HSPI The Open Access Publisher

JPSP JOURNAL OF PLANT SCIENCE AND PHYTOPATHOLOGY
ISSN 2575-0135

Research Article

Conservation Threats to Ethnomedicinal plants in Kore District, South Eastern, Ethiopia

Selamawit Nega[1]*, Agete Jerena[1] and Mesfin Boja[2]

[1]Ethiopian Biodiversity Institute, Hawassa Biodiversity Center, Ethiopia

[2]Ethiopian Biodiversity Institute, Goba Biodiversity Center, Ethiopia

Abstract

The study aimed to investigate the threats to the biodiversity of ethnomedicinal plants and to find consensus information on conservation and management practices of ethnomedicinal plants to contribute sustainable utilization of ethnomedicinal plants in Kore district, Southeastern Ethiopia. The result of the survey revealed that sixty-one medicinal plants were reported by the informants from the study area. These plants are distributed in 59 genera and 37 families. Family Lamiaceae and Asteraceae were represented by 5 (8.2%) species for each family and this is the highest number of species and followed by 4 (6.5%) species of *Solanaceae* and *Fabaceae* for each family. Preference ranking analysis shows that *Eucalyptus globulus* scored 47, indicating that it is the most used plant for firewood in the community, followed by *Olea europaea* (45) and the least used plant for firewood is *Juniperus procera* scored 36. Paired comparison analysis showed that Olea Europeae ranked first followed by *Podocarpus falcatus* for the use of charcoal production in the study area. The major purposes of plant species in the study area were construction, Charcoal, Firewood, Furniture, and Fences as well as for medicinal uses. Based on direct matrix ranking analysis *Juniperus procera*, *Eucalyptus globulus*, *Podocarpus falactus, Olea europaea*, *Hagenia abyssinica*, *Croton macrostachyus*, and *Cordia africana* were the most preferred medicinal plants by local people in the study area. The analysis's findings indicated that anthropogenic influences are endangering medicinal plants. In this study area, only about 13% of medicinal plants are collected from home gardens. This shows that the effort made by the community to conserve medicinal plants is not satisfactory. Therefore, encouraging NGOs and Government offices to participate in the conservation of medicinal plants to encourage the local people to plant indigenous trees for domestic use is necessary.

More Information

***Address for correspondence:**
Selamawit Nega, Ethiopian Biodiversity Institute, Hawassa Biodiversity Center, Ethiopia,
Email: selamnega57@gmail.com

Submitted: July 18, 2023
Approved: August 03, 2023
Published: August 04, 2023

How to cite this article: Nega S, Jerena A, Boja M. Conservation Threats to Ethnomedicinal plants in Kore District, South Eastern, Ethiopia. J Plant Sci Phytopathol. 2023; 7: 069-075.

DOI: 10.29328/journal.jpsp.1001108

Keywords: Threats; Conservation; Ethnomedicinal plants

Check for updates

OPEN ACCESS

Introduction

Background of the study

Worldwide, between 50,000 and 80,000 flowering plants are used as medicines. A minimum of 15,000 of them could become extinct due to habitat degradation and overharvesting [1]. The use of ethnomedicinal plants is very important to the lives of rural and tribal populations. To treat a variety of disorders, thousands of plant species are being used as medicines [2]. The treatment involves using a variety of plant parts, such as the roots, leaves, fruits, and flowers [3]. These plants are significant producers of new drugs on a global scale [4].

Climate change and global warming will have an impact on the distribution and availability of medicinal plants [5]. The risk to the existing natural resources is posed by high population expansion and the demand for higher living standards. Economic progress makes it necessary for the poor to rely more heavily on natural resources, which is unrelated to any policies enacted for their sustainable use. Due to their lack of resources, people had to cut down valuable plants in order to sell them for income [6]. A substantial amount of species are threatened by the collection of plants and seeds, as well as the destruction of plants from natural regions [7].

According to Demisse, et al. [8], the decline in Ethiopia's plant variety is mostly due to effects caused by anthropogenic factors. Woldeab, et al. [9] also claim that the current decline in Ethiopian medicinal plants is caused by anthropogenic and natural factors, including the loss of important indigenous knowledge (IK) related to the plants.

Accordingly, numerous factors call for periodic identification, threat assessments, attention, and follow-

up on medicinal plant species. These include the movement of people from rural to urban areas, industrialization, the loss of biodiversity due to a variety of factors such as population pressure, agricultural expansion, deforestation, and environmental degradation, the destruction of natural habitats, and due to changes in people's lifestyles [34].

Like other areas of the country, the Kore district lacks conservation initiatives and activities. The current trend in plant use in the district reveals the problems that the environment is experiencing with the loss of plant resources and related knowledge. When a plant species vanishes from the area, the knowledge it contained gradually fades and is eventually lost forever.

Therefore, the present study was designed to (i) investigate the threats to the biodiversity of ethnomedicinal plants and (ii) to find consensus information on the conservation and management practices of ethnomedicinal plants to contribute to sustainable utilization of ethnomedicinal plants in Kore district, Southeastern Ethiopia.

Materials and methods

Description of the study area

Kore district, one of West Arsi zone's 12 administrative districts, is located between $7^0$07'37" and $7^0$12'33" North and $38^0$55'14" and $38^0$58'05" East (Figure 1). In the district, there are 22 kebeles. The administrative center of the woreda is Kore town, which is situated 298 kilometers southeast of Addis Ababa and 52 kilometers southwest of the zone's seat, Shashemene. The Kore district has a 501.85 Km^2 total area [10].

According to the 2007 census conducted by the Central Statistical Agency of Ethiopia (CSA), Kore is home to 144,778 people. There were 73,133 females and 71,665 males. There are 4,342 urban residents and 140,436 rural dwellers in the district as a whole. There are 28,064 households on average throughout the district.

The topography of the area is located between 2600 and 3800 meters above sea level. Due to variations in altitude, the district is divided into two agro-climate zones. It is predominantly characterized by highland areas, which make up 88% of the total area while the midland makes up 12%. The district's maximum mean annual temperature is 21.64 °C, while the minimum is 6.56 °C. The average annual temperature is 14.39 °C and the mean monthly temperatures range from 11.83 to 17.4 °C [10].

Ethnobotanical data collection

To collect the appropriate data for this study primary source of data collection method was employed using both open and closed-ended questionnaires, interviews, and informal discussion were used. Field observation based on a checklist of the morphological features and habitats of each medicinal plant species in the field was observed.

Ethnobotanical using the techniques described by [11,12] Semi-structured interviews, guided field walks, discussions, and observation, with informants and key informants were used based on a checklist of questions using the locals' language with the assistance of translators to gather local information from people about the district's plant resources.

Voucher specimens were collected, identified, and archived at the Ethiopian Biodiversity Institute's Shashemene Botanical Garden. Consequently, informants were selected [11], and the selection was done by systematic random sampling method. A sample size of n is desired from a population containing N

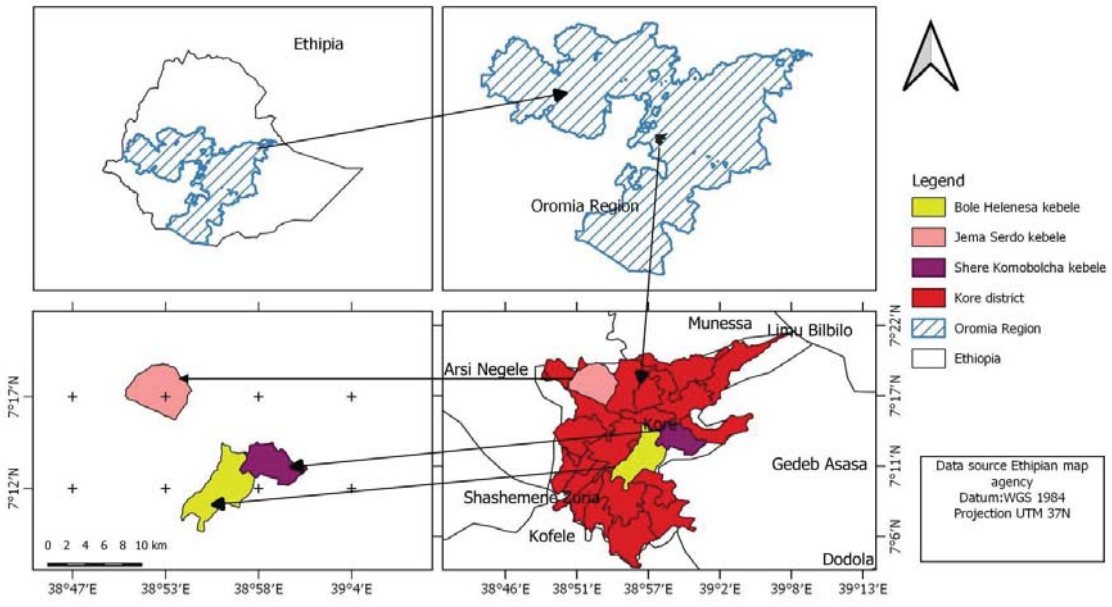

Figure 1: Map of Ethiopia showing the Oromia region and the study district.

elements and sample one element for every n/N element in the population. As a result, 98 informants in total were calculated using [13] technique. A systematic sampling procedure was used to select 77 out of the total 98 informants. From among them, 21 key informants were selected (15 men and 6 women). Typically, the number of key informants ranges from 15 to 35 [14].

The snowball sampling strategy [15] was used to select these knowledgeable elders as informants. The informants were between the ages of 20 and 89. From informants, basic data on threats to and the conservation status of plant species in the district was gathered, including their local names, part(s) used, species used for various purposes, and other extra uses.

Data analysis

Quantitative and qualitative data were analyzed and summarized. Following Martin [11] and Cotton [12], the data were analyzed and summarized using simple preference ranking, paired comparison, and direct matrix ranking. Using the statistical software SPSS-20 and Microsoft Excel 2016, descriptive statistics data were primarily analyzed and summarized using percentages, pie charts, bar graphs, rankings, and scoring.

Results and discussion

Socio-demographic characteristics of respondents/ informants

There were 98 respondents in this study. Out of the total informants, 66.33% of respondents were men and 33.67% were female. Of the total number of informants, 21 (15 men and 6 women) were key informants. The remaining 77 informants were chosen from households and contacted for interviews. The majority of the informants (51%), who belonged to the middle class, were married (76.5%), and 37.7% of them were illiterate (Figure 2).

According to WHO, respondents were classified into three age categories. The results revealed that the middle-aged class (40–59), which accounted for (51%) of informants, was followed by old adults (28.5%).

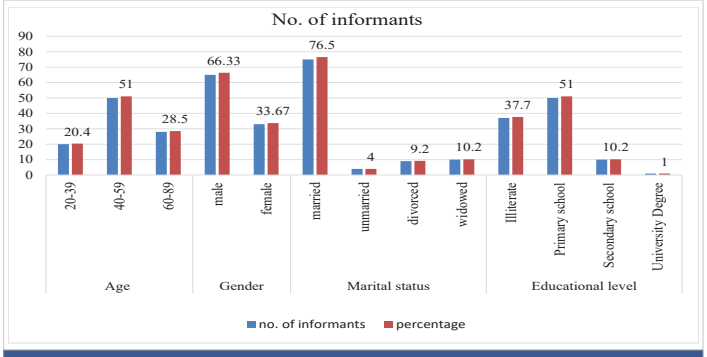

Figure 2: Demographic Characteristics of Informants (*n* = 98).

Medicinal plant species diversity and sources of medicinal plants

In the study area informants reported sixty-one medicinal plants. These plants can be found in 59 genera and 37 families. The highest number of species, 5 (8.2%) for each family of Lamiaceae and Asteraceae, was found in these families (Figure 3). This finding is consistent with those of other studies conducted in Ethiopia [16]. Consequently, for each family, there were 4 (6.5%) species each of the Solanaceae and Fabaceae. The remaining families each made three, two, and one species.

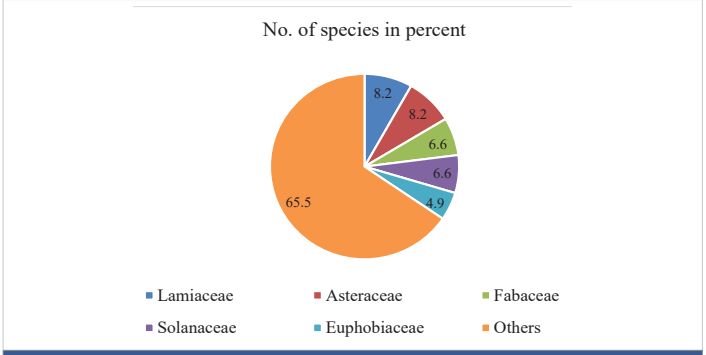

Figure 3: Medicinal Plant species Diversity and Sources of medicinal plants.

Of the 61 species, 35 (57.7%) were reported to have been from the wild, while 13 (21%) came from community-cultivated home gardens, and the remaining species were found on farmland and along roadsides. As a result of [17,18], and other studies, many medicinal plants are collected from the wild. This demonstrates how the populations of wild medicinal plant species in the future will suffer as a consequence. The cultivation of medicinal plants is extremely rare in the area. They cultivate these plants for food as well as other purposes including fencing and shade. As a result, the destruction of natural vegetation caused by deforestation, the expansion of agriculture, and population growth are responsible for the limited accessibility. This might lead to the extinction of certain species soon.

Growth form of medicinal plants

According to the analysis of the growth forms of medicinal plants, shrubs (24 species, 39.34%), trees (19 species, 31.2%), and herbs (18 species, 29.5%) constitute the largest category (Figure 4).

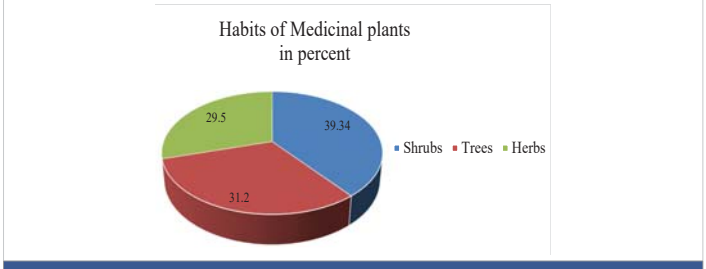

Figure 4: Habits of Medicinal Plants.

In many natural and semi-natural habitats, trees and shrubs are two of the main growth forms. Compared to herbs and trees, shrubs are multi-stemmed, short, woody plants that are more common and vital to many ecosystems [19]. Shrubs and trees were harvested more frequently than other life forms found in the study area among the reported medicinal plants, as well as for other purposes like fences, furniture, and firewood. This showed that people depend more on shrubs and trees. This result is consistent with results from similar studies conducted in other parts of Ethiopia [20].

Threats to medicinal plants

The Kore district was heavily forested until a few decades ago. Apathy for forests and wild plants has significantly developed as a result of altered agricultural techniques and lifestyles. Forests are degraded by humans due to a number of circumstances. It defies logic to wipe out all natural flora without discrimination, including medical plants that people are still using today. There are numerous vulnerable species of medicinal plants. Some of these have been threatened in various ways.

Traditional medicinal plants ranking and scoring

Preference ranking: It is well known that a variety of tree species were used in many areas of our country to produce high-quality timber, furniture, charcoal, and fences as well as for construction. Ten key informants were chosen for this study in order to determine the most widely used medicinal plant for use as firewood. The study revealed that the collection of firewood was the threat that informants in the study area most commonly mentioned.

According to the result, *Eucalyptus globulus* scored 47, indicating that it is the most commonly used plant for firewood in the community, followed by *Olea europaea* (45), and *Juniperus procera* scored 36, indicating the least use of plants for firewood (Table 1). The respondents stated that *Eucalyptus globulus* is also offered for sale as firewood. According to many respondents, *Eucalyptus globulus* is easier to prepare for firewood than other tree species additionally, it is also offered in the market as firewood.

Paired comparison: In the study area, *Olea europeae* ranked first for use in the production of charcoal, followed by *Podocarpus falcatus*, according to the responses of ten key informants. (Table 2). As a result, this finding indicated that *Olea europeae* is the most desired plant species and *Cordia africana* is the least used plant species in the study area. Communities in the study area earn a livelihood selling charcoal, either by preparing it themselves or by purchasing it already prepared and selling it again.

Table 1: Preference ranking of medicinal plants used for firewood (R stands for respondents, Total 50%).

List of medicinalplants	Respondents (R = 10)											
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	Total	Rank
Eucalyptus globulus	5	5	4	5	4	5	5	4	5	5	47	1st
Olea europaea	5	4	4	5	5	5	4	4	4	5	45	2nd
Hagenia abyssinica	4	3	4	5	4	4	3	5	3	4	39	3rd
Podocarpus falcatus	5	4	2	5	3	4	5	3	4	5	37	4th
Juniperus procera	4	3	5	4	4	3	3	3	3	4	36	5th

Table 2: A paired comparison of five medicinal plants used to production of charcoal (R stands for Respondents).

List of medicinalplants	Respondents (R = 10)											
	R	R2	R3	R4	R5	R6	R7	R8	R9	R10	Total	Rank
Olea europaea	5	5	5	5	54	5	5	5	5	5	50	1st
Juniperus procera	5	4	5	5	5	4	5	5	4	5	47	2nd
Hagenia abyssinica	4	5	5	5	4	4	5	4	5	4	45	3rd
Eucalyptus globulus	4	5	5	4	4	4	5	5	4	4	44	4th
Hagenia abyssinica	3	4	4	4	4	4	4	3	5	4	35	5th
Croton macrostachyus	4	3	3	4	4	3	4	3	3	4	35	6th
Cordia africana	3	3	4	3	4	3	3	4	3	4	34	7th

Direct matrix ranking: According to the informants, seven multipurpose plant species with a variety of purposes were noted i.e., mostly used for construction, charcoal, firewood, furniture, fences, and medicine. Accordingly, *Juniperus procera, Eucalyptus globulus, Podocarpus falcatus, Olea europaea, Hagenia abyssinica, Croton macrostachyus*, and *Cordia africana* were the most widely used medicinal plants among the locals in the study area. Key informants indicated that *Juniperus procera* is the most endangered species in the area, placing it ahead of *Podocarpus falcatus* and *Eucalyptus globulus* in the direct matrix ranking results (Table 3). In the studied area, *Juniperus Procera* is economically useful. It has been especially valued for use in constructing houses and is widely used in construction, furniture, and outdoor activities like fence posts [21].

Factors affecting the biodiversity of kore

The results of the analysis showed that medicinal plants are in danger because of anthropogenic factors. The biodiversity of the Kore district, in general, and medicinal plants in particular, are seriously threatened. The main causes of these issues, according to several sources, were human activities like population pressure, firewood gathering, timber extraction, and construction. Because these elements are interconnected and one of them may directly arise from another, habitat alteration is their overall influence. Key informants ranked agricultural expansion first, scoring 42 on a scale of damage to medicinal plants, followed by firewood collection (36), and charcoal production (29) Table 4.

The study found that both natural and man-made factors are degrading the district's biodiversity. Anthropogenic variables are the main issues with the medicinal plants in the studied area. This result is in line with [22]. Informants pointed out that, as observed by other studies, agricultural expansion has become the greatest threat to medicinal plants [23,24]. Overharvesting for construction, agricultural expansion, the production of charcoal, and habitat loss due to forest degradation are all identified as causes of the decline of plant species in the studied area. According to the local

Table 3: Average score for direct matrix ranking of seven medicinal plant species based on their general use values 5 best, 4 very good, 3 good, 2 less used, and 1 least.

Plant species	Multipurpose use of medicinal plants																															
	Construction							Charcoal							Firewood							Furniture							Fence							
	R1	R2	R3	R4	R5	R6	Tot	R1	R2	R3	R4	R5	R6	Tot	R1	R2	R3	R4	R5	R6	Tot	R1	R2	R3	R4	R5	R6	Tot	R1	R2	R3	R4	R5	R6	Tot	Sum	Rank
Juniperus procera	4	5	5	4	3	4	25	3	4	4	3	1	1	16	2	2	1	1	1	2	9	5	5	4	5	4	3	26	3	4	2	4	2	1	16	93	1st
Eucalyptus globulus	3	3	3	2	1	2	14	4	3	5	4	3	2	26	2	3	1	3	3	4	16	1	1	1	1	1	1	6	5	5	4	5	5	4	30	90	3rd
Podocarpus falcatus	5	5	4	5	4	3	26	3	2	3	1	3	3	15	2	2	3	2	1	2	12	5	5	3	4	3	5	25	2	1	3	2	3	3	14	92	2nd
Olea europaea	5	4	5	4	4	4	26	4	2	3	1	2	1	13	3	3	3	3	4	2	18	2	1	3	1	3	2	12	2	1	1	2	1	1	8	77	5th
Hagenia abyssinica	5	5	4	5	3	3	25	2	1	2	1	2	1	9	4	3	3	4	3	3	20	3	4	2	3	2	3	17	4	3	2	2	2	3	16	87	4th
Croton macrostachyus	4	3	3	2	2	3	17	1	2	2	3	1	2	11	5	4	3	3	4	3	22	1	2	1	1	2	1	8	2	1	3	2	1	2	11	69	7th
Cordia africana	2	1	3	2	3	1	12	4	4	2	3	4	3	20	3	2	2	1	3	1	12	3	4	1	1	2	3	14	2	1	1	2	3	3	12	70	6th

Table 4: Factors affecting the biodiversity of Kore district.

Threats to medicinal plants	Respondents										Total	Rank
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
Agricultural expansion	5	4	3	5	4	3	4	5	5	4	42	1st
Firewood	3	2	5	4	5	2	5	3	4	3	36	2nd
Charcoal production	2	3	4	2	3	5	2	4	3	1	29	3rd
Construction	1	1	2	3	1	1	3	1	2	2	17	5th
Overgrazing	4	5	1	1	2	4	1	2	1	5	26	4th

people, the area was once abundant in natural vegetation and forest resources, but things have changed and the resources have been degraded, making it difficult to access medicinal plants when they are needed.

Conservation and management practice of Ethno-medicinal Plants

Conservation encourages sustainable development by conserving biological resources and making use of them in ways that do not decrease the variety of genes and species on the planet or damage important habitats and ecosystems [25]. Local residents rely extensively on the plants surrounding them for building materials, medicine, fuel wood, and other uses. As a result, the ecology degrades and vegetation disappears.

According to some respondents in the study area, it is still challenging to stop locals from destroying the plants nearby, mostly because the people still depend on native plants for ornamental, medicinal, fencing, shading, and food uses. As a result loss of ethnomedicinal plants in the study area is clearly visible.

Home garden conservation: Home gardens are crucial for the conservation of beneficial plant species because they contain a high number of species that are frequently absent or vanishing from other production systems [26]. Home gardens also provide the rural poor with a multitude of ecological benefits, services, and valuable goods. The home garden is a good location to conserve ethnomedicinal plants [27]. However, only 13% of the medicinal plants in this study area are collected from home gardens. This shows that the community's efforts to conserve medicinal plants are weak. Few people, as observed in the field, cultivate useful medicinal plants in their home gardens, such as *Ruta chalepensis, Ocimum lamiifolium, Rhamnus prinoides for beverage, Brassica carinata, Lipidium sativum, Echinops kebericho*, and *Allium sativum*.

The inter-cropping of plants: The Indigenous people profit from the mixing of multipurpose plants in backyard gardens and farm fields. With indigenous techniques, this effort protects medicinal plants [28]. But in the study area, it was observed that the practice of the use of ethnomedicinal plants that were collected from the wild and planted in the home gardens is extremely low. This finding is similar to the study of [35].

Culture of diversifying income-generating and food security plant species: The result of the survey showed that the community has no interest in the trend of planting various species in their home garden and on farmlands. However, the Community's tradition of growing different species and maintaining them in their backyard gardens and farmland has made a significant contribution to the protection of biodiversity.

Similarly, people in the study area invest less effort in growing medicinal plants in their backyard gardens Instead, they travel to distant or adjacent locations to gather the plants. The finding was reported by (Birhanu and Abera, 2015).

The need for conservation and cultivation of Ethnomedicinal plants: Cultivating ethnomedicinal plants will prevent plant species from going extinct, reduce the number of wild populations that are harvested, and advance socioeconomic development [29]. The majority of medicinal plants come from the wild. Due to over-harvesting and over-exploitation by plant collectors and herb vendors, this is no longer sustainable and reliable [30]. Many ethnomedicinal plants are now extinct or extremely difficult to find. Therefore, it is necessary to invest quickly in the cultivation and conservation of ethnomedicinal plants.

Numerous plant species have seen a decline in population

in their natural habitat as a result of the continuous commercial exploitation of these plants. Therefore, it is essential to begin the systematic cultivation of medicinal plants in order to protect endangered species and preserve biodiversity.

Conclusion and recommendations

It is clear from the current study that anthropogenic causes are endangering medicinal plants. The greatest threats to the country's medicinal plants are population growth, firewood production, charcoal manufacturing, timber production, and construction. Additionally, the widespread usage of medicinal plants is causing an alarming rate of plant species extinction. According to the study, the number of thousand hectares of forest that are home to medicinal plants have been lost due to habitat degradation and deforestation for commercial timber, firewood collection, charcoal production, invasion by agriculture, and other land uses. According to a study on the use of medicinal plants in the study area, people frequently use these plants for fences, medicine, and firewood. The majority of medicinal plants are collected from the wild, and their growth forms are shrubs and trees. As a result, these plant species are the most endangered plants. For medicinal plants with limited abundance and slow growth, destructive harvesting generally results in resource exhaustion and even species extinction. Therefore, the sustainable use of medicinal plants should be considered, and good harvesting practices must be formulated. For medicinal plants with increasingly limited supplies, sustainable use of wild resources can be an effective conservation alternative. Consequently, the following recommendations are made as a result: Agricultural experts, district administrators, and researchers could provide essential training on how the people might conserve the local indigenous knowledge as well as the area's flora. NGOs and governmental organizations are urged to take part in the conservation of medicinal plants in order to inspire the local people to cultivate indigenous trees for domestic use. Encouraging farmers to grow medicinal plants in their home gardens, with the assistance of the district's agricultural office and land and environment conservation office. The target group must be informed of the situation and encouraged to manage and conserve medicinal plants. Several awareness-raising initiatives, such as FGDs, must be carried out (consultation meetings with the local communities and community leaders). Several awareness-raising initiatives, such as FGDs (consultation meetings with the local communities and community leaders) must be carried out.

References

1. Rasool A, Bhat KM, Sheikh AA, Jan A, Hassan S. Medicinal plants: Role, distribution, and future. Journal of Pharmacognosy and Phytochemistry. 2020; 9(2): 2111-2114.
2. Raghuvanshi D, Dhalaria R, Sharma A, Kumar D, Kumar H, Valis M, Kuča K, Verma R, Puri S. Ethnomedicinal Plants Traditionally Used for the Treatment of Jaundice (Icterus) in Himachal Pradesh in Western Himalaya-A Review. Plants (Basel). 2021 Jan 25;10(2):232. doi: 10.3390/plants10020232. PMID: 33504029; PMCID: PMC7910824.
3. Sen S, Chakraborty R, De B, Devanna N. An ethnobotanical survey of medicinal plants used by ethnic people in the West and South districts of Tripura, India. Journal of Forestry Research. 2011; 22: 417-426.
4. Salmerón-Manzano E, Garrido-Cardenas JA, Manzano-Agugliaro F. Worldwide Research Trends on Medicinal Plants. Int J Environ Res Public Health. 2020 May 12;17(10):3376. doi: 10.3390/ijerph17103376. PMID: 32408690; PMCID: PMC7277765.
5. Ratha KK, Sruajani MS, Arya JC, Joshi GC. Impact of climate change on diversity of himalayan medicinal plant: a threat to ayurvedic system of medicine. International Journal of Research in Ayurveda & Pharmacy. 2012; 3(3).
6. WWF. Ucchali complex (Khushab): (1994) A report on the planning the conservation of the water bodies based on the indigenous population.
7. Ahmad I, Hussain M, Rehman A, Mustafa I, Farooq M, Jabeen S, Zafer S. Threats to medicinal plant diversity in Soon Valley (Salt range) of Punjab, Pakistan. Int Res. 2012; 1: 169-58.
8. Demisse A. Biodiversity conservation of medicinal plants: problems and prospects. In Conservation and sustainable use of medicinal plants in Ethiopia. Proceedings of the national workshop on biodiversity conservation and sustainable use of medicinal plants in Ethiopia. Addis Ababa: IBCR. 2001; 56-64.
9. Woldeab B, Regassa R, Alemu T, Megersa M. Medicinal Plants Used for Treatment of Diarrhoeal Related Diseases in Ethiopia. Evid Based Complement Alternat Med. 2018 Mar 18;2018:4630371. doi: 10.1155/2018/4630371. PMID: 29743923; PMCID: PMC5878875.
10. Kore district agricultural office. (2016). Kore district south eastern Ethiopia. (Unpublished).
11. Martin GJ. Ethnobotany, conservation, and community development. In Ethnobotany: a methods manual Boston, MA: Springer US. 1995; 223-251.
12. Cotton CM. Ethnobotany: principles and applications. John Wiley & Sons. 1996.
13. Yamane T. 'Sampling distribution. 1967.
14. Kumar K. Conducting Key Informant Interviews in Developing Countries: Agency for International Development. Washington, DC. 1989.
15. Patton Q. Qualitative evaluation and research methods, 2nd ed, Sage, Newbury Park, CA. 1990.
16. Regassa R. Useful plant species diversity in home gardens and its contribution to household food security in Hawassa city, Ethiopia. African Journal of Plant Science. 2016; 10(10): 211-233.
17. Girma Z, Abdela G, Awas T. Ethnobotanical study of medicinal plant species in Nensebo District, south-eastern Ethiopia. Ethnobotany Research and Applications. 2022; 24: 1-25.
18. Shure HA, Talila H, Mohammed U, Jilo SA. Ethnobotanical study of medicinal plants and their Economic importance in Dalomana district, Southeastern Oromia, Ethiopia. 2022.
19. Götmark F, Götmark E, Jensen AM. Why Be a Shrub? A Basic Model and Hypotheses for the Adaptive Values of a Common Growth Form. Front Plant Sci. 2016 Jul 26;7:1095. doi: 10.3389/fpls.2016.01095. PMID: 27507981; PMCID: PMC4961008.
20. Tolossa T. Traditional medicinal plants used to treat human disease in and around Ambo town, western Ethiopia: An ethnobotanical study.
21. Belay H, Bekele T. Modeling Growth Performance of Juniperus procera (Hochst. Ex. Endl.) Plantations at Boter-Becho Site, Jimma Zone, Southwest Ethiopia. International Journal of Environmental Sciences & Natural Resources. 2018; 13(5): 134-137.
22. L Lulekal E, Asfaw Z, Kelbessa E, Van Damme P. Ethnomedicinal study of plants used for human ailments in Ankober District, North Shewa Zone, Amhara Region, Ethiopia. J Ethnobiol Ethnomed. 2013 Aug

28;9(1):63. doi: 10.1186/1746-4269-9-63. PMID: 23984919; PMCID: PMC3846447.

23. Megersa M, Asfaw Z, Kelbessa E, Beyene A, Woldeab B. An ethnobotanical study of medicinal plants in Wayu Tuka District, East Welega Zone of Oromia Regional State, West Ethiopia. J Ethnobiol Ethnomed. 2013 Sep 25;9(1):68. doi: 10.1186/1746-4269-9-68. PMID: 24295044; PMCID: PMC3851437.
24. Agisho H, Osie M, Lambore T. Traditional medicinal plants utilization, management, and threats in Hadiya Zone, Ethiopia. Journal of Medicinal Plants. 2014; 2(2): 94-108.
25. Rawat US, Agarwal NK. Biodiversity: Concept, threats, and conservation. Environment Conservation Journal. 2015; 16(3): 19-28.
26. Hodgkin T. Home gardens and the maintenance of genetic diversity. Home gardens and in situ conservation of plant genetic resources in farming systems. Proceedings of the Second International Home Gardens Workshop, Witzenhausen, Federal Republic of Germany. International Plant Genetic Resources Institute (IPGRI). 2022; 14-18.
27. Semu AA. The study of home garden agrobiodiversity, practices of home gardening, and its role in In-Situ conservation of plant biodiversity in Eastern Hararghe, Kombolcha Town Oromia Regional State Ethiopia. Open Journal of Forestry. 2018; 8(02): 229.
28. Andarge E, Shonga A, Agize M, Tora A. Utilization and conservation of medicinal plants and their associated indigenous knowledge (IK) in Dawuro Zone: an ethnobotanical approach. Int J Medicinal Plant Res. 2015; 4: 330-7.
29. Bhattacharjee T, Sen S, Chakraborty R, Maurya PK, Chattopadhyay A. Cultivation of medicinal plants: Special reference to important medicinal plants of India. Herbal medicine in India: Indigenous knowledge, practice, innovation and its value. 2020; 101-115.
30. Van Wyk AS, Prinsloo G. Medicinal plant harvesting, sustainability, and cultivation in South Africa. Biological Conservation. 2018; 227: 335-342.
31. Central Statistical Agency (CSA) Federal Democratic Republic of Ethiopia; Addis Ababa. 2007.
32. Cunningham AB. People, park, and plant use: recommendations for multiple-use zones and development alternatives around Bwindi Impenetrable National Park, Uganda. People, park, and plant use: Recommendations for multiple-use zones and development alternatives around Bwindi Impenetrable National Park, Uganda. 1996.
33. Kore district Land and Environment conservation office (2019). Kore district south eastern Ethiopia. (Unpublished).
34. Wood A, Stedman-Edwards P, Mang J. The root causes of biodiversity loss. Routledge. 2013.
35. Birhanu Tadesse and Dereje Abera. (2015). Survey of ethno-veterinary medicinal plants at selected Horro Gudurru Districts, Western Ethiopia. African Journal of Plant Science, 9(3), 185-192.