

*Full Length Research Paper*

# Management, use and ecology of medicinal plants in the degraded dry lands of Tigray, Northern Ethiopia

Emiru Birhane<sup>1,2\*</sup>, Ermias Aynekulu<sup>1,3</sup>, Wolde Mekuria<sup>1,4</sup> and Degitu Endale<sup>1</sup>

<sup>1</sup>Department of Land Resources Management and Environmental Protection, Mekelle University, Mekele, Ethiopia.

<sup>2</sup>Forest Ecology and Management Group, Center for Ecosystem studies, Wageningen University and Research Center, Wageningen, The Netherlands.

<sup>3</sup>Department of Ecology and Resource Management, Center for Development Studies (ZEF c), University of Bonn, Walter-Flex-Str. 3, 53113, Bonn, Germany.

<sup>4</sup>Institute of Soil Sciences and Forest Nutrition, University of Goettingen, Goettingen, Germany.

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**An ethnomedicinal study was conducted to document the indigenous medicinal plant knowledge on the management, use, and ecology of locally important medicinal plants in Tigray, Northern Ethiopia. Ethnobotanical data were collected from 250 people, using semi-structured questionnaires, field observation and informal discussion. The ethnomedicinal use of 259 plant species mainly herbs (31 to 51%), shrubs (31 to 46%) and trees (13 to 39%) used to treat 147 human and livestock ailments were documented in the study area. The most frequently used plant part were roots (49%), followed by leaves (37%) and bark (14%)... Crushing (59%), homogenizing with ingredients (17%) and chewing (14%) were the commonly used forms of herbal preparation. Drinking (45%), smoke inhalation (12%) and tie and hold on (10%) were the most frequently used methods of application. Most of the medicinal plants are collected from the wild. The use of more than one species was reported for remedy preparations and some health problems were treated by more than one medicinal plant. Our result showed that the local communities give less attention for the management of medicinal plants as local communities consider medicinal plants as wild, have unattractive market value and lack of knowledge. The mismanagement together with loss of habitat showed that ethnomedicinal plant species used by healers are under serious threat which indicates the need for urgent attention towards their documentation, conservation and sustainable utilization.**

**Key words:** Ethnobotany, ethnomedicine, ecology, healers, management, medicinal plants, dry land, Tigray.

## INTRODUCTION

Ethiopia is characterized by a wide range of ecological, edaphic, and climatic condition that accounts for the wide diversity of its biological resources both in terms of flora and fauna (Abebe and Ayehu, 1993; Girma, 1998). The plant genetic resources of the country is enormous as seen in the fact that Ethiopia is one of the twelve vanillin centers of origin for domesticated crops and their wild and weedy relatives. It is also estimated that there are more than 700 species of flowering plants recorded in

Ethiopia, of which 12% or more are probably endemic (Kaba, 1996). Among the African countries, Ethiopia is often quoted as one of the six countries of the world where about 60% of the plants are said to be indigenous with healing potential (Kaba, 1996). There are about 213 families of flowering medicinal plants in Ethiopia and of the 92 families, with one family of gymnosperm and one family of fern are known to contain medicinal properties (Edwards and Asfaw, 1992).

In Ethiopia it is well known that traditional medicines are widely used especially in the low income rural parts of the country (Addis et al., 2002). It is reported that nearly 80% of the population in the country use plant

\*Corresponding author. E-mail: [emirubirhana.hizikias@wur.nl](mailto:emirubirhana.hizikias@wur.nl).

based traditional medicines as their healthcare system (Teklehaymanot and Gidey, 2007). The wide utilization of plant based-traditional healthcare is mainly attributed to the fact that it makes use of locally available plant resources (Kassaye, 1996; WHO, 1999). The majority of medicinal plants, with few exceptions, are harvested from wild habitats, which are currently under great threat (Iwu, 1993; Abebe and Ayehu, 1993; Girma, 1998). Inadequate health centers and shortage of medicines and personnel in clinics could also be the reasons behind using traditional medicines as a substitute for modern medication (Nyazena and Kire, 1986; Akerele, 1993; Abebe, 1996).

However, medicinal plants of Ethiopia are subjected to continuous depletion and are threatened with extinction due to habitat loss and over exploitation (IBC, <http://www.ibc.gov.et/Assets/Pages/MedicinalP.html>).

The danger poses a threat to the well-being of the rural population which has, for generations, relied on the plants to ward off some of the common ailments in both human beings and domestic animals. Both the plant materials and associated traditional knowledge are being lost due to lack of systematic conservation, research, proper utilization and documentation. In addition, resource persons with the knowledge of using and processing these plants are not willing to transfer their wisdom, with the mere belief that if they tell the remedial potential of the plants will be lost. As a result the wisdom and knowledge they acquire will be buried with them, if a systematic method of documenting the existing knowledge is not employed. Thus, for the benefit of the existing and future generations we have the responsibility of ensuring that the use of medicinal plant genetic resources is scientifically sound and ecologically sustainable.

In response to this, some ethnomedicinal studies (Tadesse and Sebsebe, 1992; Abebe and Ayehu, 1993; Abbink, 1995; Giday, 2001; Tessema et al., 2001; Addis et al., 2002; Schulz et al., 2001; Gedif and Hahn, 2003; Gemedo, 2005; Teklehaymanot and Gidey, 2007) were conducted in the recent past in different parts of the country. But considering the country's varied flora and the socio-cultural diversity, these studies are few as ethnomedicinal healing systems and existence of plant species vary across cultures and agro-ecology. Today, many medicinal plant species face extinction or severe genetic loss but detailed information is lacking. For most of the endangered species no conservation action has been taken, and there is not even a complete inventory of medicinal plants. Much of the knowledge on their use is held by traditional societies, and the knowledge is usually transmitted verbally (Abebe and Ayenu, 1993; Pankhurst, 1965, 1990).

Therefore, more studies on the management, use and ecology of medicinal plants across the country are needed. This study seeks to respond to five central questions:

1. To what extent the local communities are dependent on traditional use of medicinal plants and are these resources degrading?
2. Which part(s) of the medicinal plant is mostly used for medication and what is the implication to sustainable use of the resources?
3. Do the local communities perceive medicinal plants important and should be managed properly?
4. What other ecological, cultural and economic benefits do medicinal plants have?

## MATERIALS AND METHODS

### Study area

This study was conducted in Tigray, the northern most region of Ethiopia (Figure 1). Tigray located between 12° 15' to 14° 50' N latitude and from 36° 27' to 39° 59' E longitude. It has an estimated total population of 4,335,000 consisting of 2,136,000 men and 2,199,000 women (CSA, 2005). 3,519,000 or 81.2% of the population are estimated to be rural inhabitants, while 816,000 or 18.8% are urban. With an estimated area of 50,078.64 km<sup>2</sup>, Tigray has an estimated population density of 86.56 people per km<sup>2</sup>. The land holding ranges between 0.5 and 0.75 ha per household. The climate is characterized as tropical semi-arid area with long dry season and has an erratic rainfall between June and September. Some parts of the southern and eastern zones of the region have a bimodal type of rainfall with short rains between February and April (Tesfay, 2006). The mean annual rainfall in the region varies from 200 mm in the east to over 950 mm in the south western part of the region. The length of the growing period varies from 75 to 90 days. The average annual temperature ranges from 15 to 25°C.

The major type of land use comprises 36% bush and shrub land, 28% cultivated land, 23% grass land and other forms of land use account for 11% (Tesfay, 2006). The natural forest resource of the region is overexploited and covers only about 0.2% of the total land area (Tesfay, 2006). Practically all the land is opened up for cropping and grazing. Hardly any vegetation cover is seen in the arable lands except in exclosures, churches and some fallow areas of the previous cropping season. The decline in forest cover is mainly attributed to human economic activities and population pressure (Nyssen et al., 2004).

Five districts from different agro-climatic zone (lowland and highland) of the region were selected to gather diversified information on the management, use, and ecology of medicinal plants in the region. Out of the five selected districts, three of them were selected from the lowland (500 to 1500 m.a.s.l) part of the region. This is mainly because; lowland inhabitants are more dependent on traditional medicines than the highlands. According to the information from the different health centers of each study site, the existing health facilities are inadequate. The main reason for this poor health status in the area is unavailability of some basic infrastructures, especially electricity and lack of skilled manpower. The specific situations of the five selected woredas are indicated in Table 1.

### Sampling, data collection and analyses

Ethnobotanical data were collected using purposive sampling. This sampling technique was preferred because the study focuses on specific issues that can be well known by few groups of the society. Old people, people who know traditional medicines, local healers, empowered persons, local administrators; users and women were

## Administrative Weredas of Tigray Region, Ethiopia



**Figure 1.** Location of the study sites.

included to gather a wide range of information on the management use and ecology, of medicinal plants. The full names and residential addresses of traditional healers residing in the five kebeles (lower level of administration) of the five districts selected were exhaustively identified and registered with the help of local administrators, local people, translators and field assistants. Individuals who were indicated to know and practice at least one medicinal plant species were considered as traditional healers in this study. A total of 250 respondents from the entire study sites which were identified as healers were randomly selected for interview. Semi-structured interviews were then employed and observations made to collect ethnomedicinal data with the help of local people and field assistants. Data on, human and animal diseases treated, local names of plants used, degree of management (wild/cultivated), abundance, parts used, condition of plant part used (fresh/dried), methods of remedy preparations, remedy preservation (storage), dosage prescriptions, routes of remedy administration, noticeable adverse effects of remedies, use of antidotes for adverse effects, indigenous knowledge transfer, other uses of the ethnomedicinal plant species, existing threats to these species and traditional conservation practices were gathered during the interviews. Besides, transect survey and personal observation was conducted to see and understand the ecological preference of medicinal plants. Observations were made on the morphological features and habitats of each medicinal plant species in the field. We accompanied the traditional healers and made field

visits to observe and collect medicinal plant species reported to treat ailments. Sample specimens of each medicinal plant species were collected during the field visits and allotted collection numbers. The collected specimens were then dried, identified through the flora of Ethiopia and Eritrea, and useful trees and shrubs for Ethiopia. Plants which were difficult to identify on site were pressed and taken to the National herbarium of Addis Ababa University for identification.

### Data analysis

Facilities in MS Excel spreadsheet were utilized to make simple calculations, determine proportions and draw bar graphs. Ethnobotanical data were entered in to Excel spreadsheet and summarized using descriptive statistics. The spreadsheet data filter facility was employed to determine frequencies of citations so as to identify the most common ailments in the study area, popularly used medicinal plant species and multipurpose plant species to determine proportions of different variables like growth forms, source of collection, degree of scarcity, plant part used, methods of preparation and threatening factors. The preference values/scores assigned by key informants for selected medicinal plant species were added and ranked during the preference ranking and direct matrix ranking activities.

**Table 1.** Common plant species, health facilities and top ten diseases found in the study sites.

Specific study site	Common plant species	Health facilities		Top ten diseases in the year 2006/2007 in their order
		Type	Number	
T/Abergele	<i>Acacia etabica</i>	Clinic	3	Malaria
	<i>Azadirachta indica</i> ,	Health post	4	Parasite
	<i>Acacia pilipsina pic-serm</i>	Health center	1	Diarrhea
	<i>Eucalyptus citiodora</i>			Eye infection
	<i>Acasia nubica</i>			Dyspepsia
	<i>Alisicorpus ferruginews</i>			Upper respiratory tract infection
	<i>Salanum incanum</i>			Skin disease
	<i>Calotropis procera</i>			Tonsillitis
	<i>Capparis micrantha</i>			Common cold
	<i>Bascia ongustifolia</i>			Arthritis
	<i>Piliostigma thonningii</i>			
	<i>Acacia etabica</i>			
	<i>Azadirachta indica</i>			
	<i>Acacia pilipsina pic-serm</i>			
Atsbi Wonberta	<i>Juniperous procera</i>	Clinic	8	Common cold
	<i>Eucalyptus Camalulensis</i>	Health post	11	Respiratory infection
	<i>Acacia seyal</i>	Health center	1	Intestinal parasite
	<i>Eucalyptus globules</i>			Skin disease
	<i>Dodonea angustifolia</i>			Tuberculosis
	<i>Olea European</i>			Epilepsy
	<i>Cordia africana</i>			HIV/AIDS
	<i>Acacia etibica</i>			Tonsillitis
	<i>Ficus vasta</i>			Gonorrhea
				Malaria
	<i>Boswellia papyrifera</i>	Clinic	5	Malaria
	<i>Melea azedrach</i>	Health post	6	Diarrhea
	<i>Acacia spp.</i>	Health center	1	Headache
	<i>Azadricha indica</i>			Skin disease
Tahtay Adiabo (Sheraro)	<i>Balanites aegyptica</i>			Eye infection
	<i>Delonix regia</i>			HIV/AIDS
	<i>Ziziphus spina-christi</i>			Tonsillitis
	<i>Adanasonia digitata</i>			Internal parasite
	<i>Ficus spp.</i>			Arthritis
				Dyspepsia

Table 1. Continued.

Raya Azebo	<i>Roza abyssinica</i>	Clinic	12	Malaria
	<i>Eucalyptus</i> spp.	Health post	18	Tuberculosis
	<i>Ficus palmata</i>	Health center	1	Skin disease
	<i>Calotropis procera</i>			Abdominal colic
	<i>Crinum schimperi</i>			HIV/AIDS
	<i>Hypericum revolutum</i>			Rabies
	<i>Rhamnus prinoides</i>			Gonorrhea
	<i>Solanum incunum</i>			Evil eye,
	<i>Hagenia abyssinica</i>			Eczema
Medebay zana				Abdominal parasite
	<i>Acacia lehay</i>	Clinic	6	Malaria
	<i>Cordia africana</i>	Health post	8	Diarrhea
	<i>Acacia albida</i>	Health center	1	Intestinal parasite
	<i>Eucalyptus camaldulensis</i>			Cough/Common cold
	<i>Schinus molle</i>			Eye infection
				HIV/AIDS
				Allergy
				hemorrhoids
				Respiratory infection

Source: Tigray region bureau of health 2006/2007 six month report.

## RESULTS AND DISCUSSION

### Ecology and life forms of medicinal plants

The site preference of medicinal plants was variable from site to site (Table 2). Most of the trees and shrubs were restricted to areas which are inaccessible to livestock and human interference. Almost all herbs were found in wet areas, river banks and valleys. This could be due to their shallow roots which can not bring water from deep in the surface and all of them were available during the rainy season only. Moreover some trees and a few shrubs were also found in river banks and valleys. In three of the five

investigated districts, no medicinal plants of any life form were found around homestead. This could be an indication of lack of efforts in domesticating medicinal plants and the degradation of medicinal plants was not considered as a serious problem.

The identified medicinal plants were comprised of mainly herbs, shrubs and trees. The proportion of herbs ranges from 31 - 51%, shrubs (31 - 46%), and trees (13 - 39%) across the whole studied sites (Figure 2). A study conducted by Teklehaymanot and Gidey (2007) also indicated the dominance of herbs (52%) in the list of the identified medicinal plants in Northwest Ethiopia. Other studies conducted in Ethiopia showed

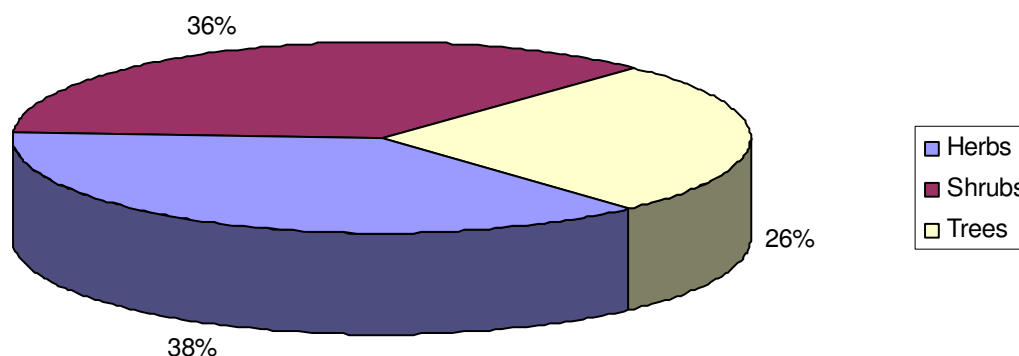
similar results (Schulz et al., 2001; Tessema et al., 2001). The dominance of herbs in the identified medicinal plants could have a negative implication since their growth could easily be hampered by recurrent drought which is common in all studied sites.

### Parts used and processes of preparation

The findings indicated that the plant parts used and condition for medicinal preparation depends on the availability of the species in question. Healers used fresh specimens from commonly available plants to prepare remedies for their

**Table 2.** Distribution of Medicinal plants among the micro-habitats of the study sites (%).

Micro-habitats	Study sites				
	T/Abergele	Atsibi	Sheraro	Raya Azebo	Medebay zana
Mountainous /hilly	31.25	18.90	22.86	12.90	62.00
Flat lands	31.25	10.00	57.14	64.30	21.00
Valley	27.80	-	5.70	6.40	-
River banks	9.70	8.90	-	4.00	5.00
Hilly and flat land	-	1.10	1.40	-	10.00
River bank and flat land	-	-	12.50	-	-
Valley and flat land	-	-	1.40	-	-
Homestead	-	11.10	-	12.40	-
No preference	-	50.00	-	-	2.00

**Figure 2.** Life forms of the identified medicinal plants (%).

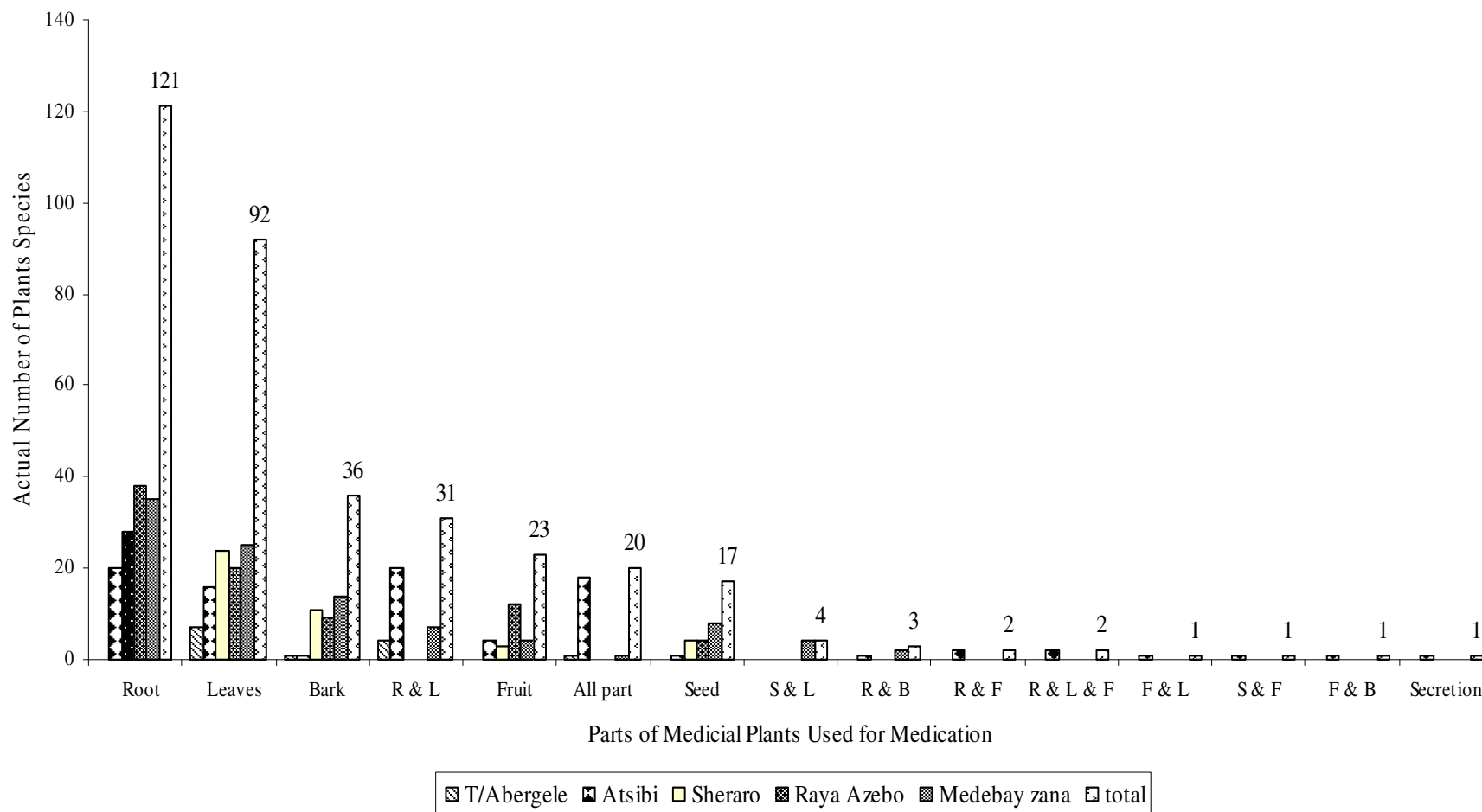
patients. But, for rare and seasonally available plant species, they stored and used dried specimens. The parts used for medication purpose varies from species to species. For most of the identified medicinal plants roots, leaves and bark were predominantly used plant part for medication (Figure 4). According to the aggregate results from the five study sites, root followed by leaf and stem were the most commonly plant parts harvested (Figure 3). The most frequently used plant part were roots (Mesfin et al., 2009) followed by leaves (Lulekal et al., 2008). The study conducted in Northwest Ethiopia (Teklehaymanot and Gidey, 2007) demonstrated that the underground part (root/rhizome/bulb) was the most frequently utilized plant part (42%). In other study conducted in Ethiopia, root (58.3%) was one of the most extensively used plant part in preparation of traditional herbal medicine (Abebe and Ayehu, 1993). Katambo (1999) has also reported 65% of herbal prescription from roots in a study carried out in Tanzania.

The extensive use of roots for preparation of traditional herbal medicine could result in complete destruction of the medicinal plants. An estimate of the threat to medicinal plants can be made from the type of plant and the part used. Harvesting the root of a tree poses more

of a threat than collecting the fruits and seeds, and this can be more threatening than using the leaves (Jensen, 1981). Widespread utility of root parts as being detrimental to the survival of plant species, especially plants with high demand and low populations (Katambo, 1999).

The medicinal plant parts are processed in various forms and administered through various routes (Table 3). The aggregate result of the five sites studied indicated that crushing (59%), homogenizing with ingredients such as water, honey, coffee, milk and local beer (17%) and chewing (14%) are the commonly used form of herbal preparation for both human and livestock health problems although there was variation from site to site. Drinking (45%), smoke inhalation (12%) and tie and hold on (10%) are the most frequently used methods of application. The routes of application of the prescriptions are oral (57%), dermal (29%), nasal (13%) and others (<1%) each.

Most of the surveyed medicinal plants prescriptions involved the use of single plant specie or a single plant part and different plants or parts used together. However, in contrast to most of the specific study sites, informants in Atsbi Wenberta site indicated that different plant species and parts of a single plant used for the



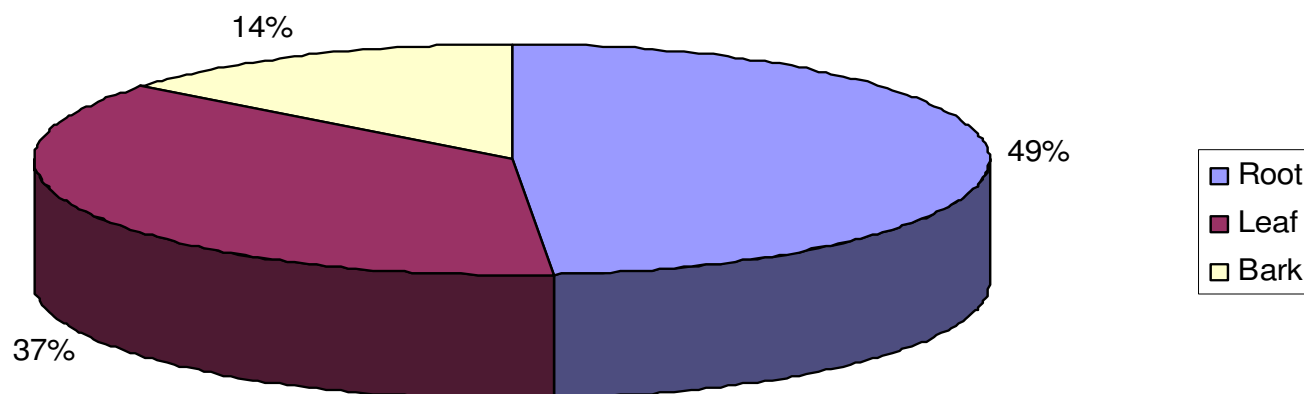
**Figure 4.** Proportion of the different parts of the identified medicinal plants used for medication: R= Root, L= Leaf, B= Bark, S= Stem, F= Flower.

Preparation of different remedies. Yirga (2010) reported that 16 plant species were commonly used to treat various human ailments. The study also revealed that a single plant species could be used to treat more than one disease. Besides, some health problems were treated by more than

one medicinal plant. Health problems such as Gussay, Colic, and Stomachache were treated by 30, 19, and 17 different plants respectively. Ingredients often used in the preparation of remedies for certain health problems include coffee, tea, honey, local beer and animal products

such as milk and butter. Milk is often used to arrest continued vomiting or diarrhea after the administration of remedies for series diseases.

The respondents' indicated that there were variation in quantity of remedies, unit of measurement of remedies, duration and time of use of



**Figure 3.** Frequency of plant parts used for the preparation of Medicinal Plants (%).

**Table 3.** Method of preparation and application of medicinal plants used to treat human ailments.

	Study sites									
	T/Abergele		Atsibi		Sheraro		Raya Azebo		Medebay zana	
	Species number	%	Species number	%	Species number	%	Species number	%	Species number	%
<b>Form of preparation</b>										
Crushing	7	53.8	40	44.4	49	68.1	38	45.8	77	77
Soaking	1	7.7	6	6.7	0	0	0	0	3	3
HIW	1	7.7	25	27.8	14	19.4	15	18.1	6	6
Chewing	3	23.1	13	14.4	5	6.9	19	22.9	11	11
Boiling	1	7.7	6	6.7	2	2.8	2	2.4	3	3
Decoction	0	0	0	0	2	2.8	9	10.8	0	0
<b>Method of application</b>										
Firing	1	7.7	0	0	0	0	0	0	0	0
Simmering	0	0.0	12	13.3	2	2.8	0	0	0	0
Washing	1	7.7	2	2.2	7	9.7	5	6.0	3	3
Dropping	0	0.0	2	2.2	7	9.7	1	1.2	1	1
Eating	0	0.0	2	2.2	0	0	1	1.2	3	3
THO	3	23.1	6	6.7	7	9.7	15	18.1	5	5
Rubbing	1	7.7	8	8.9	14	19.4	10	12.0	2	2
CSJ	3	23.1	5	5.6	3	4.2	14	16.9	8	8
Drinking	4	30.8	23	25.6	28	38.9	32	38.6	67	67
SIH	0	0	30	33.3	2	2.8	1	1.2	9	9
Smelling	0	0	0	0	2	2.8	4	4.8	2	2

SIH = smoke inhalation, CSJ = Chew and swallow juice, THO = Tie and hold on.

preparations prescribed by healers for the same kind of health problems.

#### Categories of health problems and treatment methods

During the survey 147 different health problems

confronting human and livestock health (130 human and 17 livestock) were found. These health problems are generally categorized as infections, general complications, diet-related, cancer-related, allergies, evil eye or evil spirit, wounds and sores and others. The local naming of some of these health problems is often related to specific body parts, like headache, stomachache, eye disease, or to the causative agents, such as snake bites.



Herbal preparations recommended for internal health problems are mainly taken by drinking. For the general complication such as headache and fever, steam bath or smoke inhalation was recommended. For skin diseases and fungal infections, herbal preparations are applied by rubbing on the affected regions of the body. For health Problems associated with allergies and bleeding wounds, the herbal medicines are commonly applied by holding on the affected regions.

### Management and additional use of medicinal plants by local people

Most of the respondents (90%) indicated that they did not give much attention for the management of the traditional medicinal plants. This could be explained by the lack of knowledge as important medicinal plants are known by few local healers. However, few respondents revealed that the existence of some medicinal plants like herbs in abundance could also contribute to the mismanagement of medicinal plants.

There were also some other reasons mentioned behind this, such as position of the plants (most of the plants were found too far from home gardens) which makes their management difficult. Yirga (2010) indicated that, most of the species (68.75%) identified as medicinal plants were wild. Most of the medicinal species (90.4%) were collected from the wild (Lulekal et al., 2008). The mismanagement together with deforestation, overgrazing and drought results the reduction in number and diversity of trees and shrubs used for medication. The principal threatening factors of medicinal plants were deforestation, agricultural expansion and fire (Bekalo et al., 2009, Lulekal et al., 2008). As a result, some of the trees and shrub species such as *Olea europaea* and *Hagenia abyssinica* were locally at the verge of extinction.

The survey revealed that medicinal plants have cultural, social, ecological and economic uses in addition to their major role. 36.36% of respondents from Sheraro replied medicinal plants provide additional value. However, 63.63% of the respondents confirmed that medicinal plants are not commonly used for their additional value. The justification given for this was the reduction in population of the medicinal plants. Hence it is difficult to get additional benefits from the few remnants once. This group of respondents strongly advised to use non medicinal plants for other purposes to save the extinction of important medicinal plant species.

Majority of the identified medicinal plants play ecological roles by protecting soils from erosion through reducing erosive forces of the rain drop and through reducing velocity of run-off water. Some of these plants have also cultural and economic values, means they are used to make stool (bench), bed, milk container, butter container and other culturally used home furniture.

In addition large trees like *Croton macrastachyus* have

social and economic value, used as shed during community meeting, as fodder for animals (especially for goats and camels), for house and fence constructions. Most trees and shrubs of those medicinal plants are commonly used for fuel wood.

### Market value of medicinal plants

Most of the medicinal plants had no market value. This could be explained by cultural reasons. Most of the local healers had a strong relationship with the majority of the society and this hindered to get market value or reduce the market value of medicinal plants dramatically. It was observed that few medicinal plants such as *Citrus Limon*, *Zizyphus spina-christi*, and *Lepidium sativum*, had market value. However their market price was not still attractive. They were supplied to the market in different forms, but the most common parts sold in the market were leaves, roots, seeds and fruits.

### Conclusions

The local communities in the study area did not have good plant use and management practices, which could make a valuable contribution to promoting conservation activities in the region. The major used parts were roots, leaves and barks. Widespread utility of roots, leaves and barks, existing mismanagement of medicinal plants, over harvesting for other purposes, such as fire wood and construction could lead to loss of the plants from the local area. Moreover, pressure from overgrazing and agricultural expansion together with recurrent drought aggravated the threats to the medicinal species. Therefore, awareness creation campaigns are timely needed to improve local community's knowledge on the importance and management of medicinal plants.

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