



Assessment on the Use, Knowledge and Conservation of Medicinal Plants in Selected Kebeles of Dire Dawa Administration, Eastern Ethiopia

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Abstract: The aim of the study was to assess and document the indigenous knowledge of medicinal plants used in the communities and preserve it to be used by the next generations. Ten study sites (kebeles) were selected based on a reconnaissance survey and recommendations of elders and local authorities. The study was carried out in two different seasons, from September to November, 2014 and from June to August, 2015. Eighty informants including twenty traditional herbalists (as key informants) participated in the study. Semi-structured interviews, group discussions and guided field walk constituted the main data collection methods. Techniques of Preference Ranking, Informant consensus Factor, Fidelity level index and Pearson correlation were employed in data analysis. Medicinal plant specimens were collected identified and kept at the National Herbarium (ETH) of Addis Ababa University. A total of 129 plant species in 61 families and 109 genera constituting herbs (50%), trees (24%), shrubs (23%) and climbers (3%) were reported in the treatment of various health problems. Family Fabaceae was dominant representing 8.5 % of the plant species documented. Leaves (29.4 %) were the most frequently used parts in preparing herbal remedies. Crushing (29 %) and oral route (61%) were commonly used methods of herbal remedy preparation and administration, respectively. Health conditions grouped in 22 categories were treated using medicinal plants. Informant consensus factor was highest for mental illness, poisonous animal bite and head ache and fatigue that had ICF values of 1, 0.61 and 0.60, respectively. *Sphaeranthus suaveolens*, *Barleria orbicularis*, *Solanum sepiculum* and *Cadaba farinosa* had a fidelity level of 100% this indicated their outstanding preference for treating mental illness, snake bite and swollen body part (GOFLA). There was a positive correlation ($r = 0.48$) between the age of informants and the number of species reported by the informants. However, there was a negative correlation ($r = -0.26$) between the number of species reported and informants' educational level. The present paper represents significant ethnobotanical information on medical plants which provides baseline data for future pharmacological and phytochemical studies.

Keywords: *Dire Dawa Administration, Human Aliments, Traditional Medicine, Local Communities*

1. Introduction

Ethiopia has a huge traditional knowledge of medicinal plants and has developed diverse ways to battle diseases through it. The ways are also as diverse as different cultures. Furthermore, Ethiopia is endowed with a huge diversity of medicinal plants that provide a wide contribution to the

management of human and livestock ailments [4, 18]. About 80% of Ethiopian people rely on traditional medicine to meet their primary health care needs [7]. The wide spread use of traditional medicine in the country could be attributed to its cultural acceptability and affordability [7, 26]. Efforts that have been made so far to document the associated traditional knowledge and conserve medicinal plants in the country are

not as they should be [22].

Although enriching ideas have emerged in recent years, studies conducted till now are unfinished owing to the multiethnic cultural diversity and the diverse flora of Ethiopia [7, 49]. Like other places in Ethiopia, people living in Dire Dawa administration have traditional practices which have passed from generation to generation. A large proportion of the people living in the region depend on direct herbal medicine to treat a wide range of ailments. However, the disappearance of medicinal plant species is consistently reported mainly due to changes in the ecosystems, land degradation and unsustainable use of medicinal plants; furthermore, the expansion of invasive species has contributed a lot to their disappearance [38]. The present study has been afterward initiated with an objective to document the knowledge and practices on the use of medicinal plants by the local community. The present study is supposed to add up the communities' knowledge in the country's database of traditional knowledge and will provide a baseline data for future pharmacological and phytochemical studies.

2. Materials and Methods

2.1. Description of the Study Area

Dire Dawa Administration is geographically located between 9°27' and 9°49' N latitudes and between 41°38' and 42°19'E longitudes and the town is 515 Km from Addis Ababa the capital city of Ethiopia and 333 Km from the international port of Djibouti. The total area of the administration is 128,802 ha. The Administration has 9 urban and 38 rural kebeles. Kebele is the smallest administrative unit in Ethiopia [38].

2.2. Study Site Selection

A reconnaissance survey was conducted from February, 22 to 30, 2014 and in the survey we considered the availability of traditional healers, the agroecology and ethnic diversity of the areas. Consequently, with the recommendations of elders and local authorities the selection resulted in ten study sites (kebeles), namely Wahil, Legeoda, Hulul Mojo, Qalicha, ChireMiti, Jeldesa, GerbaAneno, Melkajebdu, Asseliso and Qefira (Figure 1).

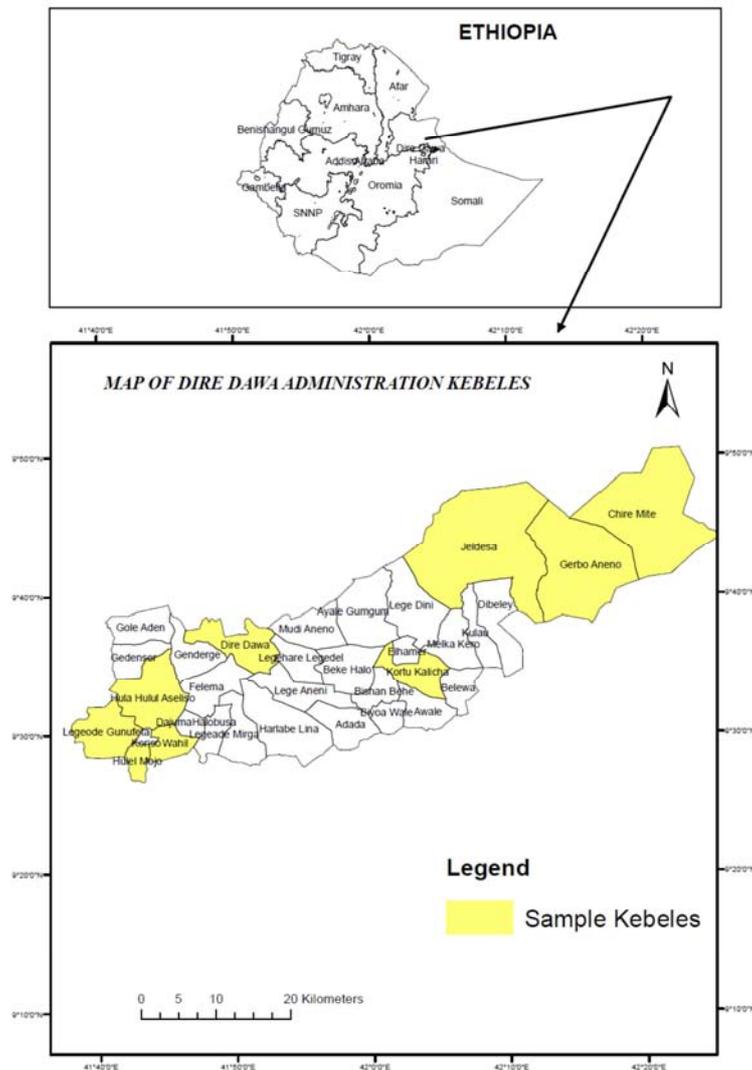


Figure 1. Map of selected kebeles.

2.3. Selection of Informants

Ethnobotanical information was collected from 80 informants (65 male and 15 female). Twenty of them were key informants (knowledgeable traditional healers), who were selected with the assistance of community leaders and elderly people while, random sampling was employed to select the other 60 informants. The informants were categorized into three age groups, young (25-40), adult (41-60) and elderly (above 60) as described in [9].

2.4. Ethnobotanical Data Collection of and Identification

Data collection was made from September to November 2014 and June to August 2015. Semi-structured interview was conducted in local language(s) (Afan Oromo and/or Somali) with the help of translators. Group discussion and field observation were also employed to collect ethnobotanical information. In addition, guided field walks with key informants were employed to collect voucher specimens of each medicinal plant species. The collected plant specimens were identified at the National Herbarium (ETH), Addis Ababa University, Ethiopia.

2.5. Ethnobotanical Data Analysis

The collected ethnobotanical data were entered into Excel spreadsheet and summarized using descriptive statistics such as frequency and percentages. Informant Consensus Factor

(ICF), Fidelity level, Preference ranking and Jaccard's Coefficient were computed to assess the use, knowledge and conservation of medicinal plants. ICF was calculated following the method of Heinrich et al [24]. Preference ranking was done using the method applied by Martin [30] and Cotton [12]. Jaccard Coefficient was conducted following the Kent and Cocker [27]. Fidelity Level index was calculated based on the formula recommended by Friedman et al [14].

3. Results and Discussions

3.1. Characteristics of Respondents

A total of 80 traditional healers (65 male and 15 female) from the age of 22 to 85 years were sampled (Figure 2). Generally, (46.25%) of the respondents were above 60 years. There was positive correlation ($r = 0.48$) between the age of informants and the number of species reported by the informants; this might be due to exposure to modern education younger people showed minimal interest in learning and practicing ethnomedicinal practices [5,39]. Differences in medicinal plants knowledge among age groups was also reported in other studies [44, 46, 48, 51, 52]. However, there was a negative correlation ($r = -0.26$) between the number of species reported and informants' educational level.

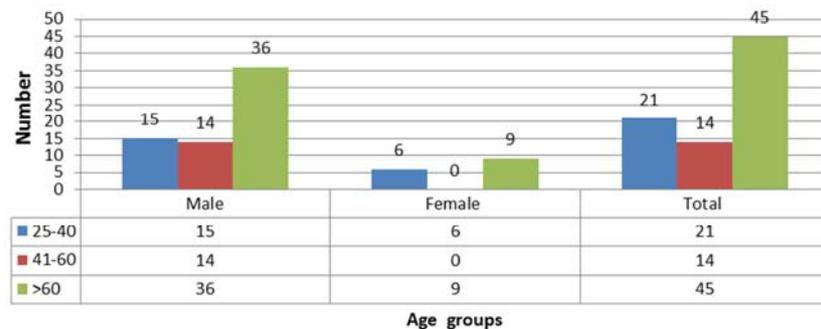


Figure 2. Characteristics of respondents.

3.2. Floristic Composition of Medicinal Plants

A total of 129 plant species belonging to 109 genera and 61 families were reported. Family Fabaceae came out as a leading family with 11 species (8.5%) followed by Astraceae 10 species (7.7%). Family Fabaceae is consistently reported in different ethnomedicinal studies conducted in Ethiopia [2, 8, 21, 25,33, 43] and other parts of the world [46], which

could be attributed to their wider distribution and abundance [11] and rich bioactive ingredient contents [15]. The majority 96(74%) of the plants were used to treat human ailments, and 24(19%) of them were used to treat both human and livestock diseases while 9 (7%) of them were used for the treatment of livestock diseases only (Figure 3).

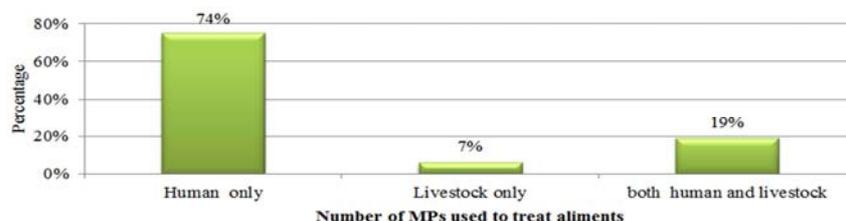


Figure 3. The proportion of medicinal plants used to treat health problems.

3.3. Source of Medicinal Plants

Out of the 129 plant species, 95 (74 %) were obtained from the wild followed by 19 (15%) from cultivated areas (Figure 4). This result is also similar to other ethnobotanical studies in Ethiopia [3, 17, 29, 33, 35] and other countries [46, 47]. The fact that the majority of medicinal plants collected

from the wild could be attributed to the need to keep the confidentiality of traditional knowledge and the argument that cultivated medicinal plants are less effective and most of the herbalists were not interested to grow medicinal plants in their home garden because they need to keep the secrecy of their medicinal value.

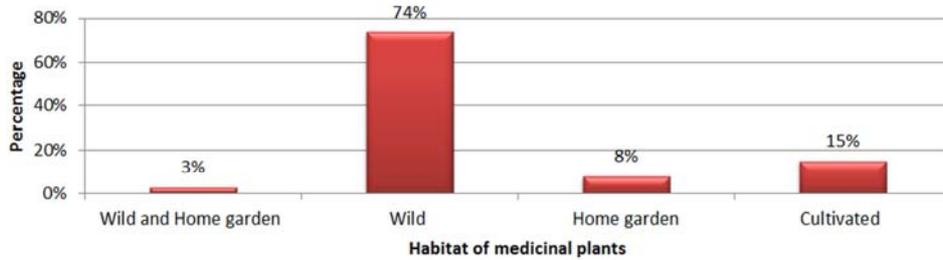


Figure 4. Sources of medicinal plants.

3.4. Growth Habit of the Medicinal Plant

The highest proportion 65 (50 %) of the growth habit was covered by herbs, followed by 31 tree species (24%) (Figure 5). This could be attributed to the fact that it takes much time and effort to harvest medicinal trees, it is also a fact in the country that woody plants are declining and most of the easily available plants became the herbs. Similar patterns were reported by some studies [1, 2, 6, 9, 16, 18, 19, 32, 36, 37, 45, 46].

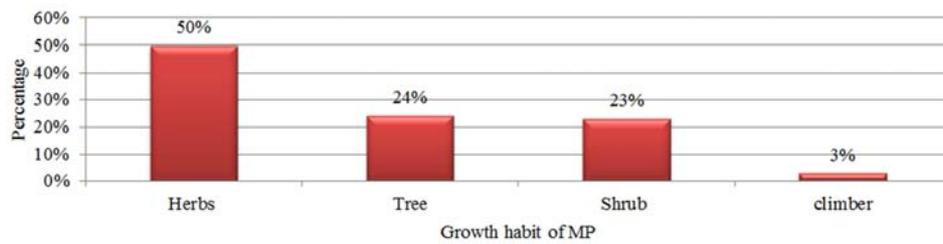


Figure 5. Growth habit of Medicinal plants for treatment of health problems.

3.5. Plant Parts Used for Medicine

Most of the medicinal plants were harvested for their leaves accounting for 29.4% of the total, followed by root (22.4%)(Figure 6). Other studies also indicated leaves as the most widely used plant parts [23, 32, 33, 39, 46, 50]. Utilization of leaves for remedy preparation is important for conservation of medicinal plants [2, 32].

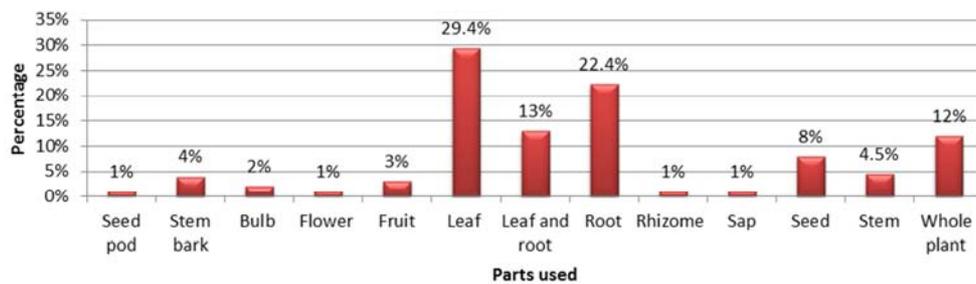


Figure 6. Percentage of plant parts used in traditional medicines.

3.6. Mode of Preparation of Medicinal Plants

Most of the remedies were prepared in the form of crushing (33.72%), followed by decoction (18.47%) and pounding (14.95%) (Figure 7). This agrees with the results of studies carried out by [1, 33, 42] they found that the main

mode of preparation is crushing, accounting for 26.2%, 29% and 28.2%, respectively. Most of the remedies were prepared from a single species and mixtures were used rarely. During preparation substances like water, coffee and milk were reported to be added with the plant materials. Most of the herbal remedies were prepared using fresh plant material.

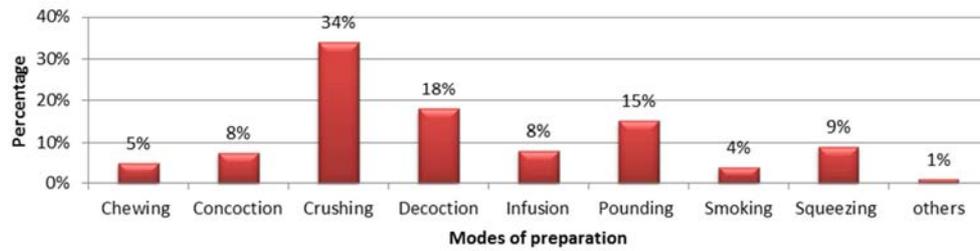


Figure 7. Percentage of method of preparation of traditional medicinal plant remedies.

3.7. Route of Administration of Medicinal Plants

Oral route contributed (61 %) of the total species, followed by dermal (22%). Percentage of other routes of administration is as indicated in (Figure 8). As mentioned by several studies like [2, 3, 10, 18, 22, 25] oral administration was the dominant route of remedy administration, which constituted 79%, 52%, 72%, 63%, 57.1%, and 54.21%, respectively. Similar pattern of administration were also reported by some medicinal plant studies in other countries

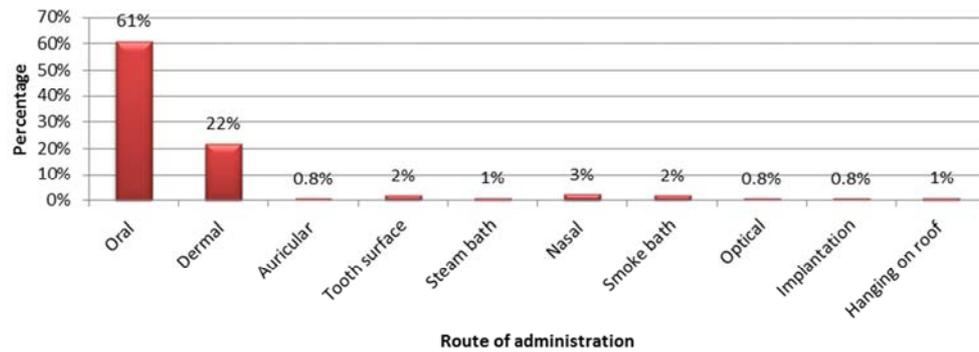


Figure 8. Percentage of administration route of medicinal plants.

3.8. Informant Consensus Factor (ICF)

In the present study ailments with a high ICF value were poisonous animal bite, head ache and fatigue and painful body parts that had ICF values of 61%, 60%, and 50%, respectively (Table 1). The important medicinal plants used for the treatment of poisonous animal bite such as snake were *Barleria orbicularis*, *Echidnopsis dammanniana*, *Solanum sepiculium*, *Cucumis ficifolius*, *Euphorbia candelabrum* and

those for headache and fatigue included *Plectranthus cylinderaceoush*, *Sphaeranthus suaveolens* and *Heteromorpha arborescens*. This will attract pharmacologists for further investigation of the plant species (Table 1). The most common health problems were gastrointestinal problems; this might be due to food and water pollution and lack of proper sanitation. These findings are in line with the studies of [8, 13, 22].

Table 1. Informant consensus factor about uses of medicinal plants for ailment categories.

S.no	Ailment categories	Specific conditions	n _t	% of spp	n _{ur}	ICF
1	Poisonous animal bite	Snake bite, scorpion and spider	9	4.3	22	0.61
2	Headache and Fatigue	Migraine	3	1.4	6	0.60
3	Painful body parts	Back pain	2	0.9	3	0.50
4	Immune and energy boosting	Nausea, low appetite	4	1.9	6	0.40
5	Sexually transmitted diseases	Gonorrhea	4	1.9	6	0.40
6	Urinary problems	Kidney infection	10	4.8	16	0.40
7	Gastrointestinal disorders	Diahhrea, gastritis, heart burn, amoebiasis, intestinal parasites, abdominal cramp, pain, bloating, constipation	40	19.3	63	0.37
8	Respiratory tract infections	Pneumonia, influenza, tuberculosis, cough, sore throat, common cold, asthma	12	5.7	18	0.35
9	Cardiovascular problems	Heart disease	3	1.4	4	0.33
10	Psychiatric disorders	Madness, night mare	5	2.4	7	0.33
11	Swelling and infections of body parts	Swollen body parts/GOFLA, hydrocele, boils	22	10.6	32	0.32

S.no	Ailment categories	Specific conditions	n _t	% of spp	n _{ur}	ICF
12	wound healing	Swelling and infection on the head(KOROKOR), cold sore	12	5.7	15	0.21
13	Dental problems	Tooth ache, gum bleeding	10	4.8	12	0.18
14	Neurological and nervous system disorders	Epilepsy, evil eye	17	8.2	20	0.15
15	General pain	Malaise, MITCH	14	6.7	16	0.13
16	Hepatic problems	Jaundice	9	4.3	10	0.11
17	Gynecological problems	Heavy menstrual flows, weakness during pregnancy, and induction of labor.	4	1.9	4	0
18	Reproductive system dysfunction	Impotence, infertility	6	2.8	6	0
19	Blood system disorder	Anemia, diabetes, hypertension	8	3.8	1	0
20	Dermatological problems	Ringworm, wart and skin rash	10	4.8	12	0
21	Bed wetting		1	0.4	1	0
22	Cancer	Breast cancer	2	0.9	2	0

Aliments category according to Tugume *et al.* (2016), A taxa may fall in more than one ailment categories. Key: n_t - Number of species in each use category, n_{ur} - Number of use reports, ICF - Informant consensus factor

3.9. Fidelity Level Index (FLI)

Fidelity level highlights the importance of plants species in the treatment of the mentioned specific conditions for instance *Sphaeranthus suaveolens* had a FLI of 100% to treat mental illness, *Barleria orbicularis*, *Solanum sepiculum*, had a fidelity level of 100 % in treatment of snake bite while,

Cadaba farinosa had a fidelity level of 100% in treatment of swollen body part/GOFLA, respectively (Table 2). High Fidelity Level Index for these species indicates their outstanding preference for treating the corresponding ailments.

Table 2. Fidelity level index on medicinal plants to treat some specific human ailments.

Plant species	Therapeutic use	Ip	Iu	FL%
<i>Sphaeranthussuaveolens</i>	Mental illness(Madness)	7	7	100
<i>Barleria orbicularis</i>	Snake bite	4	4	100
<i>Solanumsepiculum</i>	Snake bite	3	3	100
<i>Euphorbia granulata</i>	Spider bite	6	7	85
<i>Cadabafarinosa</i>	Swollen body part/GOFLA	10	10	100
<i>Maeruaoblongifolia</i>	Swollen body part/GOFLA	4	6	66.6
<i>Foeniculumvulgare</i>	Kidney problem	6	8	75
<i>Cissampelosmucronata</i>	Sudden illness	6	9	66.6
<i>Halothamnussomalensis</i>	Intestinal parasites	2	4	50
<i>Withaniasomnifera</i>	Evil eye	4	8	50

3.10. Direct Matrix Ranking for Multipurpose Uses of Plants

Direct matrix ranking was performed to assess the relative importance and to check the major impacts on each of the plant. In the area a number of medicinal plants were found to be multipurpose species being utilized for a variety of uses.

Six commonly reported multipurpose species and seven use-categories were involved in direct matrix ranking with informants. Respondents evaluate their relative importance to the local people and the extent of the existing threats related to their use values. The result showed that *Balanites aegyptiaca* and *Cadaba farinosa* stood first and second as being the most multipurpose medicinal plants (Table 3)

Table 3. Direct matrix ranking for multiple uses of medicinal plants.

Use	<i>Tamarindus indica</i>	<i>Cadaba farinosa</i>	<i>Solanum somalensis</i>	<i>Balanites aegyptiaca</i>	<i>Croton macrostachyus</i>
Medicinal	2	5	5	5	3
Charcoal	2	4	1	4	4
Fire wood	3	5	1	3	4
Construction	4	4	1	5	2
Furniture	5	3	0	3	2
Fodder	4	3	2	2	4
Fence	3	2	2	5	4
Total	26	29	10	31	25
Rank	3rd	2 nd	5 rd	1 st	4 th

3.11. Threats to Medicinal Plants in the Study Area

As mentioned by most of the informants six threats were selected in the study area. This information was used to

determine the highest threats to medicinal plants in the study area and helps to suggest the necessary appropriate conservation measures. The result of the study showed that Agricultural expansion and deforestation ranked 1st and 2nd,

respectively (Table 4). According to [29] the main threats to the survival of medicinal plants in the ManaAngetu district were agricultural expansion, drought, and soil erosion. These anthropogenic and natural factors coupled with very poor conservation efforts threatened medicinal plant survival in the study area. In addition, our result showed that roots were the second major plant parts used for remedy preparation. Use of root and whole plant parts are destructive practices which may result in species extinction. Root as the most commonly used plant part in remedy preparation was reported by [21, 22, 28, 32].

Table 4. Ranking of threats to medicinal plants in the study area.

Factors	Respondents (R1-R6)						Total	Rank
	R1	R2	R3	R4	R5	R6		
Agricultural expansion	5	6	6	6	6	5	34	1 st
Charcoal making	2	4	3	3	2	4	18	4 th
Drought	4	3	4	5	4	3	23	3 rd
Invasive species	1	2	1	1	3	1	9	6 th
Overgrazing	3	1	2	2	1	2	11	5 th
Deforestation	6	5	5	4	5	5	30	2 nd

3.12. Availability Status of Medicinal Plants in the Study Area

The availability status of reported medicinal plant species

Table 5. Ranking of threatened medicinal plants in the study area.

Plant species	Respondents						Total	Rank
	R1	R2	R3	R4	R5	R6		
<i>Croton macrostachyus</i>	5	4	5	4	3	2	23	2 st
<i>Tamarindusindica</i>	3	3	2	4	3	1	16	4 th
<i>Cissampelosmucronata</i>	1	5	2	5	1	4	18	3 rd
<i>Balanitesaegyptiaca</i>	5	4	5	5	5	5	29	1 st
<i>Ziziphusspinacristi</i>	2	2	1	3	2	3	13	5 th

3.14. Medicinal Plant Conservation Efforts of the Local People

About 50.62% of the informants reported that they had awareness of the importance of conserving medicinal plant species. However, most of the informants were practicing conservation activities they simply went to the wild to collect medicinal plants as their need arose and did not bother about the long term survival of these plants. It was found that only 11% of the medicinal plants were obtained from home garden; this shows that most of the herbalists are not interested to grow medicinal plants in their home garden. Some traditional healers have started to conserve medicinal plants by cultivating at home garden, such as, *Moringa stenopetala*, *Jatropha curcas*, *Withania somnifera*, *Tamarindus indica* and *Punica granatum*. The people's culture and beliefs such as medicinal plants are effective only if cut and administered by traditional healers has somehow helped in the conservation of medicinal plants. A similar

in the study area was categorized using an availability categories developed by [40]. Accordingly, ten species (7.7%) were reported as "rare" followed by "Middle" 52 (40.3%), "common" 40(31%), and "very common" 27(20.9%) species (Figure 9). Similarly, a study conducted in Ghimbi District, Southwest Ethiopia reported one species as "rare" followed by "Middle" 21(45%), "common" 15 (31%), and "very common" 12(24%) species [2].

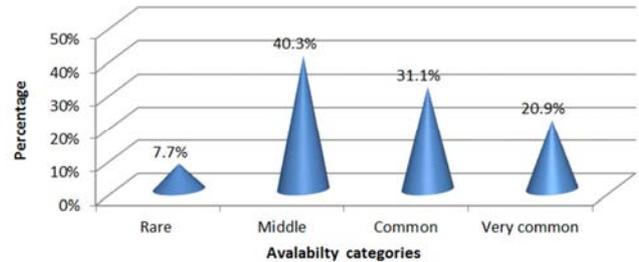


Figure 9. Availability of medicinal plants in the study area.

3.13. Threatened Medicinal Plants

Five medicinal plants that were reported by the informants as threatened in the study area were ranked using six key informants (knowledgeable traditional healers) by giving 5 for the most threatened and 1 for the least threatened plant species. The result indicated that *Balanites aegyptiaca*, is the most threatened followed by *Croton macrostachyus* (Table 5)

spiritual belief was in Wenago Woreda, SNNPR, Ethiopia by [36].

3.15. Jaccard's Coefficient of Similarity

Of the total 129 reported medicinal plants, 35 species were cited in Dengego and Harla valley, Eastern Ethiopia [9], 20 species were reported in Chilga district, North western Ethiopia [34], 21 species were cited in Minjar shenkora district, Central Ethiopia [3] and 13 species were reported in Erer valley, Eastern Ethiopia [8], 14 species were reported in Fiche district, Central Ethiopia [13]. The use of the same plant species for similar or different ethnomedicinal uses in different countries is a reliable indicator of the bioactivity potential of the plant species [31]. The similarity coefficient between the present study area and Harla and Dengego valley (0.20) is substantial (Table 6). Factors such as variation in climatic conditions, sample size, topographic features and type of flora influence the similarity coefficient [46].

Table 6. Similarity coefficient in medicinal plant composition of the current study with previous works.

Sample study area	JCS	Source
Chilga district, North western Ethiopia	0.09	Tebikewet <i>et al.</i> , (2015)
Harla and Dengego valley, Dire Dawa Administration	0.20	Belayneh and Bussa, (2014)
Minjarshenkora district, North shewa zone of Amhara	0.09	Alemayehu <i>et al.</i> , (2015)
Erer valley, Babileworeda East Harege	0.07	Belayneh <i>et al.</i> , (2012)
Fiche district, Central Ethiopia	0.05	Enyew <i>et al.</i> , (2013)

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