

**ETHNOBOTANICAL STUDY OF MEDICINAL PLANTS USED  
BY PEOPLE OF GOG DISTRICT, AGNUAK ZONE, GAMBELLA  
REGIONAL STATE, ETHIOPIA**

**MSc. THESIS**

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Final approval and acceptance of the thesis is contingent upon the submission of its final copy to the council of graduate studies (SGS) through the candidate’s department or school graduate committee (DGC or SGC).

## **DEDICATION**

I dedicate this Thesis manuscript to my beloved parents who sacrificed a lot to bring me up to this level through their advice, financial support and for their dedicated partnership in success of my life.

## STATEMENT OF THE AUTHOR

By my signature below, I declare and affirm that this Thesis is my own work. I have followed all ethical and technical principles of scholarship in preparation, data collection, data analysis and completion of this Thesis. Any scholarly matter that is included in the Thesis has been given recognition through citation.

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## **BIOGRAPHICAL SKETCH**

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## **ACRONYMS AND ABBREVIATIONS**

EMP	Ethiopian Mapping Agency
FL	Fidelity Level
GDAO	Gog District Agricultural Office
ICF	Informant Consensus Factor
WHO	World Health Organization

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# **Ethnobotanical Study of Medicinal Plants Used By People of Gog District, Agnuak Zone, Gambella Regional State, Ethiopia**

## **ABSTRACT**

*Ethnobotanical study of medicinal plants was conducted to document the indigenous knowledge in Gog District, Agnuak Zone, Gambella Regional State, South Western Ethiopia. A total of 74 informants (age $\geq$ 25) were selected to collect information on medicinal plant use from five sampled Kebeles. Of these, 14 key informants were selected purposively based on recommendation by local elders and authorities. The rest were selected randomly. Data were collected using semi-structured interviews, field observations and group discussions. Informant consensus factor (ICF) and fidelity level were calculated to assess the agreement of informants on the medicinal value of plants. A total of 67 medicinal plant species distributed in 34 families were collected and identified. All of the, 67 species were used against human ailments. From the total medicinal plant species, 23(34.37%) were herbs, followed by 20(31.25%) species of tree, 16(23.89%) species of shrubs, 6(9.37%) species of climber and 2(2.43%) species of succulent. The most frequently used plant part was root 27(29.03%) followed by leaves 24(24.73%), seeds 12(12.90%) and bark 5(5.37%). The most widely used remedy application ways were chewing, crushing and pounding of the different plant parts. The common route of administration recorded was oral 67(77.01%) followed by dermal 18(20.69%) and nasal 2(2.29%). Disease categories such as jaundice, kidney, liver, blood and cardiovascular problem, sensorial problem, febrile and fever, dental problem, dermatological problem, gastrointestinal problem, snake bite and poisoning had higher ICF values, suggesting high incidence of these diseases in the study area and agreement of people on their remedies.*

**Key words:** Ethnobotany, indigenous knowledge, informant consensus factor, Gog district, Traditional medicinal plants,

## 1. INTRODUCTION

Ethnobotany is a broad term referring to the study of direct interrelations between humans and plants (Martin, 1995; Balick and Cox, 1996). The indispensable dependency of humans on plants for their livelihood was primarily started by domestication and dates back 10,000 years (Martin, 1995). From plants, humans can obtain food, pesticides, medicines, fuel, fodder, construction materials, tools, and derives aesthetic and spiritual requirements. Thus, indigenous knowledge of plants was in existence when humans started and learned how to use plants (Posey, 1999). Over centuries, indigenous people have developed their own locality specific knowledge on plant use, management and conservation (Cotton, 1996).

Indigenous knowledge refers to the accumulation of knowledge, rule, standards, skills, and mental sets, which are possessed by local people in a particular area (Quanash, 1998). One of the widely used indigenous knowledge system in many countries is the knowledge and application of traditional medicine. Such knowledge, known as ethnomedicinal knowledge involves traditional diagnosis, collection of raw materials, preparation of remedies and its prescription to the patients (Farnsworth, 1994). Indigenous knowledge on remedies in many countries including Ethiopia, pass from one generation to the other generation verbally with great secrecy (Jansen, 1981). Traditional use of medicine is recognized as a way to learn about potential future medicines. Researchers have identified number of compounds used in mainstream medicine which were derived from “ethnomedical” plant sources (Fabricant and Farnsworth, 2001). Plants are used medicinally in different countries and are a source of many potent and powerful drugs (Srivastava, *et al.*, 1996; Mahesh and Sathish, 2008).

The medicinal plant of Ethiopia and the developing countries play major supplementary roles to the limited modern health care available. The development of useful and widely used drugs like Digoxin and Digitoxin, from *Digitalis* leaves; quinine from the cinchona bark; reserpine from *Rauwolfia Imeticline*; morphine from *Papaver somniferum*; cocaine from *Erythroxzion coca* and the anti-cancer *Vincristine* and *Vinblastine* from *Cartharathus troseus* of Madagascar and again anti-cancer agents

compound, bruceatin, from the Ethiopian plant, *Bruceaanti dysentrica*, just to name a few, are examples of the contributions of traditional pharmacopoeia (Desta, 1984). One thousand identified medicinal plant species are reported in the Ethiopian Flora, however, many others remain to be identified. About 300 of these species are frequently mentioned in many literatures. High concentrations of medicinal plants are found in the south and south western parts of Ethiopia following the concentration of biological and cultural diversities (Edwards, 2001).

Though there are some studies undertaken on medicinal plants from different corners and ecosystems of Ethiopia, much remains to be covered so as to maximize their utilization and set out conservation plan to save them and related indigenous knowledge (Debella, 2001). One such area where there were no any ethnobotanical studies conducted in Ethiopian is Gog District of Agnuak Zone, Gambella Region, Ethiopia. This necessitated us to embark on this study so as to undertake ethnobotanical investigation in the district with the following general and specific objectives.

### **General Objective**

- To conduct ethnobotanical study on medicinal plants of Gog district, Gambella regional state

### **Specific Objectives**

- To collect traditional medicinal plants that are used by people of Gog district, Gambella region
- To identify medicinal plant part (s) used, methods of preparation and ways of administration in the study area
- To document traditional medicinal plants that are used by people of Gog district

## **2. LITERATURE REVIEW**

### **2.1. Origin and Development of Ethnobotany**

Traditionally, people around the world possess unique knowledge of plant resources on which they depend for food, medicine and general utility including tremendous botanical expertise (Martin, 1995). This implies that humans are dependent on other organisms for their life. Although various animal and mineral products contribute to human welfare, the plant kingdom is most essential to human wellbeing especially in supplying his basic needs. This close interaction and dependency of humans on plants is studied under the field of ethno-botany. It is difficult to tell exactly when the term ethno-botany became part of modern science. However, it can be traced back to the time when humans started making conscious interaction with plants and animals. Ethno-botanical work seems to have started with Christopher Columbus in 1492, at a time when he brought tobacco, maize, spices and other useful plants to Europe from Cuba (Cotton, 1996) and when other immigrants from the new world documented food, medicine and other useful plants of the Aztec, Maya and Inca peoples (Martin, 1995).

John Hershberger proposed the term ethnobotany for the first time in 1895 (Balick, 1996). However, this term has been given different interpretations and definitions depending on the interest of workers involved in the study (Cotton, 1996). Hershberger (1896; cited in Cotton, 1996), defined ethnobotany as the study of the use of plants by original peoples. Martin (1995) defined ethnobotany as a study of people's classification, management and use of plants. In 1941, Shultes redefined ethnobotany as the study of the relationship, which exists between humans and their ambient vegetation (Castetter, 1944; cited in Cotton, 1996). Bye (1985) stated ethnobotany as a science that investigates the biological (including the ecological) basis of interaction and relationship between plants and people over evolutionary time and geological space. Ethnobotanical investigation documents the knowledge on cultural interaction of people with plants. It also tries to find out how local people have traditionally used plants for various purposes, and how they incorporated plants in to their cultural tradition and religions (Balick and Cox,

1996). Therefore, traditional local communities worldwide have a great deal of knowledge about native plants on which they intimately depend (Langeheim and Thimann, 1982).

As stated by Martin (1995) to achieve more detailed and reliable information of plants and plant use, ethnobotanical study needs involvement of specialists from various disciplines, such as plant taxonomists, plant ecologists, anthropologists, linguists, economic botanists, pharmacologists and others. With such interdisciplinary and multidisciplinary approaches, ethnobotany is aimed at gathering and documenting indigenous botanical knowledge, cultural practice, use and management of botanical resources and discovers benefits from plants.

## **2.2. Indigenous Knowledge**

Indigenous knowledge refers to the accumulation of knowledge, rule, standards, skills, and mental sets, which are possessed by local people in a particular area (Quanash, 1998). The immediate and intimate dependency of local people on natural resources resulted in the accumulation of indigenous knowledge that helped people to adapt and survive in the environments in which they live. It is local knowledge that is unique to a given culture or society and the base for agriculture, health care, food preparation, education, environmental conservation and a host of other activities (Thomas, 1995). The complex knowledge, beliefs and practices generally known as indigenous knowledge develops and changes with time and space. Hence, such knowledge includes time-tested practice that developed in the process of interaction of humans with their environment (Alcorn, 1984). Therefore, it is the result of many generations long year's experiences, careful observations and trial and error experiments (Martin, 1995).

Indigenous knowledge is a body of knowledge built up by a group of people through generations of living in close contact with nature and it is cumulative and dynamic. It builds up on the historic experiences of people and adapts to social, economic,

environmental, spiritual and political change. The quantity and quality of traditional knowledge differs among community members according to their gender, age, social standing, profession and intellectual capabilities. For instance, societies concerned with biological diversity most interested in knowledge about the environment; this information must be understood in a manner, which encompasses knowledge about the cultural, economic, political and spiritual relationships with the land.

It provides a distinctive worldview of which outsiders are rarely aware and at best can only incompletely grasp (Balick and Cox, 1996). Indigenous people of different localities have developed their own specific knowledge on plant resources, use, management and conservation (Cotton, 1996). Thus, systematic application of indigenous knowledge is important for sustainable use of resources and sustainable development (Thomas, 1995).

One of the widely used indigenous knowledge system in many countries is the knowledge and application of traditional medicine. Such knowledge, known as ethnomedicinal knowledge involves traditional diagnosis, collection of raw materials, preparation of remedies and its prescription to the patients (Farnsworth, 1994). Indigenous knowledge on remedies in many countries including Ethiopia, pass from one generation to the other generation verbally with great secrecy (Jansen, 1981). Such secrete and crude transfer makes indigenous knowledge or ethnomedicinal knowledge vulnerable to distortion and in most cases, some of the lore is lost at each point of transfer (Amare, 1976), hence there is a need for systematic documentation of such useful knowledge through ethnobotanical research.

### **2.3. Traditional Medicinal Plants**

Traditional medicine is defined by the World Health Organization as the sum total of the knowledge, skills and practices based on the theories, beliefs and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and social imbalance, and relying exclusively on practical experience and observation handed down

from generation to generation, whether verbally or in writing (WHO, 2002). The same source further elaborates that even though indigenous knowledge systems are rapidly disappearing under the influence of Western culture, 80% of the world's population exclusively rely on traditional medicine; especially in developing countries, where they have the resources to sustain primary healthcare systems. The plant-based traditional medicine has been repeatedly verified by phytochemical, pharmacological and clinical tests motivating further studies on medicinal plants in different parts of the world.

#### **2.4. History Use of Medicinal Plants**

Traditional Chinese medicine is still in common use in china. More than half of the populations regularly use traditional remedies, with the highest prevalence of use in rural areas. About 5000 traditional remedies are available in china; they account for approximately one fifth of the entire Chinese pharmaceutical market (Li, 2000). Herbs in native Japan were classified in the first pharmacopoeia of Japanese traditional medicine in the ninth century (Saito, 2000). Ayurveda is a medical system primarily practiced in India that has been known for nearly 5000 years. It includes diet and herbal remedies, while emphasizing the body, mind spirit in disease prevention and treatment (Morgan, 2002). India has a rich culture of medicinal herbs and spices, which includes more than 2000 species and has a vast geographical area with high potential abilities for Ayurvedic, Unani, Siddha traditional medicines but only very few have been studied chemically and pharmacologically for their potential medicinal value (Gupta *et al.*, 2005; Sandhu and Heinrich, 2005).

Human beings have used plants for the treatment of diverse ailments for thousands of years (Sofowara, 1982; Hill, 1989). Even with the advent of modern or allopathic medicine, Balick and Cox (1996) have noted that a number of important modern drugs have been derived from plants used by indigenous people. Traditional use of medicine is recognized as a way to learn about potential future medicines. Researchers have identified number of compounds used in mainstream medicine which were derived from "ethnomedical" plant sources (Fabricant and Farnsworth, 2001). Plants are used

medicinally in different countries and are a source of many potent and powerful drugs (Srivastava, *et al.*, 1996; Mahesh and Sathish, 2008).

## 2.5. Traditional Medicinal Plants in Ethiopia

The medicinal plant of Ethiopia and the developing countries play major supplementary roles to the limited modern health care available. The development of useful and widely used drugs like Digoxin and Digitoxin, from *Digitalis* leaves; quinine from the cinchona bark; reserpine from *Rauwolfia 7metic7ine*; morphine from *Papaver somniferum*; cocaine from *Erythroxzion coca* and the anti-cancer *Vincristine* and *Vinblastine* from *Cartharathus troseus* of Madagascar and again anti-cancer agents compound, bruceatin, from the Ethiopian plant, *Bruceaanti dysentrica*, just to name a few, are examples of the contributions of traditional pharmacopoeia (Desta, 1984)

The various literature show the significant role of medicinal plant in primary health care delivery in Ethiopia where 70% of human and 90% of livestock population depend on traditional medicine again similar to many developing countries particularly that of Sub-Saharan African countries. Those plants are part of the economic commodity for some members of the society which make their livelihood on their collection, trade and medicinal practices by practitioners or healers. It thus has a substantial potential to make contributions to the economic growth and alleviation of poverty in the country. Its proper management protect environment and conserve biodiversity. The traditional health care is deep rooted with oral and written pharmacopoeias. Ethiopian plants have shown very effective contributions for some ailments of human and domestic animals. Such plants include *Phytolacca dodecandra* (Aklilu, 1965), many species of *Maytenus* studied by National Cancer Institute, USA (Kupchan *et al.* 1972) and many species that show antimalarial (Nkunya, 1992).

Some have described the traditional medical system of Ethiopia as medico-religious System (Dawit and Ahadu, 1993). Ethiopian people have their own set of written and oral pharmacopoeias with the medicinal use of some species being restricted to each ethnic group. The cultural and indigenous knowledge of medicinal plants in Ethiopia is

unevenly distributed among each community members. Peoples in different zones/location with different religious, linguistic and cultural backgrounds have their own specific knowledge about use of plants which in part has gradually entered wide circulation in the country. The knowledge on medicinal plants is largely oral; however, Ethiopia's ancient church practices have documented some of the knowledge as inscribed in Parchments which partly characterize the traditional medical system usually described as medico religious written in Geez manuscripts of the 15<sup>th</sup> century (Gelahun, 1989; Dawit, and Ahadu, 1993). Other ancient written sources include the book of remedy (*Metsehafe Fewes*) of the 17<sup>th</sup> century which contains a wide range of medicinal plants prescription (Fekadu, 2001). Other cultural groups in the country have their own written or oral traditions that could be associated with individual clans or groups as partly stated by Amare (1976) and Abbink (1995).

One thousand identified medicinal plant species are reported in the Ethiopian Flora, however, many others are not yet identified. About 300 of these species are frequently mentioned in many sources. The greater concentrations of medicinal plants are found in the south and south west Ethiopia following the concentration of biological and cultural diversity (Edwards, 2001). The various citations made from various written records of medicinal plants from central, north and northwestern part of Ethiopia are thus small fractions of medicinal plants present in Ethiopia. Very recent study on the Bale Mountains National Park in the South East Ethiopia revealed that the area, as much as it is a biodiversity hotspot, also turned out to be a medicinal plant hotspot with 337 identified medicinal species of which 24 are endemic (National Herbarium, 2004; Ermias, 2005; Haile, 2005). The species comprised of 283 used as human medicine, 47 used as livestock medicine and 76 species used for both human and livestock by the community healers, harvesters, traders and users (National Herbarium, 2004; Ermias, 2005; Haile, 2005).

Ethiopia has policies and strategies that support the development and utilization of plant resources in a sustainable manner (Zemedu, 2001). The policies are reflected under various sectors including environmental protection, development of the natural resources

and diversification of the domestic and export commodities. The country also has developed policy and a guide line for intellectual property rights protection of traditional medicine (Mesfin, 1991). The policy encourages and promotes the appropriate use and protections of traditional medicine knowledge in Ethiopia taking in to account the need of the traditional medicinal knowledge holders and the communities who benefit from the use of the knowledge. Medicinal plants fit in the development activities that support public efforts in meeting livelihood requirements (Mesfin, 1991). There are few institutions concerned with the medicinal plants and assisted through government budgetary support. The status of phytomedicine, preparation of crude extracts and isolation of active principles in Ethiopia is very minimal. The data base for the recorded species of medicinal plants also needs special attention. There are however, differences in terms of prevalence of use of species overtime. Example *Taverniera abyssinica* has now declined mainly because of over-harvesting and degradation of wild bush lands in Shewa and Tigray (Mesfin, 1991).

## **2.6. Conservation of Medicinal Plants in Ethiopia**

People use many wild species of plants for food, medicine, clothing, shelter, fuel, fiber, income generation and the fulfilling of cultural and spiritual needs throughout the world (Zemedu, 2001). Ethiopia's traditional medicine as elsewhere in Africa is faced with problems of continuity and sustainability (Ensermu *et al.*, 1992). The primary causes of this problem are loss of taxa of medicinal plants, loss of habitats of medicinal plants and loss of indigenous knowledge. Some studies have shown that most of the medicinal plants utilized by Ethiopian people are harvested from wild habitats (Tesfaye and Zemedu, 1999) and hence this aggravates the rate of loss of taxa with related indigenous knowledge and loss of widely occurring medicinal plant species. The concept of sustainability is now seen as the guiding principle for economic and social development, particularly with reference to biological resources. According to Zemedu (2001), medicinal plants are considered to be at conservation risk due to over use and destructive harvesting (roots and barks collection). Dawit and Ahadu (1993) found that many medicinal preparations use roots, stem and bark by effectively killing the plant in harvest. Plant parts used to prepare remedies are different; however, root is the most widely used

part. Such wide utilization of root part for human and livestock aliments with no replacement has severe effect on the future availability of the plant.

Recent work of Haile (2005) confirms the fact that the total plant parts to prepare remedies root is widely used with 64 species (35.5%) followed by leaf 47 species (25.97%) which hence affects sustainable utilization. In a broad sense, conservation is achieved through in-situ and ex-situ means. In-situ conservation is conservation of species in their natural habitat.

Some traditional medicinal plants have to be conserved in-situ due to difficulty for domestication and management (Zemedu, 2001). Moreover, some plants fail to produce the desired amount and quantity of the active principles under cultivation out of their natural habitats. Medicinal plants can also be conserved by ensuring and encouraging their growth in special places, as they have been traditionally (Zemedu, 2001), this can be possible in places of worship (churches, mosques, grave yards, etc.), sacred grooves, farm margins, river banks, road sides, live fences of gardens and fields. According to (Zemedu, 2001), medicinal plants can be conserved using appropriate conservational methods in gene banks and botanical gardens. This type of conservation of medicinal plants can also be possible in home gardens, as the home garden is strategic and ideal farming system for the conservation, production and enhancement of medicinal plants.

### 3. MATERIALS AND METHODS

#### 3.1. Description of the Study Area

##### 3.1.1. Geographical Location

Gog district is one of the districts in the Gambela Region of Ethiopia, Agnuak Zone. Gog were bordered on the south by Dimma Woreda, on the southwest by the Akobo River which separates it from South Sudan, on the west by Jor Woreda, on the east by Godere Woreda and on the north by Abobo Woreda. The major town of Gog district is Pugnido. It is located at about 7° 0' N to 7° 54' North latitude and 33° 57' E to 35° 0' East longitudes. It is situated in Southwest of Addis Ababa at about 876 Km. The district town Pugnido is about 111 km from the regional capital Gambella (EMA, 2013).

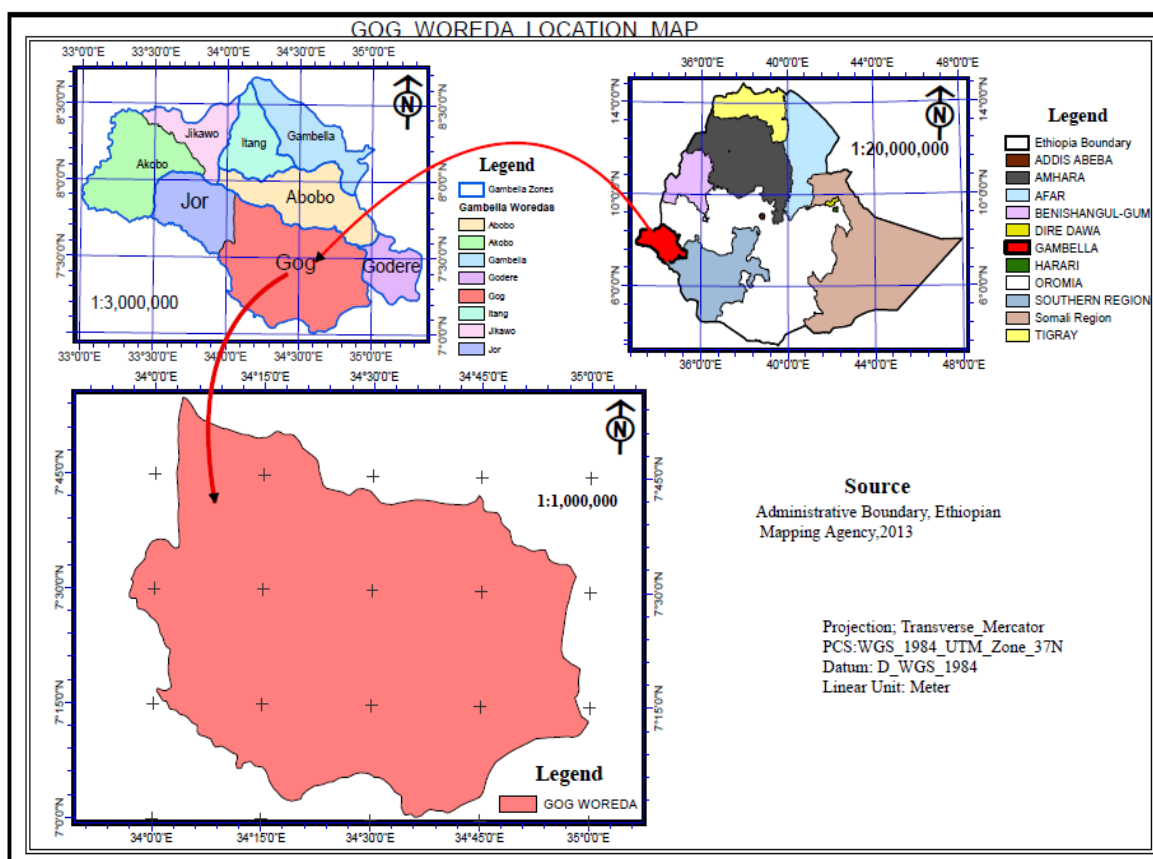


Figure 1. Map of the study area (Gog district)

Source: Administrative Boundary, Ethiopian Mapping Agency, 2013

## **2. Topography and Climate**

The terrain of Gog is predominantly flat, with the elevation ranging from 400 to 600 meters above sea level; high points include Mount Masango (552 meters). Major bodies of water in this district include the Gilo River and Lake Tata. According to Gog district Agriculture Office, around 30% of the district is covered by forest. A notable landmark is the Gambella National Park, which occupies the land west of the Pugnido – Gambela road. The average annual rainfall in Gog district ranges from 1600mm to 1800mm, while the average annual temperature varies between 27°C and 33°C. The absolute maximum temperature occurs in mid-March and is about 45°C and the absolute minimum temperature occurs in December and is 10.3°C (Gog District Agricultural Office, 2014).

## **3. Population**

According to GDAO (2014), Gog district had a total population of 16,836, of whom 7,751 are men and 9,085 are women. Gog has a population density of 5.18 km<sup>-1</sup>, which was greater than the Zone average of 4.83 persons per square kilometer. The majority of the inhabitants (77.52%) are Protestant Christians while Ethiopian Orthodox Christian, Catholic Christian, Islam and other religions constituted 15.08%, 2.6%, 0.9% and 3.9 %, respectively.

## **4. Agriculture**

The Agnuaks, who live in dispersed settlements, are dependent on the cultivation of the land to produce crops such as maize, sorghum and pumpkin. They cultivate their lands using sticks locally called *Chala* to form holes for planting seeds in their fields. The Agnuak people practice a shifting cultivation system, where agricultural fields are changed every 3-7 years. Apart from crop production for their livelihood, Agnuaks also fish on the banks of the river to supplement their nutritional requirements and to generate income. Moreover, hunting and gathering of wild animals and plants are integral part of supporting their livelihood.

## **5. Reconnaissance Survey Study and Selection of Study Sites**

Gog district has a total of 16 kebeles. Reconnaissance survey was conducted from February 16 to 28 to select potential kebeles, which included: Phugnido, Tata, Gilo, Buchalla and Gog for ethnobotanical data collections. These kebeles were purposively selected based on the availability of traditional medicine practitioners, traditional medicine use history and altitudinal variation between kebeles. Phugnido and Tata have 1400-1500 meter above sea level and are with high forest. In addition Tata has a lake that is lake Tata. Gilo has 1400-1450 meter above sea level with Gilo rever and Buchalla with 1500-1600 meter above sea level. Gog has 1450-1600 meter above sea level with high forest when compared with other kebelles.

## **6. Ethnobotanical Data Collection**

Before the commencement of ethnobotanical data collection, respondents were selected from 5 kebeles. Totally, 74 respondents (aged  $\geq 25$  years) had participated in this study. Of these, 60 (50 male and 10 female) were non-traditional healers or ordinary residents, whereas 14 (11 male and 3 female) were traditional medicine practitioners used as key informants. Key informants were selected by purposive sampling from the study kebeles based on the information gathered from the local people while other respondents were randomly selected. Ethnobotanical data were collected during rainy season of 2016. Data collection methods were through semi-structured interviews, group discussions, and guided field walks with key informants for field observations. Key informants were first interviewed individually to mention about the local names of the plants they use to treat diseases, diseases treated, part(s) of plants used, methods of preparation of remedies, route of application of the remedies, dosage, and factors that threaten medicinal plants. Thereafter, group discussions was made with them and asked for field walk for onsite observation of the plants. Similar procedure was also be applied with randomly selected non-practitioners of traditional medicine. Voucher specimens were collected, pressed, and dried for identification. Identification of all specimens was done by comparison with authentic specimens, illustrations and taxonomic keys from Flora of Ethiopia and Eritrea,

and with the assistance of experts at Addis Ababa University, National Herbarium. The identified specimens were deposited in Haramaya University Herbarium.

## 7. Data Analysis

A descriptive statistical method (percentage and/or frequency) was employed to summarize ethnobotanical data.

**Informant consensus factor (ICF):** was calculated for categories of ailments to identify the agreements of the informants on the reported cures using the formula used by (Rodrigo *et al.* (2005) and Teklehaymanot (2007).

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

Where,  $n_{ur}$  is the number of use citation in each category and  $n_t$  is the number of species used.

**Fidelity level ( FL):** the percentage of informants claiming the use of a certain plant for the same major purpose, was also calculated for the most frequently reported diseases or ailments using the following equation (Teklehaymanot, 2007).

$$\text{FL}(\%) = \frac{NP}{N} \times 100$$

Where  $N_p$  is the number of informants that claim the use of a plant species to treat a particular disease, and  $N$  is the number of informants that use the plants as a medicine to treat any given disease.

**Preference ranking:** To compare the most effective medicinal plants used by the community to treat malaria preference ranking was conducted following Martin (1995) and Cotton (1996) for six medicinal plants reported to treat malaria. For this, fourteen informants were randomly selected to prioritize the best preferred medicinal plant species for the treatment of malaria. Each informant was provided with the six medicinal plants reported to cure malaria with their leaves being paper tagged. Then informants were asked to assign the highest value (6) for the most preferred species against the malaria and the lowest value (1) for the least preferred plant and in accordance of their order for the remaining one. The values of each species were summed up and the rank for each species was determined based on the total score.

## 4. RESULTS AND DISCUSSION

### 4.1. Medicinal Plant Species Used by People of the Study Area

Totally 67 species of medicinal plants distributed in 34 families were documented from the study area (Appendix Table 1). Family Fabaceae consisted of the largest species number (9 spp) followed by Capparidaceae (7 spp), Euphorbiaceae (6 spp), Lamiaceae (4 spp), Meliaceae, Rubaceae and Rutaceae (each 3 spp), Vitaceae, Rhamnaceae and Asparagaceae (each 2 spp) and the rest were represented by one spp (Appendix Table 2).

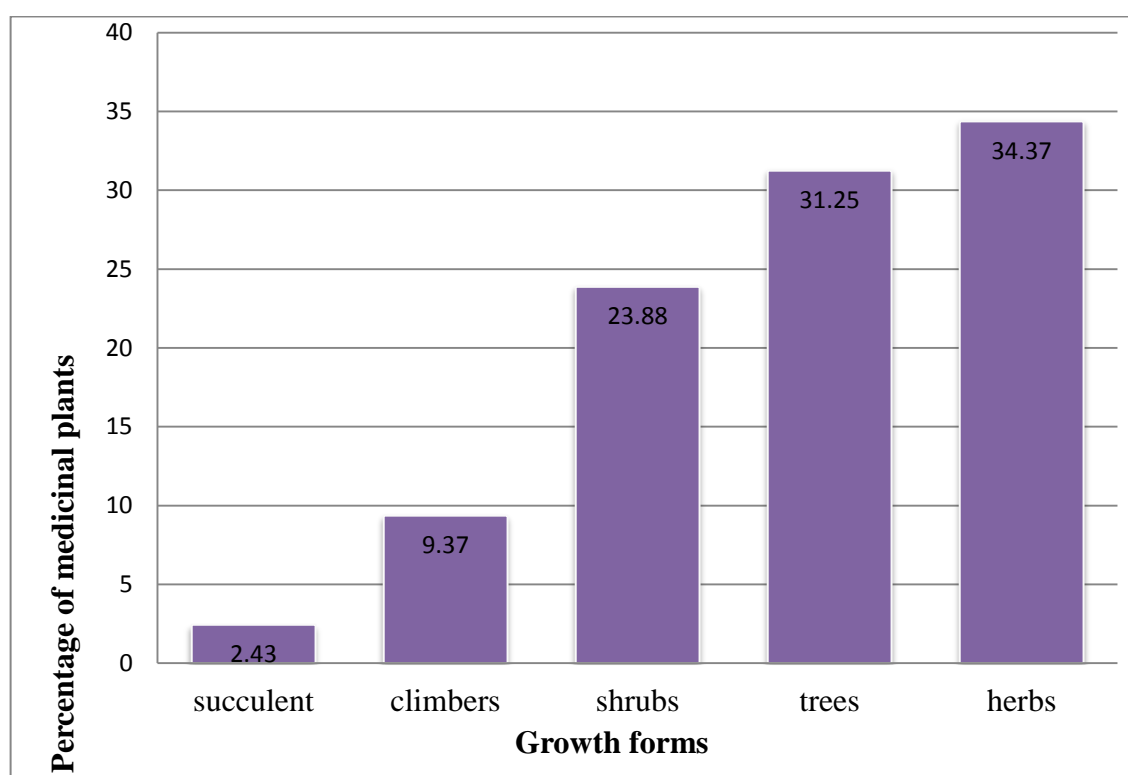
In this study some plants were reported to have high medicinal value than others to treat various ailments and reported more frequently. For example, *Azadirachata indica*, which was reported to treat malaria, abdominal cramp, intestinal worm attack and eye infections had been cited by 56(75.67%) informants followed by *Chasmanthera dependens* cited by 49(66.22%), *Dioscorea praehensilis* cited by 42(56.75%), *Moringa stenopetala* cited by 39(52.70%), *Trichilia emetic* cited by 33(44.59%), *Jatropha cureas* 31(41.89%), *Gardenia ternifolia* cited by 30(40.54%) and *Solonum incnum* cited 28(37.84%) informants (Table 1).

**Table 1: Some of the medicinal plants cited most by informants**

No	Botanical name of medicinal plants	No of informants	Percentage
1	<i>Azadirachata indica</i>	56	75.67%
2	<i>Chasmanthera dependens</i>	49	66.22%
3	<i>Dioscorea praehensilis</i>	42	56.75%
4	<i>Moringa stenopetala</i>	39	52.70%
5	<i>Trichilia emetic</i>	33	44.59%
6	<i>Jatropha cureas</i>	31	41.89%
7	<i>Gardenia ternifolia</i>	30	40.545%
8	<i>Solonum incnum</i>	28	37.84%

#### 4.1.1 Plant habit and part(s) used to treat diseases

From the total of 67 medicinal plant species collected from the study area, 23(34.37 %) were herbs followed by tree species 20(31.25%), shrub 16 (23.88%), climbers 6 (9.37%) and succulent 2(2.43) (Figure 2). This shows that most widely used medicinal plants are herbs. Similar ethnomedicinal researches (Mulugeta, 2014 and Mulatu, 2016) conducted previously have also indicated higher number of herbs being used for medicinal purpose.



**Figure 2. Growth forms of medicinal plants used for human ailments in the study area**

Analysis of plant parts used for medicine preparation revealed that people in the study area mostly use root 27(29.03%) followed by leaf 23(24.73%) and seed 12(12.90%). Sometimes, the communities use plant parts in combination for preparation of traditional medicine (Table 2).

**Table 2: Plant parts used for traditional medicine preparations in Gog district**

No	Plant parts	Total responses	% of total responses
1	Root	27	29.03
2	Leaf	23	24.73
3	Seed	12	12.90
4	Bark	5	5.37
5	Fruit	5	5.37
6	Stem	4	4.30
7	sap	3	3.22
8	Leaf and root	3	3.22
9	Bulb	2	2.15
10	Leaf and flower	2	2.15
11	Leaf and bark	1	1.07
12	Leaf and seed	1	1.07
13	Leaf and stem	1	1.07
14	Root and seed	1	1.07
15	Whole plant part	1	1.07
16	Rhizome	1	1.07
Total		93	100

#### **4.1.2 Preparation Methods of Medicines, Route of Application and Dosage**

The preparation methods vary based on the types of disease treated and area of disease occurrence. The main method of traditional medicine preparation cited was chewing 19 (21.59%), crashing 16 (18.18%), pounding 9 (10.22%), squeezing 7(7.95%) and cooking cited 6 (6.81%). The major routes of administration of remedies was reported to be oral 67 (77.01%) followed by dermal 18 (20.69%), nasal 2(2.29). The informants' responses indicated that there were variations in dosages of remedies, unit of measurement of remedies, duration and time that were prescribed for the same kind of health problems.

The major factors that determine the amount to be given were age, physical fitness, stage of illness, pregnancy and presence or absence of any disease other than the disease to be treated. Getahun (1976), Sofowara (1982) and Abebe (1986) have also discussed lack of precision and standardization as a drawback of the traditional health care system.

#### **4.1.3 Conditions of preparation for medicines**

Local people depend on both fresh and dry remedies. In this case remedy preparation for 66 plant species was reported in fresh form, whereas 17 in dry form, and 7 of them were prepared in both dry and fresh forms. The fact that fresh preparations dominate dry ones is because of the belief that the local people have curative potential over that of dry form.

#### **4.1.4 Informant consensus factor (ICF)**

All cited human diseases were grouped into 10 categories (Table 3). Disease category which comprises jaundice, kidney, kwashiorkor and liver had the highest ICF 0.944 value followed by blood and cardiovascular problems category with 0.915 ICF value, followed by Febrile and fever 0.900 ICF value and categories of dental problem, and dermatological problems with 0.895 and 0.892 ICF values, respectively. A high ICF value (closer to one) indicates that the informants rely most on the same taxa to manage specific disease conditions, while a low value (close to 0) indicates that the informants disagree on the taxa to be used in the treatment of a given ailment (Teklehaymanot and Giday, 2007). It is also an indication of the effectiveness of the cited plant species against the disease(s) (Abbasi *et al.*, 2013).

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

Where,  $n_{ur}$  is the number of use citation in each category and  $n_t$  is the number of species used.

**Table 3: Informant consensus factor (ICF) of medicinal plants in the study area**

No	Disease categories	nt,	Nur	ICF
1	Jaundice, kidney ,kwashiorkor and liver	7	110	0.944
2	Blood and cardiovascular problem	19	235	0.915
3	Febrile and fever	3	21	0.900
4	Dental problem	3	20	0.895
5	Dermatological problem	13	113	0.892
6	Gastrointestinal problem	23	169	0.869
7	Snake bite and poisoning	4	24	0.869
8	Genitourinary and fertility problem	3	14	0.846
9	Sensorial problem	8	35	0.790
10	Respiratory problem	3	7	0.667

### 8. 5 Fidelity levels index (FL) of medicinal plants

Fidelity level values were calculated for some commonly used medicinal plants against some commonly reported ailments (Table 4). Medicinal plants that are widely used by the local people to treat one or very few ailments will have higher FL values than those that are less popular (Tilahun and Mirutse, 2007). In this study, *Tylosema fassoglensis* was cited by many informants to treat wound and hence had 0.95% FL followed by *Chasmanthera dependens* cited to treat malaria with 0.92% FL, *Trichilia 19metic* to treat yellow fever 0.82% FL. High FL may indicate the efficiency of the reported plant to cure a specific ailment.

$$FL(\%) = \frac{NP}{N} \times 100$$

**Where;** NP= the number of informants that claim the use of a plant species to treat a particular disease, N = the number of informants that use the plants as a medicine to treat any given disease. And FL= fidelity level

**Table 4: Fidelity levels of some common medicinal plants in the study area**

No	Botanical name of medicinal plants	Ailment treated	NP	N	FL	FL %
1	<i>Tylosema fassoglensis</i> (Kotschy ex Schweinf) Torre & Hille.	Wound	19	20	0.95	95
2	<i>Chasmanthera dependens</i> Hochst.	Malaria	49	53	0.92	92
3	<i>Trichilia 20metica</i> Vahl	Yellow fever	34	41	0.83	83
4	<i>Dioscorea praehensilis</i> Benth	Snake bit	3	42	0.80	80
5	<i>Azadirachata indica</i>	Worms	45	56	0.80	80
6	<i>Ginger officinale</i>	Abdominal problem	13	26	0.5	50
7	<i>Solonum incnum</i>	Liver disease	29	65	0.44	44
8	<i>Moringa stenopetala</i> (Bak. F) Cufod.	Heart disease	29	78	0.37	37

#### 4.1.6 Preference Ranking

When there are different species prescribed for the same health problem, people show preference for one over the other. Preference ranking of six medicinal plants that were reported for treating malaria was conducted after selecting 14 key informants. The informants were asked to assign the highest number (6) for the medicinal plant which they thought most effective in treating malaria and least score (1) for less preferred plant to treat malaria. Result showed that of the 6 reported plants, *Chasamanthera dependens* scored a sum of 65 and ranked first indicating that it is the most effective in treating malaria followed by *Azadirichia indica* (61), and the least effective was *Mangifera indica* scored 32 (table 5).

**Table 5: Preference ranking of medicinal plants used for treating malaria**

Resp onde nt's	Species					
	<i>Chasamanthera dependens</i>	<i>Azadirachata indica</i>	<i>Allium sativum</i>	<i>Albizia lophantha</i>	<i>Tarmarindus indica</i>	<i>Mangifera indica</i>
R1	4	5	3	6	1	2
R2	5	6	3	4	1	2
R3	5	4	6	1	3	2
R4	6	3	5	2	4	1
R5	3	6	4	5	2	1
R6	6	3	5	4	1	2
R7	5	2	4	3	6	1
R8	5	6	4	3	1	2
R9	6	3	2	5	4	1
R10	4	3	1	5	2	6
R11	5	4	6	2	1	3
R12	4	5	2	1	3	6
R13	4	5	6	1	3	2
R14	3	6	5	4	2	1
Total	65	61	56	46	35	32
Rank	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>

**Key: - R=informant**

## **5. SUMMARY, CONCLUSIONS AND RECOMMENDATION**

### **5.1. SUMMARY AND CONCLUSIONS**

Ethnobotanical study was conducted in Gog District with the objective of documenting traditional medicinal plants of the area with related indigenous knowledge. Accordingly, sixty seven medicinal plant species were recorded in the study area treating 51 ailments were reported by locals. Herbs constitute the main source of traditional remedies followed by trees and shrub species. Roots were also found to be the most frequently used plant parts followed by leaves for preparation of human remedies. Traditional medicine preparation most involved single plant. Route of administration was mainly internal in which oral administration is the common route followed by dermal (external application). The preparation methods vary based on the types of disease treated and area of disease occurrence.

Medicinal plant use among Gog District is localized and dependent on plants that are found around them. The ethnobotanical knowledge on medicinal plants also varies among various social groups. A significant proportion of medicinal plants used by Gog people are collected from wild. The present study revealed people of the area have different depth and width of knowledge of natural resources in general and medicinal plants in particular in their locality. They have strong and genuine belief on healing power of plants and they know their habitat, distribution, harvesting technique, time of harvest and the status of a plant in the area.

## 5.2. RECOMMENDATION

Based on the result of the study, the following recommendations are forwarded.

- ❖ The local people need to be trained, encouraged and supported on how to use and prepared the medicinal plant species and whole plant resources found in their area.
- ❖ Local community must be aware of preserving indigenous knowledge on medicinal plants
- ❖ Young generation need raising awareness to avoid negative impacts on the medicinal plants and associated knowledge in the area, hence, documentation of the medicinal plants of the area needs to continue.
- ❖ Attention should be given to standardization of measurement and hygiene of the medicines made from plants by training both the healers and other members of the local community.
- ❖ Traditional medicinal plants are central to the indigenous cultures and material needs. Therefore, formal and non- formal education systems should be designed to create positive attitude among the young by integrating in to the curricula about the traditional use of plants in general and medicinal plants in particular.

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## 2. APPENDIX

### Appendix 1. Questionnaires for respondents

The following questions are designed only to get sufficient information about the use and how you are practicing with medical plants. Please be frank and free to give this information.

#### A. Personal information of traditional healers

1. Sex: Male  Female
2. Age:
3. Residence: Rural  Urban  Keble \_\_\_\_\_ Religion \_\_\_\_\_
4. Educational status: Diploma  Degree  Religious Education  Illiterate
5. Marital status: single  Married  single
6. Job \_\_\_\_\_

#### B. About traditional medicine for traditional healers

7. Mention the names of plants used as medical value for human, livestock or both?
8. What are the habits of these medical plants?  
Herb  Shrub  Climber  Tree
9. For what type of disease(s) are they used?
10. Which part(s) of the plant is used for the remedy?
11. What methods of preparation do you use to make the medical plants available for your local peoples? Crushed  Powdering  Burning  Pounded  Chewing  Rubbed Or Creamed  Squeezing  Boiled
12. What types of mechanism are used to diagnose your patient to give medicine?
  - A. By observing signs of the patient
  - B. By asking symptoms of the disease
  - C. By using local materials
  - D. If any other please specify \_\_\_\_\_
13. What are the criteria's ordered to the patient to use the medicinal plants correctly?

**Thank you!**

**Appendix 2. Questionaries' for traditional healers translated to Agnuak language.  
Questionaries' for traditional healers translated to Agnuak language.**

A. ngattokøny reek I jerkōōngngōmwøge.

1. dhaagødicwøø
2. cwiiri
3. karbēētō: teekpaacpääny kabala jwøkmare
4. ogôôdôdiplôômadigirŕigöörmarøt-jwøkkargöôdô
5. bēēdōjenikeere \_\_\_\_\_ ocōôdô \_\_\_\_\_ genopāāō \_\_\_\_\_
6. tiic mare

B. piēc kipper jerkōōngngō

1. nyengjaadhicakikøny mare?
2. Bēētō mar jaathmanica?  
enaluum \_\_\_\_\_ enajaath \_\_\_\_\_ enathøøl (muulø) \_\_\_\_\_
3. Jaath man joodikaa? Yithpwöøth \_\_\_\_\_ thaangjōō \_\_\_\_\_ paap(iluum)
4. Adēērjaathkaaokønydēēlkigø?  
Bøøge \_\_\_\_\_ dēērē \_\_\_\_\_ lweette \_\_\_\_\_ mananāk  
ongøøk \_\_\_\_\_ bāāttē \_\_\_\_\_ apøge \_\_\_\_\_ nyiēē \_\_\_\_\_ dēērēbārē \_\_\_\_\_
5. ajöømonyiēdinikønyidēērikigøkipernijaathmanøgønēēdēnibaranyni?  
Diwiirō \_\_\_\_\_ Diguurō \_\_\_\_\_ diwaangø \_\_\_\_\_ -  
dimoorøwaladithaalø \_\_\_\_\_ - \_\_\_ dingwāyyō dimmadhø \_\_\_\_\_
6. ajöømonyiēdiokønyddēēlkigøwalangaticatuuwaalabatuu?  
A. manrangngiccēmongattatuu  
B. man pēēnyngiccēmotāw  
C. mankønydēēlki jap atutjaak.  
D. Ninākmodajōōmørlami
- 13.ajiēthēmonyiēdi ocean jingsttatuunidēērēkønyelekijaathmanicenikare?

**Appendix 3. Observation Check List**

1. What are the main human problems in your locality Keble?
2. What are the main livestock health problems or disease?
3. How plant parts are collected?
4. Which type is used as a treatment for many diseases?
5. Do you use plants to treat disease in your locality?
  - A. Name of the plant\_\_\_\_\_
  - B. Habitat of the plant\_\_\_\_\_
  - C. Parts of the plant used\_\_\_\_\_
  - D. Preparation methods\_\_\_\_\_
  - E. Amount used\_\_\_\_\_
  - F. Application method\_\_\_\_\_
  - G. Treats to the above plant\_\_\_\_\_
  - H. Other use of the plant\_\_\_\_\_
6. Does the dose differ among males, females, children, elders and pregnant?
7. How does modernization interfere with traditional medicine application and use?
8. How do you conserve traditional medicinal plants?

## 7.1. APPENDIX TABLE

**Appendix Table 1. Medicinal Plants collected from the study area**

Coll cod e	Botanical name and plant habit	Family	Local name	Health problem treated	Part(s) used, mode of preparation and Applications
01	<i>Carica papaya</i> L. <b>Shrub</b>	Caricaceae	Ollw/ papaya	Amoeba	<b>Seed:</b> Fresh seed will be Chewed and swallowed
02	<i>Boscia albitrunca</i> (Burch.) Gilg & Ben <b>Tree</b>	Capparidaceae	Nomloj	Diarrhea	<b>Root:</b> The fresh root will be chewed and the juice will be swallowed or crushed root will be mixed with water the filtrate will be drunk
03	<i>Tylosema fassoglensis</i> (Kotschy ex Schweinf) Torre & Hille. <b>Shrub</b>	Fabaceae	Opat	Wound	<b>Seed and bark :</b> Fresh seed and bark powder will be applied onto the wounded area
				Amoeba	<b>Seed:</b> The fresh seed will be chewed and swallowed
04	<i>Flueggea virosa</i> (Willd.) Voigt. <b>Shrub</b>	Euphorbiaceae	Dijweey	Amoeba	<b>Root:</b> Fresh root will be chewed and the juice will be swallowed

05	<i>Chasmanthera dependens</i> Hochst. <b>Climber</b>	Menispermaceae	Aciika	Malaria	<b>Bark:</b> Fresh bark will be crashed mixed with water and the filtrate will be drunk
06	<i>Lonchocarpus laxiflorus</i> Guill.& Perr. <b>Tree</b>	Fabaceae	Ulweado	Wart	<b>Seed:</b> The dry seed will be roasted to crashed and boiled then extract the oil to drunk
07	<i>Crateva adansonii</i> DC. <b>Tree</b>	Capparidaceae	Woodo	Yellow fever	<b>Root:</b> The fresh root will be chewed and the juice is drunk
08	<i>Bersama abyssinica</i> Fresen. <b>Tree</b>	Meliantaceae	Kaanynyo	Diarrhea Amoeba	<b>Root :</b> The fresh will be chewed and swallowed
09	<i>Balanites aegyptiaca</i> (L.) Del. <b>Shrub</b>	Balaniteceae	Olemo	Loss of appetite	<b>Seed:</b> The fresh seed will be chewed and swallowed
010	<i>Cyphostemma adenocaula</i> (Steud. ex A. Rich.) Desc. ex Wild & Drummond <b>Herb</b>	Vitaceae	Da	Coughing, Fever	<b>Root:</b> The fresh root will be chewed and the juice is drunk
011	<i>Manihot esculenta</i> Crantz. <b>Herb</b>	Euphorbiaceae	Waljiath	Gastritis	<b>Root:</b> Crashed dry or fresh root will be mixed with water filtered and drunk
012	<i>Dioscorea praehensilis</i> Benth. <b>Climber</b>	Dioscoreaceae	Baado	Snake bit	<b>Seed:</b> The dry seed powder will be mixed with water and drunk

					<b>Leaf:</b> Fresh leaf will be pounded and drunk with water
				Skin fungal disease	<b>Seed:</b> The dry seed powder mixed with water painted the body that is affect by fungi
013	<i>Ocimum lamiifolium</i> Hochst. ex Benth. <b>Herb</b>	Lamiaceae	Akiiro	Febrile illness	<b>Leaf :</b> By fresh squeezing the liquid and washing body part
014	<i>Cissus quadrangularis</i> L. <b>Herb</b>	Vitaceae	Geebo	Breast ulcer	<b>Leaf:</b> Fresh sap from the leaf will be applied onto the breast
015	<i>Cucurbita maxima</i> Duch. <b>Climber</b>	Cucurbitaceae	Okolo	Tape worms	<b>Leaf and seed:</b> The fresh leaf and seeds will be chewed and swallowed
016	<i>Euphorbia hirta</i> L. <b>Herb</b>	Euphorbiaceae	Ateencaak	Wound	<b>Flower and leaf :</b> The fresh crushing and added to the wound
				Malaria	<b>Leaf:</b> With papaya, mingo, neem put together and cooking their fresh leaf part and drink
017	<i>Stereospermum kunthianum</i> Cham. <b>Shrub</b>	Bignoniaceae	Chippolo	Tooth problem	<b>Bark:</b> Fresh bark will be held onto the diseased tooth

019	<i>Ziziphus abyssinica</i> Hochst. ex. A. Rich <b>Shrub</b>	Rhamnaceae	Lang	Intestinal worm	<b>Seed:</b> Fresh seed will be chewed and swallowed
020	<i>Solonum incnum</i> L. <b>Climber</b>	Solanaceae	Golu	Ringworm, liver disease	<b>Seed:</b> By squeezing the liquid from the fresh seed of the fruit after that filtration and drink the liquid
021	<i>Trichilia emetica</i> Vahl <b>Tree</b>	Meliaceae	Jew	Yellow fever Wart Kidney problem Dandruff	<b>Leaf ,seed and bark :</b> The fresh leaf, seed and bark boiled to drink the ordered amount of it with food to treat yellow fever, wart and kidney problem <b>Leaf or seed :</b> Pounded fresh seed or leaf will be added on the skin
023	<i>Habenaria rhodocheila</i> Hance <b>Tree</b>	Orchidaceae	Amaathage ela	Body swelling	<b>Leaf and root:</b> Crashed fresh leaf and root will be mixed with water and applied on the swollen part
025	<i>Gloriosa superba</i> L. <b>Herb</b>	Colchicaceae	Apeto	Mengitis	<b>Stem:</b> Chopped fresh stem will be infused in water and drunk
026	<i>Maerua pseudopetalosa</i> Gilg-and Gilg-Bened.)	Capparidaceae	Albeje	Snake bit Tuberculosis	<b>Root:</b> Fresh root wash with clean water and cut in to small pieces and give it to

	Dewolf <b>Tree</b>			Scorpion bit	the patient to drink it.
				Snake	<b>Root:</b> If you put it in the house the snake will go out
027	<i>Capparis tomentosa</i> Lam. <b>Tree</b>	Capparidaceae	Ongoono	Ascaris	<b>The whole part :</b> The entire part will be crashed infused in water and suspension is drunk
028	<i>Asparagus setaceus</i> (Kunth) Jessop <b>Herb</b>	Asparagaceae	Abudo	Mengitis	<b>Root:</b> The fresh root crashed will be put on the neck
030	<i>Moringa stenopetala</i> (Bak. f) Cufod. <b>Tree</b>	Moringaceae	Adiigra	Constipation	<b>Root:</b> Cut fresh root will be infused in water and drunk
				Gastric pain	
				Digestion problem	
				Liver disease	<b>Leaf:</b> Dry leaf powder will be drunk with water
				Heart disease	
				Laxative effect	<b>Leaf:</b> Dry leaf powder will be consumed with food
Anemia					
031	<i>Ipomea purpurea</i> (L) Roth <b>Herb</b>	Convolvulaceae	Ameenho	Fever	<b>Root :</b> Dry and crashed the root part and add to water for drinking

				Menstruation period	<b>Leaf and root:</b> Dry and crashed the root as well as the leaf part of the plant and swollen
032	<i>Azadirachata indica</i> A. Juss. <b>Tree</b>	Meliaceae	Bay bay	Malaria	<b>Leaf and bark:</b> Fresh leaf and bark boiled in water and the filtrate will be drunk
				Abdominal crump	<b>Root:</b> Fresh root will be chewed and swallowed
				Intestinal Worms	<b>Leaf:</b> Fresh leaf will be chewed and the juice drunk
				Eye infection	<b>Leaf:</b> Fresh Leaf extract obtained by squeezing will be used to wash eyes with
033	<i>Senna alexandrina</i> Mill. <b>Shrub</b>	Fabaceae	Ajaada	Yellow fever	<b>Leaf:</b> Cooked fresh leaf will be eaten
034	<i>Panicum maximum</i> Jacq. <b>Herb</b>	Poaceae	Moonho	Wound	<b>Leaf:</b> Crashed fresh leaf will be used to wash the wound with water
				Cough	<b>Leaf:</b> The fresh leaf will be eaten

035	<i>Mangifera indica</i> L. <b>Tree</b>	Anacardiaceae	Mango	Malaria	<b>Leaf:</b> The fresh Leaf will be infused into to tea and drunk
036	<i>Leucas zeylanica</i> (L.)R.Br. <b>Herb</b>	Lamiaceae	Goar	Wound	<b>Leaf and stem:</b> The dry ash of the leaf and stem will be applied onto the wound, snake bitten and burned areas
				Snake bite	
				Burned Body	
037	<i>Canthium coprosmoides</i> F. Muell. <b>Tree</b>	Rubiaceae	Wuutrha	Yellow fever	<b>Stem:</b> The fresh stem will be chewed
038	<i>Tamarindus indica</i> L. <b>Tree</b>	Fabaceae	Koat	Malaria	<b>Fruit:</b> The fresh fruit will be eaten cooked or raw
				Abdominal problem	<b>Fruit :</b> From the fresh fruits the latex will be squeezed added water, after that will be drunk daily in the morning before food
039	<i>Tephrosia pumila</i> (Lam.) Pers. <b>Herb</b>	Fabaceae	Yol	Kwashiorkor	<b>Leaf:</b> Crashed dry or fresh leaf will be consumed
					<b>Root:</b> Fresh leaf will be chewed
040	<i>Indigofera spicata</i> Forssk. <b>Herb</b>	Fabaceae	Wath	Abdominal crump	<b>Root:</b> Fresh root will be chewed

041	<i>Withania somnifera</i> ( L) Dunal <b>Herb</b>	Solanaceae	Agoal	Pneumonia	<b>Leaf:</b> Fresh leaf extract obtained by squeezing will be drunk
042	<i>Desmodium incanum</i> Dc. <b>Herb</b>	Fabaceae	Wal in bor	Syphilis Gonorrhea	<b>Root:</b> The fresh and dry root crashed and give for adult people to drunk but not for child
044	<i>Euphorbia tirucalli</i> L. <b>Succulent</b>	Euphorbiaceae	Bolle	Fungus infection	<b>Stem:</b> You can used the fresh stem and cutting in to small pieces and mixed with water to cream the skin
045	<i>Pseudocedrela kotschyi</i> (Schweinf) Harms <b>Herb</b>	Meliaceae	Nyoar	Fever Head ache	<b>Root:</b> The fresh root cutting in to small pieces and putting in water after one hour drinking
				Loss of appetite Constipation	<b>Bark:</b> The dry or fresh bark of the stem crashing and putting in two water and drinking
046	<i>Vepris dainellii</i> (Pic.Serm.) Kokwaro <b>Tree</b>	Rutaceae	Olaam	Wound Guinea worm	<b>Sap :</b> Fresh sap from the stem part will be applied on the wound <b>Seed:</b> The dry seed powder will be put on the wound
047	<i>Sterculia africana</i> (Lour.) Fiori <b>Tree</b>	Sterculiaceae	Arem	Wound	<b>Sap :</b> The fresh sap from stem and petiole will be put on the wound

048	<i>Vitellaria paradoxa</i> Gaertn. F. <b>Tree</b>	Sapotaceae	Waado	Digestion problem	<b>Leaf and root::</b> Dry or fresh Leaf and root will be boiled in water and drunk
				Stomach pain	<b>Root:</b> The fresh root cooked root will be eaten
049	<i>Annona senegalensis</i> Pers. <b>Shrub</b>	Annonaceae	Obullu	Yellow fever	<b>Root:</b> Dry crashed root will be boiled in water and drunk
051	<i>Allium sativum</i> L. <b>Herb</b>	Alliaceae	Abeccleye	Malaria	<b>Bulb:</b> The fresh bulb of <i>Allium sativum</i> and rhizome of <i>Ginger officinale</i> are pounded and eaten with honey.
				Stomach Pain	<b>Bulb:</b> The fresh Pounded bulb will be consumed with coffee or honey or eaten with injera/bread
052	<i>Ruta chalepensis</i> L. <b>Shrub</b>	Rutaceae	Meeneth	Abdomen problem	<b>Leaf:</b> Fresh leaf will be chewed or infused into tea/coffee and drunk
053	<i>Albuca abyssinica</i> Jacq <b>Herb</b>	Asparagaceae	Thit thit	Tuberculosis	<b>Root and seed:</b> Dry Powdered root and seed will be drunk with water
054	<i>Harrisonia abyssinica</i> Oliv. <b>Climber</b>	Rutaceae	Buodo	Yellow fever	<b>Root :</b> Fresh root cut into pieces infused in water and suspension will be drunk
056	<i>Combretum molle</i> R.Br.ex G. Don. <b>Tree</b>	Combretaceae	Ngkaanyo	Liver disease	<b>Root:</b> Fresh root will be pounded and the extract will be drunk

057	<i>Celtis toka</i> (Frossk.) Happer wood <b>Tree</b>	Ulmaceae	Leero	Loss of appetite	<b>Leaf</b> : Boiled the fresh leaves and drunk
					<b>Seed</b> : Fresh seed will be chewed
058	<i>Diospyros mespiliformis</i> Hochst. ex A. DC <b>Herb</b>	Ebenaceae	Atiuu	Intestinal worms	<b>Leaf</b> :Dry leaf will be boiled in water and drunk
059	<i>Ginger officinale</i> Rosc. <b>Herb</b>	Zingiberaceae	Gingebel	Abdominal problem	<b>Rhizome</b> : Powder of the dry rhizome will be drunk with tea
				Coughs	
060	<i>Cleome gynandra</i> L. <b>Herb</b>	Cleomaceae	Akea	Fever	<b>Root</b> : Fresh root will be chewed
061	<i>Gardenia ternifolia</i> Schumach. & Thonn. <b>Tree</b>	Rubiaceae	Dwoong	Yellow fever	<b>Root</b> : Crshed dry or fresh root will be infused in water and suspension will be drunk
062	<i>Jatropha curcas</i> L. <b>Shrub</b>	Euphorbiaceae	Geebo	Breast ulcer	<b>Sap</b> : Painting the fresh sap of the leave
063	<i>Citrus aurantifolia</i> (Christm.) Swingle <b>Tree</b>	Rutaceae	Lemin	Mouth infection	<b>Fruit</b> : Fruit fresh juice will be drunk

065	<i>Clerodendrum myricoides</i> (Hochst.) Vatke <b>Shrub</b>	Lamiaceae	Tank	Wound	<b>Leaf and flower:</b> Dry leaf and fruit powder will be applied onto the wound
066	<i>Vitex doniana</i> Sweet <b>Shrub</b>	Lamiaceae	Jwiilo	Tooth problem	<b>Bark:</b> Fresh bark will be held on to the affected tooth
067	<i>Albiza lophantha</i> (willd.) I.C. Nielson <b>Tree</b>	Fabaceae	Albizia	Malaria	<b>Leaves :</b> Fresh leaf will be infused in water and suspension will be drunk
068	<i>Indigofera tinctoria</i> L. <b>Herb</b>	Fabaceae	Ngkoorgew	Jaundice	<b>Root:</b> Pounded fresh root will be infused in water and suspension will be drunk
069	<i>Ziziphus abyssinica</i> Hochst. ex A. Rich. <b>Tree</b>	Rhamnaceae	Ongiirro	Eye infection	<b>Root:</b> Fresh root will be sniffed
070	<i>Capparis tomentosa</i> Lam. <b>Shrub</b>	Capparidaceae	Oliillu	Eye infection	<b>Stem:</b> Fresh stem will be sniffed

071	<i>Rhynchosia malacophylla</i> (Spreng.) Eoj. <b>Climber</b>	Fabaceae	Daa	Skin Fungal infection	<b>Leaves:</b> Fresh leaves will be cooked and applied onto the skin
072	<i>Ricinus communis</i> L. <b>Shrub</b>	Euphorbiaceae	Goleey	Male Sexual impotence	<b>Leaves:</b> Dry leaf crushed will be infused in coffee and drunk
022	<i>Ocimum basilicum</i> L. <b>Herb</b>	Lamiaceae	Demakasse	Acute febrile Illness	<b>Leaves:</b> Fresh leaf will squeezed and drink with coffee
024	<i>Datura stramonium</i> L. <b>Herb</b>	Solanaceae	Mezerbaeto	Malaria	<b>Fruit:</b> Powdered dry fruit mixed with honey and two to three spoons are eaten with pounded <i>Allium sativum</i> .
				Dandruff	<b>Fruit:</b> Dried and powdered, fruit mixed with water and used to wash head skin.
055	<i>Cucumis ficifolius</i> A.Rich. <b>Climber</b>	Cucurbitaceae	Kuol	Febrile illness	<b>Root:</b> Fresh root pounded and mixed with cold water and a cup of coffee is given to human.
				Stomach pain	<b>Root:</b> A piece of fresh root chewed and swallowed by human.
029	<i>Dioscorea antaly</i> Jum. & H. Perrier <b>Climber</b>	Dioscoreaceae	Mewodo	Stomach pain	<b>Root :</b> Fresh root will cooked and eaten

**Appendix Table 2. Number of medicinal plant species in each family**

	Family name	No. of plant species	Percentage of plant species
1	Alliaceae	1	2.941
2	Anacardiaceae	1	2.941
3	Annonaceae	1	2.941
4	Asparagaceae	2	5.882
5	Balaniteceae	1	2.941
6	Bignoniaceae	1	2.941
7	Capparidaceae	7	20.58
8	Caricaceae	1	2.941
9	Colchicaceae	1	2.941
10	Combretaceae	1	2.941
11	Convolvulaceae	1	2.941
12	Cucurbitaceae	1	2.941
13 .	Dioscoreaceae	1	2.941
14 .	Ebenaceae	1	2.941
15.	Ephoribiaceae	6	17.65
16 .	Fabaceae	9	26.47
17 .	Lamiaceae	4	11.76
18 .	Liliaceae	1	2.941
19 .	Meliaceae	3	8.823

Table .2. Continued

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20 .	Melanthaceae	1	2.941
21.	Menispermaceae	1	2.941
22.	Moringaceae	1	2.941
23.	Orchidaceae	1	2.941
24.	Poaceae	1	2.491
25.	Rhamnaceae	2	5.882
26.	Rubiaceae	3	8.823
27.	Rutaceae	3	8.823
28.	Sapotaceae	1	2.941
29.	Simaroubaceae	1	2.941
30	Solanaceae	3	8.823
31.	Sterculiaceae	1	2.941
32	Ulmaceae	1	2.941
33.	Vitaceae	2	5.883
34.	Zingiberaceae	1	2.941

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**Appendix Table 3: List of informants in the study area**

No	Full Name	Sex	Age	Marital Status	Education status	Residence kebeles	Occupation
1	Simon Okach	M	58	Married	Degree	Buchala	Farmer
2	Opiew Agwa	M	54	Married	Diploma	Buchala	Farmer
3	Cham Obang	M	43	Married	Degree	Tata	Teacher
4	Obang Okello	M	28	Married	Diploma	Tata	Teacher
5	Okello Ojwok	M	50	Married	Illiterate	Buchala	Store
6	Omod Omod *	M	55	Married	Read & write	Phugnido	Farmer
7	Ojulu Owiti	M	52	Married	Diploma	Phugnido	Teacher
8	Awli Yusuf Omod	F	60	Married	Read & write	Gog	Farmer
9	Okach Ojullu*	M	40	Married	8	Gog	Merchant
10	Ojwok Agwa*	M	40	Married	Higher	Phugnido	Teacher
11	Omod Cham	M	55	Married	Read & write	Gilo	Farmer
12	Okello Agwa	M	35	Married	9	Gilo	Merchant
13	Simon Yusuf	M	45	Married	Higher	Tata	Teacher
14	Both Cham	M	20	Single	12	Buchala	Student
15	Opiew Okach	M	52	Married	Read & write	Gog	Farmer
16	Agwa Obang*	F	50	Married	Read & write	Gog	Farmer
17	Cham Tut	M	38	Married	Higher	Phgnido	Teacher
18	Ojulu Okach	M	42	Married	Read & wri	Gog	Farmer
19	Gilo Chame	M	40	Married	10	Buchala	Merchant
20	Ojalo Okimo	M	48	Married	Read & write	Tata	Merchant
21	Cham Yusuf	M	70	Married	Read & write	Buchala	Farmer
22	Okillo Obang*	M	70	Married	Read&write	Buchala	Farmer
23	Anyeng Olwaua Tut*	F	60	Married	Read&write	Phugnido	Farmer
24	Kwua Ojulu Ochan	M	65	Married	Read&write	Gog	Merchant
25	Ochudho Otor Akwy	M	68	Married	Read&write	Tata	Farmer
26	Obang Othow Owar	M	58	Married	8	Gilo	Merchant

27	Awili Ogut Ojulu	F	42	Married	9	Tata	Merchant
28	Odolo Obang Okello	M	48	Married	Read & write	Gilo	Farmer
29	Achala Omod Lero*	F	59	Married	Read & write	Phugnido	Farmer
30	Obur Oman Ochana	M	47	Married	9	Tata	Merchant
31	Jaak Odil Angauot	M	47	Married	8	Phugnido	Farmer
32	Lam Ojulu Gigilo*	M	60	Married	Read & write	Giolo	Farmer
33	Obang Aballa Ojulo	M	60	Married	Read & write	Buchala	Farmer
34	Ariet Obang Gilo	F	55	Married	Read & write	Gilo	Farmer
35	Kipero Ojho Ochalla	M	50	Married	8	Buchala	Farmer
36	Ojulu Okori Ongwch	M	61	Married	Read & write	Tata	Farmer
37	Opiew Okuma Owiti	M	50	Married	Read & write	Pnugnido	Farmer
38	Abang Oboya Ocan	M	55	Married	Read & write	Gog	Farmer
39	Okello Peter Omod *	M	52	Married	Read& write	Gog	Farmer
40	Okello Ojha Omot	M	60	Married	Read & write	Gog	Farmer
41	Kwar Obany Omod *	M	40	Married	8	Gog	Merchant
42	Ochani Okal Oboya	M	40	Married	Higher	Gilo	Teacher
43	Gillo Ojulu Odheng	M	55	Married	Read & write	Gilo	Farmer
44	Arite Omed Ojulu	F	35	Married	9	Gilo	Merchant
45	Okugn Okumo Obiey	M	45	Married	Higher	Tata	Teacher
46	Medan Oboya Omod	M	20	Single	12	Tata	Student
47	Omod Okello Omon	M	52	Married	Read & write	Phugnido	Farmer
48	Gilo Ogulu Omod	M	50	Married	Read & write	Tata	Farmer
49	Obang Gora Opera	M	38	Married	Higher	Gilo	Teacher
50	Anyeng Omod Okach	F	42	Married	Read & write	Phugnido	Farmer
51	Ariet Gilo Omod	F	40	Married	10	Gilo	Merchant
52	Okony Nyigwo Oboy	M	48	Married	Read & write	Gog	Merchant
53	Didimo Okach Ochde	M	70	Married	Read & write	Gog	Farmer
54	Obang Okuch Ojulu	M	70	Married	Read & write	Buchala	Farmer
55	Ajulu Ojulu Ochang	F	60	Married	Read & write	Gilo	Farmer
56	Ochalla Oboya Okwy	M	65	Married	Read & write	Buchala	Merchant

57	Ajulu Obang Omod	F	68	Married	Read & write	Tata	Farmer
58	Ochudiiio Ochogi Oju	M	58	Married	8	Phugnigo	Merchant
59	Odemi Obel Omod	M	42	Married	9	Phugnido	Merchant
60	Kwow Ochoyi Gar	M	48	Married	Read & write	Gog	Farmer
61	Ojulu Okoo Nark*	M	59	Married	Read & write	Tata	Farmer
62	Ojulu Okelo Agwa	M	47	Married	9	Gilo	Merchant
63	Arite Didemo Agwa	F	47	Married	8	Buchala	Farmer
64	Ojulu Ojulu Obang	M	60	Married	Read & write	Gilo	Farmer
65	Hjon Ojulu Gillo*	M	60	Married	Read & write	Gog	Farmer
66	Ojulu Oman Alebo	M	55	Married	Read & write	Buchala	Farmer
67	Okello Ogut Jobi	M	50	Married	8	Tata	Farmer
68	Okogn Didumo Ocha	M	61	Married	Read & write	Phgunido	Farmer
69	Meeri Agwa Otang	M	50	Married	Read & write	Phgunido	Farmer
70	Okuch Ochalla Oplk*	M	55	Married	Read & write	Tata	Farmer
71	Abang Obaya Ocan	F	52	Married	Read& write	Gog	Farmer
72	Okugn Obang Omod	M	60	Married	Read & write	Gog	Farmer
73	Olock Gillo Oboya	M	40	Married	8	Tata	Merchant
74	Oman Garbi Akwya*	M	40	Married	Higher	Tata	Teacher

Key: with\* are key informants