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## Ethnobotanical study of medicinal plants in Guji Agro-pastoralists, Blue Hora District of Borana Zone, Oromia Region, Ethiopia

**Mersha Ashagre Eshete, Ensermu Kelbessa, Gemedo Dalle**

### Abstract

**Background:** An ethnobotanical study of traditional medicinal plants was conducted in Bule Hora District, Borana Zone, Oromia Region, Ethiopia. The objective of the study was to identify and document medicinal plants and the associated ethnobotanical knowledge of the local people.

**Methods:** Relevant ethnobotanical data focused on traditional medicinal plants were collected using guided field walk, semi-structured interview, and direct field observation. Informant consensus method and group discussion were conducted for crosschecking and verification of the information. Both descriptive statistics and quantitative ethnobotanical methods were used for data analysis.

**Results:** We documented 106 species distributed in 98 genera and 46 families based on local claims of medicinal values. Local users collect most of these plants from the wild. The common plant families that encompass large number of medicinal plant species were Asteraceae (10 species), Rubiaceae (9 species) followed by Euphorbiaceae, Fabaceae and Lamiaceae which contributed 7 species each.

**Conclusion:** The study reported the existence of a number of medicinal plants, an indication for the presence of plant based traditional medicinal knowledge transfer that survived through generations. Informants stated that medicinal plants growing in the wild are under threat due to increased use pressure coupled with unsuitable harvesting that frequently targets leaves, roots and barks for remedy preparations. This calls for urgent and collaborative actions to keep the balance between medicinal plants availability in the wild state and their utilization by the community. Furthermore, the study attempted to prioritize the most effective medicinal plants as perceived by the local people for possible pharmacological testing.

**Keywords:** Bule Hora District, ethnobotany, indigenous knowledge

### Introduction

Ethnobotany is the study of peoples' classification, management, and use of plants. It is defined as "local peoples' interaction with the natural environment: how they classify, manage and use plants available around them" [45]. From the beginning of humanity, indigenous people have developed their own locality specific knowledge on plant use, management, and conservation [12]. This complex knowledge, systems of beliefs and practices generally known as indigenous knowledge or traditional knowledge develops and changes with time and space, with change of resources and culture. Indigenous knowledge has developed as a result of human interaction with their environment. In this view, ethnobotanical studies are useful in documenting, analyzing, and communicating knowledge and interaction between biodiversity and human society, how diversity in nature is used and influenced by human activities [6, 12, 45]. Ethnobotanical studies are useful not only for documenting, analyzing, and disseminating indigenous knowledge of local people but also to indicate interaction between biodiversity and human society, how diversity in nature is used and influenced by human activities [45]. Ethnobotanical approach is important as it involves local communities in the conservation of biodiversity. This is based on the idea that the healthiest ecosystems of the world are under the control of local communities, and local communities manage many species for which science has little information. Plants have significant medicinal value both in developing and developed countries. About half of the world's medicinal compounds are still extracted from plants [18]. Since time immemorial, traditional medicine is an integral part of local culture and is a major public health care system [21, 30]. Besides its profound cultural bases, one reason for this is inaccessibility of modern healthcare services. Thus, the need to undertake ethnobotanical researches and to document medicinal plants and associated indigenous

knowledge has come to be an urgent task as already underlined by [29]. According to the Health Sector Development Program (HSDP) of the Ethiopian Ministry of Health, the proportion of different health professionals to the service requiring citizens (patients) is not balanced. Ahead of this, the country faces shortage of competent health professionals and the ratio of one doctor is for 10,000 people, one nurse is for 5000 people, one health extension worker is for 2,500 people [31]. Thus, traditional medicine is an important means of primary healthcare for achieving the goal of the country's health policy. The various literatures available also support this fact where about 80% of human and more than 80% of livestock population in Ethiopia depend on traditional medicine. Akin to elsewhere in Ethiopia, people living in Bule Hora District have also traditional practices which they put into upshot for generations to take care of themselves and their livestock. The majority of medicinal plants, with some exceptions are harvested from wild habitats, which are currently under great threat due to anthropogenic and natural causes [59]. There are reports indicating that many potentially useful plants are disappearing throughout the world, and Ethiopia is not exceptional.

Since ethnomedicinal healing systems vary across cultures and there is no such ethnomedicinal research and documentation carried out in Bule Hora District this study therefore, aimed at documenting indigenous knowledge on use and management of medicinal plants by herbalists to treat human and livestock ailments as well as assessing of the existing threats to these medicinal plants in the district. This is believed to add up to the country's database of medicinal plants and in documenting indigenous knowledge of the people.

## Methods

### The study area

This study was conducted in Bule Hora District (formerly called Hageremariam District), Southern Oromia, which is located 467 km away from Addis Ababa to the South and 100 km North of Yabello, the capital of Borana Zone. This District lies between latitudes of 5° 26' and 5° 52' North and longitudes of 37° 56' and 38° 31' East with a total area of about 488,861.3 hectares of which 77.1% is middle land and 22.9% is lowland and the altitudinal range lies between 1465 - 2300 m a. s. l. (Figure 1).

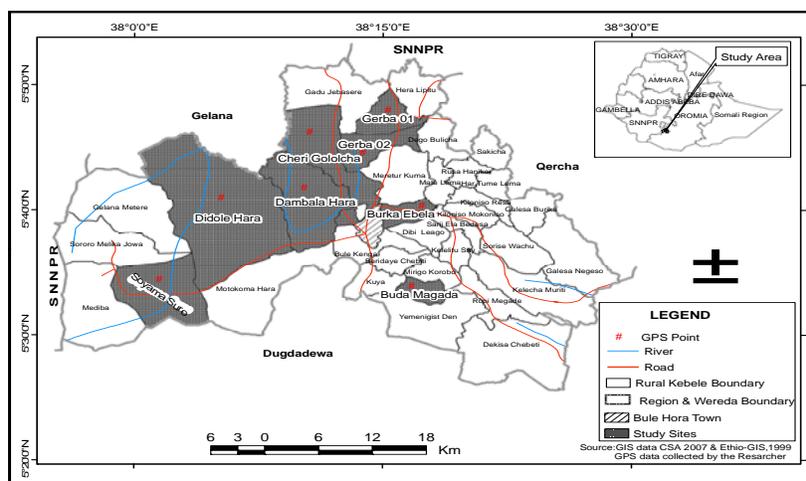


Fig 1: Map of Ethiopia showing the study area

### Population and socio-economic background of the local people

The district is predominantly occupied by agro - pastoralists Guji - Oromo people who speak Oromo language. The total population of the district is about 266,150 of which 134,603 (50.6%) are males and 131,547 (49.4%) are females. Urban dwellers are about 37,076 (13.9 %) of which 19,174 (7.2%) are males and 17,902 (6.7%) are females. Rural dwellers are about 229,074 (86.1%) of which 115,429 (43.4%) are males and 113,645 (42.7%) are females [16]. The administrative center of Bule Hora District is Bule Hora and agriculture is the main economic basis of the people. The socio-economic activity of the local population is cultivation of cash crops like *Coffea arabica*, *Catha edulis*, as well as *Zea mays*, *Triticum aestivum*, *Hordeum vulgare*, *Eragrostis tef*, *Phaseolus vulgaris* and in some parts *Ensete ventricosum* and rearing of different livestock. According to the District Agricultural and Rural Development Office report, 98% of the populations are farmers, 1.5% merchants and 0.5% government workers.

### Sampling design

A reconnaissance survey of the study area was conducted from March 26 - April 5, 2010 and out of the 48 kebeles (the

smallest administrative units) in the District, eight kebeles (Buda Magaada, Cari Saphalliisaa, Dambalaa Haraa, Diidoollee, Eeballaa, Garbaa 01, Garbaa 02, and Soyaamaa Suroo) were used as sampling kebeles for data collection. The selection of the eight kebeles was based on their altitudinal differences as well as by purposive sampling method considering the availability of traditional healers identified with the assistance of local authorities and elders. Within each kebele, localities were identified based on six habitat criteria (Forest lands, woodlands, grasslands, fallow land, farmland, and home gardens). This procedure gave 58 total localities from which 35 sampling units were selected by taking one locality for each habitat type in each kebele using the lottery method (Table 1). This stratification procedure gave 2 forest land localities, 7 woodlands, 7 grasslands, 7 fallow lands, 7 farmland, and 5 home gardens that were employed for the collection of relevant data. The selection of localities based on stratification by habitat type was chosen as it is the best representative sample for obtaining the medicinal plant and ethnomedicinal knowledge in the District. It is noted that not each kebele was represented by each of the habitat types (Table 1).

**Table 1:** Total number of localities and number of sampling units in Bule Hora District

No.	Kebeles	Localities and sampling units for each habitat corresponding to each kebele													
		Forestland		Woodland		Grassland		Fallowland		Farmland		Homegarden		Total	
		TNL	CNL	TNL	CNL	TNL	CNL	TNL	CNL	TNL	CNL	TNL	CNL	TNL	CNL
1	Buda Magaada	1	1	NR	NR	2	1	NR	NR	NR	NR	2	1	5,	3
2	Cari Saphalisa	NR	NR	2	1	2	1	1	1	2	1	NR	NR	7,	4
3	Dambala Hara	NR	NR	2	1	2	1	1	1	2	1	2	1	9,	5
4	Diidollee	NR	NR	2	1	2	1	1	1	2	1	NR	NR	7,	4
5	Eeballaa	1	1	2	1	NR	NR	2	1	2	1	2	1	9,	5
6	Garbaa 01	NR	NR	1	1	1	1	2	1	2	1	1	1	7,	5
7	Garbaa 02	NR	NR	1	1	2	1	2	1	2	1	1	1	8,	5
8	Soyaama Suro	NR	NR	2	1	2	1	1	1	1	1	NR	NR	6,	4
	TNL	2	-	12	-	13	-	10	-	13	-	8	-	58,	-
	CNL	-	2	-	7	-	7	-	7	-	7	-	5	-	35

N.B. TNL - Total number of localities; CNL - Chosen number of sampling units; NR - Not represented

**Informant selection**

Information about traditional medicine usage and its associated indigenous knowledge was gathered from informants whose age ranged from 18 to 78 who were chosen both purposively and randomly from among those born or have lived there for most of their lives. A total of 60 informants (44 males and 16 females) were used from eight kebeles (seven to eight informants from each kebele). 36 of the total informants (four to five from each kebele) were randomly selected. This was done either by tossing a coin and using him/her as informant whenever head of the coin was up if he/she volunteered to participate or accidentally during random walk made to houses in the selected areas. The other 24 of the total informants (three from each kebele) were local experts (key informants) that were selected purposively based on recommendations from the local people, local authorities, and development agents at each study site.

**Ethnobotanical data collection**

For ethical reasons, ethnobotanical data were collected in the attendance of local administrators and with the permission of each informant for the publication of the research. Materials used for data collection were mainly plant press for specimen collection, GPS 60, digital photo camera, digging and cutting materials. Ethnobotanical data collection was undertaken during two rounds of field visits during April, 2010 to June, 2010. The methods employed in the data collection were group discussion, field walk interviews, observation, market survey, scoring and ranking. A checklist of semi-structured questions consisting of issues was prepared in advance. The interviews were translated into the local language (Oromo language) with the help of field guide and implemented effectively. During the course of the study, each informant was visited 2–3 times in order to validate the reliability of the ethnobotanical information.

The visits were done without planned appointments with the informants. As a result, the responses of an informant that were not in agreement with each other were considered vague and discarded from the analysis. Field walk with guides and traditional healer(s) were made during the possibility study. Group discussions, which were employed in each kebele, were used for cross-checking and verifying the information that has been gathered from individuals by semi-structured interview. The discussions were made with key informants as well as randomly selected informants sometimes altogether or alone in their categories during field study and the information obtained was documented.

**Plant identification**

Voucher specimens of medicinal plants that were consistently reported two times or more during informant visits were collected from the wild, home gardens and crop fields and preliminary identification of some specimens was made in the field; and they were pressed and taken to the National Herbarium (ETH) of Addis Ababa University where they were dried, deep frozen, and determined. The determination was done first using keys in Flora of Ethiopia and Eritrea, and later supported with determination by comparisons with already authenticated specimens and confirmed with the help of taxonomic experts in Addis Ababa University; and all these voucher specimens were labeled and deposited at ETH.

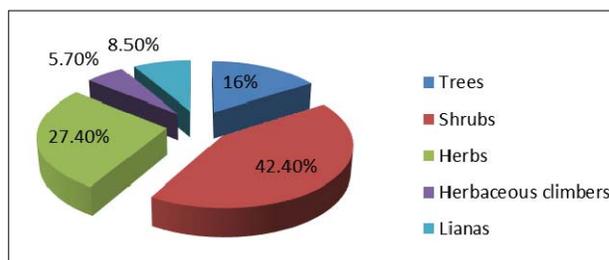
**Data analysis**

Both qualitative and quantitative analytical tools were used for data analysis. Percentage frequency method of data analysis was employed to summarize some of the descriptive ethnobotanical data obtained from the interviews on reported medicinal plants and associated knowledge. Microsoft Excel spread sheet was employed for organizing some ethnobotanical data. Preference ranking was performed to analyze the most popular and preferred medicinal plants, at least in the context of the people who used them against rabies, which was one of the most frequently reported human and livestock disease in the area. Direct matrix ranking was done to rank up medicinal plants reported frequently with various ethnobotanical roles. Pair wise comparison of medicinal plants was done for the treatment of cold disease and fidelity level index of healing potential of medicinal plants was also computed.

**Results**

**Diversity of medicinal plants in the study area**

A total of 106 species of medicinal plants were collected that were grouped under 98 genera and 46 families (Table 2). Of these plants, shrubs took the highest proportion (Figure 2).



**Fig 2:** Growth habits of medicinal plants in the study area

**Table 2:** List of medicinal plants collected from Bule Hora District (Detail descriptions about the disease treated, mode of preparations and applications)

Scientific name	Family	Local name	Hb	Pu	Ut	Cp	Ra	Disease treated	Preparation and application
<i>Acacia dolichocephala</i>	Fabaceae	Waaccu	T	Rt	Hu	D	Na,Dm	Evil eye (Driyaa)	Taking dried root parts & fumigating the patient.
<i>Acacia lahi</i>	Fabaceae	Waaccu	Sh	L	Hu,Ls	F	Na	Donkey coughing Human wound (Quffa haree fi madaa namaa)	Pounding the leaves, making s/n and dropping one coffee cup through the nostrils of the animal. Pounding the leaves and putting on the wound.
<i>Acanthospermum hispidum</i>	Asteraceae	Harmaagussa	H	L	Hu	F	O	Hypertension (Danfaa dhiigaa)	Crushing the leaves, boiling it & drinking one tea cup with in 12 hrs difference for a week.
<i>Acmella caulirhiza</i>	Asteraceae	Jiloo qaldhaa	H	L	Hu,Ls	F	O, Dm	Tissue cancer and stomach ache (Luxaa fi dhukkubaa garaa)	Chopping the whole part of the plant, making s/n and inserting it into the opening of the wound and closing the opening with its residue. Chewing the leaves.
<i>Acokanthera schimperi</i>	Apocyanaceae	Qarraruu	Sh	L	Hu,Ls	F	Dm	Scabies (Qanxoo ykn ciittoo)	Chopping the leaves, making s/n and applying on the infected part of the body.
<i>Albizia schimperiana</i>	Fabaceae	Garbii	T	L	Hu	F	O	Mouth inflammation (Banqoo)	Chewing some young leaves & spitting it in the mouth of suffering child.
<i>Allium sativum</i>	Alliaceae	Qullubi	H	B	Hu	F	O	Stomach ache (Dhukkubaa garaa)	Peeling the bulb and eating one or two splits before meal when there is pain.
<i>Aloe yavellana*</i>	Aloaceae	Hargiissa	H	La	Hu	F	O, Dm	Hepatitis (Biiirtee/ Bekkekko)	Taking the latex and drinking one coffee cup for humans and 1.5 water glass for livestock daily. Polishing on the infected part of the skin.
<i>Asparagus africanus</i>	Asparagaceae	Sariitii	Li	L	Hu	F	O	Cold disease (Gamtokke)	Crushing the lives, making solution, adding honey and drinking one water glass.
<i>Balanites aegyptiaca</i>	Balanitaceae	Baddana	Sh	Ba	Hu,Ls	F	O	Rabies (Dhukkuba Saree)	Chopping the bark, making s/n & giving a coffee cup for humans & 1-2 litres for livestock 2 times a day for a total of 5 days to cure 40 days passed rabies infection.
<i>Bersama abyssinica</i>	Melanthaceae	Xibiitroo	Sh	L	Hu	F	O	Mouth inflammation (Waan Afaani)	Crushing the leaves with the flower of <i>Solanum incanum</i> , young leaves of <i>Ehretia cymosa</i> and <i>Zingiber officinale</i> and spitting into the mouth of the child.
<i>Buddleja davidii</i>	Loganiaceae	Adiitii	Sh	L	Hu	F	O	Tonsillitis (Waan Afaani)	Pounding the leaves, making s/n & giving half a coffee cup at once.
<i>Calpurnia aurea</i>	Fabaceae	Ceekataa	Sh	L	Ls	F	Na	Early maturity of Udder (Saadhessa)	Rubbing the leaves with hands and smelling it to the animal or crushing the leaves, making s/n and dropping some droplets through the nostrils.
<i>Capparis tomentosa</i>	Capparidaceae	Goraa gaala	Li	Ba	Hu	F	O	Tooth ache (Dhukkuba ilkaa)	Chewing the root bark with the infected teeth.
<i>Carissa spinarum</i>	Apocynaceae	Agansa	Li	Rt	Hu	F	O	Cold disease (Gamtokke)	Chewing the root or crushing the root, boiling it and drinking one water glass once.
<i>Clematis hirsuta</i>	Ranunculaceae	Fiiitii	Li	L	Hu	F	O, Dm	Bone & tissue cancer, gland TB (Cacassaa xanachaa and, luxaa)	Pounding the leaves, making s/n and drinking half of small glass and applying certain amount of the solution into the hole of the wound by using syringe or other domestic material. The residue should be placed on the opening of the wound.
<i>Clerodendrum myricoides</i>	Lamiaceae	Mardhisiisaa	Sh	Rt	Ls	F	Dm	Breast cancer in cattle (Naqarsaa muchaa looni)	Crushing the roots, mixing it with butter and applying it on the infected part.
<i>Clutia lanceolata</i>	Euphorbiaceae	Kutta dhigaa	H	Rt	Ls,Hu	F	O	Hepatitis, Eczema (Biiirtee fi caccaa)	Crushing the root, boiling it and giving one water glass. Pounding the leaves, if necessary adding butter and applying on the infected part.
<i>Coffea arabica</i>	Rubiaceae	Buna	Sh	S, L	Hu	F,D	O, Dm	Dizziness, headache Wound (Dhukkuba matta fi madaa)	Roasting the seeds and leaves, crushing, boiling and drinking it as necessary. Put on the seed powder on the wound.
<i>Combretum molle</i>	Combretaceae	Rukkensaa	T	Rt	Hu	D	Na	Evil eye (Driyaa)	Fumigating the patient.
<i>Crabbea velutina</i>	Acanthaceae	Laafaa	H	L, Rt	Ls	F	Na	Dropping saliva (Dhukkuba addu)	Chopping the leaves and roots together, making solution and dropping one coffee cup through the nostrils
<i>Crinum abyssinicum</i>	Amaryllidaceae	Butte woraabessa	H	L	Ls	F	O	Swelling of stomach (Darrabbaa)	Pounding the leaves, making s/n & giving one water glass 2 times a day until the animal is cured.
<i>Crotalaria albicaulis</i>	Fabaceae	Qorsa direyaa	Sh	Rt	Hu	F	Dm	Evil eye (Driyaa)	Crushing the root, boiling it and washing part of the body where pain is feeling without touching the ground with legs.
<i>Croton macrostachyus</i>	Euphorbiaceae	Mokkoniisaa	T	Ba, L	Hu,Ls	F	O, Dm	Black leg, ring worm, tapeworm (Abbagorbaa, ciirtii & mini)	Crushing the bark, making s/n & giving one liter for Black leg. Crushing the bark, boiling it and giving one coffee cup for humans and one water glass for livestock to eradicate tapeworm. Applying the latex of the petiole on the infected skin for ringworm.
<i>Cucumis pustulatus</i>	Cucurbitaceae	Haadhatu	Hcl	Rt	Hu	F	O	TB and sharp pain on body sides (Dhukkuba Sombaa fi warrana)	Chewing the root or crushing the root, making s/n and drinking one coffee cup daily until cured.
<i>Cymbopogon caesius</i>	Poaceae	Marra garra	H	L	Hu	F	O	Stomach ache (Gara ciininu)	Chewing the leaves and swallowing the juice.
<i>Datura stramonium</i>	Solanaceae	Qobboo	H	L	Hu,Ls	F	O	Rabies (Dhukkuba Saree)	Pounding the leaves, making s/n & giving 1-2 coffee cup for adult human and

		arddaa							livestock and half of it for children and calves.
<i>Discopodium penninervium</i>	Solanaceae	Maraaroo	Sh	L	Hu	F	Dm	Eczema(Cacca)	Crushing or burning the leaves and applying the crushed form or the ash on the infected part of the body.
<i>Dodonea angustifolia</i>	Sapindaceae	Dhitachaa	Sh	L	Ls	F	O, Na	Diarrhea of calves (Busootu)	Pounding the leaves, making s/n if possible adding <i>Megado</i> salt and giving small amt through the nostrils and one coffee cup orally once for all.
<i>Dombeya torrida</i>	Sterculiaceae	Daannisa	Sh	Ba	Ls	F	Na	Donkey coughing (Gororsaa Harree)	Crushing internal part of stem bark, making s/n and giving quarter of coffee cup through the nose.
<i>Dovyalis abyssinica</i>	Flacourtiaceae	Dhugo	Sh	L	Hu	F	O	Cold disease (Gamtokkee)	Pounding the leaves, making s/n and drinking one coffee cup.
<i>Ehretia cymosa</i> var. <i>cymosa</i>	Boraginaceae	Uraaga	Sh	L	Hu	F	O	Gonorrhoea and amoebiasis(Dhukkuba dhirra fi mageana)	Crushing its leaves with the leaves of <i>Fagaropsis angolensis</i> , <i>Acmella caulirhiza</i> and internal part of stem bark of <i>Croton macrostachyus</i> , making s/n and drinking one water glass at once.
<i>Ehretia cymosa</i> var. <i>sylvatica</i>	Boraginaceae	Me'ee	Sh	L, Ba	Hu,Ls	F	O	Stomach ache in newly born child and stomach problem in cattle. (Dhukkuba raqaa and cumma)	Crushing its leaves with the leaves of <i>Clematis hirsuta</i> , <i>Prunus africana</i> , <i>Croton macrostachyus</i> and <i>Calpurnia aurea</i> , making s/n, adding <i>megado</i> salt and giving half of coffee cup for newly born child orally and a liter for cattle.
<i>Embelia schimperi</i>	Myrsinaceae	Haanquu	Li	S	Hu,Ls	F	O	Tapeworm(Mini)	Crushing the seeds, making s/n and drinking/ giving one water glass.
<i>Erythrina brucei</i> *	Fabaceae	Waleenaa	T	Ba	Hu	F	O	Tooth ache(Dhukkuba ilkaa)	Chewing internal part of stem bark if possible with <i>magado</i> salt.
<i>Erythroselinum atropurpureum</i>	Apiaceae	Batti	H	L	Hu	F	O	Rabies (Dhukkuba saree)	Pounding the leaves, making s/n & drinking or giving one water glass at once.
<i>Eucalyptus camaldulensis</i>	Myrtaceae	Baargamoo diima	T	L	Hu	F	O	Stomach ache(Dhukkuba garra)	Chewing the young leaves and swallowing it.
<i>Eucalyptus globulus</i>	Myrtaceae	Baargamoo adii	T	L	Hu	F	O,Na	Rabies and common cold(Dhukkuba saree fi quufaa)	Crushing the leaves, making s/n & dinking two coffee cup three times a day for rabies & taking the leaves, boiling them & smelling & fumigating with vapor for common cold.
<i>Euclea divinorum</i>	Ebenaceae	Mi'eessa	Sh	L	Hu	F	O	Cold disease(Gamtokke)	Pounding the leaves, making s/n and drinking one coffee cup at once.
<i>Euphorbia ampliphylla</i>	Euphorbiaceae	Hadaama	T	La	Hu	F	O	Gonorrhoea(Dhukkuba dhiiraa)	Taking some amount of the latex, cooking it with <i>Qocho</i> bread and eating it once for all.
<i>Euphorbia depauperata</i>	Euphorbiaceae	Gurii	H	La	Hu	F	Dm	Skin rash & ring worm(Kormommaan fi roobbii)	Taking the latex and applying on the infected part.
<i>Euphorbia cryptospinosa</i>	Euphorbiaceae	Aananno	Hcl	Rt	Hu	F	O	TB(Dhukkuba Sombaa)	Crushing internal part of the root with the roots of <i>Solanum incanum</i> and <i>Osyris quadripartita</i> , making s/n and adding honey then drinking as necessary when the patient becomes thirsty.
<i>Fagaropsis angolensis</i>	Rutaceae	Sisaa	T	L	Ls	F	O, Dm	Diarrhea & wound on the body of cattle(Sumuxee)	Pounding the leaves and internal part of stem bark with the leaves of <i>Protea gaguedi</i> & fruits of <i>Solanum incanum</i> , making s/n and giving one liter orally.
<i>Flacourtia indica</i>	Flacourtiaceae	Hagalaa	Sh	Ba	Hu	F	O	Cold disease(Gamtokke)	Chopping bark of the stem, making s/n driking one coffee cup 2 times a day until the patient is cured.
<i>Foeniculum vulgare</i>	Apiaceae	kalkala	H	Rt	Hu,Ls	F	O	Stomach ache in humans and to remove plastic materials from the livestock stomach(Dhukkuba garra)	Pounding the roots, making s/n and giving a coffee cup for humans and a liter for livestock.
<i>Fuerstia africana</i>	Lamiaceae	Qayaa duraa	H	L	Hu	F	Dm	Ring worm(Roobbii)	Crushing the leaves, making s/n and applying on the infected part.
<i>Gardenia ternifolia</i>	Rubiaceae	Gambello	Sh	Rt	Hu	F	O	Increased bile production due to malarial infection (Haadhootuu)	Crushing the roots, making s/n and drinking half of coffee cup once for all.
<i>Gnidia involucrata</i>	Thymelaeaceae	Bortoo	H	Rt	Hu	F	O	Gonorrhoea & ascariis (Dhukkuba dhiiraa fi Maagaa)	Crushing the root, making s/n & drinking one water glass at once.
<i>Guizotia scabra</i>	Asteraceae	Hadaa butti	H	L	Ls	F	O	Black leg (Abagorba)	Chopping the leaves, making s/n & giving one water glass.
<i>Hagenia abyssinica</i>	Rosaceae	Heexo	T	L, Fl	Hu	F,D	O	Swelling of stomach & tapeworm (Furfuraa fi mini)	Pounding the leaves and seeds together, making s/n and giving one water glass orally for cattle. Crushing the seeds, making s/n and giving one water glass for adult humans.
<i>Haplocoelum foliolosum</i>	Sapindaceae	Canaa	Sh	S	Hu	F	O	Ascaris (Maagaa)	Chewing a handful of ripened seeds and swallowing it.
<i>Heteromorpha arborescens</i>	Apiaceae	Al-Hanqaa	Sh	L	Ls	F	O	Shivering and unable to breath(Cuma'a)	Crushing its leaves with the leaves of <i>Ozoroa insignis</i> , <i>Croton macrostachyus</i> , <i>Calpurnia aurea</i> and <i>Senecio hadiensis</i> , making s/n & giving one liter orally at once.
<i>Hordeum vulgare</i>	Poaceae	Garbuu	H	S	Hu,Ls	D	O	Broken bones and worn out tissues(Lafee cabaa)	Slightly toasting and grinding the seeds, preparing soup and drinking it as necessary for humans. Giving some amount of grains daily for sick Donkey, Muel or Horse.

<i>Hymenodictyon floribundum</i>	Rubiaceae	Takkidha'aa	Sh	L	Hu	F	Op	Eye disease(Dhukkuba ija'a)	Chopping the leaves, squeezing it to get droplets of saps & put one droplet in each eye.
<i>Justicia schimperiana</i>	Acanthaceae	Ciigga	Sh	L	Hu	F	O	Hepatitis(Bekekko ykn Birtee)	Chopping young leaves, making s/n and drinking half of water glass at once.
<i>Kalanchoe densiflora</i>	Crassulaceae	Hancullee	H	L	Hu	F	Dm	Rheumatic pain(Nafaa bocu)	Heating the leaves on fire and put on where the pain is feeling.
<i>Lagenaria abyssinica</i>	Cucurbitaceae	Buqee Fardoo	Hcl	Fr	Ls	F	Dm	Swelling of legs (FMD) (Dhukkuba korraa)	Splitting the fruit, heating it on fire & put on the infected hooves.
<i>Laggera crassifolia</i>	Asteraceae	Seesiqoo	H	L	Hu	F	Dm	Blood clotting(Dhiigaa dhaabuuf)	Chopping the leaves and putting on the cut.
<i>Leonotis ocyimifolia</i>	Lamiaceae	No	Sh	L	Hu	F	O, Dm	Feverile illness and hepatitis(Michii fi birtee)	Pounding the leaves, making s/n and drinking half a coffee cup and applying certain amount on the body.
<i>Lepidium sativum</i>	Brassicaceae	Feecoo	H	S	Hu	D	O,Dm	Stomach ache & febrile illness(Garaa ciininu fi michii)	Chewing the seeds and swallowing it. Applying its s/n on the body.
<i>Leucas discolor</i>	Lamiaceae	Xuxiyee	Sh	L	Ls	F	Na	Coughing in calves (Bussotu)	Pounding the leaves, making s/n & applying half of a coffee cup through the nose.
<i>Maesa lanceolata</i>	Myrsinaceae	Abaayii	Sh	L	Ls	F	Na	Leech infection(Ulaula)	Chopping the leaves, making s/n and applying through the nostrils.
<i>Microglossa pyrifolia</i>	Asteraceae	No	Li	L	Ls	F	Dm	Dermal wound of Muel & Horse (Booccoqaa)	Pounding the leaves, making thick s/n & applying on the wound daily until it heal.
<i>Milletia ferruginea*</i>	Fabaceae	Dhaadhatu	T	L, S	HU	F,D	O, Dm	Cold & flee infection(Gamtokke fi mujalee)	Chopping the leaves, making s/n, adding honey and drinking one water glass at once for cold. Crushing the seeds, making thick s/n and applying on the infected toes and fingers for flee infection.
<i>Momordica foetida</i>	Cucurbitaceae	Suruphaa bofaa	Hcl	Rt	Hu	F	O	Rabies & Gonorrhoea (Dhukkuba Saree fi dhukkuba dhiiraa)	Pounding the roots, making s/n drinking one coffee cup at once.
<i>Nicotiana tabacum</i>	Solanaceae	Tambo	H	L	Hu,Ls	D	O, Na	Tooth ache & Leech (Dhukkuba illkaa fi ulaula)	Chewing partly crushed leaves with magado salt for tooth ache. Crushing dried leaves, making s/n and applying through the nose or mouth of the animal.
<i>Nuxia congesta</i>	Loganiaceae	Udessa	T	L	Hu	F	O	Cold disease (Gamtokke)	Pounding the leaves with the leaves of <i>Asparagus africanus</i> , making s/n & drinking one water glass at once.
<i>Ocimum urticifolium</i>	Lamiaceae	Hancabbii	Sh	L	Hu	F	O, Dm	Oral inflammation and fever(Banqoo)	Chopping the leaves, making s/n, dinking small amount and rubbing the body with the residue.
<i>Osyris quadripartita</i>	Santalaceae	Waato	Sh	L, Rt	Hu	F	O	TB(Dhukkuba sombaa)	Pounding these parts, making s/n and drinking one water glass daily for a month.
<i>Ozoroa insignis</i>	Anacardiaceae	Biiqaa	Sh	Ba	Hu	F	O	Cold disease(Gamtokke)	Chopping the inner part of the bark, boiling it, if possible adding milk or butter and drinking one water glass 2 times a day for 5 days.
<i>Pavetta gardeniifolia</i>	Rubiaceae	Qadiidaa	Sh	Rt	Hu,Ls	F	O,Dm	Tooth ache and wounded cancer(Dhukkuba illkani fi cacassaa)	Chewing the root for tooth ache. Pounding the root and putting on the infected part.
<i>Pavetta oliveriana</i>	Rubiaceae	Qadiidaa dalachaa	Sh	L	Hu,Ls	F	O, Na	Urine retention (Dhidiinsa fincaanii)	Chopping the leaves, making s/n and drinking one coffee cup at once or smelling the chopped leaves.
<i>Pentas lanceolata</i>	Rubiaceae	Cunfaa	H	L	Hu	F	O	Gonorrhoea and amoebiasis(Dhukkuba dhiiraa fi mageana)	Pounding the leaves with the leaves of <i>Fagaropsis angolensis</i> , <i>Acmella caulirhiza</i> and internal stem bark of <i>Croton macrostachyus</i> , making s/n, possible adding honey and drinking one water glass at once.
<i>Phytolacca dodecandra</i>	Phytolaccaceae	Haraanja	Li	L	Ls	F	O	Horse coughing (Gamojii)	Chopping the leaves, making s/n & giving one water glass twice per week.
<i>Pittosporum viridiform</i>	Pittosporaceae	Irbaa	Sh	L	Ls	F	Na	Paralysis(Sumuxee)	Pounding the leaves, making s/n and dropping one coffee cup through the nostrils 3 times a day
<i>Podocarpus falcatus</i>	Podocarpaceae	Birbirs	T	L	Hu	F	O	Diarrhea, fever and joint pain(Laafaa) s/n and drinking one coffee cup.	Chopping the leaves, making s/n and drinking one coffee cup 2 times a day for three days.
<i>Polysphaeria parvifolia</i>	Rubiaceae	-----	Sh	L	Hu,Ls	F	Dm	Wound(Madaa)	Pounding the leaves and putting on the wound.
<i>Polyscias fulva</i>	Araliaceae	Gudduba	T	L	Hu	F	O	Amoebiasis(Mageana)	Chopping the leaves, making s/n and drinking one coffee cup.
<i>Premna schimperi</i>	Lamiaceae	Xullangee	Sh	L	Hu	F	O, Dm	Tissue cancer(Swelling and forming deep opening) (Luxaa)	Pounding the leaves and making s/n to take it orally and applying through the opening. The residue should be used to close the opening
<i>Protea gagedi</i>	Proteaceae	Daansee	Sh	L	Ls	F	O	Diarrhea and wound(Sumuxee)	Chopping the leaves with the leaves of <i>Fagaropsis angolensis</i> and fruits of <i>Solanum incanum</i> , making s/n and giving one liter orally.
<i>Prunus africana</i>	Rosaceae	Sukkee	T	L	Ls	F	O	Diarrhea, wound and coughing in cattle (Sumuxee)	Pounding the leaves with the leaves of <i>Clematis hirsuta</i> , <i>Calpurnia aurea</i> , <i>Ehretia obtusifolia</i> , <i>Croton macrostachyus</i> and <i>Teclaea simplicifolia</i> , making s/n and giving one water glass orally at once.
<i>Rhamnus prinoides</i>	Rhamnaceae	Geeshoo	Sh	L	Hu	F	O	Tonsillitis (Waan afaani)	Chopping the leaves, making s/n and giving half a coffee cup at once

<i>Rhus natalensis</i>	Anacardiaceae	Daboobessaa	Sh	L	Hu	F	O	Snake bite(Iddansaa Bofaa)	Chewing a handful of its leaves
<i>Ricinus communis</i>	Euphorbiaceae	Qoobboo	H	L	Hu, Ls	F	O	Rabies(Dhukkuba Saree)	Pounding its leaves with the leaves of <i>Croton macrostachyus</i> , making s/n and giving one water glass orally at once.
<i>Rubia cordifolia</i>	Rubiaceae	Maxanee	Li	L, Rt	Hu	F	O	Snake bite(Iddansaa Bofaa)	Chopping the leaves and roots together, making s/n and drinking one liter at once. Applying the residue on the infected area.
<i>Rumex abyssinicus</i>	Polygonaceae	Dhangagoo	H	Rt	Hu	F	O	Gonorrhea(Dhukkuba dhiiraa)	Pounding the roots, boiling, adding butter and drinking one water glass daily until cured.
<i>Ruta chalepensis</i>	Rutaceae	Xeenaadamii	Sh	L	Hu, Ls	F	O	Stomach ache and cold disease(Dhukkuba garaa fi Gamtokke)	Chopping the leaves, making s/n, adding honey and drinking or giving one water glass.
<i>Salvia nilotica</i>	Lamiaceae	-----	H	L	Hu	F	O	Cold disease (Gamtokke)	Pounding the leaves, making s/n, adding honey and drinking one water glass daily until cured.
<i>Schrebera alata</i>	Oleaceae	Dhamee	T	Ba	Hu	F	O	Tooth ache and throat pain(Naqarsaa ilkaa fi Qalxaa)	Chewing internal part of stem bark and not swallowing the juice for tooth ache but swallowing for throat pain.
<i>Senecio hadiensis</i>	Asteraceae	Walgabbissa	Hcl	L	Ls	F	O	Shivering and unable to breath (Cuma'a)	Chopping the leaves with the leaves of <i>Heteromorpha arborensdens</i> , <i>Croton macrostachyus</i> , <i>Calpurnia aurea</i> and <i>Lagenaria abyssinica</i> , making s/n and giving one liter orally at once.
<i>Solanecio gigas*</i>	Asteraceae	Gimboodha	Sh	L	Hu	F	O	Paralysis(Cuma'a)	Pounding the leaves with the leaves of <i>Clematis hirsuta</i> , and <i>Teclia simplicifolia</i> making s/n and drinking one water glass 2 times a day for a week.
<i>Solanum incanum</i>	Solanaceae	Hiiddi	Sh	Fr	Hu	F	Na	Tonsilitis and tooth ache(Waan afaanii fi dhukkuba ilkaa)	Applying 1-2 droplets of the fruit juice through the nostrils for tonsillitis and 1 - 2 drops for infected tooth.
<i>Syzygium guineense</i>	Myrtaceae	Baddessa	T	Ba	Ls	F	Na	Leech infection (Ulaulaa)	Chopping internal part of stem bark, making s/n and giving half of a coffee cup through the nostrils.
<i>Teclia simplicifolia</i>	Rutaceae	Haadheessa	Sh	L	Hu, Ls	F	O	Mouth inflammation and black leg(Waan afaanii fi Abagorba)	Pounding the leaves, making s/n and giving a quarter of water glass for cattle and adult humans while very small amt for children and calves.
<i>Thunbergia ruspolii*</i>	Acanthaceae	-----	H	L	Ls	F	Na	Diarrhea in calves(Busootuu)	Chopping the leaves, making s/n and applying one coffee cup through the nose two times a day.
<i>Tragia cinerea</i>	Euphorbiaceae	Laalessaa	Hcl	L	Ls	F	O, Na	Diarrhea in cattle (Busootuu)	Pounding the leaves, making s/n and giving one liter orally and some droplets through the nose. s/n and giving one liter orally and some droplets
<i>Triticum aestivum</i>	Poaceae	Qamadii	H	S	Hu	D	Dm	Swelling of the body (Dhulla ykn Bugunge)	Chewing the seeds and placing the bolus on the swelling.
<i>Urera hypselodendron</i>	Urticaceae	Hajijaa	Li	L	Ls	F	O	Placenta retention(Jiila akka bussu)	Chopping the leaves, making solution, adding <i>magado</i> salt and giving one liter orally at once.
<i>Vangueria madagascariensis</i>	Rubiaceae	Bururii	Sh	L	Hu	F	Dm	Wound(Madaa)	Pounding the leaves and applying on the wound.
<i>Vernonia amygdalina</i>	Asteraceae	Eebichaa	Sh	L	Hu, Ls	F	O	Blotting and urine retention(Bokkoksaa fi dhiibiinsaa fiincaanii)	Chopping the leaves, making s/n drinking one coffee cup for humans and giving a liter for livestock at once.
<i>Vernonia auriculifera</i>	Asteraceae	Reejii	Sh	Meristem	Hu	F	O	Amoebiasis(Mageana)	Peeling the young stem near the meristem and chewing it.
<i>Vernonia smithiana</i>	Asteraceae	-----	H	L	Hu	F	O	Stomach ache during birth(Garaa ciininu)	Pounding the leaves, making s/n and drinking one coffee cup daily.
<i>Viscum turberculatum</i>	Viscaceae	Dhertoo	H	L	Hu, Ls	F	O	Paralysis and Donkey cough (Dhukkuba Cuma'a fi quffaa Harree)	Chopping the leaves, making s/n & giving one water glass for humans & two water glass for Donkey.
<i>Withania somnifera</i>	Solanaceae	Lallaafaa	Sh	Rt, L, Ft	Hu, Ls	F, D	O	Snake bite and blotting(Hadhaa boofaa fi Darabba)	Chewing small amount of the root and swallowing it for snake venom and crushing the leaves and fruits together, making s/n and giving one water glass for blotting.
<i>Zingiber officinale</i>	Zingiberaceae	Gaanjibillo	H	Rh	Hu	F	O	Tonsilitis (Waan afaani)	Pounding the rhizome with the leaves of <i>Ehretia cymosa</i> and flowers of <i>Solanum incanum</i> and spiting into the mouth of infected baby.
<i>Ziziphus mucronata</i>	Rhamnaceae	Huqunqura	Sh	L	Hu	F	Dm	Wound (Madaa)	Chopping the leaves and applying on the wound.

Key: Hb = Habit, Pu = Parts used, Ut = Used to treat, Cp = Condition of preparation, Ra = Route of application, T = Tree, Sh = Shrub, H = Herb, Hcl = Herbaceous climber, Li = Liana, Hu = Human, Ls = Livestock, B = Both, F = Fresh, D = Dried, F/D = Fresh/Dried, O = Oral, Dm = Dermal, Na = Nasal, Op = Optical, Er = Ear, L = Leaf, Rt = Root, St = Stem, Ba = Bark, Fl = Flower, Fr = Fruit, S = Seed, Bu = Bulb, Rh = Rhizome, La = Latex, \* = endemic.

### Medicinal plants used to treat human, livestock and both human and livestock ailments

Among collected medicinal plants reported by the local people in the study area, the majority (58.4%) were used to treat human ailments (Table 3).

**Table 3:** Medicinal plants used to treat human, livestock and both human and livestock ailments

User	No. of plant species	%
Human	62	58.4
Livestock	22	20.8
Both human & livestock	22	20.8
Total	106	100

### Plant parts used for remedy preparation

Widely used plant parts by the local people in the study area to treat human and livestock diseases include leaves, roots, barks, and stems. Maximum numbers of species (56.1%) were harvested for their leaves to prepare remedies, followed by roots, barks, and stems (14.4%, 9.8%, and 8.3%, respectively) (Table 4).

**Table 4:** Plant parts used for the treatment of human and livestock diseases

Plant parts	No. of medicinal plants	%
Barks	13	9.8
Bulbs	1	0.8
Fruits	3	2.3
Latex	3	2.3
Leaves	74	56.1
Rhizomes	1	0.8
Roots	19	14.3
Seeds	7	5.3
Stems	11	8.3
Total	132	100

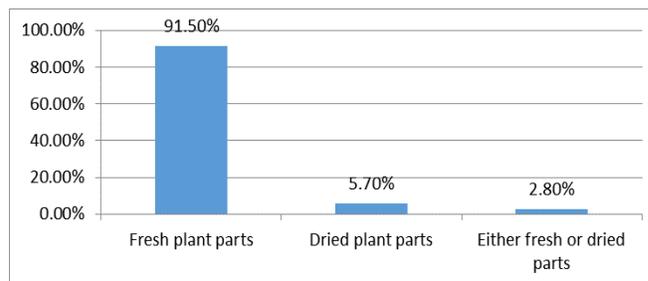
### Human and livestock ailments treated

In the study area 37 diseases of humans are treated with a total of 84 plant species and 16 preparations, where one species can treat a single disease or a number of diseases. Similarly, one ailment can be treated with multiple plant species or a single plant species. For example, cold disease is treated with ten species of plants; tonsillitis and stomach ache with nine species. This does not mean that they are necessarily used in combination; they could be used as alternative medicines for the same ailment.

Ailments reported to be handled by traditional medical practitioners of the district are those disorders, which are not prevalent in the area. Although rabies is a common problem in the district, it is not indicated in the 2010/2011 report of the District's Health Office as prevalent. This could be attributed to the preference of herbal drugs over the modern ones by the public to treat the disease. In this study 44 plant species were used to treat 25 livestock ailments, in 12 preparations. Diarrhea and body wound ranked first with seven species followed by rabies and paralysis five species each. Snake bite and diarrhea of calves ranked third with four species each. This may indicate the presence of good therapeutic experience of the local people in treating livestock ailments. Perhaps this could be due to the fact that they are agro-pastoralists which helped them follow up and treat livestock in their day to day life activities.

### Preparation of remedies

The local communities of the study area employ several methods of preparation of traditional medicines from plants. According to informants 91.5% of herbal preparations are from fresh plant parts followed by dried parts (Figure 3).



**Fig 3:** Percentages of medicinal plants used in remedy preparation

Preparation from single species accounted for 85.9% and followed by quadruple or more species (Table 5). The mixture is not changed depending on the patient but the dose may be changed with age, level of the disease, physical appearance of the patient and personal experience of the healer. As far as solvents and additives are concerned, water served as 'solvent' in most of the ethnoformulations, whenever dilution was required. Solution of roasted barley powder or local beer, charcoal powder solution and milk were reported as antidotes for remedies given for ailments such as hepatitis, rabies and gonorrhoea respectively. Different additives are incorporated in a 10.6% of the ethnoformulations. Of these additives *Magado* salt occupies 3.8%, honey 3.8% and butter 3%.

**Table 5:** Species composition of herbal medicine preparation in the study area

Composition of species	No. of species	%
Single species	91	85.9
Double species	3	2.8
Triple species	5	4.7
Quadruple or more species	7	6.6
Total	106	100

According to the healers, certain additives are frequently used to improve the acceptability of some remedies that are taken orally. This can be salt or honey which is added to preparations to reduce the bitterness of the remedies. The common preparation methods in the study area included solution (the medicinal plants in the solvent), juice/paste (extracted from fresh plant part), poultice (plant crushed or boiled and applied), unprocessed part (usually fleshy plant part), exudates (cell sap/latex) and smoke (as dry bath).

### Routes of application

The most common route of administration of traditional remedies in the study area was oral (67.19%). Most of the remedies prescribed by traditional healers are applied in different ways such as drinking their solution, taking drops of squeezed plant part or chewing and swallowing the liquid part only and dermal application is the second most important route of administration. But there are various ways of dermal application of traditional medicine such as applying in the form of paste, coating or tying or putting the powder on the affected part and so on. Only few medicinal plants were reported to be administered through nostrils and eyes (Figure 4).

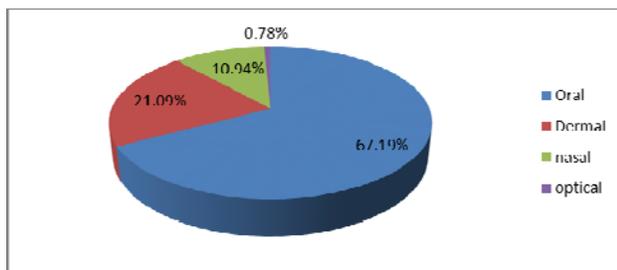


Fig 4: Route of traditional medicine administration

Some healers reported that restrictions are imposed when certain types of remedies are taken by patients. For example, food is not given from the morning until midday to a patient who is taking a remedy against intestinal worms (it is believed that food will reduce the efficacy of the remedy). This is the estimated time for getting diarrhea that expels the worm from the intestine.

**Forms of preparation of traditional medicines in the study area**

Mostly remedies are prepared by pounding the fresh plant part in a wooden mortar. The major form of preparation utilized by the people of the study area was liquid preparations (57.45%) and followed by unprocessed plant parts (Table 6).

Table 6: Forms of preparation of traditional medicines

Preparation form	%
Liquid	57.45%
Ointment	12.06%
Pounded	9.93%
Unprocessed	20.56%

**Dosages and other related applications**

The findings of this study showed that all administrations are not standardized. But healers in the study area used almost the same materials to measure the dosage. This may be due to experience sharing among them. According to [2], the real drawback in traditional medicine system mostly arises from lack of precision in dosage. Healers determine the dosages based on age, physical appearance, occupation, and duration of the illness, strength of the disease and diagnosis and experience of individual healer. Children are given smaller doses of medicine than considered in case of adult patients. As a result the local healers simply recommend or prescribe small amount such as drops, hand palms, coffee cups and for larger dosages the water glasses or other local materials that are used for drinking. They consider the type of disease and its severity to determine the frequency of treatment.

Local healers have special care for pregnant women and physically weak persons. These groups are not given those medicines that have observable adverse effects such as

vomiting and diarrhea. Most of the remedies were reported to have no serious adverse effects except vomiting, diarrhea, and temporary inflammations. According to the healers, these effects are generally due to an overdose of the remedy. Sometimes the expected effect of the remedy is diarrhea, such as in the case of constipation and intestinal worms. For intoxicification treatment, the patient is supposed to eliminate the poisons by vomiting. The people of the study area use cow milk as common antidote and the most common form of application of traditional medicines is through drinking (Table 7).

Table 7: Forms of application of remedies in the study area

Method	No. of preparation	%
Drinking	76	51.7
Put on	22	14.97
Chewing	16	10.88
Inhaled (Sniffed)	14	9.52
Creamed	9	6.12
Rubbed/Massaged	3	2.05
Eaten	2	1.36
Fumigating	2	1.36
Tooth brush	2	1.36
Washing	1	0.68
Total	147	100

**Informant Consensus on most commonly used medicinal plants**

This study clarified that some medicinal plants are well known in the study area better than others. As a result local informants cited such plants repeatedly as a remedy of various diseases of humans and livestock. For example, *Croton macrostachyus* was cited by 52 informants (86.7%) as a source of remedy for black leg & tapeworm, *Cucumis pustulatus* by 50 (83.3%) for TB (Tuberculosis) (Table 8).

Table 8: Informant consensus on most commonly used medicinal plants

Species name	No. of informants	%
<i>Croton macrostachyus</i>	52	86.7
<i>Cucumis pustulatus</i>	50	83.3
<i>Datura stramonium</i>	42	70
<i>Hagenia abyssinica</i>	44	73.3
<i>Justicia schimperiana</i>	42	70
<i>Ocimum urticifolium</i>	48	80
<i>Rumex abyssinicus</i>	48	80
<i>Solanum incanum</i>	48	80
<i>Vernonia amygdalina</i>	48	80
<i>Withania somnifera</i>	42	70

**Preference ranking of plants used to treat rabies**

Preference ranking of five medicinal plants treating rabies was made by ten informants and the result showed that *Momordica foetida* ranked first and hence is regarded as the most effective medicinal plant to cure this disease (Table 9).

Table 9: Preference ranking of five selected medicinal plants based on their degree of treating rabies as perceived by informants.

Medicinal plant	Informant (R <sub>1</sub> - R <sub>10</sub> )										T	R
	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>	R <sub>8</sub>	R <sub>9</sub>	R <sub>10</sub>		
<i>Balanites aegyptiaca</i>	4	2	3	1	2	3	3	4	5	3	30	3 <sup>rd</sup>
<i>Datura stramonium</i>	4	3	5	3	4	5	3	4	5	3	39	2 <sup>nd</sup>
<i>Eucalyptus globulus</i>	2	1	1	2	3	1	4	2	1	2	19	5 <sup>th</sup>
<i>Momordica foetida</i>	5	4	5	5	4	4	5	5	4	5	46	1 <sup>st</sup>
<i>Ricinus communis</i>	3	4	3	2	1	1	2	2	3	1	22	4 <sup>th</sup>

Since the knowledge on the use of remedies differ from healer to healer, the output of the comparison showed that there is variation among the ten key informants for rabies treatment.

### Pair wise comparison of medicinal plants used for cold disease treatment

Pair wise ranking can be used in evaluating the degree of preference or level of importance of certain selected plants or

plant parts. In this study, ten informants were selected to conduct the exercise among seven medicinal plants used to treat cold disease and *Carissa spinarum* ranked first (Table 10).

**Table 10:** Pair wise ranking of seven medicinal plants used to treat cold disease.

Medicinal plant	Informant (R <sub>1</sub> - R <sub>10</sub> )										T	R
	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>	R <sub>8</sub>	R <sub>9</sub>	R <sub>10</sub>		
<i>Asparagus africanus</i>	4	4	5	6	0	3	1	5	4	7	39	4 <sup>th</sup>
<i>Carissa spinarum</i>	6	0	6	5	6	1	5	6	6	7	48	1 <sup>st</sup>
<i>Clerodendrum myricoides</i>	7	6	4	5	1	4	6	0	6	4	43	3 <sup>rd</sup>
<i>Dovyalis abyssinica</i>	2	3	3	5	1	0	5	2	4	3	28	5 <sup>th</sup>
<i>Euclea divinorum</i>	4	5	4	4	6	6	5	7	4	1	46	2 <sup>nd</sup>
<i>Flacourtia indica</i>	2	7	0	2	2	2	0	1	2	4	22	7 <sup>th</sup>
<i>Nuxia congesta</i>	2	1	2	1	4	4	6	2	1	6	27	6 <sup>th</sup>

### Use diversities of medicinal plants collected from the study area

In the study area, some plants were reported to have uses other than their medicinal values. Of the total documented medicinal plants, 86 species (87.9%) were reported to have additional uses while 20 species of them (12.1%) were used as medicinal plants only. The additional use categories include; fuel, fodder, edible, construction, spices, life fence, ornamentals, and stimulants.

### Direct matrix ranking

Based on information gathered from informants, eight

multipurpose plant species were selected out of the documented plants. Eight use diversities of these plants were listed for eight randomly selected key informants to assess their relative importance in their respective localities. The eight use values include medicinal, fodder, food, firewood, construction, charcoal, fencing, and furniture making. Each key informant was asked to assign use values (5= best, 4= very good, 3= good, 2= less used, 1= least used and 0= not used). Consequently, each key informant use values for the eight multipurpose medicinal plant species recorded, average value of use diversities for the species was taken, and the scores of each species were summed up and ranked (Table 11).

**Table 11:** Average score for direct matrix ranking of 8 medicinal plants based on their general use values

Medicinal plant	Use categories								T	R
	Fw	For	Con	Fur	Food	Cha	Fen	Med		
<i>Croton macrostachyus</i>	3	0	3	2	0	2	4	5	19	7 <sup>th</sup>
<i>Syzygium guineense</i>	4	1	5	3	5	3	5	3	29	1 <sup>st</sup>
<i>Millettia ferruginea</i>	5	2	4	1	0	3	3	4	22	4 <sup>th</sup>
<i>Prunus africana</i>	5	0	5	3	0	3	5	3	24	3 <sup>rd</sup>
<i>Vernonia amygdalina</i>	3	4	2	0	0	1	2	5	17	8 <sup>th</sup>
<i>Carissa spinarum</i>	5	3	5	0	5	0	2	1	21	5 <sup>th</sup>
<i>Flacourtia indica</i>	4	4	1	0	5	2	2	2	20	6 <sup>th</sup>
<i>Hagenia abyssinica</i>	5	2	5	5	0	3	2	5	27	2 <sup>nd</sup>
Total	34	16	30	14	15	17	25	28	179	
Rank	1 <sup>st</sup>	8 <sup>th</sup>	2 <sup>nd</sup>	6 <sup>th</sup>	7 <sup>th</sup>	5 <sup>th</sup>	4 <sup>th</sup>	3 <sup>rd</sup>		

This investigation showed that, *Syzygium guineense*, *Hagenia abyssinica* and *Prunus africana* were ranked 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> and hence are the most preferred medicinal plants by local people for various uses and are the most threatened species as the informants reported, which is evidently shown by their scarce distribution and time required to collect them. The values for use reports across the selected species were summed up and ranked. The results showed that the local people harvested multipurpose species mainly for firewood. Thus, sustainable

use of these top-ranked species is under questions, as the pressure on their consumption is intensified, superimposed on lack of propagation techniques in the area.

### Fidelity level index of healing potential of medicinal plants

Fidelity level (FL) quantifies the importance of a species for a given purpose. Hence, fidelity level values were calculated for commonly used individual medicinal plants against the specific ailment (Table 12).

**Table 12:** The relative healing potential of individual medicinal plants used against human or livestock ailments

Medicinal plant	Ailment treated	Ip	Iu	FL	FL%	R
<i>Croton macrostachyus</i>	Black leg	52	52	1	100	1 <sup>st</sup>
<i>Hagenia abyssinica</i>	Tapeworm	44	44	1	100	1 <sup>st</sup>
<i>Justicia schimperiana</i>	Hepatitis	42	42	1	100	1 <sup>st</sup>
<i>Datura stramonium</i>	Rabies	40	42	0.95	95	4 <sup>th</sup>
<i>Rumex abyssinicus</i>	Gonorrhea	44	48	0.92	92	5 <sup>th</sup>
<i>Cucumis pustulatus</i>	TB	46	50	0.92	92	5 <sup>th</sup>
<i>Ocimum urticifolium</i>	Oral inflammation	43	48	0.9	90	7 <sup>th</sup>
<i>Solanum incanum</i>	Tooth ache	42	48	0.88	88	8 <sup>th</sup>
<i>Withania somnifera</i>	snake bite	36	42	0.86	86	9 <sup>th</sup>
<i>Vernonia amygdalina</i>	Urine retention	40	48	0.83	83	10 <sup>th</sup>

### Habitats and abundance of medicinal plants in the study area

In this study, medicinal plants were collected from various habitats including roadsides, live fence, crop fields, grazing land, forests, and home gardens. Most of the medicinal plants used by the communities were collected from the wild (87.7%). They were growing mostly in disturbed habitats, mainly in woodlands and grazing land. About 12.3% were brought under cultivation, most of which are grown for other purposes. Since most of these plants are found in the wild a big threat is seen to their existence with the current rate of habitat destruction and conversion.

### Discussion

#### Indigenous knowledge of the local people about traditional medicine

Medicinal plant species documented from the study area for the treatment of human and livestock ailments are 106 and this could be an indication of significant role of herbal remedies in addressing the primary health care needs of the people and their livestock. Some of the medicinal plants recorded from the study area were also reported by other studies to be used in the medicinal lore of other areas in Ethiopia, and it is summarized in table Table 13.

**Table 13:** Number of medicinal plant species of Bule Hora District reported by studies in other parts of Ethiopia

Part of Ethiopia	Number medicinal plants	% of medicinal plants found in Bule Hora	Source
Chelya, central Ethiopia	27	25.5	3
Harla and Dengego, eastern Ethiopia	13	12.3	9
Erob and Gulomahda, northern Ethiopia	26	24.5	60
Borana, southern Ethiopia	22	20.7	13
Kochere, Liben, and Wendogenet, southern Eth.	22	20.7	14
Goma (Jima), western Eth.	33	31.1	15
Mecha, northern Ethiopia	40	37.7	20
Debre Libanos, central Eth.	27	25.5	22
Ada'a, Central Ethiopia	36	33.9	38
Gimbi western Ethiopia,	38	35.8	40
Ankober, central Ethiopia	22	20.7	43
Wayu Tuka, western Ethiop.	45	42.5	46
Amaro, southern Ethiopia	19	17.9	48
Borena Sayint, northern Eth.	41	38.7	50
Bonga, Sheko and Yayu, western and south east Eth.	36	33.9	54

The highest level of shared documentation of this study was observed with <sup>[46]</sup> sharing 45 herbals in common. This is perhaps because of agro - ecological similarity and the people belong to the Oromo community where it is highly likely that they have shared norms, cultural beliefs, and traditional practices. This could be good indication of the widespread utilization of plant medicines over a wide geographical coverage of the country and this in turn indicates the actual therapeutic values of these species in treating various ailments. Strong belief in traditional medicine, its better efficacy in the treatment of ailments like bone cancer, rabies, hepatitis and cold disease, as some informants reported, as well as limited access to modern health facilities and low socio-economic status of the people could be among the factors that have contributed to the continued reliance on plant based traditional local pharmacopoeia in the study area.

This study also showed that most of the medicinal plants are collected from the wild environments (87.7%) and the wild habitats as a main occurrence site of medicinal plants are also reported in other ethnomedical researches conducted elsewhere in Ethiopia <sup>[5, 7, 9, 42, 43, 44, 46, 62]</sup>. This shows that the people largely rely on wild plants; which consequently indicates the existence of higher pressure/threats on the wild medicinal plants. Thus, it is a get up ring calling for urgent and more collaborative study to maintain the balance between their availability in the wild state and utilization by the community. The families Asteraceae, Rubiaceae, Lamiaceae, Fabaceae and Euphorbiaceae were represented by the highest number of medicinal plant species and this could probably be attributed to the overall species richness of these families in the area.

Out of the total medicinal plants documented five species (*Aloe yavellana*, *Erythrina brucei*, *Millettia ferruginea*, *Solanecio gigas* and *Thunbergia ruspolii*) were endemic to the floral area.

Among the medicinal plants documented in this study, it is proven that majority of them are used to treat human ailments. This finding aligns with other studies elsewhere in Ethiopia <sup>[1-2, 24, 42, 46, 47, 62]</sup> that reported the use of large number of medicinal plants for treating human diseases rather than livestock.

Indigenous knowledge of traditional medicine among informants with regard to their sex and age was not similar. In terms of sex, 44 were males and 16 were females. This may indicate that there is no equal access in the family to get indigenous knowledge of traditional medicine. In the study area the proper transfer of medicinal plant knowledge takes place through the men line which could have contributed for the women to have less knowledge as compared to men. Similarly, the fact that younger people are more exposed to modernization than older and illiterate ones could have contributed for the former to have less medicinal plants knowledge. This finding may agree with the findings of <sup>[57]</sup>. Enough knowledge of medicinal plants is mainly found among the elderly members of indigenous people. Women's knowledge of traditional medicine is largely on medicinal plants found nearby grazing or farmland, live fences and home gardens. Most youngsters (both males and females) did not have good knowledge of traditional medicine. Furthermore they did not have interest to learn from their parents, especially those who go to school. The same trend was also reported from Borana lowlands <sup>[13]</sup>. The results of this study showed that the knowledge of traditional medicine is mainly found in the age group between 60 – 80 years old. The same findings were also recorded by previous studies <sup>[13]</sup>. In terms of education, the majority of the local informants had no formal education, few had modern education, and none of them had religious education.

### Comparison of traditional medicinal plants in their growth habit

With regard to the growth form of medicinal plants the findings of this study showed that shrubs were found to be the widely used form followed by herbs, trees, lianas, and herbaceous climbers. This pattern of growth form was also reflected in other studies conducted elsewhere in Ethiopia [4, 7, 9, 28, 37, 42, 43]. The higher frequency of using shrubs and herbs may be due to the fact that the area is part of the wooded grassland ecosystem [19] where shrubs and herbs are leading growth forms than trees. This finding did not agree with the finding of [23, 26, 13] in which herbs were mentioned as the dominant groups used for this purpose. It also disagrees with the finding of [61] in which tree provides the highest services for people living in "DHEERAA" town, Arsi Zone, Ethiopia. This difference may come from the vegetation and traditional knowledge differences of these areas and people or may also be related to the fact that the natural vegetation has been changed so that people rely on the shrubs that remain as remnant species in the area which is converted to agricultural land and living quarters. The researchers also noted that most of the medicinal plants are under threat as long as the destruction and fragmentation of the wild habitat continue.

This study also revealed that using single species of medicinal plant is common practice in remedy preparation. This is in agreement with other findings in Ethiopia [28, 52] where most of the traditional drugs in Bahirdar Zuria and Ada'ar districts respectively were made from single plant preparations. Such practices may be good in preferring effective medicinal plants in treating different ailments and minimize the side effect it may impose on the patient. FL is an important means to see for which ailment a particular species has more healing power and accordingly those species with high FL are supposed to be more curative for the respective ailments. Thus, those traditionally used medicinal plants with high FL can be a focus for further pharmacological tests.

On the contrary, this current finding indicates that only few remedies were made from mixing three or more medicinal plants which is common practice in different parts of the country [1, 2, 42, 62] where most traditional remedies were prepared by mixing components of two or more plants. In addition, some diseases could be treated by multiple species coupled with the frequent occurrence of the diseases and ease of accessibility and/or efficacy of plant species for treatment. In turn, these factors widen the popularity of these species among the informants and indigenous knowledge for treating these diseases. This indicates that when there are herbal medicines from different plants species prescribed for the same health problem, people show preference of one over the other. They also show preference in searching for treatment either from the modern medication or from local healers. Some informants reported that in searching treatment for rabies and cold, they prefer the local pharmacopoeia than modern medicines. This could be attributed to accessibility and affordability of the traditional one, according to the informants. Some other informants had a belief that the traditional herbal remedy is more efficacious than the modern medicine for the treatment of these diseases. Most often, the local people of Bule Hora District prefer the fresh plant part over the dried part for remedy preparation. Similar findings were reported in other areas of Ethiopia [8, 9, 17, 24, 28, 37, 42, 43, 46, 47, 49, 52, 55, 59, 62] and elsewhere [27, 32, 34, 35, 41, 56]. This practice agrees with the scientific fact that the healing potentials of the plant are greater when fresh plant material is used for medicine preparation because the important chemicals are expected to

be more and unchanged to other forms as they do when dry resulting in the decline or disappearance of the active principles, usually intermediate metabolites [36].

Concerning parts of the plant used for the preparation of traditional medicine, this study revealed that leaf is the most extensively used plant part followed by root and bark. The most frequent use of leaves by the local people of the study area in the preparation of their remedies could partly be related to the relative availability of this plant part throughout the year, as leaves were mostly harvested from perennial trees and shrubs. Another factor could be the relatively easy preparation of remedies from this plant part and perhaps the presence of biologically active secondary metabolites.

Moreover, harvesting leaves does not pose a great danger to the survival of an individual plant as compared to collecting roots, stem/bark, and whole plant. Studies have shown that removal of up to half of tree leaves does not significantly affect the growth of species studied [51]. Root is the second most frequently sought plant part by the local people at the study area and this could be due to its year round availability. The availability of high concentration of bioactive constituents [10] could also have resulted in the frequent use of roots for remedial preparation. The frequent use of roots in a given community, however, is disastrous to the survival of individual plants unless care is taken during the harvesting process [25]. From this evidence one can understand that leaf is a very important part of plants in terms of medicinal value at least in the context of the local people. Usage of the leaf may not have a significant negative impact on the medicinal plant as compared to the root. This is because aerial parts of the plant are highly dependent on underground parts (roots) for physical support and physiological processes.

### Ways of preparation, dosage, and route of application

The fact that chopping/pounding is the most frequently used method in preparation of remedies which could be attributed to its ease of processing and water is the most frequently used 'solvent' in the preparation of remedies as a result of its easily availability in search for solvent and other/or universal solvent nature of water in which a wide range of solutes dissolve. The use of water as a solvent may be disadvantageous as some active ingredients in the medicinal plants especially non-polar compounds are insoluble in water and hence will not show the desired biological activity [53]. The reason for the popularity of liquid preparations may be ease of formulation (remedial preparation).

These people also used some additives such as honey, milk, and butter in the preparation of some remedies. The most common route of applications found in this study was oral followed by dermal. This may tell us that the widespread diseases are those that are occurring internally than on the external parts of the body. Similar findings were also noted in other studies [5, 7, 9, 17, 27, 37, 42, 43, 46, 52, 59, 62] among many others. In addition, both oral and dermal routes permit rapid physiological reaction of prepared medicines with the pathogens and increase its curative power. The most frequent way to administer remedies was drinking followed by putting on, chewing, creaming, rubbing, inhaling (sniffing), and others. In this study area, provision of doses varies with ages and ailment condition of the patient (dose is not standardized). Lack of consistency was also reported elsewhere in Ethiopia [8, 9, 24, 43, 46, 55] as a serious weakness in the delivery of traditional medicines.

### Threats to medicinal plants and associated knowledge in the study area

Threats to biodiversity are increasing noticeably from time to time. They are beyond the natural rate of regeneration and are mainly driven by habitat destruction, over harvesting, increase in pollution and introduction of alien species<sup>[11]</sup>. Some of the medicinal plants reported by the local people to be threatened are also included in the IUCN Red lists<sup>[58]</sup>. Among those in the least concern (LC) endemic species, *Millettia ferruginea* and *Solanecio gigas* are the medicinal plants recorded from the study area. *Syzygium guineense*, *Hagenia abyssinica*, *Prunus africana* and *Embelia schimperi* were reported to be locally threatened medicinal plants in need of conservation efforts even if they are not under IUCN Red List.

The most serious threats to medicinal plants in the study area are fragmentation and destruction of their habitats due to agricultural expansion and overgrazing. The present finding is also substantiated by what has been recorded and reported elsewhere in the country<sup>[25]</sup>. Informants in the study area stated that threat due to agricultural expansion and overgrazing resulted from population growth and subsequent need of farm plot and grazing land, which in turn has caused the loss of habitats and species of medicinal plants. Nowadays, more serious threat comes due to overexploitation for other uses of medicinal plants such as for timber, fuel, and construction. This overexploitation of medicinal plants for other uses indicate the low socio-economic status in energy and construction material demand of the people, as could also be common in most rural communities in the country as well as in Africa. In turn, this could be a good indication that these valuable resources are at conservation risk in different ways from that of developed countries. These factors could result in loss of different species of medicinal plants and consequently that of associated indigenous knowledge. According to FAO report, the rate of deforestation in Ethiopia is estimated to be 2000 km<sup>2</sup>/year<sup>[33]</sup>. This situation is even worse in Ethiopia where there are more environmental problems than any other country in the Sahel belt<sup>[39]</sup>.

Introduction of modernization such as schooling and new religion influenced the acculturation and negligence of the present generation to acquire the knowledge and facilitated the threat to medicinal plants and associated knowledge in the study area. Some destructive methods of harvesting such as uprooting, bark peeling and stem cutting are practiced in the study area. Such unsustainable harvesting techniques of these plant parts may lead to the disappearance of the medicinal plants. But there is no overexploitation of medicinal plants for medicinal purposes. Researches conducted elsewhere<sup>[25, 4]</sup> revealed similar trend in the disappearance of medicinal plants and associated knowledge in other areas. Therefore, a number of combined factors mentioned earlier have resulted in loss of medicinal plant species which calls for urgent measures to be taken to rehabilitate and conserve the remaining vegetation in general and medicinal plants in particular with their associated indigenous knowledge.

### Conservation status of medicinal plants and indigenous knowledge in the study area

At this moment natural habitats of medicinal plants in the study area are highly affected by factors mentioned above. The local people have brought about only a few species of the total collected medicinal plants under cultivation. As a result many medicinal plants are under serious threat. This cultivation effort is usually due to other uses of these medicinal plants such as for food, fodder, spice, live fence, and shade.

Medicinal plants are also left as remnants of trees, shrubs and herbs in and around agricultural fields due to their uses as forage, fuel wood, timber, and construction, spiritual and ritual needs. Protecting such multi-purpose plant species by agro-pastoralists in their localities is evidence for the existence of traditional conservation practices in the area.

### Conclusion

The findings of this study revealed that several plant species are used as traditional medicine in the study area. About 106 medicinal plant species were collected which have a great value to treat a wide spectrum of human and livestock diseases. These plants were distributed across 98 genera and 46 families growing over an extended area and used by the local traditional healers living in different kebeles of the study area. Out of the total collected plant species, 62 were used to treat 37 human ailments, 22 species to treat 25 livestock ailments and the rest to treat ailments of both. Traditional medicine preparation mostly involves single plant species and the mode of administration is mainly internal in which oral administration is the common route. This enables the traditional health care system to cover more than 54% of human and 59% of livestock health services in the study area. This in turn gives hint to believe that the traditional medicinal practices using native medicinal plants exist well functioning in the study area.

The local people use traditional medicines for primary health care due to the belief in its effectiveness, lack of modern medicines and medication as well as poor economic status of the people. The Guji Oromo people of Bule Hora District are rich with indigenous knowledge in using, conserving and managing plant resources in general and medicinal plants in particular. They have a wide knowledge in using plants for various purposes such as for medicine, food, household utensils, fodder, fuel, construction, etc. This knowledge is transferred from elders to youngsters entirely through oral traditions and personal experiences. But this way of knowledge transmission will lead to distortion of the original knowledge or total disappearance of the practice. Human induced and natural factors are the major threats to plant species in general and to the medicinal plants in particular in the study area. As suggested by informants, the human induced threats include farming land expansion, overgrazing, deforestation, uncontrolled burning, and multipurpose usage of plant species and natural factors such as extended dry time are cited to be major threats for reduction of medicinal plants. The main threats to indigenous knowledge are caused by modernization, introduction of new religion, increased business work, and negligence of the young generation to have the traditional knowledge.

### Recommendations

Based on the results of the study the researchers recommend the following to conserve the natural resources as well as indigenous knowledge of the study area:

- Attention should be given to the usage of traditional medicine and indigenous knowledge of traditional practitioners;
- Awareness raising activities should be undertaken so that traditional healers get organized in managing and controlling different human and livestock ailments and in ensuring the sustainable utilization of medicinal plant resources in the study area. This could be achieved through;
  - Establishment of healers association at least at the kebele

and if possible at the district level;

- Protecting, advising, licensing and encouraging their association and indigenous skills to use this traditional practice properly in controlling and managing both human and livestock diseases of the study area;
- Adjusting conditions for close discussion and cooperation of traditional healers and modern health care system officials about the preparation and applications of remedies properly and effectively. This can be carried out through providing basic training to the healers with the objective of adding values to their traditional skills, especially related to dosage and sanitation;
- The concerned bodies should give emphasis to the proper management and conservation activities of the area through involving the local people. Initiation to conserve the natural resources in general and medicinal plants in particular could be developed by providing formal and non-formal education to the society. If this is not done the existing heavy pressure on natural vegetation due to human induced and natural pressures will eradicate the remaining natural resources in the near future;
- For the benefit of the existing and coming generation, governmental and nongovernmental organizations (NGOs) should participate in conserving the natural resources through encouraging in-situ and ex-situ conservation.

#### Competing interests

The authors declare that they have no competing interests.

#### Authors' contributions

All authors have their own contribution in the preparation, editing, and proof reading of the manuscript.

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