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# Traditional Medicine Practices of Guji Semi-pastoralist People to Treat Livestock Ailments in Suro Barguda District, West Guji Zone, Ethiopia

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## Abstract

Ethnoveterinary medicine is essential in many rural areas of the world since people living in remote and marginal areas depend significantly on traditional herbal therapies to treat their domestic animals. Communities residing in such remote areas, and especially those still attached to semi-pastoralist traditions, have considerable ethnoveterinary herbal knowledge, and they usually use this knowledge for treating their animals. This original study was carried out by using proper research questions to gather information about ethnoveterinary medicinal plants and traditional knowledge in treating different livestock ailments, following the proper ethnobotanical data collection and data analysis methods in a place where such a type of study had not been carried out. The objectives of this research were to collect, identify, document, and analyze ethnoveterinary medicinal plants and their associated indigenous knowledge and to determine the corresponding conservation status in the district. Data were collected from July 1 to August 30, 2019 and November 15 to December 30, 2019, as well as plants reported as medicine by informants. A total of 196 informants (24 key informants taken purposefully and 172 general informants taken randomly) were used for this study. Semi-structured interviews, focus group discussions, participant observation, and walk-in-the-woods methods were used to gather ethnoveterinary data. The Informant Consensus Factor (ICF) and Fidelity Level (FL) values were calculated using quantitative approaches in order to check the level of informants' agreement on plant use and the healing potential of ethnoveterinary medicinal plant species, respectively. Indigenous knowledge of the use of medicinal plants for ethnoveterinary purposes among different informant groups was compared using a t-test with R-software. A total of 46 plant species representing 43 genera and 29 botanical families were identified for use in the treatment of 79 different ailments. Medicinal plant species belonging to the families Asteraceae (5 species) and Euphorbiaceae (4 species) were reported to be in frequent use in the local ethnoveterinary medical system. Herbs and shrubs (12 species each) were the growth forms most often utilized for remedy preparation. The highest ICF values were recorded for respiratory system diseases (0.85) and Viscum congolense DC. Wild. showed the highest fidelity level value (97%) for treating respiratory system ailments. A significant difference (P 0.05) was observed in the average number of therapeutic plants reported by senior members of the community, illiterate participants, and key informants. Viscum congolense DC. Wild. and Clematis simensis Fresen were the most preferred species for treating respiratory system diseases. The study indicated that the district is rich in different species of ethnoveterinary medicinal plants and indigenous knowledge about using these resources. Species with the highest consensus for curative purposes are a useful puddle for further phytochemical and pharmacological authentication for better utilization. The declining wild medicinal flora of the area calls for prior conservation attention.

**Keywords:** Indigenous knowledge • Livestock ailments • Medicinal plants • Suro Barguda District

## Introduction

### Background

Ethiopia has the highest number of livestock in Africa and the country is listed among the top 10 countries in the continent known for their livestock wealth [1]. Livestock is an integral part of agriculture, accounting for about 47 percent of the total value of agricultural production and supporting the livelihoods of a large share of the population [2]. The national herd comprises 59.48 million cattle, 30.7 million sheep, and 30.2 million goats, and 59.49 million chickens, as well as camels, equines, and a small number of pigs [2]. Due to technical, economic, and institutional constraints, livestock productivity is generally low. Beyond providing foods and other goods and services to the population, the livestock sector is a major contributor to export earnings, mainly through the export of live cattle and small ruminants. It is estimated that Ethiopian livestock contributes about 10 percent to the total export earnings, of which 69 percent are accounted for by live animal exports [1]. Despite this large number of livestock and its important economic potential, still, the sector has not developed beyond a subsistence type of undertaking, whereas it also remains with low outputs for different reasons of which animal diseases are among the top factors [3]. Animal health could be managed traditionally through ethnoveterinary medicine practices which are a mode of identifying, using, and integration of local knowledge, related skills, and customs procedures created by people to preserve the health and welfare of working and productive animals [4].

The ethnoveterinary systems are ecological units and ethnic community-specifics, and therefore, the characteristics, sophistication, and intensity of these practices differ greatly among individuals, societies, and regions. However, they are facing the threat of rapid erosion because of rapid socio-economic, environmental, and technological changes [5]. Even though indigenous knowledge systems are rapidly disappearing under the influence of Western culture, 80% of the world's population exclusively relies on traditional medicine [6]. More than 80% of the human population and 90% of the livestock depend on traditional medicine in Ethiopia [7,8]. The persistence of ethnoveterinary healthcare in Ethiopia is related to the high cost of treatment using modern veterinary drugs and the prohibitive distance of veterinary stations from rural areas [9]. Elderly community members with this knowledge were dying and the introduction of modern practices made it difficult for the younger generations to appreciate and use the beliefs and practices of their ancestors [10], and it has not yet been well documented, promoted, conserved and much effort is needed in research and integration of activities in the country. There is a wide gap in the knowledge about ethnoveterinary data

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and information from various parts of Ethiopia although the country has rich and diverse ethnolinguistic groups throughout the country. Ethnoveterinary medicine is community-based local or indigenous knowledge and methods of caring for, healing, and managing livestock. It is treated four times: the man, animals, plants and soil, old African sayings [10,11]. Ethnoveterinary medicine is a scientific term for traditional animal health management that encompasses the knowledge, skills, methods, practices, and beliefs about animal health care found among community members [11]. This knowledge is based on close observation of animals or the oral transmission of experience from one generation to the next [12]. This rich repository of local knowledge about almost all aspects of livestock care is inherent in most of the rural and tribal communities and pastorals. Ethnoveterinary medicine could be a key veterinary resource and could add useful new drugs to the pharmacopeia, and it can contribute to biodiversity conservation [13]. Ethnoveterinary medicine is more environmentally friendly and often more socio-culturally acceptable and very suitable for use with smallholdings by livestock keepers who can prepare the traditional remedies themselves [11]. The extent of knowledge and utilization of ethnoveterinary medicine differ according to the culture and prevailing socio-economic characteristics [14]. Many indigenous veterinary beliefs and practices continue to function in a wide majority of livestock raisers, particularly in developing countries [15]. Ethnoveterinary practices have been developed by trial and error and by actual experimentation [16]. Ethnoveterinary medicine comprises of traditional surgical techniques, traditional immunization, magico-religious practices, and the use of herbal medicines to treat livestock diseases [17,18]. It also provides traditional medicines to the livestock, which are locally available and usually cheaper than standard treatments. Livestock holders can prepare and use homemade remedies at a minimum expense. The knowledge of ethnomedicinal plants is on the edge of irreversible loss and declining to deterioration due to the oral passage of herbal heritage from generation to generation rather than in written form, despite their vital role in providing health for the human, and livestock population [17,18]. Environmental degradation, agricultural expansion, cultivation of marginal lands, and urbanization are also posing a significant threat to the future wellbeing of human and animal populations that have relied on these resources to combat various ailments for generations [19-22] deserving the urgent need to document and preserve the indigenous knowledge. This original study was carried out by using proper research questions to gather information about ethnoveterinary medicinal plants and traditional knowledge in treating different livestock ailments following the proper ethnobotanical data collection and data analysis methods in a place where such type of study was not carried out, Suro Barguda District, west Guji Zone, Oromia Regional State, Ethiopia based on the following research hypotheses:

- Different plant species are used for ethnoveterinary traditional medicine preparation in the study area.
- There is depletion of plant diversity and loss of indigenous plant knowledge in Suro Barguda District.
- The culture and knowledge of the study area people is unique in using traditional medicinal plants.
- The traditional herbalists in the study area are familiar with healing plants, their preparation, and their applications.

# Materials and Methods

## Description of the study area

The present study was conducted in Suro Barguda District, West Guji Zone of Oromia Regional State, Southern Ethiopia. Suro Barguda District is established recently (administrative boundaries were redrawn) and is located 497 km south of Addis Ababa - the capital of Ethiopia, and 30 km from Bule Hora town, the capital of West Guji Zone. The district is generally characterized by rough and rugged topography and lies between latitudes 5°30'0" N and 5°50'0" N, and longitudes 37°50'0" E and 38°20'0" E. The elevation ranges from 900 to 2350 m.a.s.l. and the total area of the district is 154,958.4 hectares [23] (Figure 1).

Suro Barguda District is divided into two agro-ecological zones, namely the lowlands (from 900 -1500 m a.s.l) and the middle altitude ranging from 1501-2500 m a.s.l. [24]. Accordingly, the proportion of the two agro-climatic zones in the district is 41.8% lowlands and 58.2% mid-altitude. The district falls within the southern bimodal rainfall regime of Ethiopia [25,26]. Since there was no Meteorological Station at Suro Barguda District, fifteen years of Meteorological data (2004–2018) registered by the nearby Station (Bule Hora District Station) was taken from the National Meteorological Service Agency. Based on the analysis of this data, the district receives high rainfall between March and half of June as well as a relatively good amount from half of September to half of December. The dry season extends from half of December to February and to some extent from half of June to half of September. The highest mean annual average rainfall of the study area within fifteen years was 171.3 mm recorded in May, whereas the lowest mean average was 12.4 mm recorded in February. The lowest mean average temperature over fifteen years was 10.8°C recorded in December, whereas the highest was 28.7°C recorded in February. The mean annual rainfall of the study area was 853 mm, whereas the mean annual temperature was 19.8°C [27]. Based on [28] classification of Ethiopian vegetation the study area vegetation lies in the *Acacia - Commiphora* woodland and *Bushland, Combretum Terminalia* Woodland, and Dry Evergreen Afro-Montane Forest and Grassland complex (Figure 1).

## Demographics and livestock health care system in the district

Since Suro Barguda District was established recently, a population census was not carried out. However, the district is predominantly (99.9%) occupied by Guji Oromo people who speak the Oromo language with unique dialect and the majority of the residents live in rural areas and follow a traditional belief called "Waaqqeefatta." But now a day some of them tend to attend protestant teaching [29]. Pastoralism with subsistence farming is the most common economic mainstay of the people. In one or another way, their livelihoods depend upon the presence of different plant species and vegetation. Modern veterinary services have been playing a relatively good role in the control and action taken to prevent livestock diseases in the past three decades in Ethiopia. However, they could not so far deliver complete coverage in preventive and healing health care practices because of inadequate veterinary health professionals, logistic problems, the unpredictable supply of drugs, and the high cost of drugs and equipment. Besides, the majority of livestock breeders in rural areas are far from the site of veterinary clinics/posts, and those who have access to these clinics may not be able to afford to pay for them [9,10]. Ethnoveterinary medicine provides traditional remedies, which are available nearby and usually cheaper than standard treatments. Livestock holders can prepare and use homemade remedies at minimum expense. For many livestock holders in Suro Barguda District where there are relatively few veterinarians and shortages of other facilities, traditional medications were the only choice to treat different livestock ailments.

Site and informant selection: A reconnaissance survey of the study area was conducted from May 06 -21, 2019, to obtain information about the agro-ecology of the area, status of the vegetation, and indigenous knowledge of the local people in using plants for different purposes and determine the sites from where and how the data should be collected. The study district had 10 semi-pastoralist kebeles (the smallest administrative units) and currently, these kebeles are re-arranged/sub-divided to be 19 kebeles to decentralize the administration processes. Study sites from the ten kebeles were selected based on distance from the administrative town (Suro town), and the presence/absence of health facilities for collecting medicinal plant information.

Sample size determination: Yamane T [30] suggested simplified formula for calculation of sample size from a population which is an alternative to Cochran's formula. According to him, for a 95% confidence level and p. = .05, the size of the sample should be:

$$n = N \frac{N}{1+N\,(e^2)}$$

Where,

N = sample size for the research

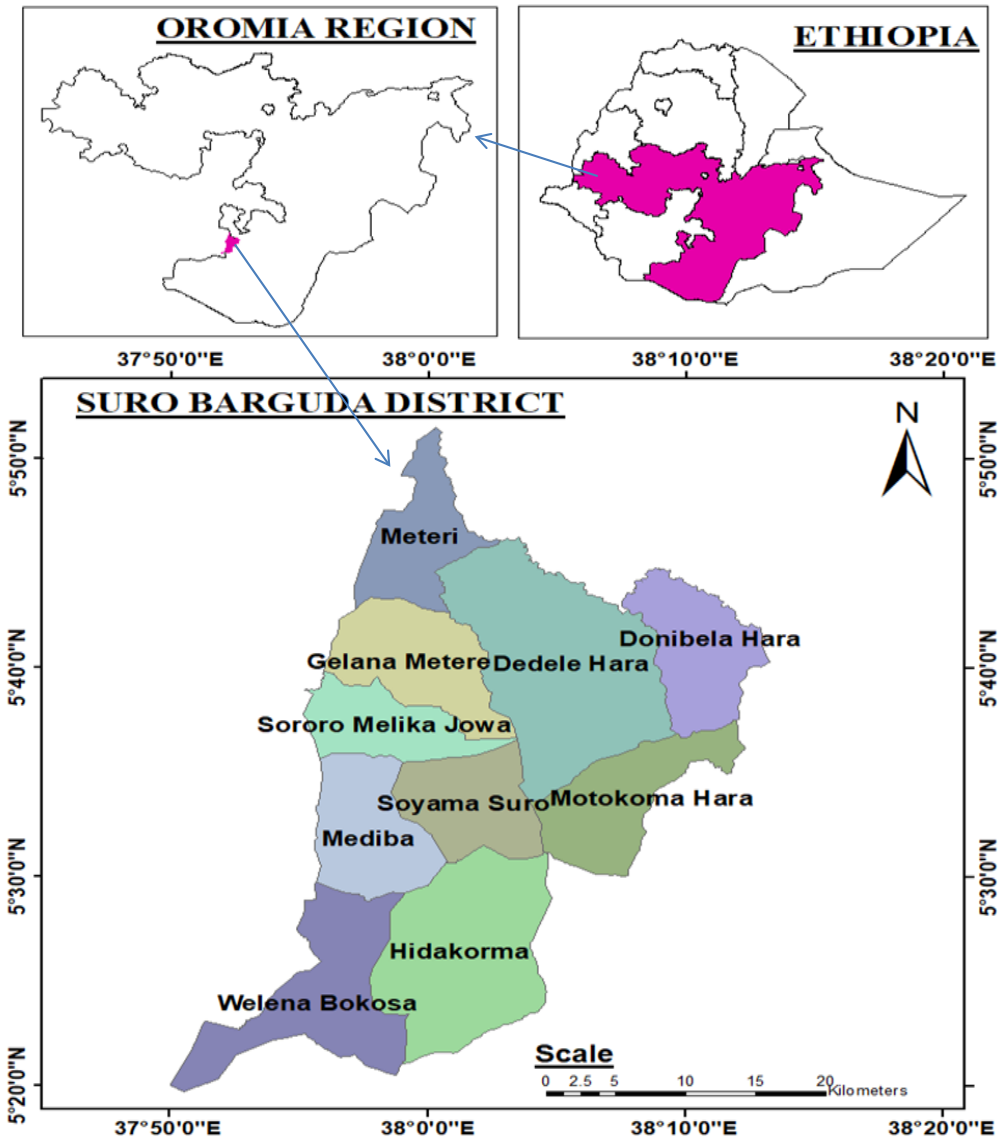


**Figure 1.** Map of Ethiopia showing Suro Barguda District (study area).

N is the population size (total number of households in all 10 kebeles)

e is the level of precision 5% (.05)

1= the probability of the event occurring

The total number of households in the 10 pastoralists' kebeles of the district was 386. Hence, the informant sample size comes to:

Informant sample size = 386/ 1+386(0.05)2 = 386/1.965 = 196 informants

Therefore, the required informant (respondent) size was 196. Informants' size for each kebele was calculated using the amount of the number of households in each kebele to the total number of households in the 10 kebeles, i.e.

Informants from each kebele = Number of households of the kebele × Total number of informants/Total number of households.

For example, the informant size of Welena Bokosa kebele with a total household of 39 was 20, i.e., (39 × 196/386 = 20). The same calculation was used for the other study kebeles and two to four key informants were taken purposefully from each kebele based on the size of the households (a total of 24 key informants). The 24 key informants were those informants who had well recognition in treating different diseases (healers/practitioners) and were selected purposively (non-probability sampling) through consulting local leaders, elders, and development agents at each kebele. The remaining 172 participants were general informants and were taken randomly to get hold of people who had no official recognition for their traditional healing practices. The general informants were ordinary people who lived in the study area for more than 15 years and used their indigenous medicinal plant knowledge within their families. They were included as respondents to gather additional data and check the transfer of indigenous knowledge within the people. The participants were involved in data collection activities at two different times; from July 01 to August 30, 2019 (for two months), and November, 15 to December 30, 2019 (for 45 days). All informants were from Guji Oromo ethnic groups who speak the Oromo language called “Oromiiffaa” (Table 1).

Data collection: Data collection was conducted two times; from July 01 to August 30, 2019, and November, 15 to December 30, 2019, and plants reported as ethnoveterinary medicine by the informants were collected. During data collection, the researchers used Motor Bicycle for accessing study kebeles and informants’ activity. The data were collected following Cotton CM [31], Cunningham AB [32], Martin G [33] and Alexiades MN [34]. Semi-structured interviews, guided field walks, discussions, market surveys, and field observation with randomly picked and key informants were applied based on a checklist of questions. The selected informants in the sample site were interviewed using semi-structured interview which was translated into the local language (Oromo language) focusing on ethnoveterinary medicinal plants: their use and management; from where they collect them; which plant was

**Table 1.** Number of households and informants included in the ethno botanical data collection.

| Name of the Kebele | Total no. of hh | Key Informants | | | | | Randomly taken Informants | | | | | Total Informants | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | M | Ag | W | Ag | T | M | Ag | W | Ag | T | M | W | T |
| Dembela Hara 1840 – 1980 m. a. s. l. | 47 | 2 | 62, 73 | 1 | 65 | 3 | 17 | 19 - 51 | 4 | 22 - 39 | 21 | 19 | 5 | 24 |
| Didole Hara 1790 – 1965 m. a. s. l. | 43 | 2 | 59, 64 | 1 | 52 | 3 | 15 | 23 - 42 | 4 | 25 - 56 | 19 | 17 | 5 | 22 |
| Gelana Meteri 1050 – 1825 m. a. s. l. | 36 | 2 | 80,54 | 0 | - | 2 | 14 | 20 - 44 | 2 | 25, 50 | 16 | 16 | 2 | 18 |
| Hidha Korma 1990 – 2350 m. a. s. l. | 37 | 2 | 78, 66 | 0 | - | 2 | 15 | 24 - 57 | 2 | 21, 71 | 17 | 17 | 2 | 19 |
| Mediba 1963 – 2185 m. a. s. l. | 40 | 2 | 48, 56 | 1 | 63 | 3 | 14 | 22 - 65 | 3 | 27 - 47 | 17 | 16 | 4 | 20 |
| Meteri 900 – 1835 m. a. s. l. | 31 | 2 | 52, 76 | 0 | - | 2 | 13 | 25 - 70 | 1 | 29 | 14 | 15 | 1 | 16 |
| Motokoma Hara, 1973 -2050 m. a. s. l. | 39 | 2 | 61, 73 | 0 | - | 2 | 16 | 21 - 43 | 2 | 34, 38 | 18 | 18 | 2 | 20 |
| Sororo Melka Jewe 945 – 1874 m. a. s. l. | 34 | 2 | 50, 77 | 0 | - | 2 | 13 | 26 – 0 | 2 | 24, 49 | 15 | 15 | 2 | 17 |
| Soyama Suro 1982 – 2100 m. a. s. l. | 40 | 2 | 68, 75 | 1 | 58 | 3 | 15 | 19 - 41 | 2 | 26, 67 | 17 | 17 | 3 | 20 |
| Welena Bokosa 2100 – 2280 m. a. s. l. | 39 | 2 | 65, 67 | 0 | - | 2 | 16 | 27 - 69 | 2 | 35, 76 | 18 | 18 | 2 | 20 |
| **Total** | 386 | 20 | - | 4 | - | 24 | 148 | - | 24 | - | 172 | 168 | 28 | 196 |

N.B hh=household; M=Men; W=Women; Ag=Age; T=Total; m.a.s.l=meter above sea level

preferable in its use; how they know their habitat and time of availability; whether they obtained any economic benefit from ethnoveterinary medicinal plants or not; whether they had any tendency to cultivate some selected ethnoveterinary medicinal plants or not; about the level of any threat to the ethnoveterinary medicinal plants; what they suggest about the current conservation status of these plants; how widespread the medicinal plant/s in the area; whether there was disappeared medicinal plant or not; whether there was any restriction or taboo in collecting medicinal plants or not; whether these plants had other purposes or not, etc.

A semi-structured interview questionnaire was an important tool for the collection of both qualitative and quantitative data at the same time. The informants participated in answering the questions by showing the plants that they used as a medicine during the guided field walk interview. An explanatory individual and group discussions were made with informants at each locality and site focusing on the status of the vegetation and acceptance of ethnoveterinary medicinal plants by the community. Detailed Notes on facts and information about the respondents, history of medicinal plant users, history of medicinal plants, and other essential information (based on the questionnaire) were taken on site. During the discussion, the informants were free to explain medicinal plants and their knowledge without being interfered with and restricted. The collected medicinal plant species were brought to Bule Hora University Herbarium where they were allowed to dry, deep-frozen and identifications were made by the researchers using taxonomic explanations and descriptions given in the relevant volumes of the Flora of Ethiopia and Eritrea. Further refining of determinations was made by visual comparison with authenticated herbarium specimens. The plant specimens with labels were finally deposited at the mentioned Herbarium and the resulting data of the study were presented in tables, graphs, and percentages.

Data analysis: Ethnobotanical data were analyzed following the basic analytical tools [29-31]. Potentially effective medicinal plants were identified by the method of informant consensus factor (Trotter and Logan 1996) in Heinrich M, et al. [35]. The rank-ordering (Preference ranking) of medicinal plants was used to determine their order of cultural importance across a community. The most important in the set was given the highest number, decreasing in number as the members of the set decreased in importance. Preference ranking was computed by taking 10 key informants to assess the degree of effectiveness of eight medicinal plants highly cited by the informants used to treat a particular disease [36]. Direct matrix ranking is a more multifaceted version of preference ranking. Here, informants order ethnoveterinary medicinal plants by considering several attributes, one at a time, i.e., it draws explicitly upon multiple dimensions. Direct matrix ranking was performed as a group exercise in which participants reach a consensus on the ranking of each item based on their evaluations [37]. The ranking of threats to five ethnoveterinary medicinal plants that were reported by most of the informants in the study area was conducted using ten key informants as described by Martin G [33] and Höft M, et al. [37]. This information was used to determine the highest threats to traditional ethnoveterinary medicinal plants in the study area and help to suggest appropriate conservation measures as considered. Informant consensus factor (ICF) was considered for each group of ailments to identify the agreement of the informants on the reported cures for the group of aliments of the plant. Informant consensus factor was computed as follows: several citations in each group ($n_{ur}$) minus the number of species used ($n_t$), divided by the number of citations in each group minus one [35]. The mentioned ailments were grouped and then the ICF values were calculated as:

$$ICF = \frac{nur - n}{nur - 1}$$

Ethnoveterinary medicinal plants that were effective in treating groups of ailments had a higher informant consensus factor.

The Fidelity Level (FL) computes the significance of a species for a given purpose. Most commonly used medicinal plants have a high fidelity level. The fidelity Level (FL) among medicinal plants of the study area was computed based on the following formula: FL= Np/N. To calculate the percentage of Fidelity level: FL% = (Np/N) × 100 was used [36,37]. Np is the number of informants who independently cited the importance of a species to treat a particular disease, and N is the total number of informants who reported the plant to treat any given disease.

The local importance of each species cited in the study area was calculated using Use-Value (UV) technique following [38]. Use-Value (UV) is a quantitative method that demonstrates the relative importance of a species known locally, which reflects the importance of each species to informants, i.e.

$$UVis = \Sigma Uis/nis$$

Where,

$UV_{is}$ = use value of a species s for informant i

$U_{is}$ = the number of uses mentioned in each event by informant i and

$n_{is}$ = the number of events for species s with informant i

## Results

Medicinal plant diversity used for ethnoveterinary medication in suro barguda district

A total of 46 ethnoveterinary medicinal plant species representing 43 genera and 29 families were identified in the district (Table 2). About 26.1% of the families (twelve families) were represented by more than one species. The highest number of species was recorded for Asteraceae (5 species, 10.9%), followed by Euphorbiaceae (4 species, 8.7%) and Apiaceae, Rubiaceae, Rutaceae, and Solanaceae with three species (6.5%) each. Two species (*Leucas abyssinica* (Benth.) Briq and *Thunbergia ruspolii* Lindau.) of the

**Table 2.** Summary of medicinal plants used to treat livestock ailments in Suro Barguda district.

| No. | Scientific name | Family | Local name (Oromo language) | Hb | Pu | Ut | Cp | Ra | Disease treated | Preparation & Application | Ds | Co.No |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | *Acokanthera schimperi* (A.DC) Schweinf | Apocyanaceae | QARAARRU | T | L | Ls | F<br>Dr | Dm<br>Dm | Itching (QANXOO/ CIITTO)<br>External parasites | Crushing the leaves and applying on the affected part.<br>Fumigating the chicken and their overnight place with dried leaves. | C | MA63 |
| 2 | *Aloe trichosantha* Berger | *Asphodelaceae* | HARGISSA | Suc | L & Lat | Ls | F and heated | Dm<br>O | Skin cancer and wound.<br>Hepatitis (BIIRTEE). | Cutting and chopping the leaf or peeling the leaf and applying on the affected part.<br>Applying the latex on the infected part.<br>Crushing the leaves with magado salt and boiling it with water and giving half a liter for animals. | R | MA280 |
| 3 | *Ammocharis tinneana* (Kotschy & Peyr.) Milne- Redh. & Schweick | Amaryllidaceae | BUTTE WERABESA | Sedge | R | Ls | F | O | Being breathless in cattle (TUMA) | Chopping the root, making s/n and giving 1 coffee cup/day for 2 days. | R | MA281 |
| 4 | *Balanites aegyptiaca* (L.) Del. | Balanitaceae | BADANAA | T | R oot | Ls | F | O | Breast cancer in cattle (MUCHA LONII) | Crushing the root, making s/n and giving ½ a liter 2 times a day for 1 week for livestock. | C | MA23 |
| 5 | *Barleria steudneri* C.B.Clarke | Acanthaceae | QILXIIPHEE | H | L | Ls | F | O | Internal parasite of the Camel | Feeding it (the whole upper part) to the Camel | R | MA303 |
| 6 | *Calpurnia aurea (Alti)* Benth. | Fabaceae | CEEKATTA | Sh | L | Ls | F<br>F | O<br>Er | Black leg (ABAGORBA), Anthrax (ABASENGA)<br>Hepatitis (BIIRTEE)<br>External parasites of chicken (ANDAQOO)<br>Ear ache (DHUKKUBIGURRA) | Chopping the leaves, making s/n and giving 1 liter for adult cattle and ½ liter for calf 2 times/day for 3 days.<br>Chopping the leaves with magado salt, making s/n and giving 1 liter for adult cattle and one coffee cup for humans at once.<br>Chopping the leaves, making s/n and spreading on their body and their overnight site.<br>Crushing the leaves, making s/n, filtering and dropping 2 drops into the infected ear 2 times a day for 3 days. | C | MA59 b |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | *Cissus quadrangularis* L. | Vitaceae | GAALLE ARBAA | Li | Ba | Ls | F | Dm | Black leg (ABAGORBA) | Chopping it, and inserting into the dissected skin of the cattle. | R | MA196 |
| 8 | *Clematis simensis* Fresen. | Ranunculaceae | FIITTI | Li | L | LS | F | O | Shivering and abnormal breathing (CUMA'A) | Crushing the leaves, making solution and giving one water glass of it to the sick animal. | C | MA103 |
| 9 | *Combretum collinum* Fresen. | Combretaceae | DHANDHASSA | T | L | Ls | F | O | Diarrhea of calves (BUSOOTU) | Pounding the leaves, making s/n if possible adding *Megado* salt & giving small amt through the nostrils & one coffee cup orally once for all. | | MA38 |
| 10 | *Croton macrostachyus* Hochst. ex Delile | Euphorbiaceae | MOKONNIISA | T | Ba, | Ls | F | O | Tooth ache | Holding/ chewing internal part of the bark with the infected tooth. Crushing the internal bark, making thick s/n and adding to infected part. Crushing internal part of the bark with its leaves, making s/n, boiling and giving 2 water glass 2 times a day for 3 days. Dropping the latex on the wound or infected part. Crushing the leaves, making s/n and giving 2 coffee cups of the s/n for tetanus. | C | MA137 |
| | | | | | Ba | | | | Swelling and forming deep opening (LUUXAA) | Crushing the leaves and internal part of the bark, making s/n and giving 3 coffee cups once. Or Crushing the leaves with the leaves of *Premna schimperi*, making s/n, and giving ½ liter 2 times a day for 1 week. | | |
| | | | | | L | | | | Wound and tetanus | Chopping the root, making s/n and giving 1 coffee cup once. | | |
| | | | | | Lat | | | | Abortion in cattle Hepatitis | | | |
| | | | | | R | | | | Shivering and abnormal breathing (CUMA'A) | Crushing root bark, making s/n, boiling and giving 1 water glass 2 times a day for 3 days. Chopping the leaves with the leaves of *Calpurnia aurea*, making s/n and giving ½ a liter for livestock. | | |
| 11 | *Cyphostemma serpens* (A. Rich.) Desc. | Vitaceae | COOPHII (YEZIHON HAREG) | Li | St &Ba | Ls | F | Dm | Blackleg (ABAA GOORBAA) | Chopping the stem with its bark, dissecting the skin of the cattle and inserting it. Heating the bark and put on (place) on the infected part. | C | MA250 |
| | | | | | Ba &L | | F | Dm | FMD (Foot and Mouth Disease) | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | *Datura sp.*L | Solanaceae | XUXIYYEE | H | L | LS | F | O | Diarrhea in calves (BUSOOTUU)<br><br>Tissue cancer (LUXAA YKN XANDHACHA) | Crushing the leaves with the leaves of *Clematis simensis,* making s/n and giving 1 coffee cup for 1 day.<br>Chopping the leaves, making thick s/n, inserting through the opening of the wound and covering the mouth of the opening with the residue. | C | MA14 |
| 13 | *Datura stramonium* L. | Solanaceae | QOBBOO ARDDAA | H | L | Ls | F | O | Rabies (DHUKKUBA SAREE) | Pounding the leaves, making s/n & giving 1-2 coffee cup for adult livestock and half of it for calves. | C | MA307 |
| 14 | *Dichrostachys cinerea* (L.) Wight & Arn. | Fabaceae | JIRMEE | Sh | R & Se | LS | F & Dr | O | Diarrhea in Calves (BIISSOTU).<br><br>Hepatitis (BIIRTEE) | Chopping the roots, making solution and giving 1 coffee cup at once.<br>Feeding the diseased animal with its seeds. | C | MA85 |
| 15 | *Dodonaea angustifolia* L.f. | Sapindaceae | DHITACHAA | Sh | L & St | LS | F | O | External parasites of livestock (TAFFI HORII) | Chopping young leaves, making s/n and giving ½ - 1 water glass to the animal. | C | MA30 |
| 16 | *Euphorbia ampliphylla* Pax | Euphorbiaceae | HADAAMAA | T | Latex | LS | F | Dm<br><br>O | Wound (NAQARSSAA)<br><br>Tooth ache<br><br>Reproduction organ infection in livestock. | Taking the latex, combining it with the crushed *Carissa spinarum* root and applying on the wound.<br>Taking small amount of the latex, adding water and giving 1 water glass 2 times a day for the animal.<br>Applying the latex on the infected tooth.<br>Applying the latex on the infected part. | C | MA48 |
| 17 | *Foeniculum vulgare* Miller | Apiaceae | KALKALA YKN INSILAALA | H | Rt | Ls | F | O | To remove plastic materials from livestock stomach (DHUKKUBA GARRA) | Pounding the roots, making s/n & giving one liter for livestock. | R | MA311 |
| 18 | *Guizotia scabra* (Vis.) Chiov. | Asteraceae | HADAA BUTTI | H | L | Ls | F | O | Black leg (ABAGORBA) | Chopping the leaves, making s/n & giving one water glass. | C | MA313 |
| 19 | *Gymnanthemum amygdalinum* (Delile) Sch.Bip. | Asteraceae | EEBIICHA | Sh | R & L | Hu | F | O | Blotting and urine retention (BOKKOKSAA FI DHIIBIINSA FIINCAANII) | Chopping the leaves, making s/n and giving a liter for livestock at once. | C | MA156 |
| 20 | *Heteromorpha arborescens* (Spreng.) Cham. & Schltdl. | Apiaceae | ALI-HANQAA | Sh | L | Ls | F | O | Shivering and abnormal breathing (CUMA'A) | Crushing its leaves with the leaves of *Ozoroa insignis, Croton macrostachyus, Calpurnia aurea* and *Senecio hadiensis*, making s/n & giving one liter orally at once. | R | MA218 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | *Hordeum vulgare* L. | Poaceae | GARBUU | H | Se | Ls | Dr | O | Broken bones & worn out tissues (LAFEE CABAA FI NAFAA DADHABAA) | Giving some amount of grains daily for sick equine. | R | MA314 |
| 22 | *Laggera crassifolia* (Sch. Bip. ex A. Rich) Oliv & Hiern | Asteraceae | TAMBOO LOOONII | H | R | Ls | F | O | Tooth ache of livestock (QOORAA LOON) | Crushing the root, making s/n giving ½ liter once per day for 3 days. | C | MA141 |
| 23 | *Lannea rivae* (Chiov.) Sacl. | Anacardiaceae | HANDARAKU | T | Ba | LS | F | O | Shivering and abnormal breathing (CUMA'A) in livestock Breathing problem in cattle | Grinding the bark with megado salt and 1 liter solution is given per day for adult cattle for 3 days. Crushing the bark, making s/n and giving 1 liter per day for 3 days. | R | MA148 |
| 24 | *Leucas abyssinica** (Benth.) Briq. | Lamiaceae | - | H | L | Ls | F | Na | Coughing & sneezing of calves (BUSSOTU) | Pounding the leaves, making s/n & applying half of a Coffee cup through the nose. | R | MA23 |
| 25 | *Leucas discolor* Sebald | Lamiaceae | XUXIYEE | Sh | L | Ls | F | Na | Breathing problem in calves | Pounding the leaves, making s/n & applying half of a coffee cup through the nose. | C | MA316 |
| 26 | *Maesa lanceolata* Forssk | Myrsinaceae | ABBAYYII | Sh | L | LS | F | O | Leech infection (ULAULA) | Chopping the leaves, making s/n, boiling and giving ½ liter 2 times a day for 3 days. | C | MA272 |
| 27 | *Microglossa pyrifolia (*Lam.) O. Kuntze | Asteraceae | QORSSAA TARAABII | Li | L | Ls | F | Dm | Dermal wound of equines (BOOCCOQAA) | Pounding the leaves, making thick s/n & applying on the wound daily until it heal. | C | MA35 |
| 28 | *Ozoroa insignis* Del. | Anacardiaceae | GARRII | Sh | Ba | Ls | F | O | Diseases of equines (DHUKKUBA TARABII). Bloody diarrhea (GARAA KAASAA) | Chopping internal part of the bark with the bark of *Pappea capensis* , making s/n, boiling it and giving ¼ - ½ liter to the equine. Crushing inner bark, making s/n and giving 1 water glass 2 times a day for 2 days. | | MA222 |
| 29 | *Pavetta abyssinica* Fresen. | Rubiaceae | KOMOQORSSA | Sh | Rt | Ls | F | O Dm | Tooth ache & wounded cancer/skin cancer (DHUKKUBA ILLKANI FI CACASSAA) | Chewing the root for tooth ache. Pounding the root & put on the infected part. | R | MA18 |
| 30 | *Pavetta oliveriana* Hiern | Rubiaceae | KOMOQORSSA | Sh | L | Ls | F | O & Dm | Urine retention (DHIDIINSA FINCAANII) | Chopping the leaves, making s/n & drinking one coffee cup at once or smelling the chopped leaves. | C | MA18 |
| 31 | *Phytolacca dodecandra* L`He`rit | Phytolaccaceae | HARAANJA | Li | L | Ls | F | O | Coughing disease in equines. (GAMOJII TARAABII ) | Chopping the leaves, making s/n & giving one water glass twice per week. | R | MA346 |

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| 32 | *Prunus africana* (Hook. f.) Kalkm. | Rosaceae | SUKKEE | T | L | Ls | F | O | Diarrhea, wound and coughing in cattle (SUMUXEE) | Pounding the leaves with the leaves of *Clematis hirsuta, Calpurnia aurea, Ehretia obtusifolia, Croton macrostachyus* and *Teclea simplicifolia*, making s/n and giving one water glass orally at once. | R | MA178 |
| 33 | *Ricinus communis* L. | Euphorbiaceae | QOOBBOO | H | L | Ls | F | O | Urine retention<br>Rabies (DHUKKUBA SAREE) | Crushing the leaves, making s/n and giving 1 liter to the diseased livestock.<br>Pounding its leaves with the leaves of *Croton macrostachyus*, making s/n and giving one water glass for the livestock at once. | C | MA322 |
| 34 | *Senecio hadiensis* Forssk | Asteraceae | WALGABISSA | Ch | L | Ls | F | O | Shivering and unable to breath normally in cattle (CUMA'A) | Chopping the leaves with the leaves of *Heteromorpha arborenscens, Croton macrostachyus,Calpurnia aurea* and *Lagenaria abyssinica*, making s/n and giving one liter orally at once. | R | MA326 |
| 35 | *Solanum dennekense* Dammer | Solanaceae | HIIDII | Sh | L & R | Ls | F | O | Swelling and forming deep opening (LUUXAA) | Chopping the leaves and root together, making s/n, introducing through the opening and closing the opening with the residue. Crushing the root, making solution and giving 1 water glass at once. | C | MA78 |
| 36 | *Steganotaenia araliacea* Hochst. | Apiaceae | LUQAALUQQE | T | L | Ls | F | O | Different diseases of equines including eye disease | Chopping its leaves together with the leaves of *Gardenia ternifolia* and magado salt, 2 cup of its s/n is given to the diseased equine. | R | MA237 b |
| 37 | *Syzygium guineense* (Wild.) DC. var. *guineense* | 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. | R | MA128 |

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| 38 | *Teclea borenensis* M.Gilbert | Rutaceae | HADHEESSA | Sh | R & L | Ls | F | O | Bloody diarrhea in livestock (WORAANA)<br><br>Being breathless in animals | Crushing the root and leaves together with magado salt, making s/n and giving 1/3 of a liter for the animal once a day.<br><br>Crushing the leaves, making s/n and giving 1 liter at once. | C | MA275 |
| 39 | *Teclea salicifolia* Engl. | Rutaceae | HADHEESSA | Sh | L & St | Ls | F | O | Diarrhea (ALBAATTII).<br><br>Wound (CACCA)<br><br>Trypanosomiasis (GANDII)<br><br>Hepatitis (BIIRTEE)<br><br>Stomach ache<br><br>Tooth ache of livestock (DHUKUBII IILKAAN) | Crushing the leaves giving 1 coffee cup of its solution for the patient.<br>Heating the leaves on fire, adding butter and putting on the wound.<br>Chopping the leaves, giving 1 liter of its solution to the diseased livestock to treat trypanosomiasis.<br><br>Crushing the leaves, making s/n and giving half a liter to the diseased animal.<br><br>Chopping the leaves and holding it with the infected tooth. | R | MA77 |
| 40 | *Thunbergia ruspolii** Lindau | Acanthaceae | - | Li | L | Ls | F | Na | Diarrhea in calves (BUSOOTUU) | Chopping the leaves, making s/n and applying one coffee cup through the nostrils two times a day. | R | MA328 |
| 41 | *Tragia cinerea* (Pax) Gilbert & Radcl. Smith | Euphorbiaceae | LALLESSAA | Ch | L | Ls | F | O<br><br>Na | Diarrhea in cattle (BUSOOTUU) | Pounding the leaves, making s/n and giving one liter orally and some droplets through the nostrils. | C | MA14 |
| 42 | *Vangueria apiculata* K. Schum | Rubiaceae | BURURII | Sh | Root bumps<br><br>L | Ls | F | O<br><br>O<br><br>Na | Liver disease<br><br>Urine retention (DHIDIINSA FINCAANII) | Chopping the root bumps, making s/n, and giving half a liter for livestock.<br>Chopping the leaves, making s/n & drinking one coffee cup at once or smelling the chopped leaves. | R | MA87 |
| 43 | *Viscum congolense* DC. Wild. | Viscaceae | BALDDOO | Epi | L & St | Ls | F | O | Shivering and abnormal breathing in cattle (CUMA'A ).<br>Cold and liver diseases of cattle (DHUKKUBA QORRA FI TIRUU LOONI) | Chopping these parts, making s/n and giving 1 water glass solution 2 times a day for adult cattle.<br>Chopping the leaves, making s/n and giving one water glass to the cattle. | R | MA71 |
| 44 | *Viscum tuberculatum* A. Rich. | Viscaceae | DHERTOO | Epi | St & L | Ls | F | O | Poisons, snake venom<br><br>Shivering and abnormal breathing (CUMA'A) | Chopping the whole part with magado salt, making s/n and giving 1 water glass 2 times a day for 1 day for the cattle.<br>Or Chopping its leaves with the leaves of *Fagaropsis angolensis* , making s/n and giving one coffee cup 2 times a day for 3 days. | C | MA330 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 45 | *Zanthoxylum chalybeum* Engl. | Rutaceae | GADDAA | Sh | Ba, R, Se, L & St | Ls | F<br>Dr | O | Back side pain (DHUKUBII DUBA) Diarrhea in goats (ALBAATTII RE'EE) | Chopping the leaves, making s/n and giving ½ liter per day for 3 days. | R | MA16 |
| 46 | *Ziziphus abyssinica* Hochst ex A. Rich. | Rhamnaceae | HUQUNQURA | T | Ba | Ls | F | Na<br>O | Weight loss and being powerless in livestock (XUXII). | Crushing internal part of the bark, making s/n and dropping 2 drops through the nostrils.<br>Chopping the bark, making s/n, boiling, adding milk or butter and giving 1 water glass 2 times a day for 3 days. | C | MA217b |

Key: (Hb=Habit; Pu=Parts used; Ut=Used to treat; Cp=Condition of preparation; Ra= Route of application; T=Tree; H=Herb; Sh=Shrub; Cl=Climber; Ls=Livestock; 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; Ds=Distribution; C=Common; R=Rare; *=Endemic).

ethnoveterinary medicinal plants of Suro Barguda District were found endemic to Ethiopia. Concerning the growth forms of plants used for livestock treatment, there were more herbs and shrubs (12 species, 26.1% each), followed by trees (10 species, 21.7%) and lianas (6 species, 13%). All documented ethnoveterinary plant species were harvested from the wild and overgrazing, deforestation; charcoal making, and firewood collection were claimed as major factors affecting the ethnoveterinary plant species of the study area.

## Livestock ailments and their prevalence

A total of 79 veterinary ailment types were identified in the study area for which informants reported to use one or more of the medicinal plant species (Table 2). Of which twenty-six (32.9%) veterinary ailment types belonged to breathing system diseases, sixteen (20.3%) were gastrointestinal diseases, and twelve (15.2%) diseases belonged to blackleg, hepatitis, and FMD (Foot and mouth) disease categories. Diarrhea and breathing problems were found to be the most commonly reported (most prevalent) types of livestock ailments in the district.

## Applications of ethnoveterinary remedies

Even if ethnoveterinary medicinal plants of the district were asserted to be applied for ailments affecting chicken, sheep/goats, cattle, equines, or camels, the majority of the reported medicinal plant species (40, 87%) were found to be applied to treat one or more of the sixty-two different cattle ailments (Table 2). Eighteen (39%) equal medicinal plant species were mentioned to be used specifically against twenty-one ailments of goats/sheep and nineteen ailments of equines, respectively (Figure 2).

## Medicinal plant parts used for ethnoveterinary remedy preparation

Regardless of the different plant parts reported to be used for remedy preparation by the community, a greater proportion (41.9%) of the preparations was found to be from leaves alone, followed by bark and roots (12.8%) each (Figure 3). Plants in mixtures of leaves rated to 10.5%, latex 5.8%, and stem 3.5% in the ethnoveterinary medication of the district. Most remedies (98.8%) were prepared from freshly harvested plant parts (Figure 3).

## The approach of remedy preparation and routes of administration

Different modes of ethnoveterinary remedy preparation were reported to be used in the district based on the type and degree of complexity of livestock ailments. Chopping / pounding the remedial part and homogenizing it with cold water was found to be the major mode of remedy preparation (93.1%) and unprocessed forms covered only 6.9% (Figure 4). These ethnoveterinary remedies were reported to be given through oral, dermal, or nasal routes. The oral application was the most cited route of administration (20 preparations, 66.7%), followed by nasal (six preparations, 20%), and dermal (four preparations, 13.3%) routes (Figure 4).

## Most preferred ethnoveterinary plants

A preference ranking exercise with 10 key informants for eight medicinal plants that were reported to be used against breathing system diseases showed that *Viscum congolense* and *Clematis simensis* were the most preferred species to treat the reported diseases (Table 3).

Multipurpose medicinal plants used for livestock ailments and their conservation status

The output of the average direct matrix ranking score of ten key informants for five medicinal plant species with six use diversities indicated that some multipurpose medicinal plant species were currently exploited more for firewood, charcoal, and construction purposes than for their medicinal uses (Table 4).

## Informant consensus on the most frequently used medicinal plants used for treating livestock ailments in the study area

This study clarified that some medicinal plants were well known in the study area than others. As a result, fifty informants cited such plants repeatedly as a remedy for various diseases of livestock. For example, *Cyphostemma serpens* and *Viscum congolense* were cited by all informants (100%) as sources of remedy for foot and mouth disease and shivering and abnormal breathings respectively. D*ichrostachys cinerea* and *Syzygium guineense* were also cited by 49 (98%) informants as sources of remedy for hepatitis and shivering and leech infection, respectively (Table 5).

## Effectiveness of ethnoveterinary medicinal plants

Six main livestock ailment categories were identified from a total of 79 veterinary diseases reported in the district. The highest Informants' Consensus Factor (ICF) values were recorded for breathing system diseases (0.85), dermatological diseases (0.84), blackleg, hepatitis, and FMD (0.83), and gastrointestinal disease (0.81) categories (Table 6). Hence, the highest plant use citation (55.1%) was recorded for breathing system diseases.

## The comparative healing potential of ethnoveterinary medicinal plants

*Cyphostemma serpens* revealed the highest fidelity level value (97%) for blackleg, hepatitis, and FMD disease categories, followed by *Viscum congolense* (96%) for breathing system diseases. In the dermatological therapeutic category, the highest fidelity level value was recorded for *Prunus africana* (92%). *Ozoroa insignis* (87%) also showed relatively high healing potential under the muscular-nervous system disease category (Table 7).

## Use diversity of ethnoveterinary medicinal plants

All 46 medicinal plant species recorded for livestock ailment treatment in the district were cited for one or more uses other than their medicinal role. The proportion of medicinal plant species over different use categories is summarized in Figure 5.

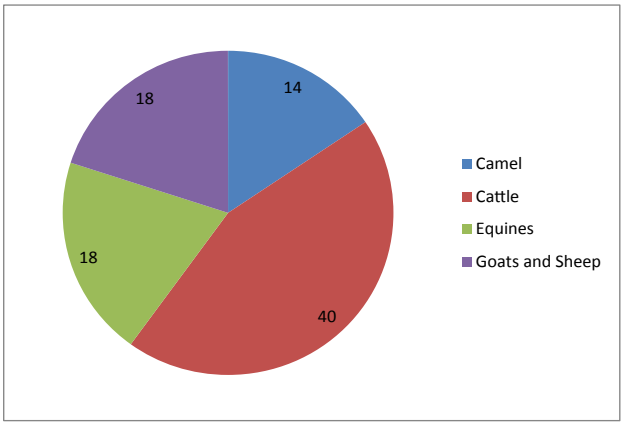


**Figure 2.** Number of ethnoveterinary plant species used for different livestock types in Suro Barguda district.

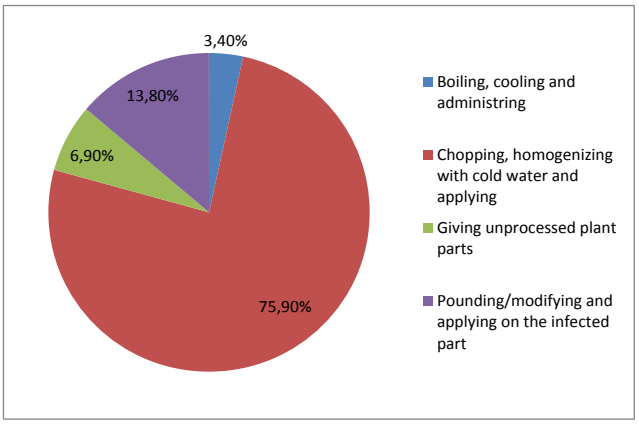


**Figure 4.** Forms of remedy preparation and administration for treating livestock ailments in Suro Barguda district.

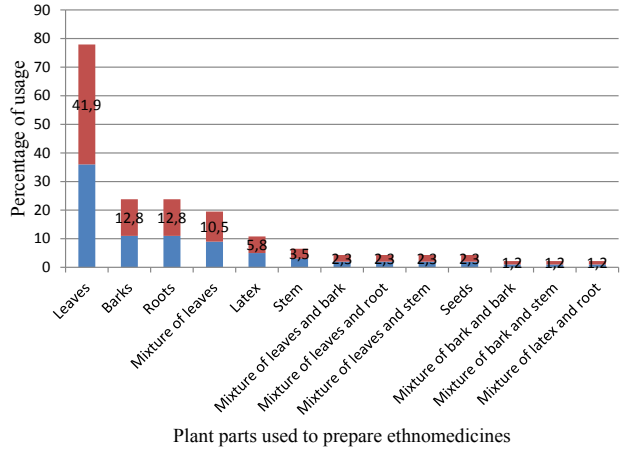


**Figure 3.** Plant parts used for ethnoveterinary remedy preparation in Suro Barguda district.

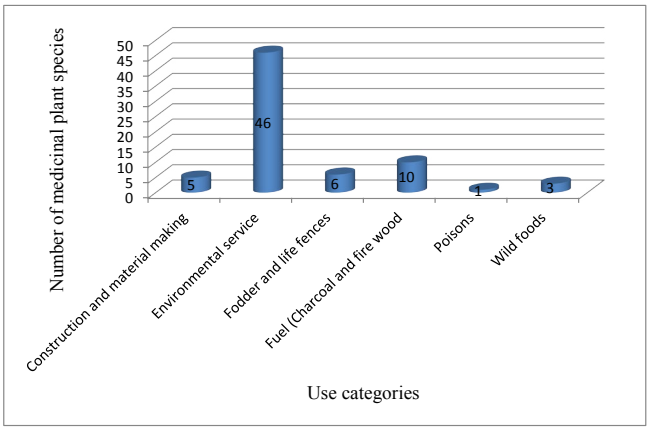


**Figure 5.** Use categories of livestock medicinal plants in Suro Barguda district.

**Table 3.** Results of preference ranking exercise of eight medicinal plants reported for treating breathing system diseases of livestock

| Plant spp. treating breathing system diseases of livestock | Informants designated A to J | | | | | | | | | | Total score | Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H | I | J | | |
| Ammocharis tinneana | 4 | 3 | 4 | 5 | 5 | 6 | 7 | 6 | 5 | 5 | 50 | 7th |
| Clematis simensis | 8 | 7 | 6 | 8 | 5 | 4 | 6 | 5 | 7 | 6 | 62 | 2nd |
| Heteromorpha arborescens | 7 | 6 | 8 | 5 | 4 | 6 | 5 | 3 | 6 | 7 | 57 | 5th |
| Lannea rivae | 8 | 6 | 5 | 7 | 6 | 4 | 6 | 7 | 5 | 6 | 60 | 3rd |
| Leucas abyssinica | 5 | 4 | 4 | 6 | 5 | 3 | 4 | 5 | 6 | 3 | 45 | 8th |
| Phytolacca dodecandra | 6 | 5 | 5 | 6 | 7 | 4 | 5 | 6 | 3 | 6 | 53 | 6th |
| Senecio hadiensis | 7 | 8 | 6 | 7 | 5 | 8 | 6 | 4 | 4 | 4 | 59 | 4th |
| Viscum congolense | 6 | 8 | 7 | 8 | 6 | 5 | 8 | 6 | 7 | 8 | 69 | 1st |

N.B. Scores in the table indicate the ranks given to medicinal plants based on their efficacy (the highest number (8) was given for the medicinal plant which informants thought most effective in treating breathing system diseases and the lowest number (3) was given for the least effective plant.

**Table 4.** Average direct matrix ranking score of ten key informants for five medicinal plant species with six use diversities.

| Medicinal plant species | Use categories | | | | | | Total | Rank |
|---|---|---|---|---|---|---|---|---|
| | Ch | Co | Fr &Tl | Fw | Md | We | | |
| *Combretum collinum* | 5 | 2 | 2 | 5 | 3 | 0 | 17 | 3rd |
| *Dichrostachys cinerea* | 5 | 4 | 1 | 3 | 3 | 0 | 16 | 4th |
| *Lannea rivae* | 2 | 2 | 1 | 3 | 3 | 2 | 13 | 5th |
| *Prunus africana* | 4 | 5 | 4 | 5 | 5 | 0 | 23 | 1st |
| *Syzygium guineense* var. *guineense* | 3 | 5 | 3 | 5 | 3 | 3 | 22 | 2nd |
| **Total** | 19 | 18 | 11 | 21 | 17 | 5 | 91 | - |
| **Rank** | 2nd | 3rd | 5th | 1st | 4th | 6th | - | - |

Where, Ch=Charcoal; Co=Construction; Fr & Tl=Furniture and Tools; Fw=Firewood; Md=Medicinal and We=Wild edible

**Table 5.** Informant Consensus on the most frequently used medicinal plants.

| Botanical Name of Medicinal Plants | Disease Treated | No. of Informants | % |
|---|---|---|---|
| *Cissus quadrangularis* | Black leg | 48 | 96 |
| *Cyphostemma serpens* | Foot and Mouth Disease | 50 | 100 |
| *Dichrostachys cinerea* | Hepatitis | 49 | 98 |
| *Microglossa pyrifolia* | Dermal wound | 48 | 96 |
| *Prunus africana* | Coughing in cattle | 47 | 94 |
| *Syzygium guineense* | Leech infection | 49 | 98 |
| *Tragia cinerea* | Diarrhea | 48 | 96 |
| *Viscum congolense* | Shivering and abnormal breathing | 50 | 100 |

**Table 6.** ICF values of traditional medicinal plants used to treat livestock ailments in Suro Barguda District.

| Disease Category | No. of Species | % of all Species | Use Citations | % of use Citations | ICF |
|---|---|---|---|---|---|
| Breathing system diseases | 17 | 37 | 108 | 55.1 | 0.85 |
| Gastro - intestinal diseases | 17 | 37 | 86 | 43.9 | 0.81 |
| Black leg, hepatitis and FMD | 11 | 23.9 | 60 | 30.6 | 0.83 |
| Dermatological diseases | 9 | 19.6 | 50 | 25.5 | 0.84 |
| Muscular - nervous system diseases | 18 | 39.1 | 52 | 26.5 | 0.67 |
| Tooth ache, leech infection and cold | 8 | 17.4 | 19 | 9.7 | 0.61 |

**Table 7.** Fidelity level values of medicinal plants commonly reported on certain livestock ailment categories

| Medicinal Plant | Healing Category | Np | N | FL value (%) |
|---|---|---|---|---|
| *Cyphostemma serpens* | Black leg, hepatitis and FMD | 22 | 23 | 96.00 |
| *Viscum congolense* | Breathing system diseases | 32 | 33 | 97.00 |
| *Prunus africana* | Dermatological diseases | 24 | 26 | 92.00 |
| *Ozoroa insignis* | Muscular -nervous system diseases | 26 | 30 | 87.00 |
| *Tragia cinerea* | Gastro - intestinal diseases | 20 | 24 | 83.00 |
| *Syzygium guineense* | Tooth ache, leech infection and cold | 12 | 16 | 75.00 |

**N.B.** FL= Fidelity Level; Np=number of informants who independently cited the importance of a species for treating a particular disease; N=total number of informants who reported the plant for any given disease.

**Table 8.** Medicinal use values of selected ethnoveterinary plants.

| Medicinal Plant Species | No. Informants Citing the Species | Total Citations | No. of Ailments Treated with | UVmed. |
|---|---|---|---|---|
| *Cyphostemma serpens* | 84 | 504 | 2 | 6.0 |
| *Dichrostachys cinerea* | 96 | 749 | 2 | 7.8 |
| *Lannea rivae* | 118 | 944 | 2 | 8.0 |
| *Ozoroa insignis* | 102 | 673 | 2 | 6.6 |
| *Solanum dennekense* | 68 | 374 | 2 | 5.5 |

**N.B.** UVmed=Medicinal use value

## Medicinal use values of selected ethnoveterinary plants

Traditional medicinal uses of 46 different medicinal plant species against several livestock ailments were compiled. Of these species, the highest medicinal use values (UVmed) were recorded for *Lannea rivae* (8.0), *Dichrostachys cinerea* (7.8), and *Ozoroa insignis* (6.6) (Table 8).

## Distribution of indigenous knowledge on medicinal plants among different social groups in the community of the study area

Although more medicinal plants were reported by men (168) than women (28), the difference was not significant (P >0.05) when the average number of medicinal plants mentioned by each group was compared. There was no significant difference seen in the number of medicinal plants listed by informants living around health centers and those living relatively far away from these health centers. However, there was a significant difference (P <0.05) in the number of medicinal plants reported by senior members of the community (>40 years old) and young- to middle-aged members (<40 years old); key informants and randomly taken informants, illiterate and literate informants (Table 9). More medicinal plants were reported by elders (>40 years old), illiterates, and key informants than by young, literates, and randomly taken informants.

**Table 9.** Statistical test of significance on the average number of medicinal plants among different informant groups in Suro Barguda District.

| Considerations | Informant Groups | N | Average ± SD | T -value** | P –value |
|---|---|---|---|---|---|
| Gender | Men | 168 | 6.62 ± 2.65 | 1.97 | P ≤ 0.97 |
| | Women | 28 | 6.05 ± 2.18 | | |
| Age | Youngsters (< 40 years old) | 110 | 5.16 ± 2.07 | -12.87 | P ≤ 0.001* |
| | Elders (> 40 years old) | 86 | 7.96 ± 2.19 | | |
| Literacy | Illiterate participants | 146 | 7.22 ± 2.31 | 12.92 | P ≤ 0.001* |
| | Literate participants | 50 | 4.28 ± 1.82 | | |
| Proximity to the health center | Near to the health center | 11 | 6.00 ± 2.37 | -0.94 | P ≤ 0.36 |
| | Far away from the health center | 185 | 6.5 ± 2.57 | | |
| Informant Category | Key informants | 24 | 10.76 ± 1.09 | 25.75 | P ≤ 0.001* |
| | Randomly taken informants | 172 | 5.85 ± 2.04 | | |

*Significant difference (p<0.05); ** t(0.05) (two-tailed), degree of freedom (df)=223, N= number of respondents

# Discussion

## Are there diversified ethnoveterinary medicinal plants in the study area?

The reported ethnoveterinary medicinal plants of Suro Barguda District showed that the study area is relatively rich in ethnoveterinary medicinal plant diversity and indigenous knowledge related to each traditionally used species (Table 2). The highest number of ethnoveterinary medicinal plant species was contributed by Asteraceae (5 species), followed by Euphorbiaceae (4 species). As indicated in Lock M [39] and Hedberg I, et al. [40] this could be due to the wide presence of the family Asteraceae which is being the second dominant family in the flora of Ethiopia and Eritrea. The existence and employment of such a large number of medicinal plants indicate that the majority of the people continue to employ indigenous medicinal practices so far. This report confirms the first hypothesis of the study which clarifies that "Different plant species are used for ethnoveterinary traditional medicinal preparation in the study area."

Comparatively, high diversity of ethnoveterinary medicinal plant species was recorded than in other cultural communities of Ethiopia and abroad such as Moliso MM, et al. [16], Tekle Y [19], Giday M, et al. [41] and Tariq A, et all [42] who reported [29, 33,40,41] medicinal plants species used by the Zay people who live on islands as well as shore areas of Lake Ziway in the Ethiopian Rift Valley, the Bensa people,, southern Ethiopia, the Wolaita and Dawuro peoples, Ethiopia; and tribal society of Sulaiman Range, Pakistan respectively.

## From where these ethnoveterinary medicinal plants are collected?

All documented ethnoveterinary plant species (100%) were harvested from the wild. Such wild harvesting implies that the medicinal plants are exposed to depletion due to environmental degradation, agricultural expansion, and cultivation of marginal lands which pose a significant threat not only to the plants but also to the future wellbeing of human and animal populations relying on these resources to combat various ailments for generations. This finding was relatively in agreement with the reports of Giday M, et al. [41] in which 95.7% of the medicinal plants were collected from the wild. Overgrazing, deforestation, charcoal making, and firewood collection were claimed as major factors affecting the ethnoveterinary plant species of the study area (Table 4).

## Which types of medicinal plant species and their parts are used to treat different livestock ailments?

Even though livestock traditional medicinal plants of the district were asserted to be applied for ailments affecting chicken, sheep/goats, cattle, equines, or camels, the majority of the reported medicinal plant species were found to be applied to treat one or more of the sixty-two different cattle ailments (Table 2). Eighteen (39%) medicinal plant species were mentioned to be used specifically against twenty-one ailments of goats/sheep and nineteen ailments of equines, respectively.

The majority of ethnoveterinary medications (42 preparations) were reported to comprise medicinal parts of a single medicinal plant. This finding was in line with the reports of Giday M, et al. [41] which stated that most of the remedies are prepared from a single species. The remaining medications were prepared using formulations from two or more species. Lulekal E, et al. [43] also reported that healers used multiple plants in the mixture to increase the strength and efficacy of the drug. Amongst all plants reported, the highest proportion of species was claimed to treat breathing problems followed by diarrhea. Multiple ethnoveterinary uses were recorded for *Croton macrostachyus* and *Teclea salicifolia* (each used against six ailment types) while *Calpurnia aurea* was used to treat five livestock diseases (Table 2). *C. macrostachyus* is regarded as a multipurpose tree by subsistence farmers in Ethiopia, Kenya, and Tanzania and the species has the potential in playing an important role in primary healthcare [44]. The bark, fruits, leaves, roots, and seeds of *C. macrostachyus* are reported to possess diverse medicinal properties and it is used as herbal medicine for at least 61 human and 20 animal diseases and ailments [44]. In the study area it has a high degree of medicinal use consensus for treating swelling and deep openings, wound, premature abortion, shivering, and abnormal breathing in different livestock species.

Similar to some other previous findings such as Giday M, et al. [41], Hunde D, et al. [45], Alemayehu, G, et al. [46], Eshete MA, et al. [47], Abebe D, et al. [48] and Mesfin F, et al. [49], leaves were the most widely used plant parts in the study area for ethnoveterinary medicine preparations, followed by bark and roots in the study area (Figure 4). This wide utilization could be attributed to the high pharmaceutical value and concentration of bioactive ingredients in these plant parts. On the other hand, other findings, for instance, [21,50] reported different results which showed that roots were the most frequently utilized plant parts in their respective research areas. The possible reason could be that people living in different ecological zones could use different plants and plant parts in their traditional treatment system.

## What form of medicinal plants is mostly used for remedy preparation?

The majority (97.8%) of remedies were prepared from freshly harvested plant parts. The predominant use of fresh materials for herbal preparation probably reflects an attempt to capture potent, volatile substances that determine the therapeutic efficacy of herbal preparations [51]. As reported by informants, from their long experience, high efficacy was attained from freshly collected plant parts since they contain many bioactive ingredients in the form of secondary metabolites. This finding was in line with the reports of Hunde D, et al. [45], Abebe D, et al. [48], Mesfin F, et al. [49], Getaneh S, et al. [52], Araya S, et al. [53], Belayneh A, et al. [54] and Belayneh A, et al. [55] which clarified that most of the remedy preparation was from freshly collected medicinal plants, whereas 2.2% were prepared from dried forms.

## Which plant species are more preferable in treating the prevalent diseases in the study area?

Viscum congolense, Clematis simensis, and *Lannea rivae* were the most preferred ethnoveterinary medicinal plants to treat breathing system diseases, which were the most prevalent animal health problems reported in the study area (Table 2). Herbal preparations from *Viscum* spp. were reported for their traditional uses in two main therapeutic areas for cardiovascular disorders and in oncology even if the species of the host tree, the harvest time, and the process of preparing the extracts determine the concentrations of the ingredients [56].

## Which livestock ailments are more prevalent in the study area?

Most of the veterinary ailments belong to the breathing system disease category followed by gastrointestinal diseases. Breathing problems and diarrhea were known to be the most commonly described forms of veterinary ailments in the district. This result corroborates with the report of Mesfin F, et al. [49] who reported that the majority of veterinary ailments claimed by the community belong to breathing system disease categories. Healers treat veterinary ailments based on observation of the animals or evidence obtained by asking the livestock owners about the major symptoms shown by the diseased animals and medicines were commonly given only after the diseased animal was visually examined by a traditional healer for any symptoms on its suspected body part.

## What is the common way of remedy preparation?

Diverse modes of ethnoveterinary remedy preparation were mentioned to be used in the district based on the type and degree of complexity of livestock ailments. Chopping/pounding the remedial part and making its solution with cold water was found to be the major method of local remedy preparation (Figure 4). This finding was in agreement with the reports of many studies such as Belayneh A, et al. [54], Belayneh A, et al. [55] and Hosonuma N, et al. [57] which clarified that crushing, pounding, and concocting were the common methods of remedy preparation. Oral administration of traditional medicines was reported as the main route in the treatment method of most diseases (Figure 4). This finding was also in line with the reports of Ngeh J, et al. [10], Alemayehu, G, et al. [46], Eshete MA, et al. [47], Getaneh S, et al. [52], Belayneh A, et al. [54] and Hosonuma N, et al. [57] which informed us that most of the traditional remedies were administered orally.

## Which route of remedy administration is effective and dominant? And how is the dose determined?

Oral administrations of remedies were reported effective due to their immediate impact in the livestock's internal system than any topical applications [43]. Rubbing or pasting herbal preparations were also commonly reported treatment methods for handling dermatological diseases. The physical appearance of the diseased animal and visually confirmed the degree of complexity of the illness was used to determine the doses of traditional medicines in treating livestock ailments. Some traditional practitioners reported the use of the coffee cup, water glasses, and bottles to determine the dosage for some traditional medicines, while others reported using the size of their fingertips or full of a small dish of unprocessed parts to treat ailments. However, no standardized doses of herbal preparations were reported by traditional healers for any of the preparations used to treat livestock ailments in Suro Barguda District even if they used such various units of measurement. Similar findings have been reported in other studies in Ethiopia such as [19,54,58-60] the result of which showed that there is a lack of precision of the dose in traditional medicine application.

## Which medicinal plant has got the highest informant consensus in treating the selected livestock ailment?

Since informant consensus is used to identify the most cited plant species for its particular importance, the highest plant use citation was recorded in the present study for breathing system diseases with the highest ICF value (Table 6). *Viscum congolense* was highly effective in treating breathing system diseases, whereas *Cyphostemma serpens* was identified as having the highest healing potential in treating blackleg, hepatitis, and FMD (Foot and Mouth Disease) with FL tests (Table 7). Informant consensus factor values (ICF values) are commonly used to identify the harmony of the informants on a reported cure for the group of ailments (breathing system diseases in the present study)) of the plant, while the Fidelity Level (FL) computes the significance of a species (Viscum congolense) to treat a given disease (breathing system diseases). Hence, their analysis values confirmed as the information obtained was tangible.

## Do these ethnoveterinary medicinal plants have other purposes?

With the direct matrix ranking, exercise made among five multipurpose ethnoveterinary medicinal plant species to identify the threat level, *Prunus africana* ranked first (most - threatened) followed by *Syzygium guineense* var. *guineense* and *Combretum collinum.* Higher direct matrix ranking values indicated that the plants have been used for different purposes and vice versa. The output indicated that these multipurpose medicinal plant species were exploited more for firewood, charcoal, and construction purposes than for their medicinal uses (Table 4).

All ethnoveterinary medicinal plant species in the district were cited for one or more uses other than their medicinal roles such as uses for environmental services, construction and material making, fodder, and live fences, fuelwood (charcoal and firewood), as wild food, or poison.

## Which ethnoveterinary medicinal plant species have the highest use value? And what is the commonly used solvent in the preparation of remedies?

Out of the 46 different medicinal plant species used for livestock ailment treatment, the highest medicinal use values (UVmed) were recorded for *Lannea rivae* followed by *Dichrostachys cinerea* (Table 8).

Water served as 'solvent' almost in all ethno-formulations of traditional medicines whenever dilution is required. Different additives were incorporated in 23.4% of the whole ethno-formulations. Informants reported that certain additives were frequently used to improve the suitability of some remedies that were taken orally. The use of additives for reducing bitterness

and bad flavor or increasing efficacy of herbal formulations was reported by Lulekal E, et al. [43]. The highest usage of the additive was reported for "Magado" salt (locally produced salt).

## What seems the distribution of indigenous knowledge on medicinal plants among different social groups in the community of the study area?

Although more medicinal plants were reported by men than women, the difference was not significant (P >0.05) when the average number of medicinal plants mentioned by each group was compared. This could be because both men and women were knowledgeable on the use of traditional plant remedies regardless of the relative dominance of medicinal plant tradition by men, which could be related to the transfer of traditional knowledge along the male line in the study area (Table 9). Similar results were reported by Getaneh S, et al. [52] and Ayantunde AA, et al. [60] who stated that considering the relative abundance of citations per species (Shannon index), they observed that men showed a higher diversity, along with a higher homogeneity of citations, compared to women (higher evenness). Among the individuals that mentioned more than 15 plant species per interview, they found 10 women and 5 men. Furthermore, Uniyal S Kr, et al. [61] reported as there was relatively equivalent medicinal plant knowledge between men and women traditional medicine practitioners among three communities in northeastern Brazil, and Giday M, et al. [62] reported similar information for a community in southwest Niger. There was no significant difference observed in the number of medicinal plants listed by informants living around health centers and those living relatively far away from these health centers. However, there was a significant difference (P = 0.00) in the number of medicinal plants reported by senior members of the community (>39 years old) and young- to middle-aged members (<40 years

old). More medicinal plants were reported by elders than by youngsters, and this could be attributed to the high degree of opportunity for more cultural contact and experience with plants and associated therapeutic uses by the elderly. Moreover, it could also be accounted to the secrecy of knowledge transfer the preferred male line flow of herbal knowledge among family members in the study area. Similar reports were made by Araya S, et al. [53], Giday M, et al [62], Teklehaymanot T [63], Slikkerveer LJ [64], Nakashima D, et al. [65], Abera Girma, HT, et al. [66] and Tolossa K, et al. [67] who clarified that elders (40 years old or more) showed a higher diversity of plant citations compared to youngsters. Similarly, significant differences were also seen in the number of medicinal plants reported by key informants and randomly taken informants, illiterate and literate informants. More medicinal plants were reported by illiterates and key informants than literates and randomly taken informants (Table 9). This could again be related to the impact of lifelong experience and serious secrecy in using medicinal plants in the former, and modernization in the latter case. This report confirms the third hypothesis of the research which states that "The culture and knowledge of the study area people are unique in using traditional medicinal plants." Similar results were reported by Phillips O, et al. [38] and Pfeiffer JM, et al. [68] who clarified as there are key individuals in the population with a very detailed knowledge of medicinal plants.

### Could significant types of livestock diseases be treated by a traditional medication system?

A large number and types of livestock diseases (79 disease types) for which diseased livestock was visited by traditional healers indicated the preference of local people in the study area to use traditional medicines than modern medication. The reported reasons for this to happen were the efficacy and availability of these medicines, cultural trends, and life standards (being poor), factors which force the community to visit traditional healthcare practitioners than modern healthcare centers with unreasonable prices. This report confirms the fourth hypothesis of the research which says "The traditional herbalists in the study area are familiar with healing plants, their preparation, and their application." Similar findings were reported by Tran BX, et al. [69] and Fokunang CN, et al. [70] who mentioned that respondents reported that a higher preference for traditional medicine than their counterparts is due to the long distance to commune veterinary health station and services dissatisfaction.

### How is the indigenous knowledge transferred from generation to generation?

Using wild plants for medicine traditionally is an indigenous science. Indigenous knowledge systems are a multifaceted assortment of knowledge, know-how, practices, and representations that guide human societies in their numerous interactions with the natural environment such as agriculture and animal husbandry; struggles against disease and injury; and strategies for coping with changing environments. It is through this day-to-day and the inevitable interplay between people and surroundings that indigenous knowledge systems have developed miscellaneous structures and content; complications, flexibility, and practicality; and distinctive patterns of interpretation anchored in specific worldviews. A similar notion was reported by Tolossa K, et al. [67] who mentioned that knowledge of the natural milieu is a product of resource-based livelihoods extending across many generations. It is through the fine-grained interplay between society and environment that indigenous knowledge systems have developed diverse structures and content; complexity, versatility, and pragmatism; and distinctive patterns of interpretation anchored in specific worldviews.

Knowledge is produced and transferred through communication within specific social and agroecological contexts [50,60,65]. reported that ethnobiological information and practices within any custom have been reported to vary by factors such as geographical basis, traditions, belief, livelihood, educational background, social status and relations, income class, age, and gender. The flow of knowledge from seniors to children and its enrichment subsequently is directly conveyed through observation, imitation, free flow of information among community members, history telling, and myths. In line with the fact Nakashima D, et al. [65] reported that most of the traditional healers acquired their knowledge from their fathers/ families and friends.

The main system of traditional knowledge transfer on types of medicinal plants, traditional concepts of disease, and ways of diagnosis among traditional healers in Suro Barguda District was through word of mouth (no written documents were obtained), with maximum secrecy following mainly the selected male line of the family. The way they are sharing their indigenous knowledge with their descendants was also found to be similar. This may cause indigenous knowledge to be threatened shortly unless certain measures are taken, which were also clearly seen in other parts of the country and abroad as reported by Teklehaymanot T [63], Slikkerveer LJ [64], Nakashima D, et al. [65], Abera Girma, HT, et al. [66], Pfeiffer JM, et al. [68] and Tran BX, et al. [69] who mentioned that the knowledge of medicinal plants use is nearly disappearing among the young generation, because, maybe most of the knowledgeable persons did not properly pass on their knowledge to the next generation.

Traditional knowledge was built with years of experience, so elders were more knowledgeable in traditional medicine than youngsters in the study area. The depth and width of traditional knowledge on medicinal plants become lesser and lesser due to its secrecy, the unwillingness of the young generation to gain knowledge, and the influence of modern education, which all result in its gradual disappearance. Ethnomedicinal knowledge diminishes with the death of elderly knowledgeable members of society since fewer and fewer young people are willing to acquire this knowledge.

### Are there conservation practices in the study area?

Dwellers of Suro Barguda District and their livestock population depend mainly on the natural resources of the area for their existence. Deforestation for timber production or construction, overgrazing, charcoal production, and fuelwood collection was claimed to be the anthropogenic causes of resource depletion. This finding was in line with the reports of Hosonuma N, et al [57] and Cunningham AB [71]. Highly affected dry evergreen montane forest and the remaining woodland area were severely degraded due to overgrazing with immense livestock population and illegal charcoal production and fuelwood collection. Not only medicinal plant species were affected but also the vegetation as a whole was in a critical condition. Some medicinal plants such as *Warburgia ugandensis* are disappearing from the study area due to their high and improper usage (peeling the bark which leads to the death of the plant). Some conservation practices were implemented in a very specific area of the district, but this did not guarantee the wellbeing of plant diversity and their contribution to the perpetuation of life in the area (no pronounced conservation effort). This report confirms the second hypothesis of the research which says "There is depletion of plant diversity and loss of indigenous plant knowledge in Suro Barguda District."

Inhabitants of the study area simply went to the forest, woodland, or grazing areas to collect medicinal plants as their needs arose and did not worry about the long-term survival of these plants. Most of these informants gave the reason that the medicinal plants were easily accessible in their surroundings and hence no need for personal effort to conserve these plants. Except for its secrecy, no taboo was reported which restricts the collection and application of these medicinal plants. Because of this, medicinal plants in the study area were highly threatened by anthropogenic and natural factors. The natural factors affecting medicinal plant species were an irregular and very short rainy season, prolonged and recurrent drought. Hence, sustainable land management, which involves both the conservation and improvement of the present vegetation cover, such as through enrichment planting, enhancing soil fertility, and rehabilitating degraded lands, is required to reduce the pressure on and destructive use of natural resources. This could be achieved by solving the problems associated with open access to forest resources through sustainable forest management involving the local communities neighboring this vegetation as co-managers and co-beneficiaries of the generated revenues.

## Conclusion and Recommendations

Most of the ethnoveterinary medicinal plants of the study area were found to play a multipurpose role across different use categories and consequently, some are under serious pressures challenging their survival. Hence, the

recorded high use value indices of multipurpose plant species in the study area can be used as signals of high pressure and hence can be utilized as keys to design and implement well-coordinated complementary *in situ* and *ex situ* conservation activities to save these widely used plant species. Findings of this study indicated that there was higher usage of leaves of most medicinal plants to prepare various traditional remedies. Even though collecting these parts does seem not to harm much the regular physiological activities of the plant, those plants only with a limited number of leaves can be endangered unless proper consideration is given. Hence, conservation work in the area needs to give prior attention to protect such types of plant species. Traditional practitioners diagnose their diseased livestock through observation and ask the owner of the animal about the signs of the disease and then prepare the medicine to administer it accordingly based on their cultural knowledge on symptoms, corresponding illnesses, and therapeutic medicinal species held in the knowledge of indigenous people. This may be more effective if these people obtain certain training from modern health professionals about how to identify some diseases based on their symptoms is important as an aid to building their capacity so as to play their part in the primary healthcare delivery of veterinary ailments. High ICF, FL, and medicinal use-value testing exercise results showed that the selected medicinal plants of Suro Barguda District are the best targets for promising bioactive elements.

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## Consent for publication

Not applicable.

## Availability of Data and Materials

All data supporting our finding is available in the Manuscript.

## Authors' Contributions

All authors have equal contributions to this work. Both authors read and approved the final manuscript.

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## Ethics Approval and Consent to Participate

This ethnobotanical study of medicinal plants used to treat human ailments was approved by the concerned bodies of Bule Hora University. During our field investigations, all stakeholders in this study, including users of traditional medicines, the local community of Suro Barguda District, and all authors willingly agreed to participate in the study, use the data related to their knowledge and publish the results. Consent for publication has been obtained from the Scientific Research Committee of the Bule Hora University, College of Natural and Computational Sciences, authors, and all stakeholders who participated in this study.

## Conflict of Interest

The authors declare that they have no competing interests.e.

## Competing Interests

The authors declare that they have no competing interests.

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