments of ailments. Bussman and Sharon (2006) noted that this might be attributed to the additive or synergistic effects of the plants. Other studies conducted by Macía *et al*. (2005) in Bolivia and Togola *et al*. (2005) in Mali have shown that most remedies were prepared from a single plant species.

It is also known that traditional herbal medicinal products usually contain over one plant or active constituents, and a single compound does not provide their therapeutic efficacy. In a study on the treatment of female reproductive health conducted in Tana River County, Kaingu *et al*. (2013) illustrated that more than one-third of the therapies were prepared by mixing the main parts of the given plant species with those of one or more spp. In contrast to this study, all plant species are used alone with the exception of few mixes have been identified, such as the use of garlic (*Allium sativum*) and verbena (*Verbena officinalis*) in the production of poultices, or the use of garlic in preparing ointments (Akerreta *et al*., 2007). Here, the most important species (*A. sativum*) frequently used in the study area also reported in another region, where its cloves are eaten as raw by diabetes patients to control blood sugar and cholesterol (Ullah *et al*., 2019).

5.1.2.7. Rankings, comparisons of medicinal plants and their potential for treating ailments

In terms of preference ranking, the result indicates that *Withania somnifera* is much favored in treating wounds followed by *Euphorbia abyssinica* and *Malva verticillata*. The present study

verified that every community has its own species preference. Preference rankings were also computed in (Ermia Lulekal *et al*., 2008; Nigussie Amsalu *et al*., 2018). Still, within a particular community, respondents' species preferences appear to vary a little through age groups and across districts or areas.

The results suggest that pair-wise comparisons of a few species were more preferable than few other plant species by the local community against similar ailments. For example, *Verbena officinalis* was the most preferable species against abdominal colic compared to some other MPs. In other region, *V. officinalis* was also used in traditional medicine as cough medicine, and anti-rheumatic (diseases of nerves, bones, muscles and tendons), and anti-inflammatory substances (Akerreta *et al*., 2007). Following comparable comparisons, *Laggera tomentosa* was also found the most important species followed by *Acmella caulirhiza* for the treatment of tooth infection. This is because of the effectiveness of the plant from the point of view of the indigenous people of the study site. Likewise, the latter two species were reported in (Nigussie Amsalu *et al*., 2018). The results disclosed that tooth infection was the most common disease cited in the study area and that local inhabitants use many remedies to cure this infection.

The results of the paired comparison showed the preference of ethnomedicinal plant species of the local community of the study area to treat particular ailments. This noticeably implies that the local community preferences of a particular species against a particular ailment were expected elsewhere in Ethiopia. A study conducted in Ethiopia, pair-wise comparison/rankings were based on individual choices (Getu Alemayehu *et al*., 2015).

Many MPs were found to be used for diverse purposes besides their medicinal values. The major uses included firewood, furniture, forage, charcoal and edible. In this regard, Zemede Asfaw (2001) confirmed that some MPs in Ethiopia have additional use-values such as food, spices, condiments, construction and cultural values. In view of that, the direct matrix ranking showed that *Tamarindus indica* was found the most threatened species. In Mana Angetu District, southeastern Ethiopia, direct matrix analysis was done to identify the most used and threatened species (Ermias Lulekal *et al*., 2008).

The handling of various types of diseases by the herbal healers was categorized into 11 categories, and the ICF values for each category were given in the study area. Gastro-intestinal and dermatological illnesses are often pointed out in these ethnomedicinal studies. Thus, in Baso Liben, the most prevalent diseases were related to digestive/gastro-intestinal disorders followed by dermatological diseases, whereas the reverse is true for Debre Elias District. In a similar study of Western Pyrenees, dermatology is found the most frequently cited category, followed by those categories related to gastro-intestinal problems and the respiratory tract (Akerreta *et al*., 2007).

The high ICF values show the usage of the same medicinal species by several healers in the two districts. These high ICF values obtained for the reported categories show the degree of shared knowledge for the treatment of each category of ailment, whereas low values indicated the disparity among healers (Heinrich *et al*., 1998). Furthermore, it was stated that common medicinal plant knowledge is consistent because people share therapies they have used and that were effective (Trotter and Logan 1986). The shared knowledge for ICF results was done in Ethiopia

(Tilahun Teklehaymanot and Mirutse Giday, 2007; Fisseha Mesfin *et al*., 2009; Alemayehu Kefalew *et al*., 2015).

The fidelity level (FL) values of top-cited species for the treatment of a specific disease varied from one disease to others. In Baso Liben, *Senna singueana* had the highest FL value followed by *Ruta chalepensis* against certain ailments such as snakebite and acute febrile illness, respiratory and gastro-intestinal, could be taken into consideration as an indication for the high healing potential of these plant species against the matching disease categories. *S. singueana* had also the highest FL value which treats snakebite and acute febrile illness followed by *Verbena officinalis* against gastro-intestinal disease in Debre Elias District. The FL is helpful for categorizing the healers' most preferred plant species used for the management of various ailments. Plant species with high FL values could be targeted for further phytochemical analysis to verify the bioactive components responsible for their high therapeutic potential (Trotter and Logan, 1986; Heinrich *et al*., 1998).

5.1.3. Ethnoveterinary plants in the study area

5.1.3.1. Diversity, habitat and growth forms of ethnoveterinary plants

In this study, a total of 81 (65 spp., Baso Liben; 57 spp., Debre Elias District) ethnoveterinary medicinal plant species were identified and documented for the treatment of fifty-three livestock ailments in the study area. These large numbers of herbal medicines and their uses in the local community revealed the depth of the local knowledge on traditional MPs and their applications. In a related study, Ermias Lulekal *et al*. (2014) have shown that the local people in the Ankober District have an age-old IK on the use of plants in the wild to treat different livestock ailments. A

study conducted elsewhere also revealed that the local people use the medicinal plants not only to cure various diseases but also for increasing body weight and milk production (Sunder *et al*., 2014).

As indicated in ethnomedicinal plants, the majority of ethnoveterinary plants were collected from the wild, and merely some were cultivated mainly for purposes other than medicinal. Similarly, various studies conducted in Ethiopia reported as most of MPs harvested from wild (Ermias Lulekal *et al*., 2008; Fisseha Mesfin *et al*., 2009; Ermias Lulekal *et al*., 2014; Moa Megersa *et al*., 2013). This is because natural habitats are far less disturbed than farmlands and thus encourage the growth of a high diversity of species in contrast to farmlands.

The family Asteraceae took over the highest share of the reported taxa, followed by Solanaceae and Lamiaceae. The domination of medicinal plant species belonging to the mentioned families may be attributed to their wider distribution and abundance in the Flora area (Mesfin Tadesse, 2004). This is also further confirmed by the regular recordings of ethnomedicinal uses of species from the above-mentioned families in other Ethiopian ethnobotanical studies (Mirutse Giday *et al*., 2010; Ermias Lulekal *et al*., 2013).

Growth form analysis indicated that herbs were represented by many species followed by shrubs and trees. The numbers of the growth forms of plant species were more or less proportional in each district. As stated in human medicines, herbs in ethnoveterinary plants also taking the top leading in the number of plants used in the preparation of therapies, which can be an indication of their fairly better abundance and easy to collect as compared to other growth forms. Mirutse Giday *et al*. (2003) and Ermias Lulekal *et al*. (2013) have also reported the dominance of herbs in their

respective study sites. This result contradicts those of Ermias Lulekal *et al.* (2014) and Fisseha Mesfin *et al.* (2009) who studied shrubs are the most commonly used habits in their respective various study areas of Ethiopia.

5.1.3.2. Types of livestock and most important livestock ailments treated by each plant species

The therapeutic indication of plant-based remedies in the study area covered all livestock species. The most frequently treated animals in the study area were cattle, sheep, goats, cows, poultry and pack animals. The remedies were more commonly used for the management of various ailments. In this study, the number of ailments treated varies from plant to plant species. For example, the informants reported that 14 MPs were documented for the treatment of leech infestation. The reported ethnoveterinary plants were also used by various local communities elsewhere in Ethiopia for the handling of the same and various ailments in livestock (Alemayehu Kefalew *et al*., 2015; Ermias Lulekal *et al*., 2014; Mirutse Giday and Tilahun Teklehaymanot, 2013). On the other hand, the most important species include *Echinops kebericho*, *Lepidium sativum*, *Vernonia amygdalina* and *Zehneria scabra* were reported to treat above four different ailments.

5.1.3.3. Plant parts used, modes and conditions for ethnoveterinary therapy preparation

Local communities apply various traditional treatments, including the use of different parts of medicinal plants, modes and conditions of preparations against livestock ailments. This study showed that the most commonly used part of plants were leaves, followed by roots which also coincides with human medicinal plants. This is because the collection of leaves was a simple labour intensive compared to roots. In relation to roots, the collection was very destructive.

In line with the present study, a study conducted by Mirutse Giday and Tilahun Teklehaymanot (2013) in the management of livestock health problems by Afar people of Ada'ar District, Afar Regional State, Ethiopian, indicated that leaf was the most frequently used part of plants followed by root. As mentioned above, the root is found to be the second most widely used plant part. However, in a comparative study, Ermias Lulekal *et al*. (2014) explained that harvesting of roots for therapy preparation is always accompanied with complete elimination of the respective medicinal plant from the natural environment has been observed in many cases posing challenges by affecting ultimate survival of the individual and ultimately the species.

It was indicated that various plant species were largely used through diverse herbal preparations. The most important form of remedial preparation in the study districts was infusion followed by extraction (such as latex). In this finding, the practice of infusion in herbal remedy preparation has also been reported from various cultural groups in Ethiopia (Haile Yineger *et al*., 2007; Ermias Lulekal *et al*., 2008; Ermias Lulekal *et al*., 2014) for the treatment of different ailments. The third-largest form of ethnoveterinary remedial preparation was decoction that is also the most frequently used method of preparation in human medicine for the same area. It has already been identified that the decoction process produces complete extraction of remedial compounds. A similar finding was also reported from other regions (Benítez *et al*., 2012), where infusion is the most commonly used method of preparation. This could be related to age-old traditional experiences on the proven efficacy of such herbal medicines.

The findings indicated that most of the herbal therapies have been prepared from fresh parts to treat livestock ailments. This is because using fresh materials could increase the efficacy as

compared to other conditions of preparations. The common use of fresh materials for the handling of different health problems was also illustrated in other parts of the country in (Mirutse Giday and Gobena Ameni, 2003; Tashale Sori *et al.*, 2004; Haile Yineger *et al*., 2008; Moa Megersa *et al*., 2013; Nigussie Amsalu *et al*., 2018).

5.1.3.4. Routes of administration and dosage determination in livestock

Respondents reported different routes of administration for the treatments of livestock ailments. Oral application was the most frequently used route of administration, followed by dermal and nasal in the respective districts. The highest number of plants taken through the oral route shows many internal livestock infections in comparison with external. Haile Yineger *et al*. (2007) in Bale Mountains National Park, Ethiopia reported similar results for an oral route of administration.

The dose of the ethnoveterinary preparations was not documented for most of the plant species. According to the informants, the dose might be increased or decreased depending upon the disease severity, size and body condition of the animal. Various additives like sugar, flour and common salt are being used in the study districts in preparing ethnoveterinary medicines. Based on the ethnobotanical information, for livestock treatments, the informants selected the dosages with less care as compared to human treatments. Nevertheless, it should be noted that some reported plants which are not used in human medicine are toxic or slightly toxic, a fact that may support the lack of use (Benitez *et al*., 2012).

5.1.3.5. Composition of ethnoveterinary plant preparation in the study area

The results showed that most of the remedies were prepared from a single medicinal plant species. However, twenty (25%) of the overall livestock MPs were prepared from more than one medicinal plant. In this regard, analysis of data on medicinal use diversity indicated that employment of a single species for a number of diseases is very common (Tigist Wondimu *et al*., 2007).

Herbal medicines prepared from over one species were also very important for the treatments of one and more than one ailment. Likewise, the healing efficacy of two or more herbal preparations used in other communities living in northwest Ethiopia (Dawit Abebe and Ahadu Ayehu, 1993) for handling various ailments were reported. Furthermore, Ermias Lulekal *et al*. (2014) in Ankober District, North Shewa Zone, Amhara Region, Ethiopia reported that using two or more MPs for treating livestock ailments might be attributed to the expected synergetic effect of combinations of parts and bioactive ingredients to treat ailments. In Spain just like other countries, veterinary medicine shows high specialization regarding the uses traditionally associated with each plant: most species used to treat just one particular condition, whereas with only 13 species used to treat over one health condition (Benitez *et al*., 2012).

5.1.3.6. Rankings, comparisons of MPs and their healing potential for treating ailments

In the present study, the result of the preference ranking exercise also indicated that *Lageneria siceraria* followed by *Nicotiana tabacum* was the most-preferred ethnoveterinary MPs used to treat leech infestation, the most commonly reported parasitic disease in the area. Results of the preference ranking exercise also indicated that *Nicotiana tabacum* and *B. polystachya* were the most-preferred ethnoveterinary MPs used to treat eye infection, which are the most commonly

reported diseases among the categories in the area. This may be attributed to the presence of bioactive compounds against leech and eye infection in these plant species. Therefore, the species should be further investigated in the laboratory for further activities and even for different ailments.

The result of the pair-wise comparison also indicated that *Lepidium sativum* is the most-preferred ethnoveterinary plant used to treat bloat, the second most commonly reported problem in the area. Following this, *Arisaema schimperianum* and *Vernonia amygdalina* ranked second and third respectively to treat the same disorder. Some studies made in Ethiopia using pair-wise ranking where informants made their choices individually include the works of (Getnet Chekole *et al*., 2015; Getu Alemayehu *et al.*, 2015).

Fidelity level (FL), as an estimation of healing potential, was determined for all reported ethnoveterinary medicinal plants. Accordingly, *Phytolacca dodecandra* and *Justicia schimperiana* were the plant species having the highest FL values (94% each) for their use to treat various livestock ailments in Baso Liben District. An increasing value of FL for a species indicates its uniqueness to treat a specific illness. However, in Debre Elias District, *Schinus molle* had the highest FL values (95%), followed by *Nicotiana tabacum* (94%) and *Lageneria siceraria* (92%) for the treatment of corresponding diseases. An increasing value of FL for a species indicates its uniqueness to treat a specific illness. Fidelity level (FL) was also calculated elsewhere in Ethiopia (Tilahun Teklehaymanot and Mirutse Giday, 2007; Haile Yinger *et al.*, 2008; Alemayehu Kefalew *et al*., 2015). Hence, these results would request pharmacological inquiries on these plant species as long as the high percentage of informants agreed on their healing values.

In relation to their ICF values, several important species were used for the treatment of various disease categories. In Baso Liben, the highest ICF score for external and internal parasites was 0.85. Twenty-three MPs with 152 citations were recorded to treat the parasites. Subsequently, dermatological and sensorial scored the second-highest value ICF with (0.77), followed by gastro-intestinal with (ICF = 0.76) and fever, evil eye and epidemic ICF value with 0.71.

On the other hand, the category with the highest ICF value was related to external and internal parasites, which score the highest value (0.82) was recorded in Debre Elias District. Twenty-four MPs with 120 citations were recorded to treat the problem. Dermatological and sensorial, and gastro-intestinal diseases were the second and third highest disease categories in the later district. Plant species scoring better ICF values are supposed to have better potency compared to plants with less informant consensus values (Trotter and Logan, 1986). Furthermore, this would indicate the relatively high healing potential of the species for treating ailments under the respective ailment categories (Heinrich *et al*., 1998; Ermias Lulekal *et al*., 2014). Heinrich *et al*. (1998) also described that high ICF values are used to select interesting plant species for the search of bioactive compounds.

5.1.4. Ethnobotany of wild edible plants in the study area

5.1.4.1. Taxonomic diversity

Species diversity of wild edible plants (WEPs) was found to be comparatively high in the study area. Fifty-two (52) wild edible plant species belonging to 44 genera under 35 plant families were considered by the local community as wild edible in the study area. Thirty-four of those

recorded species were reported as herbal medicines. This shows besides an indispensable component in the diets of man, the WEPs formed important sources of herbal medicine.

The family that had the most cited species was Moraceae with five species followed by Rosaceae with four species. Correspondingly, in Maale and Ari communities, Southern Ethiopia and Chilga District, northwestern Ethiopia, the family Moraceae was the most important species-rich family (Berhane Kidane *et al*., 2014; Mekuanent Tebkew, 2015). In contrast to this sub-topic, Capparidaceae, Tiliaceae and Fabaceae were among the dominant families constantly recorded in other ethnobotanical studies (Tilahun Teklehaymanot and Mirutse Giday, 2010; Assegid Assefa and Tesfaye Abebe, 2011). In line with Ermias Lulekal *et al*. (2011), Fabaceae was the most diverse family represented by 35 species of Ethiopian wild edible plants. In India such as the Gujjar community, Leguminoceae/Fabaceae and Moraceae were the most dominant families having a high number of species (Pandey and Pande, 2016).

Regarding the similarity of species composition, the JCS of the study districts for the reported wild edible species was 28% (Table 46). The results of the comparison using the JCS showed that the highest degree of similarity was perceived with data from Chilga District, northwestern Ethiopia (Mekuanent Tebkew, 2015). The intention might be that both studies produced good numbers of WEPs that increase the possibility of having shared species. Besides, there is closely related cultural sharing of experiences and knowledge between the two study areas. In contrast, the least similarity was related to the study conducted in Lower Omo River Valley (Tilahun Teklehaymanot and Mirutse Giday, 2010). This is due to faraway geographical settings and cultural differences of the communities.

Table 46: JCS index with four other sample areas regarding WEPs diversity

Sample of study sites	A	B	C	JCS%	R	References
Baso Liben and Debre Elias districts	44	41	33	28	2	
Chilga District	26	30	23	29	1	Mekuanent Tebkew, 2015
Derashe and Kucha districts	66	48	18	14	4	Kebu Balemie and Fassil Kebebew, 2006
Lower Omo River Valley	38	30	8	11	6	Tilahun Teklehaymanot and Mirutse Giday, 2010
Semi-arid Southern Ethiopia	30	17	13	22	3	Assegid Asefa and Tesfaye Abebe, 2011

JCS = Jaccard's coefficient of similarity index; R = Rank

5.1.4.2. Status, habitats and distribution of WEPs

During focus group discussions, the local community generated a list of the plants that are becoming rare or less visible and easily available edible plants. The majority of the WEPs are common and easily accessible. However, some plant species are becoming locally rare except in the forest patches as confirmed by informants and observation during the fieldwork.

Wild edible plants were appeared to occupy various habitats including riverine, roadsides, farmlands, home-gardens, grazing lands, churchyards and monasteries. Above all, forest patches were the most common habitats of edible plants. Forest is a common habitat for the gathering of WEPs (Debela Hunde *et al*., 2012). In Ngai and Otwal sub-counties, northern Uganda, wild food plants were found to grow in both farmlands and uncultivated habitats and were harvested for their nutritive values (Acipa *et al*., 2013). Furthermore, Zemede Asfaw (2009) also confirmed that the diversity of WEPs increases as the intensity of the wilderness increases.

5.1.4.3. Habit, parts eaten and modes of consumption

Of the reported growth forms, trees followed by shrubs make up the highest proportion of the edible plants. This shows that high percentage of woody plants in this study could be related to the ability of trees and shrubs to withstand long dry seasons. However, comparatively few in number, herbs and climbers were also consumed. In line with this, Tilahun Teklehaymanot and Mirutse Giday (2010) in the lower River Valley of Debub Omo Zone, Southern Ethiopia, investigated that trees were the major growth forms. In northern Uganda, woody species constituted the highest percentage sources of wild food plants (Acipa *et al*., 2013). This presented some advantages because they are perennial and therefore more reliable sources of food. In contrast, the herbaceous were annual and could be died out after flowering, thus undependable sources of food.

Other studies on the assessment of the growth forms of the edible species have shown that shrubs had the highest proportion of species in Ethiopia (Ermias Lulekal *et al*., 2008; Fisseha Mesfin *et al*., 2009; Assegid Assefa and Tesfaye Abebe, 2011). A study from northwest Himalaya, Jammu, and Kashmir (India) revealed that herbs make up the highest proportion of wild edible species, followed by shrub, trees and fungi (Kumar and Hamal, 2009). However, it ought to be noted that both in human and livestock herbal medicines, herbs were the most dominant growth forms than shrubs and trees from the same study area.

According to indigenous traditions, different parts of WEPs were consumed in various ways. This indicates that the different cultural groups in Ethiopia make use of diverse edible parts as food sources (Ermias Lulekal *et al*., 2011). Within the edible parts of the plants, fruits were the most dominant edible parts followed by nectars that consumed by people of the study area. The data

cited by Kumar and Hamal (2009), noted that the majority of plant species are exploited for fruit. In contrast, WEPs and their traditional use in human nutrition in Bosnia-Herzegovina (Redzic, 2006) revealed that the most frequently used parts are young and juicy shoots followed by fruits.

In this study, the majority of the WEPs were eaten fresh and raw as snacks or sometimes potion in order to supplement staple food. In the case of the mode of consumption, only two of the WEPs were served after cooking, one of them as powdering and all the rest (49) were usually eaten raw when ripe without any processing. In Maale and Ari ethnic communities, Southern Ethiopia, most fruits were also consumed raw and fresh (Berhane Kidane *et al*., 2014), or WEPs were eaten as raw without any processing (Tigist Wondimu *et al*., 2006). In comparison, cooked plant parts were the second most commonly consumed form of food plant parts in Otwal and Ngai sub-counties in Oyam District (Acipa *et al*., 2013). Generally, the various modes of consumption of WEPs were also common practice in European countries (Tardio *et al*., 2008) and elsewhere in Ethiopia (Amare Getahun 1974; Getachew Addis e*t al*., 2005, Zemede Asfaw, 2009; Getachew Addis *et al*., 2013; Mekuanent Tebkew, 2015; Tinsae Bahru *et al*., 2013).

5.1.4.4. Seasonal availability, fruiting or flowering patterns

The collection of edible plants in the study area is a seasonal activity. The season of fruiting and ripening of WEPs appeared to vary from site to site and species to species. As a result, there is considerable overlap in ripening among the different species both within and between localities. The availability not only changes from species to species but because of ecological and climatic conditions availability can also differ from place to place (Kebu Balemie and Fasil Kibebew,

2006). A study conducted in northern Uganda reported that wild food plants are not reliable sources of food for the local communities due to their seasonality (Acipa *et al*., 2013).

The plant parts eaten for their leaves, young shoots, or stems were usually collected before the flowering stage, as the edible parts were still gentle. Some of the species eaten for their root and bulb were collected in late autumn and/or beginning of winter. Each plant's part is being used in human nutrition (root, stem, leaf, rhizome, fruit, juices), depending on the season (Redzic, 2006). Additionally, the rural inhabitants of Ethiopia have immense knowledge, tradition and opportunity of using WEPs despite the variation in age, sex, time and season (Amare Getahun, 1974; Getachew Addis *et al*., 2005; Getachew Addis *et al*., 2013). In the country, these differences are marks of cultural diversity.

5.1.4.5. Relative frequency of citation and preference ranking of WEPs

Based on a number of informants who mentioned the plants for any food use, the following WEPs were most widely cited: *Ficus sur*, *Rubus apetalus*, *Cordia africana* and *Rosa abyssinica*. The most commonly cited species in the study area were those that acquired the highest relative frequency **(**RFC). According to the informants, *F. sur*, *Rubus apetalus*, *C. africana* and *R. abyssinica* were also used for the treatment of various ailments.

Concerning to taste quality, *Rosa abyssinica* followed by *Ficus sur* and *Mimusopis kumel* were found species of highest preferences. This study confirms that the local community of the study area has its own species preferences. Still, within the community, informants' species preferences appear to vary slightly among WEPs. This shows that the local communities know detailed

attributes in the long process of selection. Berhane Kidane *et al*. (2014) described the taste preference ranking of fruit species depending on availability and knowledge based on practices.

Wild edible species preference is different between trans-humans and settled farmers in Central East Shewa of Ethiopia (Debela Hunde *et al*., 2012). In contrast, the findings of Kebu Balemie and Fasil Kibebew (2006) revealed that there was no difference between the local communities and their preference for WEPs. Conversely, the same authors found that variation in responses depended on nutritional value, taste and ease of processing. Besides, Tilahun Teklehaymanot and Mirutse Giday (2010) put emphasis on the utilization of IK of preferred WEPs for further nutritional and toxicity studies. This helps the present study in indorsing additional studies for sustainable use of WEPs and the associated IK.

5.1.5. Nutraceutical plants

The intervention between food and herbal medicine is remarkable in the local community of the study area. The Amhara communities highly depend on using MPs as a remedial treatment for various human and livestock ailments. Focus group discussions and interviews with the informants indicated that nutraceuticals had dual purposes to enhance the local people's nutrition and health benefits. The species provide health benefits (Kalra, 2003), and functional food (Kasbia, 2005). This overlap shows the close relationship between health and food.

In other studies, the use of wild food plants among the local community of Ngai and Otwal was reported mainly because the plants are perceived to be nutritional (Acipa *et al*., 2013). Certain WEPs were also used because of their assumed health benefits and thus can be called medicinal

foods (Etkin, 1994). Furthermore, it was noted that several edible plants were used in the treatment of gastro-intestinal illnesses and different respiratory diseases in Bosnia and Herzegovina (Redzic, 2006).

5.1.6. Use categories and other uses of medicinal and WEPs

Throughout the field studies, information on several aspects of plant usage was recorded in the study area. Regarding the various use-categories of medicinal and WEPs, charcoal and firewood and environmental uses had the highest rank reported uses followed by materials and social uses. This vascular plant biodiversity is an important issue in the socio-economic, cultural and life of the local people. In this aspect, Debela Hunde *et al*. (2011) revealed that WEPs gratify the need for local materials, spiritual and cultural needs.

In many cases, wild species have multi-use and hence are used within cultural settings, such as building, fibers, soil conservation, firewood/charcoal, bees forage and fodder. This showed that the study area is rich in useful plants and ethnobotanical knowledge. The use of multi-purpose MPs for uses other than their traditional medicinal purpose was also reported elsewhere (Haile Yineger *et al*., 2007; Girmay Zenebe *et al*., 2012; Ermias Lulekal *et al*., 2013 and Beltran *et al*., 2014). Among the Marakwet, and indeed all Kalenjin communities, *Periploca linearifolia* is considered a sacred plant (Kipkore *et al*., 2014), whereas the same species was used as delaying of ejaculation in the present-day study.

Use-diversity is an important index of habitats for *in-situ* conservation (Zemede Asfaw and Tigist Wondimu, 2007). Plants with high recorded use-values (scores) were *Vernonia amygdalina,*

Croton macrostachyus, *Cordia africana*, *Tamarindus indica*, *Juniperus procera* and *Ficus sur*. This could be attributed to the fact that plant use-values occasionally relate to the issues of plant conservation, based on the concept that the most important plant species will suffer the highest harvesting pressure (Albuquerque *et al*., 2006). The high number of species shows the categories that are very important for peoples' existence in the study districts. This confirms that as the value getting high, the plants have multiple uses in the local community.

5.1.7. Marketability of medicinal and wild edible plants in the study area

This study has been conducted to assess the marketability of medicinal and WEPs in four local markets. Thus, the results from the market surveys indicated that marketing of medicinal and WEPs are very poor. Furthermore, the study implies that some of the species were collected and mainly sold for domestic uses, and gave the opportunity to supplement household income. Related to this ethnobotanical information, incomes generated from the sale of wild edible plant species are of specific importance to households (Debela Hunde *et al*., 2011). Tinsae Bahru *et al*. (2013) have reported that besides household consumption, various WEPs are sold at local markets, roadsides and villages to supplement household profits.

According to the informants, the known local healers generate their income through the selling of remedial preparations in their homes rather than in the open markets. This is because the culture of the community affected the marketability of the herbal medicines. In other studies, the status and accessibility of marketable MPs were described in different sources (Mander *et al*., 2006; Mirutse Giday *et al*., 2009; Ermias Lulekal *et al*., 2014) for certain cultural groups in Ethiopia. Regarding to food plants, *Tamarindus indica* was reported as one of the wild edible plants to have

good local market demand (Zemede Asfaw and Mesfin Tadesse, 2001), and fruits of *Mimusops kummel* and *Ziziphus mucronata* were also sold in the local markets (Tigist Wondimu *et al*., 2006). Debela Hunde *et al*. (2011), in their finding reported 24% of WEPs were locally marketed.

5.1.8. Ethnodemographic characteristics of the informants and IK transfer

5.1.8.1. Summary of characteristics of informants

Results from the demographic study of the informants were used to show the effect of different attribute variables on the distribution of local knowledge. The results revealed that male informants reported more species than females and hence the difference was statistically significant ($P < 0.05$). This study shows that the interest in plants (medicinal and wild edible) in the study area was unequal sharing between men and women, relatively an increase for men. Because of cultural influence, it is understandable that females could not go out of home they look after babies, and work and/or stay at home.

As stated by Moa Megersa *et al.* (2013), females mentioned a few numbers of plants as compared to males. Similarly, it has been shown that men have better herbal knowledge than women (Mirutse Giday *et al.*, 2003). Togola *et al*. (2005) from Mali (West Africa) reported that men dominated the practice of TM and women have less knowledge than men do about traditional herbal medicine. In contrast, a study conducted in Fiche shows females hold more knowledge than males (d' Avigdor *et al.*, 2014). Therefore, both and men and women had different experiences with the environment in the study districts.

The significant difference ($P < 0.05$) on an average number of medicinal and WEPs reported by various age groups compared in this study specified that local knowledge on the use of plant still stronger with senior/elderly individuals as compared to the younger generation. This proves that the elderly informants were rich in IK and/or more knowledgeable concerning herbal medicine and wild food practices. This further shows that young people do not have copious knowledge as compared to elderly ones. That is an indication of a decline and loss of the knowledge of traditional medicine besides confidentiality. Girmay Zenebe *et al*. (2012) in Asgede Tsimbila District of northwestern Tigray, Northern Ethiopia also described that the reason why elders are more knowledgeable is their personal experiences using the plants.

A study conducted in villages around Kimboza forest reserve, in Morogoro, Tanzania by Amri and Kisangau (2012) revealed that the elderly people are the main custodians of traditional knowledge, and this poses a serious challenge of the knowledge gap between the elderly and the youngsters if framework to ensure apprenticeship is not put in place. According to Beltran *et al*. (2014), elderly people knew more useful plant species than younger people, possibly because ethnobotanical knowledge accumulates through the life cycle. In Pakistan, many of the knowledgeable elders in the territory are recognized as persons having greater knowledge after healers (Ullah *et al*., 2019). In Jordan, the knowledge of using wild herbs in traditional folk medicine is more common among the elderly rather than the young generation in most of the visited domestic areas (Oran and Al-Eisawi, 2015).

The other significant difference ($p < 0.05$) was observed between key and general, and literate and illiterate (non-educated) informants. The IK regarding the use of MPs for the treatment of different

disorders was more prevalent among illiterate people and the same knowledge was decreasing in the highly educated class of the area (with modern education attendants). Mirutse Giday *et al*. (2009), Girmay Zenebe *et al*. (2012) and Ermias Lulekal *et al*. (2013) in Ethiopia reported similar results. Furthermore, Balick and Cox (1996) claimed that medicinal plant lore often recedes or completely disappears in the wake of rapid westernization.

5.1.8.2. Knowledge transfer and collection time

The ethnobotanical information revealed that the local knowledge of healing and the use of MPs are disseminated through generations (by family members) via word of mouth. In the local communities, the knowledge gained throughout their life history transferred only to an individual they wanted to pass, commonly to the eldest sons (sometimes to daughters). Similarly, it was also reported that at the family level; the transfer of information is restricted to the elders (men and women). This was followed by the elder son or daughter or their trustworthy person when the mother or the father is getting old or near to die as in Ankober District (Ermias Lulekal *et al*., 2013), Libo Kemkem District (Getnet Chekole *et al*., 2015) and Farta District (Nigussie Amsalu *et al*., 2015). Elders in the community often are the most skillful practitioners and disseminators of IK.

Conveying on local knowledge to males (especially to church attendants) is a common practice in the study area. The secrecy of traditional medical practice and the passing of knowledge in selective attention for males are also common phenomena found in other parts of Ethiopia (Kebede Deribe *et al*., 2006; Haile Yineger and Delenasaw Yewhalaw, 2007). In general, there is less

transfer of IK of ethnobotanical resources in the community of the study area as is evident in little knowledge among the youth as compared to the elderly.

The skilled and conversant informants of the Amhara community indicated that Wednesday and Friday were the most preferred days of the week for the collection of plant materials. As explained by Dawit Abebe and Ahadu Ayehu (1993), plant collection made on the first day of Ethiopian New Year, or collection made at different times of the day makes good sense. While the choice of Fridays and/or Wednesdays, and the first day of the new month for the same purpose or occasionally for administering the drug is hard to justify.

5.1.9. Threats, management, and conservation of IK associated with medicinal and WEPs

The study site is one of the most extensively cultivated and grazed land areas with a long history of population settlement tied with huge deforestation for agricultural activities, charcoal and firewood collection, and other environmental uses that led to biodiversity loss. In view of that, such kinds of intensive and holistic human pressures on plants were the most urgent issues.

Priority ranking factors indicated that deforestation for agricultural expansion contributed to the key factors to the threat of useful plant species including medicinal and wild edible foods. Results of this study showed that clearing of forests for sesame cultivation and gum-resins production was commonly practiced in the study area following Abay Gorges. This is mainly because of the increasing human population with an increasing demand for arable land. This confirms the majority of the species are harvested from the wild. It must be noted that most of the threats to Ethiopian forests are also threats to medicinal and WEPs (EBI, 2015). On the other hand, the

findings of Ermias Lulekal *et al*. (2008) and Moa Megersa *et al*. (2013) showed that intense deforestation became the major threat of MPs in their respective study sites.

The focus group discussions confirmed that the knowledge of the local community, especially the young age group, has diminished from time to time. According to Mirutse Giday *et al*. (2009), the immediate and serious threat to the local medical practice and transfer in Ethiopia arises from the increasing influence of modernization such as the increase of modern education, industrialization, changes in lifestyle and migration from rural to urban areas. Moreover, Kipkore *et al*. (2014) reported that the threat of complete vanishing of the local knowledge on herbal medicine from factors such as deforestation, lack of proper regulation, overexploitation, and socio-cultural issues warrant an urgent need to document the ethnobotanical information.

Some plant species were well protected at the spot of each farmland for various purposes. As a result, the local people were found to be tremendous conservators of vascular plant diversity. However, in this traditional practice, efforts regarding conservation were very weak. Similarly, Ermias Lulekal *et al*. (2013) reported that although traditional practitioners and local inhabitants in their study sites mainly depend on the natural environment for collecting MPs, the effort to conserve and sustainably use resources was frail.

Home-gardens and/or yards were also commonly served as herbal medicine cupboards, providing easily available MPs for household needs. This proposes that cultivating MPs in home-gardens reduced the negative effects of human activities on plants in wild habitats. This shows that plant diversity has been conserved through their uses in home-gardens. On this, Zemede Asfaw (2001)

in his findings reported that the home-garden is a strategic and ideal farming system for conservation, production, and enhancement of MPs and valuable local knowledge. Local knowledge has also been described to be important in the conservation of natural resources and biodiversity in coastal areas of Kenya (Wekesa *et al*., 2015).

In summary, some medicinal and WEPs were smashed, whereas some others were conserved mainly in areas where no anthropogenic influences such as firewood collection and agricultural activities took place. The forest patches were also preserved in various places of worship. Study in Ethiopian Church forests, opportunities and challenges for restoration indicated that the church is now the refuge for remaining forest resources that can be considered as in-situ biodiversity conservation (Alemayehu Wassie, 2007).

5.2. Conclusions

The study documented and reported that the two districts harbour a large number of plant species. The results further showed that the study area is rich in vascular plant species comprising endemic taxa and has an abundance of medicinal plants to cure a large spectrum of human and livestock ailments. Forest patches were also chief sources for several WEPs used by the local community. The family Asteraceae had the highest number of species, followed by Fabaceae and Poaceae. This is due to the wider distributions and better abundance of the families in the Flora of Ethiopia. Herbs were the most commonly represented growth forms followed by shrubs and trees, whereas climbers were least represented.

The highest species richness among the forest patches was recorded in Genetna Akababiw (Debre Elias District), whereas the least number of species was recorded in Abragit (Baso Liben District) forest patch. This shows that the analysis of floristic data on the vegetation of the forest patches indicated comparatively high species diversity. The highest diversity index and evenness were observed in *Croton macrostachyus-Accia abyssinica* community type (community 1). In terms of population structures, four representative patterns were computed and illustrated as inverted J-shaped, J-shaped, broken reverse J-shaped and bell-shaped. The patterns have shown that unhealthy status of tree species in different stages of development due to anthropogenic impacts.

In general, the results revealed that there are high floristic richness, species diversity and evenness in the study area. However, as mentioned the forest patches have been influenced by agricultural activities and overgrazing in that the bulk of those forest patches were cleared, which are two of the worst threats to the plant species. As a result, forest patches, endemic species and some other useful species were threatened.

On the other hand, the ethnobotanical information disclosed that both Baso Liben and Debre Elias districts are rich in medicinal plant diversity, and they have contributed to the highest resemblance for both species composition and the use pattern of herbal medicines. In comparison, most of herbal medicines were harvested from natural habitats followed by home-gardens. Results from this investigation revealed that local people depend on MPs to meet their basic healthcare needs. A large number of plant species were used for the handling of most prevalent disorders such as dermatological and gastro-intestinal ailments, and ecto- and endo-parasites. Thus, this study documented the local knowledge of herbal medicines used to handle human and livestock ailments.

Ethnomedicinal and ethnoveterinary plants were used for the treatment of various human and livestock ailments, respectively with herbs taking the lead in the number of plant species used in the preparation of therapies, which may be an indication of their comparatively better abundance as compared to other growth forms. The most commonly represented family with the highest number of species was Asteraceae. In this study, results also indicated that leaves followed by roots were the most commonly used parts. The local people also prepared plant remedies mainly through infusion (for livestock) and decoction (for humans), and administered them largely through the oral route followed by dermal applications.

Informant consensus of human medicinal plant usage resulted in ICF varies from 0.29 to 0.84 per disease category (in human). The highest ICF value was recorded for the category of diseases, which belonging to the skin and skin-related in Debre Elias followed by diseases related to digestive/gastro-intestinal disorders in Baso Liben District. On the other hand, the FL is helpful for categorizing the healers' most preferred plant species in use for handling certain ailments. For example, in Baso Liben, the reported highest FL values for *Senna singueana* followed by *Ruta chalepensis* were used against ailments such as snakebite and acute febrile illness, respectively. *S. singueana* had also the highest fidelity level value which treats snakebite and acute febrile illness followed by *Verbena officinalis* against gastro-intestinal disease and *Laggera tomentosa* for healing toothache infection in Debre Elias District.

The results of the preference ranking exercise also showed that *Lageneria siceraria*, followed by *Nicotiana tabacum* was the most-preferred ethnoveterinary MPs used to treat leech infestation.

The herbal remedies were prescribed against 53 kinds of livestock ailments. Most of the ailments were that of cattle. However, high numbers of MPs were used to treat leech infestation.

The season of fruiting and ripening of WEPs appeared to vary from area to area and species to species. WEPs mark a specific season of the year and most of the local inhabitants know accurately at which time the ripening of the fruits in their localities offers their gift. Most of these edible plants were harvested from October onwards. It must be noted that the plants play an important role in the livelihoods of local communities.

The results demonstrate that many plant species have been cited as both food and medicinal plants (overlapping) uses. This overlap shows the close relationship between health and food. Moreover, the documented medicinal, wild edible and other useful plants provide everything (such as charcoal, materials and environmental uses) required for the communities' continued existence.

The results of the present study also showed that local knowledge of MPs varies with socio-economic and demographic factors. Furthermore, there is less transfer of IK of ethnobotanical resources in the community of the study area is clear in young people know fewer MPs as compared to the elderly. Indigenous information on the use of medicinal and WEPs is still practiced by local communities. However, many of these useful plants and the forest patches of the study area are rapidly diminishing because of rapid population increase and the subsequent need for more resources.

A few numbers of traditional healers in the study area have brought various MPs from natural habitats into cultivation in home-gardens thereby conserving them. In addition, inaccessible areas, mosques, churches and monasteries are also contributing a lot to the conservation of MPs. The findings of the present study might be supportive to have sensitive awareness and therefore make an in-situ and ex-situ approach of the medicinal and WEPs.

5.3. Recommendations

Based on the research results and conclusions given above, the following recommendations are forwarded**:**

- Urgent conservation action has to follow by taking measures to preserve the forest patches from intensive agricultural expansions, over-grazing and other anthropogenic impacts. This can be implemented with active participation of the local communities and key stakeholders. Hence, with applicable management strategies, conservation can be achieved by ensuring that the community use the forest resources responsibly and sustainably to the advantage of the ecosystem and the human community itself;
- Forest patches, endemic species and some other species were threatened, which require special attention for their protection and conservation. Hence, more priority should be given to the forest patches including *Croton macrostachyus-Accia abyssinica* community type that harbour large number of medicinal, wild edible, threatened and endemic plant species;
- Anthropogenic disturbances are commonly practiced in the study area. Therefore, there must be generating alternative sources of energy (such as solar and electricity), employment and income generation to the local communities who involved in the firewood collection, charcoal, agricultural and many other activities that cause depletion of the forests;

- As the study shows MPs having high fidelity values included *Schinus molle*, *Senna singueana*, *Ruta chalepensis*, *Verbena officinalis*, *Laggera tomentosa*, *Withania somnifera* and *Nicotiana tabacum*. Therefore, pharmacological, toxicological and phytochemical studies should be conducted to evaluate the efficacy and safety of these herbal remedies;
- The need for further investigation on WEPs with dietary analysis of the most preferred (for example, *Rosa abyssinica*, *Ficus sur* and *Mimusopis kummel*) species;
- The limited ethnobotanical knowledge in the young generation showing loss of knowledge as it is restricted to the elderly, and therefore awareness intensification should be made among the healers to avoid erosion of the IK and to ensure its transmission, sustainable use, documentation, and to get better local community's shared knowledge related to the uses of medicinal and WEPs; and
- Results show that some medicinal and WEPs as well as many other useful plants are rare and hard to find them elsewhere except in the forest patches. Thus, call for the encouragement of in-situ and ex-situ conservation strategy for these useful plants.

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APPENDICES

Appendix-1: Semi-structured interview questions employed in the study area

I. General Information

1. Information on Respondents

- Name, gender, marital status: married/widowed/divorced/single (Underline); Age of the respondent;
- Educational status: (Read and write, can't read and write, completed (Underline);
- Locality…… Religion (Orthodox, Protestant, Muslims), Ethnic…….
- For how long have you lived in this area? Circle one of the choices. A) Since birth B) For the last 20 years C) For 15 years D) Less than 15 years

II. Ethnobotanical Data

A. Information related to medicinal plants

2. What are the most common diseases/ailments of humans in your locality?
3. What are the most common livestock diseases/ailments in your area?
4. How do you treat human health problems/diseases?
5. How do you treat livestock health problems/diseases?
6. How do you diagnose each disease/health problem?
7. Growth forms: Trees/shrubs/herbs/climbers/epiphytes;
8. Which part of each medicinal plant listed is used? (Leaves, roots, barks, stems, flowers, seeds, latexes or saps, whole plants, etc.).
9. What is the method of preparation of a medicinal plant? (Fresh, dried, crushed, powdered, used alone, mixed with others or water, exudation, concoction, poultices, infusion, juice, bathe, syrup).

10. Mode of administration: Ointment, swallow, drink, chew, smoking, fumigation, others specify_____
11. What factors determine the dosage? Age, sex, illness/disease condition, pregnancy, any others?
12. Are there any plant and/or ingredient added? If yes, what type of plant or ingredient is added?
13. Does the dose differ among males, females, children, elders, pregnant women? Mention any noticeable adverse/side effect (s) _____.
14. Are there any means of treatment for the side effects? (Are there antidotes for adverse/side effects?
15. Is the medicinal plant easily accessible? If not, why?
16. Which members of the community use medicinal plants frequently?
17. To what extent does the community depend on traditional medicinal plants as compared to modern medicine? Why?
18. Are there any taboos associated with medicinal plant use and utilization of medicinal plants (method of collection, time of collection, sex, age, storage, etc)? What is the implication of the taboo? If any, state.
19. Is the medicinal plant marketable?
20. How is the knowledge of medicinal plants use transferred from generation to generation in the community?
21. To whom do you want to share your knowledge? (To your first son or daughter, your beloved son or daughter, to any child of yours, to all of your children, others_____).
22. Do you collaborate with other traditional healers?
23. Are there any threats to the medicinal plants? Mention those threats, starting with the most serious threat.

24. How do you conserve traditional medicinal plants?

B. Information related to WEPs

1. Give the name of the plant in the local language-Amharic if known.
2. Which plant part of the WEPs is eaten (root/stem/bark/leaves/small twigs with leaves/flowers/inflorescence/fruit/seed/ bulbs/others? Specify _____.
3. Which other foods are eaten with it?
4. How is the mode of consumption of WEPs? (Fresh, cooked, raw /uncooked, specify?)
5. Who consumes the foods (men, women, girls, boys);
6. Which season of preferred for collection of wild edible plants in your area? (Wet season; dry season; all-the-year round?) [(Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec)].
7. Are there any wild foods that are said to be good as weaning foods? Why?
8. Is it stored? Yes/No
9. Is it sometimes cultivated? Yes/No
10. Can it be fermented or made into a drink? Yes/No
11. What type of food is it considered a snack, staple, relish, famine, etc.?
12. Where do the wild edible plants grow? (In the wild, in home gardens or both in the wild and home garden);
13. For a family of five, how much would be eaten at a normal meal? (Give measurement in cups and state which cup is used, i.e., an orange cup from feeding centres cup, tea glass)
14. Is it a food eaten in cattle camps, villages, towns, etc.;
15. Where is it sold or traded, i.e., in local markets, town markets, etc.?
16. Do the WEPs have any use other than food? If yes, state _____.
17. Which WEPs are the most preferred/delicious? Why?

18. Are there issues of preferences of some WEPs over the others?

19. What are the threats to wild edible plants in the area?

20. Is there any effort made to conserve and manage properly the plants in the area?

21. Is the edible plant abundant or rare?

C. To be filled by the ethnobotanist

1. Scientific name of the plant species _____
2. Family name of the plant_____
3. Collection number of the plant_____
4. Brief description of the plant (including habit, habitat, a location where collection were made)

   _____
5. Name and address of the botanist who identified the plant _____
6. Name and address of the taxonomist confirmed identity of the plant _____

D. Identification

Name of the two-study areas/districts _____Peasant Association_____

Community/Village_____ Interviewer/facilitator_____

Date/Month/Year: _____Time: From _____a.m. /p.m. to _____a.m./p.m.

Appendix-2: Floristic composition of the study area (Pooled data from all forest Patches): Key: Habit (Ha); Herb (H); Shrub (S); Tree (T); Climber (Cl); Voucher number (V. No.); Nigussie Amsalu (NA), Local name (Lo. na); Baso Liben (BL); Elias (DE); Absent (A); Present (P)

No.	Scientific name	Family	Local name (Amharic)	Ha	V. No	Districts	
						BL	DE
1	*Abutilon figarianum* Webb	Malvaceae		H	NA314	P	A
2	*Abutilon longicuspe* Hochst. ex A. Rich.	Malvaceae	Nacha	S	NA224	P	P
3	*Abutilon mauritianum* (Jack.) Medie.	Malvaceae	Nacha	H	NA316	P	A
4	*Acacia abyssinica* Hochst. ex Benth. **	Fabaceae	Girar	T	NA024	P	P
5	*Acacia etbaica* Schweinf. subsp. *etbaica* ***a**	Fabaceae	Girar	T	NA233	A	P
6	*Acacia hecatophylla* Steud. ex A. Rich.	Fabaceae		T	NA305	P	A
7	*Acacia lahai* Steud. & Hochst. ex Benth. **	Fabaceae	Cheba	S	NA035	P	P
8	***Acacia negrii* Pic.Serm.**	Fabaceae	Girar	T	NA134	P	P
9	*Acacia nilotica* (L.) Willd. ex Del. ***a**	Fabaceae	Cheba	T	NA239	A	P
10	*Acacia pilispina* Pic. –Serm.	Fabaceae	Cheba	S	NA244	P	A
11	*Acacia senegal* (L.) Wild. ***a**	Fabaceae	Chino/Qento	T	NA157	P	P
12	*Acacia seyal* Del.	Fabaceae	Neche Girar	T	NA176	P	P
13	*Acalypha fruticosa* Forssk.	Euphorbiaceae		S	NA200	A	P
14	*Acanthospermum hispidum* DC.	Asteraceae		H	NA231	A	P
15	*Acanthus eminens* C. B. Clarke	Acanthaceae	Kosheshila	S	NA245	P	P
16	*Acanthus polystachius* Delile	Acanthaceae	Kosheshila	S	NA136	P	P
17	*Acanthus pubescens* (Oliv.) Engl. ***ed**	Acanthaceae	Kosheshila	S	NA027	P	P
18	***Acanthus sennii* Chiov. *ed**	Acanthaceae	Kosheshila	S	NA042	P	P
19	*Achyranthes aspera* L.**	Amaranthaceae	Telenj	H	NA017	P	P
20	*Achyrospermum schimperi* (Hochst. ex Briq.) Perkins	Acanthaceae	Gime	H	NA086	A	P
21	*Acmella caulirhiza* Del. **	Asteraceae	Yemidir Berbere	H	NA137	P	P
22	*Acokanthera schimperi* (A. DC.) Schweninf. **	Apocynaceae	Merz	S	NA226	P	P
23	*Adiantum raddianum* C. Presl ***a**	Adiantaceae	Sire Bizu	H	NA022	P	P
24	*Aeschynomene abyssinica* (A. Rich.) Vatke	Fabaceae		H	NA267	A	P
25	*Agave sisalana* Perrine ex Engl. **, ***a, *ed**	Agavaceae	Qacha	H	NA180	A	P
26	*Ageratum conyzoides* L. **	Asteraceae	Arem	H	NA044	A	P
27	*Albizia grandibracteata* Taub. ***a**	Fabaceae		T	NA216	A	P
28	*Albizia gummifera* (J.F. Gmell.) C.A. Sm.	Fabaceae	Sessa	T	NA019	P	P
29	*Albizia schimperiana* Oliv.	Fabaceae	Sessa	T	NA080	P	P
30	*Alchemilla pedata* A. Rich.	Rosaceae		H	NA036	P	P

31	*Allophylus abyssinicus* (Hochst.) Radlk.	Sapindaceae	Medamich	T	NA046	P	P
32	*Aloe camperi* Schweinf. **	Aloaceae	Ret	H	NA127	P	P
33	*Aloe macrocarpa* Tod. **	Aloaceae	Ret	H	NA147	P	P
34	*Amaranthus caudatus* L. **, ***a**	Amaranthaceae		H	NA234	P	P
35	*Amaranthus hybridus* L. subsp. *hybridus* ***a**	Amaranthaceae		H	NA240	P	P
36	*Andropogon distachyos* L.	Poaceae	Gajja Sar	H	NA058	P	P
37	*Anogeissus leiocarpa* (A. DC.) Guill. & Perr. **	Combretaceae	Muak	T	NA297	P	A
38	*Apodytes dimidiata* E. Mey. ex Arn. **	Icacinaceae	Donga	T	NA135	A	P
39	*Argemone mexicana* L. **, ***ed**	Papaveraceae	Nechelo	H	NA275	P	P
40	*Arisaema schimperianum* Schott **, ***ed**	Araceae	Amoch	H	NA167	P	P
41	*Arundinaria alpina* K. Schum. ***ed**	Poaceae	Kerkeha	H	NA287	P	A
42	*Arundo donax* L.	Poaceae	Shenbeqo	H	NA286	P	A
43	*Asparagus africanus* Lam. **	Asparagaceae	Yeset Qest	S	NA066	P	P
44	*Asplenium aethiopicum* (Burm.f.) Bech. subsp. *aethiopicum*	Aspleniaceae	Epiphyte	H	NA121	P	P
45	*Balanites aegyptiaca* (L.) Del. **, ***ed**	Balanitaceae	Asa Maskeria	T	NA306	P	A
46	*Barleria spinisepala* E. A. Bruce ***a**	Acanthaceae		H	NA276	P	P
47	*Bersama abyssinica* Fresen. subsp. *abyssinica* **	Melianthaceae	Azamir	T	NA037	P	P
48	*Bidens pilosa* L.	Asteraceae	Yeseitan Merfe	H	NA028	P	P
49	***Boswellia pirottae* Chiov. ****	Burseraceae	Qerere/Etan	T	NA218	A	P
50	***Brassica carinata* A. Br.** **	Brassicaceae	Gomen Zer	H	NA249	A	P
51	*Brucea antidysenterica* J.F. Mill. **	Simaroubaceae	Abalo	T	NA059	P	P
52	*Buddleja polystachya* Fresen. **	Loganiaceae	Anfar	S	NA118	P	P
53	*Calotropis procera* (Ait.) Ait. f. **	Asclepiadaceae	Qilanbo	S	NA168	P	P
54	*Calpurnia aurea* (Ait.) Benth. subsp. *aurea* **	Fabaceae	Ligita	S	NA108	P	P
55	*Capparis cartilaginea* Decne.	Capparidaceae	Gumero	S	NA201	P	P
56	*Capparis tomentosa* Lam. **, ***a**	Capparidaceae	Gumero	S	NA141	P	P
57	*Cardiospermum halicacabum* L.	Sapindaceae	Semeg	Cl	NA173	P	P
58	*Carduus schimperi* Sch. Bip. subsp. *schimperi* **, ***a**	Asteraceae	Kosheshila	H	NA129	P	P
59	*Carex steudneri* Bock.	Cyperaceae	Filla	H	NA040	A	P
60	*Carissa spinarum* L. **, ***ed**	Apocynaceae	Agam	S	NA083	P	P
61	*Carthamus lanatus* L.	Asteraceae	Yeahiya Suf	H	NA130	P	P
62	*Cassipourea malosana* (Baker) Alaston **, ***a**	Rhizophoraceae	Tiqur Inchet	T	NA161	P	P
63	*Caucanthus auriculatus* (Radlk.) Niedenzu. ***a**	Malpighiaceae		Cl	NA034	P	P
64	*Caylusea abyssinica* (Fresen.) Fisch. & Mey.	Resedaceae	Rench	H	NA145	P	P
65	*Celtis africana* Burm.f. **, ***ed**	Ulmaceae	Qewt	T	NA248	P	P

66	*Cenchrus ciliaris* L.	Poaceae	Sar	H	NA303	P	A
67	*Cheilanthes erythraea* Pic.Serum ***a**	Sinopteridaceae	Fern	H	NA205	P	P
68	*Cheilantes farinosa* (Forssk.) Kaulf.	Sinopteridaceae	Fern (white)	H	NA061	P	P
69	*Chenopodium ambrosioides* L.	Chenopodiaceae		H	NA183	P	P
70	*Chenopodium murale* L.	Chenopodiaceae	Abisho	H	NA213	P	P
71	*Cirsium vulgare* (Savi.) Ten.	Asteraceae	Kosheshla	S	NA078	P	P
72	*Cissampelos mucronata* A. Rich. ***a**	Menispermaceae	Ingochit	Cl	NA197	A	P
73	*Cissus quadrangularis* L. **	Vitaceae		Cl	NA308	P	A
74	*Clausena anisata* (Willd.) Benth. **, ***ed**	Rutaceae	Limich	S	NA020	P	P
75	*Clematis hirsuta* Perr. & Guill.	Ranunculaceae	Anzo Areg	Cl	NA047	P	P
76	*Clematis simensis* Fresen. **	Ranunculaceae	Anzo Areg	Cl	NA012	P	P
77	*Clerodendrum myricoides* (Hochst.) Vatke **, ***a**	Lamiaceae	Misrich	H	NA279	P	A
78	*Clutia abyssinica* Jaub. & Spach. **	Euphorbiaceae	Fiyele Fej	S	NA009	P	P
79	*Clutia lanceolata* Forssk subsp. *lanceolata* Forssk	Euphorbiaceae	Fiyele Fej	S	NA214	A	P
80	*Coffea arabica* L. **	Rubiaceae	Bunna	S	NA288	P	A
81	*Combretum aculeatum* Vent.	Combretaceae		Cl	NA189	P	P
82	*Combretum collinum* Fresen. subsp. *collinum*	Combretaceae	Shawoch	T	NA212	A	P
83	*Combretum molle* R. Br. ex G. Don **, ***ed**	Combretaceae	Shawoch	T	NA178	P	P
84	*Commelina benghalensis* L.	Commelinaceae	Yeahiya Anjet	H	NA071	P	P
85	*Commelina diffusa* Burm.f.	Commelinaceae	Yeahiya Anjet	H	NA246	P	A
86	*Commiphora africana* (A. Rich.) Engl. ***a**	Burseraceae	Anqua	S	NA192	A	P
87	*Conyza stricta* Willd.	Asteraceae		H	NA109	P	P
88	*Cordia africana* Lam. **, ***ed**	Boraginaceae	Wanza	T	NA026	P	P
89	*Corrigiola capensis* Willd. subsp. *africana* (Turrill) Choudrhi **	Molluginaceae	Yebeg Lat	H	NA164	A	P
90	*Cotula abyssinica* Sch. Bip. ex A. Rich.	Asteraceae		H	NA253	A	P
91	***Crassocephalum macropappum* (Sch. Bip. ex A. Rich.) S. Moore**	Asteraceae		H	NA293	P	A
92	*Crepis foetida* L.	Asteraceae	Yefiyel Wotet	H	NA052	P	P
93	*Crepis rueppellii* Sch. Bip.	Asteraceae		H	NA053	P	P
94	*Crinum abyssinicum* Hochst. ex A. Rich.	Amarylidiaceae		H	NA291	P	A
95	*Crotalaria incana* L. subsp. *incana* ***a**	Fabaceae		H	NA021	P	P
96	*Crotalaria plowdenii* Bak.	Fabaceae		H	NA082	P	P
97	***Crotalaria rosenii* (Pax) Milne-Redh. ex Polhill**	Fabaceae		H	NA142	P	P
98	*Crotalaria spinosa* Hochst. ex Benth.	Fabaceae	Yemdir Girar	H	NA210	A	P
99	*Croton macrostachyus* Del. **	Euphorbiaceae	Bissana	T	NA057	P	P

100	*Cucumis ficifolius* A. Rich. **	Cucurbitaceae	Yegeberie Imbuay	H	NA011	P	P
101	*Cussonia arborea* A. Rich.	Araliaceae	Chaqimati	T	NA196	A	P
102	*Cyathula cylindrica* Moq.	Amaranthaceae	Chegogit	H	NA211	A	P
103	*Cyathula uncinulata* (Schrad.) Schinz	Amaranthaceae	Chegogit	H	NA270	P	P
104	*Cynodon dactylon* (L.) Pers. **	Poaceae	Serdo	H	NA016	P	P
105	***Cynoglossum coeruleum* Hochst. ex A. DC. in DC. subsp. *coeruleum*** **	Boraginaceae	Shimgug	H	NA089	P	P
106	*Cynoglossum lanceolata* Forssk. **	Boraginaceae	Shimgug	H	NA015	P	P
107	*Cyperus bulbosus* Vahl ***ed**	Cyperaceae	Ingicha	H	NA051	P	P
108	*Cyperus dichroostachyus* A. Rich.	Cyperaceae	Gramta	H	NA076	A	P
109	*Cyperus fischerianus* A. Rich.	Cyperaceae	Ingicha	H	NA073	P	A
110	*Cyphostemma adenocaule* (Steud. ex A. Rich.) Desc. ex Wild & Drummond	Vitaceae		H	NA064	P	P
111	*Cyphostemma niveum* (Hochst. ex Schweinf.) Desc.	Vitaceae		H	NA006	P	P
112	*Datura stramonium* L. **, ***ed**	Solanaceae	Astenagir	H	NA115	P	P
113	*Debregeasia saeneb* (Forssk.) Hepper & Wood	Urticaceae	Anfar	S	NA094	A	P
114	*Dichrostachys cinerea* (L.) Wight & Arn.	Fabaceae	Adder	S	NA179	P	P
115	*Digitaria abyssinica* (Hochst ex A. Rich.) Stapf	Poaceae	Warat	H	NA055	P	P
116	*Dioscorea abyssinica* Hochst. ex Kunth **, ***ed**	Dioscoreaceae		Cl	NA247	P	P
117	*Diospyros abyssinica* (Hiern) F. White	Ebenaceae	Selchegn	Cl	NA237	P	P
118	*Dipsacus pinnatifidus* Steud. ex A. Rich.	Dipsacaceae	Keleh Zaf	H	NA050	P	A
119	*Discopodium penninervium* Hochst. **	Solanaceae	Ameraro	T	NA283	P	A
120	*Dodonaea angustifolia* L. f. **	Sapindaceae	Kitkita	S	NA151	P	P
121	*Dombeya kefaensis* Friis & Bidgood	Sterculiaceae	Wilkifa	S	NA160	P	P
122	*Dombeya torrida* (J. F. Gmel.) P. Bamps	Sterculiaceae	Wilkifa	T	NA202	P	P
123	*Dovyalis abyssinica* (A. Rich.) Warb. ***ed**	Flacourtiaceae	Korshim	S	NA031	A	P
124	*Dracaena steudneri* Engl. **	Dracaenaceae	Merqo	T	NA280	P	A
125	*Dregea abyssinica* (Hochst.) K. Schum. **	Asclepiadaceae	Moider	Cl	NA230	P	P
126	*Drynaria volkensii* Hieron.	Polypodiaceae	Fern	H	NA062	P	P
127	*Echinops giganteus* A. Rich.	Asteraceae	Kofie	H	NA156	A	P
128	*Echinops hispidus* Fresen.	Asteraceae	Kosheshilla	H	NA093	P	P
129	***Echinops kebericho* Mesfin** **	Asteraceae	Qebercho	H	NA095	A	P
130	*Echinops pappii* Chiov. ***a**	Asteraceae	Kosheshilla	S	NA209	P	P
131	*Ehretia cymosa* Thonn. ***ed**	Boraginaceae	Olaga	S	NA186	A	P

132	*Ekebergia capensis* Sparrm. **, ***ed**	Meliaceae	Lol	T	NA187	P	P
133	*Elaphoglossum acrostichoides* (Hook. & Grev.) Schelpe ***a**	Lomariopsidaceae	Fern	H	NA120	A	P
134	*Eleusine floccifolia* (Forssk.) Spreng.	Poaceae	Akrima	H	NA199	P	P
135	*Embelia schimperi* Vatke **, ***ed**	Myrsinaceae	Inqoqo	Cl	NA110	P	P
136	*Ensete ventricosum* (Welw.) Cheesman ***ed**	Musaceae	Koba	H	NA289	P	A
137	*Entada abyssinica* Steud.ex A. Rich.	Fabaceae	Chino/Ambelt	T	NA030	P	P
138	*Eragrostis aspera* (Jacq.) Nees	Poaceae	Sar	H	NA290	P	A
139	***Eragrostis tef* (Zucc.) Trotter** **	Poaceae	Teff	H	NA029	P	P
140	***Erythrina brucei* Schweinf.** **	Fabaceae	Korich	T	NA054	P	P
141	*Eucalyptus globulus* Labill. subsp. g*lobulus* **	Myrtaceae	Nech bahir zaf	T	NA294	P	P
142	*Euclea racemosa* Murr. subsp. *schimperi* (A. DC.) White **,***ed**	Ebenaceae	Dedeho	S	NA162	P	P
143	*Euphorbia abyssinica* Gmel. **	Euphorbiaceae	Qulqual	T	NA084	P	P
144	*Euphorbia schimperiana* Scheele **	Euphorbiaceae	Yegede Wotet	H	NA292	P	A
145	*Fagaropsis angolensis* (Engl.) Dale ***a**	Rutaceae	Derg	T	NA307	P	A
146	*Ficus glumosa* Del. ***ed**	Moraceae	Sholla/Woda	T	NA217	P	P
147	*Ficus ingens* (Miq.) Miq.	Moraceae	Woda	T	NA298	P	A
148	*Ficus salicifolia* Vahl	Moraceae		T	NA105	A	P
149	*Ficus sur* Forssk. **, ***ed**	Moraceae	Sholla	T	NA085	P	P
150	*Ficus sycomorus* L. **, ***ed**	Moraceae	Sholla	T	NA008	P	A
151	*Ficus vasta* Forssk. ***ed**	Moraceae	Warka	T	NA018	P	P
152	*Fimbristylis bisumbellata* (Forssk.) Bub.	Cyperaceae	Entit	H	NA312	P	A
153	*Flacourtia indica* (Burm.f.) Merr. **, ***ed**	Flacourtiaceae	Akuk	S	NA138	P	P
154	*Flaveria trinervia* (Spreng.) C. Mohr	Asteraceae		H	NA025	P	P
155	*Flueggea virosa* (Willd.) Voigt.	Euphorbiaceae	Mist Aybelash	S	NA111	P	P
156	*Galiniera saxifraga* (Hochst.) Bridson	Rubiaceae	Buna Mesay	T	NA238	A	P
157	*Galinsoga parviflora* Cav. ***a**	Asteraceae	Asedid	H	NA277	P	P
158	*Galinsoga quadriradiata* Ruiz & Pavon ***a**	Asteraceae	Asedid	H	NA092	P	P
159	*Gardenia ternifolia* Schumach. & Thonn. **	Rubiaceae	Gambelo	T	NA182	P	P
160	*Geranium arabicum* Forssk.	Geraniaceae		H	NA067	P	P
161	*Girardinia bullosa* (Stedudel) Wedd.	Urticaceae	Kusha	H	NA107	A	P
162	*Girardinia diversifolia* (Link) Friis **	Urticaceae	Kusha/Sama	H	NA005	P	P
163	*Gnidia glauca* (Fresen.) Gilg **	Thymelaceae	Awura	S	NA100	P	P
164	***Gomphocarpus purpurascens* A. Rich**. **	Asclepiadaceae	Tifye Wotet	S	NA203	A	P
165	*Gouania longispicta* Engl.	Rhamnaceae	Hareg	H	NA114	A	P
166	*Grewia bicolor* Juss.	Tiliaceae	Somaya	S	NA299	P	A

167	*Grewia ferruginea* Hochst. ex A. Rich. **, ***ed**	Tiliaceae	Lenquata	S	NA257	P	P
168	*Grewia mollis* A. Juss.	Tiliaceae	Betre Muse	S	NA195	P	P
169	*Grewia trichocarpa* Hochst. ex A. Rich.	Tiliaceae	Lenquata	S	NA310	P	A
170	*Grewia villosa* Willd. ***a**	Tiliaceae	Lenquata	S	NA242	A	P
171	***Guizotia abyssinica* (L. f.) Cass.** **	Asteraceae	Nug	H	NA155	P	P
172	*Guizotia scabra* (Vis.) Chiov. **	Asteraceae	Mech	H	NA004	P	P
173	*Haplocarpha schimperi* (Sch. Bip.) Beauv. **	Asteraceae	Getin	H	NA101	P	P
174	*Heteromorpha arborescens* (Spreng.) Cham. & Schlecht.	Apiaceae		H	NA159	P	P
175	*Hippocratea africana* (Willd.) Loes. ***a**	Celasteraceae		S	NA191	A	P
176	*Hygrophila schulli* (Hamilt.) M. R. & S. M. Almeida	Acanthaceae	Amikalla	H	NA165	P	P
177	*Hymenodictyon floribundum* (Hoschst. & Steud.) Robinson	Rubiaceae	Gedel Amuq	T	NA194	P	P
178	*Hyparrhenia hirta* (L.) Stapf ***a**	Poaceae	Senbelet	H	NA125	P	P
179	*Hyparrhenia rufa* (Nees) Stapf	Poaceae	Degela	H	NA225	A	P
180	*Hypericum quartinianum* A. Rich. **	Hypericaceae	Amjja	S	NA166	P	P
181	*Hypoestes forskaolii* (Vahl) R. Br.**	Acanthaceae	Arem	H	NA243	A	P
182	*Hypoestes triflora* (Forssk.) Roem & Schult.	Acanthaceae	Tiqur Telenj	H	NA043	P	P
183	*Indigofera spicata* Forssk.	Fabaceae		H	NA128	A	P
184	*Ipomoea indica* (Burm. f.) Merrill ***a**	Convolvulaceae	Hareg	Cl	NA097	A	P
185	*Jasminum abyssinicum* Hochst. ex DC. **	Oleaceae	Tenbelel	Cl	NA140	P	P
186	***Jasminum grandiflorum* L.**	Oleaceae	Tenbelel	Cl	NA150	P	P
187	*Juniperus procera* Hockst. ex Endl.	Cupressaceae	Tid	T	NA117	P	P
188	*Justicia schimperiana* (Hochst. ex Nees) T. Anders. **, ***ed**	Acanthaceae	Smitha	S	NA188	P	P
189	*Kalanchoe petitiana* A. Rich. **	Crassulaceae	Endahula	H	NA048	P	P
190	*Lactuca serriola* L.	Asteraceae		H	NA258	A	P
191	*Laggera crispata* (Vahl) Hepper & Wood **	Asteraceae	Qes Bedeje	H	NA259	P	P
192	***Laggera tomentosa* (Sch. Bip. ex A. Rich.) Oliv. & Hiern** **	Asteraceae	Keskeso	H	NA185	P	P
193	*Lawsonia inermis* L. **, ***a**	Lythraceae	Mist Aybelash	S	NA198	P	P
194	*Leonotis ocymifolia* (Burm. f.) Iwarsson **	Lamiaceae	Yefers Zeng	H	NA181	P	P
195	*Lepisanthes senegalensis* (Juss. ex Poir.) Leench.	Sapindaceae	Tiqur inchet	T	NA174	P	P
196	*Leucas deflexa* Hook. f.	Lamiaceae	Feres Zeng	H	NA070	P	P
197	*Leucas jamesii* Bak.	Lamiacaeae		H	NA104	P	P
198	***Lippia adoensis* Hochst. ex Walp. var. *adoensis*** **	Verbenaceae	Kesiy	S	NA099	P	P
199	*Maesa lanceolata* Forssk. **	Myrsinaceae	Qilambo	T	NA144	P	P
200	*Malva parviflora* Hojer.	Malvaceae	Lut	H	NA296	P	A
201	*Malva verticillata* L. **	Malvaceae	Lut	H	NA119	P	P

202	*Maytenus arbutifolia* (A. Rich.) Wilczek **	Celasteraceae	Atat	S	NA014	P	P
203	*Maytenus gracilipes* (Welw. Oliv. ex Walp.) Exell subsp. *gracilipes*	Celasteraceae	Atat	S	NA013	A	P
204	*Maytenus obscura* (A. Rich.) Cuf.	Celasteraceae	Atat	T	NA003	P	P
205	*Maytenus senegalensis* (Lam.) Exell	Celastraceae	Atat	S	NA260	A	P
206	*Medicago polymorpha* L.	Fabaceae	Wazimma	H	NA274	P	P
207	***Mikaniopsis clematoides* (Sch. Bip. ex A. Rich.) Milne Redh.**	Asteraceae	Qatisa	H	NA261	A	P
208	***Millettia ferruginea* (Hochest.) Bak. subsp. *ferruginea***	Fabaceae	Birbira	T	NA163	P	P
209	*Mimusops kummel* A. DC. ***ed**	Sapotaceae	Shiye/Qoladi	T	NA302	P	A
210	*Momordica foetida* Schumach. **, ***ed**	Cucurbitaceae	Yeamora Misa	Cl	NA112	P	P
211	*Myrica salicifolia* A. Rich.**, ***a**	Myricaceae	Shinet	T	NA153	P	P
212	*Myrsine africana* L. **	Myrsinaceae	Qechemo	S	NA262	A	P
213	*Nicandra physaloides* (L.) Gaertn.	Solanaceae	Astenagir	H	NA256	P	P
214	*Nuxia congesta* R.Br. ex Fresen. **	Loganiaceae	Anfar/Atkuar	T	NA172	P	P
215	*Ocimum lamiifolium* Hochst. ex Benth.**	Lamiaceae	Dama Kesy	S	NA090	P	P
216	*Ocimum urticifolium* Roth ***ed**	Lamiaceae	Ziqaqibe	S	NA148	P	P
217	*Olea europaea* L. subsp. *cuspidata* (Wall. ex G. Don) Cif. **	Oleaceae	Woira	T	NA126	P	P
218	*Olinia rochetiana* A. Juss. **	Oliniaceae	Tifie	S	NA263	A	P
219	*Oplismenus hirtellus* (L.) P. Beauv.	Poaceae	Yeqoq Sar	H	NA049	P	P
220	*Orobanche minor* Smit **	Orobanchaceae	Jibo	H	NA106	P	P
221	*Osyris quadripartita* Decn. **	Santalaceae	Qeret	S	NA139	P	P
222	*Otostegia integrifolia* Benth. **	Lamiaceae	Tinjut	S	NA304	P	A
223	*Oxalis corniculata* L. ***ed**	Oxalidaceae	Yelmachew	H	NA264	P	P
224	*Oxytenanthera abyssinica* (A. Rich.) Munro	Poaceae	Shimel	H	NA241	P	P
225	*Paullinia pinnata* L.	Sapindaceae		Cl	NA146	A	P
226	*Pavetta abyssinica* Fresen. **	Rubiaceae	Dingay Seber	S	NA065	P	P
227	*Pavonia urens* Cav. **	Malvaceae		H	NA096	P	P
228	*Pennisetum nubicum* (Hochst.) K. Schum. ex Engl. ***a**	Poaceae	Sar	H	NA221	A	P
229	*Pennisetum setaceum* (Forssk.) Chiov.	Poaceae	Sar	H	NA206	P	P
230	*Pennisetum sphacelatum* (Nees) Th. Dur. & Sehinz ***a**	Poaceae	Sindedo	H	NA236	P	P
231	*Pennisetum thunbergii* Kunth	Poaceae	Sar	H	NA132	P	P
232	*Periploca linearifolia* Quart. -Dill. & A. Rich. **	Asclepiadaceae	Qundo Areg	Cl	NA072	P	P
233	*Peristrophe paniculata* (Forssk.) Brummitt	Acanthaceae		H	NA207	P	P
234	*Persicaria setosula* (A. Rich.) K. L.Wilson	Polygonaceae		H	NA265	P	P
235	*Phoenix reclinata* Jacq. **, ***ed**	Arecaceae	Chifera	T	NA002	P	P

236	*Phragmanthera regularis* (Sprague) M. Gilbert	Loranthaceae	Teqetila	S	NA222	P	P
237	*Physalis peruviana* L. ***a, *ed**	Solanaceae	Awot	H	NA282	P	A
238	*Phytolacca dodecandra* L' Herit. **	Phytolaccaceae	Indod	S	NA254	A	P
239	*Piliostigma thonningii* (Schumach.) Milne-Redh.	Fabaceae	Yeqola Wanza	T	NA190	P	P
240	*Pittosporum viridiflorum* Sims	Pittosporaceae	Tiqur Inchet	T	NA171	A	P
241	*Plantago lanceolata* L. **	Plantaginaceae	Gorteb	H	NA056	P	P
242	*Plectocephalus varians* (A. Rich) C. Jeffrey. ex Cufod. **	Asteraceae	Engochit	H	NA284	P	A
243	*Plectranthus punctatus* (L.f.) L`Her.	Lamiaceae		H	NA278	P	A
244	*Podocarpus falcatus* (Thunb.) R. B. ex Mirb. **, ***ed**	Podocarpaceae	Zigiba	T	NA133	P	P
245	*Premna schimperi* Engl. **	Lamiaceae	Chocho/Bes	S	NA193	P	P
246	*Prunus africana* (Hook. f.) Kalkm. **, ***ed**	Rosaceae	Komma	T	NA033	P	P
247	*Psydrax schimperiana* (A. Rich.) Bridson ***a**	Rubiaceae	Galo/Seged	S	NA204	A	P
248	*Pteridium aquilinium* (L.) Kuhn subsp. *aquilinium* ***a**	Hypolepidaceae		H	NA063	P	P
249	*Pterolobium stellatum* (Forssk.) Brenan. **	Fabaceae	Qentefa	S	NA032	P	P
250	*Pyrrosia schimperiana* (Kuhn) Alston	Polypodiaceae		H	NA088	P	P
251	*Rhamnus prinoides* L'Herit. **	Rhamnaceae	Gesho	S	NA295	P	A
252	*Rhoicissus tridentata* (L.f.) Wild & Drummand	Vitaceae	Areg	H	NA232	A	P
253	***Rhus glutinosa* A. Rich. subsp. *glutinosa* *ed**	Anacardiaceae	Ashiqammo	S	NA074	P	P
254	*Rhus natalensis* Krauss ***a**	Anacardiaceae	Mist Aybelash	S	NA228	P	P
255	*Rhus retinorrhoea* Oliv. ***a**	Anacardiaceae	Tilem	S	NA149	P	P
256	*Rhus vulgaris* Meikle	Anacardiaceae	Ashiqamo	S	NA223	P	P
257	*Ricinus communis* L. **, ***a**	Euphorbiaceae	Chaqimma	H	NA091	P	P
258	*Ritchiea albersii* Gilg ***ed**	Capparidaceae	Chomiye	T	NA023	P	P
259	*Rosa abyssinica* Lindley **, ***ed**	Rosaceae	Qega	S	NA075	P	P
260	*Rubia cordifolia* L. **	Rubiaceae	Minchir	H	NA255	P	P
261	*Rubus apetalus* Poir. **, ***ed**	Rosaceae	Injor	S	NA045	P	P
262	*Rubus steudneri* Schweinf. ***a, *ed**	Rosaceae	Injor	S	NA158	P	P
263	*Rumex abyssinicus* Jacq. **, ***ed**	Polygonaceae	Meqmeqo	H	NA266	P	P
264	*Rumex nepalensis* Spreng. **	Polygonaceae	Tult	H	NA077	P	P
265	*Rumex nervosus* Vahl **, ***ed**	Polygonaceae	Anbuatie	S	NA068	P	P
266	*Salix subserrata* Willd. **	Salicaceae	Kya	T	NA285	P	A
267	*Salvia nilotica* Jacq. ***a**	Lamiaceae	Hulgeb	H	NA273	P	P
268	*Sansevieria ehrenbergii* Schweinf, ex Baker **, ***a, *ed**	Dracaenaceae	Algeti/Chiret	H	NA315	P	A
269	*Satureja punctata* (Benth.) Briq.	Lamiaceae	Tosign	H	NA272	P	P
270	*Schefflera abyssinica* (Hochst. ex A. Rich.) Harms **, ***a**	Araliaceae	Getem	T	NA154	P	P

271	*Securidaca longepedunculata* Fresen. **	Polygalaceae	Etse Menahe	S	NA215	P	P
272	*Senna singueana* (Del.) Lock. **	Fabaceae	Guffa	S	NA124	P	P
273	*Sida schimperiana* Hochst. ex A. Rich. **	Malvaceae	Chifrig	S	NA081	P	P
274	*Sisymbrium erysimoides* Desf.	Brassicaceae	Yewof Gomen	H	NA235	P	P
275	***Solanecio gigas* (Vatke.) C. Jeffrey** **	Asteraceae	Boz	S	NA281	P	A
276	*Solanum adoense* Hochst. ex A. Rich. ***a**	Solanaceae	Imbuay	S	NA060	P	P
277	*Solanum anguivi* Lam. **	Solanaceae	Zercho	S	NA103	P	P
278	*Solanum incanum* L. **, ***a**	Solanaceae	Zercho	S	NA251	P	P
279	*Solanum marginatum* L.f. **	Solanaceae	Imbuay	S	NA079	P	P
280	*Solanum nigrum* L. **, ***a, *ed**	Solanaceae	Awotign	H	NA175	P	P
281	*Sorghum bicolor* (L.) Moench	Poaceae	Mashila	H	NA300	P	A
282	*Sparmannia ricinocarpa* (Eckl. & Zeyh.) O. Ktze.	Tiliaceae	Wulkifa	S	NA250	A	P
283	*Sphaeranthus suaveolens* Forssk. DC.	Asteraceae	Arem	H	NA271	A	P
284	*Sporobolus pyramidalis* P. Beauv.	Poaceae	Muriy	H	NA143	A	P
285	*Stephania abyssinica* (Dillon & A. Rich.) Walp. **	Menispermaceae	Yeait Joro	H	NA039	P	P
286	*Stereospermum kunthianum* Cham. **	Bignoniaceae	Zana/Washta	S	NA301	P	A
287	*Syzygium guineense* (Willd.) DC. subsp. *guineense* **, ***ed**	Myrtaceae	Bedessa /doqima	T	NA001	P	P
288	*Tacazzea conferta* N.E. Br. ***a**	Asclepiadaceae	Girangirie	Cl	NA252	A	P
289	*Tagetes minuta* L. ***a**	Asteraceae	Dedie	H	NA170	P	P
290	*Tamarindus indica* L. **, ***ed**	Fabaceae	Roqa	T	NA229	P	P
291	*Tapinanthus globiferous* (A. Rich.) Tieghem	Loranthaceae	Tegedira	S	NA087	P	P
292	*Teclea nobilis* Del. ***ed**	Rutaceae	Atesa/Sihil	T	NA069	P	P
293	*Terminalia brownii* Fresen.	Combretaceae	Defeq	T	NA227	P	P
294	*Thalictrum schimperianum* Hochst. ex Scheiwnf. **, ***a**	Ranunculaceae	Sir Bizu	H	NA010	A	P
295	*Torilis arvensis* (Hudson) Link.	Apiaceae	Arem	H	NA268	P	P
296	*Tragia brevipes* Pax **	Euphorbiaceae	Aleblabit	H	NA311	P	A
297	*Trifolium multinerve* A. Rich.	Fabaceae	Wazima	H	NA038	P	P
298	*Triumfetta flavescens* Hochst.	Tiliaceae		S	NA269	P	P
299	*Urera hypselodendron* (A. Rich.) Wedd. **	Urticaceae	Lankusso	Cl	NA041	P	P
300	***Urtica simensis* Steudel** **	Urticaceae	Samma	H	NA098	P	P
301	***Vepris dainellii* (Pic.Serm.) Kokwaro**	Rutaceae	Tiqur Inchet	T	NA169	A	P
302	*Verbascum sinaiticum* Benth. **	Scrophulariaceae	Qetentina	H	NA122	P	P
303	*Vernonia adoensis* Sch. -Bip. ex Walp.	Asteraceae	Yeferes Zeng	H	NA102	P	P
304	*Vernonia amygdalina* Del. **	Asteraceae	Girawa	S	NA131	P	P
305	*Vernonia auriculifera* Hiern. ***a**	Asteraceae	Gegerita	S	NA007	P	P

306	***Vernonia leopoldi* (Sch.Bip.ex Walp.) Vatke** *a	Asteraceae		S	NA123	A	P
307	*Vernonia myriantha* Hook. f.	Asteraceae	Gengerita	S	NA113	P	P
308	*Viscum tuberculatum* A. Rich. **	Viscaceae	Teqetsila	S	NA152	A	P
309	*Withania somnifera* (L.) Dunal **	Solanaceae	Giziewa	S	NA184	P	P
310	*Xanthium spinosum* L.	Asteraceae	Amikalla	H	NA208	P	P
311	*Xanthium strumarium* L. **	Asteraceae	Yeabay Arem	H	NA219	P	P
312	*Ximenia americana* L. **, ***ed**	Olacaceae	Enkoy	T	NA177	P	P
313	*Zehneria scabra* (Linn. f.) Sond. **	Cucurbitaceae	Hareg Sessa	H	NA116	P	A
314	*Ziziphus abyssinica* Hochst. ex A. Rich.	Rhamnaceae	Qurqura	S	NA317	P	A
315	*Ziziphus mauritiana* Lam. ***a**	Rhamnaceae		S	NA309	A	P
316	*Ziziphus mucronata* Willd.	Rhamnaceae	Gaba	S	NA313	P	P
317	*Ziziphus spina-christi* (L.) Desf. **, ***a, *ed**	Rhamnaceae	Qurqura	S	NA220	P	P
Total number of plant species in each district						**256**	**275**

** used for one or more herbal medicinal uses in the study districts (137 spp.; 43%); ***a** New records for Gojjam Floristic Region (51spp.);

***ed** = Edible (50 spp.)

N. B: Species in **Boldface** are endemic to the present day Ethiopia (22 spp.)

Appendix-3: Number of plant species along with their corresponding genera and families in Forest patches

No.	Family	Districts, genera, species and percentage (%)											
		Baso Liben				Debre Elias				Combined districts			
		Genera	%	Species	%	Genera	%	Species	%	Genera	%	Species	%
1	Acanthaceae	6	3.13	9	3.52	7	3.43	11	4.00	7	3.00	11	3.47
2	Adiantaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
3	Agavaceae	-	-	-	-	1	0.49	1	0.36	1	0.43	1	0.32
4	Aloaceae	1	0.52	2	0.78	1	0.49	2	0.73	1	0.43	2	0.63
5	Amaranthaceae	3	1.56	4	1.56	3	1.47	5	1.82	3	1.28	5	1.58
6	Amarylidiaceae	1	0.52	1	0.39	-	-	-	-	1	0.43	1	0.32
7	Anacardiaceae	1	0.52	4	1.56	1	0.49	4	1.45	1	0.43	4	1.26
8	Apiaceae	2	1.04	2	0.78	2	0.98	2	0.73	2	0.85	2	0.63
9	Apocynaceae	2	1.04	2	0.78	2	0.98	2	0.73	2	0.85	2	0.63
10	Araceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
11	Araliaceae	1	0.52	1	0.39	2	0.98	2	0.73	2	0.85	2	0.63
12	Arecaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
13	Asclepiadaceae	3	1.56	3	1.17	5	2.45	5	1.82	5	2.14	5	1.58
14	Asparagaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
15	Aspleniaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
16	Asteraceae	19	9.85	28	10.94	22	10.78	34	12.36	25	10.68	37	11.67
17	Balanitaceae	1	0.52	1	0.39	-	-	-	-	1	0.42	1	0.32
18	Bignoniaceae	1	0.52	1	0.39	-	-	-	-	1	0.43	1	0.32
19	Boraginaceae	2	1.04	3	1.17	3	1.47	4	1.45	3	1.28	4	1.26
20	Brassicaceae	1	0.52	1	0.39	2	0.98	2	0.73	2	0.85	2	0.63
21	Burseraceae	-	-	-	-	2	0.98	2	0.73	2	0.85	2	0.63
22	Capparidaceae	2	1.04	3	1.17	2	0.98	3	1.09	2	0.85	3	0.95
23	Celasteraceae	1	0.52	2	0.78	2	0.98	5	1.82	2	0.85	5	1.58
24	Chenopodiaceae	1	0.52	2	0.78	1	0.49	2	0.73	1	0.43	2	0.63
25	Combretaceae	3	1.04	4	1.56	2	0.98	4	1.45	3	1.28	5	1.58
26	Commelinaceae	1	0.52	2	0.78	1	0.49	1	0.36	1	0.43	2	0.63
27	Convolvulaceae	-	-	-	-	1	0.49	1	0.36	1	0.43	1	0.32
28	Crassulaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
29	Cucurbitaceae	3	1.56	3	1.17	2	0.98	2	0.73	3	1.28	3	0.95
30	Cupressaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
31	Cyperaceae	2	1.04	3	1.17	2	0.98	4	1.45	3	1.28	5	1.58

32	Dioscoreaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
33	Dipsacaceae	1	0.52	1	0.39	-	-	-	-	1	0.43	1	0.32
34	Dracaenaceae	2	1.04	2	0.78	-	-	-	-	2	0.85	2	0.63
35	Ebenaceae	2	1.04	2	0.78	2	0.98	2	0.73	2	0.85	2	0.63
36	Euphorbiaceae	6	3.13	7	2.73	6	2.94	7	2.55	7	3.00	9	2.84
37	Fabaceae	14	7.29	23	8.98	16	7.84	27	9.82	16	6.84	29	9.15
38	Flacourtiaceae	1	0.52	1	0.39	2	0.98	2	0.73	2	0.85	2	0.63
39	Geraniaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
40	Hypericaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
41	Hypolepidaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
42	Icacinaceae	-	-	-	-	1	0.49	1	0.36	1	0.43	1	0.32
43	Lamiaceae	9	4.69	11	4.30	6	2.94	8	2.91	9	3.85	11	3.47
44	Loganiaceae	2	1.04	2	0.78	2	0.98	2	0.73	2	0.85	2	0.62
45	Lomariopsidaceae	-	-	-	-	1	0.49	1	0.36	1	0.43	1	0.32
46	Loranthaceae	2	1.04	2	0.78	2	0.98	2	0.73	2	0.85	2	0.63
47	Lythraceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
48	Malpighiaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
49	Malvaceae	4	2.08	7	2.73	4	1.96	4	1.45	4	1.71	7	2.21
50	Meliaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
51	Melianthaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
52	Menispermaceae	1	0.52	1	0.39	2	0.98	2	0.73	2	0.85	2	0.63
53	Molluginaceae	-	-	-	-	1	0.49	1	0.36	1	0.43	1	0.32
54	Moraceae	1	0.52	5	1.95	1	0.49	4	1.45	1	0.43	6	1.89
55	Musaceae	1	0.52	1	0.39	-	-	-	-	1	0.43	1	0.32
56	Myricaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
57	Myrsinaceae	2	1.04	2	0.78	2	0.98	3	1.09	3	1.28	3	0.95
58	Myrtaceae	2	1.04	2	0.78	2	0.98	2	0.73	2	0.85	2	0.63
59	Olacaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
60	Oleaceae	2	1.04	3	1.17	2	0.98	3	1.09	2	0.85	3	0.95
61	Oliniaceae	-	-	-	-	1	0.49	1	0.36	1	0.43	1	0.32
62	Orobanchaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
63	Oxalidaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
64	Papaveraceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
65	Phytolaccaceae	-	-	-	-	1	0.49	1	0.36	1	0.43	1	0.32
66	Pittosporaceae	-	-	-	-	1	0.49	1	0.36	1	0.43	1	0.32

67	Plantaginaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
68	Poaceae	13	6.77	16	6.25	10	4.90	14	5.09	14	5.98	19	6.00
69	Podocarpaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
70	Polygalaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
71	Polygonaceae	2	1.04	4	1.56	2	0.98	4	1.45	2	0.85	4	1.26
72	Polypodiaceae	2	1.04	2	0.78	2	0.98	2	0.73	2	0.85	2	0.63
73	Ranunculaceae	1	0.52	2	0.78	2	0.98	3	1.09	2	0.85	3	0.95
74	Resedaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
75	Rhamnaceae	2	1.04	4	1.56	2	0.98	4	1.45	3	1.28	6	1.89
76	Rhizophoraceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
77	Rosaceae	4	2.08	5	1.95	4	1.96	5	1.82	4	1.71	5	1.58
78	Rubiaceae	5	2.60	5	1.95	6	2.94	6	2.18	7	3.00	7	2.21
79	Rutaceae	3	1.56	3	1.17	3	1.47	3	1.09	4	1.71	4	1.26
80	Salicaceae	1	0.52	1	0.39	-	-	-	-	1	0.43	1	0.32
81	Santalaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
82	Sapindaceae	4	2.08	4	1.56	5	2.45	5	1.82	5	2.14	5	1.58
83	Sapotaceae	1	0.52	1	0.39	-	-	-	-	1	0.43	1	0.32
84	Scrophulariaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
85	Simaroubaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
86	Sinopteridaceae	1	0.52	2	0.78	1	0.49	2	0.73	1	0.43	2	0.63
87	Solanaceae	6	3.13	10	3.91	4	1.96	8	2.91	6	2.56	10	3.15
88	Sterculiaceae	1	0.52	2	0.78	1	0.49	2	0.73	1	0.43	2	0.63
89	Thymelaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
90	Tiliaceae	2	1.04	5	1.95	3	1.47	5	1.82	3	1.28	7	2.21
91	Ulmaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
92	Urticaceae	3	1.56	3	1.17	4	1.96	5	1.82	4	1.71	5	1.58
93	Verbenaceae	1	0.52	1	0.39	1	0.49	1	0.36	1	0.43	1	0.32
94	Viscaceae	-	-	-	-	1	0.49	1	0.36	1	0.43	1	0.32
95	Vitaceae	2	1.04	3	1.17	2	0.98	3	1.09	3	1.28	4	1.26
		193	**100**	**256**	**100**	**204**	**100**	**275**	**100**	**234**	**100**	**317**	**100**

Appendix-4: Structure (frequency, relative frequency, abundance, density, basal area, dominance and importance value index) of woody species in the study area (pooled data from all forest patches) (Key: FR = Frequency; Nis = number of individuals; NPs = number of plots where the species occurred; BA = Basal area; RDe = Relative density; RFr = Relative frequency; RDO (RBA) = Relative dominance/Relative basal area; IVI Important value index)

Plant species	**FR**	**RFr**	**Nis**	**NPs**	**Density (ha^{-1})**	**RDe**	**BA (m^2ha^{-1})**	**RDo**	**IVI**
Abutilon longicuspe	10.87	0.62	20	10	5.43	0.28	0.01	0.01	0.91
Acacia abyssinica	50.00	2.85	360	46	98.00	5.00	4.76	5.94	14.00
Acacia etbaica	3.26	0.19	3	3	0.82	0.04	0.02	0.03	0.26
Acacia hecatophylla	2.17	0.12	2	2	0.54	0.03	0.02	0.03	0.18
Acacia lahai	6.52	0.32	25	6	6.79	0.35	0.47	0.62	1.29
Acacia negrii	5.43	0.31	13	5	3.53	0.18	0.04	0.05	1.48
Acacia nilotica	7.61	0.43	40	7	10.87	0.56	0.46	0.61	1.60
Acacia pilispina	34.78	1.98	132	32	35.87	1.83	0.44	0.58	4.39
Acacia senegal	20.65	1.17	51	19	13.86	0.71	0.55	0.73	2.61
Acacia seyal	31.52	1.79	282	29	76.63	3.91	3.32	4.40	10.10
Acanthus polystachius	28.26	1.61	54	26	14.67	0.75	0.05	0.07	2.43
Acanthus pubescens	23.91	1.36	116	22	31.52	1.61	0.12	0.16	3.13
Acokanthera schimperi	9.78	0.56	38	9	10.33	0.53	0.07	0.09	1.18
Albizia grandibracteata	1.09	0.06	1	1	0.27	0.01	0	0	0.07
Albizia gummifera	13.04	0.74	39	12	10.59	0.54	1.34	1.78	3.06
Albizia schimperiana	10.87	0.62	62	10	16.85	0.86	1.69	2.24	3.72
Allophylus abyssinicus	5.43	0.31	38	5	10.33	0.53	1.13	1.50	2.34
Anogeissus leiocarpa	20.65	1.17	131	19	35.60	1.82	3.29	4.36	7.35
Apodytes dimidiata	4.35	0.25	15	4	4.08	0.21	0.07	0.09	1.36
Asparagus africanus	9.78	0.56	26	9	7.07	0.36	0	0	0.92
Balanites aegyptiaca	8.70	0.50	14	8	3.80	0.19	0.37	0.49	1.18
Bersama abyssinica	17.39	0.99	97	16	26.36	1.35	0.28	0.37	2.71
Boswellia pirottae	11.96	0.68	21	11	5.71	0.29	0.72	0.95	1.92
Brucea antidysenterica	13.04	0.74	100	12	27.17	1.39	0.56	0.74	2.87
Buddleja polystachya	6.52	0.37	20	6	5.43	0.28	0.04	0.05	0.70
Calpurina aurea	11.96	0.68	77	11	20.92	1.07	0.18	0.24	1.99
Capparis tomentosa	7.61	0.43	14	7	3.80	0.19	0.01	0.01	0.63
Carissa spinarum	41.30	2.35	483	38	131.00	6.70	0.43	0.57	9.62
Cassipourea malosana	7.61	0.43	32	7	8.70	0.44	0.15	0.20	1.07
Celtis africana	4.35	0.25	4	4	1.09	0.06	0.37	0.49	0.80
Clausena anisata	26.09	1.49	73	24	19.84	1.01	0.14	0.19	2.69

Clutia abyssinica	5.43	0.31	42	5	11.41	0.58	0.03	0.04	0.93
Combretum aculeatum	9.78	0.56	12	8	3.26	0.17	0.08	0.11	0.84
Combretum collinum	3.26	0.19	8	3	2.17	0.11	0.01	0.01	0.31
Combretum molle	14.13	0.80	34	13	9.24	0.47	0.87	1.15	2.42
Cordia africana	19.57	1.11	42	18	11.41	0.58	0.88	1.17	2.86
Croton macrostachyus	55.43	3.16	365	51	99.00	5.06	5.73	7.60	16.00
Cussonia arborea	2.17	0.12	6	2	1.63	0.08	0.02	0.03	0.23
Debregeasia saeneb	1.09	0.06	2	1	0.54	0.03	0	0	0.09
Dichrostachys cinerea	36.96	2.10	235	34	63.86	3.26	1.36	1.80	7.16
Discopodium penninervium	3.26	0.19	4	3	1.09	0.06	0	0	0.25
Dodonaea angustifolia	5.43	0.31	42	5	11.41	0.58	0.05	0	0.89
Dombeya kefaensis	2.17	0.12	3	2	0.82	0.04	0.01	0.01	0.17
Dombeya torrida	4.35	0.25	5	4	1.36	0.07	0.98	1.30	1.62
Dovyalis abyssinica	5.43	0.31	17	5	4.62	0.24	0.01	0.01	0.56
Dracaena steudneri	21.74	1.24	35	20	9.51	0.49	2.29	3.04	4.77
Ehretia cymosa	9.78	0.56	27	9	7.34	0.37	0.22	0.29	1.22
Ekebergia capensis	8.70	0.50	29	8	7.88	0.40	0.43	0.57	1.47
Embelia schimperi	13.04	0.74	41	12	11.14	0.57	0.08	0.11	1.42
Entada abyssinica	14.13	0.80	37	13	10.05	0.51	0.14	0.19	1.50
Erythrina brucei	10.87	0.61	16	10	4.35	0.22	1.07	1.42	2.25
Euclea racemosa subsp. *schimperi*	33.70	1.92	140	31	38.04	1.94	0.88	1.17	5.03
Euphorbia abyssinica	23.91	1.36	42	22	11.41	0.58	2.06	2.73	4.67
Fagaropsis angolensis	2.17	0.12	4	2	1.09	0.06	0.05	0.06	0.24
Ficus glumosa	3.26	0.19	5	3	1.36	0.07	0.01	0.01	0.27
Ficus ingens	1.09	0.06	2	1	0.54	0.03	0	0	0.09
Ficus salicifolia	3.26	0.19	11	3	2.99	0.15	0.45	0.60	0.94
Ficus sur	29.34	1.67	76	27	20.65	1.05	4.68	6.21	8.93
Ficus sycomorus	22.83	1.30	48	21	13.04	0.67	4.29	5.70	7.67
Ficus vasta	6.52	0.37	7	6	1.90	0.09	2.73	3.62	5.89
Flacourtia indica	5.43	0.31	16	5	4.35	0.22	0.04	0.05	0.58
Flueggea virosa	7.61	0.43	9	7	2.45	0.13	0.05	0.07	0.63
Galiniera saxifraga	3.26	0.19	4	3	1.09	0.06	0.03	0.04	0.29
Gardenia ternifolia	21.74	1.24	71	20	19.29	0.98	0.55	0.73	2.95
Gnidia glauca	5.43	0.31	29	5	5.16	0.26	0.07	0.09	0.66
Gouania longispicta	16.30	0.93	43	15	11.68	0.60	0.04	0.05	1.58
Grewia bicolor	8.70	0.50	16	8	4.35	0.22	0.01	0.01	0.73
Grewia ferruginea	20.65	1.17	74	19	20.11	1.03	0.22	0.29	2.49

Grewia mollis	6.52	0.37	22	6	5.98	0.31	0.02	0.03	0.71
Grewia trichocarpa	7.61	0.43	8	7	2.17	0.11	0.01	0.01	0.55
Grewia villosa	11.96	0.68	38	11	10.33	0.53	0.06	0.08	1.29
Hippocratea africana	4.35	0.25	13	4	3.53	0.18	0	0	0.43
Hymenodictyon floribundum	2.17	0.12	5	2	1.36	0.07	0	0	0.19
Jasminum abyssinicum	10.87	0.62	25	10	6.79	0.35	0	0	0.97
Juniperus procera	27.17	1.55	67	25	18.21	0.93	5.32	7.06	9.54
Justicia schimperiana	28.26	1.61	76	26	20.65	1.05	0.02	0.03	2.69
Lawsonia inermis	20.65	1.17	49	19	13.32	0.68	0.09	0.12	1.97
Lepisanthes senegalensis	10.87	0.62	41	10	11.14	0.57	1.02	1.35	2.54
Maesa lanceolata	19.57	1.11	78	18	21.20	1.08	0.23	0.31	2.50
Maytenus arbutifolia	39.13	2.23	320	36	86.96	4.44	0.50	0.66	7.33
Maytenus obscura	9.78	0.56	21	10	5.71	0.29	0.15	0.20	1.05
Maytenus senegalensis	18.48	1.05	58	17	15.76	0.80	0.25	0.33	2.18
Maytenus gracilipes subsp. *gracilipes*	6.52	0.37	42	6	11.41	0.58	0.13	0.17	1.12
Milletia ferruginea	9.78	0.56	24	9	6.52	0.33	0.15	0.20	1.06
Mimusops kummel	6.52	0.37	14	6	3.80	0.19	0.42	0.56	1.12
Myrica salicifolia	16.30	0.93	39	15	10.59	0.54	0.87	1.15	2.62
Myrsine africana	21.74	1.24	55	20	14.95	0.76	0.45	0.60	2.60
Nuxia congesta	13.04	0.74	41	12	11.14	0.57	0.17	0.23	1.54
Ocimum urticifolium	9.78	0.56	71	9	19.29	0.98	0.05	0.07	1.61
Olea europaea subsp. *cuspidata*	4.35	0.25	6	4	1.63	0.08	0.04	0.05	0.38
Olinia rochetiana	11.96	0.68	19	11	5.16	0.26	0.10	0.13	1.07
Osyris quadripartita	8.70	0.50	45	8	12.23	0.62	0.03	0.04	1.16
Pavetta abyssinica	15.22	0.87	123	14	33.42	1.71	0.41	0.54	3.12
Phoenix reclinata	6.52	0.37	38	6	10.33	0.53	0.06	0.08	0.98
Phytolacca dodecandra	2.17	0.12	3	2	0.82	0.04	0	0	0.16
Piliostigma thonningii	3.26	0.19	4	3	1.09	0.06	0.13	0.17	0.42
Pittosporum viridiflorum	7.61	0.43	26	7	7.07	0.36	0.21	0.28	1.07
Podocarpus falcatus	5.43	0.31	6	5	1.63	0.08	0	0	0.39
Premna schimperi	7.61	0.43	42	7	11.41	0.58	0.42	0.56	1.57
Prunus africana	26.09	1.49	63	24	17.12	0.87	1.34	1.78	4.14
Psydrax schimperiana	1.09	0.06	2	1	0.54	0.03	0	0	0.09
Pterolobium stellatum	19.57	1.11	133	18	36.14	1.85	0.01	0.01	2.97
Rhus glutinosa subsp. *glutinosa*	20.65	1.17	76	19	20.65	1.05	0.19	0.25	2.47
Rhus natalensis	10.87	0.62	22	10	5.98	0.30	0.02	0.03	0.95
Rhus retinorrhoea	13.04	0.74	57	12	15.49	0.79	0.03	0.04	1.57

Rhus vulgaris	4.35	0.25	11	4	3.00	0.15	0.02	0.03	0.43
Ritchiea albersii	5.43	0.31	20	5	5.43	0.28	0.02	0.03	0.62
Rosa abyssinica	9.78	0.56	44	9	11.96	0.61	0.05	0.06	1.23
Rubus apetalus	10.87	0.62	72	10	19.57	1.00	0.07	0.09	1.71
Rumex nervosus	18.48	1.05	54	17	14.67	0.75	0.01	0.01	1.81
Schefflera abyssinica	7.61	0.43	25	7	6.79	0.35	1.06	1.41	2.19
Securidaca longepedunculata	6.52	0.37	31	6	8.42	0.43	0.13	0.17	0.97
Senna singueana	40.22	2.29	257	37	69.84	3.57	0.48	0.64	6.5
Solanecio gigas	4.35	0.25	18	4	4.89	0.25	0.02	0.03	0.53
Solanum marginatum	5.43	0.31	14	5	3.80	0.19	0	0	0.50
Stereospermum kunthianum	2.17	0.12	9	2	2.46	0.13	0.09	0.12	0.37
Syzygium guineense subsp. *guineense*	19.57	1.11	87	18	23.64	1.21	2.90	3.85	6.15
Tamarindus indica	32.61	1.90	74	30	20.11	1.03	3.77	5.00	7.93
Teclea nobilis	37.04	2.11	141	34	38.32	1.96	0.29	0.38	4.45
Terminalia brownii	11.96	0.68	32	11	8.70	0.44	0.18	0.24	1.36
Urera hypselodendron	30.43	1.73	130	28	35.33	1.80	0.14	0.20	3.73
Vepris dainellii	7.61	0.43	35	7	9.51	0.49	0.38	0.50	1.42
Vernonia amygdalina	25.00	1.42	48	23	13.04	0.64	0.44	0.58	2.64
Vernonia auriculifera	35.87	2.04	236	33	64.13	3.27	0.06	0.08	5.39
Vernonia myriantha	8.70	0.50	13	8	3.53	0.18	0.02	0.03	0.71
Ximenia americana	10.87	0.62	38	10	10.33	0.53	0.05	0.07	1.22
Ziziphus abyssinica	2.17	0.12	4	2	1.09	0.06	0.01	0.01	0.19
Ziziphus mauritiana	3.26	0.19	8	3	2.17	0.11	0.03	0.04	0.34
Ziziphus mucronata	8.70	0.50	16	8	4.35	0.22	0.08	0.11	0.83
Ziziphus spina-christi	14.13	0.80	24	13	6.52	0.33	0.10	0.13	1.26
Total	**1, 747**	**100**	**7, 197**	**-**	**1, 952**	**100**	**75**	**-**	**301**

Appendix-5: List of medicinal plants used for treating human diseases in the study area: with scientific name, family, local name (Amh=Amhaic), habit (Ha) (Shrub, S; Tree, T; Herb, H; Climber, Cl;), source, disease treated, parts used (PU) (Root, R; Leaf, L; Bark, Ba; Bulb, Bu; Sap, Sp; Shoot, Sh; Stem, St; Rhizome, Rh; Seed, Se; Fruit, Fr; Flower, Fl and Whole plant, Wp), mode of remedy preparation and application (MRPA) [(1 = boil and drink the decoction as soon as cooling; 2 = Crush/squeeze, soak the part with cold water and drink the infusion; 3 = Grind/crush and paint the powder or crushed parts to the affected body; 4 = Extract/remove the latex/ juice/sap/ and pour into or paint it; 5 = Chew the fresh part and take the fluid only; 6 = Crush, soak with water and then bathe; 7 = Chew and/or hold the part with teeth; 8 = Eat/ingest the part (raw/cooked/roasted); 9 = Grind and paste the crushed part and tie 10 = Drink the concoction; 11 = Boil and take a steam bathe/wash; 12 = Sniff/inhale the fumigated/smoked/burnt/heated of powdered parts; 13 = Crush and sniff the fresh part)], Route of remedy administration; (RA) (Oral, Or; Nasal, Na; Dermal, Dm; Ocular, Oc; Auricular, Au; Anal, An; Tooth surface, Ts), plant parts mixed with collection number (PMCN) and condition of parts used (CPU)(fresh, F; dry, D), District (Dist) (Baso Liben, BL; Debre Elias, DE) and Voucher number (V. No.), Nigussie Amsalu (NA).

No.	Scientific name	Family	Local name (Amh)	Ha	Disease treated	PU	MPAP	RA	PMCN	CPU	Districts	V. No.
1	*Acacia abyssinica* Hochst. ex Benth.	Fabaceae	Girar	T	Dandruff	L	3	Dm	180	F	BL, DE	NA024
					Wound	Fr	9	Dm		F/D		
2	*Acacia lahai* Steud.& Hochst.ex Benth	Fabaceae	Cheba	S	Tonsillitis	R	4	Or		F	BL	NA035
3	*Achyranthes aspera* L.	Amaranthaceae	Telenj	H	Hemorrhoids	L	3	An		D	BL, DE	NA017
4	*Acmella caulirhiza* Del.	Asteraceae	Yemidir Berbere	H	Tonsillitis	L	2	Or	185	F	BL, DE	NA137
					Toothache	Fl	7	Or		F		
5	*Acokanthera schimperi* (A. DC.) Schweinf. ***t**	Apocynaceae	Merz	S	Wound	L	9	Dm		F/D	BL, DE	NA226
					Snakebite	R	1	Or	141	F /D		
					Leprosy	L	3	Dm	059, 068	F		
					Acute febrile illness (Megagna)	L	4	Or		F		
6	*Ageratum conyzoides* L.	Asteraceae	Arem	H	Wound	L	6	Dm		F	BL, DE	NA180
					Cut	L	9	Dm		F		
7	*Allium sativum* L. ***b**	Alliaceae	Nech Shinkurt	H	Evil eye	Bu	13	No	324	F	BL, DE	NA320

					Coughing	Bu	10	Or	324, 343, 340	F		
					Indigestion	Bu	1	Or	322	F		
					Wart	Bu	3	Dm		F		
					Ringworm	Bu	4	Dm		F		
					Asthma	Bu	1	Or		F/D		
					Gastritis	Bu	8	Or	090	F		
					Snakebite	Bu	1	Or		F		
					Abdominal worms	Bu	1	Or	335	F/D		
8	*Aloe camperi* Schweinf.	Aloaceae	Ret	H	Eczema	L/St	4	Dm		F	DE	NA127
					Skin rush/allergy	La	4	Dm		F		
9	*Aloe macrocarpa* Tod.	Aloaceae	Ret	H	Wound	L/St	4	Dm		F	BL, DE	NA147
					Bone fracture	La	4	Dm		F		
10	*Amaranthus caudatus* L.	Amaranthaceae	Alumma	H	Constipation	Fr	1	Or		F	BL	NA234
11	*Anogeissus leiocarpa* (A. DC.) Guill. & Perr.	Combretaceae	Muak	T	Jaundice	L	2	Or		F	BL, DE	NA297
					Acute febrile illness	Ba	2	Or	057	F /D		
12	*Artemisia abyssinica* Sch. Bip. ex A. Rich.	Asteraceae	Chiqugn	H	Evil eye	L	13	Na	320, 324, 079	F	BL, DE	NA323
					Ear pest expellant	L	4	Au		F		
13	*Asparagus africanus* Lam.	Asparagaceae	Yeset Qest	S	Impotency	R	1	Or	341	D	BL, DE	NA066
					Abdominal colic (Qurtet)	L	2	Or		F		
14	*Balanites aegyptiaca* (L.) Del. ***t**	Balanitaceae	Yeasa Maskerya	T	Coughing	Ba	2	Or		D	BL	NA306
15	*Bersama abyssinica* Fresen.	Melianthaceae	Azamir	T	Acute febrile illness	L	1	Or		F	BL, DE	NA037
16	***Boswellia pirottae* Chiov.**	Burseraceae	Qerere/Etan	T	Stabbing pain	R	2	Or		F	DE	NA218
					Evil sprit	La	12	Na		D		
17	***Brassica carinata* A. Br. *b**	Brassicaceae	Gomen zer	H	Abdominal colic	Se	1	Or		D	BL	NA249
					Gastritis	L	1	Or		F		
18	*Brucea antidysenterica* J.F. Mill.	Simarobaceae	Abalo	T	Leishmania	Fr	3	Dm		D	BL, DE	NA059
					Dysentery	L/Fr	1	Or		D		

					Wound	L	3	Dm		D		
					"Qurba"	Sh	1	Or		F		
19	*Buddleja polystachya* Fresen.	Loganiaceae	Anfar	S	Leprosy	L	4	Or	229	F	DE	NA118
					Scorpion poison	R	7	Or	057	F		
					Tonsillitis	L	2	Or		F	DE	
20	*Calotropis procera* (Ait.) Ait. f. ***t**	Asclepiadaceae	Qilanbo	S	Syphilis	La/L	4	Dm		D	BL, DE	NA168
					Wart	La	3	Dm	081	F		
					Hemorrhoids	La	4	Dm	326	F		
21	*Calpurnia aurea (*Ait.) Benth.	Fabaceae	Ligita	S	Wound	L	9	Dm	059	F	BL	NA108
22	*Capparis tomentosa* Lam.	Capparidaceae	Gumero	S	Toothache	L	7	Or		F	BL, DE	NA141
					Evil sprit	R	12	Dm	020, 304	D		
23	*Carduus schimperi* Sch. Bip. ex A. Rich.	Asteraceae	Kosheshila	H	Febrile illness	R	6	Dm		F	BL, DE	NA129
24	*Carica papaya* L.***b**	Caricaceae	Papaya	T	Gastritis	Fr	8	Or		F	BL, DE	NA348
					Abdominal pain	R	1	Or		F		
					Malaria	L	8	Or		F		
					Diarrhoea	Fr	8	Or		F		
25	*Carissa spinarum* L.	Apocynaceae	Agam	S	Snakebite	R	1	Or	108, 326	F	BL, DE	NA083
					Evil eye	L	13	Na		F		
26	*Cassipourea malosana* (Baker) Alaston	Rhizophoraceae	Tiqur Inchet	T	Gonorrhoea	Ba	1	Or		F	BL, DE	NA161
27	*Catha edulis* (Vahl) Forssk. ex Endl.***b**	Celasteraceae	Chat	S	Leprosy	L	4	Or	297	F	BL, DE	NA319
					Heart failure	Wp	1	Or	297	F		
					Hypertension	Sh	1	Or	320	F		
					Coughing	L	1	Or		F		
					Abdominal pain	Sh	1	Or		F		
28	*Cissus quadrangularis* L.	Vitaceae		Cl	Gastritis	St	1	Or		F	BL	NA308
29	*Clausena anisata* (Willd.) Benth.	Rutaceae	Limich	S	Abdominal colic	R	5	Or		F	BL, DE	NA020
					Common cold	L	1	Or	184	F		
					Ascaris	R	1	Or		F		
					Fever	L	6	Dm	118	F		
					Ascaris	L	1	Or		F		

					Malaria	R	1	Or		F		
					Itching	L	3	Dm	229	F		
30	*Clematis simensis* Fresen. ***t**	Ranunculaceae	Anzo Areg	Cl	Fever (Mich)	L	11	Or		F	BL, DE	
31	*Clerodendrum myricoides* (Hochst.) Vatke	Lamiaceae	Misrich	S	Boil	L	3	Dm	079	F/D	BL	NA279
32	*Clutia abyssinica* Jaub. & Spach.	Euphorbiaceae	Fiyele Fej	S	Miscarriage (Shotelay)	L	10	Or		D	BL, DE	NA009
					Eczema	L	3	Dm		F		
33	*Coffea arabica* L. ***b**	Rubiaceae	Bunna	S	Open sore	Se	9	Dm		D	BL, DE	NA288
					Coughing	L	1	Or		F		
34	*Combretum molle* R. Br. ex G. Don	Combretaceae	Shawoch	T	Jaundice	Sb/ Ba	1	Or		F /D	DE	NA178
					Vitiligo	Ba	3	Dm		D		
35	*Cordia africana* Lam.	Boraginaceae	Wanza	T	Jaundice	Sb/ Ba	2	Or		D	DE	NA029
36	*Corrigiola capensis* Willd. subsp. *africana* (Turrill) Choudrhi	Molluginaceae	Yebeg Lat	H	Tonsillitis	L	4	Na		F	BL, DE	NA164
					Epiglottitis	L	2	Na		F		
37	*Croton macrostachyus* Del. ***t**	Euphorbiaceae	Missana	T	Acute febrile illness	St	2	Or		F	BL, DE	NA057
					Ringworm	La/S h	4	Dm	320, 297	F		
					Abdominal colic	Ba	2	Or		F		
					Hepatitis	Ba	2	Or		F		
					Malaria	L	1	Or		F		
38	*Cucumis ficifolius* A. Rich. ***t**	Cucurbitaceae	Yegeberie Imbuay	H	Acute febrile illness	R	5	Or		F	BL, DE	NA011
					Abdominal colic	R	5	Or		F		
					Eczema	R	3	Dm		F		
					Toothache	Se	12	Or		F		
					Rabies	R	2	Or	251, 039	F		
					Jaundice	R	2	Or		F		
					Syphilis	R	2	Or		F		
39	*Cymbopogon citratus* (DC.) Stapf.***b**	Poaceae	Teje Sar	H	Acute febrile illness	R	5	Or		F	BL	NA338

40	*Cynodon dactylon* (L.) Pers.	Poaceae	Serdo	H	Swelling	L	9	Dm		F	BL, DE	NA016
					Jaundice	Wp	10	Or		F		
					Nose bleeding	Wp	10	Dm		F		
					Spider poison	L	3	Dm		F		
41	***Cynoglossum coeruleum* Hochst. ex A. DC. in DC. subsp. *coeruleum***	Boraginaceae	Shimgug	H	Fever	L	11	Dm		F	BL, DE	NA089
42	*Cynoglossum lanceolata* Forssk.	Boraginaceae	Shimgug	H	Abdominal colic	R	2	Or		F	BL, DE	NA015
43	*Cyphostemma junceum* (Webb) Desc. ex Wild & Drummond	Vitaceae	Etse Zewe	Cl	Snakebite	R	5	Or		F	DE	NA351
					Itching	Ba	3	Dm		D		
44	*Datura stramonium* L.	Solanaceae	Astenagir	H	Dandruff	L	6	Dm		F	BL, DE	NA115
					Toothache	Fr	11	Or	015, 116	F		
					Wound	Fr	3	Dm		D		
					Eczema	Fr	3	Dm		F		
					Abdominal colic	Fr	2	Or		F/ D		
					Rheumatic pain	L	1	Or		F		
45	*Dioscorea abyssinica* Hochst. ex Kunth	Dioscoreaceae		Cl	Lactation failure	L, Se	2	Or		F	BL	NA247
46	*Discopodium penninervium* Hochst.	Solanaceae	Alumma	T	Snakebite	R	2	Or		F	BL	NA283
47	*Dodonaea angustifolia* L.f.	Sapindaceae	Kitkita	S	Eczema	L	3	Dm		D	BL	NA151
48	*Dorstenia barnimiana* Schwienf.	Moraceae	Worq Bemeda	H	Abdominal pain	R/L	2	Or		F	DE	NA339
49	*Dracaena steudneri* Engl.	Dracaenaceae	Merqo	T	Evil eye	R	13	Dm		F /D	BL, DE	NA280
					Fever	R	2	Or		F		
50	***Echinops kebericho* Mesfin**	Asteraceae	Qebercho	H	Evil eye	R	12	Na	127	D	BL, DE	NA095
					Scabies	R	3	Dm		D		
51	*Ekebergia capensis* Sparrm.	Meliaceae	Lol	T	Epidemic	Ba	12	Dm		D	BL, DE	NA187
52	*Embelia schimperi* Vatke	Myrsinaceae	Inqoqo	Cl	Tapeworm	Fr	2	Or		D	BL, DE	NA110
					Trachoma	L	4	Oc		F		
53	***Eragrostis tef* (Zucc.) Trotter *b**	Poaceae	Teff	H	Bone fracture	Se	10	Or		D	BL, DE	NA029
54	***Erythrina brucei*** Schweinf.	Fabaceae	Korich	T	Dandruff	L	6	Dm		F	BL, DE	NA054
55	*Eucalyptus globulus* Labill subsp. *globulus* ***b, *t**	Myrtaceae	Nech bahir zaf	T	Common cold	L	13	Na		F	BL, DE	NA294

					Febrile illness	L	11	Na		F		
					Tinea pedis	L	6	Dm		F		
56	*Euclea racemosa* Murr. subsp. *schimperi* (A. DC.) White	Ebenaceae	Dedeho	S	Wound	L	9	Dm	068	F	BL, DE	NA162
57	*Euphorbia abyssinica* Gmel. ***t**	Euphorbiaceae	Qulqual	T	Wound	La	4	Dm	029	F	BL, DE	NA084
					Jaundice	St	4	Or	226	F		
58	*Euphorbia schimperiana* Scheele ***t**	Euphorbiaceae	Yegede Wotet	H	Wound	Wp	4	Dm		D	BL, DE	NA292
59	*Euphorbia tirucalli* L. ***b, *t**	Euphorbiaceae	Qinchib	S	Hemorrhoids	St	4	Dm	068	F	BL	NA344
					Wound	La	4	Dm		F/D		
					Hemorrhoids	La	4	Dm		F		
					Leprosy	La	10	Or		D		
60	*Ficus sur* Forssk.	Moraceae	Sholla	T	Dysentery	La	4	Or		F	DE	NA085
61	*Ficus sycomorus* L.	Moraceae	Sholla	T	Snakebite	St/La	5	Or		F	BL, DE	NA008
62	*Foeniculum vulgare* Miller ***b**	Apiaceae	Ensilal	H	Abdominal pain	L	1	Or		F	BL, DE	NA335
					Urination problem	L, R	1	Or		F		
63	*Gardenia ternifolia* Schumach. & Thonn.	Rubiaceae	Gambello	T	Paralysis	Ba	11	Dm		F	DE	NA182
64	*Girardinia diversifolia* (Link) Friis.	Urticaceae	Kusha	H	Malaria	R	2	Or		F	DE	NA005
65	***Gomphocarpus purpurascens* A. Rich.**	Asclepiadaceae	Tifye Wotet	S	Abdominal pain	R	5	Or		F	DE	NA203
66	*Grewia ferruginea* Hochst. ex A. Rich.	Tiliaceae	Lenquata	S	Menstrual disorder	L	2	Or		F	BL	NA257
67	***Guizotia abyssinica* (L. f) Cass. *b**	Asteraceae	Nug	H	Constipation	Se	1	Or		D	BL, DE	NA155
68	*Guizotia scabra* (Vis.) Chiov.	Asteraceae	Mech	H	Ear pest expellant	L	4	Au		F	BL	NA004
					Earache	L	4	Au		F		
69	*Hagenia abyssinica* (Bruce) J.F.Gmel. ***t**	Rosaceae	Kosso	T	Amoeba	Fl	2	Or		F	BL, DE	NA334
70	*Haplocarpha schimperi* (Sch. Bip.) Beauv.	Asteraceae	Getn	H	Tinea nigra	L	3	Dm		F	DE	NA101
71	*Hordeum vulgare* L. ***b**	Poaceae	Gebs	H	Diarrhoea	Se	8	Or		D	BL	NA333
					Sinusitis	Se	12	Na		D		

72	*Hypericum quartinianum* A. Rich.	Hypericaceae	Amja	S	Abdominal colic	L	2	Or		F	BL, DE	NA166
73	*Impatiens rothii* Hook. f.	Balsaminaceae	Ensosila	H	Scabies	R	11	Dm		F	BL	NA336
74	***Impatiens tinctoria* A. Rich.**	Balsaminaceae	Gishrit	H	Snakebite	St	1	Or		F	DE	NA330
					Dandruff	La	3	Dm		F		
75	*Jasminum abyssinicum* Hochst. ex DC.	Oleaceae	Tenbelel	Cl	Snakebite	L/R	4	Or		F	BL, DE	NA140
					Tapeworm	R	2	Or		F		
					Abdominal colic	L	5	Or		F		
76	*Justicia schimperiana* (Hochst. ex Nees) T. Anders.	Acanthaceae	Smitha	S	Jaundice	L	5	Or	057	F	BL, DE	NA188
					Wound	L	3	Or		F		
77	*Kalanchoe petitiana* A. Rich.	Crassulaceae	Indahula	H	Wound	L	9	Dm		F	BL, DE	NA048
					Tonsillitis	R	5	Or		F		
					Swelling	L	9	Dm		F		
					Boil	St	9	Dm		F/D		
78	*Lagenaria siceraria* (Mollina) Standl. ***b**	Cucurbitaceae	Qill	H	Qurba	Fr	2	Or		F	BL	NA342
					Ear lesion	L	4	Au		F		
					Dandruff	L	6	Dm		F		
79	*Laggera crispata* (Vahl) Hepper & Wood	Asteraceae	Qes Bedeje	H	Fever	L	6	Dm		F	BL, DE	NA259
80	***Laggera tomentosa* (Sch. Bip. ex A. Rich.) Oliv. & Hiern *t**	Asteraceae	Keskeso	H	Toothache	L	7	Or		F	BL, DE	NA185
81	*Lawsonia inermis* L.	Lythraceae	Mist Aybelash	S	Wound	L	3	Or		D	DE	NA198
82	*Leonotis ocymifolia* (Burm. f.) Iwarsson	Lamiaceae	Ras Kimir	H	Ascaris	L	2	Or		F	BL, DE	NA181
					Fever	L	11	Dm	116	F		
83	*Lepidium sativum* L. ***b**	Brassicaceae	Feto	H	Gingivitis	Se	7	Or		F/D	BL, DE	NA321
					Malaria	Se	10	Or	320	F		
					Indigestion	Se	1	Or	340	D		
84	*Linum usitatissimum* L.***b**	Lineaceae	Telba	H	Indigestion	Se	2	Or		D	BL, DE	NA332
					Dirt expellant	Se	5	Oc		D		
					Retained placenta	Se	6	Or		F/D		
					Spider poison	Se	3	Dm		D		

85	***Lippia adoensis* Hochst ex. Walp. var. *adoensis***	Verbenaceae	Kesiy	H	Gastritis	L	1	Or		F	BL, DE	NA099
					Coughing	Fr	1	Or	315, 343	F/D		
					Common cold	L	1	Or	324	F		
86	*Lupinus albus* L. ***b**	Fabaceae	Gibto	H	Diabetes	Se	2	Or		F/D	BL, DE	NA325
					Eczema	Fr	3	Dm		D		
87	*Maesa lanceolata* Forssk.	Myrsinaceae	Qilanbo	T	Constipation	R	1	Or		F	DE	NA144
					Diarrhoea	L	1	Or		F/D		
88	*Malva verticillata* L.	Malvaceae	Lut	H	Wound	R	4	Dm		F	DE	NA119
					Tropical ulcer	R	4	Dm		F		
89	*Maytenus arbutifolia* (A. Rich.) Wilczek	Celasteraceae	Atat	S	Scorpion poison	L	3	Dm		F	DE	NA014
					Itching	R	3	Dm		D		
90	*Melia azedaracha* L. ***b**	Meliaceae	Nim	S	Tinia scaplis	L/Ba	4	Dm		F	BL, DE	NA350
					Malaria	L/Ba	1	Or		F		
					Fever	L/Ba	1	Or		F		
91	*Mimusops kummel* A. DC.	Sapotaceae	Hol /Kol	T	Amoeba	Fr	8	Or		F	BL	NA302
92	*Momordica foetida* Schumach.	Cucurbitaceae	Yeamora Genfo	H	Common cold	Fr	1	Or		F	BL, DE	NA112
					Acute febrile illness	R	8	Or		F		
					Evil eye	R	13	Na		F		
					Toothache	L	7	Or		F		
93	*Myrica salicifolia* A. Rich.	Myricaceae	Shinet	T	Leishmania	Ba	3	Dm		D	BL, DE	NA153
					Itching	L	4	Dm		F		
94	*Myrsine africana* L.	Myrsinaceae	Qechemo	S	Hypertension	Fr	2	Or		F	BL	NA262
95	*Nicotiana tabacum* L. ***b, *t**	Solanaceae	Tinbaho	H	Epilepsy	L	13	Na		F	DE	NA327
96	*Ocimum lamiifolium* Hochst. ex Benth.	Lamiaceae	Dema Kesiy	S	Fever	L	6	Dm	181	F	BL, DE	NA090
97	*Olea europaea* L. subsp. *cuspidata* (Wall. ex G. Don) Cif.	Oleaceae	Woira	T	Open sore	La	4	Dm		F	BL, DE	NA126

					Nightmare	St	12	Na		D		
					Toothache	L /St	7	Or		F		
98	*Olinia rochetiana* A. Juss.	Oliniaceae	Tifie	S	Scabies	L	4	Dm		F	BL, DE	NA263
99	*Osyris quadripartita* Decn.	Santalaceae	Qeret	S	Abdominal colic	St	7	Or		F	BL, DE	NA139
100	*Otostegia integrifolia* Benth.	Lamiaceae	Tinjit	S	Dysentery	L	2	Or		F	BL, DE	NA304
					Abdominal worms	L	2	Or		F		
					Common cold	Wp	12	Or		D		
					Abdominal colic	L	5	Or		F		
					Ascaris	Sh	2	Or		F		
					Acute febrile illness	R/L	2	Or		F		
101	*Pavonia urens* Cav.	Malvaceae	Abilalit	H	Paralysis	L	10	Or		F	BL	NA096
102	*Periploca linearifolia* Quart-Dill. & A. Rich.	Asclepiadaceae	Qundo Areg	Cl	Delay ejaculation	R	10	Or	066	D	BL, DE	NA072
103	*Phoenix reclinata* Jacq.	Arecaceae	Chifar	T	Deafness	R	4	Au	340	D	BL	NA002
104	*Phytolacca dodecandra* L. ´Herit. ***t**	Phytolaccaceae	Indod	S	Qurba	L	2	Or	340	F	BL, DE	NA254
					Indigestion	R	5	Or		F		
					Acute febrile illness	R	5	Or		F		
					Gonorrhea	St	10	Or		F		
105	*Plantago lanceolata* L.	Plantaginaceae	Gorteb	H	Cut	L	9	Dm		F	BL, DE	NA056
					Abdominal colic	R	5	Or		F		
					Burn	L	9	Dm		F		
					Diarrhoea	L	1	Or		F		
					Swelling	L	9	Dm		F		
106	*Plumbago zeylanica* L.	Plumbaginaceae	Amera	H	Snakebite	R	2	Or	083	D	BL, DE	NA326
					Toothache	R	7	Or		F		
					Snakebite	R	2	Dm		F		
					Dysentery	R	10	Or		F		
					Swelling	L	6	Dm	017	F		
107	*Podocarpus falcatus* (Thunb.) R. B. ex Mirb.	Podocarpaceae	Zigiba	T	Evil sprit	L	6	Dm		F	BL, DE	NA133

108	*Premna schimperi* Engl.	Lamiaceae	Chocho	S	Tinea nigra	L	6	Dm		F	BL	NA193
					Qurba	L	5	Or		F		
					Abdominal colic	L	5	Or		F		
109	*Psidium guajava* L. ***b**	Myrtaceae	Zeyitun	T	Dysentery	L	1	Or		F	BL, DE	NA341
					Diarrhoea	Ba	1	Or		F		
110	*Pterolobium stellatum* (Forssk.) Brenan.	Fabaceae	Qontir	S	Evil sprit	R	12	Na		D	BL, DE	NA032
111	*Ranunculus oligocarpus* Hochst. ex A. Rich. ***t**	Ranunculaceae	Etse-siol	H	Eczema	L	3	Dm		F	BL, DE	NA328
					Hemorrhoids	R	3	An	338, 048	F		
					Leishmania	L	9	Dm		F		
					Toothache	L	7	Or		F		
112	*Rhamnus prinoides* L'Herit. ***b**	Rhamnaceae	Gesho	S	Tonsillitis	F	2	Or		D	BL, DE	NA295
					Febrile illness	L	6	Dm		F		
113	*Ricinus communis* L. ***t**	Euphorbiaceae	Chaqimma	H	Epistaxis	R	4	Or		F	BL, DE	NA091
					Qurba	R	5	Or		F		
					Impotency	Se	2	Or	147	D		
114	*Rosa abyssinica* Lindley	Rosaceae	Qega	S	Delay ejaculation	R	12	Na		D	BL, DE	NA075
					Tinea nigra	L	6	Dm		F		
					Tapeworm	Fr	7	Or		F		
115	*Rosmarinus officinalis* L. ***b**	Lamiaceae	Siga Metbesha	H	Wound	Sh	3	Dm		F	DE	NA329
					Halitosis	L	11	Or		F		
116	*Rubus apetalus* Poir.	Rosaceae	Injor	S	Abdominal worms	L	1	Or		F	BL, DE	NA045
					Dysentery	L	7	Or		F		
					Wound	Fr	3	Dm		F		
117	*Rubia cordifolia* L.	Rubiaceae	Minchir	H	Coughing	R	1	Or		D	DE	NA255
					Lung TB	R	1	Or		D		
					Slight bleeding	L	9	Dm		F		
118	*Rumex abyssinicus* Jacq.	Polygonaceae	Meqmeqo	H	Acute febrile illness	R	5	Or		F	BL, DE	NA266

					Skin rush	L	6	Dm	011, 229	F		
					Burn	L, St	9	Dm		F		
					Pneumonia	L	1	Or	320	F		
					Heart failure	R	2	Or	180	F		
					Hypertension	R	1	Or		D		
					Tinea nigra	L	6	Dm		F		
119	*Rumex nepalensis* Spreng.	Polygonaceae	Yewsha milas	H	Abdominal colic	R	5	Or		F	BL, DE	NA077
					Headache	R	1	Or		F		
					Skin rush	L	3	Dm		F		
					Toothache	R	7	Or		F		
120	*Rumex nervosus* Vahl	Polygonaceae	Anbuatie	S	Hypertension	R	1	Or		D	BL, DE	NA068
					Burn	St	3	Dm		F/D		
121	*Ruta chalepensis* L. ***b**	Rutaceae	Tena/Tila Adam	H	Common cold	L/Fr	1	Or	320	F	BL, DE	NA324
					Influenza	L	1	Or	228	F		
					Abdominal colic	WP	1	Or	228	F		
					Evil eye	L	13	Na	320	F		
					Gastritis	L	1	Or	320, 079	F		
122	*Salix subserrata* Willd.	Salicaceae	Kya	T	Ascaris	L	10	Or		D	BL	NA285
123	*Saccharum officinarum* L. ***b**	Poaceae	Ageda	H	Coughing	St	8	Or		F	BL, DE	NA318
					Common cold	St	8	Or		F/D		
					Indigestion	St	8	Or		F		
124	*Sansevieria ehrenbergii* Schweinf. ex Baker	Dracaenaceae	Algeti	H	Impotency	R	3	Or		D	BL, DE	NA315
125	*Schefflera abyssinica* (Hochst. ex A. Rich.) Harms	Araliaceae	Getem	T	Snakebite	St	2	Or		F	BL, DE	NA154
126	*Schinus molle* L. ***b**	Anacardiaceae	Qundo Berbere	T	Acute febrile illness	Fr	2	Or		D	BL, DE	NA343
					Abdominal pain	Fr	8	Or		D		
127	*Securidaca longepedunculata* Fresen.	Polygalaceae	Etse Menahe	S	Evil sprit	R	12	Na	153, 141	D	BL, DE	NA215

128	*Senna singueana* (Del.) Lock.	Fabaceae	Goffa	S	Acute febrile illness	Ba	5	Or		F	BL, DE	NA124
					Snakebite	R	5	Or		F		
129	*Sesamum angustifolium* (Oliver) Engl. *__b__	Pedaliaceae	Selit	H	Dandruff	Se	3	Dm	115	D	BL, DE	NA340
					Coughing	Se	1	Or	333	D		
					Abdominal colic	Se	10	Or	321	D		
					Epidemic	Se	10	Or		D		
					Mogn bagegn	Se	2	Or		D		
130	*Sida schimperiana* Hochst. ex A. Rich.	Malvaceae	Chifrig	S	Wart	Ba	3	Dm		F	BL, DE	NA081
					Dysentery	L	2	Or		D		
					Toothache	St	7	Or		F		
131	*Silene macrosolen* A. Rich.	Caryophyllaceae	Wegert	H	Evil eye	R	12	Or		F/D	BL, DE	NA349
					Gastritis	R	1	Or	215	F/D		
					Headache	R	12	Or		F/D		
					Impotency	R	1	Or		F		
					Tapeworm	R	10	Or	155	D		
132	*Solanum angiuvi* Lam.	Solanaceae	Zercho	S	Itching	Fr	3	Dm		F	BL, DE	NA103
133	*Solanum incanum* L.	Solanaceae	Zercho	S	Acute febrile illness	R	5	Or		F	BL	NA251
					Epistaxis	R	4	Na		F		
134	*Solanum marginatum* L.f.	Solanaceae	Imbuay	S	Acute febrile illness	R	5	Or		F	BL, DE	NA079
					Ear infection	L	3	Au		F		
					Swelling (breast)	L	4	Dm		F		
					Toothache	Fr	12	Or		F/D		
135	*Solanum nigrum* L.	Solanaceae	Awot	H	Itching	L	3	Dm		F	BL	NA175
136	*Stephania abyssinica* (Dillon & A. Rich.) Walp.	Menispermaceae	Yeait Joro	H	Meningitis	L	2	Or		F	BL, DE	NA039
					Snakebite	R	5	Or		F		
					Sudden sickness (Qurba)	R	1	Or		F		

					Rabies	R	1	Or	002, 251	F		
					Coughing	R	1	Or		F/D		
137	*Stereospermum kunthianum* Cham.	Bignoniaceae	Zana/Washt	S	Scorpion poison	Ba	4	Dm		F	BL, DE	NA301
					Snakebite	Ba	5	Or		F		
138	*Syzygium guineense* (Willd.) DC. subsp. *guineense*	Myrtaceae	Bedessa	T	Abdominal worms	Wp	2	Or		F	BL, DE	NA001
139	*Tamarindus indica* L.	Fabaceae	Roqa	T	Cancer	L	3	Dm		F	BL, DE	NA229
					Malaria	Ba, L	2	Or		F/D		
					Ascaris	Fr	2	Or		F/D		
					Snakebite	R	1	Or		F		
					Bloat in human	F	8	Or		F		
					Joint ache	L	1	Or		F		
					Diarrhoea	Fr	2	Or		F		
140	*Tragia brevipes* Pax.	Euphorbiaceae	Aleblabit	H	Swelling	R	9	Dm		F	BL, DE	NA311
					Toothache	R/L	7	Or		F		
					Impotency	R	1	Or		F		
141	***Urtica simensis* Steudel**	Urticaceae	Samma	H	Indigestion	Sh	8	Or		F	BL	NA041
					Epistaxis	L/St	4	Na		F		
142	*Verbascum sinaiticum* Benth. ***t**	Scrophulariaceae	Qetentina	H	Jaundice	R	1	Or		F	BL, DE	NA122
					Heart failure	R	2	Or		F		
					Burn	L	9	Dm		F		
					Toothache	R	7	Or		F		
					Gastritis	R	2	Or		F		
143	*Verbena officinalis* L. ***t**	Verbenaceae	Atuch	H	Abdominal colic	R	5	Or		F	BL, DE	NA331
					Dysentery	R	1	Or		F		
144	*Vernonia amygdalina* Del.	Asteraceae	Girawa	T	Nausea	L	1	Or		F	BL, DE	NA131
					Qurba	L	1	Or		F		
					Retained placenta	L	1	Or		F		
					Ascaris	L	2	Or		F		
					Itching	L	6	Dm	020	F		
					Acute febrile illness	L	2	Or		F		

					Hypertension	L	1	Or		F		
					Abdominal colic	L	2	Or		F		
145	*Vicia faba* L. ***b**	Fabaceae	Baqela	H	Boil	Se	9	Dm		D	BL, DE	NA337
146	*Viscum tuberculatum* A. Rich.	Viscaceae	Teqetsila	S	Acute febrile illness	L	2	Or		F	BL, DE	NA152
147	*Vitis vinifera* L.***b**	Vitaceae	Woin	Cl	Nausea	L	2	Or		F	BL, DE	NA347
					Coughing	L	1	Or		F		
					Snakebite	L	1	Or		F		
148	*Withania somnifera* (L.) Dunal ***t**	Solanaceae	Gizewa	S	Wound	L	3	Dm		F	BL, DE	NA184
					Wart	L	3	Dm		F		
					Intelligence booster	R	10	Or	251	D		
149	*Ximenia americana* L.	Olacaceae	Enkoy	S	Scorpion poison	L	2	Or		F	BL, DE	NA177
					Vomiting	Fr	8	Or		F		
150	*Xanthium strumarium* L.	Asteraceae	Yeabay Arem	H	Tinea nigra	L	3	Dm		F	BL	NA219
					Malaria	L	1	Or		F		
151	*Zehneria scabra* (Linn. f.) Sond.	Cucurbitaceae	Hareg Sessa	Cl	Wound	L	3	Dm		F	BL, DE	NA116
					Malaria	L	2	Or		F		
					Fever	L	11	Or /Dm	020, 15, 181, 090	F		
					Headache	L	11	Dm		F		
					Evil sprit	L	6	Dm		F		
					Foot disease/rot	L	3	Dm		F		
152	*Zingiber officinale* Roscoe ***b**	Zingiberaceae	Zinjible	H	Abdominal pain	Rh	1	Or	321	F/D	BL, DE	NA322
					Tonsillitis	Rh	8	Or		F/D		
153	*Ziziphus spina-christi* (L.) Desf.	Rhamnaceae	Qurqura	S	Backache	L, Ba	3	Dm		D	BL, DE	NA220

Key ***b** = Cultivated medicinal plant species (No. of spp. = 28); **Boldface** = Endemic species to the present day Ethiopia (11 spp.); ***t** = Toxic medicinal plants (No. of spp. = 19; 12%)

Appendix-6: List of traditional medicinal plants used for treating livestock ailments in the study area: with scientific name, family, local name (Amh = Amharic), habit (Ha) [shrub (S); tree (T); herb (H); climber (Cl); seed (Se); fruit (Fr); flower (Fl)], disease treated; methods of preparation and application (MPAP) (1 = Crush/squeeze and soak the part in cold water and give the infusion to animal; 2 = Extract/remove the latex/juice/sap/ and pour into or paint it; 3 = Boil and drink the decoction when cool; 4 = Grind/crush and paste the powder or the crushed parts to the affected body; 5 = Eat the plant part (raw/cooked/roasted); 6 = Sniff/inhale the fumigated/smoked/burnt/heated of powdered parts; 7 = Crush, soak with water and wash; 8 = Grind/pulverize and paste the crushed part and tie), Route of administration (RA) [Oral (Or); Dermal (Dm); Nasal (Na); Ocular (Oc); Auricular (Au)], parts mixed with collection number (PMCN), parts used (PU) [root (R); leaf (L); stem (St); bark (Ba); Latex (La) and rhizome (Rh)] condition of parts used (CPU) [fresh (F) and dry (D)], District (Dist.) [Baso Liben (BL); Debre Elias (DE)], Voucher number (V. No.); Nigussie Amsalu (NA).

Scientific name	Family	Local name (Amh)	Ha	Disease treated	MPAP	RA	PMCN	PU	CPU	Dist.	V. No.
Acokanthera schimperi (A.DC.) Schweinf.	Apocynaceae	Merz	T	Trypanosomiasis (‘Gendi’) in cattle	3	Or		L	F	BL, DE	NA226
				Rabies (‘Kilabat’) in dog	1	Or		R	F		
Agave sisalana Perrine ex Engl.*	Agavaceae	Chiret	S	Wound in cattle	2	Dm		La	F	BL	NA180
				Blackleg in cattle	1	Or		R	F		
Allium sativum L. ***b**	Alliaceae	Nech shinkurt	H	Trypanosomiasis	3	Or		Bu	F	BL, DE	NA320
				Dermatophilosis in cattle	4	Dm		Bu	F		
				Anthrax in cattle	1	Or		Bu	F/D		
				Leech (‘Alqit’) in cattle	1	Or/Na	057	Bu	F/D		
Aloe macrocarpa Tod.	Aloaceae	Ret	H	Dermatophilosis	2	Dm		La	F	DE	NA147
				Bloat in cattle	1	Or	320, 324	La	F		
				Leech	2	Na		La	F		
				Eye infection in animal	2	Oc		La	F		
Apodytes dimidiata E. Mey. ex Arn.*	Icacinaceae	Donga	T	African horse sickness	1	Or		Ba	F	BL	NA135
Argemone mexicana L.*, ***t**	Papaveraceae	Nechelo	H	Wound in cattle	2	Dm		La/L	F	BL	NA275
Arisaema schimperianum Schott*	Araceae	Amoch	H	Bloat	5	Or		R	F	BL	NA167
Artemisia abyssinica Sch. Bip. ex A. Rich	Asteraceae	Chiqugn	H	Emaciation (‘Qumegna’) in cattle	1	Or		L	F	DE	NA323

				Evil eye in cattle	6	Na	17	L	F		
Asparagus africanus Lam.	Asparagaceae	Yeset Qest	S	Bloat	1	Or	122	L	F	BL, DE	NA066
				Coccidiosis (yelam geta)	3	Or		L	F		
				Slight bleeding in cattle	4	Dm		R	F		
Buddleja polystachya Fresen.	Capparidaceae	Anfar	S	Eye infection in animal	2	Oc		L	F	BL	NA118
Calotropis procera (Ait.) Ait.f. ***t**	Asclepiadaceae	Qilanbo	S	Wound in animal	4	Dm		La	F	BL, DE	NA168
				Swelling in equine	4	Dm		La	F		
				Swelling in cattle	4	Dm		R	F		
				Scabies	4	Dm		La	F		
Calpurnia aurea (Ait.) Benth. subsp. *aurea*	Fabaceae	Ligita	S	External parasite in animal	7	Dm		L	F	BL	NA108
				Helminthiasis in animal	1	Or		L	F		
Carica papaya L. ***b**	Caricaceae	Duba	T	Leech in cattle	2	Na		L	F	DE	NA348
Cassipourea malosana (Baker) Alaston	Rhizophoriaceae	Tikur Inchet	T	Coughing in animal	3	Or		Sb	F	DE	NA161
				Leech in cattle	1	Or/Na		Sb	F		
Celtis africana Burm.f.*	Ulmaceae	Qewt	T	Mouth infection in animal	6	Or/Na		Fr	F	BL	NA248
Clausena anisata (Willd.) Benth.	Rutaceae	Limich	S	Emaciation in cattle	1	Or	66, 122	R	F	BL, DE	NA020
Clerodendrum myricoides (Hochst.) Vatke	Lamiaceae	Misrich	H	Infertility in cattle	3	Or		R	F	BL, DE	NA278
				Constipation in cattle	1	Or		L	F		
Croton macrostachyus Del.	Euphorbiaceae	Bisana	T	Bloat in cattle	1	Or		L	F	BL, DE	NA057
Cucumis ficifolius A. Rich.	Cucurbitaceae	Yemidir Inbuay	Cl	Diarrhoea in cattle	1	Or		R	F	BL, DE	NA011
				Coughing in sheep & goat	5	Or		Fr	F/D		
				Emaciation in sheep & goat	5	Or		R/Fr	F		
				Rabies in dog	3	Or	254, 301	R	F		
Datura stramonium L.	Solanaceae	Astenagir	H	Bloat in cattle	1	Or		L	F	DE	NA115
Discopodium penninervium Hochst.	Solanaceae	Alumma	T	Coughing in sheep & goat	2	Or		L	F	BL	NA283
Dodonaea angustifolia L.f.	Sapindaceae	Kitkita	S	Bone fracture in animal	8	Dm		L	F	BL	NA151
Dracaena steudneri Engl. ***b**	Dracaenaceae	Merqo	T	Sudden/acute disease ('Dingetegna') in cattle	1	Dm		R	F	BL, DE	NA280

				Coccidiosis ('Fengil')	1	Or		L	F		
				Swelling of neck cattle and pack animal	8	Dm		L	F		
				Leech infestation	2	Or/Na		L	F		
*Dregea abyssinica (*Hochst.) K. Schum.*	Asclepiadaceae	Moider Hareg	Cl	Rabies in cattle	1	Or		R	F	BL	NA230
***Echinops kebericho* Mesfin**	Asteraceae	Qebercho	H	Nasal infection in pack animal	6	Na		R	D	BL, DE	NA095
				Bloat	1	Or		R	F		
				Coccidiosis	3	Or		R	D		
				Eye infection in cattle	2	Au		R	F		
				Snakebite in animal	1	Or		R	F		
				Epilepsy in sheep & goat	6	Na	141	R	D		
Embelia schimperi Vatke	Myrsinaceae	Inqoqo	Cl	Nasal affliction (**'**Kuro'**)** in pack animal	6	Na		L	D	BL, DE	NA110
				Emaciation in cattle	1	Or		Fr	D/F		
				Epilepsy in sheep	6	Or	141	R	D		
				Bloat in cattle	1	Or		Fr	F		
***Erythrina brucei* Schweinf.**	Fabaceae	Korch	T	Eye disease in cattle	2	Oc		L	F	DE	NA054
Euphorbia abyssinica Gmel. ***t**	Euphorbiaceae	Qulqual	T	Nasal affliction in pack animal	2	Na	141	L	D	BL, DE	NA084
Flacourtia indica (Burm.f.) Merr.*	Flacourtiaceae	Akuk	S	Pasteurollosis in Sheep and goat	1	Or		L	F	BL	NA138
Gnidia glauca (Fresen.) Gilg *	Thymelaceae	Awura	S	Epidemic in cattle	6	Or		St	F	DE	NA100
				Calf rejection	8	An		St	F		
***Gomphocarpus purpurascens* A. Rich.**	Asclepiadaceae	Tifye Wotet	S	Clumsiness ('Abeya') in ox during ploughing	4	Dm		St	F	DE	NA203
Grewia ferruginea Hochst ex A. Rich.	Tiliaceae	Lenquata	S	Leech infestation	1	Or/Na		L	F	BL, DE	NA257
				Retained placenta	1	Or		L	F		
Guizotia scabra (Vis.) Chiov.	Asteraceae	Mech	H	Tick infestation in animal	7	Dm		L	F	DE	NA004
Hagenia abyssinica (Bruce) J.F.Gmel. ***b**	Rosaceae	Kosso	T	Scabies in equine	4	Or		Ba	D	BL, DE	NA334

Haplocarpa schimperi (Sch. Bip.) Beauv.	Asteraceae	Getin	H	Physical damage in animal	1	Or/Oc	024	L	F	BL	NA101
Hypoestes forskaolii (Vahl) R.Sch.*	Acanthaceae		H	Anthrax in cattle	3	Or	017, 079, 122	Wp	F	BL	NA043
Justicia schimperiana (Hochst. ex Nees) T. Anders.	Acanthaceae	Smitha	S	Coccidiosis	1	Or		L	F	BL, DE	NA188
				Epidemic in cattle	1	Or		L	F		
				External parasite in animal	7	Dm		L	F		
				Anthrax	3	Or		L	F		
Kalanchoe petitiana A. Rich.	Crassulaceae	Endahula	H	Neck infection in cattle	4	Dm		L/St	F	BL, DE	NA048
Lageneria siceraria (Molina) Standl ***b**	Cucurbitaceae	Qil	H	Retained placenta	2	Or		L	F	BL, DE	NA342
				Coli in cattle	1	Or		L	F		
				Leech	2	Na		L	F		
				Rabies in animal	3	Or	029	Fr	F		
***Lagera tomentosa* (Sch.Bip.ex A. Rich.) Oliv. & Hiern**	Asteraceae	Keskeso	H	Termite infestation in animal	7	Dm		L/Wp	F/D	BL	NA185
Leonotis ocymifolia (Burm. f.) Iwarsson	Lamiaceae	Ras Kimir	H	Colic in cattle, sheep and goat	1	Or	131	L	F	DE	NA181
Lepidium sativum L. ***b**	Brassicaceae	Feto	H	Eye infection in animal	1	Oc		Fr	D	BL, DE	NA321
				Diarrhoea in animal	3	Or		Se	D		
				Rabies in animal	3	Or		Se	F		
				Fever in cattle	3	Na		Se	D		
				Bloat in cattle	1	Or		Se/Fr	F		
				Cowdriosis/heart water in cattle	3	Or		Se	F		
Lycopersicum esculentum Mill.*, ***b**	Solonaceae	Timatim	H	Leech	2	Na		L	F	BL, DE	NA352
				Indigestion in cattle	1	Or		R	F		
Maesa lanceolata Forssk.	Myrsinaceae	Qilanbo	T	Leech in cattle	2	Or		Wp	F	BL, DE	NA144
				Poisonous in fish	1	Or		Fr	D		
Melia azedarcacha L. ***b**	Meliaceae	Nim	S	Coccidiosis	3	Or		L	F	BL	NA350
Malva verticillata L.	Malvaceae	Lut	H	Emaciation	1	Or		R	F	BL	NA119
Myrica salicifolia A. Rich.	Myricaceae	Shinet	T	Eye infection in cattle	2	Oc		Sb	D	DE	NA153

Nicotiana tabacum L. ***b, *t**	Solanaceae	Tinbaho	H	Leech infestation	2	Na	320, 304	L	F	BL, DE	NA327
				Foot rot/disease in animal	4	Dm		L	F/D		
				Wound in goat and sheep	4	Dm		L	F/D		
				Tick infestation in sheep	7	Dm		L	F		
				Tapeworm in sheep and goat	1	Or		L	F		
Nuxia congesta R.Br. ex Fresen.*	Loganiaceae	Atkuar	T	Cowdriosis	1	Or		St	F	BL	NA172
Ocimum lamiifolium Hochst. ex Benth.	Lamiaceae	Dama Kesy	S	Fever in cattle	1	Or		L	F	BL, DE	NA090
				Bloat	1	Or		L	F		
Olea europaea L. subsp. *cuspidata* (Wall. ex G. Don) Cif.	Oleaceae	Woira	T	Cowdriosis in cattle	6	Or/Na		St/L	D	BL	NA126
Orobanche minor Smith.*	Orobanchaceae	Jibo	H	Unspecified disease in cattle	6	Na		Wp	F	DE	NA106
Pavetta abyssinica Fresen.*	Rubiaceae		S	Eye infection in animal	2	Au		L	F	BL, DE	NA065
				Blackleg	1	Or		Ba	F/D		
Phoenix reclinata Jacq.	Arecaceae	Chifar	T	Eye infection	2	Oc		L	F	BL, DE	NA002
				Diarrhoea in sheep and goat	1	Or		St	F		
Phytolacca dodecandra L. Herit. ***t**	Phytolaccaceae	Indod	S	External parasite	7	Dm		L	F	BL, DE	NA254
				Emaciation in cattle	5	Or		L	F		
				Intestinal parasites In cattle, goat and sheep	2	Or		L	F		
				Rabies in dog	3	Or		L	F		
Prunus africana (Hook. f.) Kalkm. *	Rosaceae	Komma	T	Fashiolsis in goat and sheep	1	Or		R	D	DE	NA033
Plectocephalus varians (A. Rich) C. Jeffrey. ex Cufod. *	Asteraceae	Engocht	H	Infertility in cattle	5	Or		R	F	BL, DE	NA284
				Emaciation in sheep and goat	1	Or		R	F		
Premna schimperii Engl.	Lamiaceae	Bes	S	Eye infection in animal	2	Oc		L	F	BL	NA193
Prunus persica (L.) Batsch *	Rosaceae	Kok	S	Dermatophilosis in cattle	4	Dm		L	F	DE	NA354
Rhamnus prinoides L'Herit. ***b**	Rhamnaceae	Gesho	S	Leech infestation in cattle	1	Or		L	F	BL, DE	NA295
				Colic in equine	1	Or		L	F		

Ricinus communis L.	Euphorbiaceae	Chaqima	H	Constipation in animal	1	Or		Fr	D	BL, DE	NA091
				Lactation failure in cattle	3	Or		L	D		
				Bloat	1	Or		Fr	F		
				Mouth infection in pack animals	4	Dm		Fr	F/D		
Rubia cordifolia L.	Rubiaceae	Minchir	H	Lactation failure	5	Or		R/Wp	F	BL	NA255
Rumex nepalensis Spreng.	Polygonaceae	Yewusha Milas	H	Colic in cattle (megagna)	5	Or		R	F	DE	NA077
Rumex nervosus Vahl	Polygonaceae	Anbuatie	S	External parasite in sheep	7	Dm		L	F	BL, DE	NA068
				Physical damage (Lebitir) in animals	1	Or		St	F	BL, DE	
Ruta chalepensis L. ***b**	Rutaceae	Tila Adam	H	Epidemic	3	Or	320	Wp	F	BL	NA324
Sansevieria ehrenbergii Schweinf. ex Baker	Dracaenaceae	Algeti	H	Leech	1	Or		L	F	BL	NA315
				Bloat	1	Or/Na		L	F		
Schinus molle L. ***b**	Anacardiaceae	Qundo Berbere	T	Epidemic	6	Or	322 & 332	Fr/Se	D	BL, DE	NA343
				Leech in cattle	3	Or /Na		Fr	D		
				Rabies in animals	1	Or		Fr	D		
				“Abiriq” in quuen	1	Or		L	F		
***Solanecio gigas* (Vatke.) C. Jeffrey * *b**	Asteraceae	Boz	S	Dysentery in cattle	1	Or		L	F	BL, DE	NA281
Solanum incanum L.	Solanaceae	Zercho	S	Sore in animals	8	Dm		R	F	BL, DE	NA251
				Pasteurollosis in sheep and goat	2	Na		L	F		
				Mastitis in cattle	3	Or		L/R	D		
Solanum nigrum L.	Solanaceae	Awotign	H	Leech in cattle	2	Or		L	F	BL, DE	NA175
Solanum marginatum L.f.	Solanaceae	Imbuay	S	Coughing in sheep and goat	6	Na/Or		Se	F	BL, DE	NA079
Stereospermum kunthianum	Bignoniaceae	Botoro	T	Eye infection	2	Oc		Ba	F	BL	NA301
	Menispermaceae		H	Anthrax	1	Or		R	F	BL, DE	NA039

Stephania abyssinica (Dillon & A. Rich.) Walp. Var		Yeait Joro		Tick infestation in animal	4	Dm		R	F		
				Rabies in animal	1	Or		L	F		
Thalictrum schimperianum Hochst. ex Scheiwnf.	Ranunculaceae	Sire Bizu	H	Emaciation in cattle	5	Or		R	F	BL, DE	NA010
				Epidemic	1	Or	079	L	D		
Urera hypselodendron (A. Rich.) Wedd.*	Urticaceae	Lankuso	Cl	Retained placenta	2	Or		L	F	DE	NA041
Verbascum sinaiticum Benth.	Scrophulariaceae	Qetentina	H	Rabies in dog	1	Or		R	F	BL, DE	NA132
				External parasite	7	Dm		L	F		
				Emaciation in goat and sheep	5	Or		L	F		
Vernonia amygdalina Del.	Asteraceae	Girawa	T	Helminthiasis in sheep and goat	1	Or		L	D	BL, DE	NA131
				Coccidiosis	1	Or		L	F		
				Colic in equine	1	Or		L	F		
				Bloat	1	Or		L	F		
Withania somnifera (L.) Dunal	Lamiaceae	Giziewa	S	Diarrhoea in animal	3	Or		R	F	BL, DE	NA184
				Blackleg	1	Or		R	F/D		
				Downer in cattle	5	Or	322	R	F		
Zea mays L.*, ***b**	Poaceae	Beqollo	H	Diarrhoea sheep and goat	5	Or		Se	D	BL	NA355
				Mouth infection in mule	2	Or	229	L	F/D		
Zehneria scabra (Linn. f.) Sond.	Cucurbitaceae	Hareg Sessa	H	Eye infection in animal	2	Oc		L	F	BL, DE	NA116
				Wound in animal	4	Dm		R	F		
				Emaciation in cattle	5	Or		R	F		
				Mouth disease in cattle	7	Or		L	F		
				Trypanosomiasis	1	Or		L	F		
Zingiber officinale Roscoe ***b**	Zingiberaceae	Zinjible	H	Indigestion in cattle	1	Or	320	Rh	F/D	BL, DE	NA322

* = MPs restricted only the treatment of livestock ailments (not for human ailments; 19 spp.); ***b** = cultivated (15 spp.)**; Boldface** = endemic species to the present day Ethiopia (5 spp.); ***t** = Toxic medicinal plants (No. of spp. = 5; 6%)

Appendix-7: Fidelity level of traditional medicinal plants used to treat human ailments in the study area

Herbal medicine	Baso Liben			Debre Elias			Herbal medicine	Baso Liben			Debre Elias		
	Ip	Iu	FL (%)	Ip	Iu	FL (%)		Ip	Iu	FL (%)	Ip	Iu	FL (%)
Acacia abyssinica	5	10	50.00	8	14	57.00	*Catha edulis*	16	22	72.72	6	10	60.00
Acacia lahai	8	15	53.33	0.00	0.0	0.00	*Cissus quadrangularis*	4.0	7	57.14	0.0	0.0	0.00
Achyranthes aspera	7	9	77.78	5	8	62.50	*Clausena anisata*	16	21	70.19	12	17	70.59
Acmella caulirhiza	17	20	90.00	14	16	87.50	*Clematis simensis*	10	15	66.67	11	16	68.75
Acokanthera schimperi	12	17	70.59	9	12	75.00	*Clerodendrum myricoides*	7.0	14	50.00	0.0	0.0	0.00
Ageratum conyzoides	11	16	68.75	13	18	72.22	*Clutia abyssinica*	8.0	14	57.00	10	16	62.50
Allium sativum	30	36	83.33	25	33	75.76	*Coffea arabica*	3.0	5	60.00	4	7	57.14
Aloe camperi	0.0	0.0	0.00	6	14	43.00	*Combretum molle*	0.0	0.0	0.00	4	8	50.00
Aloe macrocarpa	6	15	40.00	0.00	0.0	0.00	*Cordia africana*	0.0	0.0	0.00	8	12	72.72
Amaranthus caudatus	10	16	62.50	15	25	60.00	*Corrigiola capensis*	2.0	4	50.00	8	14	57.14
Anogeissus leiocarpa	14	17	82.35	20	25	80.00	*Croton macrostachyus*	20	25	80.00	25	28	89.29
Artemisia abyssinica	3	5	60.00	6	10	60.00	*Cucumis ficifolius*	4.0	5	80.00	5	6	83.33
Asparagus africanus	14	16	87.50	12	15	80.00	*Cymbopogon citratus*	2.0	4	50.00	0.0	0.0	0.00
Balanites aegyptiaca	5	9	55.55	0.00	0.0	0.00	*Cynodon dactylon*	8.0	14	57.00	11	15	73.33
Bersama abyssinica	20	32	62.50	20	28	71.42	*Cynoglossum coeruleum*	11	17	64.71	7	11	64.00
Boswellia pirottae	0.0	0.0	0.00	3	7	42.86	*Cynoglossum lanceolata*	16	22	72.72	14	20	70.00
Brassica carinata	5	10	50.00	0.00	0.0	0.00	*Cyphostemma junceum*	0.00	00	0.00	8	15	53.00
Brucea antidysenterica	21	30	70.00	8	11	72.72	*Datura stramonium*	15	17	88.24	21	24	87.50
Buddleja polystachya	0.0	0.0	0.00	6	12	50.00	*Dioscorea abyssinica*	4.0	7	57.14	0.0	0.0	0.00
Calotropis procera	8	11	72.72	9	12	75.00	*Discopodium penninervium*	8.0	14	57.14	0.0	0.0	0.00
Calpurnia aurea	6	10	60.00	0.00	0.0	0.00	*Dodonaea angustifolia*	3.0	6	50.00	0.0	0.0	0.00
Capparis tomentosa	25	32	78.00	20	23	86.96	*Dorstenia barnimiana*	0.0	00	00.00	5	7	71.43
Carduus schimperi	5	9	55.56	6	11	54.55	*Dracaena steudneri*	10	14	71.42	13	17	76.47
Carica papaya	16	19	84.21	12	15	80.00	*Echinops kebericho*	20	27	74.07	10	13	76.92
Carissa spinarum	5	7	71.42	11	15	73.00	*Ekebergia capensis*	10	15	66.67	7	10	70.00
Cassipourea malosana	8	14	57.00	16	25	64.00	*Embelia schimperi*	11	14	78.14	13	17	76.47

Appendix-7: contd.

Herbal medicine	Baso Liben			Debre Elias			Herbal medicine	Baso Liben			Debre Elias		
	Ip	Iu	FL (%)	Ip	Iu	FL (%)		Ip	Iu	FL (%)	Ip	Iu	FL (%)
Eragrostis tef	7	10	70.00	11	16	68.75	*Lagenaria siceraria*	10	22	45.45	10	19	52.63
Erythrina brucei	7	16	46.67	3	6	50.00	*Laggera crispata*	4	7	57.14	0.00	0.00	0.00
Eucalyptus globulus	12	16	75.00	15	21	71.43	*Laggera tomentosa*	10	11	90.00	11	12	91.67
Euclea racemosa subsp. *schimperi*	11	16	68.75	13	15	86.67	*Lawsonia inermis*	0.00	0.00	0.00	10	23	43.47
Euphorbia abyssinica	17	19	89.47	13	17	76.47	*Leonotis ocymifolia*	9	20	45.00	9	19	47.37
Euphorbia schimperiana	12	17	70.59	13	19	68.49	*Lepidium sativum*	9	10	90.00	20	30	66.67
Euphorbia tirucalli	5	6	83.33	0.00	0.00	00.0	*Linum usitatissimum*	6	8	75.00	3	4	75.00
Ficus sur	0.00	0.00	00.00	8	10	80.00	*Lippia adoensis* var. *adoensis*	24	26	92.31	30	32	93.75
Ficus sycomorus	8	14	57.00	6	10	60.00	*Lupinus albus*	20	30	66.67	17	21	80.95
Foeniculum vulgare	8	9	89.00	7	11	63.64	*Maesa lanceolata*	0.00	0.00	0.00	4	6	66.67
Gardenia ternifolia	0.00	0.00	00.00	16	19	84.20	*Malva verticillata*	0.00	0.00	0.00	2	3	66.67
Girardinia diversifolia	0.00	0.00	00.00	2	4	50.00	*Maytenus arbutifolia*	0.00	0.00	0.00	5	8	62.25
Gomphocarpus purpurascens	0.00	0.00	00.00	2	5	40.00	*Melia azedaracha*	13	17	76.47	17	24	70.83
Grewia ferruginea	6	9	66.67	0.00	0.00	00.00	*Mimusops kummel*	5	7	71.43	0.00	00.00	00.00
Guizotia abyssinica	6	10	60.00	6	8	75.00	*Momordica foetida*	8	11	72.72	9	12	75.00
Guizotia scabra	7	11	63.64	0.00	0.00	0.00	*Myrica salicifolia*	7	11	63.63	8	15	53.33
Hagenia abyssinica	25	31	80.65	26	30	86.67	*Myrsine africana*	6	10	60.00	0.00	00.00	00.00
Haplocarpha schimperi	0.00	0.00	0.00	5	7	71.42	*Nicotiana tabacum*	00.00	0.00	0.00	7	10	70.00
Hordeum vulgare	11	17	64.71	0.00	0.00	0.00	*Ocimum lamiifolium*	11	12	91.67	9	10	90.00
Hypericum quartinianum	8	14	57.00	8	15	53.33	*Olea europaea* subsp. *cuspidata*	9	11	81.82	8	10	80.00
Impatiens rothii	12	14	87.71	0.00	0.00	0.00	*Olinia rochetiana*	11	14	78.57	10	13	76.92
Impatiens tinctoria	0.00	0.00	0.00	7	9	77.77	*Osyris quadripartita*	10	15	66.67	14	18	77.78
Jasminum abyssinicum	26	31	83.87	25	31	80.65	*Otostegia integrifolia*	15	19	78.95	10	15	66.67
Justicia schimperiana	11	14	78.57	19	24	79.17	*Pavonia urens*	9	13	69.23	0.00	0.00	0.00
Kalanchoe petitiana	10	21	47.62	10	20	50.00	*Periploca linearifolia*	11	13	78.57	8	12	66.67

Appendix-7: contd.

Herbal medicine	Baso Liben			Debre Elias			Herbal medicine	Baso Liben			Debre Elias		
	Ip	Iu	FL (%)	Ip	Iu	FL (%)		Ip	Iu	FL (%)	Ip	Iu	FL (%)
Phoenix reclinata	3	4	75.00	0.00	0.00	0.00	*Sesamum angustifolium*	17	27	62.96	17	26	65.38
Phytolacca dodecandra	17	20	85.00	11	15	73.33	*Sida schimperiana*	14	20	70.00	24	30	80.00
Plantago lanceolata	5	7	71.43	4	5	80.00	*Silene macrosolen*	7	12	58.33	9	13	69.23
Plumbago zeylanica	8	11	72.72	5	8	62.50	*Solanum angiuvi*	11	15	73.73	17	22	77.27
Podocarpus falcatus	5	6	83.33	2	3	66.67	*Solanum incanum*	7	12	58.33	0.00	0.00	0.00
Premna schimperi	5	7	71.43	0.00	0.00	0.00	*Solanum marginatum*	14	17	82.35	6	11	54.55
Psidium guajava	7	10	70.00	5	9	55.55	*Solanum nigrum*	5	10	50.00	0.00	0.00	0.00
Pterolobium stellatum	24	31	77.42	17	21	80.95	*Stephania abyssinica*	11	12	91.67	7	10	70.00
Ranunculus oligocarpus	7	10	70.00	8	10	80.00	*Stereospermum kunthianum*	11	20	55.00	11	19	57.89
Rhamnus prinoides	8	12	66.67	12	14	85.71	*Syzygium guineense* subsp. *guineense*	4	6	66.67	7	11	63.63
Ricinus communis	8	11	72.72	9	15	60.00	*Tamarindus indica*	7	13	53.85	9	13	69.23
Rosa abyssinica	7	14	50.00	9	15	60.00	*Tragia brevipes*	8	13	61.54	17	24	70.83
Rosmarinus officinalis	0.00	0.0	0.00	3	4	75.00	*Urtica simensis*	5	9	55.56	0.00	0.00	0.00
Rubia cordifolia	0.0	0.0	0.00	4	8	50.00	*Verbascum sinaiticum*	6	12	50.00	11	15	73.73
Rubus apetalus	3	5	60.00	2	3	66.67	*Verbena officinalis*	18	20	90.00	12	13	92.31
Rumex abyssinicus	6	11	54.54	10	15	72.50	*Vernonia amygdalina*	17	20	85.00	17	22	77.27
Rumex nepalensis	10	16	62.50	9	15	60.00	*Vicia faba*	4	7	57.14	7	13	53.85
Rumex nervosus	12	16	75.00	11	16	68.75	*Viscum tuberculatum*	6	8	75.00	10	14	71.43
Ruta chalepensis	27	29	93.10	22	25	88.00	*Vitis vinifera*	3	6	50.00	2	4	50.00
Saccharum officinarum	18	23	78.26	16	20	80.00	*Withania somnifera*	11	12	91.67	10	11	90.90
Salix subserrata	7	14	50.00	0.00	0.00	0.00	*Xanthium strumarium*	4	7	57.14	0.00	0.00	00.00
Sansevieria ehrenbergii	11	18	61.11	11	16	68.75	*Ximenia americana*	5	10	50.00	6	11	54.54
Schefflera abyssinica	9	14	64.29	8	13	61.54	*Zehneria scabra*	18	24	75.00	20	26	76.92
Schinus molle	10	12	83.33	11	16	68.75	*Zingiber officinale*	18	26	69.23	22	26	84.62
Securidaca longepedunculata	9	13	69.23	11	14	78.57	*Ziziphus spina-christi*	9	14	64.29	5	11	45.45
Senna singueana	26	27	96.30	28	30	93.33							

Appendix-8: Fidelity level of traditional medicinal plants used to treat livestock ailments in the study area

Herbal medicine	Baso Liben			Debre Elias			Herbal medicine	Baso Liben			Debre Elias		
	Ip	Iu	FL (%)	Ip	Iu	FL (%)		Ip	Iu	FL (%)	Ip	Iu	FL (%)
Acokanthera schimperi	12	18	**66.67**	11	19	57.89	*Embelia schimperi*	7	9	77.78	5	7	71.43
Agave sisalana	7	13	53.85	0.0	0.0	0.00	*Erythrina brucei*	10	13	76.92	0.0	0.0	0.00
Allium sativum	23	28	82.14	20	24	83.33	*Euphorbia abyssinica*	14	15	93.33	15	17	88.23
Aloe macrocarpa	0.00	0.0	0.00	12	16	68.75	*Flacourtia indica*	7	11	63.64	0.0	0.0	00.00
Apodytes dimidiata	4	8	50.0	0.00	0.00	0.00	*Gnidia glauca*	0.00	0.0	0.0	5	8	62.50
Argemone Mexicana	4	7	57.14	0.00	0.0	0.00	*Gomphocarpus purpurascens*	0.00	0.0	00.0	8	10	80.00
Arisaema schimperianum	4	9	44.44	0.00	0.00	0.00	*Grewia ferruginea*	6	9	66.67	0.00	0.00	00.00
Artemisia abyssinica	0.00	0.00	0.00	5	10	50.00	*Guizotia scabra*	7	10	70.0	0.00	0.00	0.00
Buddleja polystachya	5	10	50.00	0.0	0.0	0.00	*Hagenia abyssinica*	25	31	80.64	26	30	86.67
Calotropis procera	10	16	62.50	15	25	60.00	*Haplocarpha schimperi*	7	12	58.33	0.00	0.00	0.00
Calpurnia aurea	5	6	83.00	0.00	0.0	0.00	*Hypoestes forskaolii*	7	9	77.78	0.00	0.00	0.00
Carica papaya	9	16	56.25	0.0	0.0	0.00	*Justicia schimperiana*	15	16	93.75	14	16	87.50
Cassipourea malosana	0.0	0.0	0.00	14	25	56.00	*Kalanchoe petitiana*	11	15	73.33	8	13	61.54
Celtis africana	5	11	45.45	5	9	55.56	*Lageneria siceraria*	9	11	81.82	12	15	80.00
Clausena anisata	6	7	85.71	8	12	66.67	*Laggera tomentosa*	10	11	90.90	11	12	91.67
Clerodendrum myricoide	8	11	72.72	7	13	53.85	*Leonotis ocymifolia*	0.00	0.0	0.00	6	8	75.00
Croton macrostachyus	20.0	24	83.33	26	29	89.66	*Lepidium sativum*	11	14	78.57	10	12	83.33
Cucumis ficifolius	7	8	87.50	11	13	84.62	*Lycopersicum esculentum*	11	13	84.62	9	10	90.00
Datura stramonium	0.0	0.0	0.00	7	10	70.00	*Maesa lanceolata*	6	9	66.67	9	14	64.29
Discopodium penninervium	4	6	66.67	0.0	0.0	0.00	*Malva verticilata*	7	10	70.00	9	13	69.23
Dodonaea angustifolia	3	6	50.00	0.0	0.0	0.00	*Melia azedaracha*	6	9	66.67	0.00	0.00	0.00
Dracaena steudneri	4	10	40.00	13	17	76.47	*Myrica salicifolia*	7	11	63.63	8	15	53.33
Dregea abyssinica	8	14	57.14	0.0	00	00.00	*Myrsine africana*	5	6	83.33	8	13	61.54
Echinops kebericho	20	24	83.33	12	15	80.00	*Nicotiana tabacum*	22	24	91.67	17	18	94.44

Appendix-8: contid.

Herbal medicine	Baso Liben			Debre Elias			Herbal medicine	Baso Liben			Debre Elias		
	Ip	Iu	FL (%)	Ip	Iu	FL (%)		Ip	Iu	FL (%)	Ip	Iu	FL (%)
Nuxia congesta	5	8	62.50	7	12	58.33	*Solanum incanum*	9	16	56.25	14	18	77.78
Ocimum lamiifolium	15	20	75.00	14	18	77.78	*Solanum marginatum*	13	16	81.25	10	15	66.67
Olea europaea subsp. *cuspidata*	5	7	71.43	0.00	0.00	0.00	*Solanum nigrum*	3	5	60.00	5	7	71.43
Orobanche minor	0.00	0.00	0.00	5	7	71.43	*Stereospermum kunthianum*	3	5	60.00	0.00	0.00	0.00
Pavetta abyssinica	10	14	71.43	7	12	58.33	*Stephania abyssinica*	7	8	87.50	8	9	88.89
Phoenix reclinata	6	10	60.00	6	11	54.54	*Thalictrum schimperianum*	10	13	76.92	8	11	72.72
Phytolacca dodecandra	16	17	94.12	17	20	85.00	*Urera hypselodendron*	0.0	0.0	0.00	2	4	50.00
Plectocephalus varians	14	18	77.78	12	15	85.71	*Verbascum sinaiticum*	13	16	81.25	12	14	85.71
Premna schimperi	9	15	60	0.00	0.00	0.00	*Vernonia amygdalina*	20	23	86.96	16	20	80.00
Prunus africana	0.00	0.0	0.00	9	12	75.00	*Withania somnifera*	6	7	85.71	5	8	62.50
Prunus persica	0.00	0.0	0.00	10	15	66.67	*Zea mays*	6	10	60.00	0.00	0.00	0.00
Rhamnus prinoides	11	13	84.62	10	11	90.91	*Zehneria scabra*	14	16	87.50	18	23	78.26
Ricinus communis	18	23	78.26	16	19	84.21	*Zingiber officinale*	14	18	77.78	6	10	54.55
Rubia cordifolia	6	11	54.54	0.00	0.0	0.00							
Rumex nepalensis	0.0	0.0	0.00	3	4	75							
Rumex nervosus	16	21	76.19	13	15	86.67							
Ruta chalepensis	4	6	66.67	0.0	0.0	0.00							
Sansevieria ehrenbergii	4	10	40.00	9	16	56.25							
Schinus molle	13	14	92.86	18	19	94.73							
Solanecio gigas	15	19	78.94	10	16	62.50							

Appendix-9: List of human ailments and their respective number of plant species used to treat each ailment in the study area

No.	Ailments treated	BL dist.		DE dist.		Both dist.		No.	Ailments treated	BL dist.		DE dist.		Both dist.	
		No spp.	**%**	**No spp.**	%	**No spp.**	%			**No spp.**	%	**No spp.**	%	**No spp.**	%
1	Abdominal colic	18	5.42	16	4.95	18		30	Epidemic	02	0.60	02	0.62	02	0.55
2	Abdominal pain	05	1.51	07	2.17	07		31	Epiglottitis	01	0.30	01	0.31	01	0.28
3	Abdominal worms	04	1.20	04	1.24	04		32	Epilepsy	-	-	01	0.31	01	0.28
4	Acute febrile illness	16	4.82	14	4.33	16		33	Epistaxis	03	0.30	01	0.31	03	0.55
5	Amoeba	02	0.60	01	0.31	02		34	Evil eye	08	2.41	08	2.48	08	2.21
6	Ascariasis	07	2.11	06	1.86	07		35	Evil sprit	06	1.81	06	1.86	06	1.66
7	Asthma	01	0.30	01	0.31	01		36	Fever (Mich)	09	2.71	09	2.79	09	2.50
8	Backache	01	0.30	01	0.31	01		37	Febrile illness	03	0.90	03	0.93	03	0.83
9	Bloat	01	0.30	01	0.31	01		38	Foot disease/rot	01	0.30	01	0.31	01	0.28
10	Boil	03	0.90	02	0.62	03		39	Gastritis	08	2.41	06	1.86	08	2.21
11	Bone fracture	02	0.60	02	0.62	02		40	Gingivitis	01	0.30	01	0.31	01	0.28
12	Burn	04	1.20	04	1.24	04		41	Gonorrhoea	02	0.60	02	0.62	02	0.55
13	Breast cancer	01	0.30	01	0.31	01		42	Halitosis	-	-	01	0.31	01	0.28
14	Common cold	07	2.11	07	2.17	07		43	Headache	03	0.90	03	0.93	03	0.83
15	Constipation	02	0.60	02	0.62	03		44	Heart failure	03	0.90	03	0.93	03	0.83
16	Coughing	09	2.71	09	2.79	10		45	Hemorrhoids	05	1.51	03	0.93	05	1.38
17	Cut	02	0.60	02	0.62	02		46	Hepatitis	01	0.30	01	0.31	01	0.28
18	Dandruff	06	1.81	05	1.55	06		47	Hypertension	05	1.51	04	1.24	05	1.38
19	Deafness	01	0.30	-	-	01		48	Impotency	05	1.51	05	1.55	05	1.38
20	Delay ejaculation	02	0.60	02	0.62	02		49	Indigestion	06	1.81	05	1.55	06	1.66
21	Diabetes	01	0.30	01	0.31	01		50	Influenza	01	0.30	01	0.31	01	0.28
22	Diarrheoa	05	1.51	05	1.55	06		51	Intelligence failure	01	0.30	01	0.31	01	0.28
23	Eye dirt expellant	01	0.30	01	0.31	01		52	Itching	05	1.51	06	1.86	07	1.93
24	Dysentery	07	2.11	08	2.48	08		53	Jaundice	06	1.81	08	2.48	08	2.21
25	Ear infection	01	0.30	01	0.31	01		54	Joint ache	01	0.30	01	0.31	01	0.28
26	Ear lesion	01	0.30	-	-	01		55	'Qurba'	07	2.11	05	1.55	07	1.93
27	Ear pest expellant	02	0.60	01	0.31	02		56	Lactation failure	01	0.30	-	-	01	0.28
28	Earache	01	0.30	01	0.31	01		57	Leishmania	03	0.90	03	0.93	03	0.83
29	Eczema	06	1.81	06	1.86	07		58	Leprosy	03	0.90	03	0.93	04	1.10

Appendix -9: Contd.

No.	Ailments treated	BL Dist.		DE Dist.		Both Dist.		No.	Ailments treated	BL Dist.		DE Dist.		Both Dist.	
		No spp.	%	**No spp.**	%	**No spp.**	%			**No spp.**	%	**No spp.**	%	**No spp.**	%
59	Lung TB	-	-	01	0.31	01	0.28	79	Slight bleeding	-	-	01	0.31	01	0.28
60	Malaria	08	2.41	08	2.48	09	2.50	80	Snakebite	14	4.22	15	4.64	16	4.42
61	Meningitis	01	0.30	01	0.31	01	0.28	81	Spider poison	02	0.60	02	0.62	02	0.55
62	Menstrual disorder	01	0.30	-	-	01	0.28	82	Stabbing pain	-	-	01	0.31	01	0.28
63	'Mogn bagegn'	01	0.30	01	0.31	01	0.28	83	Swelling	06	1.81	06	1.86	06	1.66
64	Nausea	02	0.60	02	0.62	2	0.55	84	Syphilis	02	0.60	02	0.62	02	0.55
65	Nightmare	01	0.30	01	0.31	1	0.28	85	Tapeworm	04	1.20	04	1.24	04	1.10
66	Nose bleeding	01	0.30	01	0.31	1	0.28	86	Tinea nigra	04	1.20	03	0.90	05	1.38
67	Open sore	02	0.60	02	0.62	2	0.55	87	Tinea pedis	01	0.30	01	0.31	01	0.28
68	Paralysis	01	0.30	01	0.31	2	0.55	88	Tinia scaplis	01	0.30	01	0.31	01	0.28
69	Pneumonia	01	0.30	11	0.31	1	0.28	89	Tonsillitis	06	1.81	06	1.86	07	1.93
70	Rabies	02	0.60	02	0.62	2	0.55	90	Toothache	14	4.22	14	4.33	14	3.87
71	Retained placenta	02	0.60	02	0.62	2	0.55	91	Trachoma	01	0.30	01	0.31	01	0.28
72	Rh^- (Shotelay) frequent misscarriage	01	0.30	01	0.31	1	0.28	92	Tropical ulcer	-	-	01	0.31	01	0.28
73	Rheumatic pain	01	0.30	01	0.31	1	0.28	93	Urination problem	01	0.30	01	0.31	01	0.28
74	Ringworm	02	0.60	02	0.62	2	0.55	94	Vitiligo	-	-	01	0.31	01	0.28
75	Scabies	03	0.90	02	0.62	3	0.83	95	Vomiting	01	0.30	01	0.31	01	0.28
76	Scorpion poison	02	0.60	04	1.24	4	1.10	96	Wart	04	1.20	04	1.24	04	1.10
77	Sinusitis	01	0.30	-	-	1	0.28	97	Wound	16	4.82	17	5.26	19	5.23
78	Skin rush	03	0.90	03	0.93	3	0.83	**Total**		**332**	**100**	**323**	**100**	**362**	**100**

Key: BL= Baso Liben; DE = Debre Elias; dist. = district

Appendix-10: List of ethnoveterinary ailments and the respective number of plant species used to treat each ailment in the study area

No.	Ailments treated	BL dist.		DE dist.		Both dist.		No.	Ailments treated	BL dist.		DE dist.		Both dist.	
		No spp.	%	No spp.	%	No spp.	%			No spp.	%	No spp.	%	No spp.	%
1	"Abiriq" in quuen	1	0.07	1	0.72	1	0.61	28	Indigestion	2	1.39	2	1.45	2	1.22
2	African horse sickness	1	0.07	-	-	1	0.61	29	Infertility	2	1.39	2	1.45	2	1.22
3	Anthrax	4	2.78	3	2.17	4	2.44	30	Intestinal parasite	1	0.07	1	0.72	1	0.61
4	Blackleg	3	2.08	2	1.45	3	1.83	31	Lactation failure	2	1.39	1	0.72	2	1.22
5	Bloat	10	6.94	10	7.25	12	7.32	32	Leech infestation	11	7.64	13	9.42	14	8.54
6	Bone fracture	1	0.07	-	-	1	0.61	33	Mastitis	1	0.07	1	0.72	1	0.61
7	Calf rejection	-	-	1	0.72	1	0.61	34	Mouth infection	4	2.78	3	2.17	4	2.44
8	Clumsiness	-	-	1	0.72	1	0.61	35	Nasal affliction	3	2.08	3	2.17	3	1.83
9	Coccidiosis	7	4.86	6	4.35	7	4.27	36	Neck infection	1	0.07	1	0.72	1	0.61
10	Colic	3	2.08	5	3.62	5	3.05	37	Pasteurollosis	2	1.39	1	0.72	2	1.22
11	Constipation	2	1.39	2	1.45	2	1.22	38	Physical damage	2	1.39	1	0.72	2	1.22
12	Coughing	3	2.08	3	2.17	4	2.44	39	Poisonous	1	0.07	1	0.72	1	0.61
13	Cowdriosis	3	2.08	1	0.72	3	1.83	40	Rabies	9	6.25	8	5.79	9	5.49
14	Dermatophilosis	1	0.07	3	2.17	3	1.83	41	Retained placenta	2	1.39	3	2.17	3	1.83
15	Diarrhoea	5	3.47	4	2.89	5	3.05	42	Scabies	2	1.39	2	1.45	2	1.22
16	Downer	1	0.07	1	0.72	1	0.61	43	Slight bleeding	1	0.07	1	0.72	1	0.61
17	Dysentery	1	0.07	1	0.72	1	0.61	44	Snakebite	1	0.07	1	0.72	1	0.61
18	Emaciation	9	6.25	9	6.52	10	6.10	45	Sore	1	0.07	1	0.72	1	0.61
19	Epidemic	4	2.78	4	2.89	5	3.05	46	Sudden disease	1	0.07	1	0.72	1	0.61
20	Epilepsy (Azurit)	2	1.39	2	1.45	2	1.22	47	Swelling	3	2.08	3	2.17	3	1.83
21	Evil eye	-	-	1	0.72	1	0.61	48	Tapeworm	1	0.07	1	0.72	1	0.61
22	External parasite	5	3.47	4	2.89	5	3.05	49	Termite infestation	1	0.07	-	-	1	0.61
23	Eye infection	9	6.25	8	5.79	11	6.71	50	Tick infestation	2	1.39	3	2.17	3	1.83
24	Fashiolsis	-	-	1	0.72	1	0.61	51	Trypanosomiasis	3	2.08	3	2.17	3	1.83
25	Fever	2	1.39	2	1.45	2	1.22	52	Unspecified disease	-	-	1	0.72	1	0.61
26	Foot rot	1	0.07	1	0.72	1	0.61	53	Wound	5	3.47	3	2.17	5	3.05
27	Helminthiasis	2	1.39	1	0.72	2	1.22	**Total**		**144**	**100**	**138**	**100**	**164**	**100**

Key: BL = Baso Liben; DE = Debre Elias; dist. = district

Appendix-11: Ethnomedicinal plants in terms of genera, species and their percentage in the study area

No.	Family	Districts, genera, species and percentage (%)											
		Baso Liben				Debre Elias				Combined districts			
		No genera	%	No spp.	%	No genera	%	No spp.	%	No genera	%	No spp.	%
1	Acanthaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
2	Alliaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
3	Aloaceae	1	0.82	1	0.75	1	0.85	2	1.59	1	0.72	2	1.31
4	Amaranthaceae	2	1.64	2	1.50	1	0.85	1	0.79	2	1.44	2	1.31
5	Anacardiaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
6	Apiaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
7	Apocynaceae	2	1.64	2	1.50	2	1.69	2	1.59	2	1.44	2	1.31
8	Araliaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
9	Arecaceae	1	0.82	1	0.75	-	-	-	-	1	0.72	1	0.65
10	Asclepiadaceae	2	1.64	2	1.50	3	2.54	3	2.38	3	2.16	3	1.96
11	Asparagaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
12	Asteraceae	9	7.38	11	8.27	9	7.63	10	7.94	10	7.19	12	7.84
13	Balanitaceae	1	0.82	1	0.75	-	-	-	-	1	0.72	1	0.65
14	Balsaminaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	2	1.31
15	Bignoniaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
16	Boraginaceae	1	0.82	2	1.50	2	1.69	3	2.38	2	1.44	3	1.96
17	Brassicaceae	2	1.64	2	1.50	1	0.85	1	0.79	2	1.44	2	1.31
18	Burseraceae	-	-	-	-	1	0.85	1	0.79	1	0.72	1	0.65
19	Capparidaceae	1	0.82	1	0.75	2	1.69	2	1.59	2	1.44	2	1.31
20	Caricaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
21	Caryophyllaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
22	Celasteraceae	1	0.82	1	0.75	2	1.69	2	1.59	2	1.44	2	1.31
23	Combretaceae	1	0.82	1	0.75	2	1.69	2	1.59	2	1.44	2	1.31
24	Crassulaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
25	Cucurbitaceae	4	3.28	4	3.28	3	2.54	3	2.38	4	2.88	4	2.61
26	Dioscoreaceae	1	0.82	1	0.75	-	-	-	-	1	0.72	1	0.65
27	Dracaenaceae	2	1.64	2	1.50	2	1.69	2	1.59	2	1.44	2	1.31
28	Ebenaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
29	Euphorbiaceae	5	4.10	7	5.26	5	4.24	6	4.76	5	3.60	7	4.58
30	Fabaceae	8	6.56	9	6.77	7	5.93	7	5.56	8	5.76	9	5.88
31	Hypericaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
32	Lamiaceae	5	4.10	5	3.76	4	3.39	4	3.18	6	4.32	6	3.92
33	Lineaceae	1	0.82	1	0.5	1	0.85	1	0.79	1	0.72	1	0.96
34	Lythraceae	-	-	-	-	1	0.85	1	0.76	1	0.72	1	0.65

35	Malvaceae	2	1.64	2	1.50	2	1.69	2	1.59	3	2.16	3	1.96
36	Meliaceae	2	1.64	2	1.50	2	1.69	2	1.59	2	1.44	2	1.31
37	Melianthaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
38	Menispermaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
39	Molluginaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
40	Moraceae	1	0.82	1	0.75	2	1.69	3	2.38	2	1.44	3	1.96
41	Myricaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
42	Myrsinaceae	2	1.64	2	1.50	2	1.69	2	1.59	3	2.16	3	1.96
43	Myrtaceae	3	2.46	3	2.26	3	2.54	3	2.38	3	2.16	3	1.96
44	Olacaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
45	Oleaceae	2	1.64	2	1.50	2	1.69	2	1.59	2	1.44	2	1.31
46	Oliniaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
47	Pedaliaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
48	Phytolaccaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
49	Plantaginaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
50	Plumbaginaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
51	Poaceae	5	4.10	5	3.76	3	2.54	3	2.38	5	3.60	5	3.27
52	Podocarpaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
53	Polygalaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
54	Polygonaceae	1	0.82	3	2.26	1	0.85	3	2.38	1	0.72	3	1.96
55	Ranunculaceae	2	1.64	2	1.50	2	2.54	2	1.59	2	1.44	2	1.31
56	Rhamnaceae	2	1.64	2	1.50	2	2.54	2	1.59	2	1.44	2	1.31
57	Rhizophoraceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
58	Rosaceae	3	2.46	3	2.26	3	2.54	3	2.38	3	2.16	3	1.96
59	Rubiaceae	1	0.82	1	2.26	3	2.54	3	2.38	3	2.16	3	1.96
60	Rutaceae	2	1.64	2	1.50	2	1.69	2	1.59	2	1.44	2	1.31
61	Salicaceae	1	0.82	1	0.75	-	-	-	-	1	0.72	1	0.65
62	Santalaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
63	Sapindaceae	1	0.82	1	0.75	-	-	-	-	1	0.72	1	0.65
64	Sapotaceae	1	0.82	1	0.75	-	-	-	-	1	0.72	1	0.65
65	Scrophulariaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
66	Simarobaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
67	Solanaceae	4	3.28	7	5.26	4	3.39	5	3.96	5	3.60	8	5.23
68	Tiliaceae	1	0.82	1	0.75	-	-	-	-	1	0.72	1	0.65
69	Urticaceae	1	0.82	1	0.75	1	0.85	1	0.79	2	1.44	2	1.31
70	Verbenaceae	2	1.64	2	1.50	2	1.69	2	1.59	2	1.44	2	1.31
71	Viscaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65
72	Vitaceae	2	1.64	2	1.50	2	1.69	2	1.59	3	2.16	3	1.96
73	Zingiberaceae	1	0.82	1	0.75	1	0.85	1	0.79	1	0.72	1	0.65

Appendix-12: Ethnoveterinary plants in terms of genera, species and their percentage in the study area

No.	Family	Districts, genera, species and percentage (%)											
		Baso Liben				Debre Elias				Combined districts			
		No. genera	%	No. species	%	No. genera	%	No. species	%	No. genera	%	No. species	%
1	Acanthaceae	1	1.67	2	3.08	1	1.96	1	1.75	2	2.63	2	2.47
2	Agavaceae	1	1.67	1	1.54	-	-	-	-	1	1.32	1	1.23
3	Alliaceae	1	1.67	1	1.54	1	1.96	1	1.75	1	1.32	1	1.23
4	Aloaceae	-	-	-	-	1	1.96	1	1.75	1	1.32	1	1.23
5	Anacardiaceae	1	1.67	1	1.54	1	1.96	1	1.75	1	1.32	1	1.23
6	Apocynaceae	1	1.67	1	1.54	1	1.96	1	1.75	1	1.32	1	1.23
7	Araceae	1	1.67	1	1.54	-	-	-	-	1	1.32	1	1.23
8	Arecaceae	1	1.67	1	1.54	1	1.96	1	1.75	1	1.32	1	1.23
9	Asclepiadaceae	2	3.33	2	3.08	2	3.92	2	3.51	3	3.95	3	3.75
10	Asparagaceae	1	1.67	1	1.54	1	1.96	1	1.75	1	1.32	1	1.23
11	Asteraceae	6	10	6	9.23	6	11.76	6	10.52	8	10.53	8	9.88
12	Bignoniaceae	1	1.67	1	1.54	-	-	-	-	1	1.32	1	1.23
13	Brassicaceae	1	1.67	1	1.54	1	1.96	1	1.75	1	1.32	1	1.23
14	Capparidaceae	1	1.67	1	1.54	-	-	-	-	1	1.32	1	1.23
15	Caricaceae	-	-	-	-	1	1.96	1	1.75	1	1.32	1	1.23
16	Crassulaceae	1	1.67	1	1.54	1	1.96	1	1.75	1	1.32	1	1.23
17	Cucurbitaceae	3	5.00	3	4.62	3	5.88	3	5.26	3	3.95	3	3.75
18	Dracaenaceae	2	3.33	2	3.08	1	1.96	1	1.75	2	2.63	2	2.47
19	Euphorbiaceae	2	3.33	3	4.62	2	3.92	3	5.26	2	2.63	3	3.75
20	Fabaceae	1	1.67	1	1.54	1	1.96	1	1.75	2	2.63	2	2.47
21	Flacourtiaceae	1	1.67	1	1.54	-	-	-	-	1	1.32	1	1.23
22	Icacinaceae	1	1.67	1	1.54	-	-	-	-	1	1.32	1	1.23
23	Lamiaceae	4	6.67	4	6.15	4	7.84	4	7.02	5	6.58	5	6.17
24	Loganiaceae	1	1.67	1	1.54	-	-	-	-	1	1.32	1	1.23
25	Malvaceae	1	1.67	1	1.54	-	-	-	-	1	1.32	1	1.23
26	Meliaceae	1	1.67	1	1.54	-	-	-	-	1	1.32	1	1.23
27	Menispermaceae	1	1.67	1	1.54	1	1.96	1	1.75	1	1.32	1	1.23
28	Myricaceae	-	-	-	-	1	1.96	1	1.75	1	1.32	1	1.23
29	Myrsinaceae	2	3.33	2	3.08	2	3.96	2	3.51	2	1.32	2	2.47
30	Oleacea	1	1.67	1	1.54	-	-	-	-	1	1.32	1	1.23
31	Orobanchaceae	-	-	-	-	1	1.96	1	1.75	1	1.32	1	1.23
32	Papaveraceae	1	1.67	1	1.54	-	-	-	-	1	1.32	1	1.23
33	Phytolaccaceae	1	1.67	1	1.54	1	1.96	1	1.75	1	1.32	1	1.23
34	Poaceae	1	1.67	1	1.54	-	-	-	-	1	1.32	1	1.23

35	Polygonaceae	1	1.67	1	1.54	1	1.96	2	3.51	1	1.32	2	2.47
36	Ranunculaceae	1	1.67	1	1.54	1	1.96	1	1.75	1	1.32	1	1.23
37	Rhamnaceae	1	1.67	1	1.54	1	1.96	1	1.75	1	1.32	1	1.23
38	Rhizophoriaceae	-	-	-	-	1	1.96	1	1.75	1	1.32	1	1.23
39	Rosaceae	1	1.67	1	1.54	2	3.92	3	5.26	2	2.63	3	3.75
40	Rubiaceae	1	1.67	2	3.08	1	1.96	1	1.75	2	2.63	2	2.47
41	Rutaceae	2	3.33	2	3.08	1	1.96	1	1.75	2	2.63	2	2.47
42	Sapindaceae	1	1.67	1	1.54	-	-	-	-	1	1.32	1	1.23
43	Scrophulariaceae	1	1.67	1	1.54	1	1.96	1	1.75	1	1.32	1	1.23
44	Solanaceae	4	6.67	6	9.23	4	7.84	6	10.52	5	6.58	7	8.64
45	Thymelaceae	-	-	-	-	1	1.96	1	1.75	1	1.32	1	1.23
46	Tiliaceae	1	1.67	1	1.54	1	1.96	1	1.75	1	1.32	1	1.23
47	Ulmaceae	1	1.67	1	1.54	-	-	-	-	1	1.32	1	1.23
48	Urticaceae	-	-	-	-	1	1.96	1	1.75	1	1.32	1	1.23
49	Zingiberaceae	1	1.67	1	1.54	1	1.96	1	1.75	1	1.32	1	1.23
Total		**60**	**100**	**65**	**100**	**51**	**100**	**57**	**100**	**76**	**100**	**81**	**100**

Appendix-13: Species combination for the treatment of certain ailments

No.	Name of species	Disease treated	Along with
1	*Acacia abyssinica*	Dandruff	*Ageratum conyzoides*
2	*Acmella caulirhiza*	Tonsillitis	*Laggera tomentosa*
3	*Acokanthera schimperi*	Leprosy	*Brucea antidysenterica, Rumex nervosus,*
		Snakebite	*Capparis tomentosa*
4	*Allium sativum*	Coughing	*Ruta chalepensis, Schinus molle, Sesamum angustifolium*
		Indigestion	*Zingiber officinale*
		Evil eye	*Ruta chalepensis*
		Gastritis	*Ocimum lamiifolium*
		Abdominal worms	*Foeniculum vulgare*
5	*Anogeissus leiocarpa*	Acute Febrile illness	*Stereospermum kunthianum*
6	*Artemisia abyssinica*	Evil eye	*Allium sativum, R. chalepensis, Solanum marginatum*
7	*Asparagus africanus*	Impotency	*Psidium guajava, Acokanthera schimperi*
8	*Calotropis procera*	Wart	*Sida schimperiana*
		Hemorrhoids	*Plumbago zeylanica*
9	*Calpurnia aurea*	Wound	*Brucea antidysenterica*
10	*Capparis tomentosa*	Evil eye	*Clausena anisata, Otostegia integrifolia*
11	*Carissa spinarum*	Snakebite	*Calpurnia aurea, Plumbago zeylanica*
12	*Catha edulis*	Leprosy	*Anogeissus leiocarpa*
		Heart failure	*A. leiocarpa*
		Hypertension	*Allium sativum*
13	*Clausena anisata*	Common cold	*Withania somnifera*
		Fever	*Buddleja polystachya*
		Itching	*Tamarindus indica*
14	*Clerodendrum myricoides*	Boil	*Solanum marginatum*
15	*Croton macrostachyus*	Ringworm	*A. sativum, A. leiocarpa*
16	*Cucumis ficifolius*	Rabies	*Solanum incanum, Stephania abyssinica*
17	*Datura stramonium*	Toothache	*Cynoglossum lanceolata, Zehneria scabra*
18	*Echinops kebericho*	Evil eye	*Aloe camperi*
19	*Euclea racemosa* subsp. *schimperi*	Wound	*Rumex nervosus*
20	*Euphorbia abyssinica*	Wound	*Eragrostis tef*
		Jaundice	*Acokanthera schimperi*
21	*Euphorbia tirucalli*	Hemorrhoids	*R. nervosus*
22	*Justicia schimperiana*	Jaundice	*Croton macrostachyus*
23	*Leonotis ocymifolia*	Fever	*Zehneria scabra*
24	*Lepidium sativum*	Malaria	*Allium sativum*
		Indigestion	*S. angustlfollum*
25	*Lippia adoensis* var. *adoensis*	Coughing	*Schinus molle, Saccharum officinarum*
		Common cold	*Ruta chalepensis*
26	*Ocimum lamiifolium*	Fever	*Leonotis ocymifolia*
27	*Periploca linearifolia*	Premature ejaculation	*Asparagus africanus*
28	*Phoenix reclinata*	Deafness	*S. angustlfollum*
29	*Phytolacca dodecandra*	"Qurba"	*S. angustlfollum*
30	*Plumbago zeylanica*	Swelling	*Achyranthes aspera*
		Snakebite	*Carissa spinarum*
31	*Ranunculus oligocarpus*	Hemorrhoids	*Croton macrostachyus, Cymbopogon citratus*
32	*Ricinus communis*	Impotence	*Aloe macrocarpa*
33	*Rumex abyssinicus*	Skin rush	*Cucumis ficifolius, Tamarindus indica*
		Pneumonia	*A. sativum*
		Heart failure	*Ageratum conyzoides*
34	*Ruta chalepensis*	Common cold	*A. sativum*

		Influenza	*Coffea rabica*
		Abdominal colic	*C. arabica*
		Evil eye	*A. sativum*
		Gastritis	*A. sativum, Solanum marginatum*
35	*Securidaca longepedunculata*	Evil sprit	*Capparis tomentosa, Myrica salicifolia*
36	*Sesamum angustifolium*	Dandruff	*Datura stramonium*
		Coughing	*Guizotia scabra*
		Abdominal colic	*Lepidium sativum*
37	*Silene macrosolen*	Gastritis	*Securidaca longepedunculata*
		Tapeworm	*Guizotia abyssinica*
38	*Stephania abyssinica*	Rabies	*Phoenix reclinata, Solanum incanum*
39	*Vernonia amygdalina*	Itching	*Clausena anisata*
40	*Withania somnifera*	Intelligence failure	*Solanum incanum*
41	*Zehneria scabra*	Fever	*C. anisata, Leonotis ocymifolia, Ocimum lamiifolium*
42	*Zingiber officinale*	Abdominal pain	*Lepidium sativum*

Appendix-14: Wild edible plant lists collected from the study area**:** (Keys-Ha = habit-T = tree, S = shrub, H = herb, Cl = climber, Pu = parts used-Bu = bulb, Fr = fruit, In = inflorescence, L = leaf, Ne = Nectar, R = root, St = stem, Fl = flower, Tu = tuber, Sh = shoot, Gu = Gum, Pr = preparations, BL = Baso Liben, DE = Debre Elias, A = absent, P = present, V. No. = Voucher Number, NA = Nigussie Amsalu, **ä** = Cultivated; c* = MPs).

No.	Scientific name	Family	Local name (Amharic)	Ha	Pu	Prs	Flowering &/or Fruiting seasons	BL	DE	V. No.
1	*Acanthus pubescens* (Oliv.) Engl.	Acanthaceae	Kosheshila	S	Ne	Raw	October-March	P	P	NA027
2	***Acanthus sennii*** Chiov. **	Acanthaceae	Kosheshila	S	Ne	Raw	October-March	P	P	NA042
3	*Arisaema schimperianum* Schott *c	Araceae	Amoch	H	R	Raw	Rainy seasons	P	A	NA167
4	*Arundinaria alpina* K. Schum. ***a**	Poaceae	Qerqeha	H	Sh	Raw	All year round	P	P	NA287
5	*Balanites aegyptica* (L.) Del. *c	Balanitaceae	Asa Masgeria	T	Fr	Raw	September-May	P	A	NA306
6	*Carissa spinarum* L. *c, r *	Apocynaceae	Agam	S	Fr	Raw	October-June	P	P	NA083
7	*Celtis africana* Burm.f. r *, *c	Ulmaceae	Qewt	T	Fr	Raw	Rainy season	P	A	NA248
8	*Clausena anisata* (Willd.) Benth. *c	Rutaceae	Limich	S	Fr	Raw	July-August	P	P	NA020
9	*Combretum molle* R. Br. ex G. Don *c	Combretaceae	Shawoch	T	Fr	Raw	January-April	A	P	NA178
10	*Cordia africana* Lame. *c	Boraginaceae	Wanza	T	Fr	Raw	December-June	P	P	NA026
11	*Cyperus bulbosus* Vahl	Cyperaceae	Engicha	H	Bu	Raw	July-October	P	P	NA051
12	*Datura stramonium* L. *c	Solanaceae	Astenagir	H	Ne	Raw	August-February	P	P	NA115
13	*Dioscorea abyssinica* Hochst. ex Kunth *c, r *	Dioscoreaceae	Yechaka Buna	Cl	Tu	Boiled	Winter	P	A	NA247
14	*Dovyalis abyssinica* (A. Rich.) Warb. r *	Flacourtiaceae	Korshim	S	Fr	Raw	May-June	A	P	NA031
15	*Dovyalis caffra* (Hook.f. & Harv.) Hook.f. *a	Flacourtiaceae	Korshim	S	Fr	Raw	All year round	A	P	NA358
16	*Ehretia cymosa* Thonn.	Boraginaceae	Olaga	T	Fr	Raw	March	A	P	NA186
17	*Ekebergia capensis* Sparrm. *c	Meliaceae	Lol	T	Fr	Raw	November-May	P	A	NA187
18	*Embelia schimperi* Vatke *c	Myrsinaceae	Inqoko	Cl	Fr	Raw	December-March	P	P	NA110
19	*Ensete ventricosum* (Welw.) Cheesman*a	Musaceae	Koba	H	Fr	Raw	February-March	P	A	NA289
20	*Euclea racemosa* Murr. Subsp. *schimperi* A. DC.) White *c	Ebenaceae	Dedeho	T	Fr	Raw	July-April	P	P	NA162
21	*Ficus glumosa* Del.	Moraceae	Sholla/woda	T	Fr	Raw	Unspecified	P	P	NA217
22	*Ficus palmata* Forssk. r *	Moraceae	Beles	T	Fr	Raw	October-December	A	P	NA353
23	*Ficus sur* Forssk. *c	Moraceae	Sholla	T	Fr	Raw	January-June	P	P	NA085
24	*Ficus sycomorus* L.*c	Moraceae	Wodda	T	Fr	Raw	October-May	P	P	NA008
25	*Ficus vasta* Forssk.	Moraceae	Warka	T	Fr	Raw	Januar-April	P	P	NA018
26	*Flacourtia indica* (Burm.f.) Merr. *c	Flacourtiaceae	Akuk	S	Fr	Raw	February-May	P	A	NA138
27	*Grewia ferruginea* Hochst. ex A.Rich.*c	Tiliaceae	Lenquata	S	Fr	Raw	May-July	P	P	NA257

28	*Justicia schimperiana* (Hochst. ex Nees) T. Anders. *c	Acanthaceae	Smitha	S	Ne	Raw	October-January	P	P	NA188
29	*Mimusops kummel* Bruce ex. DC. *c, r *	Sapotaceae	Shiy/Qoladi	T	Fr	Raw	Apri-May	P	P	NA302
30	*Momordica foetida* Schumach.*c	Cucurbitaceae	Yamora Misa	Cl	Fr	Raw	October-December	P	P	NA112
31	*Ocimum urticifolium* Roth	Lamiaceae	Ziqaqibe	S	In	Powder	October-December	A	P	NA148
32	*Opuntia ficus-indica* (L.) Miller	Cactaceae	Qulqual	H	Fr	Raw	September-April	P	P	NA345
33	*Oxalis corniculata* L.	Oxalidaceae	Yelam Chew	H	L	Raw	July-October	P	A	NA264
34	*Phoenix reclinata* Jacq. *c	Arecaceae	Chifar	T	Fr/ St	Raw	October- December	P	P	NA002
35	*Physalis peruviana* L.	Solanaceae	Awot	H	Fr	Raw	August-October	P	A	NA282
36	*Podocarpus falcatus* (Thunb.) R. B. ex Mirb. *c, r *	Podocarpaceae	Zigiba	T	Fr	Raw	January onwards	P	P	NA133
37	*Prunus africana* (Hook. f.) Kalkm. *c	Rosaceae	Komma	T	Fr	Raw	October-December	P	P	NA033
38	***Rhus glutinosa* subsp. *glutinosa*** Gilbert **	Anacardiaceae	Ashiqammo	S	Fr	Raw	April-June	A	P	NA074
39	*Ritchiea albersii* Gilg	Capparidaceae	Chomiye	T	Fr	Raw	October-June	A	P	NA023
40	*Rosa abyssinica* Lindley *c, r *	Rosaceae	Qega	S	Fr	Raw	October-April	P	P	NA075
41	*Rubus apetalus* Poir. *c	Rosaceae	Injor	S	Fr	Raw	October-December	P	P	NA045
42	*Rubus steudneri* Schweinf. r *	Rosaceae	Injor	S	Fr	Raw	October-December	P	A	NA158
43	*Rumex abyssinicus* Jacq. *c	Polygonaceae	Meqmeqo	H	St	Raw	January- December	P	P	NA266
44	*Rumex nervosus* Vahl *c	Polygonaceae	Anbuatie	S	Sh	Raw	June-January	P	P	NA068
45	*Sansevieria ehrenbergii* Schweinf. ex Baker *c	Dracaenaceae	Algeti/chiret	H	Gu	Raw	July- October	P	A	NA315
46	*Schinus molle* L. ***a** , ***c**	Anacardiaceae	Qundo Berbere	T	Fr	Powder	November-February	P	P	NA343
47	*Solanum nigrum* L. *c	Solanaceae	Awtign	H	Fr	Raw	July-September	P	P	NA175
48	*Syzygium guineense* Willd.) DC. subsp. *guineense* *c	Myrtaceae	Bedessa	T	Fr	Raw	December-May	P	P	NA001
49	*Tamarindus indica* L. *c, r *	Fabaceae	Roqa	T	Fr	Raw	September-April	P	P	NA229
50	*Teclea nobilis* Del. *c	Rutaceae	Qoladie	T	Fr	Raw	Rainy seasons	P	P	NA069
51	*Ximenia americana* L. *c, r *	Olacaceae	Enkoy/Kol	T	Fr	Raw	December-April	P	P	NA177
52	*Ziziphus spina-christi* (L.) Desf.*c, r *	Rhamnaceae	Gaba/Qurqura	S	Fr	Raw	December-March	P	P	NA220

***a** = Cultivated (4 spp.); r * = rare (not easily accessible; 12 spp.) WEPs in the study area

*c = Medicinal plants (34 spp.); **Boldface** = Endemic (2) species

Appendix-15: List of plant families together with genera and species of WEPs

No.	Family	Districts, genera, species and percentage (%)											
		Baso Liben				Debre Elias				Combined districts			
		No. genera	%	No. species	%	No. genera	%	No. species	%	No. genera	%	No. species	%
1	Acanthaceae	2	5.26	3	6.82	2	2.94	3	7.32	2	4.55	3	5.77
2	Agavaceae	1	2.63	1	2.27	-	-	-	-	1	2.27	1	1.92
3	Anacardiaceae	1	2.63	1	2.27	2	2.94	2	4.88	2	4.55	2	3.85
4	Apocynaceae	1	2.63	1	2.27	1	2.94	1	2.44	1	2.27	1	1.92
5	Araceae	1	2.63	1	-	-	-	-	-	1	2.27	1	1.92
6	Arecaceae	1	2.63	1	2.27	1	2.94	1	2.44	1	2.27	1	1.92
7	Balanitaceae	1	2.63	1	-	-	-	-	-	1	2.27	1	1.92
8	Boraginaceae	1	2.63	1	2.27	2	2.94	2	4.88	2	4.55	2	3.85
9	Cactaceae	1	2.63	1	2.27	1	2.94	1	2.44	1	2.27	1	1.92
10	Capparidaceae	-	-	-	-	1	2.94	1	2.44	1	2.27	1	1.92
11	Combretaceae	-	-	-	-	1	2.94	1	2.44	1	2.27	1	1.92
12	Cucurbitaceae	1	2.63	1	2.27	1	2.94	1	2.44	1	2.27	1	1.92
13	Cyperaceae	1	2.63	1	2.27	1	2.94	1	2.44	1	2.27	1	1.92
14	Dioscoreaceae	1	2.63	1	-	-	-	-	-	1	2.27	1	1.92
15	Ebenaceae	1	2.63	1	2.27	1	2.94	1	2.44	1	2.27	1	1.92
16	Fabaceae	1	2.63	1	2.27	1	2.94	1	2.44	1	2.27	1	1.92
17	Flacourtiaceae	1	2.63	1	2.27	1	2.94	2	4.88	2	4.55	3	5.77
18	Lamiaceae	-	-	-	-	1	2.94	1	2.44	1	2.27	1	1.92
19	Meliaceae	1	2.63	1	2.27	-	-	-	-	1	2.27	1	1.92
20	Moraceae	1	2.63	4	9.10	1	2.94	5	12.19	1	2.27	5	9.62
21	Musaceae	1	2.63	1	2.27	-	-	-	-	1	2.27	1	1.92
22	Myrsinaceae	1	2.63	1	2.27	1	2.94	1	2.44	1	2.27	1	1.92
23	Myrtaceae	1	2.63	1	2.27	1	2.94	1	2.44	1	2.27	1	1.92
24	Olacaceae	1	2.63	1	2.27	1	2.94	1	2.44	1	2.27	1	1.92
25	Oxalidaceae	1	2.63	1	2.27	-	-	-	-	1	2.27	1	1.92
26	Poaceae	1	2.63	1	2.27	1	2.94	1	2.44	1	2.27	1	1.92
27	Podocarpaceae	1	2.63	1	2.27	1	2.94	1	2.44	1	2.27	1	1.92
28	Polygonaceae	1	2.63	2	4.55	1	2.94	2	4.88	1	2.27	2	3.85
29	Rhamnaceae	1	2.63	1	2.27	1	2.94	1	2.44	1	2.27	1	1.92
30	Rosaceae	3	7.90	4	9.10	3	8.82	3	8.82	3	6.82	4	7.69
31	Rutaceae	2	5.26	2	4.55	2	5.88	2	4.88	2	4.55	2	3.85
32	Sapotaceae	1	2.63	1	2.27	1		1	2.44	1	2.27	1	1.92
33	Solanaceae	3	7.90	3	6.82	2	5.88	2	4.88	3	6.82	3	5.77
34	Tiliaceae	1	2.63	1	2.27	1	2.94	1	2.44	1	2.27	1	1.92
35	Ulmaceae	1	2.63	1	-	-	-	-	-	1	2.27	1	1.92
Total		**38**	**100**	**44**	**100**	**34**	**100**	**41**	**100**	**44**	**100**	**52**	**100**

Appendix-16: List of species with nutraceutical values in the study area: Ha = habit, Ln = local name (Amharic), IPUF = Information on parts used as food/related to food, V. No. = Voucher Number, NA = Nigussie Amsalu

No.	Scientific name	Family	Ha	Ln	IPUF	Ailments treated	V. No.
1	*Allium sativum*	Alliaceae	H	Shinkurt	Bulb & leaf as food	Abdominal worms, anthrax, coughing, dermatophilosis, evil eye, asthma, gastritis, indigestion, ringworm, snakebite, trypanosomiasis, wart	NA320
2	*Balanites aegyptiaca* **R**^{BL}	Balanitaceae	T	Yeasa Masgeria	Edible fruit	Coughing, fish poison	NA306
3	*Brassica carinata* **R**^{ED}	Brassicaceae	H	Gomen zer	Leaf/seed as food; oil	Abdominal colic, gastritis	NA249
4	*Carica papaya*	Caricaceae	T	Papaya	Edible fruit	Abdominal pain, dirrhoea, gastritis, leech, malaria	NA348
5	*Carissa spinarum*	Apocynaceae	S	Agam	Edible fruit	Evil eye, snakebite	NA085
6	*Catha edulis*	Celasteraceae	S	Chat	Edible shoot	Abdominal pain, coughing, heart failure, hypertension, leprosy	NA319
7	*Coffea arabica* **R**^{BL}	Rubiaceae	S	Bunna	As stimulant	Coughing, open sore	NA288
8	*Cordia africana*	Boraginaceae	T	Wanza	Edible fruit	Jaundice	NA026
9	*Datura stramonium*	Solanaceae	H	Astenagir	Nectar	Abdominal colic, bloat, dandruff, eczema, rheumatic pain, toothache, wound	NA115
10	*Dioscorea abyssinica*	Dioscoreaceae	Cl		Edible fruit	Lactation failure	NA247
11	*Ekebergia capensis* **R**^{BL}	Meliaceae	T	Lol	Edible fruit	Epidemic	NA187
12	*Embelia schimperi*	Myrsinaceae	Cl	Inqoqo	Edible fruit	Bloat, tapeworm, trachoma, emaciation "kuro", epilepsy (azurite)	NA289
13	*Eragrostis tef*	Poaceae	H	Teff	Human food	Bone fracture	NA029
14	*Euclea racemose* subsp. *schimperi*	Ebenaceae	S	Dedeho	Edible fruit	Wound	NA162
15	*Ficus sur*	Moraceae	T	Sholla	Edible fruit	Dysentery	NA085
16	*Ficus sycomorus* **R**^{BL}	Moraceae	T	Worka	Edible fruit	Snakebite	NA008
17	*Foeniculum vulgare*	Brassicaceae	H	Ensilal	Used as spices	Abdominal pain, urination problem	NA335
18	*Grewia ferruginea*	Tiliaceae	S	Lenquata	Edible fruit	Menstrual disorder, leech infestation, retained placenta	NA257
19	*Guizotia abyssinica*	Asteraceae	H	Nug	Sources of oil & fodder	Constipation, leech infestation,	NA155
20	*Hordeum vulgare* **R**^{BL}	Poaceae	H	Gebis	Seed as food	Dirrhoea, sinusitis	NA333
21	*Justicia schimperiana*	Acanthaceae	S	Smiza	Source of nectar	Anthrax, coccidiosis, constipation, epidemic, external parasite, jaundice, wound	NA188
22	*Laggera tomentosa*	Asteraceae	H	Keskeso	As spice	Toothache, termite infestation	NA185

23	*Linum usitatissimum*	Lineaceae	H	Telba	Oil crop & fodder	Indigestion, retained placenta, eye dirt expellant, spider poison	NA332
24	*Lipidium sativum*	Brassicaceae	H	Feto	As spices/food	Bloat, diarrhea, eczema, eye infection, indigestion, gastritis, gingivitis, fever, malaria, rabies	NA321
25	*Lippia adoensis* var. *adoensis*	Verbenaceae	S	Kesiy	Spice	Common cold, coughing, gastritis	NA099
26	*Lupinus albus*	Fabaceae	H	Gibito	Seed as food	Diabetes, eczema, hypertension	NA325
27	*Mimusops kummel*	Sapotaceae	T	Hol /Kol	Fruit as food	Amoeba	NA302
28	*Momordica foetida*	Cucurbitaceae	Cl	Yamora Genfo	Fruit as food	Common cold, evil eye, toothache, megagna (colic)	NA112
29	*Phoenix reclinata* **R^{BL}**	Arecaceae	T	Zembaba	Edible fruit	Diarrhoea, eye infection, deafness	NA002
30	*Podocarpus falcatus*	Podocarpaceae	T	Zigiba	Fruit oil	Evil sprit	NA133
31	*Psidium guajava* ***a**	Myrtaceae	T	Zeytun	Fruit as food	Diarrhoea, dysentery	NA341
32	*Rhamnus prinoides*	Rhaminaceae	S	Gesho	Fruit & leaf as stimulant	Colic, leech infestation, tonsillitis, skin infection, febrile illness	NA295
33	*Rosa abyssinica*	Rosaceae	S	Qega	Fruit as food	Tinea nigra, delaying ejaculation	NA075
34	*Rosmarinus officinalis* **R^{DE}**	Lamiaceae	H	Siga Metbesha	Leaf	Common cold , wound and halitosis	NA329
35	*Rubus apetalus*	Rosaceae	S	Injor	Fruit	Abdominal worms, dysentery, wound	NA045
36	*Rumex abyssinicus*	Polygonaceae	H	Tult	Edible young stem	Skin rush, burn, hypertension, tinea nigra, pneumonia, heart failure, acute febrile illness	NA266
37	*Rumex nervosus*	Polygonaceae	S	Anbuatie	Edible young stem	Hypertension, physical damage, external parasite	NA068
38	*Ruta chalepensis*	Rutaceae	H	Tila Adam	Seed/leaf as spices	Abdominal colic, common cold, evil eye, influenza, gastritis	NA324
39	*Saccharum officinarum*	Poaceae	H	Ageda	Stem food	Common cold, coughing, indigestion	NA318
40	*Schinus molle*	Anacardiaceae	T	Qundo	Fruit s spice	Acute febrile illness, stomach trouble, leech, abirq, epidemic, rabies	NA343
41	*Sesamum angustifolium*	Pedaliaceae	H	Selit	Seed oil	Coughing, epidemic, dandruff, abdominal colic, "mognbagegn"	NA340
42	*Solanum nigrum* **R^{BL}, *a**	Solanaceae	H	Awotign	Fruit as food	Itching, leech infestation	NA175
43	*Syzygium guineense* subsp. *guineense*	Myrtaceae	T	Bedessa	Edible fruit	Abdominal worms	NA001
44	*Tamarindus indica*	Fabaceae	T	Roqa	Fruit as food	Cancer, malaria, diarrhoea, ascaris, joint ache, snakebite, megangna (colic)	NA229
45	*Vicia fava*	Fabaceae	H	Baqella	Seed as food	Boil	NA337
46	*Vitis vinifera*	Vitaceae	Cl	Woin	Fruit as food	Nausea, coughing, snakebite	NA347
47	*Ximenia americana*	Olacaceae	T	Enkoy	Fruit as food	Scorpion poison, vomiting	NA177
48	*Zingiber officinale*	Zingiberaceae	H	Zinjible	Rhizome food	Abdominal pain, indigestion	NA083
49	*Ziziphus spina-christi* ***a**	Rhamnaceae	S	Kurkura	Fruit as food	Backache	NA220

Key: **R^{BL}** = Restricted to Baso Liben only; **R^{ED}** = Restricted to Debre Elias only (the information for that species); ***a** = new records for Gojjam Floristic Region

Appendix-17: Other uses of the most cited medicinal and WEPs in the study area [Use of codes: environmental uses (EU), Material (MA), Charcoal & firewood (CF), Social (SO), Fodder (FO), Forage (FR) and Poisonous (PO), V. No. = Voucher Number, NA = Nigussie Amsalu]

No.	Scientific name	Family	Ha	Local name (Amharic)	Other uses	Use of codes	V. No.
1	*Acacia abyssinica*	Fabaceae	T	Girar	Charcoal, utensils, shade, live fence, furniture, fodder	CF, EU, MA, FO	NA024
2	*Acacia lahai*	Fabaceae	S	Cheba	Firewood, charcoal, shade, fumigation of milk containers, forage	CF, EU, SO, FR	NA035
3	*Acokanthera schimperi*	Apocynaceae	S	Merz	Shade, firewood, poison, dry fence, smoke	EU, CF, PO, SO	NA226
4	*Aloe macrocarpa*	Aloaceae	H	Ret	Tanning, soil conservation/mulch	MA, EU	NA147
5	*Anogeissus leiocarpa*	Combretaceae	T	Muak	Firewood, charcoal, farm handles	CF, MA	NA297
6	*Apodytes dimidiate*	Icacinaceae	T	Donga	Tool handles, charcoal, firewood, ornamental, forage	MA, CF, EU, FR	NA135
7	*Balanites aegyptiaca*	Balanitaceae	T	Gaba	Firewood, charcoal, dry fence, toxic, fodder, ceremonial	CF, EU, PO, FO, SO	NA306
9	*Bersama abyssinica*	Melianthaceae	T	Azamira	Live fence, firewood, mulch/soil conservation	EU, CF	NA037
8	*Boswellia pirottae*	Burseraceae	T	Etan	Gum-resins, fumigation, firewood, charcoal, utensil	SO , CF, MA	NA218
10	*Brucea antidysenterica*	Simarobaceae	T	Abalo	Shade, mulch, firewood, wash pots	EU, CF, MA	NA059
11	*Buddleja polystachya*	Capparidaceae	S	Anfar	Firewood, charcoal, live fences, forage	CF, EU, FR	NA118
12	*Carissa spinarum*	Apocynaceae	S	Agam	Firewood, conservation, forage, dry fence	CF, EU, FR	NA218
13	*Clausena anisata*	Rutaceae	S	Limich	Toothbrush, firewood, forage, ornamental	MA, CF, FR, EU	NA020
14	*Combretum molle*	Combretaceae	T	Aballo	Firewood, charcoal, timber, tool handles, conservation	CF, MA, EU	NA178
15	*Cordia africana*	Boraginaceae	T	Wanza	Firewood, timber, furniture, live fence, shade, fodder	CF, MA, EU, FO	NA029
16	*Croton macrostachyus*	Euphorbiaceae	T	Bisana	Firewood, shade, charcoal, hand tool, soil conservation, furniture, forage, dry fence, fumigation, washing, fodder	CF, EU, PO, SO, MA, FO	NA057
17	*Cymbopogon citratus*	Poaceae	H	Teje Sar	Scent, ceremonial, ornamental, forage, fodder	SO, EU, FR, FO	NA338
18	*Dichrostachys cinerea*	Fabaceae	S	Adder	Farm tools, charcoal, dry fence, firewood, fodder	MA, CF, EU, FO	NA179
19	*Dodonaea angustifolia*	Sapindaceae	S	Kitkita	Firewood, charcoal, handle tools, tanning, conservation	CF, MA, EU	NA151
20	*Dracaena steudneri*	Dracaenaceae	T	Merqo	Dry fence, shade, baking local bread, ornamental	EU, MA	NA280
21	*Ekebergia capensis*	Meliaceae	T	Lol	Shade, soil conservation, hand tools, fodder	EU, MA, CF, FO	NA187
22	*Eucalyptus globulus*	Myrtaceae	T	Bahir Zaf	Furniture, live fence, charcoal, firewood, house construction, building pole, windbreak, insect repellent, bedding of floors	MA, EU, CF, PO	NA294
23	*Euclea racemose* subsp. *schimperi*	Ebenaceae	S	Dedeho	Dye, firewood, live fence, forage	MA, CF, EU, FR	NA162
24	*Euphorbia abyssinica*	Euphorbiaceae	T	Qulqual	Live fence, firewood, timber, poisons	EU, CF, MA, PO	NA084
25	*Ficus sur*	Moraceae	T	Sholla	Timber, shade, ceremonial, fodder, marker, furniture	MA, EU, FO, SO	NA085
26	*Ficus sycomorus*	Moraceae	T	Sholla	Timber, shade, soil conservation, firewood	MA, EU, CF	NA008
27	*Gardenia ternifolia*	Rubiaceae	T	Gambello	Tool handles, firewood, shade, soil conservation/mulch	MA, CF, EU	NA182
28	*Girardinia bullosa*	Urticaceae	H	Kusha	Rope, washing, forage, live fence	MA, SO, FR, EU	NA107
29	*Grewia bicolor*	Tiliaceae	S	Somaya	Farm tool, tool handle ("Mensh"), firewood	MA, CF	NA299
30	*Grewia ferruginea*	Tiliaceae	S	Lenquata	Farm tools, firewood, timber, rope	MA, CF	NA257

32	*Juniperus procera*	Cupressaceae	T	Tid	Ornamental, hedges, furniture	EU, MA	NA117
31	*Justicia schimperiana*	Acanthaceae	S	Smiza	Live fence, marker, ornamental, firewood, cleaning pots	EU, CF, MA	NA188
33	*Lagenaria siceraria*	Cucurbitaceae	Cl	Qill	Utensil, live fence	MA, EU	NA342
34	*Laggera tomentosa*	Asteraceae	H	Keskeso	Spices, insect repellent, fumigant, cleansing containers, perfuming butter, forage	PO, SO, FR, MA	NA259
35	*Lippia adoensis* var. *adoensis*	Lamiaceae	S	Kesiy	Ritual ceremonies, forage, scenting home	SO, FR	NA099
36	*Maesa lanceolata*	Myrsinaceae	T	Qilanbo	Live fence, baking & softening bread, firewood, forage, farm tools	EU, MA, CF, FR	NA144
37	*Mimusops kummel*	Sapotaceae	T	Kol	Firewood, timber, tool handles, local utensil, construction	CF, MA, EU	NA302
38	*Olea europaea* subsp. *cuspidata*	Oleaceae	T	Woira	Toothbrush, walking stick, forage, charcoal	MA, FR, CF	NA126
39	*Otostegia integrifolia*	Lamiaceae	S	Tinjit	Fumigation/for good scent of utensils, firewood, conservation	SO, CF, EU	NA304
40	*Pavetta abyssinica*	Rubiaceae	S	Dingay Seber	Firewood, tool handles, house construction, conservation	CF, MA, EU	NA065
41	*Phoenix reclinata*	Arecaceae	T	Cifar	Basket, ceremonial, dye, local doors, roofing, ornamental, soil con., fodder, firewood	MA, SO, EU, FO, CF	NA002
42	*Phytolacca dodecandra*	Phytolaccaceae	S	Indod	Soap-substitute, live fence, soil conservation	MA, EU, CF	NA254
43	*Prunus africana*	Rosaceae	T	Komma	Shade, utensil, ceremonial/washing body, firewood, timber	EU, MA, SO, CF	NA033
44	*Psidium guajava*	Myrtaceae	T	Zeytun	Firewood, charcoal, hand tool	CF, MA	NA341
45	*Pterolobium stellatum*	Fabaceae	S	Qontir	Live fence, firewood	EU, CF	NA032
46	*Rhamnus prinoides*	Rhamnaceae	S	Gesho	Flavoring, firewood, shade, forage	MA, CF, EU	NA265
47	*Ricinus communis*	Euphorbiaceae	H	Chaqimma	Firewood, castor oil, live fence, tannery work	CF, MA, EU, SO	NA091
48	*Rosa abyssinica*	Rosaceae	S	Qega	Firewood, live fence, forage	CF, EU, FR	NA075
49	*Rumex nervosus*	Polygonaceae	S	Anbuatie	Firewood, soil conservation, fodder, forage	CF, EU, FO, FR	NA068
50	*Ruta chalepensis*	Rutaceae	H	Tena Adam	flavor milk, cottage cheese, coffee and tea, forage	MA, SO, FR	NA324
51	*Salix subserrata*	Salicaceae	T	Keya	Tooth brush, firewood, mulch	MA, CF, EU	NA285
52	*Schefflera abyssinica*	Araliaceae	T	Getem	Timber, farm tool, dry fence	MA, EU, CF	NA154
53	*Solanecio gigas*	Asteraceae	S	Boz	Ornamental, shade, forage, dry fence, fodder	EU, FR. FO	NA281
54	*Solanum marginatum*	Solanaceae	S	Inbuay	Soap-substitute, firewood, dry fence	MA, CF, EU	NA079
55	*Stereospermum kunthianum*	Bignoniaceae	T	Zana/Washt	Incense, dye, tannin, charcoal, timber	SO, MA, CF	NA301
56	*Syzygium guineense* subsp. *guineense*	Myrtaceae	T	Bedessa	Farm tools, charcoal, firewood	MA, CF	NA001
57	*Tamarindus indica*	Fabaceae	T	Roqa	Firewood, timber, shade, Fodder, tannin, charcoal	CF, FO, MA, EU	NA229
58	*Vernonia amygdalina*	Asteraceae	T	Girawa	Firewood, smoke, wash and fumigate pots, charcoal, forage, fodder	CF, SO, FR, FO	NA007

*Plant species cited by a minimum of 20% of the informants (n = 394) for other uses are included; 31% of the total medicinal and WEPs

Appendix-18: List of all plant species in the study area

No.	Scientific name	Family	Ha	No.	Scientific name	Family	Ha
1	*Abutilon figarianum*	Malvaceae	H	36	*Amaranthus hybridus* subsp. *hybridus*	Amaranthaceae	H
2	*Abutilon longicuspe*	Malvaceae	S	37	*Andropogon distachyos*	Poaceae	H
3	*Abutilon mauritianum*	Malvaceae	H	38	*Anogeissus leiocarpa*	Combretaceae	T
4	*Acacia abyssinica*	Fabaceae	T	39	*Apodytes dimidiata*	Icacinaceae	T
5	*Acacia etbaica* subsp. *etbaica*	Fabaceae	T	40	*Argemone mexicana*	Papaveraceae	H
6	*Acacia hecatophylla*	Fabaceae	T	41	*Arisaema schimperianum*	Araceae	H
7	*Acacia lahai*	Fabaceae	S	42	*Artemisia abyssinica*	Asteraceae	H
8	*Acacia negrii*	Fabaceae	T	43	*Arundinaria alpina*	Poaceae	H
9	*Acacia nilotica*	Fabaceae	T	44	*Arundo donax*	Poaceae	H
10	*Acacia pilispina*	Fabaceae	S	45	*Asparagus africanus*	Asparagaceae	S
11	*Acacia senegal*	Fabaceae	T	46	*Asplenium aethiopicum* subsp. *aethiopicum*	Aspleniaceae	H
12	*Acacia seyal*	Fabaceae	T	47	*Balanites aegyptiaca*	Balanitaceae	T
13	*Acalypha fruticosa*	Euphorbiaceae	S	48	*Barleria spinisepala*	Acanthaceae	H
14	*Acanthospermum hispidum*	Asteraceae	H	49	*Bersama abyssinica* subsp. *abyssinica*	Melianthaceae	T
15	*Acanthus eminens*	Acanthaceae	S	50	*Bidens pilosa*	Asteraceae	H
16	*Acanthus polystachius*	Acanthaceae	S	51	*Boswellia pirottae*	Burseraceae	T
17	*Acanthus pubescens*	Acanthaceae	S	52	*Brassica carinata*	Brassicaceae	H
18	*Acanthus sennii*	Acanthaceae	S	53	*Brucea antidysenterica*	Simaroubaceae	T
19	*Achyranthes aspera*	Amaranthaceae	H	54	*Buddleja polystachya*	Loganiaceae	S
20	*Achyrospermum schimperi*	Acanthaceae	H	55	*Calotropis procera*	Asclepiadaceae	S
21	*Acmella caulirhiza*	Asteraceae	H	56	*Calpurnia aurea*	Fabaceae	**S**
22	*Acokanthera schimperi*	Apocynaceae	S	57	*Capparis cartilaginea*	Capparidaceae	S
23	*Adiantum raddianum*	Adiantaceae	H	58	*Capparis tomentosa*	Capparidaceae	S
24	*Aeschynomene abyssinica*	Fabaceae	H	59	*Cardiospermum halicacabum*	Sapindaceae	Cl
25	*Agave sisalana*	Agavaceae	H	60	*Carduus schimperi* subsp. *schimperi*	Asteraceae	H
26	*Ageratum conyzoides*	Asteraceae	H	61	*Carex steudneri*	Cyperaceae	H
27	*Albizia grandibracteata*	Fabaceae	T	62	*Carica papaya*	Caricaceae	T
28	*Albizia gummifera*	Fabaceae	T	63	*Carissa spinarum*	Apocynaceae	S
29	*Albizia schimperiana*	Fabaceae	T	64	*Carthamus lanatus*	Asteraceae	H
30	*Alchemilla pedata*	Rosaceae	H	65	*Cassipourea malosana*	Rhizophoraceae	T
31	*Allium sativum*	Alliaceae	H	66	*Catha edulis*	Celasteraceae	S
32	*Allophylus abyssinicus*	Sapindaceae	T	67	*Caucanthus auriculatus*	Malpighiaceae	Cl
33	*Aloe camperi*	Aloaceae	H	68	*Caylusea abyssinica*	Resedaceae	H
34	*Aloe macrocarpa*	Aloaceae	H	69	*Celtis africana*	Ulmaceae	T
35	*Amaranthus caudatus*	Amaranthaceae	H	70	*Cenchrus ciliaris*	Poaceae	H

No.	Scientific name	Family	Ha	No.	Scientific name	Family	Ha
71	*Cheilantes farinosa*	Sinopteridaceae	H	105	*Cussonia arborea*	Araliaceae	T
72	*Cheilanthes erythraea*	Sinopteridaceae	H	106	*Cyathula cylindrical*	Amaranthaceae	H
73	*Chenopodium ambrosioides*	Chenopodiaceae	H	107	*Cyathula uncinulata*	Amaranthaceae	H
74	*Chenopodium murale*	Chenopodiaceae	H	108	*Cymbopogon citratus*	Poaceae	H
75	*Cirsium vulgare*	Asteraceae	S	109	*Cynodon dactylon*	Poaceae	H
76	*Cissampelos mucronata*	Menispermaceae	Cl	110	*Cynoglossum coeruleum* subsp. *coeruleum*	Boraginaceae	H
77	*Cissus quadrangularis*	Vitaceae	Cl	111	*Cynoglossum lanceolata*	Boraginaceae	H
78	*Clausena anisata*	Rutaceae	S	112	*Cyperus bulbosus*	Cyperaceae	H
79	*Clematis hirsute*	Ranunculaceae	Cl	113	*Cyperus dichroostachyus*	Cyperaceae	H
80	*Clematis simensis*	Ranunculaceae	Cl	114	*Cyperus fischerianus*	Cyperaceae	H
81	*Clerodendrum myricoides*	Lamiaceae	H	115	*Cyphostemma adenocaule*	Vitaceae	H
82	*Clutia abyssinica*	Euphorbiaceae	S	116	*Cyphostemma junceum*	Vitaceae	Cl
83	*Clutia lanceolata* subsp. *lanceolata*	Euphorbiaceae	S	117	*Cyphostemma niveum*	Vitaceae	H
84	*Coffea arabica*	Rubiaceae	S	118	*Datura stramonium*	Solanaceae	H
85	*Combretum aculeatum*	Combretaceae	Cl	119	*Debregeasia saeneb*	Urticaceae	S
86	*Combretum collinum* subsp. *collinum*	Combretaceae	T	120	*Dichrostachys cinerea*	Fabaceae	S
87	*Combretum molle*	Combretaceae	T	121	*Digitaria abyssinica*	Poaceae	H
88	*Commelina benghalensis*	Commelinaceae	H	122	*Dioscorea abyssinica*	Dioscoreaceae	Cl
89	*Commelina diffusa*	Commelinaceae	H	123	*Diospyros abyssinica*	Ebenaceae	Cl
90	*Commiphora africana*	Burseraceae	S	124	*Dipsacus pinnatifidus*	Dipsacaceae	H
91	*Conyza stricta*	Asteraceae	H	125	*Discopodium penninervium*	Solanaceae	T
92	*Cordia africana*	Boraginaceae	T	126	*Dodonaea angustifolia*	Sapindaceae	S
93	*Corrigiola capensis* subsp. *africana*	Molluginaceae	H	127	*Dombeya kefaensis*	Sterculiaceae	S
94	*Cotula abyssinica*	Asteraceae	H	128	*Dombeya torrida*	Sterculiaceae	T
95	*Crassocephalum macropappum*	Asteraceae	H	129	*Dorstenia barnimiana*	Moraceae	H
96	*Crepis foetida*	Asteraceae	H	130	*Dovyalis abyssinica*	Flacourtiaceae	S
97	*Crepis rueppellii*	Asteraceae	H	131	*Dovyalis caffra*	Flacourtiaceae	S
98	*Crinum abyssinicum*	Amarylidiaceae	H	132	*Dracaena steudneri*	Dracaenaceae	T
99	*Crotalaria incana* subsp. *incana*	Fabaceae	H	133	*Dregea abyssinica*	Asclepiadaceae	Cl
100	*Crotalaria plowdenii*	Fabaceae	H	134	*Drynaria volkensii*	Polypodiaceae	H
101	*Crotalaria rosenii*	Fabaceae	H	135	*Echinops giganteus*	Asteraceae	H
102	*Crotalaria spinosa*	Fabaceae	H	136	*Echinops hispidus*	Asteraceae	H
103	*Croton macrostachyus*	Euphorbiaceae	T	137	*Echinops kebericho*	Asteraceae	H
104	*Cucumis ficifolius*	Cucurbitaceae	H	138	*Echinops pappii*	Asteraceae	S

No.	Scientific name	Family	Ha	No.	Scientific name	Family	Ha
139	*Ehretia cymosa*	Boraginaceae	S	176	*Gouania longispicta*	Rhamnaceae	H
140	*Ekebergia capensis*	Meliaceae	T	177	*Grewia bicolor*	Tiliaceae	S
141	*Elaphoglossum acrostichoides*	Lomariopsidaceae	H	178	*Grewia ferruginea*	Tiliaceae	S
142	*Eleusine floccifolia*	Poaceae	H	179	*Grewia mollis*	Tiliaceae	S
143	*Embelia schimperi*	Myrsinaceae	Cl	180	*Grewia trichocarpa*	Tiliaceae	S
144	*Ensete ventricosum*	Musaceae	H	181	*Grewia villosa*	Tiliaceae	S
145	*Entada abyssinica*	Fabaceae	T	182	*Guizotia abyssinica*	Asteraceae	H
146	*Eragrostis aspera*	Poaceae	H	183	*Guizotia scabra*	Asteraceae	H
147	*Eragrostis tef*	Poaceae	H	184	*Hagenia abyssinica*	Rosaceae	T
148	*Erythrina brucei*	Fabaceae	T	185	*Haplocarpha schimperi*	Asteraceae	H
149	*Eucalyptus globulus*	Myrtaceae	T	186	*Heteromorpha arborescens*	Apiaceae	H
150	*Euclea racemosa* subsp. *schimperi*	Ebenaceae	S	187	*Hippocratea africana*	Celasteraceae	S
151	*Euphorbia abyssinica*	Euphorbiaceae	T	188	*Hordeum vulgare*	Poaceae	H
152	*Euphorbia schimperiana*	Euphorbiaceae	H	189	*Hygrophila schulli*	Acanthaceae	H
153	*Euphorbia tirucalli*	Euphorbiaceae	S	190	*Hymenodictyon floribundum*	Rubiaceae	T
154	*Fagaropsis angolensis*	Rutaceae	T	191	*Hyparrhenia rufa*	Poaceae	H
155	*Ficus glumosa*	Moraceae	T	192	*Hyparrhenia hirta*	Poaceae	H
156	*Ficus ingens*	Moraceae	T	193	*Hypericum quartinianum*	Hypericaceae	S
157	*Ficus palmata*	Forssk	T	194	*Hypoestes forskaolii*	Acanthaceae	H
158	*Ficus salicifolia*	Moraceae	T	195	*Hypoestes triflora*	Acanthaceae	H
159	*Ficus sur*	Moraceae	T	196	*Impatiens rothii*	Balsaminaceae	H
160	*Ficus sycomorus*	Moraceae	T	197	*Impatiens tinctoria*	Balsaminaceae	H
161	*Ficus vasta*	Moraceae	T	198	*Indigofera spicata*	Fabaceae	H
162	*Fimbristylis bisumbellata*	Cyperaceae	H	199	*Ipomoea indica*	Convolvulaceae	Cl
163	*Flacourtia indica*	Flacourtiaceae	S	200	*Jasminum abyssinicum*	Oleaceae	Cl
164	*Flaveria trinervia*	Asteraceae	H	201	*Jasminum grandiflorum*	Oleaceae	Cl
165	*Flueggea virosa*	Euphorbiaceae	S	202	*Juniperus procera*	Cupressaceae	T
166	*Foeniculum vulgare*	Apiaceae	H	203	*Justicia schimperiana*	Acanthaceae	S
167	*Galiniera saxifraga*	Rubiaceae	T	204	*Kalanchoe petitiana*	Crassulaceae	H
168	*Galinsoga parviflora*	Asteraceae	H	205	*Lactuca serriola*	Asteraceae	H
169	*Galinsoga quadriradiata*	Asteraceae	H	206	*Lagenaria siceraria*	Cucurbitaceae	Cl
170	*Gardenia ternifolia*	Rubiaceae	T	207	*Laggera crispata*	Asteraceae	H
171	*Geranium arabicum*	Geraniaceae	H	208	*Laggera tomentosa*	Asteraceae	H
172	*Girardinia bullosa*	Urticaceae	H	209	*Lawsonia inermis*	Lythraceae	S
173	*Girardinia diversifolia*	Urticaceae	H	210	*Leonotis ocymifolia*	Lamiaceae	H
174	*Gnidia glauca*	Thymelaceae	S	211	*Lepidium sativum*	Brassicaceae	H
175	*Gomphocarpus purpurascens*	Asclepiadaceae	S	212	*Lepisanthes senegalensis*	Sapindaceae	T

No.	Scientific name	Family	Ha	No.	Scientific name	Family	Ha
213	*Leucas deflexa*	Lamiaceae	H	248	*Paullinia pinnata*	Sapindaceae	Cl
214	*Leucas jamesii*	Lamiacaeae	H	249	*Pavetta abyssinica*	Rubiaceae	S
215	*Linum usitatissimum*	Lineaceae	H	250	*Pavonia urens*	Malvaceae	H
216	*Lippia adoensis* var. *adoensis*	Verbenaceae	S	251	*Pennisetum nubicum*	Poaceae	H
217	*Lupinus albus*	Fabaceae	H	252	*Pennisetum setaceum*	Poaceae	H
218	*Lycopersicum esculentum*	Solanaceae	H	253	*Pennisetum sphacelatum*	Poaceae	H
219	*Maesa lanceolata*	Myrsinaceae	T	254	*Pennisetum thunbergii*	Poaceae	H
220	*Malva parviflora*	Malvaceae	H	255	*Periploca linearifolia*	Asclepiadaceae	Cl
221	*Malva verticillata*	Malvaceae	H	256	*Peristrophe paniculata*	Acanthaceae	H
222	*Maytenus obscura*	Celasteraceae	T	257	*Persicaria setosula*	Polygonaceae	H
223	*Maytenus senegalensis*	Celastraceae	S	258	*Phoenix reclinata*	Arecaceae	T
224	*Maytenus arbutifolia*	Celasteraceae	S	259	*Phragmanthera regularis*	Loranthaceae	S
225	*Maytenus gracilipes* subsp. *gracilipes*	Celasteraceae	S	260	*Physalis peruviana*	Solanaceae	H
226	*Medicago polymorpha*	Fabaceae	H	261	*Phytolacca dodecandra*	Phytolaccaceae	S
227	*Melia azedarcacha*	Meliaceae	S	262	*Piliostigma thonningii*	Fabaceae	T
228	*Mikaniopsis clematoides*	Asteraceae	H	263	*Pittosporum viridiflorum*	Pittosporaceae	T
229	*Millettia ferruginea* subsp. *ferruginea*	Fabaceae	T	264	*Plantago lanceolata*	Plantaginaceae	H
230	*Mimusops kummel*	Sapotaceae	T	265	*Plectocephalus varians*	Asteraceae	H
231	*Momordica foetida*	Cucurbitaceae	Cl	266	*Plectranthus punctatus*	Lamiaceae	H
232	*Myrica salicifolia*	Myricaceae	T	267	*Plumbago zeylanica*	Plumbaginaceae	H
233	*Myrsine africana*	Myrsinaceae	S	268	*Podocarpus falcatus*	Podocarpaceae	T
234	*Nicandra physaloides*	Solanaceae	H	269	*Premna schimperi*	Lamiaceae	S
235	*Nicotiana tabacum*	Solanaceae	H	270	*Prunus africana*	Rosaceae	T
236	*Nuxia congesta*	Loganiaceae	T	271	*Prunus persica*	Rosaceae	S
237	*Ocimum lamiifolium*	Lamiaceae	S	272	*Psidium guajava*	Myrtaceae	S
238	*Ocimum urticifolium*	Lamiaceae	S	273	*Psydrax schimperiana*	Rubiaceae	S
239	*Olea europaea* subsp. *cuspidata*	Oleaceae	T	274	*Pteridium aquilinium* subsp. *aquilinium*	Hypolepidaceae	H
240	*Olinia rochetiana*	Oliniaceae	S	275	*Pterolobium stellatum*	Fabaceae	S
241	*Oplismenus hirtellus*	Poaceae	H	276	*Pyrrosia schimperiana*	Polypodiaceae	H
242	*Opuntia ficus-indica*	Cactaceae	H	277	*Ranunculus oligocarpus*	Ranunculaceae	H
243	*Orobanche minor*	Orobanchaceae	H	278	*Rhamnus prinoides*	Rhamnaceae	S
244	*Osyris quadripartite*	Santalaceae	S	279	*Rhoicissus tridentata*	Vitaceae	H
245	*Otostegia integrifolia*	Lamiaceae	S	280	*Rhus glutinosa* subsp. *glutinosa*	Anacardiaceae	S
246	*Oxalis corniculata*	Oxalidaceae	H	281	*Rhus natalensis*	Anacardiaceae	S
247	*Oxytenanthera abyssinica*	Poaceae	H	282	*Rhus retinorrhoea*	Anacardiaceae	S

No.	Scientific name	Family	Ha	No.	Scientific name	Family	Ha
283	*Rhus vulgaris*	Anacardiaceae	S	320	*Syzygium guineense* subsp. *guineense*	Myrtaceae	T
284	*Ricinus communis*	Euphorbiaceae	H	321	*Tacazzea conferta*	Asclepiadaceae	Cl
285	*Ritchiea albersii*	Capparidaceae	T	322	*Tagetes minuta*	Asteraceae	H
286	*Rosa abyssinica*	Rosaceae	S	323	*Tamarindus indica*	Fabaceae	T
287	*Rosmarinus officinalis*	Lamiaceae	H	324	*Tapinanthus globiferous*	Loranthaceae	S
288	*Rubia cordifolia*	Rubiaceae	H	325	*Teclea nobilis*	Rutaceae	T
289	*Rubus apetalus*	Rosaceae	S	326	*Terminalia brownii*	Combretaceae	T
290	*Rubus steudneri*	Rosaceae	S	327	*Thalictrum schimperianum*	Ranunculaceae	H
291	*Rumex abyssinicus*	Polygonaceae	H	328	*Torilis arvensis*	Apiaceae	H
292	*Rumex nepalensis*	Polygonaceae	H	329	*Tragia brevipes*	Euphorbiaceae	H
293	*Rumex nervosus*	Polygonaceae	S	330	*Trifolium multinerve*	Fabaceae	H
294	*Ruta chalepensis*	Rutaceae	H	331	*Triumfetta flavescens*	Tiliaceae	S
295	*Saccharum officinarum*	Poaceae	H	332	*Urera hypselodendron*	Urticaceae	Cl
296	*Salix subserrata*	Salicaceae	T	333	*Urtica simensis*	Urticaceae	H
297	*Salvia nilotica*	Lamiaceae	H	334	*Vepris dainellii*	Rutaceae	T
298	*Sansevieria ehrenbergii*	Dracaenaceae	H	335	*Verbascum sinaiticum*	Scrophulariaceae	H
299	*Satureja punctata*	Lamiaceae	H	336	*Verbena officinalis*	Verbenaceae	H
300	*Schefflera abyssinica*	Araliaceae	T	337	*Vernonia adoensis*	Asteraceae	H
301	*Schinus molle*	Anacardiaceae	T	338	*Vernonia amygdalina*	Asteraceae	S
302	*Securidaca longepedunculata*	Polygalaceae	S	339	*Vernonia auriculifera*	Asteraceae	S
303	*Senna singueana*	Fabaceae	S	340	*Vernonia leopoldi*	Asteraceae	S
304	*Sesamum angustifolium*	Pedaliaceae	H	341	*Vernonia myriantha*	Asteraceae	S
305	*Sida schimperiana*	Malvaceae	S	342	*Vicia faba*	Fabaceae	H
306	*Silene macrosolen*	Caryophyllaceae	H	343	*Viscum tuberculatum*	Viscaceae	S
307	*Sisymbrium erysimoides*	Brassicaceae	H	344	*Vitis vinifera*	Vitaceae	Cl
308	*Solanecio gigas*	Asteraceae	S	345	*Withania somnifera*	Solanaceae	S
309	*Solanum adoense*	Solanaceae	S	346	*Xanthium spinosum*	Asteraceae	H
310	*Solanum anguivi*	Solanaceae	S	347	*Xanthium strumarium*	Asteraceae	H
311	*Solanum incanum*	Solanaceae	S	348	*Ximenia americana*	Olacaceae	T
312	*Solanum marginatum*	Solanaceae	S	349	*Zea mays*	Poaceae	H
313	*Solanum nigrum*	Solanaceae	H	350	*Zehneria scabra*	Cucurbitaceae	H
314	*Sorghum bicolor*	Poaceae	H	351	*Zingiber officinale*	Zingiberaceae	H
315	*Sparmannia ricinocarpa*	Tiliaceae	S	352	*Ziziphus abyssinica*	Rhamnaceae	S
316	*Sphaeranthus suaveolens*	Asteraceae	H	353	*Ziziphus mauritiana*	Rhamnaceae	S
317	*Sporobolus pyramidalis*	Poaceae	H	354	*Ziziphus mucronata*	Rhamnaceae	S
318	*Stephania abyssinica*	Menispermaceae	H	355	*Ziziphus spina-christi*	Rhamnaceae	S
319	*Stereospermum kunthianum*	Bignoniaceae	S				

Appendix-19: Socio-demography of informants in the study area

Baso Liben District			**Debre Elias District**		
Personal data	Fr	%	Personal data	Fr	%
Gender			**Gender**		
Male	161	65.45	Male	111	75
Female	85	34.55	Female	37	25
Age group			**Age group**		
18-29	62	25	18-29	47	32
30-39	91	37	30-39	44	30
40-60	59	24	40-60	39	26
61 and above	34	14	61 and above	18	12
Marital status			**Marital status**		
Single	69	28	Single	44	30
Married	172	70	Married	97	65
Divorced	5	2	Divorced	7	5
Educational level			**Educational level**		
Formal school	91	37	Formal school	52	35
Church school	54	22	Church school	37	25
Illiterate	101	41	Illiterate	59	40
Informant category			**Informant category**		
General informants	198	80.49	General informant s	112	75.68
Key informants	48	19.51	Key informants	36	24.32
Total	246	100	**Total**	148	100

Fr = Frequency; % = percentage