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Ecology and Plant Use Diversity in Sof Umer Area of Bale, Southeastern Ethiopia

BY

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ABSTRACT

An ethnobotanical survey was conducted in Sof Umer area of Bale in September and November 2005 and April, 2006 on ecology and plant use diversity. Data were collected by using ethnobotanical methods that include guided field walk, semi-structured interview and focus group discussion. Two hundred thirteen plant species that belong to 148 genera and 68 families were documented. The highest species number is in family Fabaceae which is represented by 25 species (11.7 %), while Acanthaceae 18 species (8.5 %), Asteraceae 10 species (4.6%), Burseraceae 10 species (4.6) and Poaceae 10 species (4.6%). Considering growth form herbs are represented by 79 species (37.1%), shrubs 62 species (29.1%), trees 58 Species (27%), climbers 12 species (5.6%) and 2 parasitic species (0.94%). Nine major plant use diversity were documented. Those are: medicinal (46 species used for treatment of human diseases & 21 species those used in ethnoveterinary), wild edible (23 species), fire (36 species) & charcoal production (17 species), in beekeeping (27 species), forage (53 species), material culture (33 species), perfuming and cleansing (13 species), religious and cultural (8 species) and shade (13) species. From preference ranking activities, charcoal production and cutting trees for forage were major cause of species threat on the vegetation. Tradtional beliefs and taboos have seen very important for resource conservation. Vegetation data were collected from 52 releves that were distributed in altitudinal range between 1181-1317 m. Percentage cover/abundance of 118 plant species was analyzed using TWINSPAN program that resulted in 6 community types. These are: *Ruspolia hypocrateriforms-Commiphora erythreae, Acacia mellifera-Euclea divinorum, Barleria quadrispina-Ruellia discifolia, Lannea triphylla- Carphalea glaucescens, Baphia sp.-Combretum molle* and *Acacia tortilis* community types. The community's Shannon diversity (H`) index ranges between 1.14 to 1.42 and evenness J between 0.74 to 0.83. Phytogeographical analysis indicated that Sof Umer has shown floristic similarity with Borana vegetation. The density of woody species having DBH >2 cm was found to be 619.2 individuals/ hectare. Three vertical stories were identified where 80 % of woody individuals of species were confined to the lower story. A total of 7 species are identified to be endemic to Ethiopia. Five of them are included in Red Data list of threatened species of IUCN, 2004. Three endemic species are identified to be new record for Bale floristic region. *In situ* conservation and community participatory approach for natural resources conservation are recommended.

1. INTRODUCTION

1.1. Background

Ethiopia is a country with different landscapes and one of the countries with the widest cultural diversities in eastern Africa. The geographical location in the tropics, the variability in environmental factors and socio-cultural diversity result in a diverse flora and wide variety of traditional practices. The diversity of higher plants in Ethiopia is estimated at about 6000 species, out of which over 500 taxa are endemic (Ensermu Kelbessa, personal communication). According to Viviro ***et al***. (2005), 107 endemic plants are trees and shrubs. About 135 taxa are threatened woody species which are included in the IUCN red list.

Human survival is linked with natural resources; humans being reliant on their surroundings to get food, shelter, medicine, energy sources, socio-cultural and ecological services. As indicated by Martin (1995), local botanical and ecological knowledge is interrelated with the perception of local people to landform, soil, climate, vegetation type and stages of ecological succession. Communities generate knowledge over time that allows them to understand and cope with their particular agro-ecological and socio-economic environment. Local communities that have lived in a particular area for many generations, and who live a non-industrialized life style, are named indigenous people (Martin, 1995; Cotton, 1996). According to IDCR (2005), local knowledge systems deal with diversity in the natural environment and social organization.

Plants are the material base for human culture (Balick and Cox, 1996). This is due to human dependency on plants for daily consumption as plants accumulate many metabolites by photosynthesis for many needs. This dependency on plants helps indigenous people to have better understanding of plants growing on their surroundings. The ethnobotanical approach for the documentation of biological botanical knowledge is important as it involves local communities in the conservation of biodiversity. This is based on the idea that healthiest ecosystems of the world are under the control of local communities, and local communities manage many species that have little information to science (Regassa Feyissa, 2000).

Loss of biodiversity and its related indigenous knowledge erodes the genetic base on which scientists depend for continuous improvement of crops, livestock and new drug production. Monoculture, like tree plantation, does not provide multipurpose uses, such as food, fodder, fertilizer, fiber and fuel. The failure of single high yield varieties due to any natural calamity has high impact on local communities that have no other alternatives (Shiva, 1993).

1.2. Statement of the Problem

Biodiversity is the raw material for biotechnology and genetic engineering. Loss of biodiversity limits the genetic raw material for any future green or gene revolution in this molecular era. Genetic uniformity increases the vulnerability of food crops to pests and diseases. Conversely, ecological and genetic diversity provides farmers with security against pests, diseases and unexpected climatic conditions (Roger, 1999; WWF, 2001). It is difficult to predict the future value of any plant genetic resources based on the current use. All genetic material covering a wide range of variability must be conserved (WCMC, 1992; Regassa Feyissa, 2000).

The loss of biodiversity in all its forms is irreversible. Furthermore, it is very difficult to quantify the loss of biodiversity because only few biota of the earth have been named and described (WCMC, 1992; Campbell, 1996). Most medicinal drugs are derived from natural plant products. The majority of medicinal plants of Ethiopia are wild in source (Zemede Asfaw, 2002). Overexploitation of medicinal plants from the wild and the lack of knowledge about proper conservation practice result in genetic erosion (WCMC, 1992). The loss of medicinal plant taxa is a common problem in Ethiopia for sustainable use (Ensermu Kelbessa *et al.*, 1992).

In Ethiopia, the annual loss of forest is estimated to be about 150,000 to 200,000 hectares (EFAP, 1994). Natural high forests that covered 16% of the land in 1950 were reduced to 2.7% by 1989 (Demel Teketay *et al.*, 2000). Rapid economic growth and cultural changes threaten the traditional lifestyles of indigenous peoples. At a global level, there is great need to identify new medicinal plants due to the lack of cures for some diseases like HIV/ AIDS and growing resistance of existing diseases. It is essential and reasonable to care for and conserve ancient heritage and indigenous knowledge (Dawit Abebe and Ahadu Ayehu, 1993).

Baseline data and the status of fauna and flora are very important for conservation prioritization, proper management and sustainable use of biological resources. Despite recent efforts to document ethnobotanical data, information on dryland areas is still very scarce. The work of Bayafers Tamene (2000) in Cheffa area of South Welo, Debela Hunde (2001) in Welinciti area, Miruts Giday (2003) in Lake Zway area, Kebu Belemie *et al*. (2004), in East Shewa and Hussien Adal (2004), in North Shewa, are widely cited works that involve indigenous people. The present study focuses on the systematic documentation of the diversity of plants and their use in Sof Umer area of Bale for which there are no data on scientific information todate.

2. LITERATURE REVIEW

2.1. Vegetation of Ethiopia

Vegetation formation is influenced by a combination of many factors, such as climate, geology, edaphic factors and biotic factors, including interference by humans in ecological succession. Vegetation is dynamic, that is, constantly changing. Reasons for the changes can be ecological or evolutionary processes, climatic change, human land use, and interaction between factors (Skarpe, 1991).

According to the work of many scholars, the vegetation of Ethiopia is classified into eight major types (Ensermu Kelebessa *et al*, 1992; Zerihun Woldu, 1999; Friss & Sebsebe Demissew, 2001; Sebsebe Demissew *et a*l., 2003). The detailed description and distribution of these vegetation types is indicated in Figure 1 and Table 1. As demonstrated by White (1983), the vegetation of lowland of Bale and southeastern Ethiopia belongs to Somalia-Massai regional center of endemism.

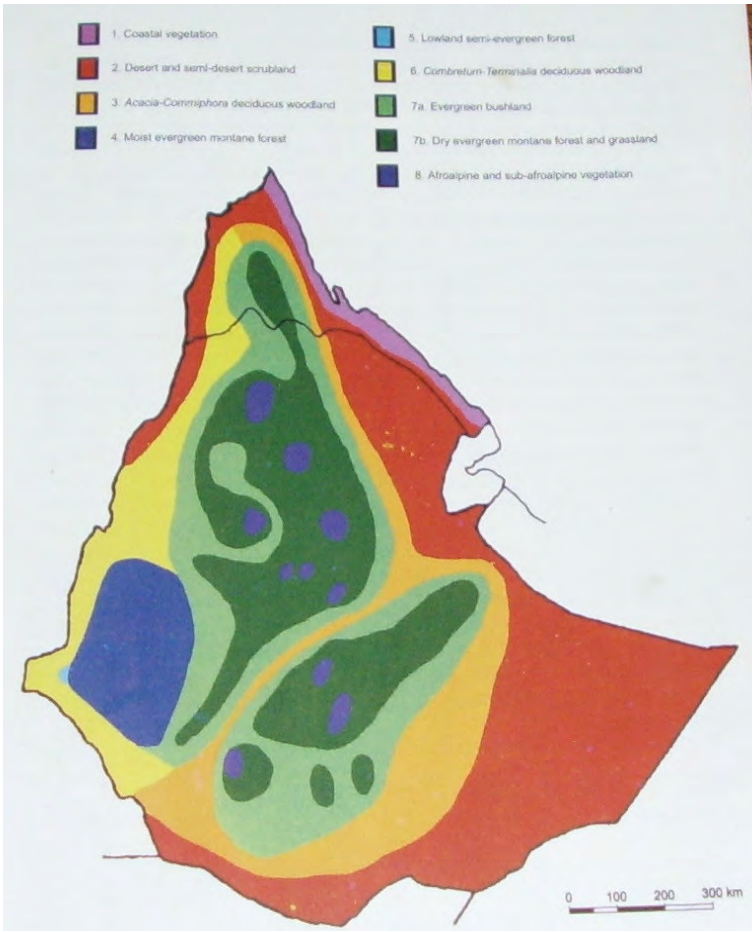

Figure 1. Map of Ethiopia and Eritrea showing types of Vegetation. (Source: Sebsebe Demissew *et al*., 2003)

Table 1. Summary of the major vegetation types with their major characteristic species and distribution in Ethiopia

Vegetation Type	Habit	Unique features	Distribution	*Common examples*
1.Desert and semi-desert scrub land	Small trees and shrubs	Drought tolerant < 500 m	Afar, Ogaden and Omo	*Acacia, Commiphora, Boscia, Cadaba, Euphorbia, Aloe*
2. Acacia-Commiphora small leaved, deciduous woodland	Trees and shrubs	Drought tolerant, deciduous or evergreen leaves500-1900 m, 410-820 mm & 18 - 27^{o}C	Northern, Eastern, Central and Southern	*Acacia,Balanites, Commiphora, Combretum, Terminalia, Acalypha, Barleria*
3.Moist evergreen montane forest	Emergent tree w	Evergreen forest epiphytes lianas 1500-2400 m 1500-2400 mm 15-20^{o}c	Bale, west Wellega, Illubabor and Kafa	*Vernonia, Maytenus, Acacia abysinica, Albizia and Ficus spp*

	with canopy understorey shrub and			
4.Lowland semi-evergreen forest	Tree deciduous sorevergr	Less closed,1300-1800 mm; 450-600 m 35-38^{o}C	Dry lowland of South western Gambella	*Baphia abyssinica, Celtic toka, Diosyros abyssinica*

	e e n			
5.Combretum-Terminalia, broad-leaved, deciduous woodland	Small to mo dera te size d tree d eci duo us	Fire adaptation 500-900 m	Kafa, Omo, Benis hangul Gumuz, Dedessa Gambella	*Terminalia, Combretum, Lannea, Boswellia papyrifera*
6.Dry evergreen Montane forest, Evergreen bushland and Grassland	Herbal gra sss	Agricultural area 800-1500 m asl 1500-2200 mm 18-20^{o}C	Northern, Northwestern, Central & Southwest.	*Juniperus procera, Hagenia abyssinica and Ekebergia capensis Carissa edulis Euclea, maytenus*

	hrub Small tolargetree e			
7. Afroalpine and sub-afroalpine	Small trees shrub & herb	Above 3200 m On mountains	Choke, Bale, Siemen, Guge	*Hypericum, Lobelia Erica arborea, E. trimora*
8. Riparian and swamp vegetation	Swamp grass, he	Along major river bank		*Ficus sycomorus, Mimusop kummel, Tamarindas indica, Syzgium guineese*

	r b a n d ri v e ri n e tr e e s			

Compiled from Ensermu *et al.*, 1992; Zerihun Woldu, 1999; Sebsebe *et al.*, 2003 with minor modification.

2.2. Dryland Vegetation

Dryland represents 54% of the World and 61 % of African productive land and supports a quarter of the world population. Because of recurrent drought, there is significant variation in crop yield, livestock productivity and natural biomass availability for harvesting in the Horn of Africa. In this region, as result of high human and animal population, lack of alternatives for economic activities other than agriculture causes pressure on natural resources at times of drought (UN, 1995).

In the drylands of Ethiopia, pastoralism and agropastoralism are the predominant production systems, supporting 26% of national populations and 62 % of land coverage. The majority of dry rangeland of Ethiopia is distributed at the periphery of the country (Alemayehu Mengistu, 2003) Ethiopia`s dryland is under pressure from moist stress due to erratic rainfall, recurrent drought, rangeland degradation as result of human and livestock population pressure, bush encroachment and conflict for grazing land resources (Amaha Kassahun, 2002; Alemayehu Mengistu, 2003). Deforestation and replacement of indigenous species is a common phenomenon in many parts of Ethiopia. In areas of high population densities, exotic species are essential for particular uses, such as firewood and construction materials (Legesse Negash, 1995). However, exotic trees

cannot provide as wide a variety of products and services as indigenous trees. Due to these complex factors, many multipurpose trees are threatened.

2.3. Plant Resource Utilization

Wild naturalized plants give green social security to people of the world by providing low cost building material, fuel, food supplement, herbal medicine and basketry (Cunningham, 2001). The great importance of tropical forest product is ability of ensuring sustainability. According to Peters (1989); as cited in Balik and Cox, (1996), a sustainable system for exploiting non timber forest resources is one in which fruit, nuts, latexes and other products can be harvested indefinitely from limited area of forest with negligible impact on the structure and dynamics of the plant population being exploited.

It is estimated that about 40% of the world economy is based on biological products and processes (IDRC and IPGRI, 2000). Non-timber forest products (NTFPs) provide a wide variety of services and play significant role in local economy. Multiple use management of forest products generates direct benefits for local people. The major benefits of NTFPs are:

- Rural employment due to labor intensive methods;
- Income from non-farm activities like sale from medicinal plants and beekeeping;
- Ecologically less destructive than timber harvesting;
- Low capital input, so accessible to poor sectors of society; and
- Provides food, medicine and household items.

Only ecologically sound management plan developed based on scientific studies for resources extraction will help in use of resources to contribute the conservation of biological diversity (Balik and Cox, 1996).

In Ethiopia, gum, incense resin, spices, and honey and wax from beekeeping play an important role in income diversification for rural communities. However, the role of forest products in rural communities is poorly documented and little understood (Vivero, 2001).

2.3.1. Plants as a food source

In many parts of the developing world, wild food is considered as emergency and famine food to cope with unpredictable climatic change. Rural people still widely use wild plants as a food source in times of drought, war and famine. Traditional communities are well conscious about geographical distribution (adaptation) and seasonal availability (phenology) of wild food (Cotton, 1996). Wild plants are a source of subsistence food, a food supplement and a means of survival during times of devastation in developing world. In Ethiopia, wild food adds diversity and flavoring, as well as providing vitamins and minerals to a grain-dominated diet (Vivero, 2001).

Exploiting the potential of wild-food plants is a naturally sustainable, cheap and locally available solution to resolving at least part of the food shortage problems. Food preference and customs of plant use are deeply embedded in culture. These cultural factors are important in maintaining the rich genetic resources and associated knowledge of plant diversity (Euzaguirre, 2001).

Vavilov (1997) considered Ethiopia as the centre of origin of many domesticated crops, such as teff *(Eragrostis tef (Zucc.) Trotter*, noog (*Guizoita abyssinica* (L.f.) Cass), coffee (*Coffea arabica* L.) and inset (*Ensete ventricosum* (Welw.) Cheesman). Wild relatives of plants share a common ancestor with modern crops and remain in the wild as product of nature. Natural selection has adapted the wild varieties, increasing their efficiency to survive drought, extreme temperature, cope with many natural hazards and develop resistance against pests and diseases. Cross breeding between wild relatives can improve productivity as well as tolerance to pests, disease and bad growing conditions (Erich, 1992). Wild food that is used by traditional communities can provide clues for selecting potential plant for domestication.

2.3.2. Plant as traditional medicine

Traditional medicine in Africa is culturally based, and closely tied to religion. The use of plants in religious ceremonies as well as for magic and medicinal purposes is very common and widely distributed in Ethiopia (Amare Getahun, 1976). The World Health Organization estimated that about 80% of the world depends on plants for their primary health care (WCMC, 1992). Although there is certain critic on traditional medicine on quantification, on dose associated to age and degree of sickness and hygienic in preparation and storage, it has many advantages for

developing countries where many people die because of communicable diseases. Developing countries are poor in economy and low infrastructure to provide quality basic sanitation, to prevent and control communicable diseases. According to Sofowora (1982), traditional medicines have the following major advantages:

- Cheaper than modern medicine which poor communities can afford;
- More available to most population in 3rd World countries;
- Do not need high skilled manpower and health centre;
- Traditional medicine is from a natural product that has less side effects; and
- Time saving for diagnosis

There are about 120 chemicals extracted only from 90 species of plants for medical purpose that cannot be produced synthetically (WCMC, 1992). The therapeutic value of plants depends upon secondary metabolites that they store for defense against herbivores, fungi and other microbial invasion (Dawit Abebe *et al.,* 2003). Secondary metabolites have no direct role in normal cellular function. Ruther they play a great deal in many biological activities like antibacterial properties (Cotton, 1996). Plants that are used in traditional medicine contain high concentrations of particular chemicals that are the basis of modern drugs, and many plants preferred for their traditional medicine have high concentration of vitamins and mineral that can help to counteract illnesses caused by dietary deficiency.

Folk knowledge uses in discovering of novel pharmaceutical is increasing because molecular search is more expensive. Three quarters of medicinal plants that are used in modern pharmaceuticals are discovered through traditional use. Examples of ethnobotanical lead for the discovery of modern drug include the widely useful antibiotics like Aspirin and Quinine (Balick and Cox, 1996). Therefore, traditional medicine has vital applicability both in local healthcare improvement and in the development of modern pharmaceuticals.

The sustainable use of traditional medicine has been facilitated by many indirect controls and management practices. Taboos, seasonal and social restrictions on gathering traditional medicinal plants limit their harvest. Protection of vegetation for religious and spiritual reasons provide important means through which biodiversity is maintained outside the core conservation area (Chirchir, 2002)

The rate at which medicinal plants are disappearing puts the world's health at great risk. Traditional medicinal practitioners are usually selective and use plants on a small scale based on traditional conservation. Commercialization due to high urban demand and open access for medicinal plants has resulted in overexploitation (Balick and Cox, 1996; Cotton, 1996). Legesse Negash (1995), stated that most medicinal and nitrogen fixing indigenous trees of Ethiopia are lost due to deforestation.

2.3.3. Ecological services

Every species plays its own role in an ecosystem. Vegetation is important for wild animals by providing food, shelter and protection from natural enemies. Ecologically, certain umbrella species ensure the survival of many other species by providing protection and food. Habitat loss and deterioration can lead to the extinction of umbrella and keystone species. This can further result in the disappearance of many ecologically valuable species, including decomposers, predators, producers and parasites that can directly check the population (Hunter, 1996)

2.3.4. Indigenous knowledge and resource management in respect to biodiversity conservation

According to IDRC and IPGRI (2000), indigenous knowledge has evolved over centuries and represents the biggest source of biodiversity knowledge. This involves conservation, proper use, production and consumption. Indigenous knowledge is found in daily activities including farming, gardening, animal breeding, nutrition, health care, spiritual and religious activities, folklore, songs, poetry, and theatre (Martin, 1995).Traditional knowledge is transmitted by word of mouth, drawings, painting and carvings. According to Amare Getahun (1976) and Martin (1995), oral transmission of ethnobotanical knowledge has the limitation of being crude and highly conducive to distortion. There may be modification or omission of ingredients, making the 'knowledge' erroneous and dangerous to use. Indigenous knowledge (IK) developed and acquired through observation and practical experiences by resources user in long time scale (Cotton, 1996). The relation between plants and people link of traditional community is direct in use. Local indigenous knowledge changes in response to local innovation and experimentation; accumulated over a long period by trial and error. IK is accessible to the members of the social group for the resource management and production to ensure the group survival. This kind of

knowledge is holistic, localized and gender based (Cotton, 1996; Martin, 1996; Stockard, 1997; Fassil Kebebew, 2000 and IDCR, 2005). Due to social differentiation based on gender, there is specialization of activities. As a result, local knowledge and skills held by women often differ from those held by men. This specialization is publicly recognized (Stockard, 1997; IDCR, 2005). Cultural system is more dynamic than biological system. There is shift from subsistent economy to cash dominated production system that weakens IK in traditional community (Cunningham, 2001).

Traditional botanical knowledge has at least fundamental uses in economic development and resources conservation. The ethno directed for new drug production and improvement in local income from local marketable products has wide interest. Traditional knowledge is also very important for germ-plasm conservation that is adapted to local agro ecological zone (Cotton, 1996). Indigenous knowledge is important in providing problem-solving strategies for local communities. Active participation of local communities based on their IK creates a sense of ownership in development initiatives. Furthermore, documentation of IK is fundamental to preserving this knowledge for current and future generations, as well as protecting intellectual property rights (IDRC & IPGRI, 2000).

3. OBJECTIVES OF THE STUDY

3.1. General Objective

The general objective of the study was to:

- Document the diversity of plant species use in the Sof Umer area of Bale, describe the floristic composition of the vegetation in the area, and investigate the traditional natural resource management and conservation in the study area

3.2 Specific Objectives

The specific objectives of the study were:

1. To produce check lists and document plant species in the study area
2. To identify the diversity of uses and document indigenous knowledge about plant resources
3. To identify the distribution, species richness, abundance and community types of plant species in the study area
4. To identify threats to useful plant species in the study area

5. To identify traditional plant resource management systems

4. DESCRIPTION OF THE STUDY AREA

4.1. Geographical Location

Sof Umer is located in Goro District in Bale Zone of Oromia National Regional State in southeastern Ethiopia. It is geographically found between $6^0$45` - $7^0$00`N and $40^0$45`E – $41^0$00`E. It is bound by Rayitu District in the east, Ginir in the north, Dinsho in the northwest and in the south by Gurdha Mole District (Fig. 2). Goro town is the center of the District's administration. Sof Umer is about 42 km from Goro and 554 km away from Addis Ababa. The Sof Umer valley is discharged by Weybe River.

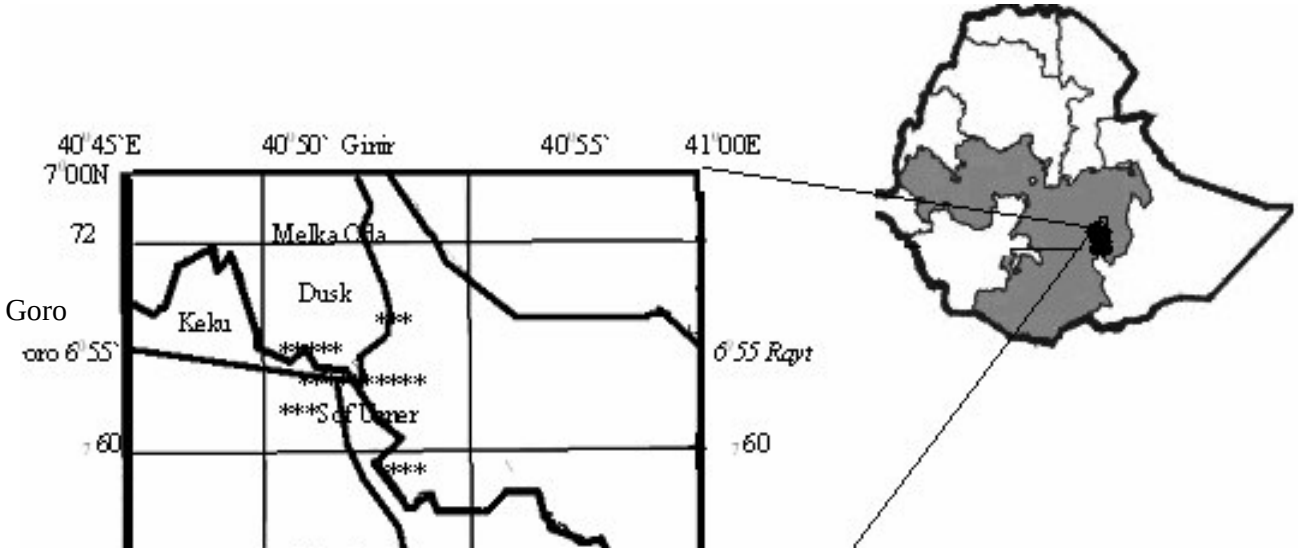

Figure 2. Map of study the area showing the study site.

4.2. Climatic Factor

The agroclimate of Goro District is Kolla (67%), Weina Dega (25%) and Dega (8%) (OPED, 2000). According to Daniel Gamachu (1977), the lowlands of Bale have five rainy months showing bimodal type of rainfall. The rainy month is March to May having a high concentration of rainfall in April and May, and in October and November, very high in October. The summer months of June, July, and August are dry. According to NMSA (2004), April to March has the longest rainfall period and October and November have the shortest. The maximum average temperature is 23.9 ^{0}C and the minimum annual temperature is 11.7^{0}C. The hottest months are February (25.25^{0}C) and May (25.15^{0}C) (NMSA, 2004). The climadiagram is shown in Figure 3.

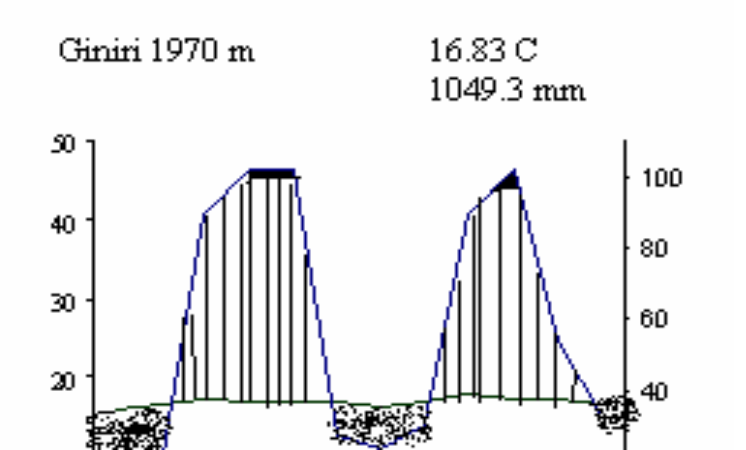

Figure 3. Climadiagram base on data from 1979 to 2004 at Ginir Station. The raw data is from National Meteorological Service agency.

4.3. Soil

The soil of Goro District is gypsic yeromosols (20%), chromic, eutric and calcic cambisols (about 75%) and regosols (5%) (OPED, 2000).

4.4. Vegetation

The lowland of Goro District is dominated by semi-desert vegetation and the thorn type (OPED, 2000). The vegetation of Sof Umer area belongs to Somalia- Massai regional center of Endemism which is covered by deciduous bushland and thicket that forms ecotone between montane forest and decioudous *Acacia- Commiphora* bush and thicket. This type of vegetation is mainly characterized by *Acacia-Commiphora* deciduous bushland and thicket represented by *Commiphora erythreae, Boswellia neglecta, Buxus hildebranditii, Cadaba forinosa, Acacia mellifera, A. nilotica and A. Bussei.* The ecotone taxa include *Euclea, Acokanthera, Aloe, Euphorbia* and *Carissa* species (White, 1983).

4.5. Population and Land Use

The indigenous people of Sof Umer are mainly Oromo ethnic group who are Cushitic in origin and speak “Afaan Oromo”. According to ECSA (1996), the population of Goro District is about 71,256 that consist of 35,295 males and 35,961 females. The rural population is 66.88%.

Concerning the land use system of Goro District; arable land covers 17% of the area, pastureland constitutes 38%, vegetation (woodland, forest, bush and shrub) covers 39.3% and other land use contribute was 5.3%. The average farm size per household is about 2.5 hectares. About 60% of the annual crop production comes from Belg season (OPED, 2000).

According to the information from Department of Agriculture and Rural Development of Goro District, in Sof Umar area livestock production is predominating and agricultural activity is based on the availability of rainfall. The major crops include teff, wheat and sorghum. Minor products are maize and chickpea. The area has a high potential to produce spice like ***Trigonella foenum-graecum*** and ***Nigella sativum***. The livestock production includes mainly 144,606 cattle, 3,339 sheep, 18,203 goats, 1,329 mules, 2,061 horses, 4,224 donkeys, 4,048 camels, 6,381 traditional and 31 modern beehives. Blackleg, pasterolosis, African horse sickness, internal parasites, external parasite and haemo parasite are common diseases of livestock in the Goro District (OPED, 2000). The most frequent 10 top diseases affecting humans are indicated in Table 2.

Table 2. The top 10 diseases seen in Goro district at clinical level of the year 1997

Diseases	No. cases	percentage
RTI except TB	5758	30.70
Diarrhea disease	3102	16.54
Unspecified skinness	1821	9.71
Intestinal parasite	1806	9.63
Rheuitism	1571	8.38
Gastritis	1329	7.09
Anemia	1032	5.50
Fever unknown origin	816	4.35
Malaria	801	4.27
Eye diseases	720	3.84
total	18756	100.00

Sources: Unpublished documents from Goro District Health Office, 1997.

5. MATERIALS AND METHODS

A reconnaissance survey was carried out in September 2005 to get general information about the local community and the study area. During this preliminary survey, the area was studied. Purposeful sampling was done to select villages in the study area to get ethnobotanical data on use of plants and about indigenous knowledge on resources management system. These localities were selected with the help of agricultural experts in the area. The villages that were selected are Sof Umer, Duski, Magalo Sarbo, Arda Oru and Oda Didibisa.

5.1. Vegetation Data

5.1.1. Sampling design

Data on vegetation was collected in the field visits in November 2005. Physiognomically homogenous natural vegetation stands were selected to analyze the vegetation. Vegetation data were collected along four belts transects along altitudinal gradient from the bottom edge to the top edge of Weybe Valley. The four transects were 500 m apart and nested plots laid down every 25 m altitudinal drop. Selective sampling was used to capture vegetation in different landscapes

outside of the valley. Nested quadrats 20 m by 20 m for trees, 5 m by 5 m for shrubs and 1m by 1 m for ground cover were used following Kent and Cooker (1992). The altitudinal range of the sample plots was between 1180-1320 m.a.s.

Data on position of releves were recorded at the center of each plot using Garmin GPS. Altitude, aspect and coordinate were recorded. In each quadrate the plant local name, total number of individuals for each species was recorded. Percentage cover abundance was estimated and later converted into modified Braun Blanquet scale. The 1-9 modified Braun-Blanquet scale was used following Van der Maarel, (1979). Accordingly, the scale represents:

1 = rare, generally one individual
2 = occasional or sporadic with less than 5% cover of the total area
3 = abundant, with less than 5% cover of total area
4 = very abundant, with less than 5% cover of the total area
5 = 5-12% cover of the total area
6 = 12.5 -25% cover of total area
7 = 25-50% cover of the total area
8 = 50-75% cover of the total area
9 = >75-100% cover of the total area

Individual trees and shrub species with diameter greater than 2 cm had their DBH measurement taken following Cunningham (2001). The heights of tree and shrub species were visually estimated and grouped into height classes. The estimation was made by classifying height of each species in to high, medium and low size classes.

5.2. Ethnobotanical Data

5.2.1. Guided field walk

Field walk was done with local guides for observation of different vegetation, landscape and land use system. Any plant species encountered in the study area was collected. The inventory was a useful means to produce a checklist of species in the study area.

5.2.2. Informant selection

Thirty-five informants, of whom six were females and twenty-nine males were involved. However, age was a guiding factor in the selection. Old and Knowledgeable informants were systematically selected and interviewed following Martin (1995). This was done by taking the consideration that not all informants have equal knowledge about plant uses (Appendix 7).

5.2.3. Semi structured interview

Pre-designed questionnaires with open-ended questions were used to collect information on plant use diversity. Information about wild edible plants, medicinal plants, plants used for fuel and construction, plants used in culture and religion and factors for threat on plants use were included in the questionnaires (Appendix 8.) The objectives of the study were briefly explained to the informants and interview conducted using local language "Afaan Oromo".

5.2.4. Preference ranking

Five to ten participants were systematically selected to make preference and paired comparison rankings. These methods were used in identification of threats to tree species, charcoal quality preference and wild food preferences. The informants were given a list of plants and asked to rank them from the most important to the least in decreasing order according to their perception following Martin (1995).

5.2.5. Focus group discussion

Group discussions with key informants including elders and healers were made to counter-check information elicited from informants' survey. Key informants who were identified by the help of local administrators reached consensus on use diversity. The use value of plant species were compared following Philips (1996); cited in Belachew Wassihun *et al*., (2003). Accordingly, use value were given 0 = for no related use, 0.5 for minor use and 1 for major use. The total sum of the use value indicates the relative importance of that species.

5.2.6. Market survey

Market survey was carried out to trace market map of non-timber products in Goro and Urgo towns. Pre-prepared questionnaires were used to collect information on non-timber plant products following Martin (1995) and Cunningham (2001) (Appendix 9).

5.3. Plant Species Identification

All species were collected and identified at the National Herbarium (ETH), Addis Ababa University. The nomenclature follows the published volumes of Flora of Ethiopia and Eritrea and unpublished manuscripts. Voucher specimens were deposited at the National Herbarium.

5.4. Data Analysis

5.4.1. Ethnobotanical data analysis

Ethnobotanical data were summarized in tables and charts. Data were analyzed by the use of a Minitab version 12.22 and Ms Excel packages.

5.4.2. Vegetation data analysis

The cover/abundance data were analyzed by using TWINSPAN program to identify plant community types. Synoptic values were calculated from average cover/abundance value and frequency of each species in the community. Plant Communities were named based on one or two dominant and/or characterstics species. Shannon diversity index and community similarity were determined using Biodiversity Professional Version 2 (McAleec, 1997).

- Shannon diversity index

$$H` = -\sum_{i=1}^{s} Pi \ lnPi$$

Pi = the proportion of individuals

S= the total number of species

ln = log base n

- Equitability (Evenness)

$$J\ (H/Hmax) = -\sum_{i=1}^{s} Pi \ lnPi \ /lns$$

S= no of species per community type

Hmax is diversity index assuming all the constituent species are evenly distributed. The value of J is between 0 and 1. Where 1 representing a situation in which all species are equal abundant.

- Sorensen similarity coefficient was calculated following Muller-Dommbois and Ellenberg (1974) and Kent and Coker (1992)

Sorensen coefficient = 2 C/ (A + B)

Whereby: A= number of species to be compared

B= number of species in other area

C= number of common species.

- Density = no. of individuals in species / hectare
- Frequency= no. quadrats where species found divided by all quadrats sampled

6. RESULTS AND DISCUSSION

6.1. Floristic Composition of the Study Area

A total of 213 plant species were identified and documented in the study area (Appendix1). These are distributed in 148 genera and 68 families. Fabaceae represented by 25 species (11.7 %), while Acanthaceae contributed 18 species (8.5 %), Asteraceae, Burseraceae and Poaceae are represented by 10 species each (4.6 %). One hundred and eighteen plant species were collected from the 52 releves and the rest were collected during the ethnobotanical analysis in the surrounding area. The top ten families containing the highest species numbers are presented in Figure 4.

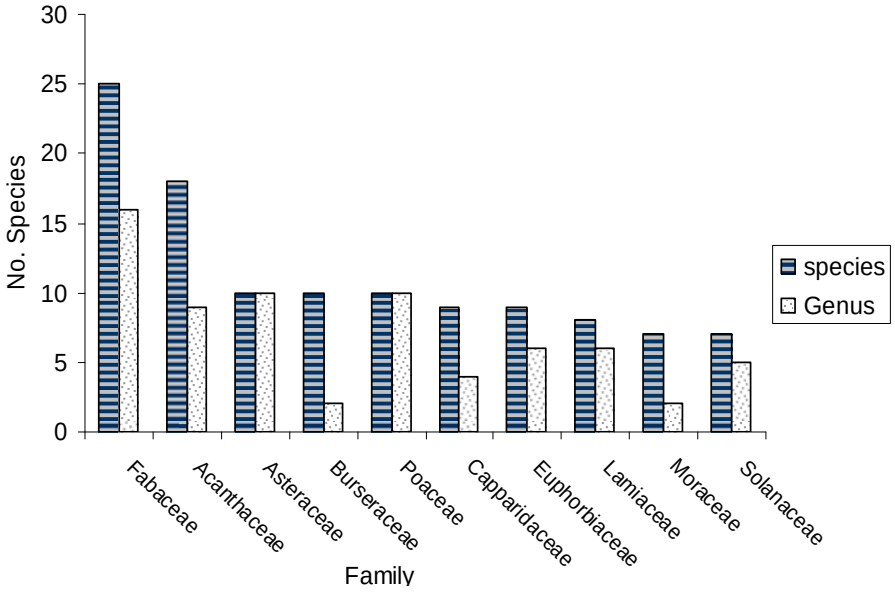

Figure 4. The top ten abundant taxa having high species number in the study area.

In terms of growth habits distribution, herbs comprised 79 species (37.10%), shrubs are represented by 62 species (29.10%), trees by 58 species (27.23%), climbers by 12 species (5.60%) and parasites by 2 species (0.94%).

6.2. Plant Use Categorization by Indigenous People

The study identified nine major perceived plant use categories as shown in Table 3. Plants as sources of food in the wild, domestic animal browse and graze, medicinal plants, and plants for domestic energy sources are the most widely mentioned uses.

Table 3. Emic plant use categorization and number of taxa documented

Taxonomic	Wild edible	Medicinal	Fuel	Beekeeping	Forage	Material culture	Perfuming &	Religion	shade

rank		Human	Livestock	Fire	Charcoal						
Family	14	33	15	17	9	14	21	17	8	7	8
Genera	17	41	21	21	12	23	40	26	8	7	8
species	23	46	21	36	17	27	53	33	13	8	13

As indicated in the above Table, the highest use by the local community is for Ethnomedicine (61 species) followed by forage and fuel wood (53 plant species each). The species used in five use categories are presented in Table 4. Descriptions of the main uses are indicated in the following sections.

Table 4. Species listed in five use categories.

Species name	**Bee keeping**	**Fire wood**	**charcoal**	**Shade**	**Forage**
Abutilon fruticosum	x				
Acacia brevispica	x	x			x
Acacia bussie	x	x	x	x	
Acacia etabaica		x			
Acacia mellifera		x	x	x	x
Acacia nilotica		x	x	x	x
Acacia senegal	x	x	x	x	x
Acacia seyal	x	x	x		x
Acacia tortilis		x	x	x	x
Achyrospermum schimperii					x

Acokanthera schimperii		x			
Albizia anthelmintica		x	x		
Andropogon chinensis	x				
Pennisetum unisetum					x
Balanites aegyptiaca		x			x
Barleria quadrispina	x				x
Berchemia discolor		x	x	x	
Blepharis maderaspatensis	x				
Boscia angustifolia		x			
Boscia senegalensis			x		x
Cadaba farinosa	x				x
Cadia purpurea					x
Calpurnia aurea					x
Carissa spinarum		x			
Cissus quadrangularis				x	
Cissus rotundifolia				x	
Combretum aculeatum		x	x		x
Combretum molle	x			x	
Commelina imbebris					x
Commiphora ogadensis					x
Commiphora erythreae	x	x	x		x
Cussonia holstii					x
Datura stramonium	x				
Dalbergia commiphoroides		x			x
Delonix elata		x	x		
Dichrostachys cinerea					x
Dombeya kirkii		x			x
Dracaena ellenbeckiana					x
Dracaena ombet	x				
Ehretia cymosa Continued				x	
Eleusine indica					x
Entada abyssinica	x				x
Enteropogon macrostachyus					x
Entrepogon desvauxii					x
Erythrina burana	x				
Erythrochlamys spectabilis	x	x			x
Euclea divinorum	x	x	x		x
Ficus sycomorus		x			
Grewia bicolor		x			x
Grewia erythraea		x			
Grewia kakothamnos		x	x		x
Grewia tenax					x
Grewia villosa		x			

Haplocoelum foliolosum		x	x	x	
Hermannia paniculata					x
Hypoesetes forskaolii	x				x
Ipomoea trifolia					x
Isoglossa parvifolia					x
Justicia cordata		x			
Justicia rendlei		x			
Justicia schimperiana		x			
Lannea fruticosa	x	x	x		x
Lannea malvifolia	x				
Leucas martinicensis	x				
Maerua crossifolia					x
Maytenus undata				x	
Mimusops kummel		x			
Mueria crossifolie	x				
Ochna inermis					x
Opuntia ficus- indica					x
Panicum maximum					x
Parthenium hysterophorus	x				
Rhus natalensis					x
Rhus vulgaris					x
Ruellia discifolia	x				x
Ruellia patula					x
Ruspolia hypocrateriformis					x
Salvadora persica				x	
Sida ovata	x				
Tagetes minuta					x
Terminalia brevipes					x
Terminalia brownii			x		
Terminalia prunioides	x	x			x
Tetrapogon ferrugineus					x
Vernonia adoensis	x				x

6.2.1. Ethno-medicinal plants

6.2.1.1. Plants used for human medicine

A total of forty-six plant species were identified by the local community to be used for the treatment of human ailments. These species are distributed in 41 genera and 33 families. Local people involve various taxa in therapeutic use. The most frequently used families are Solonaceae, which is represented by five species (10.00%) and Euphorbaceae, Burseraceae and Fabaceae, each represented by three species (6.52%). Details of the mechanisms by which medicinal plants used are presented in Appendix 2.

Other researchers in different parts of Ethiopia have reported some of the medicinal plant species identified in this study. Sixteen species by Bayafers Tamene (2000), 15 species by Debela Hunde (2001), 12 species by Mirutse Giday and Gobena Ameni (2003), 20 species by Hussien Adal (2004), 18 species by Kebu Balemie *et al.* (2004), 11 species by Haile Yineger (2005) and 9 species by Gemedo Dalle (2005).

In terms of the growth form distribution of the medicinal plant species; herbs represented by 21 species (45.60%), trees 15 species (32.60%) and shrubs 8 species (17.39%). Similar results on the growth form trend were reported by Debela Hunde (2001) and Haile Yineger (2005). The use of herbs by the local people is of primary importance compared to woody species.

In terms of plant part utilization, roots' use ranked first, represented by 22 species (37.93%), leaves' use ranked second with 15 species (25.86%) and latex is the third with 6 species (10.34%). Other plant parts used for therapeutic purposes are shown in Figure 5.

Debela Hunde (2001), reported roots (31.4%) as the most widely used plant part followed by leaves (24.4%) for medical purposes. Kebu Balemie *et al.* (2004), also indicated a similar observation with roots ranking first (33.6%), followed by leaves (29.4%). The dominance of root use requires uprooting during harvesting which has a negative impact as it kills the whole plant.

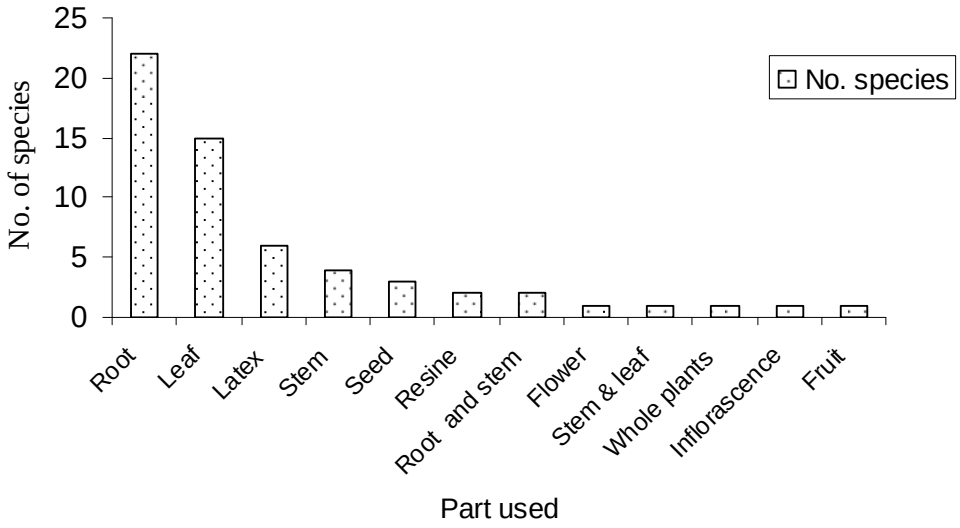

Figure 5. Plant parts used in human traditional medicine

Traditional healers and local people use different methods of preparation for herbal medicine. Crushing, pounding, grinding, using as ointments or cream, smoke bathing and chewing are the most frequent methods of preparation.

The most widely used routes of administration were oral that accounts for 44.3% of total case used and dermal 31.4%. Other means of administration indicated in Fig. 6.

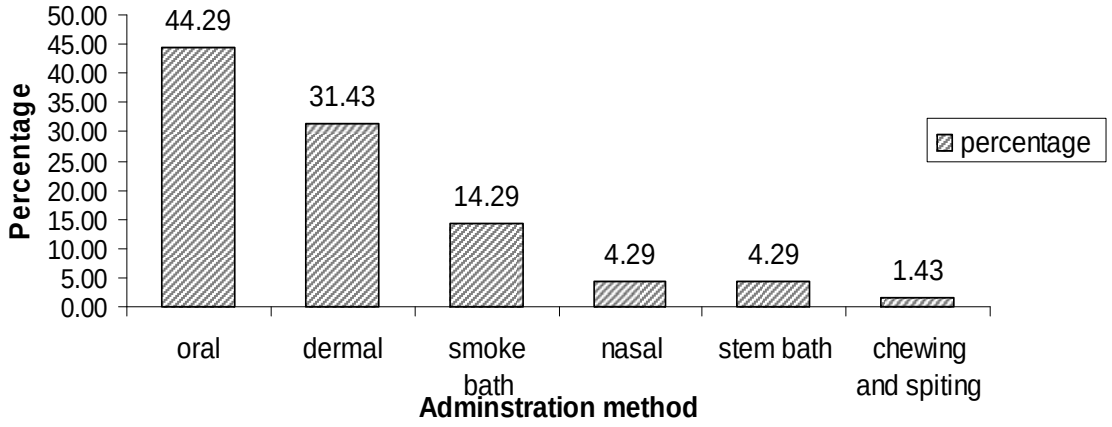

Figure 6. The route of administration of human medicine in the study area

One or more plants can treat one disease, and different parts of the same plant can be used for the treatment of one or more diseases. As shown in Table 5, ascariasis and gonorrhea each can be treated by five plant species. On the other hand one plant species can be used for threatment of more than one disease. For instance, *Albizia anthelmintica* used to treat five diseases (Appendix 2).

Table 5. Common diseases treated by two or more medicinal plant species

Ailments	**No. plant species**	**Percentage to all medicinal plant used (46 species)**
Ring worm	4	8.7%

Gonorrhea	5	10.9%
Common cold	3	6.5%
Diarrhea	2	4.3%
Ascariasis	5	10.9%
Ambiasis	3	6.5%
Wound/ sore/ bleeding	4	8.7%
Anthelments	2	4.3%
Lymphatic and Swelling of foot	3	6.5%
Stomach ache	2	4.3%
Headache	2	4.3%
Toothache and gum disease	5	10.9%
Giardiasis	2	4.3%
Liver disease	5	10.9%
Lung cancer	3	6.5%

6.2.1.2.Ethno-veterinary plant use

A total of 21 plant species were identified for the treatment of livestock diseases. These plants belong to 21 genera and 15 families. The growth form distribution is as follows: herbs 7 species (33.33%), climbers 5 species (23.80%), trees 4 species (19.10%), shrubs 4 species (19.10%) and 1 parastic plant species (4.80%) (Appendix 3).

The plant parts used for ethnoveterinary medicine include the leaves of 8 species (34.78 %), roots of 7 species (30.45 %), latex of 4 species (17.39 %), seeds of 2 species (8.69 %) and the fruit of 1 species (4.3 %). Herbs are the dominant sources of medicine in the treatment of both livestock and human ailments. The usage of root and leaf parts is almost comparable for the case of livestock, unlike that of human ailments, whereby roots are predominantly used. Mirutse Giday

and Gobena Ameni (2003), showed that the dominance of leaf use for medical purposes has less risk for the survival of the medicinal plants.

Five plant species were reported to be used for the treatment of both human and livestock ailments. These species are *Moringa rivae, Euphorbia nubica, Solanum incanum, Aloe trichosantha* and *Hydnora johannis.*

6.2.1.3. Collection and use of traditional medicine

This study has identified that the majority of medicinal plants used by traditional healers are from wild natural vegetation in occurrence. Zemede Asfaw (2002), reported that the majority of medicinal plants in Ethiopia are wild in source. Herbs of medicinal value are collected fresh for use. Medicinal plant species of tree origin can be collected fresh based on demand. However, medicines from herbs that are seasonal in growth or collected from far areas are dried and stored.

According to traditional healers, dry and old parts of plants are believed to be inactive or weak in effectiveness for use as traditional medicine. Seventy-five percent of the herbal medicine are prepared in liquid form and put in plastic jerrycans. The rest are presented in powder form for sale and use.

Even though there is no standard dose for application, traditional healers have their own ways of deciding on the amount to be used. They may estimate in terms of the number of seeds, use of a spoon to measure the powder or estimate in the palm based on the patient's degree of tolerance and age. The majority of plants are used singly while some are applied in mixtures of two or more plant species.

Traditional healers mainly depend on the sale of traditional herbal medicine to get income for their livelihoods. Nowadays, traditional healers have to spend a lot more time in the collection of medicinal plants due to the expansion of farmland and overexploitation leading to plant resource depletion. According to local traditional healers, most active medicinal plants are collected from dryland areas of Bale. The most common places for collection include Districts like Mada

Walabu, Goro, Dolo Mana, Bidire and Sof Umer Valley. As noted by traditional healers, it takes them about a month to find certain medicinal plants from Borana Zone. According to traditional healers, no effort is being made to ensure the conservation and sustainable use of medicinal plants.

According to this study, the idea of providing information about traditional medicine is highly sensitive. This is due to:

- Traditional taboo: It is believed that the medicine will lose its curing power if its' use is disclosed to a non-religious person. The same case was noted by Kebu Balemie *et al.* (2004);
- Telling someone who has insufficient knowledge about traditional medicine carries a high risk; they can cause health problems to others just to get money;
- There is fear of misuse and abuse by outsiders. This was also noted by Gemedo Dalle (2005); and
- Exposing the secrets of traditional medicine by healers is a question of survival since it is a means of income for their livelihoods.

6.2.2. Wild edible plants

A total of 23 plant species were identified as wild edible plants by local communities (Table 6). These belong to 17 genera and 14 families. Tiliaceae is the most widely consumed. It is represented by 6 species (26.10%), Moraceae ranks second, comprising four species (17.40%) and Rhamnaceae 2 species (8.70%). In terms of growth form, the most widely used plants are shrubs, represented by 11 species (47.83%). Trees comprise 9 species (39.13%), herbs represented by 2 species (8.7%) and 1 parasitic species (4.35%). Most plants are consumed raw. Fruit eating accounts for 87 % of the use of wild plants (Table 7). This is in line with the work of Hussien Adal (2004), where fruit uses accounted for 80 % of edible wild food.

Table 6. Wild edible plants, part consumed, month and reason of consumption (F = fruit, R= root, S= stem AF=Additional food and Fam= Famine).

Scientific name	Part	Month of fruit collection												Reason of use
		Se	Oc	No	De	Ja	Fe	Ma	Ap	Ma	Jun	Jul	Au	
Bridelia cathartica	F												■	AF
Balanites aegyptiaca	F		■	■										AF
Rhus natalensis	F	■	■											AF
Grewia tenax	F							■	■					Fam
Grewia kakothamnos	F			■	■									AF
Carissa spinarum	F								■					AF
Commiphora erythreae	F				■	■	■							Fam
Grewia bicolor	F				■	■								AF
Berchemia discolor	F				■	■								AF
Dorstenia foetida	S								■	■				AF
Canthium setiflorum	F											■	■	Fam
Ficus exasperata	F			■	■									AF
Euclea divinorum	F			■										AF
Dorstenia barnimiana	R								■					AF
Ficus sycomorus	F					■	■							Fam
Grewia villosa	F					■	■							AF
Grewia erythreae	F			■	■									AF
Sterculia stenocarpa	F							■	■					Fam
Mimusops kummel	F							■						AF
Zyzyphus spina -christi	F													AF
Opuntia ficus- indica	F											■	■	Fam & war
Vernonia adoensis	F				■									AF
Grewia tenax	F								■	■				AF
Hydnora johannis	R								■					Fam & war

Table 7 plant part used as wild food

Part used	No. of species	Percentage
Fruit	20	87%
Root	2	8.7
Stem	1	4.3 %
Total	23	100%

As identified in this study, the wild edible plants are classified into four major categories:

- Wild edible plants used as additional food at all times;
- Wild edible plants only eaten during famine due to prolonged drought;
- Wild edible plants eaten during war in the absence of any alternatives; and
- Wild edible plants consumed all the time because of their medicinal importance.

The different seasons for maturation of wild edible plants help the local community to ensure the availability of food, especially during extended drought where there is no crop harvest due to erratic rainfall in the area. During the normal rainy season, mainly children use the wild edible plants as food supplements.

Local communities have their own especial preferences concerning wild edible plants. For example, fruits that are widely preferred include *Canthium setiflorum* (*Ladhana)* that has a honey taste and *Commiphora erythreae* (*Hugarsu* or Qacama*)* which has delicious taste similar to butter (Table 8). According to the local elders, marketable wild edible plants include Z*yzyphus spina-christi* (Qurqura*), Ficus sycomorus* (Odda*)* and *Commiphora erythreae* (Hagarsu). These species are collected from the wild and sold. Even though there is no well-developed home garden, in the study area, there is an attempt to domesticate wild edible plant like *Ehretia cymosa* near the home garden.

Table 8. Preference ranking of widely mentioned wild edible plants based on local importance, as given by respondents

Species name	Respondents score											
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	Total	Rank
Hydnora johannis	6	5	4	4	3	3	5	6	4	6	47	7th
Commiphora erythreae	5	1	5	2	5	5	7	5	5	2	42	8th
Canthium setiflorum	10	7	10	8	10	9	10	10	9	10	93	1st
Carissa spinarum	2	2	1	3	1	2	2	1	2	4	20	9th
Grewia villosa	8	10	9	9	6	10	8	9	8	9	86	2nd
Grewia kakothamnos	1	6	2	1	2	1	1	2	1	1	18	10th
Opuntia ficus-indica	9	9	7	10	8	7	6	8	7	5	76	3rd
Ficus exaperata	5	8	8	5	4	8	9	7	10	7	71	4th
Zyzyyphus spina- christi	7	3	6	7	7	4	4	4	6	3	51	5th
Grewia erythreae	4	4	3	6	5	6	3	5	3	8	47	6th

6.2.3. Forage plants

Fifty three plant species were identified be used as forage in the study area (Table 4.). They belong to 40 genera and 21 families. Fabaceae ranks first with 11 species (20.75%), followed by Acanthaceae and Poaceae is third, accounting for 13.20% and 11.32% of the species respectively. The most commonly used forage species belongs to seven families as indicated in Figure 7.

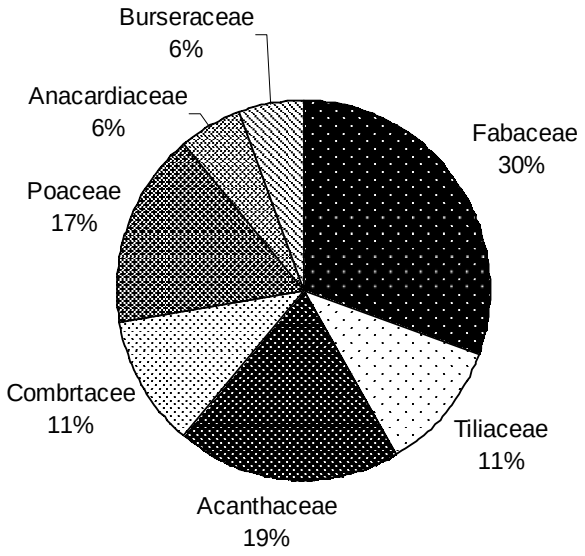

Figure 7. Foraged plant species and family distribution in the study area

Concerning the growth form, trees are represented by 19 species (35.85%), shrubs by 17 species (32.10%) and herbs by 15 species (28.30%). The dominant use of trees and shrubs for feed was reported by Hussien Adal (2004), where 87% of forage was browses and 12.68% graze.

According to the local agropastoralist, livestock prefer to consume leaves during the rainy season, while their diet is based on branches and twigs during prolonged drought. Browsing has higher importance than grazing in the area due to the erratic rainfall that limits the availability of plants. The branches of tree species like *Commiphora erythreae* and *Lannea fruticosa are* used during prolonged droughts.

Livestock show high feed preference based on the availability. Table 9 shows that camels and goats have wider feed preference and most forage species to browse. This indicates the suitability of the area for ranching goats for market and camels (21 species) than donkeys and sheep.

Table 9. Animals` plant forage preference according to information from the local community.

Animals	No. Species preferred
Donkey	3
Camel and goat	21
Cattle	20
Cattle , camel and goat	8
Camel	33
Goat	33
Camel and cattle	1

6.2.4. Plants used as sources of fuel

In this study, 'plants used as fuel' is refers to all plants that contribute to domestic energy source, including charcoal production and firewood (Table 4). The use of plants as an energy source is basic to local communities in the study area as in other rural parts of Ethiopia. According to Vivero (2001), 90% of Ethiopian energy comes from biomass where fuel wood being the highest component. Thirty five species belonging to 21 genera and 17 families are used as firewood.
Even though any dry tree species can be used as firewood, certain tree species are more preferred by local communities. Fabaceae accounts for 31.4 % and Tiliaceae for 17.14 % of firewood. In case of growth forms: 21species (60%) are trees and 14 species (40%) are shrubs.

Seventeen species were mentioned by local communities as having been used for the production of charcoal. They are distributed into 12 genera and 12 families. Fabaceae contributes the most fuel wood demand (47.1%); and *Acacia busssie* is the most widely preferred plant species for production of good quality charcoal (Table 10). This preference by local community was attributed to highly energy content of the plant.

Table 10. Paired comparisons of six tree species used for the production of quality charcoal

Plant species name	Respondents					Total score	Rank
	R1	R2	R3	R4	R5		
Acacia bussie	5	3	5	5	5	23	1st
Acacia mellifera	4	4	2	3	3	16	3rd
Acacia tortilis	3	5	4	4	4	20	2nd
Terminalia prunioides	2	2	3	1	2	10	4th
Haplocoelum foliolosum	1	1	1	2	1	6	5th
Commiphora erythreae	0	0	0	0	0	0	6th

6.2.5. Plants for cultural materials

Plants that are important for construction, for making farming implements, carving and fencing are included in this category. They comprise 33 plant species that belong to 26 genera and 17 families. They are mainly trees and shrubs (Appendix 5).

6.2.6. Plants used for shade

Thirteen plant species, belonging to eight genera and eight families, are well thought-of in providing shade for both humans and livestock (Table 4). The family Fabaceae accounts for 61.53% of the plant identified for shade. The species' growth habits are mainly trees (8 species, 61.53%) and climbers (3 species, 23.07%). Climbers are mainly useful when the deciduous plant species shed their leaves in the dry season.

6.2.7. Plants for beekeeping

Local communities identified twenty- seven plant species that have significance in beekeeping for good honey production (Table 4). They belong to 23 genera and 14 families. Acanthaceae is the highest number for this purpose and represented by six species (22.22%) followed Fabaceae represented with five species (18.52%). The growth form distribution is as follows: trees 11 species (40.7%), herbs 9 species (33.33%) and shrubs 6 species (22.22%).

Hanging traditional beehive is widely common among agropastoralist of the area (Figure 8). The sale of honey is a good source of income generation in Sof Umer area. The area is popular as it provides a medicinally important type of honey. The local community has noted that there are different kinds of honey interims of taste and color based on the season. This is related to the

flowering time of different kinds of plants (Figure 9). One kilogram of honey costs about 20 birr in Urgo market. The sale of honey is an attractive means of supplementing the income of the local community. Providing modern beehives could improve production further. According to Vivero (2001), the production from traditional hives is low and he reported an average of 8 kg of honey and 1 kg of bee wax per hive annually. He noted that modern box hives could yield as twice as high the traditional one can do.

This kind of economic activity is ecologically sound and environmentally friendly. Moreover, it would be easy for any development initiative to use local resources to develop modern beekeeping. Small processing and packaging systems would also provide a good source of income to pastoralists at a local level, and export would generate hard currency.

Figure 8. Hanging traditional beehive

Figure 9 *Acacias senegal* is important nectar source of bee

6.2.8. Perfuming, cleansing and marketable plants

Perfuming plant species are mainly members of the family Burseraceae. This tradition is valued among the public; as perfuming, is considered a good quality of women. For the fumigation process, a small hole is made inside the home where wood material is placed on a fire and women cover their body with cloth below their neck. This traditional activity is practiced to avoid smell from sweating and to perfume cloths. According to local informants, the fumigation can arouse the woman; making ready for sexual activities. The same case was reported by Gemedo Dalle *et al*. (2005), in Borana community.

The tree species used for perfuming and cleansing include the following. *Commiphora terebinthina, C. ogadensis, C. monoica, C. erythreae, C. africana C. schimperii, Boswellia*

microphylla, B. neglecta, Cadaba longifolia, C. samharensis, C. myrrha, Combretum molle and *Mimusops kummel.*

Marketable plant products are mainly resins and gums from different plant species of the family Bursercaceae. These include of *Commiphora erythreae, C. myrrha, Boswellia neglecta and B. microphylla.* The importance of such marketable non-timber forest products (NTFPs), like resin, harvesting does not affect the tree itself. This allows the plant to mature for reproduction. This activity provides a means of income generation for many poor people in the area. Samples from market survey are shown in Fig.10 & Table 11.

Figure 10. NTFPs for perfuming and cleansing displayed at Sof Umer market for sale.

Table 11. Samples of non-timber forest products collected from Goro and Sof Umer markets.

Scientific name	**Part used**	**C**	**I**	**Traditional Use**
Mixture of *Boswelia*	Resin and root	5	3	To fumigate house and perfuming used by women

neglecta & Withania somnifera				
Terminalia brownii	Pieces of wood	5	1	Perfuming house, cloths and after birth the mother uses to smoke the children
Boswelia neglecta	Resin	3	3	Fumigating inside the house & on traditional ceremony
Commiphora erythreae	Resin & pieces of wood	7	2	It has medication for mich, common cold, sunburn allergy, Hazaba/ disease that close the nose. Women on menses are believed to aggravate disease "Gadidu" if she visit patient. The smoke of resin " Habaqorto" help to avoid relapse.
Mixture of *Terminalia brownii* & *Mimusops kummel*	Pieces of wood	2	1	Fumigation by women, perfuming, believed to be aphrodisiac and remove /relapse "Afraa"

6.2.9. Plants of cultural and religious importance

Eight plant species, belonging to eight genera and seven families, were identified as having religious and traditional ceremonial values. Table 12 shows the detailed descriptions of those tree species used for religious and traditional ceremonies. According to local key informants, Sof Umer is a popular site in the Oromo's Gada system (a socio-political institution) and the Muslim tradition. The Sof Umer proper around the cave is highly respected for both traditional and religious purposes (Fig 11). It is the place where indigenous people have practiced traditional activities and beliefs for many generations.

According to key informants, the area is highly respected due to cultural ceremonial activities that are carried out twice every year, and its being the earliest place for the establishment of the

Gada system. Accordingly, for annual ceremonial activities many people come from different parts of the country. During this time they make " Dhu'aa`i" i. e. praying activities by which people believed to be cured from sickness, and where they make gifts for their God according to pledge that they have made.

No one is allowed to cut trees from the ritual site. Especially, plant species like ***Ficus sycomorus*** (Odda) and ***Acacia tortilis*** (Dhadacha) which are highly respected by local community. This is attributed to the socio-political and religious use of those trees (Table 12). Such trees with strong cultural ties and importance are good flagship species for any Biodiversity conservation strategy in Biodiversity. The findings agree with the work of Gemedo Dalle ***et al.*** (2005), on the Borana people's tradition.

Table 12. Descriptions of plant species of cultural and religious important

scientific name	Plant with cultural significance
Acacia tortilis	Judiciary shade; to produce "Gabata" furniture that is used to eat on during religious ceremony
Commiphora ogadensis	It is old traditional practice to lay down twig of tree in front of a gate during marriage day
Grewia bicolor	Traditional stick for Aba Boku, to build tradtional house, stick for husband as indication of respect, to produce traditional door" Sabaqaa", to make "Xaxoo" tradtional material used to carry fragile material and food for new married lady.
Phoenix reclinata	Traditionally, leaves is sign for peace
Euclea divinorum	Leaf is used for blessing rite
Ficus sycomorus	It is believed to be a symbol of identity, a symbol for Gada system and under which law and rule established, Locally called "Seraa Tumuu"; Legislation
Grewia tenax	Tradtional stick, leaves for blessing ceremony and leaves is tied in front of the door to show sign of joy
Dracaena ellenbeckiana	Local people hung in front of the door as indication of fasting and sign of celabration of traditional cermony.

Figure 11. Sof Umer proper “Awoliyaa” is sacred land.

6.3. Multi-purpose Tree Species and Plants with Miscellaneous uses

Systematically selected key informants ranked plant species that were widely mentioned and having many use categories. This is to evaluate the importance of each plant species to local people. The ranking is shown in Table 13.

Table 13. Use value of multipurpose trees tree species.

Scientific name	Use categories												
	Cultural significance	Charcoal	fire wood	construction	medicine	food	forage	Timber	carving	shade	bee keeping	Total	Rank
Acacia bussie	0.5	1.0	1.0	1.0	0.5	0.0	0.5	0.5	0.5	0.5	1.0	7.0	5th
Acacia mellifera	0.0	1.0	1.0	0.5	0.5	0.5	1.0	0.5	0.5	0.5	1.0	7.0	5th
Acacia tortilis	1.0	1.0	1.0	1.0	1.0	0.5	1.0	0.5	0.5	1.0	1.0	9.5	1st
Albizia anthelmintica	0.5	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.5	1.0	6.0	10th
Berchemia discolor	0.0	1.0	1.0	0.5	0.0	0.0	0.5	0.0	0.0	0.5	1.0	4.5	13th
Boswellia neglecta	1.0	0.0	1.0	0.5	1.0	0.0	0.0	0.5	0.5	0.0	0.0	4.5	14th
Commiphora erythreae	0.0	0.5	0.5	0.5	1.0	0.5	1.0	1.0	1.0	0.5	1.0	7.5	3rd
Commiphora ogadensis	1.0	0.5	1.0	0.5	0.0	0.0	1.0	0.0	0.0	0.5	0.5	5.0	11th
Erythrina burana	0.5	0.5	0.5	0.5	0.0	0.0	0.0	1.0	1.0	0.5	0.0	4.5	14th
Ficus sycomorus	1.0	0.0	0.5	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	9.0	2nd
Grewia bicolor	1.0	0.5	1.0	1.0	0.0	1.0	1.0	0.0	0.0	0.5	1.0	7.0	5th
Lannea fruticosa	0.0	0.0	0.5	1.0	0.5	0.5	1.0	1.0	1.0	0.5	1.0	7.0	5th
Terminalia brownii	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	5.0	11th
Terminalia prunioides	0.0	1.0	1.0	1.0	0.0	0.0	1.0	1.0	1.0	0.5	1.0	7.5	3rd
Zyzyphus spina -christi	0.0	1.0	1.0	1.0	0.0	1.0	0.0	1.0	0.5	1.0	0.5	7.0	5th
total	7.5	9.0	12.0	9.5	6.5	4.0	9.0	7.0	7.0	8.0	11.5		
Rank	6th	4th	1st	3rd	10 th	11th	4th	8th	8th	6th	2nd		

According to the comparson made, *Acacia tortilis*, *Ficus sycomorus* and *Commiphora erythreae* are the most important multipurpose tree species ranking 1-3 respectively.

Plant species in the study area having other uses than major use categories and unique ethnobotanical knowledge are indicated in Table 14. Local community have good indigenous knowledge on biochemical active compounds that have toxicity to kill carnivores like lion, plants used as cleansing agents as soap, and flavoring agent as local technology during different activities in their daily life like butter making..

Table 14. Plant with miscellaneous use and unique character in the study area

SCIENTIFIC NAME	UNIQUE USE AND /OR PROPERTIES
Asparagus africanus	Used as painting and writing to learn Quran by local children
Boscia senegalensis	Flower is very irritant to the human eye
Baphia sp.	The fruit and seed are toxic for goat that can lead to death
Caucanthus auriculatus	The leaf is ground, mixed with meat and given to wild carnivore. It is toxic and kills even lions
Commiphora ogadensis	The pieces of wood "Ancaa" is as torch (flash)
Dalbergia commiphoroides	Leaves are used for washing cloths
Lannea triphylla	Flat board is used as a blackboard
Maerua angolensis	The leaves are chewed as stimulant in shortage of chat
Maeria crassifolia	When the goat eat, it change the taste of milk and also makes smell bad
Ocimum forskolei	The leaf is used to make butter for flavor
Plectranthus otostegioides	Leaf is very toxic for mule and donkey by affecting spinal cord
Pyrenacantha malvifolia	During drought *Tragelaphus spp*. "Gadamisaa" eat the root tuber to get water
Sclerocarya birrea	The stem is used to make the handle of gun
Sesamothamnus rivae	The leaves are used for washing cloth

6.4. Desrcription of Selected Plant Species

The descriptions of the most widely mentioned medicinal and other useful plants in Sof Umer area are given bellow.

1. ***Hydnora johannis*** **Schweinf; HYDNORACEAE; Xuqaa (Oro.)**

The species is a subterranean holoparasitic herb with massive root system spreading from the host (Figure 12). It is an obligate root parasite on *Acacia* and *Albizia,* growing in between 1000-1500 m. The species occurs in Shewa, Sidamo, Bale and Hararge. It has also seen reported occurring in Eritrea, Somalia, Kenya, Tanzania, Rwanda and Democratic republic of Congo. The species is widely distributed but seldom collected (Musselman, 1995).

The collection of *H. johannis* is rare and fragmented. As indicated on the specimens in the Herbarium by Peter Kuchar and Mandi M. Kidar in 1993, *H. johannis* protrudes a few cm through its apex from the ground surface, cylindrical in body shape and reddish brown in color. In the study area, the plant is used as medicinal for both human and livestock. The root is consumed to increase appetite. The root is also taken with honey for lung cancer, breast cancer and intestinal diseases. Swollen breast of cow will get relieved if it is washed with soil taken nearby the root of *H. johannis.*

2. ***Albizia anthelmintica*** **(A. Rich.) Brogn; FABACEAE; Hawacho (Oro.)**

It is a shrub or small tree that grows in bushland (Figure 13), woodland and dry scrubland at altitudinal range of 500-1350 m. It occurs in Tigray, Hararge, Kefa and Gamo Gofa floristic regions. The species is also found in Eritrea, Sudan and Natal. It is used as vermifuge and taenicide (Thulin and Asfaw Hunde, 1989). As indicated by Dawit *et al*. (2003), the bark powder is cooked with meat and soup is made and taken as taenifuge, gonorrhea and syphilis. Gemedo Dale (2004), also reported the use of the same plant as ant intestinal worm.

According to the current study, the bark of the root and/ or the whole root is used for liver disease, anti-helminths, gonorrhea and ascariasis. The root is boiled with meat and only the soup is taken because the plant is toxic.

3. ***Commiphora erythreae*** **(Ehrenb.) Engl.; BURSERACEAE; Hagarsu (Oro.)**

It is a tree 8 m tall and with dbh 0.5 cm; barks whitish to yellow or bluish grey often with pink spots, smooth, peeling in large irregular papery flakes (Figure 14). Commonly distributed in *Accacia –Commiphora* woodland, wooded grassland and bushland, *Combretum- Terminalia* wooded grassland, dry coastal bushland, often on rock slope that can be grow from near sea level to 1900 m. It is widespread in Ethiopia occurring in Afar, Shewa, Arsi, Gamo Gofa, Sidamo, Bale and Hararge floristic region. The species also occur in Eritrea, Sudan, Kenya, Somalia, North Tanzania and Arabia. The resin is used as an insecticide against cattle fleas by Borana (Vollesen, 1989a). Gemedo Dale (2004), indicated the use of exudates as anti ticks by Borana people.

People of Sof Umer area use the plant as a multipurpose tree. Branches of the tree are used as feed for livestock during dry season; fruit consumed during famine and the bark is used to smoke to the house. Local communities use the plant also for its medicinal value. The resin is smoked for common cold, root and stem are used for headache, and the gum is chewed for stomachache and ascariasis.

4. ***Moringa rivae Chiov;*** **MORINGACEAE; Boyii (Oro.)**

It is a small tree 3-7 m tall and trunk 8 cm in diameter (Figure 15). It grows in deep rocky gorge, on lime stone slopes, about river at altitudinal range between 1100-1300 m. The species distributed in Sidamo, Bale and Hararge floristic regions, which is endemic to Ethiopia.

In the study area, the local people use the plant as traditional medicine for human and livestock. For human lung cancer, the root is ground and taken with honey. For cattle swollen stomach, root is pounded, mixed with pounded root of *Rhus natalensis and* powder of *Nigella sativum* and the mixture is given orally.

Figure 12 Rhizome of *Hydnora johannis*

Figure13. *Albizia anthelmitica*

Figure 14 *Commiphora erythreae*

Figure 15 *Moringa rivae*

5. ***Euphorbia longituberculosa*** **Boiss.; EUPHORBICEAE; Hokobkob (Oro.)**

Succulent herb up to 25 cm high. All parts are glabrous and the main stem is succulent (Fig.16). The species is distributed in open disturbed site on steep rocky slopes in *Acacia* or *Acacia-Commiphora* bushland. It grows in altitudinal range of 600-1150 m. In Ethiopia, it is found in Afar, Tigray, Shewa and Sidamo floristic regions and the species also occurs in Somalia, Kenya and Yemen (Gibert, 1995).

Indigenous people of the study area use the plant for healing of different human ailments. The small quantity of fleshy stem is boiled with meat or coffee and the soup is drunk for gonorrhea, abdominal pain after labor and amoebiasis. Kebu Balemie *et al.* (2004), also reported the use of the plant root for the treatment of gonorrhea, respiratory problems and fever.

6. ***Carissa spinarum*** **L.; APOCYNACEAE; Hagamisa (Oro.)**

Richly branched, sometimes creeping, shrub or climber. It grows in open *Acacia* woodland often on termite mounds and riverine fringing vegetation between altitudes of 550-2500 m. The species occurs in Afar, Tigray, Gonder, Gojam, Welo, Shewa, Arsi, Gamo Gofa, Bale and Hararge floristic regions. It is widely distributed in Africa, Yemen and Thailand. The ripe fruit is widely eaten by children. Bushes are grazed. Its spiny stems are used for fencing crop field (Albers *et al.*, 2003).

In the study area, this plant is commonly found along the riverbank. The root is chewed and juice swallowed for epilepsy and smoked for evil spirit. Jansen (1981), indicated the use of the root for snakebite, toothache and stomachache. Dawit *et al*. (2003), reported the use of the plant root for snakebite, toothache, colic, scabies, aphrodisiac, headache, evil eye, rheumatic pain, poison antidote, cough, analgesic, stimulant and epilepsy. Bayafers Tamene (2000), noted the uses of leaves for headache, diarrhea, gastro-intestinal disease and the root for kidney, headache and hepatitis.

7. ***Dorstenia foetida*** **(Forssk.) Schweinf.spp.lancifolia (Rendle) Friss; MORACEAE; Kurtee ree`ee (Oro.)**

Perennial succulent herb, with base swollen and stem one to several together from common base upto 1-1.5 cm thick and up to 10 cm tall (Fig. 17). It grows in rocky out crops, in decidous bushland and distributed at altitudes of 700- 2100 m. The species occurs in Bale and Sidamo floristic regions. The species also occurs in Yemen and Somalia (Friis, 1989).

The local community widely uses the plant for human medicine. The fleshy stem is chewed and the juice swallowed for any body pain, stomach pain, gonorrhea, diarrhea and blood pressure.

8. ***Pyrenacantha malvaifolia*** **Engl.; ICACINACEAE; Burii (Oro.)**

Woody climber or scrambling, shrub; stem arising from the subglobose partly buried tuber like part of the stem; tuber to 1 m tall and 1.5 m in diameter (Fig.18). *Accacia – Commiphora* woodland and bushland, on sandy to loamy soil overlying limestone or rocky limestone slopes. It is found at altitudinal range of 900-1400 m. It distributed in Sidamo, Bale and Hararge floristic regions and also occurs in Somalia, East Kenya and Tanzania (Vollesen, 1989b).

In the study, the root is ground and mixed with water and given orally for the treatment of black leg “Abagorba”. The tuber is eaten by *Tragelaphus spp.* ‘Gadamsa’ during dry season as source of water.

9. ***Grewia villosa*** **Wild; TILIACEAE; Ogomidi (Oro**.)

It is a branching shrub or climber up to 1-3 m long (Fig.19). It occurs in *Accacia-Terminalia-Combretum* woodland in rocky, sandy and limestone area at 400- 1800 m. It is widely distributed occurring in Tigray, Welo, Shewa, Kefa, Gamo Gofa, Sidamo, Bale and Hararge. It is also widely distributed through drier Africa, Arabia and India (Vollesen & Sebsebe Demissew, 1995). Kebu Balemie ***et al.,*** (2004) indicated that crushed bark is applied to diseased part of finger swelling in human and helps to remove retained placenta in cow. In the study area, the fruit of the plant is edible and pastoralists use it for livestock ailment as medicinal. Leaves are crushed and tied on the wound of an ox.

10. ***Ficus sycomorus*** **L.; MORACEAE; Odda (Oro.)**

A large tree up to 30 m tall, buttressed, with a trunk up to 3.5 cm in diameter, crown spreading bark grayish brown; fig edible. It grows along rivers and lake margins in woodland and forest edges at altitudinal range of 500-2000 m. It is widely distributed occurring in Tigray, Welo, Gonder, Gojam, Shewa, Hararge, Illubabor, Kefa, Gamo Gofa and Sidamo floristic regions. It also occurs in East Africa, Egypt, South Africa and Yemen (Friis, 1989).

In the study area, the tree is found around the riverbank. It is one of the important multipurpose trees, for local communities. The people use the tree for shade, to hang hives, as cultural symbol and as a sign of identity. The fruit is edible; the woody stem used for furniture and production of cultural material.

11. ***Zyzyphus spina-christi*** **(L) Des.; RHAMNACEAE; Qurqura (Oro.)**

It is shrub or tree that grows up to 10 m high. It is distributed in wooded grassland on limestone slopes, *Acacia* bushland on alivivial soils, in and along dry riverbeds, edges of cultivation and garden at altitudinal range of 0-12400 m. It is widely distributed occurring in Afar, Tigray, Gonder, Welo, Shewa, Gamo Gofa, Bale and Hararge floristic regions. It also occurs in Near and Middle East in Dryland of North Africa, introduced and naturalized in east Africa. The ripe fruit is edible and marketable (Vollesen, 1989c). The fruit is eaten raw and marketable in the study area.

12. ***Caralluma penicillata*** **(Defl.) N. E. Br.; ASCLEPIADACEAE; Halaku ajee (Oro.)**

The stems procumbent ascending erect and forming small clumps upto 1m tall (Fig.20). It grows in *Acacia-Commiphora* bushland overlaying limestone and basalt at altitude of 600-1900 m. In Ethiopia, it occurs in Shewa and Hararge floristic regions. Elsewhere, it occurs in Eritrea, Somalia and Tropical Arabia (Albers *et a*l., 2003). The plant has an ethnoveterinary use by local community of Sof Umer area for their cattle against boils “Joksa”. The milk latex is applied as ointment on affected body part.

13. ***Caralluma priogonium*** **K. Schum.; ASCLEPIADACEAE; Hajoo/coogee (Oro.)**

Stems in dense clumps, spreading to erect, base more or less woody, usually not rooting adventitiously. Vegetative stem sharply four angled (Fig. 21). It occurs in *Acacia- Commiphora* bushland overlaying basement complex rock or limestone. Altitudinal distribution ranges from 50-1200 m. It is distributed in Gamo Gofa, Sidamo, Bale and Hararge floristic regions. Outside of Ethiopia, it is also found in Uganda and Tanzania (Albers *et al.,* 2003**).** In the study area**,** it grows in rocky and disturbed open area associated with *Acacia-Commiphora –Terminalia* bushland.

In Sof Umer area, the plant is used as medicine for livestock against nematodes. Small amount of milky latex is dropped on the sore. According to Gemedo Dale (2004), the exudate is applied for wound or burn by Borana pastoralists.

14. ***PLumbago zeylanica*** **L.; PLUMBAGINACEAE; Dhigaji or Igaji (Oro.)**

The plant is small, shrub that grows up to 1 m long (Fig 22). It grows in *Acacia- Commiphora* bushland in open and rocky soil. Locally, the root is used as medicinal for liver and spleen diseases, for abortion and anti-helminthes.

Dawit *et al*., (2003), also noted that the root is used for the treatment of tumor of the hand, rabies, leprosy, gonorrhea, and syphilis and lung cancer. Infusion or decoction of root powder is applied against Tinea corporis (ringworm) and T. nigra (Quaquchaa).

15. ***Dorstenia barnimiana*** **Schweinf; MORACEAE, Morodee (Oro**.)

Perennial herb with slightly depressed or subglobose tuber 2-5 cm in diameter sometimes with small swelling above but aerial stem absent; leaves and receptacles arise from the tuber (Fig. 23). It grows in deciduous wooded or bushland, upland grassland, evergreen bushland clearing in evergreen forest at 500-2450 m. The species occurs in Gonder, Shewa, Hararge, Bale, Illubabor and Gamo Gofa in Ethiopia. It also occurs in Sudan, Somalia, Democratic republic of Congo, Uganda, Kenya and Tanzania (Friis, 1989). In the study area, it is the most loved edible wild food. The root is eaten raw. In other areas of Bale, the root of the plant is used against common cold, evil spirit and the leaves are used to remove retained placenta (Haile Yineger, 2005). Gemedo Dale *et al.,* (2005) also indicated as wild food for Borana communities.

Figure16. Euphorbia tuberculosa

Figure 17. *Dorestinia foetida*

Figure 18. *Pyrenacantha malvifolia*

Figure 19. *Grewia villosa*

Figure 20. *Caralluma penicilata*

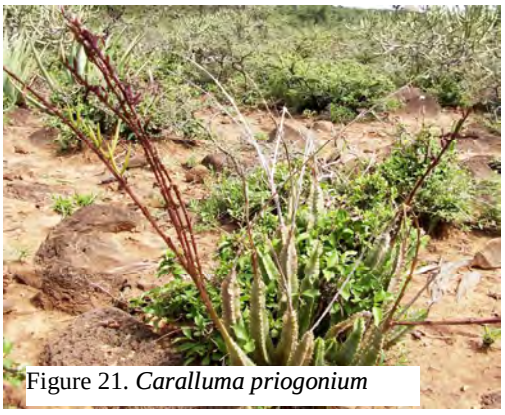

Figure 21. *Caralluma priogonium*

Figure 22 .*Plumbago zeylanica*

a.

b.

c.

Figure 23. *Dorstenia barnimiana*- a: Whole plant; b: root and tuber; c: inflorescence

6.5. Threats to Plant Species

In the study area, there are many factors identified, that can threaten plant species. As in any other part of the country, there is an increase in population and further demand for natural resources. The major issues identified in the study area as factors of threat are charcoal making, expansion of farmland, overgrazing and cutting branches of trees for fodder.

The traditional way of harvesting branches and leaves as fodder for cattle during dry season is destructive (Fig 24). *Commiphora erythreae* is over exploited due to such kind of activities. The frequent use of *Commiphora erythreae* for local and commercial timber aggravates the degree of overexploitation. The same observation was noted by Vivero (2001), that Ethiopia has the largest population of livestock in Africa where over grazing increase the rate at which trees and shrub species are becoming scarce. Other threatened tree species based local informants are presented in Table 16.

A comparison of degree of importance of threats is given in Table 14. Charcoal production is the major factor identified whereas collection for medicinal use at domestic level is low in importance. Tree species like *Acacia bussie* and *Terminalia brownii* are under high exploitation for charcoal production. Expansion for agricultural activities is replacing multipurpose locally useful trees with less and uniform crops which opens the land for degradation and susceptibility to drought (Fig. 25).

Figure 24 Cutting *Commiphora erythreae* for browse

Figure 25. Land clearance activities for agricultural purpose

All factors of threats are associated with high population pressure and demand related to mechanism of income generation. According to the local key informants, due to cultural erosion as a result of people becoming more religious, the tradtional taboo which helps to protect people from tree cutting are not respected. Modernization and expansion of modern education has also contributed to the disrespect for local taboos and traditions and vegetation is exposed for over exploitation. This kind of cultural change has forced the people to harvest forest products from the sacred land "Awoliyaa". Such activity of deforestation exposes the land for erosion and formation of big gulley that directly affect the landscape of the cave. The cave that is a unique heritage and one of the longest caves in the World that is 16 km long (Gordon, 2000) is at risk.

According to Vivero (2001), cultural and religious value of forest, patches surrounding Ethiopian churches in northern highlands have decline in recent times then when compared to last century. This shows the over all cultural change towards sacred groves where we can find the most important gene pool for biodiversity.

Table 15. Preference ranking on factors of threats in the study area by five informants.(value 1 to 10 given based on the degree of importance. 10 is allocated for the most significant factor while one is the least compared to the other factors).

Threaten factors	Respondents					Total	Rank
	R1	R2	R3	R4	R5		
Charcoal production	9	6	10	10	10	45	1st
Carving material	6	10	9	6	3	34	4th
Fire wood	5	5	2	3	5	20	8th
Commercial sale	10	3	1	2	4	20	8th
household material production	4	8	4	9	6	31	5th
Timber	8	9	5	5	8	35	2nd
Construction of house	3	4	6	4	9	26	6th
Cutting tree for fodder during dry season	7	7	7	7	7	35	2nd
clearing for agriculture	2	2	8	8	2	22	7th
Exploitation for medicinal use	1	1	3	1	1	7	10th

Table 16. Factors of threat threatening tree species in the study area based on the semi-structured interview.

Factor for threat	Threatened tree species
Charcoal production	*Commiphora erythreae, Acacia bussie, Acacia mellifera, Acacia tortilis and Terminalia prunioides*
Carving material	*Commiphora terebinthina* and *Commiphora ogadensis*
House hold material production	*Commiphora erythreae, C. ogadensis* and *Erythrina burana*
Timber	*Commiphora erythreae*
Construction of house	*Terminalia prunioides*
Fodder during dry season	*Ficus sycomorus, C. erythreae* and *C. ogadensis*
Clearing for agriculture	Not selective
Medicinal use	*Albizia anthelmintica*

6.6. Vegetation Data

6.6.1. Plant community types

The analysis of vegetation data was based on cover abundance of 118 plant species. A total of six clusters were identified from the TWINSPAN output. These clusters were recognized as plant community types. Those communities were designated as A, B, C, D, and E & F. Naming and description was made on one or two dominant and/ or characteristic species using the magnitude of mean cover abundance in each community (Table 17). These plant communities are described as follows.

A. *Ruspolia hypocrateriforms-Commiphora erythreae* community type

This community is found in the altitude range between 1181-1262 m. The dominant species of this community type are *Ruspolia hypocrateriforms and Commiphora erythreae. Dracaena ellenbeckiana* and *Ruellia patula* have also high average cover abundance. Tree like *Acacia bussie* and *Grewia bicolor* and under story species *Abutilon fruticosum* and *Vernonia adoensis* occur in this community type. Sixty two species occurred in this community type. A total of 14 medicinally important plant species are found in this plant community. The community occurs at steep slopes and in thicket type of bushland. The vegetation is only accessible for goat and there is less human interference.

B. *Acacia mellifera - Euclea divinorum* community type

This community is distributed in the altitudinal range of 1283-1295 m. In this type of plant association, *Acacia mellifera* has the highest mean cover abundance. *Euclea divinorum* is characteristic species that occurs only in this community type. Tree species like *Terminalia brownie* and *Combretum aculeatum* common. Fifty eight plant species belong to this community type, out of which 12 have medicinal values. The community occurs in open woodland. There is some degree of disturbance by cattle, camel and tree cutting.

C. *Barleria quadrispina - Ruellia discifolia* community type

This community is distributed in altitudinal range of 1234 -1317 m. In this community type, *Ruellia discfolia* and *Barleria quadrispina* are the dominant species. Tree species such us *Commiphora samharensis, Lannea fruticosa* and *Boswellia neglecta* are common. Pteridophyte species like *Selaginella yemensis* also occurs in this community type. Seventy species occur in the plant association; out of which 11 species are medicinally important. This community occurs in open woodland. Other plant species that occur in this kind of community include *Boswellia microphylla, Grewia tenax, Dracaena ellenbeckiana and Terminalia prunioides.* Under growth is dominated by unpalatable species like *Barleria quadrispina*.

D. *Lannea triphylla- Carphalea glaucescens* community type

This type of community is distributed in the altitudinal range of 1210-1292 m. *Lannea triphylla* is the dominant species and *Carphalea glaucescens* is characteristic species. Tree species like *Lannea fruticosa* and *Dalbergia commiphoroides* occur with relatively high mean cover abundance. Undergrowth layer is dominated by *Durantha erecta* and *Solanum hastifolium.* Sixty two plant species occur in the community type out of which 14 have medicinal use. The community is easily accessible for charcoal production, browse by camels and clearance for agricultural land.

E. *Baphia sp. – Combretum molle* community type

In this community type *Baphia sp.* Moreover, *Combretum molle* are the dominant species. They are distributed at altitudinal range of 1192-1247 m. Tree species like *Commiphora terebinthina, Canthium setiflorum and Haplocoelum foliolosum* occur in relatively high cover abundance. Other species includes *Grewia bicolor, Berchemia discolor, Commiphora ogadensis* found in this community type. Under growth is dominated by herbaceous species like *Solanum hastifolium* and *Commelina imberbis.* Climber species like *Cissus quadrangularis* occur in this type of community. A total of 27 species belong to the community type out of which 13 of them have medicinal use. They occur on hillsides and in seasonally flooded landscape.

F. *Acacia tortilis* community type

This community occurs near the river at lower altitudinal range of 1188-1284 m. *Acacia tortilis* is the dominate species. Tree species like *Acokanthera schimperii* occur only in this type of community. Undergrowth is dominated by characteristic herbaceous species like *Acalypha acrogyna, Xanthium strumarium, Schoenoplectus maritimus* and *Parthenium hysterophorus.* Other species that occur in this community type are include: *Buxus hildebranditii, Diospyros mespiliformis, Ficus vasta* and *F. thonningii.* The community is riparian ecotone type. Thirty-four species occur in this community type out of which 11 species have medicinal uses. The woodland habitat is features of this community type. Grazing and charcoal production are common activities.

Table 17. Synoptic table of species reaching a synoptic value of > = 0.3 in at least one community type.

Community number	**A**	**B**	**C**	**D**	**E**	**F**
Cluster size	**8**	**9**	**18**	**10**	**3**	**4**
Ruspolia hypocrateriformis	**5.0**	1.3	0.7	2.1	2.0	2.8
Commiphora erythreae	**4.1**	3.1	3.1	3.5	3.3	0.8
Dracaena ellenbeckian	2.0	0.0	1.5	0.1	0.0	0.0
Ruellia patula	2.5	0.7	1.6	1.4	0.3	0.0
Abutilon fruticosum	0.9	0.0	0.1	0.0	0.0	0.0
Grewia bicolor	2.1	0.0	0.6	0.1	1.4	0.2
Acacia bussie	1.9	0.3	0.6	0.9	0.0	0.8
Vernonia adoensis	1.2	0.4	0.5	0.3	0.0	0.0
Acacia mellifera	1.9	**2.8**	1.0	1.2	0.0	0.6
Terminalia brownii	0.9	1.5	1.4	0.8	0.0	0.0
Combretum aculeatum	0.3	0.7	0.0	0.0	0.0	0.0
Euclea divinorum	0.0	**0.4**	0.0	0.0	0.0	0.0
Ruellia discifolia	2.1	1.4	**3.2**	3.0	0.0	0.0
Barleria quadrispina	2.6	3.3	**4.6**	3.2	0.3	0.5
Commiphora samharensis	0.4	1.0	1.5	1.0	0.0	0.0
Dalbergia commiphoroides	0.0	0.0	0.2	0.9	0.0	0.0
Lannea triphylla	0.6	0.3	0.3	**1.4**	0.0	0.0
Carphalea glaucescens	0.0	0.0	0.0	**0.3**	0.0	0.0
Lannea fruticosa	0.8	0.1	1.0	1.0	0.0	0.0
Durantha erecta	0.3	0.1	0.6	1.0	0.0	0.0
Solanum hastifolium	0.0	0.2	0.5	0.1	2.0	0.0
Canthium setiflorum	0.1	0.4	1.0	1.3	1.9	0.0
Commiphora terebinthina	1.6	0.1	0.1	1.0	2.0	0.3
Baphia sp.	0.0	0.0	0.0	0.2	**3.8**	1.5
Combretum molle	0.0	0.1	0.0	0.1	**2.2**	0.5
Acalypha acrogyna	0.0	0.0	0.0	0.0	0.0	0.4
Xanthium strumarium	0.0	0.0	0.0	0.0	0.0	0.4
Schoenoplectus maritimus	0.0	0.0	0.0	0.0	0.0	0.4
Parthenium hysterophorus	0.0	0.0	0.0	0.0	0.0	0.4
Acacia tortilis	0.0	0.0	0.2	0.0	0.2	**0.9**
Acokanthera schimperii	0.0	0.0	0.0	0.0	0.0	0.3

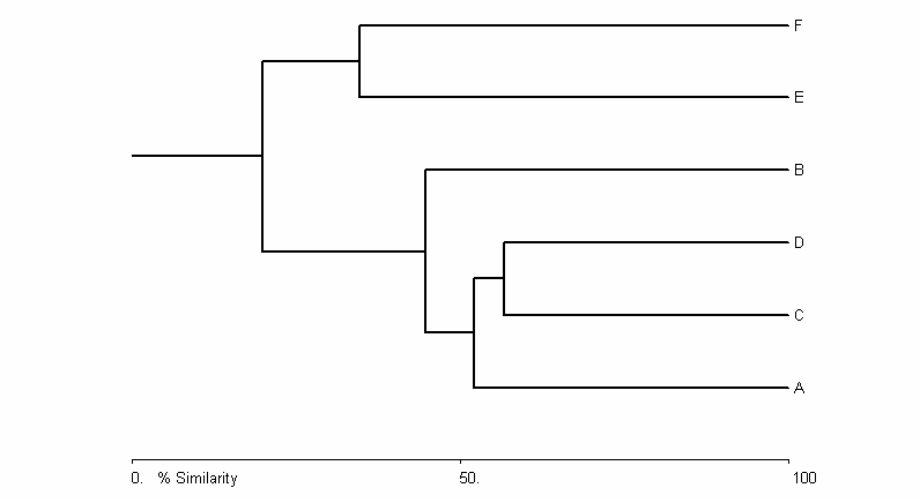

Figure 26. Dendogram showing the Jaccard similarity of communities by group average link.

The community types in the study area were compared by using Jaccard similarity index which is based on presence and absence of species. The Jaccard similarity analysis showed that community types A and B show 43.9% of similarity (Fig. 26). This can be due to occurrence of the two community types in the similar altitudinal range. The community types C & D show 56.63% similarity. This can be attributed to the occurrence of these communities in reddish brown type of soil and open woodland type of habitat. The community types E and F demonstrated similarity of 34.69%. This can be attributed to their occurrence closer to the river. This area is moist and seasonal flooded. The comparson of Jaccard similarity matrices of community types is presented in Table 18.

Table 18. Jaccard similarity matrix

Community	A	B	C	D	E	F
A	*	43.90	54.12	50.00	28.00	16.05
B	*	*	38.89	51.95	25.00	18.92
C	*	*	*	56.63	28.75	17.44
D	*	*	*	*	28.38	19.23
E	*	*	*	*	*	34.69
F	*	*	*	*	*	*

6.6.2. Measurement of diversity index

The Shannon-Wiener diversity was determined based on abundance of each species in the community type. The Hmax range 1.505 to 1.839. Community type C showed highest diversity (1.839) and community F showed lowest diversity index (1.505). Species richness is highest in community type C (70 species) but this community shows the least evenness (0.741). The high diversity index and species richness of this community type might be attributed to high number of cluster size (18) and/or wider altitudinal range and optimal environmental factors. The lowest species richness was found to be in community type E (27 species). This can be due to small cluster size. Community types E and B showed higher evenness (J) 0.833 and 0.811 respectively. The diversity of other community types is presented in Table 19.

Table 19. Summary of community's Shannon- Wiener diversity index

Community	A	B	C	D	E	F
Shannon H'	1.395	1.418	1.362	1.422	1.276	1.142
Shannon Hmax	1.792	1.748	1.839	1.785	1.531	1.505
Shannon J' (Evenness)	0.778	0.811	0.741	0.797	0.833	0.758
Richness	62	58	70	62	27	34
Cluster size	8	9	18	10	3	4
Altitude(m)	1181-1262	1283-1295	1234-1317	1210-1292	1192-1248	1188-1284

6.6.3. Phytogeographical comparison

The vegetation of Sof Umer is compared with other six vegetation in Ethiopia. These vegetations are the Borana forest that is found in southern Ethiopia, at altitudinal range of 1576 to 1777 m (Gemedo Dalle, 2004). The vegetation of Ethiopian rift valley (Zerihun Woldu & Mesfin Tadesse, 1990; cited in Zerihun Woldu, 1999) that occurs at altitude of 900-1900 m. Harena forest in Bale Mountain National Park that occurs at altitude 1510 and 3300 m (Lissanework Nigatu, 1987; cited in Zerihun, 1999; Kumlachew Yeshitela and Tamrat Bekele, 2002). Kimphee Forest natural reserve , in Arsi zone, southeastern Ethiopia which occurs at altitudinal range of 1600 to 1750 m. Gambella forest found in southwest of Ethiopia at altitudinal range of 500- 600 m (Tesfaye Awas, 1997). Nechisar National Park located near Arbaminchi in Rift valley system at elevation of 1110 to 1650 m (Tamrat Andargie, 2001).

The comparison is based on similarity analysis of woody species composition. The result of the similarity analysis is presented in Table 20.

Table 20. Sorensen's similarity coefficient of woody plants between Sof Umer with six forests of Ethiopia.

Forest	Sof Umer	Nechisar	Borana	Rift valley Lakes	Gambella	Herana	Kimphee
Total no. number of species compared	110	80	130	29	19	85	83
Number of species in common	110	20	38	15	4	13	17
Sorensen's similarity Coefficient	1	0.21	0.32	0.22	0.06	0.13	0.18

The floristic analysis showed that the Sof Umer vegetation is more related to the lowland semi-desert vegetation of Borana forest with Sorensen's similarity coefficient of 0.32. The common species that occur in Sof Umer and Borana include *Acacia brevispica, A. bussie, A. nilotica, A. Senegal, Combretum aculeatum, C. molle, Commiphora schimperi, C. terebinthina, C. africana, Boswelia neglecta* and *Rhus natalensi*s. These are typical dryland species. This is mainly attributed to the geographical proximate and similar pattern of climatic condition. Borana exhibits bimodal type of rainfall similar to Sof Umer area (Gemedo Dalle, 2004). The vegetation of Sof Umer shows the lowest floristic similarity with Gambella vegetation. This can explained due to the two areas have different climatic condition, altitudinal and geographically very far apart.

The next closely related forest is the Rift valley lakes with Sorensen's similarity coefficient value of 0.22. The common species are mainly *Acacia spp*. like *A. etabaica, A. mellifera, A. nilotica, A. senegal* and *Balanites aegyptiaca.* There is no representative of *Commiphora spp.*

Eventhough the altitudinal distribution is different; Sof Umer also showed species similarity with Dry Evergreen and Moist Evergreen Montane forest of Herena (0.13). The common species include *Ficus sycomorus, F. vasta, F. thonningii, Mimusops kummel* and *Syzygium guineens.* These are riparian vegetation occurring near the Weybe River. This makes area as ecotone zone between montane forest and *Acacia-Commiphora* woodland.

6.6.4. Vegetation structure

6.6.4.1.Frequency

The frequency was determined from the number of quadrats where the species were recorded from a total of 52 quadrats. The most frequent tree species is *Commiphora erythreae* that has a frequency of 78%, the second is Acacia mellifera 53%, and the third is *Terminalia prunioides* 46%. The frequency of other tree species is indicated in Appendix 6.

6.6.4.2.Density

Density was determined from abundance of tree species that have more than 2 cm diameter at breast height (DBH). The total density of tree species is 619.2 stem per hectare. *Commiphora erythreae* contributes 15.15% and *Commiphora samharensis* 14.5% of the density in the area. The density of the top ten species is indicated in Figure 27 and the proportion of other species are shown in Appendix 6.

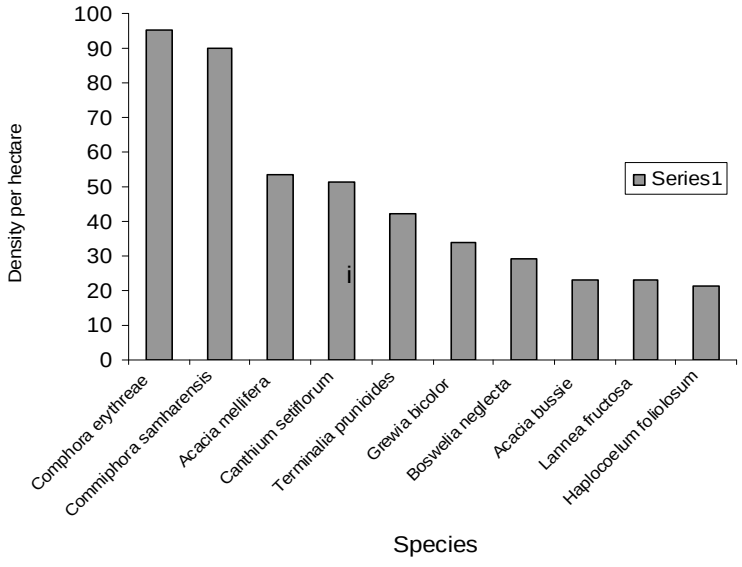

Figure 27. Density of top ten tree species

6.6.4.3.Height distribution of trees and shrubs

Three canopy layers or storeys are described based on the criteria of IUFRO classification scheme, which uses top tree-height to determine the vertical structure of the vegetation (Leinbunget, 1958; as cited in Mateos Ersado & Yoseph Assefa, 2004). Accordingly, the lower storey includes all trees that are one third of the height of the uppermost tree. The upper canopy includes all trees that are more than two-thirds the height of highest tree, and the middle storey describes tree heights between one-third and two thirds of the highest tree.

In this study, the highest tree species were *Acacia tortilis* and *Ficus sycomorus*, which have an average height of 15 m. These species were used to determine the different storeys. Therefore, the lower storey includes all individuals of species that are less than 5 m high, the middle storey includes all individuals that fall between 5 and 10 m, and the upper storey includes all individuals taller than 10 m.

A total of 66 trees and shrubs species have 25624 total individuals that have DBH > 2 cm. The majority of individuals are confined to the lower canopy (80%) while very few individuals contribute to the highest canopy (166 stems of tree & shrub, individuals/hectare). The ratio of stems per species is very high in the lower storey (39.4) showing the predominance of shorter high individuals of woody species in the study area (Table 21).

Table 21. The vertical distribution of individuals of species in three layers and their proportion

Storey	**lower**	**middle**	**upper**
No. of stem of trees/ shrub	2050 (80%)	347 (13.5%)	166 (6.5%)
No of species in storey	52 (78%)	34 (51%)	15 (22.2)%
Ratio stem/ species	39.42	10.2	11.07
No. species confined to only the story	30 (45.4%)	5 (7.5%)	2 (3%)

6.7. Endemism and IUCN Red Lists Species in the Sof Umer Area

In the study area, seven plant species were identified to be endemic to Ethiopia. Out of those, five of them are included in the Red list of threatened species of IUCN (Table 22). *Commiphora monoica, Euphorbia burgeri* and *Maerua boranensis* are critically endangered. *Erythrina burana* and *Moringa rivae* are vulnerable (Vivero *et al,* 2005). In addition to those endemic species, *Dracaena ombat,* which is a threatened species (UN, 1995), is also encountered in the study area. Out of the eight endemic species, three of them are new records for Bale floristic region. *Commiphora monoica* is endemic and restricted to Sof Umer area. Therefore, the species requires special conservation attention.

Table 22. IUCN Red list status and distribution of endemic plants in the study area

Scientific name	Family	Habits	IUCN Status	Distribution	Remark
Commiphora monoica	Burseraceae	Tree	Critically endangered	Only Sof Umer Bale	Specific in distribution
Erythrina burana	Fabaceae	Tree 1350-2100 m	Vulnerable	Hararge, Bale?	New for Bale
Euphorbia burgeri	Euphorbiaceae	Shrub	Critical endangered	Hararge	New for Bale
Isoglossa parvifolia	Acanthaceae	Herb	Vulnerable	Sidamo and Bale	
Leucas abyssinica	Lamiaceae	Shrub	Least concern	Tigray, Gonder, Gamo Gofa Sidamo, & Bale	
Maerua boranensis	Capparidaceae	Shrub	Crittical endangered	Sidamo	New record for Bale
Moringa rivae	Moringaceae	Tree	Vulnerable	Sidamo, Bale & Harage	

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7. CONCLUSIONS AND RECOMMENDATIONS

7.1. Conclusion

Sof Umer possesses high plant diversity of major taxa and endemism. In this study, a total of 213 plants species belonging to 148 genera and 68 families were documented. Out of these, seven of the species are found to be endemic to Ethiopia. Moreover, one of the species, *Commiphora monoica*, is strictly endemic to Sof Umer. Out of the plant species recorded from the area, *C. monoica, Erythrina burana, Euphorbia burgeri, Maerua boranensis* and *Moringa rivae* are included in the list of threatened endemic species. Other species like *Commiphora erythreae and C. Ogadensis are* under high pressure at local level due to their multipurpose overuse.

Charcoal production and cutting tree branches as a fodder for livestock are the major factors identified for the threats of useful plant species in the area. The indiscriminate destruction of vegetation for agricultural land and overgrazing can further threaten the use of NTFPs. NTFPs like honey is affected due to reduced nectar sources and medicinal plants. Like wise, there is elimination of wild edible plants which are essential diet supplements particularly during drought time.

The local people of Sof Umer area are depending on plant resources as subsistence basis for their daily life activities that include medicine, food, cultural material and energy sources. Indigenous knowledge on use of plants for medicine is very broad and culturally tied. In the current study, forty six plant species for human medicine and twenty one plant species for ethnoveterinary use were identified. Twenty three plant species were documented as wild edible plants. These plants supplement children's' diet; and important sources of diet for adult as well during prolonged drought. Thus, it is possible to conclude that the vegetation found in Sof Umer is highly important both as cultural and economic biological resources.

The traditional beliefs were found to be an important contribution for conservation of some useful species in the area. *Ficus sycomorus* and *Acacia tortilis* are some of the plant species identified to be cultural keystone species of the area. These trees are deep rooted in local people's culture and play great role both in socio-political and economic importance.

Vegetation of Sof Umer is classified in to six community types. These are: ***Ruspolia hypocrateriforms-Commiphora erythreae, Acacia mellifera-Euclea divinorum, Barleria quadrispina-Ruellia discifolia, Lannea triphylla-Carphalea glaucescens, Baphia sp.- Combretum molle*** and ***Acacia tortilis community types.*** The Phytogeographical comparison identified that the vegetation of Sof Umer showed more floristic similarity with Borana vegetation. A total 66 woody species of DBH > 2 cm have total individuals of 2564. Out of these, 80% of them are below 5 m long. This shows the dominance of shrubs in the Sof Umer vegetation. The most frequent tree species are *Commiphora erythreae* (78%), *Acacia mellifera* (53%) and *Terminalia prunioides* (46%).The total density of tree species having DBH >2 cm is 619.2 stem per hectare where *Commiphora erythreae* contributed for 15.15 % and *Commiphora samharensis* 14.5%.

7.2 **Recommendation**

According to this study, the following recommendations are forwarded:

- There is need for research along the whole Weybe valley to exhaust the species list in the area that can strengthen the status of endemism in Ethiopia. Research on the soil seed bank, population dynamics, biology and ecology of endemic species found in the area is recommended.
- The local indigenous knowledge on use of traditional medicine should be supported by plant chemistry test. This is necessary for the identification of active ingredients for the discovery of new drugs. There should be a link with other related institution like school of pharmacy for achievements of chemical test. The active participation of traditional healers particularly, in conservation of medicinal plants is necessary and important.
- Domestication of potential wild edible plants are highly recommended. Moreover, this should be supplemented by biochemical assay so as to identify the nutritive value of locally preferred wild edible plants like *Canthium setiflorum* and *Commiphora erythreae.*
- Ecotourism was found to be viable source of income. Therefore, there is need to develop and improve the physical infrastructure like hotels, lodges, roads, telecommunication and electrification. Modern beekeeping and gum- resin processing and marketing should be initiated in the area to improve income of local community.
- It is essential to create awareness among the local community about plant genetic resources utilization and conservation.
- Sof Umer is a very important area in terms of culture, religion and plant endemism, therefore, its inclusion in the protected areas' list of Ethiopia is suggested.

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9. APPENDICES

Appendix 1. The list of plant species from the Sof Umer area (T= tree, S= Shrub, H =Herb, P=parasitic & C= climber

Scientific name	**Family**	**Local name**	**Habit**
Abutilon figarianum Webb	Malvaceae	Balanbulaa	H
Abutilon fruticosum	Malvaceae	Gurbi horii	H
Acacia brevispica Harms.	Fabaceae	Hamaressa	T
Acacia bussie Harms ex Sjostedt	Fabaceae	Hallo	T
Acacia etbaica Schweinf.	Fabaceae	Halaqabessa	T
Acacia mellifera Benth.	Fabaceae	Bilalaa	T
Acacia nilotica (L.) Wild. ex.Del.	Fabaceae	Burquqee	T
Acacia oerfota (Forssk.) Schweinf.	Fabaceae	Ajo	S
Acacia robusta Burch.	Fabaceae	Wangayi	T
Acacia senegal (L) Wild.	Fabaceae	Saphansaa	S
Acacia seyal Del.	Fabaceae	Waacu	T
Acacia tortilis (Forssk.) Hayne	Fabaceae	Dhadacha	T
Achyranthes aspera L.	Amaranthaceae	Maxanee	H
Achyranthes sp.	Amaranthaceae	Maxanee haree	S
Achyrospermum schimperii (Hochst. Ex Brig.) perkins	Lamiaceae	Urgo haree	H
Acokanthera schimperii (A.DC.) Benth.	Apocynaceae	Qararu	S
Acalypha acrogyna Pax	Euphorbiaceae	Xirdho warabessa	H
Adiantum ineisum	Adiantaceae	Ferns	H
Agavae sisalana Perrine ex Engl.	Agavaceae	Ijiji	H
Albizia anthelmintica (A. Rich.) Brogn.	Fabaceae	Hawachoo	T
Albuca abyssinica Jacq.	Hyacinthaceae	Buri warabessa	H
* * *Allium sativum* L.	Alliaceae	Qulubi	H
Aloe citrina Carter & Brandham	Aloaceae	Hargisa Baru	H
Aloe trichsantha Berger	Aloaceae	Hargisa Guracha	H
Andropogon chinensis (Nees) Merr.	Acanthaceae	Shokoru gagura	S
Anemia aethiopica Pichi- serm	Schizaeaceae	Ferns	H
Asepaium erianthermum (Vatke) Marais	Cyclocheilaceae	Hilamsaa	S

Appendix 1 continued

Scientific name	**Family**	**Local name**	**Habit**
Asparagus africanus Lam.	Asparagaceae	Saritii	S
Aspilia mossambicensis (Oliv.) Wild.	Asteraceae	Hadha karara	S
Balanites aegyptiaca (L.) Del.	Balanitaceae	Baddana	T
Baphia sp.	Fabaceae	Gulgula adi	S
Barleria acanthoides Vahl	Acanthaceae	Jamariga	H
Barleria argentea Balf. f.	Acanthaceae	Jamariga	H
Barleria eranthemoides R.Br. ex DC. B.Cl.	Acanthaceae	Dhumuda	S
Barleria quadrispina Lindau	Acanthaceae	Balawarantii	H
Berchemia discolor (Klotzsch) Hemsl.	Rhamnaceae	Jajaaba	T
Bidens pilosa L	Asteraceae	Coogee	H
Blepharis maderaspatensis (L.) Roth	Acanthaceae	Yamaruka	H
Boscia angustifolia A. Rich.	Capparidaceae	Qalqalcha	S
Boscia senegalensis Lam.ex.Poiret	Capparidaceae	Qalqalcha	S
Boswellia microphylla Chiov.	Burseraceae	Muglo/Ixanaa	T
Boswellia neglecta S. Moore	Burseraceae	Muglo/Ixanaa	T
Bridelia cathartica Bertol. f.	Euphorbiaceae	Bacoo	S
Buxus hildebrandtii Bail.	Buxaceae	Gulgula guracha	S
Cadaba farinosa Forssk.	Capparidaceae	Megagaa	T
Cadaba longifolia DC.	Capparidaceae	Maramaa	S
Cadia purpurea (Picc.) Ait.	Fabaceae	Ceqataa	T
Calpurnia aurea (Ait) Benth.	Fabaceae	Hinjiree	T
Canthium setiflorum Hiern	Rubiaceae	Ladhana	T
* * *Capsicum frutescens* L.	Solanaceae	Miximix	H
Caralluma penicillata (Defl.) N. E. Br.	Asclepiadaceae	Halaku ajee	H
Caralluma priogonium K. Schum.	Asclepiadaceae	Hajoo/coogee	H
Cardiospermum halicarbum L	Sapindaceae	Sarii kurkurfa atura	C
* * *Carica papaya* L.	*Caricaceae*	Papaye	T
Carissa spinarum L.	Apocynaceae	Hagamisa	S
Carphalea glaucescens (Hiern) Verdc	Rubiaceae	Qardi	H

Scientific name	Family	Local name	Habit
Caucanthus auriculatus (Radlk) Nied	Malphigiaceae	Gadila lenqa	C
* * *Cicer arietinum* L.	Fabaceae	Shumbura	H
Cissus quadrangularis L.	Vitaceae	Cophii	C
Cissus rotundifolia (ForssK) Vahl	Vitaceae	Cophii broud leaved	C
* * *Citrus lemon* (L.) Brumf.	Rutaceae	Lomi	T
Cleome gynandra L	Capparidaceae	Caamardaa	H
Combretum aculeatum Vent	Combretaceae	Hurufoo/Keegno	S
Combretum molle R. Br.ex G.Don	Combretaceae	Birdhe Luko	T
Commelina imberbis Ehrenh ex Hassk	Commelinaceae	Qayoo	H
Commicarpus plumbagineus (Cav.) Steudl.	Nyctaginaceae	Sari muka	C
Commiphora africana (A. Rich.) Engl.	Burseraceae	Hamessa	T
Commiphora erythreae (Ehrenb.) Engl.	Burseraceae	Hagarsu	T
Commiphora monoica Vollesen	Burseraceae	Hadha gobee	T
Commiphora myrrha (Nees) Engl.	Burseraceae	Qunbi	T
Commiphora ogadensis Bar	Burseraceae	Dhiga	T
Commiphora samharensis Schewent.	Burseraceae	Qanqanaa	T
Commiphora schimperi (Berg) Engl.	Burseraceae	Hidaa	T
Commiphora terebinthina Vollesen	Burseraceae	Baksa Iyo	S
Corbichonia decumbens (Forssk) Execll	Mulluginaceae	Gale gara	C
Cordia crenata Delile	Boraginaceae	Mandhera	T
Crotalaria bogdaniana Polhill	Fabaceae	Ater(Unknown)	H
Cucumis dipsaceus Ehrenb. ex Spach	Cucurbitaceae	Hidii hololo / sari lafaa	C
Cussonia holstii Engl.	Araliaceae	Luqoo	T
Cynodon dactylon (L.) Piers.	Poaceae	Coqorsa	H
Cyperus dichostachyus A. Rich	Cyperaceae	Maxaa/ grass	H
Datura stramonium L	Solanaceae	Banji/ Hasangiraa	H
Dalbergia commiphoroides Bak. f.	Fabaceae	Calcala	S
Delonix elata (L) Gamble	Fabaceae	Shukelaa	T

Scientific name	Family	Local name	Habit
*Dichrostachys cinerea (*L) Weight. ex A.Rich.	Fabaceae	Jirimee	T
Diospyros abyssinica (Hiern) F. White	Ebenaceae	Looko	S
Diospyros mespiliformis A.DC.	Ebenaceae	Qolati B	T
Dombeya kirkii Mast.	Sterculiaceae	Silalicha	S
Dorstenia barnimiana Schweinf.	Moraceae	Morodee	H
Dorstenia foetida (Forssk.) Schweinf. subsp lancifolia (Rendle) Friis	Moraceae	Kurtee ree	H
Dracaena ellenbeckiana Engl.	Dracaenaceae	Yabaloo	S
Dracaena ombet Ktschy Pebritsch subsp. schizantha (Baker) Bos	Dracaenaceae	Harfatuu	T
Durantha erecta L.	Verbenaceae	Qaxe ree	S
Ecbolium viride (Forssk.) Alston.	Acanthaceae	Dhumuga Guracha	S
Ehretia cymosa Thonn.	Boraginaceae	Hulagaa	T
Eleusine indica (L.) Gaert.	Poaceae	Muja/ Grass	H
Entada abyssinica Stead. ex. A. Rich.	Fabaceae	Dhangaa galaa	C
Enteropogon macrostachyus (Hochst. ex A. Rich.) Benth.	Poaceae	Cita/Sula	H
Entrepogon desvauxii P. Beauv.	Poaceae	Muja/ Grass	H
Equisetum ramosissimum	Equistaceae	Cita	H
* * *Eragrostis tef* (Zucc.) Troteer	Poaceae	Tefi	H
Erythrina burana Chiov.	Fabaceae	Walena	T
Erythrochlamys spectabilis Gurke	Lamiaceae	Qaxatesa/xaxesa	S
Euclea divinorum Hiern	Ebenaceae	Miesa	S
****Euphorbia abyssinica* Gmel.	Euphorbiaceae	Adami	T
Euphorbia burgeri Boiss.	Euphorbiaceae	Ciiraa	H
Euphorbia longetuberculosa Hochst. ex Boiss.	Euphorbiaceae	Hokubkubii	H
Euphorbia nubic NE. Br.	Euphorbiaceae	Hanoo	S
Ficus exasperata Vahl	Moraceae	Leedi	T
Ficus ingens (Miq.) Miq.	Moraceae	Qilinixo	T

Scientific name	Family	Local name	Habit
Ficus sycomorus L.	Moraceae	Odda	T
Ficus thonningii Blume	Moraceae	Dambi	T
Ficus vasta Forssk.	Moraceae	Qilxuu	T
Grewia bicolor Jass	Tiliaceae	Haroresa	S
Grewia kakothamnos K. Schum.	Tiliaceae	Dheka	S
*Grewia tenax (*Forssk) Fiori	Tiliaceae	hurgesaa	S
Grewia villosa Wild.	Tiliaceae	Ogomdii	S
Gerwia erythraea Schweinf.	Tiliaceae	Qacalee	S
Gutenbergia somalensis (O.Hoffm.) M.Gilbert	Asteraceae	Gurbii gara	H
Haplocoelum foliolosum (Hiern.) Bullock	Sapindaceae	Canaa	T
Helinus mystacinus (Alt.) E. Mey.	Rhamnaceae	Sari muka	H
Heliotropium aegyptiacum Lehm.	Boraginaceae	Qorsaa /urgo mich	H
Helixanthera thomsoni Sprague	Loranthaceae	Dhertoo hallo	C
Hermannia paniculata F.Franch	Sterculiaceae	Dhigrii ree	S
Hibiscus ovalifolius (Forssk.) Vahl	Malvaceae	Hija lenqa	C
Hibsicus macranthus L.	Malvaceae	Balanbula	H
Hippocartea africana (Wild.) Loes.	Celasraceae	Adee	T
Hydnora johannis Schweinf.	Hydnoraceae	Xuqaa	P
* * * *Hagena abyssinica* (Bruce) J. F.Gmel.	Rosaceae	Anquu/ hexoo	T
Hypoesetes forskoalii (Vahl) Soland. ex Roem & Schultz	Acanthaceae	Herayaa	H
Ipomoea cicatricose (Bark.) Hall. F.	Convolvulaceae	Dhama ee	H
Ipomoea trifolia Forsk.	Convolvulaceae	Lokatoo	S
Indigofera amorphoides Jaub. & Spach	Fabaceae	Gurbi dhaga/Lafaa	H
Isoglossa parvifolia Rendle	Acanthaceae	Yalka	H
Justicia cordata (Nees) T. Anders			
Justicia rendlei C.B Clarke	Acanthaceae	Dhumuga	S

Scientific name	Family	Local name	Habit
		Guracha	
Justicia schimperiana (Hochst ex. Nees) T. Anders.	Acanthaceae	Dhumuga Guracha	S
Justicia flava (Vahl) Vahl.	Acanthaceae	Yamaruka	H
Kalanchoe lanceolata (Forssk.) Perr.	Crassulaceae	Bokonsa/Kontoma	H
Kanahia laniflora (Forssk.) R. Br.	Asclepiadaceae	Jida hanani	H
Lannea fruitcosa (Hochst. ex. A.Rich) Engl.	Simaroubaceae	Misdhugaa	T
Lannea malifolia (Chiov) Sac.	Anacardiaceae	Cilee	T
Lannea triphylla (A.Rich) Engl.	Anacardiaceae	Rogicha	T
Launaea intybacea (Jacq.) Beavuerd	Asteraceae	Adho	H
Leucas abyssinica Benth.	Lamiaceae	Hara/Hari	H
Leucas martinicensis (Jacq.) R. Br.	Lamiaceae	Harama	S
Maerua angolensis DC.	Capparidaceae	Jima Xilo	S
Maerua boranensis Chiov.	Capparidaceae	Jima xulloo C	S
Maytenus undata (Thunb.) Blakelock	Celasraceae	Gale	C
Megalochlamys linifolia (Lindau) Lindau	Acanthaceae	Jamariga	H
*Megalochlamys violacea (*Vahl) Vollesen	Acanthaceae	Higaji/ Dhigaji	H
Melhania eraemorsa Forrsk.	Sterculiaceae	Dhigiri gala	S
Mimusops kummel Bruece ex A. DC.	Sapotaceae	Qolati	T
Moringa rivae Chiov.	Moringaceae	Boyi	T
Maeria crossifolia Forssk.	Capparidaceae	Qaxe ree	S
* * *Nicotiana tabacum* L.	Solanaceae	Tobacoo	H
* * *Nigella sativum* L	Ranuculaceae	Abasuda	H
Ochna inermis (Forssk.) Schwtz. ex Penzig	Ochnaceae	Qadidaa	S
Ocimum forskolei Benth.	Lamiaceae	Urgo lonii	H
Ocimum lamifolium Benth.	Lamiaceae	Qoricha mich	H
Opuntia-f icus-indica L.	Cactaceae	Shonka/	S

Scientific name	Family	Local name	Habit
Panicum maximum Jacq.	Poaceae	Cita lonii	H
Parthenium hystrophorus L.	Asteraceae	Anamale	H
Pennisetum unisetum (Nees) Benth.	Poaceae	Cita Dafa	H
Phoenix reclinata Jacq.	Arecaceae	Meexi	T
Phyllanthus sepialis Muell. Ag.	Euphorbiaceae	Dhigirihola	S
****Phytolacca dodecandra* L.	Phytolaceae	Endodi	S
Plantago africana Verdc.	Plantaginaceae	Qortobi	H
Plectranthus otostegioides (Gurke) Ryding	Lamiaceae	Barbarisa	S
Plectranthus puberulentus J.H. Morton	Lamiaceae	Barbarisa	H
Plumbago zeylanica L.	Plumbaginaceae	Higaji/ Dhigaji	S
Pyrenacantha malvifolia Engl.	Icacinaceae	Burii/ buri gadamisa	C
Rhoicissus tridentata (L.f.) Wild. & Drummond.	Vitaceae	Laluu	C
Rhus natalensis Krauss	Anacardiaceae	Dabobesaa	T
Rhus vulgaris Meikle	Anacardiaceae	Karuu	T
Ricinus communis L.	Euphorbiaceae	Qobo	S
Ruellia discifolia Oliv.	Acanthaceae	Dhala dimma	H
Ruellia patula Jacq.	Acanthaceae	Shokoru ree	H
Ruspolia hypocreteriformis (Vahl) Mine-Redh	Acanthaceae	Dhumuga adii	S
Salvadora persica L.	Salvadoraceae	Ade kulo	S
Schoenoplectus maritimus (L.) Lye	Cyperaceae	Cafaa	H
Schrebera alata (Hochst.) Wel. W.	Oleaceae	Karuu	T
Sclerocarya birrea (A.Rich.) Hochst.	Anacardiaceae	Bubayoo	T
Secamone parvifolia (Oliv.) Bullock	Asclepiadaceae	Sari muka A	C
Selaginella yemensis (Sw.) Spring.	Selaginellaceae	Gurbii dhaga	H
Senna occidentalis (L.) Link	Fabaceae		S
Senna didymobotrya (Fresen) Irwin & Barneby	Fabaceae	Dholdholesa	T
Sesamothamnus rivae Engl.	Pedaliaceae	Gorora	T

Scientific name	Family	Local name	Habit
Sesamum indicum L.	Asteraceae	Saliti	H
Sida ovata Forssk	Malvaceae	Balanbulaa	H
Solanium tettense klotsch	Solanaceae	Hidi buda	H
Solanum hastifolium Hochst ex Dunal	Solanaceae	Hidi buda	H
Solanum incanum L.	Solanaceae	Hidi lonii	H
Sorgum bicolor L.	Poaceae	Mishingaa	H
Sterculia stenocarpa H. Winkler	Sterculiaceae	Qarari	S
Syzygium guineense DC.	Myrtaceae	Gosuu	T
Tagetes minuta L.	Asteraceae	Ajee	H
Termminalia sp.	Combretaceae	Digdigsaa	S
Terminalia brevipes Pampanini	Combretaceae	Liqimee	S
Terminalia brownii Fresen.	Combretaceae	Birdhesa	T
Terminalia prunioides Laws	Combretaceae	Hererii	T
*Tetrapogon ferrugineus (*Revoize) S.M Phillips	Poaceae	Cita Gadamisaa	H
Tragia mixtam Gilbert	Euphorbiaceae	Lalesa/ Dobii	H
* * *Trigonella foenum-graecum* L.	Fabaceae	Abishi	H
Vernonia adoensis Sch. Bip.ex Walp	Asteraceae	Shukumii	S
Withania somnifera (L) Dunal	Solanaceae	Unzoo/Hunzo	S
Xanthium strumarium L.	Asteraceae	Habdulakim	H
Xerophyta schnizeinia (Hochst) Baker	Velloziaceae	Dhurbo	H
* * *Zea mays* L.	Poaceae	Boqoloo	H
Zinnia elegans L	Asteraceae	Pipi	H
Zyzyphus spina- christi (L.) Dest.	Rhamnaceae	Quriqura	T

Note: * * = cultivated plants and

*** = those plants included for Ethnobotanical information, they collected near by areas

Appendix 2. List of medicinal plants used for human diseases (C= climber, H= herb, P = parasitic, S= shrub, T= tree)

Scientific Name	Local name	Growth form	Ailment	Mechanism of application
Salvadora persica	Ade kulo	S	Ringworm	The root is pounded and mixed with edib make paste. The paste is applied to the area for three days and exposed to sunligh
			Gum disease	The root is used to brush teeth and gums
Balanites aegyptiaca	Baddana	T	Ring worm	Leaf is pounded and juice applied on the s
Commiphora terebinthina	Baksa Iyo	S	Wound/ Scrabies ' Citoo'	The latex is dropped on the wound and ap ointment
Barleria quadrispina	Balawarantii	H	Tooth ache	The root is ground and taken with milk
Cissus quadrangularis	Cophii	C	Ringworm	Leaf is burned and the ash rubbed on the s
			Lymphadopathy 'Xandhachaa'	Stem and leaf ground and applied as ointm
Acacia tortilis	Dhadacha	T	Trachoma	Small amount of latex is dropped into the
			Ear ache	Small amount of latex is dropped inside th
Ipomea cicatricosa	Dhama ee	H	Gonorrhea	The root is boiled with coffee and tak goat's milk
Xanthium strumarium	Habdulakim	H	Ringworm	The leaf juice is rubbed on the infected are
Carissa spinarum	Hagamisa	S	Evil sprit "Gini lafa"	The smoke of the root is inhaled / the ground and the body bathed to avoid relap
			Blood pressure "Sardamaa"	The root is chewed and the juice swallowe
Commiphora erythreae	Hagarsu /Habaqorto/	T	Common cold	Inhaling the smoke of the resine

			Head ache	Fumigate the root and the stem
			Stomach ache	The gum is chewed
			Ascariasis	
Euphorbia nubica	Hanoo	S	Liver disease	A small drop of latex is taken with wat causes serious vomiting so excess water taken afterwards
Aloe trichosantha	Hargisa Guracha	H	Malaria	Small drop of latex is taken with honey
			Stomach ache "illikee"	
			Gonorrhea	
			Sexual impotence in man	
Aloe citrina	Hargisa baru	H	Swollen foot	Latex is applied as ointment for three days
Albizia anthelmintica	Hawachoo	T	General health problem	Root without bark is boiled with meat c and the soup is drunk. Only the fluid is ta plant itself is poisonous.
			Liver disease "Adhofitu"	
			Helminths of the stomach	
			Gonorrhea	
			Ascariasis	
Solanum hastifolium	Hidi buda	H	Evil sprit	The root minus the bark is ground and mi butter. The cream is used to wash the b three days
			Achne "Biguri"	
			Skin allergies	

Solanum incanum	Hidi lonii	H	Nasal bleeding	The leaf juice is taken by sniffing
			Wound	The leaf juice is applied to the wound or
			Tooth ache	Root is chewed to kill germ
Plumbago zeylanica	Iigaji/ Dhigaji	H	Lliver and spleen disease	The root is ground and a pinch of the pc taken with milk. Afterwards goat's milk is
			Abortion	Moistened root is chewed and the juice sw
			Helminths	A small quantity of root is boiled with n the meat eaten
Asepaium eriantherum	Hilamisaa	S	Tooth ache	The root is chewed and the juice is swallo
Euphorbia longetuberculosa	Hokubkubii	H	Gonorrhea	The fleshy stem is boiled with tea, coffee and the soup is taken orally.
			Abdominal pain after labour	
			Any stomach ache	
			Amoebiasis /Qorsa Dubardha/	
Kanahia laniflora	Jida hanani	H	Jinii/ evil spirit	The root is ground and taken with milk. It sprayer with Quran
			Foot paralysis	The foot is washed and the leaf juice is ap an ointment. The foot is then covered wi overnight. This is repeated for three days, by applyi leaf juice every night.
			Swelling of the foot	
Dorstenia foetida	Kurtee ree	H	General body pain	The fleshy stem is chewed and th swallowed. Alternatively, the stem is boi coffee and taken with edible fruit or milk
			Stomach pain	
			Gonorrhea	
			Diarrhea	
			Blood pressure	
Ficus exparata	Leedi	T	Menstruation problem	Root is boiled with coffee and taken orall
Achyranthes aspera	Maxanee	H	Rhaniti or Sinusitis	The inflorescence is covered by cloth and

			"sonbori"	inside the nose. Bleeding will give relief.
Lannea fruitcosa	Misdhuga	T	Common cold	The smoke of the stem inhaled
			Asthma 'xixaa'	The leaf is crushed with water and the jui by sniffing
Heliotropium aegyptiacum	Qorsaa mich/ Urgo mich/	H	Fibrile illness	The juice of leaf is rubbed on the skin.
			Sun burn	Women mix the leaf juice with butter an their heads to avoid sun burn
Commiphora myrrha	Karbee/ Qunbi	T	Allergies	The leaf is chewed and the juice sprayed / spat/ on the affected skin
			Sore/ wound	
			Stomach ache	The root is chewed and the juice swallowe
			Snake repellent	Smoke is repellent to the snake
			Snake bite	Resine is chewed and swallowed
			Zoster infection "Almazee"	Resine is applied as ointment
			Evil eye ' Buda'	The smoke of resine is inhaled
Zyzyphus spina-christi	Quriqura	T	Long term pain	The leaf is boiled and water used for bath
Withania somnifera	Unzoo/Hun zo	S	Headache	The smoke of the root inhaled
			Sleeplessness or night mare' of children	
			Partial paralysis	The whole plant parts crushed and ap ointment
Hydnora johannis	Xuqa/ tuqa	P	Loss of appetite	Root is eaten for good health
			Lung cancer	Leaf is boiled in water and taken with hon
			Breast cancer	
			Intestinal disease	
			Under weight	
Ehretia cymosa	Hulagaa	T	Mich/ fibrils illness/	Inhaling the smoke of the stem
			Evil eye "Buda"	Seed is tied on the neck to avoid infection
				buda
			Relapse " Afraa"	Leaf smoke is inhaled by covering the

			General health problem	cloth and the body is washed by leaf juice
Agave sisalana	Ijiji	H	Any skin bleeding	Leaf juice is added on the wound. It anticoagulant
Nicotiana tabacum	Tobacoo	H	Snake bite	The leaf is chewed and the juice swallowe
			Repellent	Smoke is repellents to snake
Mauerua crossifolia	Qaxe ree	S	Liver and stomach cancer	The root is boiled and taken with coffee
Kalanchoe lanceolata	Bosoqala/ kontoma	H	Tooth ache	The root is chewed and juice swallowed tl any worm associated with the teeth
Hagena abyssinica	Anquu/ hexoo	T	Conspitation	The flower is ground, mixed with water a orally
Allium sativum	Qulubi	H	Common cold	Boiled and taken with milk
Citrus lemon	Lomii	T	Dermatophyte 'Forophor'	Fruit juice is used as cream ointment
Achyrospermum schimperii	Urgo haree	H	Mich	Leaf is squeezed on palm and the juice is
Mimusops kummel	Qolati/Qolat icha	T	Lung cancer	The root is ground and small quantity tak water
Euphorbia abyssinica	Adami anani	T	Ascaris	The root is ground and mixed with wa drank
			Giardiasis	
Cadia purpurea	Ceqata	T	Sore	Leaf is crushed and taken with milk
			Abortion	
			Amoebiasis	
			Giardiasis	
Phytolacca dodecandra	Endod	S	Athelet foot	The foot is washed with leaf juice
			abortion	Root is pound and drunk
Datura stramonium	Banji	H	Depression	The seed is ground and smoked or mix butter and put on head

Moringa rivae	Boyi	T	Lung cancer	The root is ground and taken with honey
Plectranthus puberulentus	Barbarisa	H	Bleeding	Leaf juice is applied on affected body
Albuca abyssinica	Buri warabessa	H	Elephantiasis	Root ground and cream ointment on foot
Carica papaya	Papaye	T	Diarrhea	Seed ground and boiled with coffee an with honey
			Ascaris	
			liver disease	
			Cholera	
			Snake bite	
			Swelling of foot	

Appendix 3. List of plants used for Ethno-veterinary

Scientific & Family name	Local name	Growth form	Disease/ailment	Mechanism of application	part used
Acacia mellifera	Bilalaa	T	Thinning disease "Jokisa	Root is ground and mixed with water and given oral	root
			Stimulate pregnancy in goat		
			eye illness	Juice of the leaf dropped inside the eye	leaf
Kalanchoe lanceolata	Bokonsa / Kontoma bosoqola	H	Sore on neck of ox	Leaf juice is rubbed on area of affect neck.	leaf
			Swollen neck	Leaf is warmed and rubbed on the neck	
Moringa rivae	Boyi	T	Antigerm	Root is ground and mixed with water and oral given. It has fattening effect.	root
			Coughing 'Jokisa'		
			Any lung disease		
			Worm		
			Stomach ache		
Pyrenacantha malvifolia	Burii	C	"Qalicha" kill cattle immediately/aba gorba	Ground root and mix with water and given oral	root
Sesamothamnus rivae	Gorora	T	Swollen stomach	Leaves are pounded, mix with water and oral given	leaf
Caralluma penicillata	Halaku ajee	H	Bolka/dhula/ boils	Latex is applied as ointment on affected part	latex

Aloe trichosantha	Hargisa Guracha	H	Stomach ach of camel	Latex is mixed with water and given orally	latex
Solanum incanum	Hidi lonii	H	Bleeding due to fire accident	Root is ground and added on sore	root
			itching	Seed is ground, mixed with water and bathed the body and applied as ointment	seed
Cucumis dipisaceas	Hidii hololo/ sari lafaa	C	Buka/ dodo/ boils	Root is pound and given orally	
Rhoicissus tridentata	Laluu	C	Sore/wound by hyena	Root is pounded, mixed with water, rubbed and applied as ointment on sore	root
			Retention of placenta	Root is pounded, mixed with water and given orally. It facilitates labor	
Mauerua crassifolia	Qaxe ree	S	Liver disease/fluke	Root is pounded, mixed with water and orally given	root
Delonix elata	Shukelaa	C	Skin disease	Leaf is crushed and rubbed on the skin	leaf
Dombeya kirkii	Silalicha	S	Ascariasis	Leaf is ground and orally given	leaf
Cissus quadrangularis	Coppi	C	Bulka/ dodo'oo/ boils	Fruit is boiled and rubbed on infected body part	fruit
			Insect infestation	Stem and leaf is chopped put inside	
Moringa rivae	Boyii	T	Swollen stomach	Root is pounded and mixed with tiquri asmudi Shunta, root of dabobesa, edible oil and the soup given orally.	root

Capsicum frutescens	Miximixa a	H	Skin disease due to anthropoids	Leaf is pounded and the skin washed.	leaf
Acacia etbaica	Hajo	T	Insect infestation	Leaf is fumigated inside the house. The smoke is insect repellent.	leaf
Nigella sativum *Grewia villosa*	Abasuda Ogomidi	H S	Swollen stomach Sore of neck of ox	The seed is ground and mixed with edible oil and orally given Leaf is crushed and tied on the wound on the neck of ox	seed leaf
Euphorbia burgeri	Ciiraa	S	Swelling/bulka/	Milk juice is applied on swollen body part	latex
Caralluma priogonium	Ajo	H	Sore due nematodes	Small amount of milky latex is dropped on the sore	latex
Hydnora johannis	Xuqa	P	Swollen breast	Soil from 7 spot near *Hydnora abyssinica* was taken, mixed with water and breast washed for three days	root

Appendix 4. List of plant species foraged by livestock in the study area.

Scientific name	Growth form	Local name	kind of animal browse and graze
Abutilon fruticosum	H	Gurbi horii	Cattle & camel
Acacia brevispica	T	Hamaressa	Camel & goat
Acacia mellifera	T	Bilalaa	Camel & goat
Acacia nilotica	T	Burquqee	Goat
Acacia senegal	S	Saphansaa	Camel & goat
Acacia seyal	T	Waacu	Goat & camel
Acacia tortilis	T	Dhadacha	Camel & goat
Achyrospermum schimperii	H	Urgo haree	Donkey

Pennisetum unisetum	H	Cita daafa	Cattle
Balanites aegyptiaca	T	Baddana	Camel & goat
Barleria quadrispina	H	Balawarantii	Camel
Boscia mossambicensis	S	Qalqalcha	Donkey
Cadaba farinosa	T	Megagaa	Camel
Cadia purpurea	T	Ceekata	Camel &goat
Calpurnia aurea	T	Injeree	Camel &goat
Combretum aculeatum	S	Hurufoo	Goat, camel & cattle
Commelina imberbis	H	Qayo	Cattle, camel & goat
Commiphora ogadensis	T	Dhiga	Camel & goat
Comphora erythreae	T	Hagarsu	Cattle
Cussonia holstii	T	Luqoo	Goat
Dalbergia commiphoroides	T	Calcala	Camel
Dichrostachys cinerea	T	Jirimee	Camel& goat
Dombeya kirkii	S	Silalicha	Cattle, goat & cattle
Dracaena ellenbeckiana	S	Yabaloo	Cattle
Eleusine indica	H	Muja/ Grass	Cattle
Entada abyssinica	C	Dhangaa galaa	Camel & goat
Enteropogon macrostachyus	H	Cita/sula	Cattle
Entrepogon desvauxii	H	Muja/ Grass	Cattle
Erythrochlamys spectabilis	S	Qaxatesa/xaxesa	Goat
Euclea divinorum	S	Miesa	Camel & goat
Grewia bicolor	T	Haroresa	Camel, goat & cattle
Grewia kakothamnos	T	Dheka	Camel, goat & cattle
Grewia tenax	S	Hurgesaa	Cattle
Hermannia paniculata	S	Dhigrii ree	Camel & goat
Hypoesetes forskaleii	H	Herayaa	Cattle
Ipomoea trifolia	S	Lokatoo	Camel
Isoglossa parvifolia	H	Yalka	Goat & camel
Lannea fruticosa	T	Misdhugaa	Camel & goat
Baphia sp.	S	Qaxe ree	Goat & camel
Ochna inermis	T	Qadidaa	Goat & camel
Opuntia ficus- indica	S	Shonka	Camel
Panicum maximum	H	Cita lonii	Cattle

Rhus natalensis	S	Dabobesa	Camel & goat
Rhus vulgaris	S	Karuu	Goat & camel
Ruellia discifolia	H	Dhala dimaa	Cattle
Ruellia patula	H	Shokoru ree	Cattle, goat & camel
Ruspolia hypocrateriforms	S	Dhumuga adii	Camel, goat & cattle
Tagetes minuta	H	Ajee	Donkey
Terminalia brevipes	S	Liqimee	Camel & goat
Terminalia prunioides	T	Hererii	Goat & camel
Tetrapogon ferrugineus	H	Cita Gadamisaa	Cattle
Vernonia adoensis	S	Shukumii	Cattle, goat & camel

Appendix 5. List plants with traditional material uses.

Scientific name	*Traditional use*
Acacia brevispica	*Pole and side wall*
Acacia bussie	*Pole, bark for fiber and to make saddle*
Acacia mellifera	*Farming implements*
Acacia senegal	*Dry fence*
Acacia seyal	*Dry fence and farm implement*
Acacia tortilis	*Household furniture "Gabataa"*
Acokanthera schimperi	*To produce; milking material/coocoo, bell for camel "Dawalaa"*
Pennisetum unisetum	*Thatching*
Asparagus africanus	*1 writing material for learning Quran*
Balanites aegyptiaca	*Farming implements*
Calpurnia aurea	*Roof*
Canthium setiflorum	*Shuttle and dry fence*
Baphia sp.	*Pole and side wall of house*
Combretum aculeatum	*Dry fence and pole*
Combretum molle	*Pole of the house*
Commiphora africana	*Dry fence*
Cordia creneta Delines	*Dry fence*

Dalbergia commiphoroides	*To make stool, "Xiloo" traditionally it is used to carry fragile material and to make bed.*
Delonix elata	*Dry fence, mortar and furniture "Gabataa"*
Diospyros abyssinica	*Pole ''Hutubaa''*
Dombeya kirkii	*Shuttle and sidewall*
Erythrina burana	*Traditional stool for marriage day, to produce "Dibee", Qudi for milking, "Fulii" used for fetching water.*
Euclea divinorum	*Pole*
Grewia bicolor	*Pole & sidewall*
Grewia kakothamnos	*Shuttle/Magari*
Justicia schimperiana	*to make bed*
Lannea fruticosa	*Door*
Lannea triphylla	*Plat or board to write on and*
Melhania eraemorsa	*Pole for roof 'mari'*
Panicum maximum	*Thatching*
Ruspolia hypocrateriforms	*Shuttle/Magari*
Terminalia prunioides	*Pole "Kanchi"*

Appendix 6. Density and frequency of tree species having DBH> 2cm.

Species name	Indi/viduals/ hectar	Percentage	Frequenc y
Acacia brevispica	18.8	3.0	26.9
Acacia bussie	23.1	3.7	32.7
Acacia etbaica	0.5	0.1	1.9
Acacia mellifera	53.4	8.6	53.8
Acacia nilotica	1.9	0.3	7.7
Acacia tortilis	4.3	0.7	5.8
Albizia anthelmintica	1.0	0.2	1.9
Balanites aegyptiaca	1.0	0.2	3.8

Berchemia discolor	2.4	0.4	3.8
Boswelia neglecta	29.3	4.7	13.5
Cadia purpurea	9.1	1.5	9.6
Canthium setiflorum	51.4	8.3	30.8
Combretum molle	7.2	1.2	13.5
Commiphora monoica	7.2	1.2	17.3
Commiphora ogadensis	8.7	1.4	21.2
Commiphora samharensis	89.9	14.5	28.8
Commiphora schimperi	1.9	0.3	3.8
Commiphora terebinthina	13.5	2.2	36.5
Commiphora erythreae	95.2	15.4	78.8
Cussonia holstii	3.8	0.6	9.6
Delonix elata	1.0	0.2	3.8
Dichrostachys cinerea	7.2	1.2	13.5
Diospyros mespiliform	0.5	0.1	1.9
Dracaena ombet	1.0	0.2	1.9
Ficus exparata	0.5	0.1	1.9
Ficus thonningii	1.0	0.2	1.9
Ficus vasta	2.4	0.4	5.8
Grewia bicolor	33.7	5.4	23.1
Haplocoelum foliolosum	21.2	3.4	36.5
Lannea fruticosa	23.1	3.7	1.9
Lannea malifolia	1.0	0.2	1.9
Lannea triphylla	13.9	2.3	34.6
Ochna inermis	4.8	0.8	11.5
Rhus natalensis	1.4	0.2	17.3
Schrebera alata	4.3	0.7	11.5
Sclerocarya birrea	20.7	3.3	3.8
Sesamothamnus rivae	13.5	2.2	23.1
Terminalia brownii	0.5	0.1	1.9

Terminalia prunioides	42.3	6.8	46.2
Zyzyphus spina-christi	1.9	0.3	1.9
Total trees density.	619.2	100.0	

Appendix 7. List of informants

code	Name of informants	Sex	Age	Martial status	Educational level	Address
1	Hussen Qorcho	M	48	married	6	Robe 02
2	Mohammed Gabi	M	38	married	8	Goro 01
3	Aman Mohammed Ali	M	20	single	5	Urgo
4	Abduli Mohammed	M	23	married	5	Sof Umer
5	Yasin Ali Guracha	M	27	married	7	Dibe Mole
6	Seid Abdi	M	32	married	6	Sof Umer
7	Abduliqadir Abdubaker	M	32	married	6	Sof Umer
8	Ahimmed Nur Kedir	M	32	married	6	Sof Umer
9	Mohammed Mami Mole	M	25	married	9	Dibe Mole

10	Rashid Mohammed	M	40	married	4	Sof Umer
11	Jamel Adam Ibrehim	M	46	married	0	Urgo
12	Sofiya Abdi	F	30	married	2	Duski
13	Hussen Boru	M	55	married	0	Duski
14	Johar Mohammed Mole	M	31	single	12+2	Sof Umer
15	Sheki Inderis Liban	M	44	married	0	Goba 04
16	Zeniba Kadiri	F	38	married	0	Goro 01
17	Jemila Ismeal	M	20	single	10 +1	Malkabuta
18	Tusadin Alindube	M	16	single	5	Duski
19	Yebayi Badiru Waqo	M	15	single	6	Arda Oru
20	Mohammed Abdurhamin Husman	M	14	single	6	Oddaa Didibisaa
21	Beyan Umer Ahmad	M	13	single	6	Duskii
22	Sulitan Umer	M	15	single	5	Sof Umer
23	Johar Mohammed	M	14	single	6	Sof Umer
24	Abdulayi Umer Roba	M	15	single	6	Magalo
25	Nahima Mohammed Ali	F	13	single	5	Sof Umer
26	Kedija Sheki Ibrahim	F	14	single	6	Sof Umer
27	Yasin Osman Roba	M	16	single	5	Duski
28	Desu Abbo	F	15	single	4	Garii
29	Abasii Haga Roba	M	50	married	3	Arda Oru
30	Abduraman Adam Abdullahi	M	16	single	5	Megalo Sarbo
31	Hibro Abakar Humayi	m	52	married	0	Sof Umer
32	Halima Haji Ibrahim	F	22	single	10	Sof Umer
33	Abdul Jabari Shei Ahimed Mame	m	35	married	6	Sof Umer
34	Bidiru Ali	m	45	married	0	Sof Umer
35	Shukuri Mamad	m	40	married	0	Sof Umer

Appendix 8. Items for semi structured interview

Information about informant (name, sex, age, martial status, educational level & specific location)

1. Mention the name of useful plants that you know growing in your area
2. For what purpose do you use plants in your area?
3. What kind of crops are growing in your village? In homegardan? On farmland?
4. Mention the names of wild edible plants you know.
   4.1. When do you get the plants?
   4.2. Which age group consume?
   4.3. What is the reason of consumption?
   4.4. Which part do you eat?
5. Mention medicinal plant used in your area :
   5.1. For human ailment/ part used indicate mechanism of preparation and application
   5.2. For ailment of livestock/ part used indicate mechanism of preparation and application
   5.3. From where do you get? How do collect?
   5.4. Indicate if there is any taboo related to use and collection of medicnal plants
6. Mention plant species used for:
   6.1. Fire wood
   6.2. Charcoal
   6.3. Construction purpose
   6.4. Cultural material
   6.5. Livestock forage
   6.6. Cultural and religious importance
   6.7. Multipurpose tree
   6.8. Indicates plants for any other uses
7. What are threats on useful plant species in your area? Which species are threatened?
8. How do you conserve plant species in your area?

   _____

9. Is there any conservation activity in your area?
   9.1. By community?
   9.2. By government?

Appendix 9. Ethinobatanical Market survey

Date_____

1. Location of the Market _____
2. Information on vendor (Name, age, location)
3. Do you have other source of income? Yes No
4. Information on the collection
    a. Local name: _____
    b. Origin/source;_____
    c. Cultivation status: Cultivate wild
    d. Number of species in collection: single mixture of ____ plants
    e. Condition of plants: fresh dried
    f. Availability: month _____
    g. Any change on availability. If any, why?
    h. Is there any over exploitation?
    i. Any conservation _____
    j. Any traditional beliefs used for conservation
5. Use._____ Part used _____ preparation. _____
6. Additional information _____

DECLARATION

This Thesis is my own original work, the Thesis has not been presented for Degree in any University; all sources of material used for the Thesis have been duly acknowledged.

Candidate

Name: NEGUSSE TADESSE Signature_____