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Harla journal of Applied Science and Materials

Use and Management of Medicinal Plants by Local People of Harari People National Regional State, Eastern Ethiopia

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Abstract

The Ethiopian people used traditional medicine predominantly as primarily health care system. Therefore, an ethnobotanical study of medicinal plants was carried out from February to August, 2022 in Peoples of Harari Regional State, Eastern Ethiopia. The main objective of this study was to investigate and document indigenous knowledge of people on the use and management of medicinal plants in the study area. The study involved traditional healers, knowledgeable elders and local communities that have the practice of handling medicinal plants. Eighty informants were involved in data acquisition and used semi-structured interviews, guided field walks and focus group discussions. Preference ranking, informant consensus factor, direct matrix ranking and descriptive statistical method were employed to analyze the data. A total of 57 medicinal plants species were recorded to treat livestock and human ailments and these medicinal plants belong to 52 genera, 35 families. From the total medicinal plants species, 42 species were recorded for the treatment of human health problems, 7 species for livestock and 8 species for the treatment of both human and livestock. The highest habit of medicinal plants were tree accounted for 27 (47.36%). The most frequently plant parts used were leaf accounted for 23 (40.3%). Oral administration was the dominant route of administration which accounted for 17 (32.5%). Crushing and pounding accounted for 40 (70.2%) were the highest methods of preparation. The main threat for medicinal plants in the area arises from agricultural expansion, firewood, charcoal production, and others. Therefore, beyond awareness creation for sustainable use of medicinal plants, wise land use planning and encouragement for their cultivation to enhance their availability and complement ex-and in-situ conservation need due attention in the study area.The abstract part of the manuscript is not full. The discuss and the conclusion were not included. The background of the study which is also another part of the abstract explained poorly, needs revision.

Key words/ phrases: Ethnobotany, indigenous knowledge, traditional, medicine,

1. Introduction

Ethnobotany is defined as the study of local people's interaction with the natural environment: how they classify, manage, and use plants available around them (Limenih Yigezu *et al.*, 2015; Getaneh Zenebe, 2019). In Ethiopia, about 80% of the human

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Doi: https://doi.org/10.20372/hjasm.v1i2.48

Received: March 2022; Received in revised form: April 2022; Accepted: May 2022

population and 90% of livestock is believed to be dependent on traditional medicine (Mengistu Mola *et al.*, 2019; Aragaw Tesema *et al.*, 2020). About 887 plant species were utilized in traditional medicine in Ethiopia. Amongst these 26 species are endemic and they are becoming gradually rare and are on the verge of extinction (Tesema Tefari *et al.*, 2003; Tefera Biniyam and Kim, 2019).

Ethiopia is increasingly making efforts to protect their genetic resources and traditional medicinal knowledge through conservation and national legislation for benefit sharing but, lack of well documented information on community knowledge (EBI, 2020). Therefore, there is a need to document the medicinal and aromatic plants associated indigenous traditional knowledge demanding due attention before depletion of indigenous knowledge in the elder people of the community (Tamer and Sanjay, 2013). Various study indicated that local experiences which have been gained through generation to solve indigenous problems are disappearing due to lack of written documents, death of elders, migration of people due to drought and social problems, urbanization, influence of modern veterinary medicine and exotic cultures (Bekele Endale, 2007; Agisho Heyle *et al.*, 2014).

Collecting and documentation of indigenous traditional medicinal plants are important than ever to preserve associated knowledge and medicinal plant biodiversity in different area of the country in order to assist modern drug improvement. Though people around Harari Agroecology and vegetation are gifted with indigenous knowledge of how to use and conserve herbal plants to secure their health as well as the health of their livestock, it is not yet scientifically documented as few ethno-botanical documentations on most medicinal species and the indigenous knowledge in the study area. It can be said that ethnobotanical studies were merely at the start in Ethiopia there have been some attempts in investigating medicinal plants uses and there was as yet, no in depth study on the relation between medicinal plants and indigenous knowledge on sustainable management of such plant species (Habtamu Tedila and Getu Dida, 2019). Therefore, the aim of this study was to investigate and document the traditional medicinal plants used by local people, way of practice and mode of delivery for the treatment of human and livestock aliments, as well as to document the current status of traditional knowledge and utilization of medicinal plants in the Harari regional state, East Ethiopia.

2. Materials and Methods

2.1. Description of the study area

The study was conducted in Harari Regional State, Eastern Ethiopia; 525km far from Addis Ababa, Ethiopia. The study area lies between 9º 31`N latitudes and 42º 12` E longitude (Fig. 1). The climate of the area is described as 66% of the sub-tropical and 34% of tropical. The study area is found within the altitudinal range of 1310 (Erer Valley) to 2250 (Aw-Hakim Mountain) meters above sea level (m.a.s.l.) (UNESCO, 2006). The area is dominated by mountainous and undulating landforms, including rugged terrain, steeply sloping hills and valley bottoms (Harari Regional State Planning and Economic Development Bureau, 2015). The average annual daily temperature of the area is 19.3 ^{0}C, while the annual average minimum and average maximum daily temperatures are 13.1^{0}C and 25.3 ^{0}C, respectively. February to May are the warmest months whereas November to January are the coldest months. The regional state has total population of 183,415 (92,316 men and 91,099 women) where majority of them live in urban area (99,368, 54.18%) with an estimated area of 311.25 square kilometers (CSA, 2009).

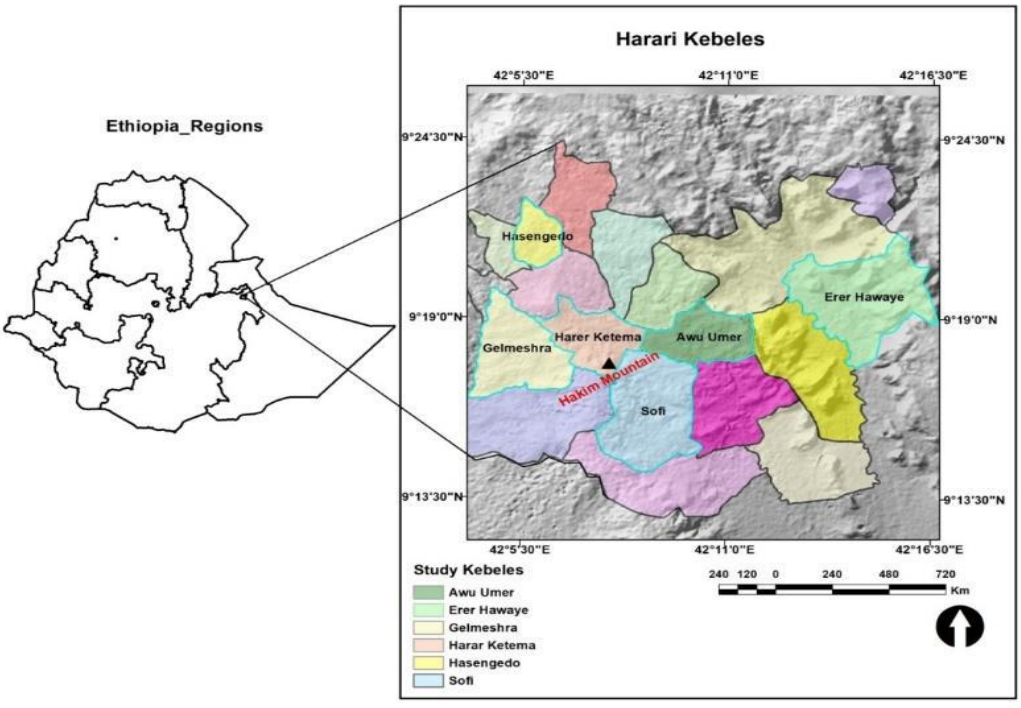

Figure 1. Map showing the study areas of medicinal plants.

The reconnaissance survey was conducted from October, 2021 to November 2021 before data collection for selection of study sites based on the information gathered from

Harari Regional State health office, agricultural office and other people in the study area. The study was conducted from five districts namely Aboker (Awu-Umar), Hakim (Harar Ketema), Sofi, Erer and Dire-Teyara (Hasenge) of Harari People's National Regional State, Eastern Ethiopia.

2.2. Data collection method

The date was collected through purposive sampling method based on availability of traditional healers identified with the assistance of regional state health office, local authorities, Kebele administration leaders, elders and religious leaders. it was collected from March 2022 to April 2022.

Sampling of Informants

A total of 80 informants (60 males and 20 females) between 30 – 80 years of age were selected from the five districts by using purposive and random (probability) sampling techniques. The purposive sampling technique was used key informants that had an official permission for their traditional health care practices. Information regarding healers was obtained from regional state health office. In the same views, random sampling techniques was used to select 60 general informants (Table 1).

Table 1. Number and distribution of general and key informants used in the study

Districts	Total households	General informants			Key informants			Total
		M	F	Total	M	F	Total	
Aboker(Awu-Umar)	1300	9	5	14	3	1	4	18
Hakim (Harar Ketema)	791	5	3	8	2	1	3	11
Sofi	1155	8	4	12	3	1	4	16
Erer	1007	7	3	10	3	1	4	14
Direteyara (Hasenge)	1515	11	5	16	4	1	5	21
Total	5768	40	20	60	15	5	20	80

Interviewing protocol and ethical consideration

In this study, legal supportive letters were obtained from Dire Dawa University Biology department. Harari Peoples' National regional state health offices and regional health offices were permitted and gave a collaborative letter and lists of officially recognized traditional healers of each district to conduct the study in the selected districts. Oral informed consent was obtained from all study participants. Then after field guides were used to contact healers and collect Medicinal plant specimens.

Ethnobotanical data collection

Ethnobotanical data was collected from March to April, 2022. In the data collection procedures, first Key informants were interviewed individually to mention about the local names of the plant species, their use to treat diseases, habit, habitat and type of diseases treated with, part(s) of plants used, and methods of preparation of remedies, dosage, route of application and factors that threaten medicinal plants. Then, group discussions and field walk for onsite observation of the plants was made with them respectively. Similar procedure was applied with randomly selected non-practitioners of traditional medicine for collecting medicinal plant data organized through survey questions. This study used Semi-structured interview, focus group discussions and field observation. Semi-structured interviews were conducted in the local Oromo language to collect the basic information on the indigenous knowledge, for instance, traditional uses of medicinal plant species together with their local names, local name of the disease treated, clinical symptoms of diseases treated, parts of plant used, solvents or ingredients added, methods of preparation and the route of administration. All relevant data including the strategies they use for the conservation of medicinal plants were collected and the collected data was translated into English with the help of experts in the field observation. During the discussion ethnobotanical knowledge was gathered from the residence and knowledgeable members of the community and recorded carefully.

Voucher specimen collections and identifications

Medicinal plants were collected mainly from wild and home garden sources. The local names, habits, habitats and associated information about plants were recorded for each of the species. Voucher specimens were collected, pressed, numbered and given vernacular names on each sheets and dried. The plant specimens were transported to Haramaya University, School of Plant Science Herbarium to identify and give scientific name using taxonomic keys from the volumes of the Flora of Ethiopia and Eritrea (Hedberg *et al.*, 2006) by the help of deposited authenticated specimens and plant taxonomists and by making a comparison with the already identified specimens. Then after, the identified medicinal plant specimens were deposited at Haramaya University Herbarium.

Data Processing and Analysis

Descriptive statistics were applied to analyze the required information gathered on medicinal plants' number and percentage as well as their families, medicinal value, application, methods of preparation, route of application, disease treated, part and growth form used, threats and conservation methods (Alexiades, 1996). Data on informants' backgrounds and medicinal plants in the districts were entered into Excel spreadsheet software and prepared for statistical analysis. Statistics such as percentiles, figures and Graphs were used to summarize the collected medicinal plants. SPSS Statistical Package for Social Science Version 20 software was used to produce presented graphs. The ethnobotanical data were analyzed both qualitatively and quantitatively using informant consensus factor (ICF), fidelity level (FL), preference ranking, Jaccard's coefficient of similarity and direct matrix ranking. All of these mechanism for data analysis and triangulation techniques were stated as the following:
Preference ranking was computed following Martin (1995) for six medicinal plants in treating diseases. The key informants were selected to identify the best preferred MPs for the treatment of ailments based on their personal preference or perceived degree of importance in the community. They were informed to assign the highest value (6) for the most preferred plant species and the lowest value (1) for the least preferred ones. Finally, the values were summed up and the ranks given to each plant. Direct matrix ranking was determined by using multipurpose plant species selected out of the total medicinal plants, and use diversities of these plants. Based on information gathered from informants, average value of each use diversity for a species was taken and the values of each species sum up and ranked. In addition, some ethnobotanical analytical tools including fidelity level index (FL), Jaccard`s Coefficient of Similarity (JCS) and informant consensus factor (ICF) were used for data analysis.

3. RESULTS AND DISCUSSTION

3.1 Distribution and types of medicinal plants in the study site

In the study areas, a total of 57 plant species distributed in 35 families and 52 genera were documented as medicinal plants to treat 24 ailments of both human and livestock. The ethno medicinal study result showed that there are 57 medicinal plants used to treat various ailments (Table 1). This indicated people in the study area have a tradition of using diverse plants as herbal medicine for themselves and their livestock. Cultural

acceptability, ease of accessibility and less cost could be the factor to rely on traditional medicine (Ermias Lulekal, 2014).

The number of medicinal plants species recorded in the study area was higher than to those reported elsewhere in Ethiopia such as in Aba'ala district (50 species; Meragiaw Mola, 2016), Asgede Tsimbila districts (51 species; Zenebe Girma *et al*., 2012) but it was less in Ankober (151 species; Ermias Lulekal, 2014), Central Zone of Tigray (129 species; Abreha Girma *et al*. 2018), Kilte Awlaelo (114 species; Teklay Ayale *et al.*, 2013), South Omo (91 species; Tolossa Kebede*et al.*, 2013). The variation in the number of reported medicinal plants of the study area with other parts of the country, possibly associated with cultural use and perception difference among the study communities, altitudinal variations and climate difference of the study area (Masika and Afolayan, 2003; Akhagba, 2017).

Out of fifty-seven medicinal plant species distributed and documented in the study area which belong to 35 families and 52 genera, family Solanaceae were the highest number of genera accounted 4 (7.4%), and family Lamiaceae has the highest number of species which contributed 5 species. The presence of a higher number of plant species for traditional medicines from the family Lamiaceae could be due to the adaptation potential of the species in the family in a wide range of altitudes in the study area.

of the reported medicinal plants, 42 (73.7%) species which belong to 41 genera and 31 families were used to treat 15 types of human ailments, 7 (12.3%) species which belong to 7 generaand7families were used to treat 4 types veterinary ailments, and 8 (14%) species which belong to 8 generaand7families were used to treat 5 both veterinary and human ailments. The finding shows large numbers of medicinal plants were used to treat human diseases compared with livestock ailments. As a result, they could acquire lower knowledge of medicinal plants to treat livestock ailments than knowledge of medicinal plants treating human ailments. To compare this result with the study of Endalew Amenu, (2007) that a total of 47 diseases of humans were treated by 48 medicinal plants, 15 medicinal plant species were used to treat both human and livestock ailments, 34 livestock ailments were found to be treated with 27 plant species.

Human and Livestock ailments treated with medicinal plants. Medicinal preparation varied in plant composition for different human ailments as more than one medicinal plant species recorded in the study area were reported to treat 15 human ailments. Out of total medicinal plants recorded in the study area the highest number reported to treat human ailments, because in the area human diseases is dominant and most of the traditional healers worked on human diseases. Out of the reported human diseases, Evil eye diseases were treated with the highest number of medicinal plant species (*Clerodendrum myricoides*, S*chinus molle* L., *Ruta chalepensis* L., *Buddleja polystachya, Otostegia integrifolia* Benth, *Jasminum Obyssinicum* Hochst.ex DC) accounted 6 (0.86%) (Table 1). Therefore, these plant species are popular to treat human diseases. The result was disagreeing with Endalew Amenu (2007), reported that headache in human treated with 9 plant species, but in this study Headache, anti-depressant and loose of appetite treated with 4 plant species indicating the variation of knowledge in different location of study.

Out of fifty-seven Medicinal plant species, 7 (12.3%). Medicinal plants recorded in the study area were reported to treat 4 Livestock ailments. Mastitis diseases were treated with the highest number of medicinal plants accounted 3 species (*Rumex nervosus* Vahl, *Lycopersicon esculentum* L. *Hibiscus calyphyllus* Cav.) (42.9%), followed by Diarrhea in cattle 2 species (*Azadirachta indica* A. Juss, *Lycopersiconesculentum* L.) (28.6%) (Table 1). These medicinal plants used to treat various livestock ailments were also mentioned in the study conducted by Endalew Amenu (2007)

3.2 Source (habitat) of Medicinal plants

Medicinal plant species can be collected from different environment but some medicinal plants found in a particular habitat. The results of the study showed that, 32 (56.14%) species of medicinal plant were collected from wild environment, and followed by cultivated land (home garden) accounted 15 (26.32%) (Table 3). This observation is a good indication of the fact that the local people have not yet started cultivating most of the plant species they are using as remedies. The communities of the study area indicated that the medicinal plants identified is highly depend on the wild resource to obtain the medicinal plants. In other words, the habit of cultivating medicinal plants in home gardens was not much developed. This is due to the fact that wild environment are good places for conservation of medicinal plants and plants are abundant, grown freely with

no human interference in relative to those grown in/around agricultural areas and human dwellings. Related findings were reported elsewhere in Ethiopia by Tesfaye was and Demissew Sebsibe (2009), Giday Misfit *et al.* (2009), Ermias Lulekal *et al.* (2013) and Beltran *et al.* (2014).

3.3 Growth forms (habit) of Medicinal plants

Of the total 57 medicinal plants collected from the study area, 27 species (47.4 %) were trees, followed by 15 species (26.3 %) shrubs, 13 species (22.8%) herbs and 2 species (3.5%) climber (Fig 5; Table 2). This may be due to a high level of abundance of these habits in the study area compared to shrubs, herbs and climber. The possible reason might be being the current study area, farmers planted in their farmland *Catha edulis Vahl,* locally known as "Khat", the main source of income for farmers. This would not have created conducive growing environment for other plants under the "Khat'', there for healer collects medicinal plants from wild which is dominated by trees species. The highest proportion of growth habit was covered by trees. This might be related with easily accessible trees in the vicinity of the community and shrubs are dominant woody species. Nonetheless, predominant tree and shrub means they are major source of charcoal and fire wood sources that need due attention for conservation of medicinal plants in the study area. The result was disagreeing with Tesfaye Awas *et al*. (2009).

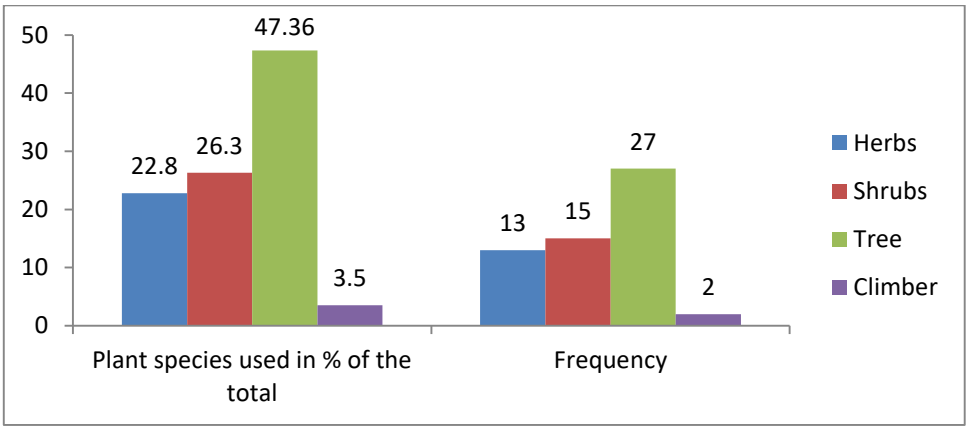

Figure 5. Growth forms or Habit of medicinal plants

3.4 Plant part used, Method of Preparation and Route of Administration, for Livestock and Human Ailments

The local inhabitants used different plant parts to prepare human and livestock remedies (Table 2). About 7 plant parts were mentioned to prepare remedies to cure different

ailments in the study area. Of these, the most common plant parts used for the preparation of remedies were leaf accounted 23(40.3%) and roots 11(19.3%) followed by whole part 7 (12.3%) (Table 2).

According to this finding, the part of the plant which is highly used for the preparation of the remedies was leave. Predominantly leaves for medicine means the contribution of local people for deforestation become less but other part of the plants used for medicine may result in destruction of the whole plants that need due attention for conservation of medicinal plants. This means harvesting leaves does not have detrimental effects on the survival of the medicinal plants, whereas harvesting roots and whole plants has a negative impact on the survival. Studies conducted in other parts of Ethiopia by different researchers such as Yirga Gidey (2010), Teklehaymanot Tilahun *et al.*, (2007) and by Alemayehu Girma *et al*. (2015) reported similar results. Therefore, the analysis of this result agrees with the work of Teklehaymanot Tilahun *et al.*, 2007) and Yirga Gidey (2010) as they report leaves were the dominant plant parts used as plant remedies**.**

Table 2. Plant parts used and Rout of administration for medicine

No.	Plant part	plant species used	Percent	Ranking	**ROA ***	**Frequency**	**Percent**
1	Leaf	23	40.3	1st	Oral	17	29.8
2	Root	11	19.3	2nd	Dermal	15	26.3
3	Whole part	7	12.3	3rd	Nasal	11	19.3
4	Fruit	5	8.8	4th	Through ear	9	15.8
5	Stem	5	8.8	4th	Anal	5	8.8
6	Leaf and Root	3	5.3	5th	Total	57	100
7	Bark	3	5.3	5th			
	Total	57	100				

ROA* Root of administration

Herbal medicines were prepared in diverse modes of preparation by the local people of the study area to treat both human and livestock ailments. Five modes of remedy preparations and applications were reported to treat disease (Fig. 6). The preparation and application methods vary based on the type of disease and the actual site of the ailment. The common forms of preparation are crushing, pounding, chewing, sniffing, boiling, roasting and smashing. The result indicated that the major methods of

preparation of medicinal plants for treating different human and livestock ailments were crushing and pounding 40 (70.2%), followed by boiling 6 (10.5%) (Fig. 6). This is due to the effective extraction of the plant gives immediate response for health problems when crushed or pounded to increase its curative potential. The mode of remedy preparation and application are managed according to the type of ailment, which they identify with reference to symptoms observed either on humans or livestock. Abebe Eshetu (2011), Getaneh Girma (2014), Mesfin Kebede *et al*. (2013) reported comparable ethnobotanical study results. This result was also similar with the work of Gidey *et al.* (2009) in that the most popular mode of preparation was in the form of crushed which accounts 31.25%.

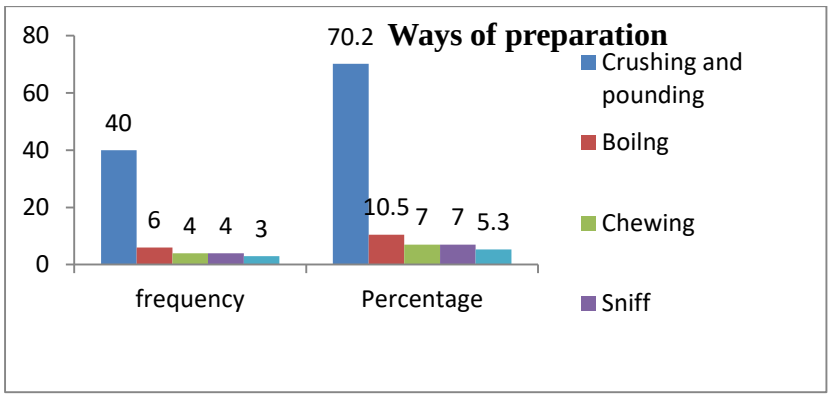

Figure 6. Mode of preparation of medicinal plants

Five administrative routes such as, oral, dermal, nasal, through ear, and anal were commonly employed by the local people in the study area (Table 3), the majority of the prescriptions were taken orally 17 (29.8 %) followed by Dermal 15 (26.3%). This is the reason that oral and dermal routes permit rapid physiological reaction of the prepared medicines with the pathogens and increase its curative power. The oral application was the most common which is in line with various studies in Ethiopia and other countries (Amsalu Nuguse *et al.*, 2018; Kidane Legese *et al.*, 2018; Tefera Biniyam and Kim, 2019; Hu *et al.*, 2020). They reported that the major way of medicinal plants administration was the oral route with 42.5–74 percent. This also agrees with the result of various ethnobotanical researchers such as Debela Hunde (2001) and Yirga Gidey (2010).

3.5 Ranking and Scoring

Some medicinal plants are popular than the others, in view of that, *Ruta chalepensis* took the lead where it was cited by 20 (25%) informants for its medicinal value for treating Evil eye. The popularity of this medicinal plant may be due to the preference of the species for treating Evil eye in the community rather than going to modern medication for the disease and its easy access in the home gardens of many people. *Allium sativum, Eucalyptus globulus* and *Citrus limon* are cited by 16 (20%), 13 (16.25%) and 10 (12.5%)informants ranking 2nd, 3rd and 4th respectively. Popularity of these medicinal plants according to key informants is due to their wide range of diseases they treat or due to the abundance of the plant in the area for easy access (Table 3).

Table 3. List of Medicinal plants, the corresponding informants (Percentage ≥ 5) and Consensus Informant by categories of the 4 highest popular diseases

Scientific Name	No of informants cited	% of informants	Ranking	Category of aliments	Number of species used (nt)	Number of use citations in each category (nur)	ICF	Rank
Ruta chalepensis	20	25	1st	Evil eye	7	65	0.91	1st
Allium sativum	16	20	2nd	Diarrhea	5	39	0.89	2nd
Eucalyptus globules	13	16.25	3rd	Bronchitis	6	36	0.86	3rd
Citrus limon	10	12.5	4th	Abdominal pain	3	10	0.78	4th
Olea europaea	7	8.75	5th					
Cordia Africana	5	6.25	6th					
Coffea arabica	5	6.25	6th					
Ocimum lamiifolium	4	5	7th					

The calculation of the informant consensus factor (ICF) was used to test homogeneity on the informant's knowledge in choosing certain medicinal plants against a given ailment. ICF is important to select ailment categories where there is consensus on the use of plants among the informants and to identify species with particular importance in culture. Four categories were taken based on the highest site of occurrence of the disease, condition of the disease as well as treatment resemblance of the disease to the local people. The overall informant consensus was found to be high (0.78-0.91) which indicates the

participants seem to have similar perceptions and knowledge on the nominated medicinal plants. On the other hand, high informant consensus implies, few species are used by a large proportion of people, while a low value indicates that the informants disagree on the species to be used in the treatment within the category of disease (Canales *et al*., 2005) (Table 3). Of the human disease categories, the highest informant consensus value (0.91) was scored for the Evil eye complaints related disease whereas the least informant consensus value (0.78) was scored for abdominal pain disease category.

Concerning the livestock disease, the category of Mastitis disease and ectoparasite had the highest informant consensus factor value whereas Skin wound and Eye diseases scored the least ICF value (0.78). The ICF score of these disease categories indicates the relative incidences of these diseases in the area. The score of ICF is also a good indicator to identify plants of particular interest in the search for bioactive compounds. Accordingly, medicinal plants including *Ruta chalepensis, Allium sativum, Eucalyptus globules, Citrus limon, Olea europaea, Cordia africana, Coffea arabica and Ocimum lamiifolium* which were used to treat a large number of (≥ 5) human and livestock ailments. This indicates that some human and livestock ailments have an opportunity to be treated by more plant species in the study area.

Based on the preference ranking done by the selected key informants, *Ruta chalepenisis, Schinus molle, Buddleja polystachya, Clerodendrum mricoidens, Jasminum abyssinicum* and *Otostegia integrifolia* were the most preferred human medicinal plant species to treat Evil eye, which was among the highly cited ailment by the informants in the area. The result of the study shown that *Ruta chalepensis* scored the highest mark and ranked first indicating that it was the most effective in treating Evil eye and *Otostegia integrifolia* scored the least mark and ranked indicating that it was the least effective in treating evil eye in the study area. In another study in Southern Ethiopia, *Vernonia amygdalina Del.* was the second most preferred plants for the treatment of diarrhoea (Fisseha Mesfin *et al*., 2009). *Allium sativum* L. was third ranked plant medicine for the treatment of tapeworm infestation in a study done in Western Ethiopia (Balcha Abera, 2014) (Table 4).

Table 4. Preference ranking of six selected medicinal plants treating Evil eye

List of medicinal plants	Key informants coded (A-F)										Total score	Rank
	A	B	C	D	E	F	G	H	I	J		
Ruta chalepenisis	1	2	2	2	2	2	5	4	5	5	30	1st
Schinus molle	1	2	1	3	3	1	3	3	4	4	25	2nd
Buddleja polystachya	2	1	1	2	1	1	4	1	4	3	20	3rd
Clerodendrum mricoidens	1	1	1	2	1	3	1	2	3	3	18	4th
Jasminum abyssinicum	1	1	1	2	3	1	2	2	2	1	16	5th
Otostegia integrifolia	1	1	2	1	1	1	1	1	2	1	12	6th

The value of FL of the four medicinal plants cited by four or more informants for being used against same ailment category indicated that *Citrus limon* 38% were having high fidelity level treated for diarrhea as well as any uses and the least fidelity level was Senna singueana20% for treating Abdominal pain (Table 5). The fact that plants *Citrus limon* (for the treatment of Diarrhea), *Ruta chalepensis* (for the treatment of Evil eye), *Olea europaea sub sp. cuspidata* (for the treatment of Bronchitis), *Senna singueana* (for the treatment of Abdominal pain) had the highest FL values could be an indication of their good healing potential. Plants which are used in some repetitive fashion are more likely to be biologically active. This finding was fairly in line with a study conducted by Zenebe Girma et al. (2012) in Asgede Tsimbila District, Northern Ethiopia.

Table 5. Fidelity level (FL) of four medicinal plants

Scientific name	Disease treated	IP(number of informants particularly used)	IU(total number of informant for any used)	FL=IP/IU	%of FL	Rank
Ruta chalepensis	Evil eye	23	65	0.35	35	2st
Citrus limon	Diarrhea	15	39	0.38	38	1nd
Olea europaea sp. *cuspidata*	Bronchitis	10	36	0.28	28	3rd
Senna singueana	Abdominal pain	4	20	0.2	20	4th

In the study area, a number of medicinal plants were found to be multipurpose species being utilized for a variety of uses (Table.6). The study result showed that, *Olea europaea, Acacia etabaica* and *Cordia africana* were found on 1st, 2nd and 3rd level ranks, respectively. Use for medicinal purpose ranked first followed by firewood and Forage purposes. The results of the direct matrix ranking revealed that *Olea europae*a

sub sp. *cuspidata* ranked first and hence it is the most preferred plant by local people for various uses and is the most threatened species as the informants reported, which is evidently shown by its scarce distribution in the area. This scarcity of *Olea europae*a is due to over harvesting for not only medicinal but also for other uses particularly for firewood. Conversely, *Cordia africana*, *Dodonea angustifolia* and *Eucalyputus globulus* were the least preferred multipurpose medicinal plants and less threatened since they are not widely exploited by local communities. This results disagree with the results of Teklay Ayele *et al*., (2013) indicated *Cordia africana, Eucalyptus globules, Opuntiaficus indica,* and *Dodonia angustifolia* as the most preferred multipurpose plants by the local people in Kilte Awulaelo district.

Table 6. Direct matrix ranking of medicinal plants with different uses other than medicinal value

Species name	Use with the scores in the corresponding boxes					total	Rank
Olea europaea L.	Medicinal use	Food	Firewood	Forage	Constrictio n		
	5	0	5	3	2	15	1st
Acacia etabaica	4	0	5	3	2	14	2nd
Cordia Africana	2	1	1	1	4	9	3rd
Dodonea angustifolia	2	1	1	1	3	8	4th
Eucalyputus globulus	3	0	2	1	1	7	5th
Total	16	2	14	10	12		
Rank	1st	5th	2nd	4th	3rd		

The results of the comparison by using Jaccard coefficient of similarity indicated that the highest degree of similarity was observed with the study conducted by Mengistu Gebrehiwot (2010), Getu Alemayehu (2010), Behailu Etana (2010) and Tewodros Tesfaye (2016). The least similarity was linked with the study conducted by Jarsso Belay (2016) (Table 7). According to Behailu Etana (2010) the highest degree of similarity observed between two or more study areas is due to socio-cultural factors that could contribute to the medicinal plant knowledge base of people or the nearness to each other of the study area. In contrast, the lowest degree of similarity might be due to vegetation difference of the two study areas and cultural difference of the two groups of people.

Table 7: The Jaccard coefficient of similarity of Harari regional state with five other areas with respect to medicinal plant composition

Sample area	A	b	c	JCS%	Sources
Harari region	57	-	-	-	Present
Jigjiga District	50	26	24	20	Jarsso Belay(2016)
Jima Rare District	82	46	36	28	Behailu Etana (2010)
Melka Belo District	66	32	34	27	Tewodros Tesfaye(2016)
Minjar-Shenkora District	118	82	32	33	Getu Alemayehu(2010)
Seru District	121	85	36	35	Mengistu Gebrehiwot(2010)

3.6 Current status and conservation practices of Medicinal plants

Field observation indicated that there is high rate of reduction of species particularly, for those plants which are not suitable for khat and coffee (Table 8). That is, most naturally grown plant species have been removed if it is less significant for coffee shade. The study showed that most threats to medicinal plants of the study area were agricultural expansion 40 (50%) and followed by fire wood and charcoal production 30 (37.5%) **(**Table 8**).** Expansion of agriculture and charcoal production were among the most serious threats to medicinal plants in the study area. This may be due to the majority (> 85%) of the local people are engaged mainly in agricultural activities and Charcoal production was also the additional source of income for many people. Hence, these activities severely affect the medicinal plants in the study area. These threats were also common in other parts of the country as reported by different authors (Abreha Girma.*et al*., 2018 and Kidane Legese *et al*., 2018). Similar results were obtained in different investigation in Ethiopia. Endalew Amenu (2007) showed that need for agricultural land and population pressure severely threatened plant species in general and medicinal plants in particular.

Table 8. Factors affecting the status of medicinal plants in the locality

Induced factors of medicinal plants	**Frequency**	**Percent**
Agricultural expansion	40	50
For fire wood & charcoal production	30	37.5
Others factors: Poor management and Conservation measures of medical plants	10	12.5
Total	80	100

People in the study area practice different techniques to conserve medicinal plants. Out of these, home gardening, fencing, replanting and education (awareness) were the most used mechanisms reported by the informants. The results of the study showed that

cultivation of plant species in and around home gardens for different purposes and protecting some areas for spiritual and cultural purposes have great contribution to the conservation of medicinal plants and the associated knowledge in the study area. Despite, the local community uses different conservation mechanisms, most of the medicinal plants were found in the wild environment which is out of their management scope and not reliable to rescue them. The field observation, and discussion with the informants showed that many of the plants in home gardens or grown near the home gardens were mainly cultivated for other purposes than for their medicinal value especially as a food crop but species like *Ruta chalepensis, Ocimum lamiifolium* and *Withania somnifera* are cultivated for their medicinal value. The same information was document by Amsalu Nuguse *et al.,* (2018).

3.7 Distribution of indigenous knowledge on medicinal plants among the informants

There was a significant difference (P< 0.05) in the number of medicinal plants reported by age groups of 30-40 (young age groups) and > 40 years (Elder age group), illiterate and literate informants. High average numbers of medicinal plants were reported by elders than younger age groups, illiterate than literate and key informants than general informants. Although there was no significant difference (P > 0.05) in the number of medicinal plants reported by men and women, high numbers of medicinal plants were reported by men than women (Table 9).

Table 9. Statistical test of significance, t-test, on the average number of reported medicinal plants among different informant groups (*Significant difference (p<0.05)

Parameters	Informant group	Number	Average ± SD	t-Value	P-value
Age	Youngster (30-40 years)	20	1.48 ± 0.50	-7.36	0.00
	Elder (> 40 years)	60	1.89 ± 0.32		
Educational Status	Illiterate	50	1.52 ± 0.50	7.6	0.00
	Literate	30	1.1 ± 0.30		
Gender	Male	60	1.59 ± 0.5	2.9	0.15
	Female	20	1.38 ± 0.49		
Informants	General	60	1.0 ±0.00	4.37	0.00*
	Key	20	1.16 ± 0.36		

Gender had no significant difference (P >0.05) in the reporting of medicinal plants in the study area. This indicates females in the study area are equally knowledgeable with males, which could be related to the exposure similarity toward the interaction with medicinal plants as well as equal opportunity in receiving indigenous knowledge from

their parents. Similar reports were stated by other authors (Bisht*et al*., 2006; Almeida *et al*., 2010, Erimias Lulekal, 2014). The number of medicinal plants reported by different age groups in the study area showed significant differences (P = < 0.05). The elder age groups of the community (age > 40 years old) reported a high number of medicinal plants than the young age groups (18 - 40 years old). This reveals the elderly age groups have more experience and knowledge about medicinal plant species than young age groups. Livelihood modernizations including urbanization and the advent of formal education might be the other factors that affect youngsters' indigenous knowledge of medicinal plants (Bussmann, 2006). The educational status of the community members has a significant variation in the number of reporting different medicinal plants. More than 76% of the medicinal plants were reported by the illiterate individuals. This indicates that illiterate people relatively have good knowledge of medicinal plant species whereas the literate groups rely on the modern health care system than on traditional medicinal plants use. Related findings were reported by Bussmann (2006), Erimias Lulekal *et al*. (2013), and Alemayehu Girma (2015).

3.8 Knowledge transfer system

The ethnobotanical knowledge source of medicinal plant use varies from person to person. Majority informants in the study area reported that the most source of traditional medicinal plant knowledge was parents 72 (90%) followed by neighbor 6 (7.5%) **(**Fig 7). In the study area the result indicated that Parents were major sources of knowledge and transfer orally to their children. Accordingly, 72 (90%) of the total is transferred to the trusted eldest son. This indicated that traditional professional medical practitioners want their knowledge to be kept secret. The result agrees with the result of Mengistu Gebrehiwet (2010), which reported, the highest number of transfer of knowledge of traditional medicine is to trusted eldest son which accounted for 24 (30%) followed by trusted sons 22 (27.5%). According to the information gathered from the informants and other traditional medicine users of the study area, majority of the professional traditional healers do not show and share the medicinal plants and their traditional knowledge freely to anybody. But they share their knowledge of medicinal plants to one or in some cases to their family member who they trust most when they become older and older. In doing this, they told to the person to follow the same principle of secrecy and even some healers die without transferring their knowledge. When the practitioners are asked why they kept their knowledge secret, they answered in such a way that the knowledge of

medicinal plant is one means of income generating, and also said the healing power of the plant remedy decreases if the secret is out. Similar findings were reported elsewhere (Fassil Kibebew, 2001; Mirutse Giday and Gobena Ameni, 2003).

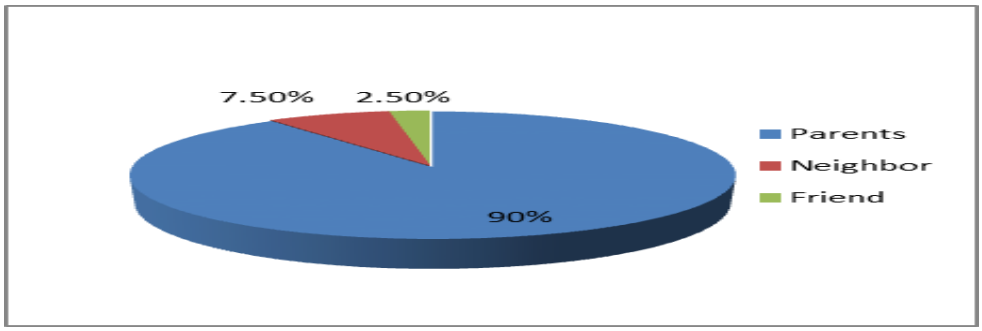

Figure 7. Source of Medicinal plants knowledge

4. Conclusion and Recommendations

4.1. Conclusion

Harari Regional State is relatively rich in medicinal plant diversity. People in the study area used 57 medicinal species to treat 24 human and livestock ailments. Family Solanaceae has the highest number of genera and family Lamiaceae has the highest number of species in the study area. The most frequently revealed ailments for humans and livestock in the study area were Evil eye and Mastitis diseases, respectively. Thus, more numbers of species were prescribed to treat these diseases. Most of medicinal plants in the study area were harvested from wild. Trees and Leaf were found to be the dominant growth form and most frequently used plant parts for the preparation of traditional remedies, respectively. The major methods of preparation of medicinal plants were crushing and pounding, whereas the mode of administration is mainly internal in which oral administration is the common route. The majority of the medicinal plants have multiple or more than one use. The main threat on medicinal plants in the study area arises from agricultural expansion and charcoal production. To reduce factors affecting the status of medicinal plants in the study area, there are conservation measures taken for forest and other natural plant resources including in-situ and *ex-situ* conservation.

4.2. Recommendations

Based on the results of the study, the following recommendations are forwarded:

1. The Government and health office should give attention so as to standardize measurements and maintain hygiene of the medicines made from plants by training both the healers and other members of the local community.
2. The main reason for the conservational problem was deforestation, agricultural activities, firewood and charcoal. To overcome these problems local government in collaboration with other concerned body give training and awareness to the communities on how to conserve and manage the medicinal plant species in the area
3. The regional state administration must involve in awareness creations to the communities and traditional healers to conserve the medicinal plants and transfer indigenous knowledge to the next generation without secrecy.

The regional state as well as federal government must give due attention for multipurpose medicinal plants like *Olea europae*a sub sp. *cuspidata, Lagenaria siceraria,* and *Ocimum lamiifolum* for further biochemical and pharmaceutical studies.

4. Conflict of interests

The authors state that they have no conflicting interests.

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