Ethnobotanical study of medicinal plants used for the treatment of human ailments in the Sodo district of East Gurage Zone Central Ethiopia

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Research

Abstract

Background: In Ethiopia, traditional medicine has long been a vital aspect of healthcare, with knowledge passed down orally. However, habitat loss from agriculture and deforestation threatens the availability of medicinal plants. This study documents the medicinal plants used in the Sodo District of East Gurage Zone, Central Ethiopia, and explores the challenges they face.

Methods: Between July 2020 and November 2022, 120 informants (90 males, 30 females) participated in interviews and surveys. Data was collected through semi-structured interviews, focus group discussions, field observations, and market surveys. Identified plant specimens were deposited in a herbarium. Ethnobotanical data were analyzed using various statistical methods, including informant consensus factor and relative frequency of citation.

Results: A total of 106 plant species from 49 families were identified, with Lamiaceae, Asteraceae, Euphorbiaceae, and Solanaceae being most commonly used. Herbs were the primary plant habit. Common preparation methods included crushing and squeezing, with oral administration being most frequent. *Ocimum lamiifolium* had the highest fidelity for treating febrile illnesses. Sexually transmitted infections and intestinal issues had the highest consensus among informants. Demographic factors significantly influenced plant knowledge. Major threats included agricultural expansion, firewood collection, and overharvesting.

Conclusion: Traditional medicinal knowledge is integral to the local culture, with a diverse range of plants used for healthcare. However, challenges such as the aging healer population, lack of successors, and resource overharvesting threaten this knowledge. This study highlights the need for conservation and sustainable use of medicinal plants and traditional knowledge.

Keywords: Central Ethiopia, Ethnobotany, Medicinal plants, Sodo district

Background

Throughout history, communities across the globe have depended on plant resources to meet their fundamental survival needs. Consequently, these communities have cultivated unique, localized knowledge regarding the use of plants, particularly in traditional medicine (Balick & Cox 1996, Cotton 1996). Ethiopia is renowned for its abundant variety of medicinal plants. While earlier literature identified 887 species of medicinal plants in the country (EBI 2009), current estimates suggest that this number has likely increased. The Ethiopian Flora Project has recorded 6,027 vascular plant species, including 27 subspecies (Kelbessa & Demissew 2014). Despite this extensive documentation, the exact number of medicinal plants remains unclear. By applying the ratio of medicinal plants found in earlier studies to the total vascular plants documented, it is estimated that about 15% of Ethiopia's flora may possess medicinal properties. The relationship between humans and forests is influenced by a complex interplay of biophysical and human factors over time and across different regions (Friis *et al.* 2010). In developing nations, where poverty and limited access to modern healthcare prevail, approximately 80% of the population relies on plants as their primary source of medical care (Agize *et al.* 2022). As a result, people depend on plants not only for food but also for medicinal preparations (Rai *et al.* 2012).

Ethiopia boasts a remarkable variety of climates and ecological conditions, resulting in an incredibly diverse array of flora and fauna (Bekele-Tessema *et al*. 2007, Woldu 2017). The country's geographical diversity has fostered the development of numerous vegetation and habitat zones. Additionally, Ethiopia is home to diverse languages, cultures, and beliefs. That inturn has shaped the traditional knowledge and practices of its people, particularly in the realm of medicinal plant usage. The indigenous flora has proven effective in treating a wide range of human ailments. It is due to the communities' in-depth belief in the healing properties of traditional medicine and the relatively low costs associated with these natural remedies (Eshete & Molla 2021). As a result, there is a significant demand for medicinal plants throughout the country. Much of the knowledge surrounding traditional medicine is passed down orally, with practitioners playing a vital role in this transmission process (Morka & Duressa 2021). While traditional medicine has greatly contributed to societal well-being, it has received little attention in contemporary research and development. Only few initiatives aimed at enhancing its practice. Recently, however, Ethiopian higher education institutions and health authorities have begun to take an interest in promoting and advancing this field. The central region of Ethiopia, known for its rich biological and cultural diversity, is particularly abundant in medicinal plants (Teka *et al*. 2020a, b). Unfortunately, threats such as deforestation, environmental degradation, and population growth pose significant risks to this invaluable repository of medicinal plant knowledge (Kloos 2023). These pressing issues have led to a decline in indigenous knowledge that is intricately linked to the preservation of the nation’s forests. Forests serve as habitats for these medicinal plants. The forests of Central Ethiopia provide a variety of ecosystem services, including forest coffee, honey, spices, building materials, and cultural rituals (Kassa *et al*. 2020). Regrettably, many of these pristine forests have been fragmented and converted into agricultural landscapes (Tamene *et al.* 2023, Tamene *et al.* 2020).

The residents of Sodo district maintain a traditional rural lifestyle and have a deep connection with plants (Teka *et al. 2*020a, b). Prior to this research, there had been limited investigation into the ethnobotany of medicinal plants in this area. Therefore, it is crucial to conduct a survey to document the indigenous knowledge and medicinal flora of the Sodo district in the East Gurage zone. Although the region is characterized by diverse traditional cultures, it suffers from inadequate infrastructure, particularly concerning educational and healthcare facilities. Traditional healers in the area have noted that it is significantly remote from hospitals and health centers. Hence, increased risk of mortality from various health issues and forcing residents to depend on traditional medicine. Most health concerns are addressed through remedies provided by local healers with indigenous knowledge, rather than through modern medical solutions.

The Sodo district is culturally diverse and rich in plant life, indicating valuable traditional knowledge about medicinal plants. However, this knowledge is fading as it is passed down through generations, with younger people showing less interest. Agriculture and deforestation threaten the plants’ availability, while modern education has decreased reliance on traditional medicine. This loss endangers both traditional remedies and the cultural integrity of local communities. With modernization influencing healthcare practices, it is essential to assess the status of medicinal plants in the region. Comparing this study’s findings with Ethiopia’s central ethnobotanical database could enhance our understanding of the distribution and use of these plants, offering insights into Ethiopia’s plant-based healthcare traditions.

This study aims to: (i) document traditional medicinal plants used in Sodo district for various ailments, including their botanical names, local names, and uses; (ii) assess their impact on food security and public health; (iii) explore the link between informants' knowledge and their demographics; (iv) identify threats to these plants; and (v) evaluate their conservation status, focusing on those endangered by human activities. The research will propose conservation strategies, promote sustainable use, and support future pharmaceutical development.

Materials and Methods

Location and description of study area

Sodo District, located 103 km southwest of Addis Ababa, is part of the East Guraghe Zone. It derives its name from the Soddo Gurage people. As of August 2023, it falls within the newly established Central Ethiopia Regional State. The district is positioned at average latitude of 8°26’760.00”N and longitude of 38°36’43.56”E, with an average elevation of 2,292 meters above sea level (Figure 1). Spanning approximately 93,800 hectares, the altitude in the area varies from 1,362 to 3,606 meters. Bu’i Town serves as the administrative center. Notable sites such as **Mederkebid Gedam** and **Tiya Tikle Dingay** are recognized for their tourist attractions. **Sodo** District is bordered by Meskane to the south and the Oromia Region to the west, north, and east. The Soddo, or **Kistane** (***ክስታኔ***), represent a subgroup of the Gurage people residing in south-central Ethiopia. They are considered a northern geographic and linguistic subset of the Gurage. They speak the Soddo Gurage language, also known as **Kistanigna (*ክስታንኛ*)**. While they primarily inhabit Sodo District in the East Gurage Zone, significant populations can also be found in various locations across Ethiopia, including Addis Ababa, Nazret, Butajira, and Dire Dawa. Although they share cultural ties with the Sebat Bet Gurage and other Gurage sub-groups, the Soddo Gurage predominantly identify as Ethiopian Orthodox **Tewahedo** Christians. This strong Orthodox Christian identity has been maintained since ancient times and is a source of pride for the community. The name "**Kistane**," meaning "Christian," reflects this heritage and is the traditional term preferred by locals, although "Soddo" remains widely used. The Soddo Gurage people are closely related to other groups within the Gurage community.

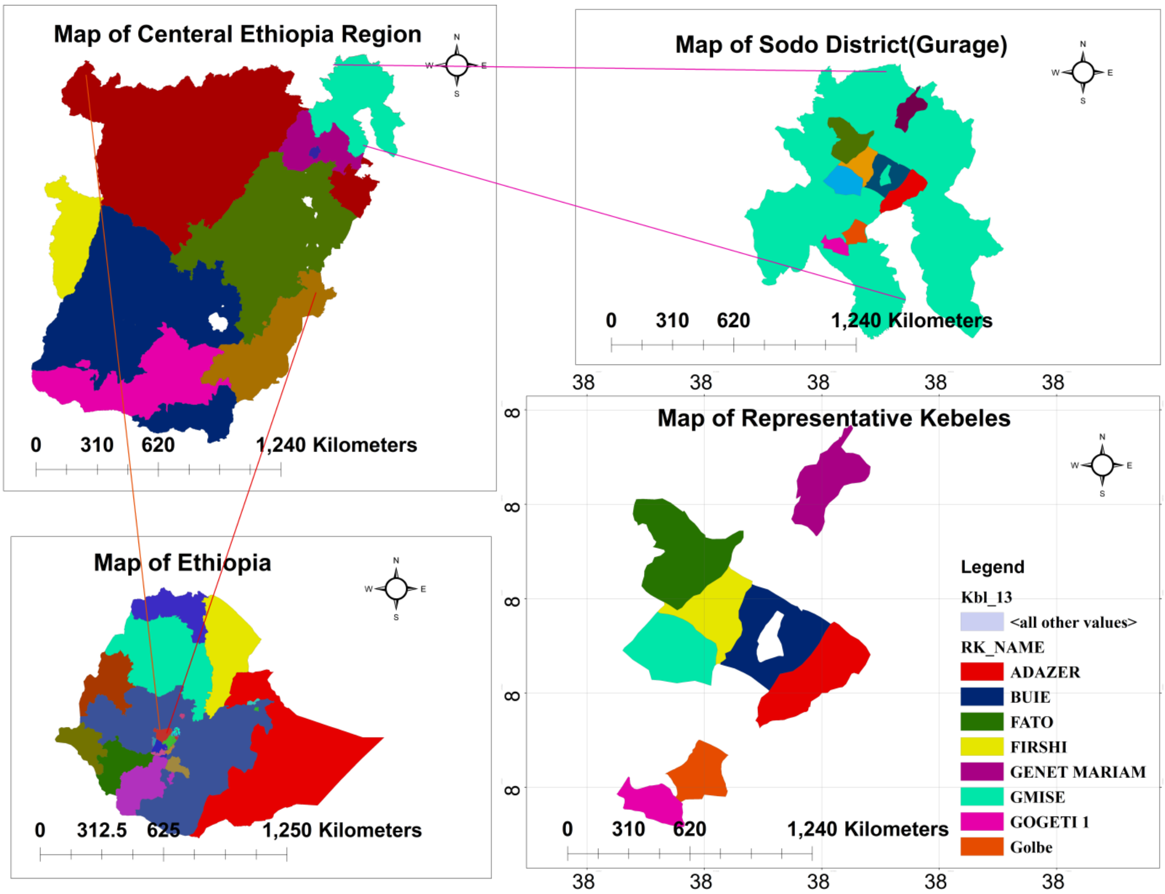

Figure 1. Map of the study area (Generated by ArcGis 10.4.1)

The Inhabitants

The 2007 Census by the Ethiopian Statistical Service (ESS) projected Sodo's population at 2,683,743, with 1,341,000 men and 1,342,743 women. Of this, 10.19% live in urban areas. Ethiopian Orthodox Christianity is the dominant religion (93.35%), followed by Muslims (3.3%) and Protestants (3.28%). The main ethnic groups are Soddo Gurage (85.25%), Oromo (11.58%), and Amhara (1.47%). Most residents speak Soddo Gurage (91.06%), followed by Afan Oromo (5.17%) and Amharic (2.54%). Regarding sanitation, 82.24% of urban households and 12.45% of all households had access to safe drinking water, while 25.15% of urban homes and 3.15% of all households had toilet facilities.

Climate, ecology, and vegetation of the study area

An analysis of 30 years of meteorological data for Sodo district, based on the Walter climate diagram, reveals a unimodal rainfall pattern. The district receives an average annual precipitation of 1,356 mm and maintains an average annual temperature of 15°C. The driest months are from November to January, while the wet season extends from March to October. Highest rainfall typically occurs between March and September (Figure 2). The study area features highland elevations ranging from 1,700 to 2,900 meters and is part of the Dry Evergreen Afromontane Forest vegetation ecosystem. This ecosystem is primarily dominated by *Juniperus procera*, with additional species such as *Olea europaea* L. subsp. *cuspidata* and *Podocarpus falcatus*. Unique species like *Acacia abyssinica* and *Acacia negrii* further define the wooded grassland vegetation of the area.

Preliminary survey and study sites selection

The initial survey was conducted from April to May 2020. The objective the objective of the survey was to gain a comprehensive understanding of the region's agro-ecological characteristics, assessing the current state of vegetation, collecting insights into local communities' indigenous knowledge regarding the various uses of plants, evaluating accessibility, and considering other relevant environmental factors. The actual data collection was conducted Between July 2020 and November 2022. Purposive sampling was utilized to select the kebeles (subdistricts) for study. Priority was given to those subdistricts with substantial vegetation cover and a documented history of medicinal plant use. The subdistricts were also identified as potential sites for home gardening initiatives. The selection process was further guided by previous data gathered from local healthcare practitioners, respected elders, community leaders, participants in focus group discussions, and traditional healers. Consequently, eight subdistricts were selected for the study: Adazer, Golbe, Gemise, Firshi, Gogeti1, Bu'ie, Fato, and Genete Mariam (Table 1).

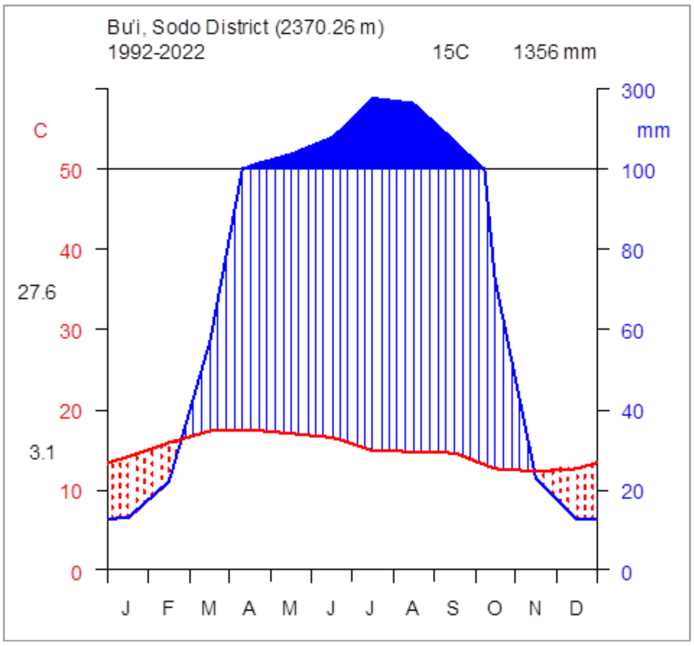

Figure 2. Climate diagram of the study area

Informant selection

The research involved interviews with 120 participants, aged 18 to 85 years. Fifteen individuals were chosen from each of the eight kebeles. As noted in previous literature (Alexiades 1996, Cotton 1996), 100 regular informants (non-expert healers) were identified through simple random sampling from the local community. About 20 key informants (expert healers) were selected using purposive sampling based on established guidelines. Participants were categorized into two distinct age groups: young adults (18–35), middle-aged individuals (36–55), and seniors (56–85). The study primarily focused on investigating the intergenerational transmission of knowledge regarding medicinal plants, particularly among individuals under the age of 30 (Awoke *et al*. 2024, Kassa *et al*. 2020).

Ethical considerations

Before field excursions, supportive correspondence was sent from the Department of Biology to relevant entities. These include the District Agriculture Office, district administrators, and kebele leaders. We prioritized ethical standards throughout the research; all herbalists were informed that the study was conducted for academic purposes. Ethical approval was secured to ensure confidentiality before interviews commenced. We were diligent in preserving the confidentiality of the local communities' knowledge, secrets, and taboos while documenting our findings.

Ethnobotanical data collection

Medicinal plants were gathered from the district's three agro-ecological zones lowlands, midlands, and highlands through guided field walk. Elevations below 1,500 meters are classified as lowlands, 1,500–2,300 meters as midlands, and 2,300–3,200 meters as highlands (Bekele-Tessema *et al*. 2007). The stratification aimed to maximize the diversity of medicinal plant species collected. Methods such as group discussions, semi-structured interviews, and guided field walks were used. Interviews, conducted with checklists in English, Amharic, and Sodo Guraghe (*Kistane*) languages, focused on participants' personal details, plant species, parts used, preparation, ailments treated, and dosage. Additional plant uses and threats to species were recorded. Voucher specimens of identified plants were collected from various ecological settings with key informants. Ethnobotanical data, including plant names, habitats, and treatment methods, were documented, with critical georeferenced data captured via GPS.

Table 1. Sampled study sites, altitude, latitude, and longitude, agro-ecology, number of households, and sociodemographic characteristics of Informants

Name of Subdistricts	Altitude	GPS Coordinates		Gender		Ethnicity (Ks,Gu,Or,Am)	Age categories			Language (Ksg ,Gun,Ao,Amc)	Occupation (Far,Mer,HW,Stu,Tch)	Religion (Ort,Mus,Pro)	NH	AE
		Latitude (N,S)	Longitude (E,W)	M	F		18-30	31-55	56-85					
Adazer	2054m	8°18'03"N	38°34'20"E	12	3	Ks,Gu,Or,Am	1	5	8	Ksg ,Gun,Ao,Amc	Far,Mer,HW,Stu,Tch	Ort,Mus,Pro	1034	Highland
Golbe	1927m	8°15'15"N	38°31'21"E	11	4	Ks,Gu,Or,Am	2	6	10	Ksg ,Gun,Ao,Amc	Far,Mer,HW,Stu,Tch	Ort,Mus,Pro	927	Highland
Gemise	2216m	8°19'02"N	38°36'25"E	9	5	Ks,Gu,Or,Am	1	7	9	Ksg ,Gun,Ao,Amc	Far,Mer,HW,Stu,Tch	Ort,Mus,Pro	1089	Highland
Firshi	2058m	8°20'32"N	38°31'20"E	12	3	Ks,Gu,Or,Am	1	6	8	Ksg ,Gun,Ao,Amc	Far,Mer,HW,Stu,Tch	Ort,Mus,Pro	1187	Highland
Gogeti1	1914m	8°14'23"N	38°28'56"E	11	4	Ks,Gu,Or,Am	3	4	9	Ksg ,Gun,Ao,Amc	Far,Mer,HW,Stu,Tch	Ort,Mus,Pro	1276	Highland
Buie	2049m	8°19'21"N	38°32'59"E	12	4	Ks,Gu,Or,Am	1	3	8	Ksg ,Gun,Ao,Amc	Far,Mer,HW,Stu,Tch	Ort,Mus,Pro	789	Highland
Fato	2540m	8°23'07"N	38°30'07"E	12	3	Ks,Gu,Or,Am	2	5	7	Ksg ,Gun,Ao,Amc	Far,Mer,HW,Stu,Tch	Ort,Mus,Pro	612	Highland
G.mariam	2345m	8°24'57"N	38°34'56"E	11	4	Ks,Gu,Or,Am	1	4	9	Ksg ,Gun,Ao,Amc	Far,Mer,HW,Stu,Tch	Ort,Mus,Pro	856	Highland
Total				**90**	**30**		**12**	**40**	**68**				**7770**	

Key:G.mariam=Genetemariam**,Ks=**Kistane,**Gu=**Gurage**,Am=**Amhara**,Or=**Oromo**,Ksg=**Kistanigna**,Gun=**Guragegna**,Amc=**Amharic**,Ao=**Affanoromo**,Ort=**Orthodox**,Mus=**Muslim**,Pro=**Protestant, **M**=Male, **F**=Female, **AE**= Agro-ecology,**NH**= Number of households,**Far**=Farmer,**Mer**=Merchant,**HW**=House wife,**Stu**=Student,**Tch**=Teacher

Plant voucher specimens collection, identification and herbarium preparation

During field excursions, medicinal plant specimens were collected with herbalists and experts. Three specimens of each species were gathered, labeled with a collection number and collector names. They were arranged between blotting paper sheets, secured with a specimen presser, and dried in sunlight while checking for insect infestations. A guidebook on Ethiopia's useful trees and shrubs assisted in identification. Specimens were verified at the National Herbarium (ETH) using taxonomic keys and comparison with authenticated specimens. Scientific names were cross-referenced with various databases such as Plants of the World Online, the Royal Botanic Gardens Kew, Plant Net Identification, Flora Finder, Google Images, the African Plant Database, and the World Checklist of Selected Plant Families. For complete Latin binomial nomenclature, the JSTOR Global Plants website was consulted. The specimens were deposited at the National Herbarium (ETH), Mizan-Tepi University, and Salale University for future research.

Data analysis

Microsoft Word 2019 was used to collect, organize, categorize, and document field data, including both scientific and local plant names, their families, life forms, utilized parts, and habitats. Analytical tools such as tables, bar graphs, and pie charts were employed for frequency analysis. Descriptive statistics, including means and standard deviations, were calculated using R software version 4.3.3. Before conducting t-tests, the Shapiro-Wilk test was performed to check for normality. Gender differences in traditional medicinal plant knowledge were analyzed using an independent t-test based on the reported plants. Variations in knowledge across different educational levels and healing experiences were assessed with separate t-tests. Differences among age groups were analyzed using ANOVA. The relationship between age and reported plants was examined through Pearson correlation and linear regression.

Additionally, quantitative ethnobotanical methods, such as the informant consensus factor (ICF), plant part value (PPV), fidelity level (FL), direct matrix ranking (DMR), and preference ranking, were employed for data analysis. The ethnobotanical indices were supplemented by statistical tests, models and ordination methods to display the structure of relationships among plants and humans (Kikvidze & Bussmann 2024). These data were further processed and analyzed using appropriate statistical methods within R to reveal patterns and structures in human-plant interactions. It was observed that using numerical methods in ethnobotanical studies effectively represents the structure of plant-human relationships (Andrade-Cetto 2011, Ghabbour *et al*. 2024, Gum *et al.* 2024).

Preference ranking

Eight key informants evaluated the effectiveness of seven medicinal plants for treating abdominal ailments. The plants were ranked based on the informants' selections, with values assigned from 1 (least effective) to 7 (most effective). Rankings were determined by summing the values assigned to each species (Cotton 1996, Martin 2010).

Paired comparison

Using the method outlined in previous literature (Martin 2010), ten informants conducted paired comparisons to assess the perceived effectiveness of medicinal plants for treating Mich (fever). The number of comparisons was calculated using the formula n (n−1)/2, where n represents the number of plant species. The plant that was chosen most frequently received the highest score.

Direct matrix ranking

To evaluate the multipurpose uses of medicinal plants, seven species were ranked by eight key informants across eight use categories, including food, firewood, and medicinal applications. Values assigned ranged from 0 (not used) to 5 (best use) (Martin 2010). The average scores for each species were summed to determine their overall utility ranking.

Informant consensus

The reliability of the recorded information was verified by contacting informants at least twice regarding the same concepts, allowing for an assessment of the data's dependability collected during interviews. Any original information was deemed unreliable if it contradicted the consensus of the informants. To evaluate the level of agreement among informants about the reported treatments for specific illnesses, the informant consensus factor (ICF) was calculated for each category (Heinrich 2000). This calculation was performed as follows:

$$\mathbf{ICF} = \frac{\mathbf{Nur - Nt}}{\mathbf{Nur - 1}}$$

Where Nur is the number of informant use reports for a specific plant-use category and Nt is the total number of taxa or species used for that plant-use category across all informants. The index has a range of 0 to 1, where values close to 1 indicate that informants strongly agree that the same species is used (Alexiades 1996).

Fidelity level (FL)

Fidelity level (FL), as proposed by (Alexiades 1996, Friedman *et al*. 1986), was employed to assess the relative therapeutic potential of medicinal plants in addressing human health issues. The calculation of the fidelity level (FL) was conducted using the following formula:

$$\mathbf{FL}(\%) = \frac{\mathbf{IP}}{\mathbf{IU}} \times \mathbf{100}$$

Hence, Fidelity Level (FL) is a metric used to assess the healing potential of medicinal plants for specific health conditions. It is calculated by the number of informants who independently cite a plant for treating an ailment (IP) divided by the total number of informants reporting the plant for that disease (IU). A high FL indicates that the plant is highly regarded for its effectiveness and may contain bioactive compounds with therapeutic properties, making it a priority for further pharmacological research and drug development.

Use values diversity of medicinal plants

The Use-Value (UV) is an index commonly employed in ethnobotany to assess the relative importance of useful plants. In rural, remote, and biodiversity regions, human communities often engage in diverse livelihood strategies, including the utilization of various cultural environments. Use values can be calculated as: $UVs = \sum_{i=1}^{n} Vlue\ use\ categories\ (i)$ (Jaric *et al*. 2024, Prance *et al*. 1987) while use value diversity is estimated as: (UVDs) $=\sum_{i-1}^{S} UVilnUVi$. Use value is essential for identifying highly valuable medicinal plants for potential further detailed pharmacological research and other ethnobotanical aspects (Jaric *et al*. 2024).

Statistical tests models and ordination methods

To see the structure of relationships among plants and humans, statistical tests, modeling and ordination were performed (Kividze & Bussmann 2024). The R Statistical Software was used to run the programs for data analysis (Borcard *et al*. 2018, Woldu 2017). The ERA editorial was consulted for the required standards for statistical analysis (Yebouk 2025).

Results

Socio-demographic characteristics of informants

Analysis of informants' socio-demographic characteristics showed that 75% were male, providing reliable data. Young adults (18-35 years) made up 40.84%, while older adults (36-85 years) represented 59.16% of the respondents. About 80% were Orthodox Christians, indicating church forests as key sources of medicinal plants, with 4.16% Muslims and 15.83% Protestants. Regarding education, 82.5% were illiterate and 17.56% were literate.

Taxonomic diversity and distribution of medicinal plants in the study area

A total of 106 medicinal plant species from 91 genera and 49 families were recorded. The most prominent families included Lamiaceae (12 species, 11.32%), Asteraceae (8 species, 7.55%), Euphorbiaceae (7 species, 6.60%), and Solanaceae (6 species, 5.66%). Fabaceae had 5 species (4.72%), while Boraginaceae, Celastraceae, and Malvaceae each had 4 species (3.77%). Poaceae, Polygonaceae, Ranunculaceae, Rutaceae, and Verbenaceae each contributed 3 species (2.83%). Amaranthaceae, Apiaceae, Asparagaceae, Cucurbitaceae, and Rosaceae each had 2 species (1.89%), with the remaining 31 families having 1 species each (0.94%) (Appendix 1).

Growth forms and habitat of medicinal plants

The growth form analysis revealed that herbs were the most common, with 49 species (46.23%), followed by shrubs (32 species, 19%), trees (16 species, 15.10%), and climbers (9 species, 8.49%). Of the 106 medicinal plants, 68 species (64.2%) were wild-sourced, 16 species (15.1%) came from both wild and home gardens, 10 species (9.4%) were from home gardens, and 12 species (11.3%) were market-sourced (Supplementary file 1.1).

Medicinal plant parts and methods of application

The study found that different plant parts were used for various health issues. Leaves being the most common (56.4%), followed by roots (16.5%), bark (7.3%), seeds (5.8%), and fruits (3.6%). Eleven application methods were reported, including drinking (35.2%), creaming (14.4%), swallowing (11.5%), fumigation (9.8%), eating (7.5%), and others like smoking, washing, and sniffing (Supplementary file 1.2).

Routes of administration and forms of medicinal plant preparation

The study identified seven routes of administration, with the most common being oral (59.9%), followed by dermal (19.2%), nasal (7.8%), optical (6.7%), auricular (3.4%), anal (1.9%), and vaginal (1.4%). Most medicinal plants (80.2%) were used fresh, while 15 (14.1%) were used in both fresh and dry forms, and six species (5.6%) were prepared dry (Supplementary file 1.3).

Dosage of administration and diagnostic features

Herbal medicine dosages varied based on the disease, patient's age, and condition. Practitioners used tools like spoons, cups, and even hand palms to measure doses. The dosage was determined by the illness, its duration, and diagnostic factors. Healers commonly diagnosed health issues through patient interviews and visual inspections, asking patients or their attendants about observed symptoms and their duration. Moreover, they visually examine the changes in the eyes, urine, skin color, tongue, and throat. They monitored factors such as body temperature, swelling, edema, coughing, bleeding, diarrhea, vomiting, the presence of parasites, and the condition of sores.

Informant consensus factor (ICF)
The Informant Consensus Factor (ICF) analyzed diseases into 12 groups based on factors like disease nature, causes, affected areas, and symptoms. Sexually transmitted infections (STIs) had the highest ICF at 100%, followed by intestinal issues (85%), febrile illnesses (68%), physical problems (66%), dermal issues (60%), cardiovascular diseases, hypertension, and hepatitis (58%), and complaints related to the evil eye (50%) respectively (Supplementary file 2.1). The results show higher consensus for common ailments in the area.

The relative healing potential of medicinal plants
The Fidelity Level (FL) was determined by calculating the ratio of informants who reported using a specific plant species to treat a particular disease to the total number of informants who utilized that plant for medicinal purposes across various diseases. The results for the fidelity levels of the top seven medicinal plants are presented in (Supplementary file 2.2).

Market surveys in Tiya, Bu'i, and Kela Towns assessed the availability of medicinal plants, focusing on their forms like seeds, roots, bark, fruits, and whole plants. Sellers were interviewed, and plant samples were collected. The observations revealed limited trading of medicinal plants in these markets. During the survey, only a few species—such as *A. abyssinica, A. caudatus, E. ventricosum, H. abyssinica, T. schimperi, C. limon, N. tabacum, R. chalepensis,* and E. *kebericho* were noted as being sold for their medicinal value. Informants noted that selling medicinal plants in formal markets was rare, as healers typically prepare and sell them from their homes. The community prefers gathering plants or seeking treatment directly from local healers. Cultural beliefs suggest that selling medicinal plants could diminish their healing properties and erode indigenous knowledge. Both healers and community members emphasized the importance of keeping traditional medicine private. Market observations showed that most plants for sale were used for food, spices, stimulants, and beverages, not for medicinal purposes.

Preference ranking of medicinal plants
In the study area, seven medicinal plants were reported to be effective in treating abdominal problems. Eight informants, chosen for their experience, were asked to evaluate the effectiveness of these seven medicinal plant species. The results indicated that *D. angustifolia, F. vulgare*, and *L. sativum* were identified as the most effective medicinal plants for this purpose (Supplementary file 2.3).

Paired comparison of medicinal plants
To check consistency of informant preferences of the medicinal plants, paired comparison of the top four medicinal plants in the above table were done. Hence, *D. stramonium, D. angustifolia, F. vulgare* and *L. sativum* were selected and compared. Number of pairs, N= $\frac{n(n-1)}{2}$ =$\frac{4(4-1)}{2} = 6$ pairs were obtained; the four items were arranged in alphabetical order as: 1. *D. stramonium* 2. *D. angustifolia* 3. *F. vulgare and* 4. *L. sativum* the order pairs were created in (Supplementary file 2.4).

The order of presentation for the four items was randomized for respondents using a draw of numbers 1 through 6 written on cards. Additionally, the order of the medicinal plants within each pair was randomized by flipping a coin: heads (H) indicated that the original order was maintained, while tails (T) indicated that the original pair was reversed (Supplementary file 2.5). The pooled sum of scores for the eight respondents is presented in the table below for the four medicinal plants. To assess the consistency of the informants' responses, a transitivity test was conducted using paired comparison techniques among the eight respondents (Supplementary file 2.6). The results of the simple preference ranking for the seven medicinal plants used to treat abdominal problems indicated that *D. angustifolia, F. vulgare, D. stramonium*, and *L. sativum* ranked first, second, third, and fourth, respectively. Similarly, paired comparisons of eight medicinal plants for treating fever were conducted by ten respondents using paired comparison techniques (Suplementary file 2.7). In this comparison, *O. lamiifolium, E. globulus*, and *S. anguivi* were ranked first, second, and third, respectively.

Direct matrix ranking of medicinal plants
Seven multipurpose medicinal plant species were selected from the total list of documented medicinal plants. Eight key informants were asked to evaluate the usage status of these seven plants across eight categories (medicine, firewood, fodder, charcoal, construction, fencing, furniture, and food) using a scale of 1 to 5 (where '5' indicates "best", '1' indicates "least used" and '0' indicates "no use"). The average ratings provided by the informants were then summed and ranked. Consequently, *Calpurnia aurea, Acacia siesberiana*, and *Croton macrostachyus* ranked first, second, and third, respectively, for their multipurpose applications. Additionally, *Calpurnia aurea* was found to be abundantly available in both forests and home gardens within the study area (Supplementary file 2.8).

Traditional classification of health problems versus clinical explanations
In the study area, visits were made to local health centers to identify common health issues. The information collected from healthcare professionals was cross-referenced with indigenous knowledge to uncover potential correlations. Clinical explanations for traditional remedies were developed using established references and guidelines. Additionally, interviews were conducted with traditional pharmacists—those who prepare and sell herbal remedies—to gain insights into the treatments they offer. Their understanding of the ailments they address was then compared with contemporary medical practices for clinical validation (Appendix 2).

Use value diversity of medicinal plants

The diversity of medicinal plant usage reflects the varying significance of different plant species for medicinal purposes. This diversity is commonly assessed using the Shannon-Wiener Use Value Diversity Index, which considers both the frequency of mentions and the range of uses associated with each species in relation to various health issues (Supplementary file 2.9).

Overall use value diversity of medicinal plants

The overall use value diversity of medicinal plants is assessed using the Shannon-Wiener Use Value Diversity Index, which evaluates the combined use values of all species within a dataset across all use categories for each medicinal plant (Table 4). Additionally, the Use Value (UV) index is calculated by summing the total number of citations for a particular species from all informants and dividing this total by the number of informants. Use diversity of the top 29 medicinal plants with an overall UV index greater than 0.05 is presented in Supplementary file 2.10.

Statistical tests, models, and ordination methods

Statistical tests are essential for enhancing the multivariate analysis of sociodemographic data and use-value in ethnobotanical studies. Cluster analysis results are typically depicted visually through dendrograms. In this context, agglomerative clustering algorithms are frequently employed. These algorithms create a hierarchical tree-like structure that can accommodate varying numbers of clusters (k), facilitating flexible analysis and interpretation (Figure 3). A dendrogram illustrates the clustering process and can be "cut" at different heights to establish a specific number of clusters. The x-axis of the dendrogram lists all respondents, while the y-axis represents the similarity at which clusters are combined. This hierarchical framework is particularly valuable for supporting decisions regarding partitioning in grouping respondents based on sociodemographic variables. To enhance interpretability, a dendrogram can be rearranged so that similar items are placed nearer to each other, regardless of their cluster affiliation. This reordering is guided by weights, with the leaves of the dendrogram adjusted to align closely with these weights. At each node, the branches are organized in ascending order of weight, thereby improving the visualization of relationships within the data (Supplementary file 1.4).

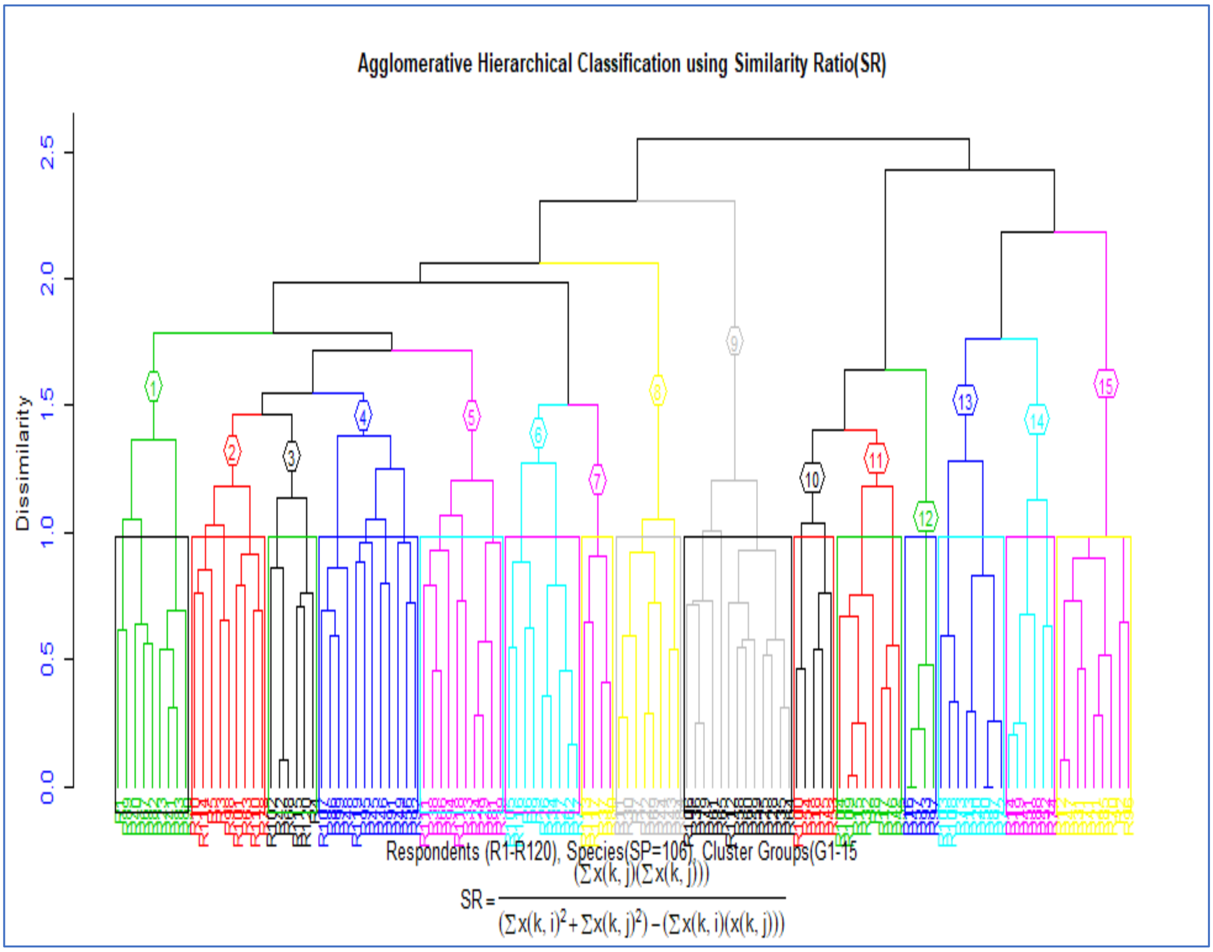

Figure 3. Agglomerative hierarchical classification dendrogram based on similarity ratio (SR)

Ordination

Ordination refers to a collection of techniques designed to convert vector observations into a new set of vectors that represent the main trends in the data as continuous axes. This transformation seeks to reduce the complexity of information regarding differences among observations into fewer dimensions, facilitating the interpretation of patterns and relationships. Supplementary file 1.5 presents an ordination using Redundancy Analysis (RDA), featuring colored clusters and constrained by species scores scaled according to eigenvalues based on sociodemographic variables. Similarly, a result for RDA ordination of use value variables where the ordination is constrained with species scores scaled by eigenvalues is represented in Supplementary file 1.6. Classical principal coordinate analysis uncovers the connections among the 120 respondents and 106 medicinal plant species categorized into 15 cluster groups (Figure 4). Detrended Correspondence Analysis (DCA) is a statistical method specifically developed to mitigate the "arch effect" frequently encountered in Principal Component Analysis (PCA) through the use of detrending techniques. This approach is commonly utilized to produce ordination diagrams that visually depict patterns in ethnobotanical or multivariate data (Supplementary file 1.7).

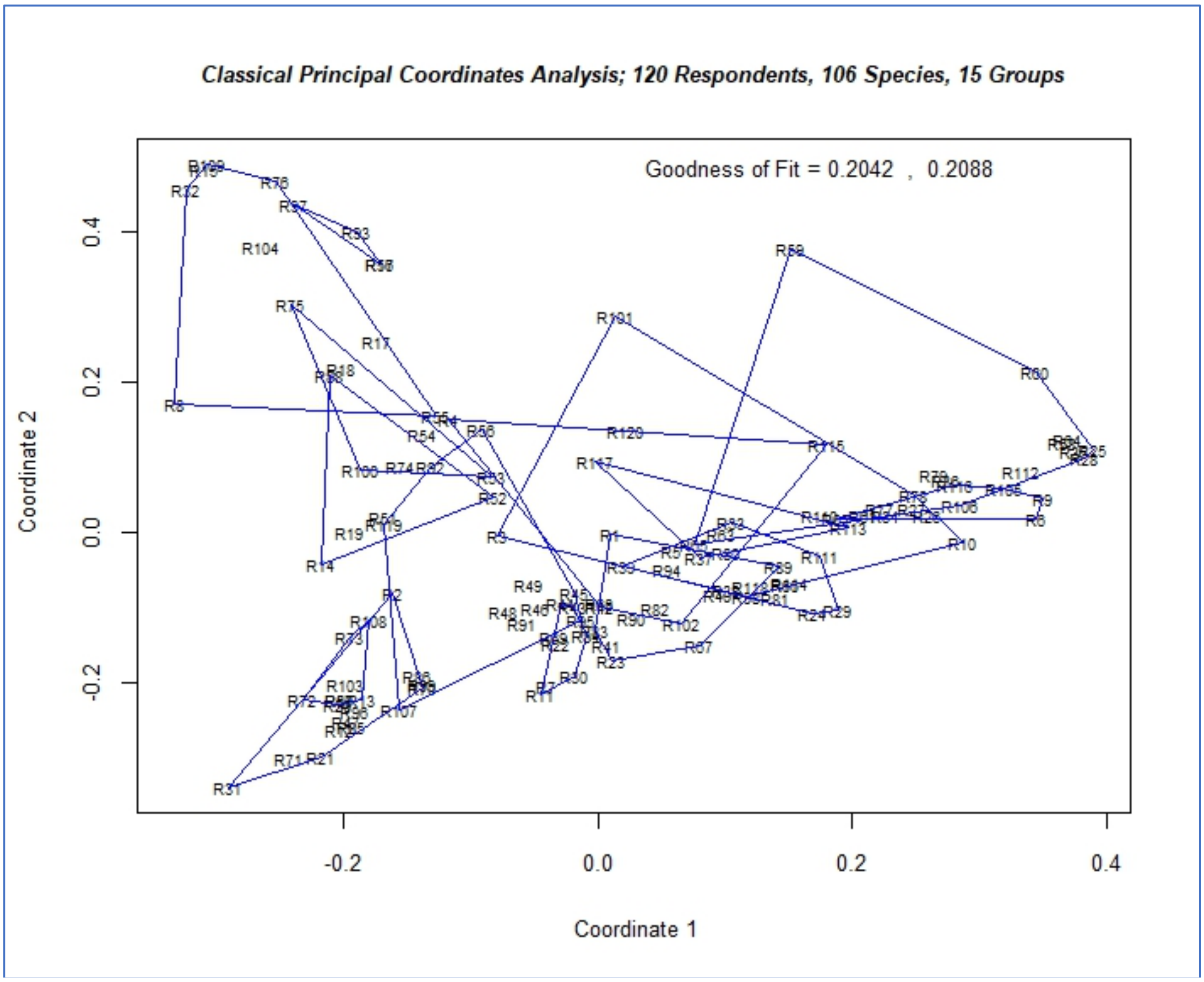

Figure 4. Classical principal coordinate analysis (R1-R120= Respondents)

Association of informant socio-demographic variables and medicinal plant knowledge

A t-test was conducted using R software to evaluate the differences in medicinal plant knowledge between key informants (expert healers) and general informants (non-expert healers). The results indicated a statistically significant difference between the two groups ($t = 8.0$, $P < 0.05$). Key informants demonstrated a considerably higher average medicinal plant knowledge score ($M = 10.2$, $SD = 4.2$) compared to general informants (non-expert healers) ($M = 2.8$, $SD = 1.5$), as detailed in Table 2. Additionally, a t-test was performed to assess differences in medicinal plant knowledge scores based on gender. The analysis revealed a statistically significant difference ($t = 4.6$, $P < 0.05$).

Table 2. Medicinal plants knowledge among informant groups (t-test)

Characters	**Informant groups**	***N***	***Mean± SD***	***t –value***	***p – value***
Gender	Male	90	3.7±1.9	4.6	*P<0.05*
	Female	30	2.3±1.2		
Literacy level	Illiterate	99	3.9±1.9	4.9	*P<0.05*
	Literate	21	2.2±1.3		
Experience of Informant	Key informant	20	10.2±4.2	8.0	*P<0.05*
	General informant	100	2.8±1.5		

Male informants reported a higher average knowledge score (M = 3.7, SD = 1.9) than female informants (M = 2.3, SD = 1.2). Furthermore, a t-test was used to examine variations in medicinal plant knowledge based on educational background. The analysis highlighted a statistically significant difference between illiterate and literate informants (t = 4.9, P < 0.05). Specifically, illiterate informants had a higher mean medicinal plant knowledge score (M = 3.9, SD = 1.9) than literate informants (M = 2.2, SD = 1.3) (Table 2).

ANOVA analysis of medicinal plants knowledge by age group

The analysis of variance (ANOVA) conducted in R revealed significant age-related differences in medicinal plant knowledge scores, indicating that age groups—young, middle-aged, and elderly—differ markedly in their understanding and knowledge of medicinal plants (F = 25.4, p < 0.05) (Table 3).

Table 3. Age categories with informant knowledge (One way ANOVA)

Source of Variation	**Df**	**SS**	**MS=SS/Df**	**F Ratio**	***P-value***
Between Groups	k – 1 3-1=2	168.1	84.03	25.4	*P<0.05*
Residual (within)	n-k 120-3=117	386.7	3.3		
Total	n – 1 120-1=119	554.8	87.33		

Note: **K**=number of level, **n**=number of observation, **Df**=degree of freedom, **SS**= Sum of Squares, **MS**= Mean of Square, Significant codes: 0.05

The substantial variance between age groups (SS = 168.1, MS = 84.03) compared to the variance within groups (SS = 386.7, MS = 3.3) underscores the importance of age as a factor influencing knowledge acquisition (Table 3). The Tukey's HSD post hoc tests further elucidated these differences, showing that the elderly group had notably higher mean knowledge scores (M = 4.5, SD = 2.1) than both the middle-aged (M = 2.6, SD = 1.2) and young groups (M = 1.3, SD = 1.0), with all comparisons yielding p-values less than 0.05 level of significant difference.

The analysis shows a strong positive correlation between age groups and knowledge of medicinal plants, with a correlation coefficient of 0.78 (Suppementary file 1.8). Additionally, regression analysis revealed that at a significance level of $p < 0.05$, the estimates for $\beta 0$ and $\beta 1$ were -1 and 0.11, respectively. This positive $\beta 1$ value indicates that as individuals move to the next age category, their expected knowledge of medicinal plants increases by 0.11 (Supplementary file 1.9).

Threats of medicinal plants

Medicinal plants in the study area face several threats, primarily from deforestation for agriculture, firewood collection, construction, charcoal production, and overgrazing. Informants ranked these threats based on their potential damage with agriculture, construction, and firewood collection being the most significant. House and fence construction followed, while charcoal production ranked fifth. Overgrazing and urbanization were considered the least impactful threats to medicinal plants (Supplementary file 2.11).

Management and conservation practice of medicinal plants

Traditional practitioners in the study area actively manage and conserve medicinal plants for various purposes, including food, construction, firewood, fodder, commercial, and spiritual uses. Indigenous communities have extensive knowledge of plant habitats, harvesting methods, and conservation status. They are seen as more effective custodians of medicinal plants, which are mainly conserved through cultivation in home gardens and sacred sites. These plants are especially protected in spiritual and ritual areas, with strict restrictions on harvesting and cutting to preserve their cultural and material value. Notable species such as *J. schimperiana*, *P. falcatus*, *C. macrostachyus*, *J. procera*, *E. globulus*, *R. communis*, and *O. europaea* were found to be well-preserved around the Orthodox Church. Further observations at ritual sites highlighted a diverse array of well-conserved plant species, many of which are utilized for medicinal purposes.

Discussion

Relationship between informant socio-demographic variables and medicinal plant knowledge

The t-test results revealed a significant difference in medicinal plant knowledge between key informants (such as traditional healers and herbalists) and general informants, with a t-value of 8.0 and a p-value under 0.05 level of significant difference. Key informants exhibited much higher knowledge scores, emphasizing their expertise in local medicinal practices. This aligns with prior studies, highlighting the critical role of traditional practitioners in preserving and using medicinal plants (Awoke *et al*. 2024a, b, Tahir *et al*. 2021). The knowledge gap between key informants and the general public suggests opportunities for educational programs to raise awareness and promote conservation (Kassa *et al*. 2020). Policymakers should integrate traditional knowledge into biodiversity conservation efforts for more effective strategies (Agize *et al.* 2025). Further research is needed to explore the factors behind this knowledge gap.

Moreover, a significant gender difference in medicinal plant knowledge, with males having higher average scores (M = 3.7, SD = 1.9) compared to females (M = 2.3, SD = 1.2), supported by a t-value of 4.6 and a p-value less than 0.05 level of significant difference. This finding raises questions about the factors behind the gender gap, as some studies suggest women may have comparable or even greater knowledge (Gnahore *et al*. 2022, Hankiso *et al*. 2024, Kidane *et al.* 2018, Tadesse *et al*. 2024; Van Damme *et al.* 2024), while others confirm male dominance in the field (Awoke *et al*. 2024). The disparity may result from societal and cultural factors, with men often having more opportunities to engage with natural environments and traditional practices (Belayneh *et al.* 2012, Flatie *et al.* 2009, Kidane *et al.* 2014, Singh 2019). These differences underscore the need for targeted educational programs to empower women, promoting gender equity in medicinal plant knowledge. Further research is required to explore the cultural influences shaping knowledge transmission across genders.

With regard to education, a significant difference in medicinal plant knowledge was observed, with illiterate individuals having higher knowledge scores than literate ones. This suggests that formal education does not always correlate with better knowledge of medicinal plants, as illiterate individuals may gain their knowledge through experiential learning and cultural traditions. The findings challenge the idea that education universally enhances knowledge and highlight the importance of recognizing indigenous knowledge systems. These findings are consistent with previous nationwide studies (Tahir *et al*. 2021).

The analysis of variance (ANOVA) performed using R indicated significant differences in medicinal plant knowledge across age groups—young, middle-aged, and elderly ($F = 25.4$, $p < 0.05$). Subsequent Tukey's HSD post hoc tests clarified these differences, revealing that the elderly group had substantially higher mean knowledge scores (M = 4.5, SD = 2.1) compared to both the middle-aged (M = 2.6, SD = 1.2) and young groups (M = 1.3, SD = 1.0), with all comparisons yielding p-values below 0.05. This trend is supported by international research, including studies conducted in Ethiopia (Awoke *et al.* 2024, Liu *et al*. 2023, Sultan *et al*. 2024). It shows that older individuals are more likely to utilize medicinal plants than their younger counterparts, a pattern visible in our findings. These results have implications for public health and education policies, suggesting the integration of traditional knowledge into formal systems to promote a more inclusive approach to healthcare.

The disparities in medicinal plant knowledge between ages groups can be attributed to the extensive experience older adults have with traditional practices, whereas younger generations are increasingly detached due to modernization and globalization. Older individuals possess a wealth of knowledge, passed down through generations, which younger people may lack as traditional practices fade. This highlights the importance of preserving and promoting traditional plant knowledge through intergenerational transfer, especially since it is often orally transmitted. The fact that the knowledge of medicinal plants is still taught orally, with no written records as noted by (Bussmann & Sharon 2006) calls for need to written documents about medicinal plants and associated indigenous knowledge. The relationship between age groups and medicinal plant knowledge reveals a positive correlation, suggesting that as individual's age, their understanding of medicinal plants tends to increase. This finding aligns with previous research (Amjad *et al.* 2020, Megersa *et al.* 2013, Tahir *et al*. 2023). The strong positive correlation (0.78) between age categories and medicinal plant knowledge, as indicated by the $\beta 1$ estimate suggests that for each increment in age category, the expected value of medicinal plant knowledge increases by 0.11. Educational programs should recognize the expertise of older community members and aim to integrate this knowledge into contemporary health practices, ensuring its preservation for future generations.

Medicinal plant taxonomic diversity and habitat distribution in relation to biodiversity hotspots

In Ethiopia, approximately 887 species of medicinal plants have been documented, primarily herbs (Kidane *et al*. 2014). In contrast, the Western Ghats, a biodiversity hotspot, has around 700 medicinal species, many of which are endangered (Malavika 2023, Malavika & Athira 2023). While plant families such as Lamiaceae, Asteraceae, and Apiaceae dominate in both regions, the differences in plant distribution can be attributed to varying phytogeography. Most medicinal plants in Ethiopia are herbs, with only 2.7% being endemic (Alemu *et al*. 2024). Preferences for easily accessible and safe plants highlight the importance of these species in traditional medicine, underscoring the need for conservation and further research into their therapeutic potential. Ethnic diversity and limited access to modern healthcare contribute to the wide use of medicinal plants in Ethiopia (Alemu *et al*. 2024, Megersa & Nedi 2023, Tadesse *et al.* 2024).

Rural populations often rely on traditional treatments, viewing them as more effective, especially for issues modern medicine cannot address (Mengistu *et al.* 2024). Cultural and ritual use of plants further strengthens this preference, with communities maintaining a deep connection to plant-based remedies due to their biological properties (Ma *et al*. 2024, Eshete & Molla 2021, Heinrich et al. 1998). Most local populations gather medicinal plants from the wild, but habitat loss due to human activity and population growth threatens these resources (Lulekal *et al*. 2011). Efforts to cultivate these plants face challenges due to mismatched soil and climate conditions. This highlights the urgent need for conservation to preserve these vital natural resources (Asfaw *et al*. 2023, Fekadu *et al*. 2023, Getachew *et al.* 2022).

The study found that leaves are the most commonly used part of medicinal plants, followed by flowers/fruits, whole plants, and roots, highlighting the risk of overharvesting and sustainability concerns (Kassa *et al*. 2020). Similar research (Awoke *et al*. 2024) supports the preference for fresh preparations, as they are believed to retain greater healing properties compared to dried forms. The limited availability of certain plants, due to habitat alteration, overharvesting, and climate change, makes collection increasingly difficult. Oral administration is the most common method, often linked to the region's high prevalence of internal illnesses. Dermal use is also preferred for its ease and lower toxicity risks, although healers lack comprehensive knowledge of long-term health effects (Kim & Jesus 2013, Maiyo *et al*. 2024). This reliance on fresh plant parts and unregulated use raises concerns about the safety, dosage, and potential overdosing, with milk often recommended as an antidote in such cases (Tuasha *et al*. 2018).

Direct matrix ranking and preference ranking of medicinal plants
Ethnobotanical methods, as described by Alexiades (1996) and Martin (2010), often use ranking analysis from free lists created by researchers. In this method, informants rank plants based on personal criteria, and the data is structured into a matrix to assign scores and calculate an index, helping to highlight local preferences (Getaneh & Girma 2014, Mosissa *et al.* 2021). Seven medicinal plants were found effective for treating abdominal issues in the study area, with *P. dodecandra* used for intestinal parasites. Moreover, *D. angustifolia, F. vulgare*, and *L. satium* were identified as the most effective medicinal plants. A more complex approach, direct matrix ranking, involves evaluating multiple attributes of plants, such as the study in Quara District, which identified *Ziziphus spina-christi*, *Terminalia liocarpa*, and *Ficus sycomorus* as top medicinal species (Tadesse *et al*., 2024).

The study found that *C. aurea*, *A. sieberiana*, and *C. macrostachyus* were the top three most utilized plants in the community. While *D. angustifolia* and *E. globulus* were recognized for medicinal uses, they were less valued for other purposes. These species are primarily used for firewood, charcoal, and strong materials for furniture and fencing, making them widely preferred. Firewood, fencing, and medicinal uses ranked as the top three categories for multipurpose plants. The study suggests that deforestation, driven by firewood demand and lack of electricity, is leading to a decline in plant biodiversity. Overharvesting of species like *C. aurea* raises concerns about scarcity without proper replanting and conservation efforts. A similar study by Birhan *et al*. (2017) identified *C. aurea* as a key multipurpose species in the Enarj Enawga District of East Gojjam Zone, Ethiopia.

Paired comparison of medicinal plants
In paired comparison methods, interviewees are shown sets of two items to assess consistency in information. Researchers select key options, typically five to ten, based on community discussions or previous interviews (Cotton 1996, Martin 2010). Triadic comparison, which involves sets of three items, can be more complex and may require sample questions for clarity. In this study, the consistency of data from eight respondents about the effectiveness of medicinal plants for treating abdominal issues was confirmed through both simple preference ranking and paired comparisons. Additionally, ten informants identified eight plants: *O. lomiifolium, E. globulus, S. anguivi*, *C. macrostachyus, C. amplifolium, Z. scabra, S. nilotica*, and *R. abyssinica* used to treat Mich (fever illness), the most common condition treated by traditional healers. As a result, O. lamiifolium, E. globulus, and S. anguivi were the three top ranked medicinal plants. The effectiveness of these plants was ranked based on their ability to address Mich (fever illness), with findings similar to those of Awas (2007).

Informant consensus factor (ICF)
The Informant Consensus Factor (ICF) is a key tool for identifying plants with significant intercultural importance, helping to reach consensus on their uses. Medicinal plants, often recognized for treating various ailments, have local names and are well-known among traditional healers. High ICF values typically indicate widespread recognition of a plant's effectiveness and availability, as seen in plants like *D. angustifolia* and *V. sinaticum* used for abdominal pain. Low ICF values suggest disagreement among informants and a wider range of plants, possibly due to random selection or limited knowledge exchange (Tadesse *et al*. 2024, Tadesse & Teka 2023). The ICF is vital in ethnobotanical research for identifying culturally significant plants and understanding health concerns within communities (Ayele *et al.* 2024). It helps prioritize plants and diseases for further study, highlighting pressing health issues and common uses for multiple ailments (Getnet *et al*. 2016, Giday *et al*. 2010, Tadesse *et al.* 2005, Teklehaymanot *et al.* 2007).

The relative healing potential of medicinal plants
In this study, *O. lamiifolium* achieved the highest FL value at 97.67%, followed by *C. macrostachyus* at 94.29%, *S. nilotica* at 93.75%, *R. chalepensis* at 92.10%, *S. abyssinica* at 90.9%, and *J. schimperiana* at 90%. These plants are recognized for their use in treating conditions such as fibril illness, the evil eye, and Eclipsys/Dingetegna. Previous research has demonstrated that traditional medicinal plants serve as the most affordable and accessible treatment options in resource-limited communities, where local therapies often represent the primary form of healthcare, thereby supporting the findings of the current study (Ayele *et al*. 2024).

Medicinal plant use diversity
The study identified 14 key categories of plant use, including firewood, construction, medicinal applications, food, and more, based on their cultural significance. A diversity index is a quantitative tool used to measure the variety and abundance of different types within a dataset, offering insights into biodiversity, biocultural diversity and use diversities. While commonly applied in ecology to analyze species, it can also be used for genera, families, or other groupings in ethno-ecological and ethnobiological studies. The Shannon-Wiener diversity index, typically ranging from 1.5 to 3.5, is the most widely used, with values above 4.5 being rare. It helps assess biological variability and facilitates comparisons across different spatial or temporal scales (Magurran 2003, Kent 2012, Kindt & Coe 2005). The Shannon-Wiener diversity index for all uses across 106 plant species was 4.43, with medicinal use alone scoring 4.57, highlighting the diverse cultural importance of medicinal

plants. These indices provide a quantitative measure of medicinal plant use diversity and multicultural/intercultural relations in diverse knowledge. The high diversity reflects the rich traditional knowledge and extensive plant use in the community, similar to findings by Kassa *et al*. (2020) and Uprety *et al*. (2012). The study underscores the importance of promoting sustainable plant use for income generation and conservation. Furthermore, communities should actively work to mitigate threats to these valuable resources to ensure their long-term availability and ecological balance through a bicultural conservation strategy (Anas *et al*. 2024, Gobvu *et al.* 2024, Latore *et al*. 2024, Lulekal *et al*. 2013).

Statistical tests models and ordination methods

To uncover well-established relationships between humans and plants, statistical tests and ordination methods supplemented ethnobotanical indices (Kividze & Bussmann 2024). Statistical tests are vital for enhancing the multivariate analysis of sociodemographic data and use-value in ethnobotanical research. They are instrumental in various ordination methods, providing deeper insights into patterns and relationships within datasets. One significant approach in this context is cluster analysis, which employs classification algorithms to group data into homogeneous subgroups (Hoffman & Gallaher 2007; Höft *et al.* 1999, Tessema *et al*. 2024, Woldu 2017). As an exploratory technique, cluster analysis seeks to minimize variability within groups while maximizing it between them. When applied to respondents, this method organizes individuals based on the similarity or dissimilarity of their ethnomedicinal knowledge, creating clusters of those with similar expertise while distinguishing those with differing knowledge into separate groups.

Cluster analysis is often visualized through dendrograms tree-like diagrams that illustrate hierarchical relationships among objects, with each branch representing a specific category or class. Agglomerative clustering algorithms are commonly used for this purpose, constructing hierarchical structures that allow for flexible interpretation and accommodate varying numbers of clusters (k). The gclus library aids in reordering members within a cluster based on their similarities (Scrucca *et al.* 2016). Comparing dendrograms reordered using gclus with those generated without it reveals differences in arrangement and clarity.

Ordination techniques are designed to simplify complex data and uncover patterns by transforming the original variables into new axes that capture primary trends while reducing dimensionality. This process facilitates the interpretation of relationships and differences among observations, particularly in the context of medicinal plant-human interactions. Although ordination itself is not intended for formal statistical testing, it can complement statistical analyses and help formulate hypotheses for future research (Dip & Vattuone 2024).

Ordination methods are mainly divided into eigenvalue-based and distance-based approaches. Eigenvalue-based methods, such as PCA, CA, DCA, CCA, and RDA, focus on identifying variation axes and calculating scores for observations and variables. Distance-based methods, like MDS and NMDS, emphasize differences in composition or similarity among observations, often using indices like the Bray-Curtis index, and represent relationships in two- or three-dimensional spaces (Höft *et al.* 1999).

In this context, the relationships between medicinal plant-human interactions were visualized on a plot with new variables as axes, reflecting dissimilarities among objects (Kutal 2021). Principal Coordinate Analysis (PCoA) can represent various similarity measures and include sociodemographic or use-value variables in the ordination, with its Goodness of Fit (GOF) indicated by two numbers (Borcard *et al*. 2018). Detrended Correspondence Analysis (DCA) allows visualization of species and respondents in a biplot, integrating external variables to explore relationships, making it valuable for ethnomedicinal studies. Moreover, DCA also addresses the arch effect in PCA through detrending (Höft *et al.* 1999).

Threats, management and conservation of medicinal plants

This study identifies several factors impacting medicinal plants in the area, with agriculture, firewood collection, and construction activities being the top threats. These activities, driven by local community needs, contribute significantly to the decline of medicinal plants. Agricultural expansion, particularly due to population growth, and widespread firewood collection, including the cutting of large trees, are major causes. Urbanization, leading to road and house construction, also harms plant populations. Charcoal production has further exacerbated deforestation, especially of species like *C. africana*, *J. procera*, *A. abyssinica* and *O. europaea* L.subsp. *cuspidata*. Overgrazing is less of a concern, as local communities do not heavily rely on animal husbandry. These findings align with previous studies highlighting agriculture, firewood collection, construction, and charcoal production as key threats to medicinal plants (Awoke *et al*. 2024, Ghabbour *et al.* 2024, Giday *et al*. 2010, Gum *et al.* 2024).

Informants in the study area report that traditional practitioners actively manage and conserve local plants for food, construction, firewood, fodder, commercial purposes, and cultural or spiritual values, alongside medicinal uses This observation is consistent with findings from previous studies (Nuro *et al.* 2024a,b, Tawseef *et al.* 2021, Teklehaymanot *et al.*2007). Indigenous people possess extensive knowledge about plant habitats, harvesting, and conservation. Traditional practitioners are particularly effective in conserving medicinal plants, often cultivating them in homegardens and spiritual sites, which are better managed than wild plants (Agize *et al.* 2025). Spiritual and ritual areas, especially in mountainous regions, are strictly protected, with plants from these areas considered to have superior medicinal properties. Field observations identified species such as *P. falcatus, C. macrostachyus, J. procera, R. comunis,* and *O. europaea* L.subsp.

cuspidata in spiritual areas like the Orthodox Church within the study area. However, modernization and changing attitudes, especially among younger generations, are threatening the conservation practices linked to these plants.

Implications of the present findings

The findings of this study on traditionally used medicinal plants in the Sodo district of Central Ethiopia underscore significant implications for environmental sustainability, food security, and public health. The region's rich biodiversity of medicinal plants highlights the importance of traditional knowledge systems in maintaining ecological balance and promoting sustainable practices. Despite the progress made in the field of ethnobotany in Ethiopia since its inception, there remain considerable gaps in research. To our knowledge, no ethnobotanical studies have specifically documented the medicinal plants traditionally used by the Kistane ethnic group or their associated knowledge within the study area. This gap is evident in our review of over two decades of ethnobotanical literature conducted by various researchers across the country, which illustrates the evolution of ethnobotany in Ethiopia. The field has progressed from the initial documentation of a limited number of medicinal plant species to more comprehensive and rigorous investigations, including phytochemical screenings and antimicrobial activity testing (Fekadu *et al*. 2023, Getachew *et al*. 2022, Giday *et al.* 2010). Currently, numerous ethnobotanical research projects are underway throughout Ethiopia, with the aim of addressing these gaps as a primary objective.

Environmental implications of the current findings

The study has significant implications for environmental conservation and sustainability. It highlights various threats to medicinal plants, including environmental degradation, deforestation, overgrazing, firewood collection, and urbanization. By identifying critical conservation issues, such as the over-exploitation of plant resources, the research points out instances where the use of certain plants exceeds their natural regrowth rate, indicating a risk of depletion (Zamin *et al.* 2024). Furthermore, it plays a crucial role in documenting indigenous knowledge about plants, particularly medicinal species, which can offer valuable insights for modern medicine and conservation efforts (Wubu *et al*. 2023, Yimam *et al*. 2022). Numerous similar studies have shown that ethnobotanical research fosters the integration of local and scientific knowledge, promoting biocultural conservation through enhanced collaboration and communication between indigenous communities and scientists. Consequently, this study also supports local conservation initiatives by identifying plants vital for food security and other community needs.

Additionally, it aids in understanding the selection criteria for medicinal plants, which could streamline bioprospecting efforts and ensure the sustainable use of plant resources (Derso *et al.* 2024, Gatersleben & Andrew 2023, Georgiadis 2022, Kumar *et al*. 2021). Moreover, many medicinal plants are essential for habitat restoration, contribute to soil stabilization; providing shelter for various wildlife thereby enhancing overall ecosystem health. These plants also deliver important ecosystem services to the community, such as attracting pollinators essential for the productivity of both wild and cultivated plants and improving soil health through processes like nitrogen fixation and organic matter enhancement (Anas *et al.* 2024, Zemede *et al*. 2024).

Food security implications of the current findings

Ethnobotanical studies play a crucial role in enhancing food security in several ways (Anbessa *et al*. 2024a, Asfaw *et al.* 2023, Biri *et al*. 2024, Lulekal *et al.* 2011, Yiblet *et al.* 2023). This study highlight that identify and conserve medicinal plants, which serve as essential food sources during periods of scarcity or natural disasters, while also being traditionally utilized for medicinal purposes. By encouraging the cultivation of these plants, findings from ethnobotanical research contribute to the protection of threatened species and the preservation of both wild and domesticated food plant heritage. Consistent with other similar studies, this research aids in safeguarding traditional knowledge related to the use of wild edibles and nutraceutical plants, which is vital for effectively leveraging biodiversity (Vrancheva *et al*. 2018) elsewhere in general and within the study area in particular. Moreover, ethnobotanical research supports food security by uncovering farmers' preferences for various landraces, which helps enhance the maintenance of these varieties and ensures genetic diversity. However, environmental challenges such as overgrazing and agricultural expansion threaten the availability of these plants and the traditional knowledge associated with them, underscoring the increasing importance of ethnobotany in addressing food security issues. A decline in the availability of these resources could negatively impact local economies that rely on the harvesting and sale of these plants, potentially worsening poverty and further jeopardizing food security as households may struggle to access adequate food and healthcare. Additionally, traditional knowledge regarding the preparation and consumption of these plants can play a significant role in combating malnutrition and promoting dietary diversity.

Public health implications of the current findings

The study enhances conservation efforts by providing insights into strategies aimed at protecting and restoring forests that serve as reservoirs of medicinal plants, which are vital for both environmental and public health. Ethnobotanical research on medicinal plants has significant implications for public health, as it contributes to drug discovery, conservation, and sustainable practices (Anbessa *et al.* 2024a,b, Lulekal *et al*. 2008, Mekonnen *et al.* 2022, Tamene *et al.* 2023, Tessema *et al*. 2024, Yinger & Yewhalaw 2007). By examining active compounds, these studies can uncover new sources of treatments and medications, thereby enriching medical resources (Alelign *et al.* 2018, Asnake *et al*. 2016, Kassa *et al.* 2016, Woldemariam *et al.* 2021). Furthermore, they are instrumental in preserving indigenous knowledge about medicinal plants, which is traditionally transmitted orally from generation to generation. These studies support local customs and traditions that aid in the conservation of medicinal plants by involving local communities in their cultivation, helping to prevent further decline. Additionally, they raise awareness about the importance of medicinal plants and the necessity for their sustainable use, fostering a deeper appreciation for their roles in public health and environmental conservation. Documenting and safeguarding indigenous knowledge is crucial, as this knowledge forms the foundation for the widespread use of ethnomedicine in treating common ailments, ensuring its legacy for future generations. This research emphasizes the need to integrate traditional medicine into formal healthcare systems (Yudharaj *et al*. 2016). Many communities rely on these phytomedicines for various health issues, with their efficacy often rooted in centuries of empirical knowledge (Adugna 2014, Frehiwot *et al.* 2015). However, threats to these resources could increase dependence on synthetic pharmaceuticals, which may be less accessible or culturally accepted within these communities. Promoting the sustainable use and protection of traditional medicines can enhance public health outcomes by providing affordable and culturally relevant healthcare options. This finding aligns with reports from (Filatie *et al*. 2009, Giday *et al*. 2009a, b, Kassa 2009, Lulekal *et al*. 2014, Teklay *et al*. 2013, Yinger *et al*. 2008).

Comparison of the current study with earlier researches conducted elsewhere in Ethiopia

Ethiopia is renowned for its diverse ecosystems and a rich heritage of herbal medicine. Numerous studies have reporeted the ethnobotanical knowledge held by local communities regarding the medicinal uses of plants (Beyene *et al*. 2024, Cunningham 2001). The traditional medicinal applications of these plants, detailed in Appendix 1, were compared with selected ethnomedicinal sources published over 22 years, from 2001 to 2024, at both regional and national levels (Table 13). To evaluate cultural similarities among various ethnic communities based on shared plant species and their medicinal uses, the Jaccard's Similarity Index (JSI) was utilized. This comparative analysis highlights both similarities and differences between current findings and previous research. The highest JSI recorded was 13.3% from a study in the Yem district, Central Ethiopia, followed by 12.4% from research in the Yeki district; Southwestern Ethiopia, 11.7% from the Abaya district in South Ethiopia and 10.7% from the Sheka zone (Table 4)

Table 4. JSI comparing current study the with earlier research conducted in Ethiopia

Study Area	Species Number (a or b)	Common species(c)	Jaccard Index	Similarity (%)	References
Sodo district	**106**	**-**	**-**	**-**	**Current study**
Yem	213	49	0.133	13.3	(Woldemariam *et al*. 2021)
Yeki	98	29	0.124	12.4	(Awoke *et al.* 2024b)
Abaya	188	39	0.117	11.7	(Zemede *et al*. 2024)
Guraferda	81	25	0.117	11.7	(Awoke *et al.* 2024)
Sheka	266	45	0.107	10.7	(Kassa *et al*. 2020)
Ankober	135	28	0.104	10.4	(Lulekal *et al.* 2013)
Ejere	138	28	0.102	10.2	(Kassa *et al*. 2016)
Kofale	106	23	0.097	9.7	(Nuro *et al.* 2024b)
Boricha	42	16	0.097	9.7	(Asnake *et al.* 2016)
Meinit	51	17	0.097	9.7	(Giday *et al.* 2009b)
Dalle	71	19	0.096	9.6	(Tuasha *et al.* 2018)
Jeldu	165	29	0.096	9.6	(Kassa 2009)
Dibatie	170	28	0.092	9.2	(Anbessa *et al*. 2024b)
Mana Angetu	230	33	0.089	8.9	(Lulekal *et al*. 2008)
Awulaelo	114	21	0.087	8.7	(Teklay *et al.* 2013)
Quara	128	22	0.085	8.5	(Tadesse *et al.* 224)
Damot	57	15	0.084	8.4	(Megerssa & Woldetsadik 2022)
Bench	35	12	0.078	7.8	(Giday *et al.* 2009a)
Bale	101	17	0.075	7.5	(Yinger *et al.* 2008)
Assosa	54	12	0.069	6.9	(Tessema *et al*. 2024)
Sheko	71	13	0.068	6.8	(Giday *et al*. 2010)
Robe	36	10	0.065	6.5	(Birii *et al*. 2024)]
Sekoru	27	7	0.05	5	(Yinger *et al.*2007)
Berta	40	5	0.033	3.3	(Filatie *et al*. 2009)
Fentale	17	3	0.023	2.3	(Alelign *et al.* 2018)

Limitation of the study

The ethnobotanical study of medicinal plants in the Sodo districts of East Gurage Zone faced several limitations. Cultural biases and language barriers as the researcher was not from the indigenous community impacted data collection and analysis. Seasonal variability in plant use, a limited sample size, and challenges in documenting oral knowledge further constrained the findings. Ethical concerns over informed consent also affected participation. Additionally, rapid changes due to urbanization, globalization, and environmental factors, like land use changes and climate shifts, limited the scope of the study. While the study successfully documented plant uses, it lacked scientific validation of efficacy or safety, highlighting areas for future research.

Conclusion

In the study, we identified 106 plant species from 90 genera and 49 families in the Sodo District, with Lamiaceae, Asteraceae, Euphorbiaceae, and Solanaceae being the most common. This highlights the district's rich medicinal plant diversity and indigenous knowledge. Despite Ethiopia's Flora documenting 6,027 vascular plant species, it lacks comprehensive ethnobotanical coverage, stressing the need for an updated Flora. Comprehensive documentation of medicinal plants, especially in remote areas, is crucial for filling this gap. Furthermore, up-to-date research is essential for policies on conservation, ecotourism, food security, and public health. The study area’s Tiya Stele, a World Heritage Site, offers ecotourism potential. Medicinal plants also contribute to primary healthcare, food security, and disease prevention. However, issues like non-standardized dosages in traditional remedies highlight the need for public education on health and safety.

Addressing health challenges in communities is crucial, and this research contributes to that effort by highlighting the benefits of focusing on environmental, food security, and public health. The study on medicinal plants in Sodo district, Central Ethiopia, emphasizes the role of traditional knowledge in environmental sustainability and healthcare. Threats to these plants, such as agriculture and urbanization, can be mitigated by supporting traditional healers' conservation practices, including home gardens and spiritual areas. Raising awareness and promoting sustainable practices can help preserve these vital resources and improve public health.

Declarations

List of abbreviations: ESS: Ethiopian Statistical Service; ICF: Informant consensus factor ; FL: Fidelity level; UV: Use value; UVD: Use diversity; STI: Sexually transmitted infection; WHO: World health organization; CDC: Center for diseases control; RDA: Redundancy analysis; DCA/DECORANA: Detrended correspondence analysis ; PCA: Principal component analysis; PCoA: Principal component analysis; CA: Correspondence analysis; CCA: Canonical correspondence analysis; MDS: Multidimensional scaling; NDMS: Non-metric multidimensional scaling; GOF: Goodness of fit

Ethics approval and consent to participate: This study received approval through a joint collaboration among the Department of Biology at Mizan-Tepi University, the Department of Biology at Salale University, and the Ethiopian Biodiversity Institute.

Consent for publication: Not applicable

Availability of data and materials: Not applicable

Competing interests: Not applicable

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Authors’ contribution: Z.K. Supervised the entire process, including title selection and conceptualization, categorized and analyzed the data using R Statistical Software, authenticated voucher specimens, prepared the manuscript and proofreading. **E.N.** Selected the title, developed the research proposal, collected the data, and presented the findings. **A.A.** concentrated on language editing, verifying the botanical names of plants, and conducting a comprehensive review.

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Appendices: - List of voucher specimens and health problems

Appendix 1.List of medicinal plants used by local community to treat various human ailments

Scientific Names (VON= VN)	Family	VRN	HBT	GF	PU	DT	Methods of preparation and administration
Acacia abyssinica Hochst. ex Benth. **VON-EN01**	Fabaceae	**Lafto (Or)**	W	T	L	Wound	*A. abyssinica* Hochst. ex Benth. is utilized in traditional medicine, where its leaves are combined with those of *A. africanus* and *P. lanceolata*. This mixture is then crushed and applied as a cream, blended with butter, to treat wounds.
Achyranthes aspera L. **VON-EN02**	Amarantaceae	**Angagiyo (Gur)**	W		L	Mich/alergy	Leaves are crushed and then applied to the skin.
					R	Kurumba	The root is pulverized, combined with water, and consumed as a beverage.
Acmella caulirhiza Delile **VON-EN03**	Asteraceae	**Yemidir berbere (Amh)**	HG	H	Fl	Toothache	The affected teeth are subjected to the chewing of flowers.
					Fl	Tonilitis	Flowers are masticated and ingested.
Ajuga integrifolia Buch.-Ham. ex D.Don **VON-EN04**	Lamiaceae	**Ematelit (Gur)**	HG	H	WP	Arthritis	Leaves subjected to combustion, subsequently extracted and ingested orally.
					WP	as dostinex/ cabergoline	Leaves were applied and pressed against the nipples to inhibit breastfeeding.
					WP	Abdominal	Leaves subjected to combustion, subsequently extracted and ingested orally.
Allium sativum L. **VON-EN05**	Amaryllidaceae	**Nechishinkurt (Amh)**	HG, Mk	H	Bu	Fengil	The stems combined with the seeds of *C. aurantium* and *L. sativum* are crushed in water and consumed as a beverage.
					Bu	Evil eye	The stem of *R. chalepensis*, along with the bulbs plant, was combined and subjected to fumigation for the patient.
Aloe trichosantha A.Berger **VON- EN06**	Asphodelaceae	**Yegedelfuga (Amh)**	W	H	Lx	Stomachache	The sequel should be combined with milk and administered orally.
					R	Dandruff	Root latex was harvested and utilized as a topical skin cream.
Amaranthus caudatus L. **VON- EN07**	Amaranthaceae	**Meriz (Gur)**	W	H	Fl	Stomachache	The flower is ground, baked, and consumed in the form of bread.
Argemone mexicana L. **VON- EN08**	Papaveraceae	**Mexican poppy (Eng)**	W	H	Lx	Wound	The latex extracted from the roasted seeds of *A. mexicana* is combined with the leaves of *A. abyssinica* and *A. africanus*. This mixture is then roasted in a horn, subsequently blended with butter to create a body cream.
Artemisia abyssinica Sch.Bip. ex Oliv. & Hiern **VON- EN09**	Asteraceae	**Chanch (Gur)**	HG, Mk	H	L	Hypertension	Leaves are subjected to boiling in water, subsequently filtered, and then consumed as a beverage.
					L	Common cold	A leaf is crushed between the palms and then placed into the nostrils for inhalation.
					L	Devil diseases	Leaves were processed and combusted to serve as a fumigant for the patient.

Artemisia rehan Chiov. **VON- EN10**	Asteraceae	**Niatran (Gur)**	HG, Mk	H	L	Abdominal	Fresh leaf stem latex is utilized as a cream.
Asparagus africanus Lam. **VON- EN11**	Asparagaceae	**Seriti (Or)**	HG	S	L	Wound	The leaves of *A. africanus, A. abyssinica*, and the seeds of *P. lanceolata* are subjected to roasting in a horn and subsequently applied as a cream to treat wounds.
Asparagus setaceus (Kunth) Jessop **VON- EN12**	Asparagaceae	**Seriti (Or)**	HG	S	L	Wound	The leaves of *A. africanus, A. abyssinica*, and the seeds of *P. lanceolata* are subjected to roasting in a horn and subsequently applied as a cream to treat wounds.
Azadirachta indica A.Juss. **VON- EN13**	Meliaceae	**Neemzaf (Amh)**	W	T	L	Malaria	Freshly extracted leaf juice mixed with water and consumed.
					L	Abdominal	Freshly extracted leaf juice mixed with water and consumed.
Calpurnia aurea (Aiton) Benth. **VON- EN14**	Fabaceae	**Zegnet (Gur)**	W	S	Se	Hebit/Gohnorrhea	Seeds are ground and combined with water before being ingested orally.
					Fr	Hepatitis	Fruits and leaves are extracted and consumed orally.
					Fr	Skin diseases	Fruits and leaves are extracted and consumed orally.
					R	Rabies	Roots combined with *P. urens* and the fruits of *R. abyssinica*, mixed in water and administered orally.
Capparis tomentosa Lam. **VON- EN15**	Capparaceae	**Gmero (Gur)**	HG	S	R	Toothache	The root is being chewed by the impacted tooth.
Carica papaya L. **VON- EN16**	Caricaceae	**Papawo (Eng)**	W,HG	T	L/Fr	Hepatitis	Dried leaves are processed into a fine powder.
Carissa spinarum L. **VON- EN17**	Apocynaceae	**Agam (Amh, Gur)**	W	S	L	Alegy	The leaves were crushed and combined with those of *O. lamiifolium*, then infused into tea and consumed for seven consecutive days alongside a cup of coffee.
					R	Evil eye	Burn the roots along with the entire plant of *R. chalepensis* and use the smoke for fumigation.
Capsicum annuum L. **VON- EN18**	Solanaceae	**Berbere (Amh, Gur)**	W,HG	H	Fr	Fengil	Fruits combined with salt, *A.sativum*, bitter, *C. aurantium*, and *L. sativum* are blended with water and consumed as a beverage.
Catha edulis (Vahl) Endl. **VON-EN19**	Celastraceae	**Cafta (Gur)**	W,HG,Mk	S	BK	Vomit	Bark is masticated and ingested.
Citrus × aurantium L. **VON-EN20**	Rutaceae	**Lemi (Gur)**	W	T	Fr	Asma	The juice from the fruit is inhaled through the nostrils.
					Fr	Cough	A mixture of fruit juice, egg yolk, and honey presented in a coffee cup.
			HG		Fr	Snake repellent	Fruits that have been scorched by fire and permeated with smoke influenced the ambient environment.
Citrus × limon (L.) Osbeck **VON-EN21**	Rutaceae	**Lomi (Amh, Gur)**		T	Fr	Asma	The juice from the fruit is breathed in through the nostrils.
					Fr	Cough	A combination of fruit juice, egg yolk, and honey served in a coffee cup.

			HG, W,Mk		Fr	Snake repellent	Fruits were charred over an open flame, imparting a smoky aroma to the surroundings.
Clematis simensis Fresen.	Ranunculaceae	**Hadifeti (Gur)**	W	Cl	L	Toothache	The affected teeth are subjected to the chewing of leaves.
VON-EN22	Lamiaceae	**Alige (Gur)**	W	S	Lf	Herpes zoster	Leaves are crushed and incorporated into butter to create a skin cream.
Clerodendrum myricoides (Hochst.) R.Br. ex Vatke **VON-EN23**					L	Headachae	The leaf is subjected to boiling, and the resulting smoke is utilized for fumigation.
					Lf	Devil diseases	The leaf is subjected to boiling, and the resulting smoke is utilized for fumigation.
					R/L	Rabies	Crushed and consumed with honey or milk.
Clutia abyssinica Jaub. & Spach **VON-EN24**	Peraceae	**Fiyelefeji (Amh)**	W	S	L	Tonsilitis	The leaf is masticated, and the resulting solution is ingested.
Coriandrum sativum L. **VON-EN25**	Apiaceae	**Dimbilal (Amh)**	W,NK	H	Se	Cough	Crushed seeds incorporated into coffee or tea and consumed.
						Asthma	Crushed seeds incorporated into coffee or tea and consumed.
Croton macrostachyus Hochst. ex Delile **VON-EN26**	Euphorbiaceae	**Mekel (Gur)**	W,HG	T	BK	Rabies	Bark that has been crushed and combined with milk is administered orally.
					Lx	Common cold	Boil the leaf tips or shoots and expose them to steam for fumigation.
					Fr	Cough	Fruits and leaves subjected to boiling and fumigation.
					Fr	Ear insect	Fruits are crushed, filtered, and then introduced into the ear.
					Fr	Tinea capitis	The crushed tips or shoots of the leaf are utilized in the formulation of creams.
Cucumis ficifolius A.Rich. **VON-EN27**	Cucurbitaceae	**Yemidirkinbiba (Gur)**	W	Cl	R	Abdominal pain	The root is ground, combined with water, filtered, and then consumed orally.
					Rt	Arteritis	The root is ground, combined with water, filtered, and then consumed orally.
					R	Adaa/Life	Crushed roots are applied and secured to the affected area.
Cymbopogon citratus (DC.) Stapf **VON-EN28**	Poaceae	**Tejisar (Amh, Gur)**	HG		WP	Headachae	The steam produced from boiling is directed towards the patient for therapeutic purposes.
Cynodon dactylon (L.) Pers. **VON-EN29**	Poaceae	**Coqorsa (Or)**	W	H	WP	Abdominal	The entire plant is masticated, and the resulting liquid is ingested.
Cynoglossum amplifolium Hochst. ex A.DC. **VON-EN30**	Boraginaceae	**Shingug (Gur)**	HG	H	L	Mich/alergy	Fresh leaves of *O. lamiifolium* are crushed, combined with water, and then applied to the affected area of the body.
Cynoglossum coeruleum Hochst. ex A.DC. **VON-EN31**	Boraginaceae	**Shingug (Gur)**	HG	H	L	Mich/alergy	Fresh leaves of *O. lamiifolium* are crushed, combined with water, and then applied to the affected area of the body.

Cynoglossum lanceolatum Forssk. **VON-EN32**	Boraginaceae	**Shingug (Gur)**	W	H	L	Mich/alergy	*C. lanceolatum* should be crushed, combined with water, and applied to the face.
Cyphostemma adenocaule (Steud. ex A.Rich.) **VON-EN33**	Vitaceae	**Gororafarda (Or)**	W	H	L	Bovine pasteurellosis	Cattle are provided with leaves that have been pounded and soaked in water.
Datura stramonium L. **VON-EN34**	Solanaceae	**Manji (Or)**	W	H	L/Se	Dandruff	Crushed leaves and seeds are utilized as an ingredient in body cream.
					L	Wound	Crushed leaves and seeds utilized as a cream.
					Se	Toothache	Crushed seeds are combined with heated butter, and the resulting smoke is inhaled using a pipe or straw.
Dodonaea viscosa subsp. *angustifolia* (L.f.) J.G.West **VON-EN35**	Sapindaceae	**Kitkita (Amh)**	SW	S	L	Abdominal Bone fracture	Fresh leaves are extracted, combined with water, strained, and consumed, while leaves are applied to the affected area.
Echinops kebericho Mesfin **VON-EN36**	Asteraceae	**Qabaricho (Amh, Or)**	W,Mk	S	R	Devil diseases	The root is incinerated in a sealed container to produce smoke for the purpose of fumigating the patient.
					R	Snake repellent	Root is incorporated into the fire to purify the air in living rooms.
Ensete ventricosum (Welw.) Cheesman **VON-EN37**	Musaceae	**Bishaenset (Gur) (White variety)**	HG, Mk	H	L/Rh	Bulad	Heated leaves are applied to the affected area and wrapped around it to promote healing of the injuries.
					R	Bone fracture	The patient is provided with roots or rhizome for consumption.
Ensete ventricosum var. montbeliardii (Bois) Cufod. **VON-EN37**	Musaceae	**Anbilenset (Gur) (Red variety)**	W	H	L	Bulad	Heated leaves are applied to the affected area and wrapped around it to promote healing of the injuries.
					R	Bone fracture	The patient is provided with roots or rhizome for consumption.
Eucalyptus globulus Labill. **VON-EN38**	Myrtaceae	**Bahirzaf (Amh)**	HG, W	T	L	Common cold	Leaves, along with *C. macroastachyus* and *S. gigas*, were subjected to boiling and fumigation.
					L	Cough	Leaves, along with *C. macroastachyus* and *S. gigas*, were subjected to boiling and fumigation.
Euclea racemosa L. **VON-EN39**	Ebenaceae	**Mi'esa (Or)**	W	S	L	Athelet's foot	Freshly extracted leaves are pressed and utilized as a cream.
Euphorbia abyssinica J.F.Gmel. **VON-EN40**	Euphorbiaceae	**Kolkol (Gur)**	W	T	Lx	Abdominal	Latex is combined with milk and consumed.
					Lx	Hepatitis	A minimal quantity of latex is combined with red teff flower (*Eragrostis tef*), then baked and consumed over a period of three consecutive days.
					Lx	Ecezema	The latex is applied to the wound in a manner similar to that of an ointment.
Euphorbia depauperata Hochst. ex A.Rich. **VON-EN41**	Euphorbiaceae	**Abaydem (Gur)**	W	H	Lx	Kintarot	Latex is applied as a topical cream to address the hemorrhage.
					Lx	Male genital	Latex is applied as a cream to the male pine trees during the process of mutilation.
Euphorbia lathyris L.	Euphorbiaceae	**Kolkol**	W	H	Lx	Kintarot	Latex is applied as a topical cream to address the hemorrhage.

VON-EN42		**(Gur)**					
Foeniculum vulgare Mill. **VON-EN43**	Apiaceae	**Ensilal**	W	H	L	Hypertension	Leaves are ground, strained, and consumed as a beverage.
					L	Urogenital	Leaves are ground, combined with water, filtered, and the resulting solution is consumed.
Fuerstia africana T.C.E.Fr. **VON-EN44**	Lamiaceae	**Yetijalebek (Amh)**	W	Cl	L	Eye disease	Leaves are extracted and utilized as eye drops.
Gladiolus dalenii Van Geel **VON-EN45**	Iridaceae	**Yejibshinkurt (Amh)**	W	H	R	Fever	The root is masticated and ingested.
Hagenia abyssinica (Bruce) J.F.Gmel. **VON-EN46**	Rosaceae	**Koso/kebse (Gur)**	W,Mk	T	Fr	Tapeworm	Crushed fruits and flowers are combined with locally brewed beer (*Tella*) and consumed.
Heteropogon contortus (L.) P.Beauv. ex Roem. & Schult. **VON-EN47**	Poaceae	**Shikoksa (Gur)**	W	Cl	R	Snake bite	Crushed roots are applied and secured to the impacted area.
					L	Kintarot	A fresh leaf is applied to the wound.
Hoslundia opposita Vahl **VON-EN48**	Lamiaceae	**Michi medihanit (Amh)**	W	H	L	Alegy	Fresh leaves are extracted in water and consumed as a beverage.
Indigofera amorphoides Jaub. & Spach **VON-EN49**	Fabaceae	**Yeayit misir (Amh)**	W	S	L	Skin rush	Fresh leaves pressed in water for cleansing.
Jatropha curcas L. **VON-EN50**	Euphorbiaceae	**Ayderke (Amh)**	W	S	Fr/Se	Abdominal	Seeds are consumed each morning until full recovery is achieved.
					Se	Hepatitis	Seeds are consumed each morning until full recovery is achieved.
					Se	Malaria	A solution of soaked seeds was consumed.
Justicia schimperiana (Hochst. ex Nees) T.Anderson **VON-EN51**	Acanthaceae	**Xumuga (Or)**	W,HG	S	L	Rabies/Hepatitis	Crushed leaves were extracted and consumed with milk.
					L	Abdominal	Crushed leaves were extracted and consumed with milk.
					L	Epilepsy	Crushed leaves were extracted and consumed.
Kalanchoe petitiana A.Rich. **VON-EN52**	Crassulaceae	**Bosoqe (Or)**	W,HG	H	R	Tonsilitis	Roots are masticated and ingested.
					St	Wound	The stem is crushed and secured to the injury.
Lantana camara L. **VON-EN53**	Verbenaceae	**Yewofkolo (Amh)**	W	S	L	Headache	Fresh leaves were crushed and inhaled through the nose.
Lantana trifolia L. **VON-EN54**	Verbenaceae	**Yewofkolo (Amh)**	W	S	L	Headache	Fresh leaves were crushed and inhaled through the nose.
Lens culinaris Medik. **VON-EN55**	Fabaceae	**Misir (Amh)**	W	H	Se	Spider bite	Seeds are crushed and applied to the injury.
Leonotis ocymifolia (Burm.f.) Iwarsson	Lamiaceae	**Awirawiro (Gur)**	W	S	L	Mich/alergy	Fresh leaves, along with those of *O. lamiifolium*, are crushed and combined with coffee before being consumed. Additionally, fresh leaves

VON-EN56							are pressed, mixed with water, filtered, and the resulting solution is ingested.
Lepidium sativum L. **VON-EN57**	Brassicaceae	**Fexo (Amh, Gur)**	Mk, W	H	Se	Mich/alergy	Seeds are ingested along with water.
					Se	Abdominal	Seeds are ingested along with water.
Leucas jamesii Baker **VON-EN58**	Lamiaceae	**Bokkolu adi (Or)**	W		L	Mich/alergy	Crushed leaves, combined with *O. lamiifolium*, are then consumed alongside a cup of coffee.
Linum usitatissimum L. **VON-EN59**	Linaceae	**Telba (Amh, Gur, Or)**	Mk	H	Lf	Mich/Alergy	Crushed leaves, combined with *O. lamiifolium*, are then consumed alongside a cup of coffee.
					Se	Eye disease	Seeds are directly introduced into the affected eye to facilitate the expulsion of a foreign body that has unexpectedly entered.
					Se	Retained placenta	Seeds that have been ground into a powder and combined with water for oral consumption.
Lycopersicon esculentum Mill. **VON-EN60**	Solanaceae	**Timamatim (Amh)**	HG, W	H	L	Wound	Fresh leaves are extracted and applied as a body cream to the wound.
					L	Mich/alergy	Fresh leaves are extracted and applied as a body cream to the affected area.
Malva verticillata L. **VON-EN61**	Malvaceae	**Liitii (Or)**	W	S	R	Retained placenta	The root is ground into a fine powder and applied within the vagina.
					R	Abdominal	Crushed roots mixed with water and consumed.
Maytenus arbutifolia (Hochst. ex A.Rich.) R.Wilczek **VON-EN62**	Celastraceae	**Kombolcha (Amh)**	W		L	Headache	The leaves are masticated, and the resulting solution is ingested.
Maytenus gracilipes (Welw. ex Oliv.) Exell **VON-EN63**	Celastraceae	**Atat (Amh)**	HG	S	L	Headache	Leaves are masticated and the resulting solution is ingested.
Maytenus undata (Thunb.) Blakelock **VON-EN64**	Celastraceae	**Kombolcha (Or)**	W		L	Headache	The leaves are masticated, and the resulting solution is ingested.
Myrsine africana L. **VON-EN65**	Primulaceae	**Limichi (Amh)**	Mk, W		L/Fr	Poison/wound	The leaf is ground and then applied to the injury.
Momordica foetida Schumach. **VON-EN66**	Cucurbitaceae	**Hareg (Amh)**	HG	Cl	L/Fr	Eczema, Tonsilitis, Wound	Finely crushed leaves are extracted and utilized.
Moringa stenopetala (Baker f.) Cufod. **VON-EN67**	Moringaceae	**Shiferaw (Amh)**	W,HG	T	L	Hypertension	Dried leaves are pulverized into a fine powder and consumed.
Nicotiana tabacum L. **VON-EN68**	Solanaceae	**Tamboo (Amh)**	W	H	L	Common cold	Fresh leaves are pressed and combined with water, which is allowed to sit for three days before being filtered. The resulting solution is then inhaled through the nasal passages.

Nigella sativa L. **VON-EN69**	Ranunculaceae	**Tikurazmud (Amh)**	HG	H	Se	Cough	Seeds ground in combination with *A. sativum* and consumed with Coffee.
					Se	Headache	Finely pounded seeds drunk with *A. sativum* and consumed with Coffee.
Ocimum lamiifolium Hochst. ex Benth. **VON-EN70**	Lamiaceae	**Damakesy (Amh, Gur)**	HG, Mk	S	L	Mich/alergy/	Leaf extract incorporated into tea or coffee for beverage enhancement.
					L	Headache	Leaf is prepared for olfactory examination through the nose.
					L	Abdominal	A leaf is squeezed while enjoying a cup of tea.
Ocimum urticifolium Roth **VON-EN71**	Lamiaceae	**Damakesy (Amh, Gur)**	HG	S	L	Mich/alergy/	Leaf squeeze has been incorporated into tea or coffee as an additive for beverages.
					L	Headache	Extracting essence from leaves and inhaling their aroma.
					L	Abdominal	A leaf sequizee indulged in a cup of tea.
Olea europaea L.subsp. *cuspidata* (Wall. & G.Don) Cif. **VON-EN72**	Oleaceae	**Weyira (Amh)**	W,Mk	T	L	Insectcide Tuberculosis	Seeds are utilized as a fumigant within the home, while the root bark, along with that of *J. pocera*, is crushed and administered to the patient.
Pavonia urens Cav. **VON-EN73**	Malvaceae	**Dobihareg (Gur)**	W	Cl	R	Rabies	The root of *R.abyssinica* is crushed, combined with water, and consumed.
Persea americana Mill. **VON-EN74**	Lauraceae	**Avocado (Eng)**	SW	T	Fr	Heart diseases	Fruits are consumed each afternoon for a duration of seven consecutive days, accompanied by periods of rest.
					Fr	Skin problems	A fleshy segment of the fruit utilized as a topical application.
Phytolacca dodecandra L'Hér. **VON-EN75**	Phytolaccaceae	**Endod (Amh)**	W	S	L	Snake bite	Leaves are masticated, and the resulting liquid is ingested.
					R	Rabies	Leaves are masticated, and the resulting liquid is ingested.
					R	Malaria	Roots are masticated, and the liquid is ingested.
					L	Abortion	Leaves are pressed, combined with water, filtered, and the resulting solution is consumed orally.
Plantago lanceolata L. **VON-EN76**	Plantaginaceae	**Qorxobbii (Or)**	W	H	L	Wound	Leaves were crushed and applied to the wound.
					L	Urinary infection	The leaf solution is consumed alongside a cup of coffee.
					L	Bleeding	Crushed leaves are applied to the area of bleeding.
Coleus cylindraceus (Hochst. ex Benth.) A.J.Paton **VON-EN77**	Lamiaceae	**Kentelisa (Gur)**	W	Cl	L	Herps zoster	Leaves that have been boiled in water and utilized for cleansing purposes.
					L	Cough	Leaves, along with *C. macroastachyus* and *S. gigas*, were subjected to boiling and fumigation processes.
					L	Shingles	Leaves are crushed and combined with water for the purpose of washing.

Polygala abyssinica R.Br. ex Fresen. **VON-EN78**	Polygalaceae	**Ebab medihanit (Amh)**	W	H	WP	Snake bite	The substance is ground, combined with water, and administered orally.
Rhus vulgaris Meikle **VON-EN79**	Anacardiaceae	**Kamo (Gur)**	HG	S	St	Dental	The stem is boiled in water and utilized for rinsing the affected teeth suffering from dental caries.
Ricinus communis L. **VON-EN80**	Euphorbiaceae	**Qobboo (Or)**	HG, W	H		Rabies	The root tip is pulverized, combined with water, and utilized.
Rosa abyssinica R.Br. ex Lindl. **VON-EN81**	Rosaceae	**Qaga (Amh)**	W	S	L	Alegy	Leaves, along with *C. macroastachyus*, were subjected to boiling and fumigation.
Rubia cordifolia L. **VON-EN82**	Rubiaceae	**Minchir (Gur)**	W	W	WP	Eczema	Ground, pressed, and utilized as a cream for boys.
Rumex abyssinicus Jacq. **VON-EN83**	Polygonaceae	**Maqmaqqoo (Amh, Gur, Or)**	W	H	L	Anaemia	Leaves are masticated and the resulting solution is ingested.
Rumex nepalensis Spreng. **VON-EN84**	Polygonaceae	**Wusha milas (Amh)**	W		L/R	Stomachache	The root was masticated with honey, while the leaf was pressed onto the injury.
Rumex nervosus Vahl **VON-EN85**	Polygonaceae	**Enbac'o (Amh)**	HG, W	S	L	Abdominal	Water-saturated leaves are pressed and consumed.
Ruta chalepensis L. **VON-EN86**	Rutaceae	**Chirkote (Gur)**	HG, Mk	H	WP	Evil eye	Crushed leaves combined with *A. sativum* for inhalation through the nostrils.
					Fr	Ear pus	Fruits were masticated, and the juice was allowed to flow into the ear.
Salvia nilotica Juss. ex Jacq. **VON-EN87**	Lamiaceae	**Amam (Gur)**	W	H	L	Mich/alergy/	Fresh leaves are pressed and massaged onto the impacted area of the body.
Sida rhombifolia L. **VON-EN88**	Malvaceae	**Gebre sed (Gur)**	W	H	L	Bleeding	Fresh leaves are pressed, combined with water, filtered, and consumed.
Sida schimperiana Hochst. ex A.Rich. **VON-EN89**	Malvaceae	**Chifrig (Amh)**	W	S	L	Yewofkusil	Ground dry leaves are applied as a fine powder and mixed into a paste, which is then placed on the affected area of the body.
					R	Snake bite	The root is masticated and ingested.
Solanecio gigas (Vatke) C.Jeffrey **VON-EN90**	Asteraceae	**Bozy (Gur)**	W	S	L	Mich	Leaves that have been subjected to boiling and fumigation.
					L	Eye disease	Leaves were rinsed and utilized for eye cleansing.
					L	Common cold	Leaves, along with *O. lamiifolium, C. macroastachyus, E. globulus,* and *A. abyssinica*, were crushed and subjected to fumigation.
Solanum anguivi Lam. **VON-EN91**	Solanaceae	**Zerch eboy (Gur)**	W	S	Fr	Tonsilitis	A liquid formulation applied as a cream on the epiglottis.
					L	Epitaxis	A leaf was crushed and placed into the nostrils.
					R	Dingetegna	Roots were pulverized, combined with water, and consumed.
Sonchus asper (L.) Hill **VON-EN92**	Asteraceae	**Ye-ahiya choma (Amh)**	W	H	Lx	Wody warts	Latex is applied to the impacted area of the body.

Stephania abyssinica (Quart.-Dill. & A.Rich.) Walp. **VON-EN93**	Menispermaceae	**Kelela (Or, Gur)**	HG	Cl	R	Abdominal	The root is ground, combined with water, filtered, and the resulting liquid is consumed orally.
					R	Emergency	The root is ground, combined with water, filtered, and the resulting liquid is consumed orally.
					R	Rabies	The root is ground, combined with water, filtered, and the resulting liquid is consumed orally.
Stereospermum kunthianum Cham. **VON-EN94**	Bignoniaceae	**Wedimu (Gur)**	HG	T	BK	Dingetegna	Bark is ground, combined with water, and consumed as a beverage.
Thalictrum rhynchocarpum Quart.-Dill. & A.Rich. **VON-EN95**	Ranunculaceae	**Sirabizu (Amh)**	W	H	R	Wound	The crushed root is applied as a paste to the wound.
					R	Hadha/poison	The crushed root is applied as a paste to the affected area.
Thymus schimperi Ronniger **VON-EN96**	Lamiaceae	**Tosign (Amh)**	W	S	WP	Cough	The entire plant is thoroughly washed, dried, ground into a powder, boiled, and then consumed in a teacup.
						Hypertension	The entire plant is thoroughly washed, dried, ground into a powder, boiled, and then consumed in a teacup.
Thymus vulgaris L. **VON-EN97**	Lamiaceae	**Tosign (Amh)**	W	H	L	Common cold	A leaf, when crushed and combined with water, is consumed from a teacup.
Trichodesma zeylanicum (Burm.f.) R.Br. **VON-EN98**	Boraginaceae	**Tumy (Gur)**	W	H	L	Wound/hadha	Leaves are ground into a fine powder and incorporated into coffee or tea for consumption. Additionally, a paste made from the crushed leaves can be applied or secured to the affected area.
					R	Abotion	peeled and inserted into vagina
					R	Haemorrage	Crushed dry root is combined with honey and consumed over a period of three days.
					Se/L	Wound/hadha	Crushed leaves and seeds roasted with horn mixed with butter and applied as body cream
Trigonella foenum-graecum L. **VON-EN99**	Fabaceae	**Abish (Amh)**	W	H	Se	Baby Paralyse	Boiled seeds were splattered onto the infant's back.
Verbascum sinaiticum Benth. **VON-EN100**	Scrophulariaceae	**Ketetina (Gur)**	W	H	R	Dingetegna	The root is pulverized, combined with water, subjected to filtration, and the resulting solution is administered orally.
					L	Abdominal	The leaf is pulverized, combined with water, subjected to filtration, and the resulting solution is administered orally.
					L	Stomachache	A leaf is subjected to boiling in water within a vacuum flask for duration of two days. The resulting extract is then administered orally.
					R	Kurumba	Roots are ground and combined with water, then filtered, and the resulting aqueous solution is consumed orally.
Urtica simensis Hochst. ex A.Rich. **VON-EN101**	Urticaceae	**Saammaa (Or)**	W	H	L	Hepatitis	Leaves are crushed, prepared, and consumed alongside various dishes.
Verbena officinalis L.	Verbenaceae	**Atoch**	W	H	L	Parasites	Freshly extracted juice from leaves mixed with water and consumed.

VON-EN102		**(Amh)**			R	Dental	Roots are masticated, and the resulting liquid is ingested.
Vernonia amygdalina Del. **VON-EN103**	Asteraceae	**Grawa (Amh)**	HG, W	T	L	Parasites	Leaves were crushed, immersed in water, filtered, and subsequently consumed.
Withania somnifera (L.) Dunal **VON-EN104**	Solanaceae	**Gizawa (Amh)**	W,HG	S	WP	Evil eye	The entire plant is subjected to crushing, incineration, and fumigation processes.
					Lf	Yewof kusil	Ground dry leaves are processed into a fine powder and applied as a paste to the affected area of the body.
Zehneria scabra (L.f.) Sond. **VON-EN105**	Asteraceae	**Ararat (Gur)**	W	Cl	L	Mich/alergy	Leaves subjected to boiling in water and subsequently exposed to fumigation.
					R	Snake bite	Roots were masticated and ingested.
					WP	Eye disease	The entire plant was subjected to boiling and subsequent fumigation.
Zingiber officinale Roscoe **VON-EN106**	Zingiberaceae	**Zingibil (Amh)**	HG, Mk	H	Rh	Cough	The rhizome, when combined with crushed *A. sativum*, is prepared by boiling and subsequently consumed alongside a cup of tea.
					Rh	Sinuses/ Asthma	The rhizome, when combined with crushed A*. sativum*, is prepared by boiling and subsequently consumed alongside a cup of tea.

Key: **VRN**=VernacularName, **HBT**=Habitat, **GF**=Growth form, **PU**= Parts used, **DT**= Disease treated, **VON=VN**= Voucher number, **W**=Wild, **HG**=Homegarden, **Mk**=market, **T**=tree, **H**=Herb, **Cl**=climber, **S**=shrub, L=leaf, **R**=root, **Fl**=flower, **WP=**whole part, **St**=Stem, **Lx**=Latex, **Fr**=fruit, **Se**=Seed, **Bk**=Brk, **Bu**=Bulb, **Rh**=Rhizome, **Amh**=Amharic, **Or**=Afaan Oromoo, **Gur**=Guragigna/(Kistanigna (ክስታንኛ)/, **Eng**=English

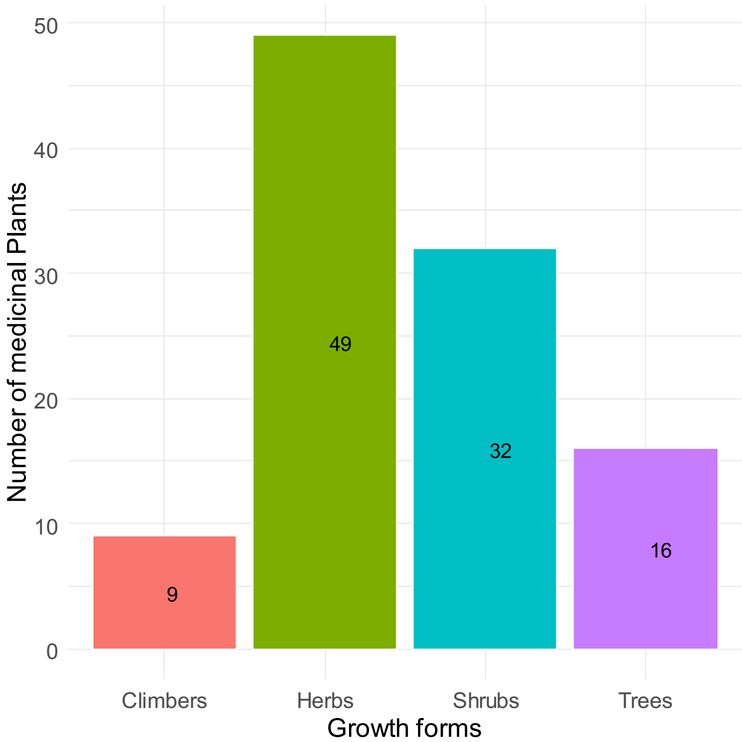
Appendix 2. Most frequently cited health problems in the study area with clinical explanations.

Health problems	**Local name**	Clinical terms and explanations
Febrile illness	**Michi (Gur, Amh)**	Pertaining to or characterized by an elevated body temperature, such as a febrile reaction to an infection agent. A body temperature above 37.8℃ or 37.6℃ rectally, is commonly regarded as febrile.
Evil eye	**Buda (Amh)**	Folk illness or health disorders that are attributed nonscientific causes. The major categories are naturalistic illness caused by impersonal factors such as yin-yang forces and personalist illnesses caused by evil eye or other "magic"
Rabies	**Wisa milet (Gur)**	An acute, usually fatal viral disease of the central nervous system of mammals transmitted from animals to people through infected saliva.
Wound	**Meza (Gur)**	Any physical injury involving a break in the skin, usually caused by an act or accident rather than by a disease, such as a chest wound, gunshot wound, or puncture wound.
Swelling	**Menfet (Gur)**	Enlargement mostly localized. Edema is the medical term for swelling caused by a collection of fluid in the spaces that surround the body's tissues and organs. Edema can occur nearly anywhere in the body.
Fungal infections	**Shifita (Gur, Amh)**	Mycosis, are diseases caused by a fungus (yeast or mold). Fungal infections are most common on skin or nails, but fungi (plural of fungus) can also cause infections in mouth, throat, lungs, urinary tract and many other parts of the body.
Heart disease//hypertension	**Demi bizat (Amh)**	Cardiovascular disease is the term for all types of diseases that affect the heart or blood vessels, including coronary heart disease (plaque accumulation in arteries), which can cause heart attacks, stroke, heart failure, and peripheral artery disease.
Anemia	**Demi males (Gur)**	Reduction in the oxygen carrying pigment hemoglobin in the blood. It is the condition of having a lower-than-normal number of red blood cells or hemoglobin. Anemia diminishes the capacity of the blood to carry oxygen.
Hepatitis	**Yofe (Gur)**	Inflammation of the liver caused by viruses, toxic substances including alcohol, immunological abnormalities or excess deposition of fat.
Abdominal problem	**Keris mitet (Gur)**	Visceral pain or peritoneal pain. The contents of the abdomen can be divided into the foregut, midgut, and hindgut.
Ascariasis	**Keris menishet (Gur)**	Infestation with or disease caused by ascarids. Ascariasis is a type of roundworm infection. These worms are parasites that use your body as a host to mature from larvae or eggs to adult worms that reproduce, can be more than 30 centimeters long.
Tape worm	**Kebsetile (Gur)**	CDC: Taeniasis in humans is a parasitic infection caused by the tapeworm species *Taenia saginata* (beef tapeworm), *Taenia solium* (pork tameworm), and *Taenia asiatica* (Asian tape worm).
Diarrhea	**Mida (Gur)**	The passage of fluid or unformed stools. In acute diarrhea, the frequency of bowel movements and the volume of fluid lost determine the severity of the illness.
Malaria	**Weba (Gur, Amh)**	Disease that is due to parasites of the genus *Plasmodium* in the blood or tissues. Malaria is a generic term often used for protozoa of the genus *Plasmodium*, usually as part of the compound term 'malaria parasites
Headache	**Gunen filtet (Gur)**	Cephalalgia is a symptom that refers to any type of pain located in the head. It is a pain in the head with the pain being above the eyes or the ears, behind the head (occipital) or in the back of the upper neck. Headache, like chest pain or back ache, has many causes.
Amoeba	**Amoeba (Eng)**	Any of various one-celled aquatic or parasitic protozoans of the genus Amoeba or related genera, having no definite form and consisting of a mass of protoplasm containing one or more nuclei surrounded by a flexible outer membrane. Ameobiasis, or amoebic dysentery, is a gastrointestinal illness that develops when an organism called a parasite enters your intestines. The illness may cause diarrhea, nausea, stomach cramps and fever. Healthcare providers usually treat it with antibiotics.
Typhoid	**Typhoid (Eng)**	WHO: Typhoid fever is a life-threatening infection caused by the bacterium Salmonella Typhi. It is usually spread through contaminated food or water. Once Salmonella Typhi bacteria are ingested, they multiply and spread into the bloodstream.
Fever	**Tikuset (Amh)**	In physiological terms, fever has been defined as "a state of elevated core temperature. It is often, but not necessarily part of the defensive response of multicellular organisms to invasion by live microorganisms or inanimate matter recognized as pathogenic or alien by the host".
Bone fracture	**Atime mesiber (Gur)**	A bone fracture is the medical definition for a broken bone. Fractures are usually caused by traumas like falls, car accidents or sports injuries. But some medical conditions and repetitive forces (like running) can increase your risk for experiencing certain types of fractures.

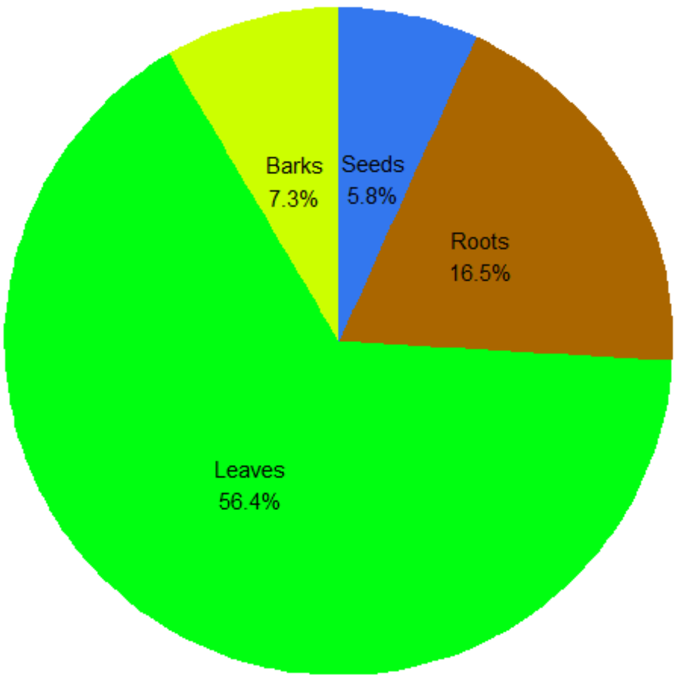
Fire burn	**Esat manided(Amh)**	WHO: A burn is an injury to the skin or other organic tissue primarily caused by heat or due to radiation, radioactivity, electricity, friction or contact with chemicals.
Skin cut	**Koda maret (Gur)**	A laceration or cut refers to a skin wound. Unlike an abrasion, none of the skin is missing. A cut is typically thought of as a wound caused by a sharp object, like a shard of glass.
Bleeding	**Deme tegode (Gur)**	A period of time of usually about two and a half minutes during which a small wound (as a pinprick) continues to bleed. Medically, hemorrhage is the medical term for bleeding. It most often refers to excessive bleeding. Hemorrhagic diseases are caused by bleeding, or they result in bleeding (hemorrhaging).
Common cold	**Sale (Gur)**	An acute disease of the upper respiratory tract that is marked by inflammation of the mucous membranes of the nose, throat, eyes, and Eustachian tubes and by a watery then purulent discharge and is caused by any of several viruses (such as a rhinovirus or an adenovirus).
Asthma	**Asime (Gur, Amh)**	WHO: Asthma is a chronic lung disease affecting people of all ages. It is caused by inflammation and muscle tightening around the airways, which makes it harder to breathe. Symptoms can include coughing, wheezing, shortness of breath and chest tightness. These symptoms can be mild or severe and can come and go over time. Although asthma can be a serious condition, it can be managed with the right treatment. People with symptoms of asthma should speak to a health professional.
Eye infection	**Eine mitet (Gur)**	An eye infection is a disease of the eye that you get because of a microorganism like a bacterium, a virus or a fungus. The most common eye infection is pink eye (conjunctivitis). Viruses cause most cases of pink eye, but bacteria can cause pink eye.
Ear infection	**Enizilmitet (Gur)**	Otitis is a term for infection or inflammation of the ear. Ear infections occur when a virus or bacteria infects the space behind eardrum. Symptoms include ear pain that may cause the patient to be especially fussy or irritable. Often, ear infections clear in their own time. Sometimes children need antibiotics, pain-relieving medications or ear tubes
STDI/STD	**Chetign (Gur)**	WHO: Sexually transmitted diseases (STDs) are caused by sexually transmitted infections (STIs). They are spread mainly by sexual contact. STIs are caused by bacteria, viruses or parasites. A sexually transmitted infection may pass from person to person in blood, semen, or vaginal and other bodily fluids.
Tonsillitis	**Gurer (Gur)**	WHO: Tonsillitis is inflammation of the tonsils, two oval-shaped pads of tissue at the back of the throat — one tonsil on each side. Signs and symptoms of tonsillitis include swollen tonsils, sore throat, difficulty swallowing and tender lymph nodes on the sides of the neck.

Key: **Gur**= Gurage, **Amh**=Amharic, **Or** =Afaan Oromoo, **Eng**= English

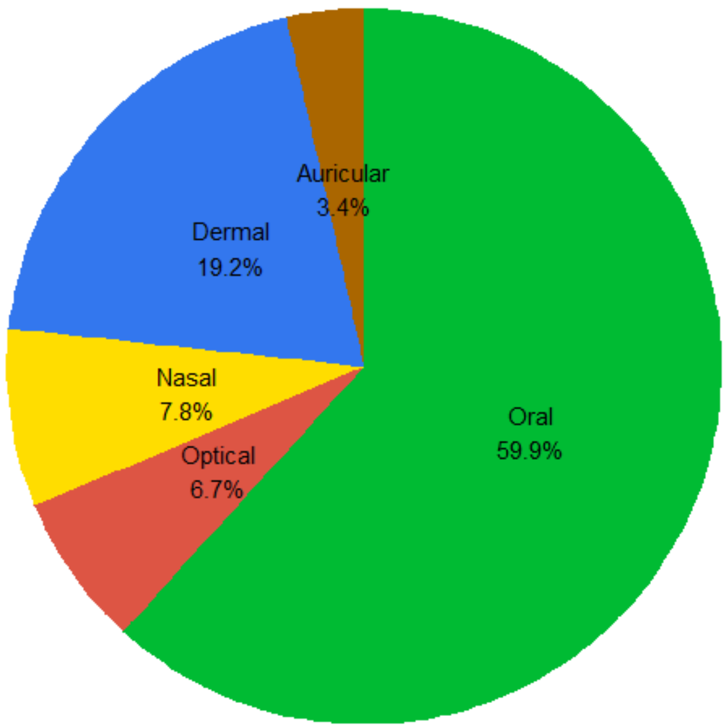
Supplementary files: 1-Figures



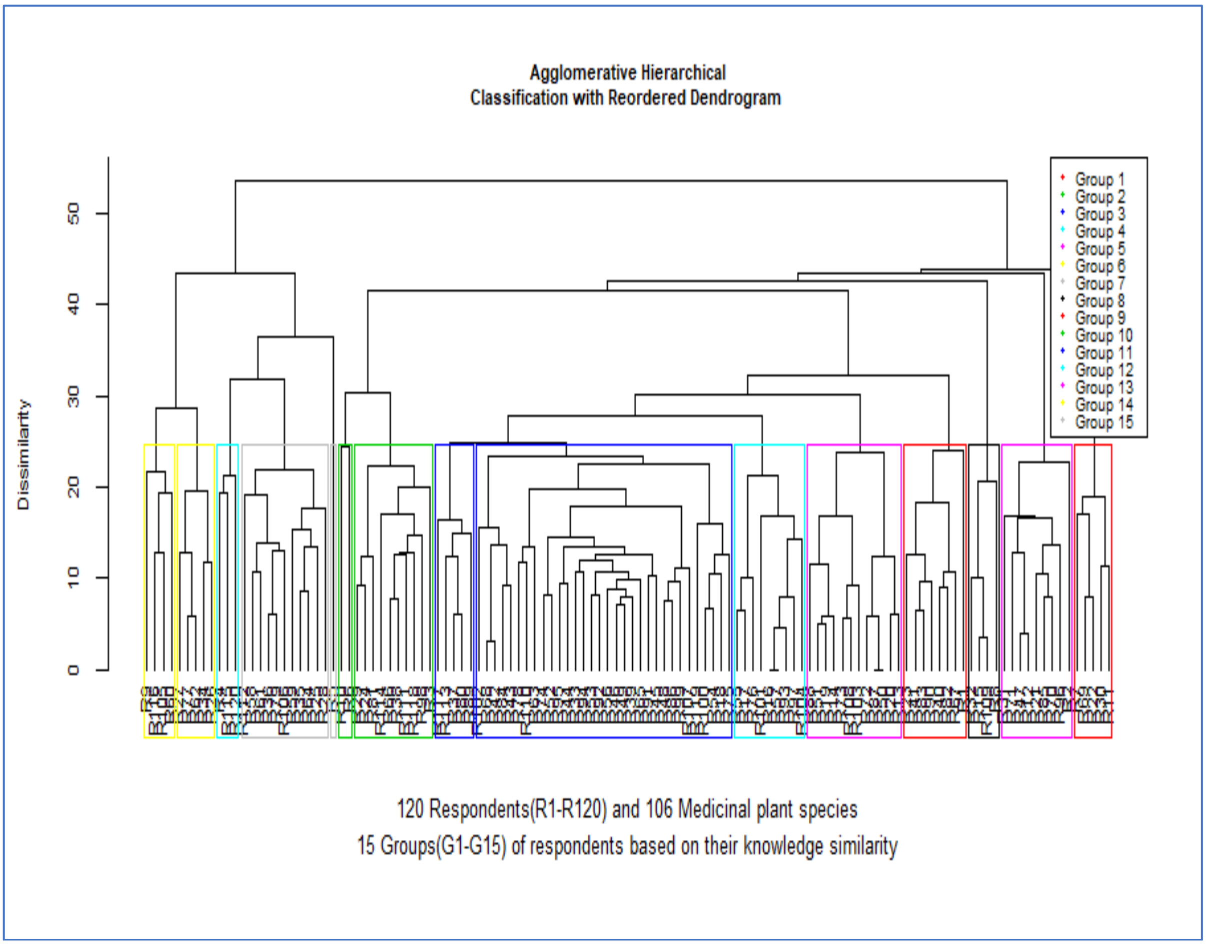
Supplementary file 1.1. Growth forms of medicinal plants



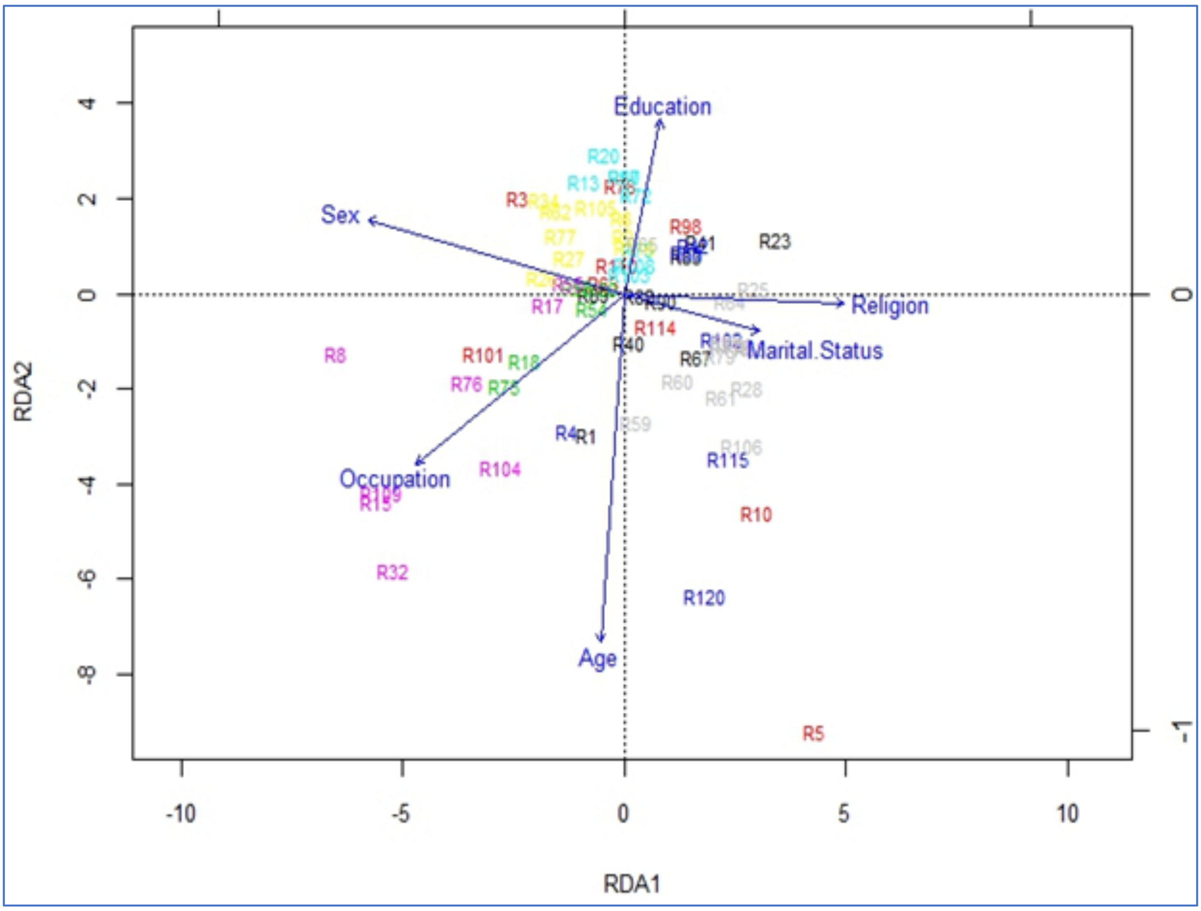
Supplementary file 1.2. Most cited medicinal plant parts used



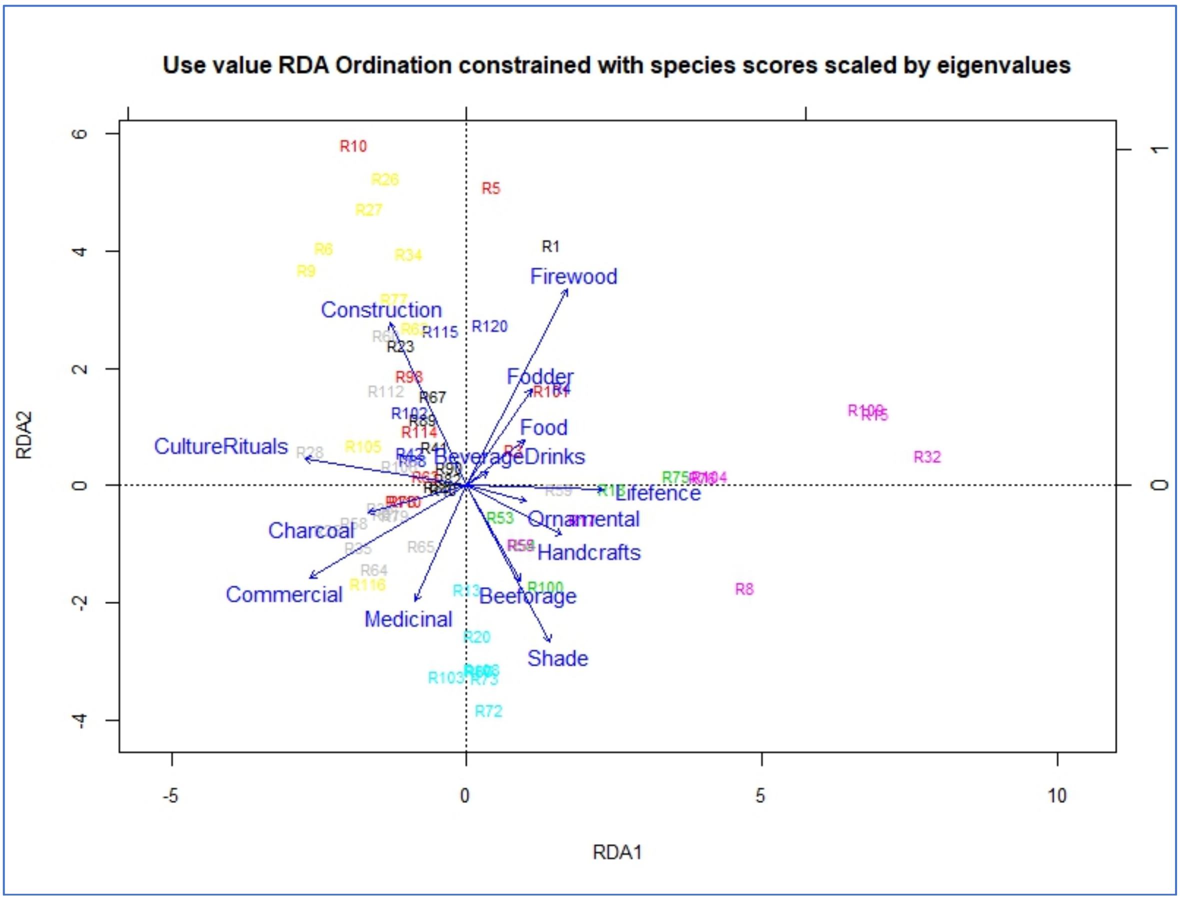
Supplementary fie 1.3. Most cited routes of medicinal plant administration



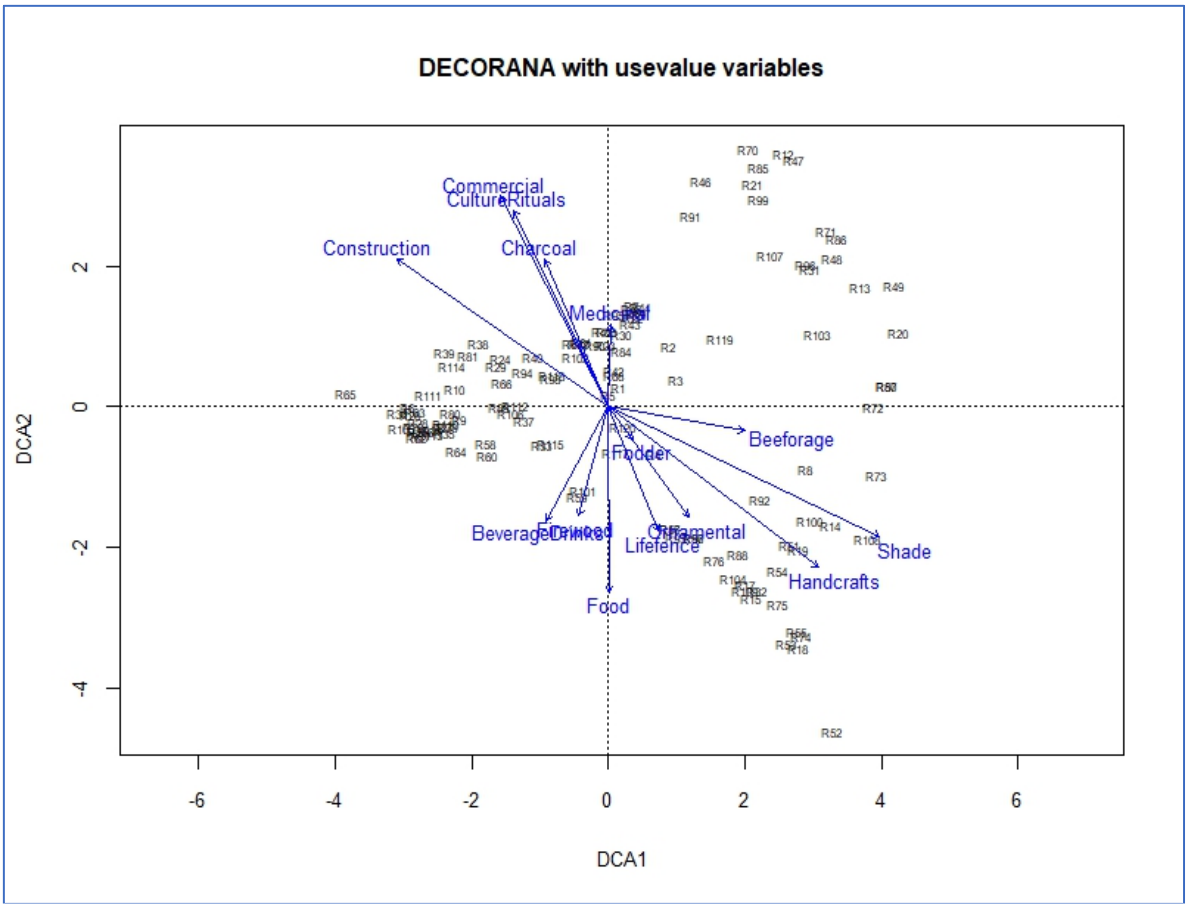
Supplementary file 1.4. Agglomerative hierarchical classification with reordered dendrogram



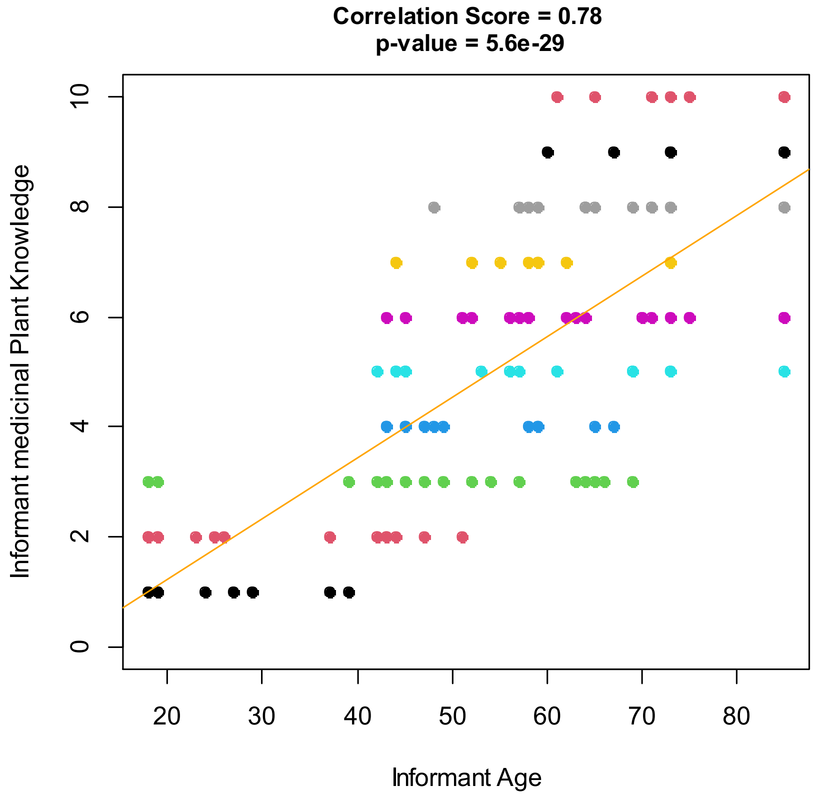
Supplementary file 1.5. RDA ordination of sociodemographic variables



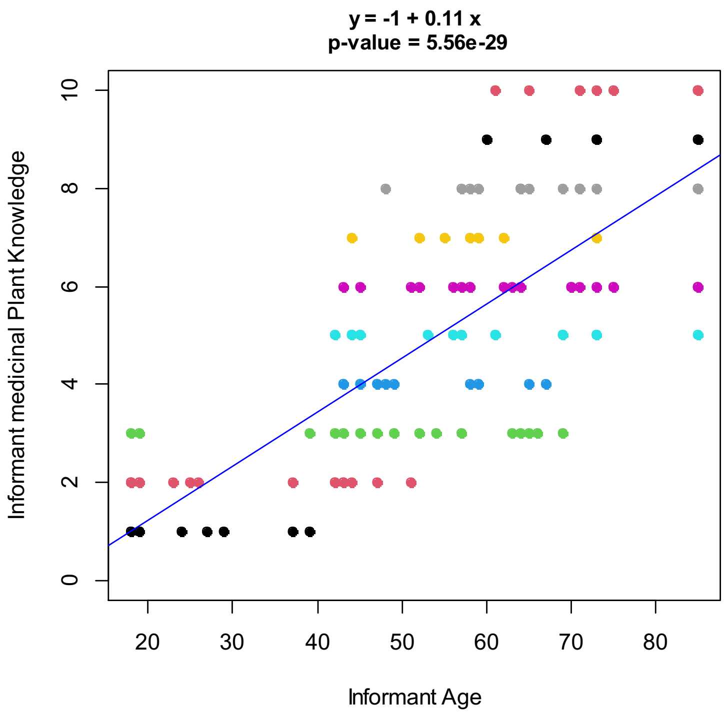
Supplementary file 1.6. Use value RDA ordination



Supplementary file 1.7. Detrended correspondence analysis (DECORANA)



Supplementary file 1.8. Correlation model of informant age groups



Supplementary file 1.9. Regression model of informant age groups

Supplementary files 2-Tables

Supplementary file 2.1. Informant consensus factor (ICF) values against 12 therapeutic categories

Ailments/Therapeutic Categories/	Nt	Nur	ICF	% ICF
Sexually Transmitted Infections(STI)	1	3	1.00	100
Intestinal problems (abdominal problem, abdominal cramp, ascariasis, tape warm, diarrhea, intestinal problems, gastritis)	6	34	0.85	85
Fibril illness (**Mich**)	7	20	0.68	68
Physical problems (bone fracture, fire burn, skin cut, skin bleeding, mechanical injuries)	4	10	0.667	66
Dermal problems (spider poison, swelling, wound, skin cancer, fungal infection, bat urine)	15	36	0.62	62
Cardiovascular diseases, hypertension, hepatitis, anemia	8	13	0.583	58
Evil eye/BUDA/	4	7	0.5	50
Animal bite (snake bite, dog bite/rabies)	7	11	0.4	40
Dental problems	3	4	0.33	33
Sensorial problem (eye and ear infections)	5	7	0.33	33
Respiratory infection (common could, influenza, pneumonia, asthma, tonsillitis, and acute bronchitis.)	15	21	0.3	30
Malaria, headache, amoebae, typhoid, and fever	5	6	0.2	20

Supplementary file 2.2. Fidelety level (FL) of medicinal plants

Medicinal plant species	Primary use	Np	N	FL	%)FL
O. lamiifolium	Febrile illness/*Mich*	42	43	098	98
C. macrostachyus	Ringworm	33	35	0.94	94
S. nilotica	Wound	15	16	0.94	94
R. chalepensis	Evil eye	35	38	0.92	92
S. absyssinica	Eclipsys/ *Dingetegna*/	20	22	0.91	91
J. schimperiana	Hepatitis	9	10	0.90	90
E. kebericho	Common cold	18	23	0.78	78

Supplementary file 2.3. Simple preference ranking of seven medicinal plants against abdominal problems

Medicinal plant species	Respondents									
	R1	R2	R3	R4	R5	R6	R7	R8	Total	Rank
D. angustifolia	6	7	7	7	7	6	6	7	53	1st
F. vulgare	7	1	6	6	6	7	7	6	46	2nd
D. stramonium	5	5	5	4	5	5	5	5	44	3rd
L. sativum	4	4	3	3	4	3	4	4	29	4th
C. ficifolius .	1	2	4	5	1	2	3	2	20	5th
A. integrifolia	3	6	2	2	2	1	1	1	18	6th
S. absyssinica	2	3	1	1	3	2	2	3	17	7th

Supplementary file 2.4. Randomization for paired comparison to check for transitivity

Ordered pairs	Items compared	Randomization
1, 2	*D. stramonium, D. angustifolia*	Flipping coin where:
1, 3	*D. stramonium, F. vulgare*	Head (H) indicated the original
1, 4	*D. stramonium, L. sativum*	order is maintained,
2, 3	*D. angustifolia, F. vulgare*	Tail (T), the original pair was
2, 4	*D. angustifolia, L. sativum*	reversed
3, 4	*F. vulgare, L. sativum*	

Supplementary file 2.5. Result of single respondent for paired comparison

D. stramonium	*D.angustifoila*	*F.vulgare*	*L. sativum*	Selected items	Scores	Rank
	D.angustifoila	*D. stramonium*	*D. stramonium*	*D. stramonium*	2	2nd
		D.angustifoila	*D.angustifoila*	*D. angustifoila*	3	1st
			F.vulgare	*F. vulgare*	1	3rd
				L. sativum	0	4th

Supplementary file 2.6. Results of eight respondents for paired comparison against abdominal problem

Medicinal Plants	Respondents R1	R2	R3	R4	R5	R6	R7	R8	Total	Rank
D. angustifolia	3	3	3	3	2	2	2	2	20	1st
F. vulgare	2	1	0	1	1	3	1	3	12	2nd
D. stramonium	1	2	2	1	0	1	3	1	11	3rd
L. sativum	0	0	1	2	3	0	0	0	6	4th

Supplementary file 2.7. Results of paired comparison on eight medicinal plants against Mich (Fever illness)

Medicinal plants	Respondents (R) R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	Score	Rank
O. lamiifolium	4	5	4	5	4	5	3	4	8	7	49	1st
E. globulus	5	4	5	3	4	4	5	5	7	6	48	2nd
S. anguivi	4	4	3	3	3	5	4	4	6	2	38	3rd
C. macrostachyus	3	3	2	4	4	3	4	3	5	4	35	4th
S. nilotica	2	3	1	4	2	1	3	2	3	8	29	5th
C. amplifoilum	2	2	2	3	3	3	3	2	2	5	27	5th
Z. scabra	3	2	1	3	3	3	1	3	4	1	24	7th
R. abyssinica	1	2	1	1	1	1	2	1	1	3	13	8th

Supplementary file 2.8. Direct matrix ranking of seven medicinal plants against eight use values

Medicinal plants	Use Categories MD	FW	FDD	CH	CN	FN	FR	FD	Total	Rank
C. aurea	3	5	3	5	3	2	5	0	26	1st
A. sieberiana	3	5	2	5	3	2	5	0	25	2nd
C. macrostachyus	4	4	1	3	1	5	2	0	20	3rd
A. htaindica	4	3	4	1	1	4	3	0	19	4th
J. schimperiana	2	3	2	3	3	2	3	0	18	5th
D. angustifolia	3	3	2	1	2	2	1	0	14	6th
E. globulus	3	5	1	2	1	2	1	0	15	7th

Key: MD=medicinal, FW=fire wood, FDD=fodder, CH=charcoal, CN=construction, FN=fencing, FR=furniture, FD=Food

Supplementary file 2.9. Use value diversity of medicinal >0.05 for top 18 medicinal plants

Medicinal plants	UV. Scores	UVi	lnUVi	Abs(lnUVi)	UVilnUVi
C. auranticum	13	0.02	-3.89	3.89	0.08
C. limon	13	0.02	-3.89	3.89	0.08
M. stenoptela	13	0.02	-3.89	3.89	0.08
P. americana	13	0.02	-3.89	3.89	0.08
H. abyssinica	12	0.02	-3.97	3.97	0.07
A. dolicocephala	11	0.02	-4.06	4.06	0.07
A. indica	11	0.02	-4.06	4.06	0.07
C. aurea	11	0.02	-4.06	4.06	0.07
E. ventricosum	11	0.02	-4.06	4.06	0.07
C .papaya	10	0.02	-4.16	4.16	0.07
C. edulis	10	0.02	-4.16	4.16	0.07
C. macrostachyus	10	0.02	-4.16	4.16	0.07
O. europea	10	0.02	-4.16	4.16	0.07
C. spinarum	9	0.01	-4.26	4.26	0.06
E. globulus	9	0.01	-4.26	4.26	0.06
M. undata	9	0.01	-4.26	4.26	0.06
M. africana	9	0.01	-4.26	4.26	0.06
V. amygdalina	9	0.01	-4.26	4.26	0.06
UVD_ medicinal (S=106, UV=1*)	639	1.00	-505.25	505.25	4.57

1*=Indicates only medicinal use but different human health problems.

Supplementary file 2.10. Use diversity over all of top 29 medicinal plants with UVDs-all >0.05.

Scientific names	UVs all	UVi	lnUVi	Abs(UVi)	UVilnUVi
P. americana	104	0.04	3.31	3.31	0.12
A. indica	88	0.03	3.47	3.47	0.11
C. macrostachyus	80	0.03	3.57	3.57	0.10
C. myricoides	72	0.03	3.67	3.67	0.09
C. papaya	70	0.02	3.70	3.70	0.09
F. vulgare	64	0.02	3.79	3.79	0.09
E. globulus	63	0.02	3.81	3.81	0.08
C. edulis	60	0.02	3.86	3.86	0.08
L. usitatissimum	56	0.02	3.93	3.93	0.08
T. schimperi	56	0.02	3.93	3.93	0.08
L. ocymifolia	54	0.02	3.96	3.96	0.08
A. rehan	48	0.02	4.08	4.08	0.07
S. gigas	48	0.02	4.08	4.08	0.07
M. undata	45	0.02	4.14	4.14	0.07
V. amygdalina	45	0.02	4.14	4.14	0.07
C. dactylon	42	0.01	4.21	4.21	0.06
J. schimperiana	42	0.01	4.21	4.21	0.06
M. arbutifolia	42	0.01	4.21	4.21	0.06
R. communis	42	0.01	4.21	4.21	0.06
C. simensis	40	0.01	4.26	4.26	0.06
D. stramonium	40	0.01	4.26	4.26	0.06
H. opposita	36	0.01	4.37	4.37	0.06
L. sativum	36	0.01	4.37	4.37	0.06
M. gracilipes	36	0.01	4.37	4.37	0.06
M. africana	36	0.01	4.37	4.37	0.06
S. schimperiana	36	0.01	4.37	4.37	0.06
S. kunthianum	36	0.01	4.37	4.37	0.06
T. rhyncocarpum	36	0.01	4.37	4.37	0.06
T. zeylanicum	36	0.01	4.37	4.37	0.06
UVD_ overall (S=106, UV=14**)	2840	1.00	522.20	522.20	4.43

14**=Indicates all use values including medicinal and non-medicinal uses

Supplementary file 2.11. Treating factors of medicinal plants in the study area

Threatening factors	**Respondents**										**Total**	**Rank**
	R1	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**		
Deforestation	7	6	6	5	7	7	6	7	5	7	62	1st
Construction	6	7	7	2	5	6	5	7	4	6	55	2nd
Fire wood	5	4	2	7	6	5	6	6	1	5	47	3rd
House construction	3	5	4	7	3	3	7	3	7	3	45	4th
Charcoal production	5	5	3	6	2	2	1	2	6	2	34	5th
Overgrazing	4	2	5	1	4	1	2	1	3	4	30	6th
Urbanization	1	3	2	4	4	4	3	4	2	1	28	7th