Ethnobotanical Study of Medicinal Plants in Nagelle Arsi District, West Arsi Zone of Oromia, Ethiopia

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Abstract
Ethnobotanical study was conducted in Nagelle Arsi District, Ethiopia with the objective of identifying and documenting medicinal plants, associated indigenous knowledge and ethnobotanical practices of local communities. Household survey using semi-structured interviews, key informant interview, group discussions, field observations and market survey methods were used for data collection. A total of 17 kebeles (smallest administrative unit) out of the 34 in the District were selected for this study, from which 90 informants for the household survey were interviewed. Eight key informants per each site were selected following purposive sampling method. Qualitative and quantitative statistical methods, priority ranking, paired comparison, direct matrix ranking, informant consensus and percentage distribution were used for data analysis. A total of 102 medicinal plants belonging to 85 genera and 55 families were collected and identified including four endemic plants to Ethiopia. The finding indicated that 65 species were used for treating human diseases, 31 species for both human and livestock diseases and 7 for livestock diseases. Species used for treating cancer, blood pressure, malaria, diabetes, hemorrhoids and prostate problems were identified and documented. Seventeen medicinal plants were found to be wild edibles. Commonly used plant parts were leaves followed by roots and barks. The common routes of administration were oral followed by dermal. It was concluded that although the District was rich in medicinal plants, these species have been under serious threat due to agricultural expansion, deforestation, forest degradation and over harvesting for different purposes including firewood collections. Therefore, urgent conservation measures applying in-situ and ex-situ methods and strengthening sustainable management of natural forest were recommended.

Keywords: Biodiversity conservation, indigenous knowledge, medicinal plants, Nagelle Arsi, sustainable use.

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1. Introduction

Ethnobotanical studies are useful in documenting, analyzing, and communicating knowledge and practices that would contribute to potential bioprospecting and production of commercial medicine for the betterment of human society. Indigenous and local communities have developed their own locality specific knowledge on plant use, management, and conservation (Balick & Cox 1996). Plants are indispensable and most important sources of both preventive and curative traditional preparations for human beings and for their animals since ancient times. Indigenous knowledge and practices have been major factors for the use and domestication of many multipurpose species. Local communities in developing countries such as Ethiopia are still dependent on locally available medicinal plants as about 80% of the country’s population live in rural areas where availability and affordability of modern medicines remain out of reach for many families. Limited access to health stations, low number of nurses and medical doctors in those rural areas and lack of modern medicine in most clinics have been common features in many rural areas of Ethiopia.

As a result, indigenous and local communities developed and still making use of their rich knowledge on the taxonomy and use medicinal plants, preparations and applications of local medicines in their vicinity. Medicinal plants have been in use in traditional medicine and contemporary and alternative medicine both in developing and developed countries; thus a large number of people habitually use such medication. And its popularity also stems from the efficacy of the treatment and relative safety, with few or no side effects. Herbal medicines, because of their decentralized nature, are easily and quickly available, relatively cheaper and sustainable alternative to synthetic drugs and pharmaceuticals (Aziz et al. 2018; Wendimu et al. 2007).

Indigenous and local communities in Ethiopia have been using medicinal plants for treating various ailments of both human and livestock for centuries. The strong linkage between medicinal plants and indigenous knowledge has been documented by many authors. Ethnobotanical studies have been widely recognized as critical to identify threatened plants so that appropriate conservation measures are taken in time (Lulekal et al. 2008). However, conservation status of these plants has become a serious concern in many rural areas. The current loss of medicinal plants in the country due to climate change and anthropogenic factors has also negative impacts on indigenous knowledge of the communities that has been associated with these plants and their habitats. Deforestation and forest degradation, agricultural expansion, loss of grasslands and woodlands, over-harvesting, agricultural practices in marginal lands, overgrazing and urbanization are some of the major factors threatening biodiversity in
general and medicinal plants and their ecosystems in particular. Although these factors are common in most parts of Ethiopia, the situation in Nagelle Arsi is unique in two ways: there has been high demand for firewood widely used for the production of local alcohol called “Ärake” and suitability of the agroecology has attracted many farmers from different regions of the country further exacerbating conversion of grasslands, woodlands and forest ecosystems into agricultural fields for crop cultivation. Other major factors causing loss of biodiversity in the area include illegal logging and timber production.

In the face of these threatening factors, there has been high need to document indigenous knowledge of local communities on the taxonomy, use and applications of medicinal plants. In Ethiopia, documentation of medicinal plants and associated indigenous knowledge has been incomplete (Balemie et al. 2004) as little emphasis has been given to ethnobotanical studies over the past decades (Giday 1999). However, there have been some efforts in investigating medicinal plants and indigenous knowledge on use and management of plant medicinal plant resources in recent years. We noted that limited data is available on medicinal plants and their uses in Nagelle Arsi District. Therefore, this study aimed at contributing to filling existing gap in data and knowledge on ethno botany and local phytomedicine preparations and applications in Nagelle Arsi District, West Arsi Zone of Oromia Regional National State, Ethiopia with the objectives of documenting medicinal plants and their conservation status; compiling data on uses of medicinal plants; documenting indigenous knowledge of local communities and collecting voucher specimen of medicinal plants thereby contributing to enriching collections in the National Herbarium of Ethiopia.

2. Materials and Methods
2.1 Description of the study area
Nagelle Arsi District is located in West Arsi Zone of Oromia National Regional State, Ethiopia. Langanno, Shalla and Abijata lakes are found in this District. The capital town of the District is also called Nagelle Arsi which is located at about 225 kms away from of Addis Ababa to South between 7° 13' 58.8" N to 7° 29' 24.4" N and 38° 43' 10.9" E to 38° 78' 07.5" E (Figure1). The altitudinal variation of the Woreda ranges from 1614 to 2540 meters above sea levele (masl).

2.1.2 Climate (Rainfall and Temperature)
Nagelle Arsi District is classified into three agroecological zones based on altitude. These are low, mid and high altitude climatic zones. Average annual temperature varies from 16-25° C and rainfall varies between 500-1500 mm.

2.1.2 Vegetation
The natural vegetation of the area has been broadly classified as dry evergreen montane forest and Acacia woodland vegetation type (Demissew & Friis 2009). Principal categories of forest vegetation include high forest from approximately 2100 m to 2450 m, Bamboo thicket from 2450 to 2650 m and low forest and woodland at the edge of and on the plain above the steep slopes occupied by bamboo. Large trees include Podocarpus falcatus, Celtis africana, Olea capensis and Prunus africana. Furthermore, understory species include Brueca antidisenterica, Cassipourea malosana, Lepidotrichilia volkensii, Maytenus spp., and Vepris dainelli, Albizia schimperiana, Calpurnia aurea, Cordia africana, Olea europea subsp.cuspidata are frequent at mountain edges (Dalle 2015).

2.2 Ethnobotanical Data Collection
Following reconnaissance survey, ethnobotanical data was collected from December 2016 to January 2017. During the survey, three representative agroecologies were selected using a stratified sampling technique. Altitude was used to stratify the study area in the district. In the second stage, proportional allocation techniques were used to determine the number of sample kebeles from each agroecology. Stratified and random sampling techniques were employed to select study kebeles and informants. Accordingly, a total of 17 kebeles (50% of the total kebeles) were selected and separated by altitude: high, medium and low altitude ranges. Concerning number of kebeles sampled, six, eight and three were selected from high, medium and low altitudinal ranges, respectively. Relatively more samples were taken from the medium altitude category because of the fact that most of the kebeles in Nagelle Arsi District belong to this category.

Furthermore, a preliminary survey was conducted on some kebeles to sketch out the overall status of medicinal plant distribution and indigenous knowledge in the study area. Following this, the study sites within the agroecology were systematically selected in accordance with their status of forest coverage and population settlement.

2.2.1 Informants selection
Following identified sample areas, informants were selected for the ethnobotanical study from the selected 17 kebeles using lottery methods. This was done by considering a list of households and their recognized indigenous knowledge on medicinal plants and their uses in each kebeles. Traditional healers were selected systematically with the help of local elders and administrators. As the result, a total of 90 informants (48 males and 42 females)
were selected from the age of 18 and above. Age group of the informants consists of young (18-35), middle (36-49) and elders (>50).

2.2.2 Data collection

Semi-structured interviews were conducted following Cotton (1996). These interviews were made with the help of translators who were conversant with the local language (Afan Oromo). But before conducting the interview, open discussions were held with to get consensus from the informants and also to clearly explain the objectives of the study. After consensus was reached, the interviews were conducted and data collected. The interviews were done mostly in the field in order to avoid the probable confusions with regard to the identity of medicinal plants. Moreover, the morphological characteristics, habitats and habits of medicinal plants were observed and recorded during and after the interviews. To correlate the common name with its scientific name, we collected plant specimens in the field, showed them to those interviewed in order to confirm the correct name of each species.

Group discussions were conducted in three different agroecological zones with number of 30 local community members which included eight traditional healers.

Guided field walks were also included in data collection aimed at observing, feeling, smelling and tasting different medicinal plants with the help of local informants. These ethnobotanical data collections were found to be more explanatory than talking without visualizing the plants. On the other hand, this guided field walk was used as an opportunity to record data on habitat, habit, and appearance, relation with other species and also for collecting voucher specimen.

Furthermore, market survey was made by selecting representative market places of the study area. Different sellers are interviewed and recorded the type of herbal drug sold in the market and multipurpose medicinal plants such as timber, farm implement, walking stick, food, spices, forage, wild edible fruits and traditional drug. And also data degree of utilization, variety, and economic importance of medicinal plants for the local community were collected.

2.2.3 Plant specimens collection and Identification

Herbarium samples of the listed medicinal plants were collected and recorded with the help of informants. The voucher specimen were coded, pressed, properly dried and taken to the National Herbarium of Addis Ababa University. Preliminary identification was also done in the field and further confirmation and identification of unknown species was done by using taxonomic key, comparison of authenticated voucher specimens deposited in Addis Ababa University herbarium and by the help of experts. Nomenclature of plant species follows published volumes of the Flora of Ethiopia and Eritrea.

2.3 Data analysis

Descriptive statistical method such as percentage and frequency distribution were employed to analyze and summarize the data on medicinal plants and associated knowledge. The relevant information collected and reported by local people, plant habit, plant parts used, methods of preparation, dosages and route of applications were analyzed through descriptive statistics.

Information provided by different informants was calculated using informants’ consensus factor (ICF) following Leonti et al. (2001). Seven use-categories were used for that purpose. An ICF value close to one is taken as an indication of high intra-cultural consensus, that is, more healers use the same plant species, where as, a value close to zero as a low probability of similarity in use of plants by different informants.

Preference or priority ranking was calculated for seven selected medicinal plants important to treat human and livestock stomach problem and degree of scarcity in each Kebeles following Martin (1995). These plants were chosen based on the information obtained from key informants. Eight key informants from each study site were selected and invited to rank these plants. Accordingly, each informant given the highest value for the most effective medicinal plants used by local community to treat stomach problem and least scarce plant species, and the lowest value for the plants species that is the least preferred medicinal plants and commonly available (not scarce). The values assigned by each key informant for each of the seven medicinal plants were summed up and the total scores were calculated and ranked.

To compare the relative importance of those medicinal plants in multipurpose role and dominant use, a use value ranking was done following Martin (1995) and Cotton (1996). Eight key informants were chosen to give use value to each medicinal plant species. The use values were given as five = best, four = very good, three = good, two = less used, one = least used, zero = not used. Based on the relative benefits obtained from each plant species, each key informant gave scores for each use value for six multipurpose medicinal plants and then average value (average score) of the total value of each use diversity for each species in each study site were summed up and ranked to compare the degree of preference and the various uses of the plant species in each study site.

Paired comparison is another analytical technique used for evaluating the degree of preferences or levels of importance of certain selected medicinal plants. After random arrangement the pairs ordered alphabetically and numbered them sequentially. Five of the most important medicinal and wild edible plants of the study areas (based
on their high use values as perceived and suggested by most informants of each study area) were selected and paired comparison was done following Martin (1995).

3. Results

3.1 Medicinal plants diversity and associated Knowledge

A total of 102 medicinal plants belonging to 85 genera and 55 families that were used for treating human and livestock ailments were collected and identified (Appendix 1). Four medicinal plants endemic to Ethiopia were also identified during this study. Top five Plant Families with the highest number of medicinal plants included Fabaceae (seven species in seven genera), Asteraceae (seven species in six genera), Lamiaceae (seven species in four genera), Solonaceae (six species in four genera) and Euphorbiaceae (five species in three genera). Trees and shrubs were the most commonly used medicinal plants comprising of 71.6% (shrubs represented by 37 species and trees 36 species) followed by herbs (23.5% or represented by 24 species). Besides, three climbers and two lianas were used as medicinal plants in the study area (Appendix 1).

Most identified and documented species (65 species or 63.74%) were used for treating human diseases, 30 species (29.40%) for treating both human and livestock diseases and seven species (6.86%) were used for treating only livestock diseases.

Out of the 90 informants participated in this study, males were 48 (53%) and females were 42 (47%). Comparison of their indigenous knowledge showed that women were more knowledgeable on medicinal plants collected from homesteads and men were better on species collected from wild. Furthermore, comparison between old (both men and women as one group and young including boys and girls) showed that elders had better knowledge on medicinal plants than young inhabitants. It was documented that traditional healers do transfer their knowledge to the eldest son in their family and try to keep their knowledge as top secret.

3.2 Plant parts used for preparing traditional medicine

Commonly used plant parts by local communities to treat human and livestock disease included leaves, roots, barks and seeds. Leaves were the most widely used plant parts (46.66%) followed by roots and barks (Table 1). The total number of species in Table 1 was greater than the total number of documented species showing the fact that different parts of the same plant were used for preparing remedy for different treatments (Appendix 2).

3.3 Types of human and livestock diseases treated with a number of species

Local communities used one or many species to prepare remedies. This study documented that a total of 30 human diseases were treated with a total of 65 plant species using 168 different types of preparations. Some plant species mixed with others plant species or mixtures of various substances were used to treat number of ailments (Table 2 and Appendix 2).

Similarly, the study showed that 13 livestock diseases were found to be treated with a total of 37 plant species and 68 preparations. For example, Anthrax is treated with 25 different plant species (Table 3 and Appendix 2).

3.4 Preparations, routes of administration and dosages

According to informants’ perception, 85% of herbal preparations were from freshly collected plant materials followed by 15% of dried parts of the plants. There were number of mixtures using hot or cold water, coffee or milk. On the other hand, it was perceived that as volume of solvents increase, the time required for healing increases, reduces uncomfortable taste and limit adverse side effects. Methods of preparation included crushing and boiling, powdering for chewing, squeezing, grinding, smoking, washing, rubbing and cream treatments (Table 4 and Appendix 2). Traditional healers also used mixing two or more medicinal plants to treat selected ailments. For example, leaves of Artemisia rehan was mixed with bark of Croton macrostachyus for the treatment of evil eyes.

Different applications were reported by the informants in the treatment of various human and livestock ailments (Appendix 2). The commonly recorded routes of administration were oral (53.33 %), followed by dermal (40 %), nasal (4%) and optical (2.66%). The most preferred mode of administration was oral because it was reported to be more effective for various ailments such as anti-parasites, and anti-bacterial diseases.

Different measuring materials such as glass of water, cup of tea, cup of coffee, tea spoons, and a range of litters were used to determine dosage. Most of the time prescriptions are based on age of the patient, gender, pregnancy status and the amount of remedies given by traditional healers. It was noted that dosages also vary based on indigenous knowledge of individuals. There also variations in time of the day, treatment duration, and mixture of substances. During this study, it was observed that there was a gap in having standard dosage determination among different traditional healers.
3.4 Ranking and scoring

3.4.1 Medicinal plants used for treatment of types of ailments
Eight traditional healers were asked to rank seven medicinal plants based on their indigenous knowledge using the degree of treatments for human and livestock disease and effectiveness. Bacterial, parasitic and fungal diseases were reported to be the most common in the study area. Verenonia amygdalina, Croton macrostachyus, and Podocarpus falcatus, were ranked as the most useful medicinal plants for treating parasitic and bacterial diseases (Table 5). Hagenia abyssinica was also perceived as important medicinal plant for treating tape worm problems.

3.4.2 Direct matrix ranking
Using direct matrix ranking method most important multipurpose species were identified. The eight key Informants reached consensus on the rank and score for six highest preferred multipurpose species by considering their value or desirability. Accordingly, Syzgium guineense was found to be the most important multipurpose plant scoring 23 followed by Allophylus abyssinicus and Celtis africana, each scoring 20 (Table 6).

3.4.3 Paired comparisons for five marketable medicinal plants
A paired comparison was made for five medicinal plants which have market values in the study area. Ximenia americana and Syzgium guineense were the most highly preferred species (Table 7). These species were found in local market places during their fruiting season and sold to different users. All these species were found in natural forest in the wild.

3.5 Informant consensus
Ten most popular plant species agreed upon during the study were selected and ranked. It was observed that some of medicinal plants were in higher demand and most frequently used by the local community than others. Informant consensus analysis showed that Ruta chalepensis (14%), followed by Ocimum lamiifolium (11%) and Vernonia amygdalina (13%) were most important medicinal plants for treating human ailments (Table 8).

3.6 Economic importance of some medicinal plants in the study area
In addition to their medicinal value, several plant species recorded during this study do play an important role in economic activities of the local communities. Some wild and cultivated medicinal plants such as Podocarpus falcatus, Agave sisalina, Artemisia rehan, Brassica olearceae, Croton macrostachyus, Coriandrum sativum, Cordia africana, Celtis africana, Ekebergia capensis, Hagenia abyssinica, Lippia adoensis, Moringa stenopetala, Opuntia ficus-indica, Olea europea subsp.cuspidata, Prunus africana, Ricinus communis, Ruta chalepensis, Syzgium guineense, Withania somenifera, are commonly collected and sold in the local or urban market places. Olea europea subsp.cuspidata, and Ekebergia capensis. Withania somenifera, Brassica olearceae are used for smoking traditional bee hives. It was reported that the good smell of smoke from these species has been used to attract bees to bee hives. Several of the documented medicinal plants (for example, Opuntia ficus-indica, Syzgium guineense and Ximenia Americana) are also widely used for human consumption as fruits. Coriandrum sativum, Lippia adoensis, Ruta chalepensis and Brassica olearceae are highly demanded for their condiment value in almost all markets in the study area. Furthermore, a number of tree species were used to produce good quality timber and also for construction including Podocarpus falcatus, Cordia africana, Croton macrostachyus, Celtis africana, Ekebergia capensis, Hagenia abyssinica and Prunus africana. It was recorded that 1Pices of timber was sold for 250 to300 Ethiopian Birr or $9-13 US Dollars in local market. Moringa stenopetala was perceived as the most important and widely used plant species for different human ailments and food value and was sold 150 Ethiopian Birr per kg or $6.12 US Dollars. Artemisia rehan and Ricinus communis werea lso commonly sold in the markets (Table 9).

3.7 Threats to medicinal plants
This study covered three different agroecological zones: High lands (altitude range greater than 2500 m asl), mid altitudinal range (1500-2500m asl) and low lands (< 1500m asl). The highest numbers of medicinal plants were collected from altitude between 1500-2500m asl followed by low land areas.

According to perception of pastoralists and observations during this study, major factors causing decline of medicinal plants and associated indigenous knowledge included anthropogenic and natural factors (climate change). Agricultural land expansion into forest and grasslands, deforestation, over exploitation of some selected species, land degradation, unsustainable fuel wood and charcoal production and overgrazing were identified as anthropogenic problems in the area. Frequent drought was perceived as natural problem resulting in environmental degradation and loss of species in the lowland areas (Table 10). Ten Informants’ ranked their degree of damage. Deforestation was identified as the main threatening factor, followed by agricultural land expansion, fuel wood and charcoal production.
4. Discussions

4.1 Medicinal Plants Diversity and Habitats Comparisons

The study result showed that Nagelle Arsi District was rich in medicinal plants having 102 species in 85 genera, and 55 families. Fabaceae, Asteraceae, Lamiaceae and Solonaceae were most important families with many medicinal plants. Similar results were reported from different parts of Ethiopia (Kidane et al. 2018; Lulekal et al. 2008; Lulekal 2013; Yineger 2005). Most medicinal species were found in natural vegetations (wild) in agreement with previous reports (Awas & Demissew 2009; Gebrehiwot 2010; Issa et al. 2018; Kidane et al. 2018; Lulekal et al. 2008; Yineger 2005) and also indicating the fact that there is high need to conserve and sustainably manage forest ecosystems and grasslands to ensure availability of these medicinal plants for current and future generations.

The habitats of most medicinal plants were mid altitudinal ranges. Similar results have been reported from other study areas (Abdela et al. 2018; Gebrehiwot 2010). On the other hand, this altitudinal range is the most favorable for cereal crop production causing a serious concern of further loss of medicinal plants. This concern need to be noted and practical action is needed on time to minimize the unregulated negative impacts of agricultural expansions on medicinal plants.

4.2. Indigenous knowledge on the use and parts used of medicinal plants

Indigenous and local communities rely on herbal medicines to prevent and cure various health problems. Traditional healers have been playing an important role in the primary health care system of the rural community who had less access and could not afford the cost of modern medication. We documented that old and middle aged women and men had more knowledge than the young generation in agreement with previous research findings (Asfaw and Nigatu 1995; Awas 2007; Gemedo-Dalle et al. 2005; Giday et al. 2003; Teklehaymanot 2007). It was also observed that the young generation showed no interest to learn and make use of traditional medicines. The other practical challenge noted during this study was that there was no documentation of indigenous knowledge by traditional healers as the knowledge is transferred orally to the eldest son in the family.

4.3. Comparative assessments on medicinal plants used for treating ailments, parts used and routes of administration

This study documented many medicinal plants used for the treatment of both human and livestocks ailments. Most (63%) medicinal plants were used for treating human ailments. Similar result was reported (Lulekal et al. 2008) from Mana Angetu District, southeastern Ethiopia where 78.70 % medicinal plants were used as human medicine. Many medicinal plants identified and recorded during this study were also reported as medicinal in other parts of Ethiopia (Lulekal et al. 2013). Verononia amygdalina, Croton macrostachyus and Podocarpus falcatus were the most valuable medicinal plants for treating parasitic and bacterial diseases followed by Hagenia abyssinica. Other medicinal plants used for the treatment of human ailments in the study area included Moringa stenopetala for treating blood pressure, Acokanthera schimperi for treating Cancer and Grewia ferruginea for treating diabetes.

Leaves were the most widely used plant parts in Nagelle Arsi District followed by roots in agreement with many studies elsewhere (Giday et al. 2003; Kidane et al. 2018). However, other research results reported roots as the most frequently used plant parts in many areas in Africa (Abdela et al. 2018; Issa et al. 2018; Lulekal et al. 2008; Lulekal et al. 2013).

Shrubs were the most commonly used (43 %) followed by trees (35%) and herbs (22 %). This finding was not in agreement with report by Issa et al. (2018) who documented that the dominant medicinal plants in Algoz area, South Kordofan, Sudan were herbs followed by trees and shrubs. The dominance of trees and shrubs in Nagelle Arsi District could be an indicator of high degree of unregulated agricultural expansion into high forests, woodland and grasslands resulting in loss of herbaceous species.

The majority of remedies in the study area were prepared from fresh materials of leaves, barks, roots, and fruits of the plants. Most of them were prepared by crushing, boiling, chewing, smoking, grinding, and powder forms.

The most commonly used route of administration was oral followed by dermal. Oral administration was preferred because it was believed to be more effective in agreement with research results from somewhere else (Gebrehiwot 2010; Giday et al. 2003).

It was also observed that traditional medicine was prescribed or given based on the age of the patient, gender and pregnancy status. And also amount or volume of remedies given by traditional healers varies according to their respective indigenous knowledge. It was also noted that dosage still remains serious concern as there was differences among healers for treating the same kind of health problem by applying different dosages of the same herbal medicine as there was no established standard of measurement. Similar problem was also reported from other places (Ashagre et al. 2016; Gebrehiwot 2010; Lulekal et al. 2008; Tolasa 2007; Yineger 2005). Lack of precision and standardization has been mentioned as a global drawback of the traditional healthcare system that needs to be rectified by putting in place global and national system that would recognize the role and contribution of traditional healing and also that ensures effective benefit-sharing mechanism including intellectual property
rights of the knowledge holders.

4.4 Threats to medicinal plants and potential solutions
The most serious threats to medicinal plants in the study area were agricultural land expansion, deforestation, over exploitation and land degradation, unsustainable fuel wood and charcoal production and overgrazing. Similar threatening factors have been reported from different regions within Ethiopia (Ashagre et al. 2016; Lulekal et al. 2008). This unregulated agricultural expansion resulted from high population growth and lack of land use policy in the Country. With the aim of increasing agricultural productivity, forest lands and grasslands have been converted into farmlands causing loss of local biodiversity including medicinal plants. Increasing agricultural productivity should not be at the expense of forest and grassland biodiversity and associated ecosystem services. Agricultural intensification should be considered as the only option to increase productivity using all technological inputs and human technical expertise. The other threatening factor was overexploitation of medicinal and other plants for timber, fuelwood and construction materials. Increasing energy availability to inhabitants in local towns and promoting plantation forestry to minimize negative impacts on natural forest and woodland ecosystems was noted as critical actions that should be taken as soon as possible. Some of the medicinal plants perceived by local communities as being threatened such as Milletia ferruginea, Urtica simensis, Solanecio gigas and Maytenus addat were also included in the IUCN Red lists. This could be one practical example of the complementary nature of indigenous and scientific knowledge that we need to make use of for the conservation and sustainable use of medicinal plants.

It was recommended that there is high need to conserve medicinal plants and their ecosystems in Nagelle Arsi District and other parts of the Country. Both regional and federal governments should give priority to conservation of these precious resources using both in-situ and ex-situ conservation methods. Ethiopia has good environmental and biodiversity domestic legislations. However, law enforcement remains a practical challenge. Therefore, empowering institutions by both human and financial resources is critical to ensure sustainable utilization of medicinal plants in the Country. There should be strong regulation on production and sale of firewood. Furthermore, putting in place a functional system that would protect intellectual property rights of the traditional healers and also ensures their benefit sharing is important and timely. Technical support and capacity development of traditional healers for safe handling of medicinal plants and and their medicine were identified as important interventions. Bioprospecting on most commonly used medicinal species and establishing pharmacological industries was identified as one area of priority to promote conservation and sustainable use of medicinal plants in Ethiopia. Protection of intellectual property rights, capacity development and participatory bioprospecting researches were identified as important measures that would promote sustainable use of the rich medicinal plants in the study area and beyond.

5. Conclusion
The findings of this study revealed that Nagelle Arsi District was endowed with several medicinal plant species used for treating human and livestock ailments. Diverse medicinal plants were used for treating different diseases. Human ailments such as stomach discomfort and internal parasites, cough, fever, diarrhea, malaria, hemorrhoids, tapeworm, blood pressure, liver, kidney, toothache, tonsillitis, wound, cancer, headache, diabetes, prostate gland problem, asthma (respiratory complication), and many others were treated using indigenous knowledge of the local communities.

Local communities did prefer to use traditional medicines for their primary health care because of the fact that these remedies were available easily and also cheaper than the modern medicine. As leaves, roots and barks are the most frequently used plant parts for the preparation of remedies; there is a serious concern over the sustainable use of these medicinal plants. There is a need for conservation of these plants and public awareness raising with focus on threats to natural resources in general and medicinal plants in particular.

Although remedies were prescribed and given based on age, gender and pregnancy status, the knowledge gap on the right and effective dosage remained a serious concern calling for close follow up and support from the health sector and also from other related Institutions. The major threats to medicinal plants in the study area were anthropogenic factors such as agricultural land expansion, deforestation, over exploitation and land degradation, fuel wood and charcoal production and overgrazing. Conservation of medicinal plants using both in-situ and ex-situ methods, rehabilitation of degraded ecosystems, sustainable use of natural resources and market linkages for potential medicinal plant products were recommended as a result of this study.

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Figure 1. Map of Ethiopia showing regional states and the study area

Table 1. Plant parts used for the treatment of human and livestock diseases in Nagelle Arsi District, Oromia, Ethiopia

| Plant parts | No. of medicinal plants | %  |
|-------------|-------------------------|----|
| Leaves      | 70                      | 46.66 |
| Roots       | 26                      | 25.49 |
| Barks       | 23                      | 15.33 |
| Seeds       | 5                       | 3.33  |
| Flowers     | 3                       | 2.00  |
| Sap         | 1                       | 1.00  |
| Bulbs       | 1                       | 1.00  |
| Fruits      | 6                       | 4.19  |
| Stems       | 1                       | 1.00  |
| Total       | 150                     | 100   |
Table 2. Major human disease treated with remedies prepared from medicinal plants in Nagelle Arsi District, Oromia, Ethiopia.

| Types of diseases       | No. of medicinal plants used |
|-------------------------|-----------------------------|
| Internal parasite       | 14                          |
| Malaria                 | 15                          |
| Cough                   | 6                           |
| Cancer                  | 4                           |
| Blood pressure          | 2                           |
| Hemorrhoids             | 6                           |
| Liver                   | 5                           |
| Diabetes                | 2                           |
| Diarrhea                | 6                           |
| Tuberculosis            | 3                           |

Table 3. Major livestock disease treated with remedies prepared from medicinal plants in Nagelle Arsi District, Oromia, Ethiopia.

| Disease                   | No. of medicinal plants used |
|---------------------------|-----------------------------|
| Anthrax                   | 25                          |
| Black leg                 | 7                           |
| Sudden sickness           | 5                           |
| Diarrhea                  | 8                           |
| Skin disease              | 4                           |
| Wound                     | 5                           |
| Cough                     | 4                           |
| Mastitis                  | 1                           |
| Internal parasites        | 10                          |
| Bone deafening            | 2                           |
| Eye disease               | 1                           |
| Hemorrhagic Septicemia    | 9                           |

Table 4. Methods of traditional medicine preparations in Nagelle Arsi District, Oromia, Ethiopia.

| Method                  | Total No. preparations | %   |
|-------------------------|------------------------|-----|
| Crushing & boiling      | 73                     | 43.45|
| Powdering form          | 42                     | 25.00|
| Chewing                 | 10                     | 5.95 |
| Squeezing               | 14                     | 8.33 |
| Smoking                 | 8                      | 4.76 |
| Washing                 | 11                     | 6.54 |
| Rubbing                 | 7                      | 4.19 |
| Cream                   | 3                      | 1.78 |
| Total                   | 168                    | 100  |

Table 5. Preference ranking of medicinal plants used to treat human and livestock disease in Nagelle Arsi District, Oromia, Ethiopia.

| List of medicinal plants | Respondent |
|--------------------------|------------|
| Podocarpus falcatus      | R1 5 R2 3 R3 6 R4 5 R5 7 R6 7 R7 6 R8 5 Total 44 Rank 3 |
| Croton macrostachyus     | R1 6 R2 5 R3 7 R4 6 R5 5 R6 5 R7 5 Total 45 Rank 2 |
| Hagenia abyssinica       | R1 3 R2 4 R3 4 R4 3 R5 5 R6 3 R7 2 R8 1 Total 25 Rank 4 |
| Maesa lanceolata         | R1 4 R2 2 R3 3 R4 2 R5 2 R6 4 R7 4 R8 3 Total 23 Rank 5 |
| Syzygium guineense       | R1 2 R2 4 R3 1 R4 4 R5 3 R6 3 R7 1 R8 3 Total 21 Rank 6 |
| Shifferia abyssinica     | R1 1 R2 5 R3 2 R4 1 R5 1 R6 1 R7 3 R8 2 Total 16 Rank 7 |
| Vernonia amygdalina      | R1 7 R2 7 R3 6 R4 6 R5 5 R6 7 R7 6 Total 50 Rank 1 |
### Table 6. Direct matrix ranking by respondents for six plant species and five major uses in Nagelle Arsi District, Oromia, Ethiopia.

| List of medicinal plants        | Use categories |   |   |   |   | Total | Rank |
|---------------------------------|----------------|---|---|---|---|-------|------|
|                                 | Medicine       | Food | Fuel | Forage | Construction |       |      |
| **Allophylus abyssinicus**      | 6              | 5   | 3   | 4     | 2            | 20    | 2    |
| **Celtis africana**             | 4              | 0   | 5   | 5     | 6            | 20    | 2    |
| **Cordia africana**             | 2              | 3   | 5   | 2     | 6            | 18    | 4    |
| **Erythrina abyssinica**        | 6              | 0   | 3   | 5     | 2            | 16    | 5    |
| **Prunus africana**             | 6              | 0   | 5   | 2     | 6            | 19    | 3    |
| **Syzgium guineense**           | 6              | 5   | 5   | 3     | 4            | 23    | 1    |

### Table 7. Paired comparisons for five marketable medicinal plants in Nagelle Arsi District, Oromia, Ethiopia

| List of medicinal plants       | Respondent 1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | R10 | Total | Rank |
|--------------------------------|--------------|----|----|----|----|----|----|----|----|-----|-------|------|
| **Allophylus abyssinicus**     | 3            | 3  | 2  | 2  | 1  | 2  | 1  | 3  | 1  | 7   | 17    | 5    |
| **Balanites aegyptica**        | 3            | 3  | 4  | 2  | 3  | 4  | 3  | 2  | 24  |     | 24    | 4    |
| **Carissa spinarum**           | 4            | 3  | 4  | 3  | 2  | 4  | 2  | 25  |     |     | 25    | 3    |
| **Syzgium guineense**          | 4            | 4  | 4  | 3  | 4  | 3  | 4  | 30  |     |     | 30    | 2    |
| **Ximenia americana**          | 4            | 4  | 4  | 4  | 4  | 4  | 4  | 32  |     |     | 32    | 1    |

### Table 8. Informant consensus of most popular medicinal plants in Nagelle Arsi District, Oromia, Ethiopia

| Scientific Name                  | No. of informants | %  |
|----------------------------------|-------------------|----|
| **Ocimum lamiifolium**           | 19                | 11 |
| **Moringa stenopetala**          | 13                | 9  |
| **Croton macrostachyus**         | 17                | 12 |
| **Artemisia rehan**              | 15                | 10 |
| **Olea europea subsp.cuspidata** | 11                | 8  |
| **Ruta chalepensis**             | 20                | 14 |
| **Vernonia amygdalina**          | 18                | 13 |
| **Hagenia abyssinica**           | 12                | 8  |
| **Withania somenifera**          | 10                | 7  |
| **Prunus africana**              | 11                | 8  |

### Table 9. Most common medicinal plants sold in the local market area in Nagelle Arsi, Oromia, Ethiopia

| Scientific name               | Unit of measure | Price (Ethiopian Birr) |
|-------------------------------|-----------------|------------------------|
| **Brassica olearcea**         | Cup of coffee   | 10                     |
| **Coriandrum sativum**        | Cup of coffee   | 7                      |
| **Hagenia abyssinica**        | Kg              | 20                     |
| **Lippia adoensis**           | Tie bundles     | 5                      |
| **Moringa stenopetala**       | Kg              | 150                    |
| **Olea europea subsp.cuspidata** | Tie bundles   | 200                    |
| ** Ricinus communis**         | Cup of coffee   | 10                     |
| ** Ruta chalepensis**         | Tie bundles     | 5                      |
| **Withania somenifera**       | Tie bundles     | 10                     |

### Table 10. Major threats to medicinal plants in Nagelle Arsi District, Oromia, Ethiopia.

| Threats                      | R1  | R2  | R3  | R4  | R5  | R6  | R7  | R8  | R9  | R10 | Total | Rank |
|------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|------|
| **Agricultural Expansion**   | 5   | 4   | 5   | 5   | 4   | 4   | 4   | 4   | 4   | 4   | 45    | 2    |
| **Deforestation**            | 6   | 6   | 6   | 6   | 5   | 6   | 5   | 5   | 5   | 5   | 56    | 1    |
| **Fuelwood and Charcoal**    | 3   | 5   | 4   | 4   | 3   | 3   | 4   | 5   | 5   | 4   | 40    | 3    |
| **Over exploitation**        | 4   | 4   | 5   | 4   | 3   | 3   | 4   | 4   | 3   | 5   | 39    | 4    |
| **Overgrazing**              | 2   | 2   | 3   | 2   | 3   | 2   | 3   | 3   | 2   | 5   | 24    | 5    |
| **Drought**                  | 2   | 3   | 2   | 2   | 1   | 2   | 1   | 1   | 2   | 1   | 17    | 6    |

\[ T^1 = \text{Total and } R^1 = \text{Rank and R1 to R10 are respondents 1 to 10.} \]
Appendix 1. List of medicinal plants in Nagelle Arsi district, Oromia, Ethiopia.

| No. | Plant Name | Family Name | Local Name (Afaan Oromoo.) | Code | Growth Habit |
|-----|------------|-------------|-----------------------------|------|--------------|
| 1   | Acacia abyssinica | Fabaceae | Laaftoo | MBGH-084 | T |
| 2   | Acyranthes aspera | Amaranthaceae | Darguu | MBGH-026 | H |
| 3   | Acokanthera schimperi | (A.DC) | APOCYNACEAE | MBGH-070 | S |
| 4   | Podocarpus falcatus | (Thunb.) | PODOCARPACEAE | MBGH-005 | T |
| 5   | Agave sisalina | Borgoraceae | Qachaa | MBGH-064 | H |
| 6   | Ajuga integrifolia | Buckwheat | lam. ex D. Don | LAMIAEACEAE | Harimmaguussaa | MBGH-103 | H |
| 7   | Allium sativum | Liliaceae | Qulfubbi adii | MBGH-105 | H |
| 8   | Albizia gummifera | (J.F.Gmel.) | C.A.Sm.var | FABACEAE | Qaracee | MBGH-035 | T |
| 9   | Allophylus abyssinicus | Fabaceae | Sapindaceae | Hirqamuu | MBGH-010 | T |
| 10  | Aloe spp. | ALOACEAE | Hargisa | MBGH-008 | H |
| 11  | Amaranthus caudatus | Amaranthaceae | Urgoo harree | MBGH-027 | H |
| 12  | Amaranthus spinosus | Amaranthaceae | Raafu harre | MBGH-074 | H |
| 13  | Apodytes dimidiatus | Euphorbiaceae | E.Mey.ex .Arn | ICACINACEAE | Odaa baddaa | MBGH-038 | T |
| 14  | Artemisia rehan Chiov. | Acanthaceae | Arititti | MBGH-080 | H |
| 15  | Asparagus africanus | Lamiaceae | ASPARAGACEAE | Sarahiit | MBGH-034 | S |
| 16  | Balanites aegyptica | (L.) Del.De | BALANTACEAE | Badana | MBGH-055 | T |
| 17  | Bursaria abyssinica | Fabaceae | Fresen. | MBGH-017 | T |
| 18  | Brassica olarcea var. Capitata | Brassicaceae | LAM. | Danqalee | MBGH-037 | H |
| 19  | Bruea antidesmatis | (J.F Miller | SIMAROBACEAE | Cirotaa | MBGH-023 | T |
| 20  | Buddleja polystachya | Fabaceae | Fresen. | UGGIDA | MBGH-090 | S |
| 21  | Calpurnia aurea | (Ait.) Benth. | Fabaceae | Ceketaa | MBGH-013 | S |
| 22  | Capparis tomentose | Fabaceae | Lam. | MBGH-095 | L |
| 23  | Carissa spinarum | Fabaceae | LAM. | Agamsa | MBGH-040 | S |
| 24  | Celtis africana | ULMACEAE | Burm.f. | AMALAAQA | MBGH-002 | T |
| 25  | Clematis sinensis | Fabaceae | Fresen. | MBGH-046 | C |
| 26  | Clerodendrum myricoides | (Hochst.) | R.Br.ex vatke | VERBENACEAE | Marachissa | MBGH-048 | S |
| 27  | Cordia africana | Boraginaceae | Lam. | Wodesse | MBGH-096 | T |
| 28  | Corydalis sativum | Papaveraceae | LAM. | Dimbelal | MBGH-105 | H |
| 29  | Croton dichogomas | Euphorbiaceae | Pax | Ulee foontii | MBGH-056 | S |
| 30  | Croton macrostachyus | Euphorbiaceae | Hochst. | Mokonissaa | MBGH-019 | T |
| 31  | Cynoglossum lanceolatium | Boraginaceae | Forsk. | MBGH-024 | H |
| 32  | Cyphostemma adenocalya | (Steud.ex | Vitaceae | Maranhica | MBGH-057 | C |
| 33  | Datura stramonium | Solanaceae | L. | Banji | MBGH-009 | H |
| 34  | Delonix elata | Fabaceae | Maralilo | MBGH-104 | T |
| 35  | Discocodium penninervum | (Hochst.) | SOLANACEAE | Maralilo | MBGH-087 | S |
| 36  | Dovallia abyssinica | (A.Rich,)Warb. | LAMIAEACEAE | Dhangango | MBGH-094 | S |
| 37  | Echinopex angustilolus | A.Rich. | S.Mooro | ASTERACEAE | Anishookakalaa | MBGH-039 | S |
| 38  | Ekebergia capensis | Sapindaceae | Sparrr | MBGH-052 | S |
| 39  | Embeilia schimperi | Vitaceae | VITACEAE | Gaalee | MBGH-057 | C |
| 40  | Erythrina abyssinica | Fabaceae | Lam.ex.Dc | Woleenaa | MBGH-009 | T |
| 41  | Eucalyp schimperi | Fabaceae | (De) Dandy | EBERACEAE | M’eesa | MBGH-060 | T |
| 42  | Euphorbia abyssinica | Euphorbiaceae | Gmel. | EUPHORBIACEAE | Adamaa | MBGH-082 | T |
| 43  | Euphorbia depauperata | Euphorbiaceae | Gurlii | MBGH-036 | H |
| 44  | Ficus thonningii | Moraceae | Blume | MBGH-031 | T |
| 45  | Galenia saxifrage | Rubiaceae | (Hochst.) | BRUNIA | Dambii | MBGH-031 | T |
| 46  | Grewia ferrarina | TILIACEAE | Hochst.ex | Dhoquna | MBGH-071 | S |
| 47  | Hagenia abyssinica | (Bruce).J.F.Gmelin | A.Rich. | ROSACEAE | Heexoo | MBGH-051 | T |
| 48  | Hypericum quintirnainum | A.Rich. | HYPERICACEAE | Garanbaa | MBGH-081 | S |
| 49  | Justicia schimperiana | (Hochst.ex | T.Ander. | ACHANTHACEAE | Dhummuugaa | MBGH-066 | S |
| 50  | Juniperus procera | Cupressaceae | Hochst. ex Endl. | HIDHEESSA | MBGH-102 | T |
| 51  | Kalanchoe pettiana | CRASSULACEAE | A.Rich. | Hancuurraa | MBGH-016 | H |
| 52  | Lippia adoensis | Verbenaceae | L. | Sokorrui | MBGH-063 | S |
| 53  | Maesa Lanceolata | Myrsinaceae | Forsk. | ABAYAY | MBGH-011 | T |
| No. | Plant Name | Family Name | Local Name (Afaan Oromoo.) | Code | Growth Habit |
|-----|------------|-------------|-----------------------------|------|--------------|
| 54  | Malva verticillata L. | MALVACEAE | MBGH-075 | H | |
| 55  | Maytenus bidwillii (Loes.) | CELASTERACEAE | Kombolcha | MBGH-073 | T | |
| 56  | Maytenus arbutifolia (A.Rich.) Wilczek | CELASTERACEAE | Kombolcha | MBGH-077 | T | |
| 57  | Millettia ferruginea (Hochst.) Bakk. | FABACEAE | Dallatu/ Birbiraa | MBGH-092 | T | |
| 58  | Mimusops kummel A.DC. | SAPOTACEAE | Olaati | MBGH-059 | T | |
| 59  | Moringa stenopetala (Bok.f.) cuft | MORINGACEAE | Moringaa | MBGH-100 | T | |
| 60  | Myrica salicifolia A.Rich. | MYRICACEAE | Qamoo | MBGH-102 | T | |
| 61  | Myrsine africana L. | MYRSINACEAE | Xeexee/Abeyee | MBGH-095 | S | |
| 62  | Myrsine melanophlophous (L.) R.Br. | MYRSINACEAE | Tuulla | MBGH-020 | S | |
| 63  | Nuxia congesta R.Br. ex Fresen | BUDDLEIACEAE | Biixannaa | MBGH-078 | T | |
| 64  | Ocimum basilicum L. | LAMIACEAE | Bassobila | MBGH-028 | S | |
| 65  | Ocimum gratissimum L. | LAMIACEAE | Canbiicha | MBGH-098 | S | |
| 66  | Ocimum lamiifolium Hochst.ex Benth. | LAMIACEAE | Qoricha micii | MBGH-012 | S | |
| 67  | Ocimum utricifolium Roth. | LAMIACEAE | Canbiicha | MBGH-085 | S | |
| 68  | Olea europea subsp. cuspidata L. | OLEACEAE | Ejersa | MBGH-008 | T | |
| 69  | Olinia rochetiana A.Juss. | OLINIACEAE | Gunaa | MBGH-101 | T | |
| 70  | Opuntia ficus-indica (L.) Miller. | CACTACEAE | Qulquali | MBGH-061 | S | |
| 71  | Plecanthus marrubatus | LAMIACEAE | Qoricha micii/Damakasee | MBGH-072 | H | |
| 72  | Phytolacca dodendandra L Her. | PHYTOLACCAEACE | Handoodee | MBGH-030 | L | |
| 73  | Prunus africana (Hook.f)Kalkm | ROSACEAE | Sukkee | MBGH-001 | T | |
| 74  | Psidixs scimperiana (A.Rich.) Bridson | RUBIACEAE | Gaaliilo | MBGH-050 | H | |
| 75  | Plantago lanceolata L. | PLANTAGINACEAE | Gooxobi | MBGH-106 | H | |
| 76  | Rhus tenuinervis Engl. | ANACARDIACEAE | Ooalsa | MBGH-097 | S | |
| 77  | Ricinus communis L. | EUPHORBIACEAE | Qoboo | MBGH-029 | S | |
| 78  | Rubus steudneri Schweinf. | RUBIACEAE | Gora | MBGH-089 | S | |
| 79  | Rumex abyssinica Jacq. | POLYGONACEAE | POLYGONACEAE | MBGH-067 | H | |
| 80  | Rumex nepalensis Spreng. | POLYGONACEAE | Shabbee | MBGH-045 | H | |
| 81  | Ruta chalepensis L. | RUTACEAE | Xenadam | MBGH-025 | H | |
| 82  | Saliva nilotica Juss.ex Jacq. | LAMIACEAE | Hulegebi | MBGH-101 | H | |
| 83  | Senna septomorlisis | FABACEAE | Ajaawaa | MBGH-047 | S | |
| 84  | Shifleria abyssinica | SAPOTACEAE | Gataame | MBGH-003 | T | |
| 85  | Sida rhombifolia L. | MALVACEAE | Chifiriga | MBGH-053 | H | |
| 86  | Senecio gigas Vatke | ASTERACEAE | Agadenaa | MBGH-022 | H | |
| 87  | Solanisio myrioecephalus Sch. Bip. | ASTERACEAE | ASTERACEAE | MBGH-091 | S | |
| 88  | Solanum anguivi L. | SOLANACEAE | SOLANACEAE | MBGH-107 | S | |
| 89  | Solanum incanum L. | SOLANACEAE | Hiddii | MBGH-044 | S | |
| 90  | Solanum marginatum L.f. | SOLANACEAE | Hiddii Oromo | MBGH-043 | S | |
| 91  | Spilanthes uliginaosa SW. | ASTERACEAE | ASTERACEAE | MBGH-032 | H | |
| 92  | Stephania abyssinica (Dillon & A.Rich.). Walp. | MENISPERMACEAE | Kalaala | MBGH-015 | C | |
| 93  | Syzygium guineense (wildl).Dc. | MYRTACEAE | Baadaessa | MBGH-006 | T | |
| 94  | Trelea simplicifolia (Engl.) Verdoorn. | RUTACEAE | Hadheessa | MBGH-007 | T | |
| 95  | Trelea nobilis Del. | RUTACEAE | Hadheessa | MBGH-108 | T | |
| 96  | Urica simensis Steudel | URTICACEAE | Doobi | MBGH-014 | S | |
| 97  | Urea lyselondron (A.Rich) | URTICACEAE | Haliraa | MBGH-053 | S | |
| 98  | Vernonia amygdalina Del. | ASTERACEAE | Ebicha | MBGH-004 | S | |
| 99  | Vernonia urchefolia A.Rich | ASTERACEAE | Rejii | MBGH-099 | S | |
| 100 | Withania somenfera (L.) Dunal in DC. | SOLANACEAE | Unsoo | MBGH-054 | S | |
| 101 | Ximenia americana L. | OLEACEAE | Hudhaa | MBGH-068 | S | |
| 102 | Ziziphus spina-christi (L.) Desf. | RHAMNACEAE | Qurquraa | MBGH-093 | T |
### Appendix 2. Medicinal plants used for treating human and livestock diseases in Nagelle Arsi District, Oromia, Ethiopia.

| Scientific name                      | PU Use | Diseases             | Mode of preparation                                      | Route of Add. |
|--------------------------------------|--------|----------------------|----------------------------------------------------------|---------------|
| **Acacia abyssinica**<br>Hochst.ex Benth. | L Hu   | Cancer               | Crushed the leaves and mixed with water 1/2 cup of tea   | Oral          |
|                                      | R Hu   | Swelling             | Crushed the root part and put on the swelling part of the body | Dermal        |
|                                      | R Hu   | Malaria, TB          | Crushed the root part and mixed with water 1 cup of coffee for 2 days | Oral          |
|                                      | R Hu   | Abortion             | Crushed the root & mixed with water, 1 cup of coffee      | Oral          |
|                                      | R Ls   | Internal parasite    | Crushed the root part and mixed with salt 1 litter for 3 days | Oral          |
| **Achyranthes aspera** L.            | L Hu   | Cancer               | Crushed the leaves and mix with water for 5days 1 cup of tea | Oral          |
|                                      | L Hu   | Tooth ache           | Crushed the leaves & ponded, then chewing                | Oral          |
|                                      | L & R  | Anthrax              | Crushed the leaves and root part & mixed with water for 7days 1 litter | Oral          |
| **Acokanthera schimperi**<br>(A.DC) Schweinf. | B Hu | Hemorrhoids, Cancer, TB | Crushed the leaves & mix with water for 7days | Dermal |
|                                      | B Ls   | Internal parasites   | Crushed the bark & with water 1litter for 3 days         | Oral          |
|                                      | B Ls   | Anthrax              | Crushed the bark mix with water 1litter for 5 days       | Oral          |
| **Podocarpus falcatus**<br>(Thunb.) R.B ex..mirb | L Hu | Hemorrhoids, cancer | Crushed the leaves & mixed with water            | Oral          |
|                                      | L Ls   | Anthrax              | Crushed the leaves & mixed with salt for 5days           | Oral          |
| **Agave sisalina**<br>perrine ex. Engl. | R Hu | Internal parasites   | Crushed the root part & mix with water 2tea spoon 1 day  | Oral          |
| **Ajuga integrifolia**<br>Buch.-Ham. ex D. Don | L & R | Hemorrhoids, Liver   | Crushed the leaves, roots & mixed with water ½ cup of tea | Oral          |
| **Albizia gummifera**<br>(J.F.Gmel.) C.A.Sm.var | L Ls | Anthrax              | Crushed the leaves, roots & mixed with water, 1lit for 3days | Oral          |
| **Allium sativum** L.                | BL Hu  | Common cold          | The bulb boiled with milk & honey until the disease will cure | Oral          |
|                                      | BL Hu  | Malaria              | The bulb boiled with honey for 7 days                    | Oral          |
| **Allophylus abyssinicus**<br>(Hochest.) Radlk. | B Hu | Diarrhea             | Crushed the bark part & mix with water ½ cup of coffee for 1 week | Oral          |
|                                      | B Hu   | Wound                | Crushed the bark part & mix with butter, put on infected part of the skin | Dermal |
| **Aloe spp.**                        | L Hu   | Diarrhoea            | Boiled the leaf part, ½ cup of coffee                    | Oral          |
| **Amaranthus caudatus** L.           | L Ls   | Sudden sickness      | Crushed the leaves and take sap & mix with water, 1lit, for 1-2days | Oral          |
| **Amaranthus spinosus** L.           | S Hu   | Diarrhea             | Grind the seed or crushed the leaves & mixed with Allium s. | Oral          |
| **Apodytes dimidata**<br>E.Mey.ex .Arn | B Hu | Stomach ache, cough  | Crushed & bold the bark part & mixed with milk          | Oral          |
| **Artemisia rehan** Chiov.           | L Hu   | Evil eye             | Crushed the leaves, fumigate                            | Nasal         |
| **Asparagus africanus**<br>Lam.      | R L Hu | TB, cough, wound     | Crushed the root part & mix with water 2tea spoon 7 day  | Oral & dermal |
|                                      | R L    | Anthrax, black leg   | Crushed the root part & mix with water 1cup of tea 5 day | Oral          |
| **Balanites aegyptica** (L.) Del.De. | L Hu   | Malaria              | Crushed & boiled the Leaves part & mix with water 1cup of tea for 5 day | Oral          |
| **Aloe spp.**                        | L Hu   | Diarrhoea            | Boiled the leaf part, ½ cup of coffee                    | Oral          |
| Scientific name                  | PU | Use  | Diseases                          | Mode of preparation                                      | Route of Add. |
|---------------------------------|----|------|-----------------------------------|----------------------------------------------------------|---------------|
| Bersama abyssinica Fresen.      | B  | Hu   | Cough                             | Crushed the Leaves part & mix with water                 | Oral          |
| Brassica oleracea var. Capitata L. | S  | Hu   | Amoeba, common cold               | Grind the seed & mix with water. 3 tea spoon 2 times a day | Oral          |
| Brueca antidysentrica J.F Miller | S  | Hu   | Amoeba                            | Grind the seed & mix with water.                         | Oral          |
| Buddleja polystachya Fresen.    | L  | Hu   | Wound                             | Crushed the leaves & put on the wound                    | Dermal        |
|                                | L  | Hu   | Tonsillitis                        | Crushed the leaves                                      | Oral          |
| Calpurnia aurea (Alt.) Benth.   | L  | Hu   | Malaria, Common cold              | Crushed the leaves & mixed with water                    | Oral          |
|                                | R & L | Ls | Internal parasites                | Crushed the leaves, root and mix with salt 3 litters for ox | Oral          |
| Capparis tomentose Lam.         | R  | Hu   | Internal parasites                | Root is dried & powdered mixed with water 3 tea spoon for 3 days | Oral          |
|                                | L  | Hu   | Tooth infection                   | Leaf of Capparis tomentose & Carissa spinarum leave mixed together put on infected tooth | Oral          |
| Carissa spinarum L.             | B & R | HU | Malaria                           | Crushed the Bark, root part and mixed with water 1 cup of coffee | Oral          |
|                                | B & R | Ls | Anthrax                           | Crushed the Bark, root part and mixed with water         | Oral          |
| Celtis africana Burm.f.          | B  | Hu   | TB                                | Crushed & Build the bark, 1 cup of tea for 3 days        | Oral          |
| Clerodendrum myricoides (Hochst.) R.Br.ex vatke | R  | Hu   | Liver, Diarrhoea, cancer          | Crushed the root part and mixed with liver 1 cup of tea for 7 days then 3 days diarrhea 7 days for cancer | Oral          |
|                                | R  | Hu   | Tonsilites                        | Crushed the root part & mix with water, ½ cup of coffee for 1 day | Oral          |
|                                | R  | Ls   | Anthrax, black leg                | Crushed the root part & mixed with water, 1 lit for 5 days | Oral          |
| Cordia africana Lam.            | L  | Hu   | Stomach problem                   | Boil the leaves & taken for 3 days 1 cup of coffee       | Oral          |
| Coriandrum sativum L.           | L  | Hu   | Malaria                           | Crushed the Leaves & mixed with water, 1 cup of tea for 3 to 5 days | Oral          |
|                                | L  | Ls   | Anthrax                           | Crushed the Leaves & mixed with water                     | Oral          |
| Croton dichogonias Pax.         | L  | Hu   | Liver                             | Crushed the leaves & mixed with water, ½ cup of coffee for 7 days after 4 hrs milk will given | Oral          |
|                                | L  | Hu   | Kidney                            | Crushed the leaves & mixed with water, ½ cup of coffee for 3 days | Oral          |
|                                | B  | Hu   | Evil eye                          | Fumigate the leaves & bark                               | Nasal         |
| Croton macrostachyhus Hochst.   | B  | Ls   | Internal parasites                | Crushed the leaves & mixed with water, 1 lit for 1 day   | Oral          |
| Cynoglosum lanceolatum Forsk.    | L & R | Hu | Cold, headache                    | Crushed the leaves and root & mix with water, for 1 cup of tea until the disease is cured | Oral          |
| Scientific name                      | PU       | Use | Diseases                  | Mode of preparation                                                                 | Route of Add. |
|--------------------------------------|----------|-----|---------------------------|--------------------------------------------------------------------------------------|---------------|
| Cyphostemma adenocalule (Steud.ex A.Rich) Desc.ex Wild & Dr. | R        | Hu  | Wound                     | Crushed the root part & put on the skin                                              | Dermal        |
|                                      | R        | Ls  | Internal parasites       | Crushed the root part & mixed with water                                              | Oral          |
| Datura stramonium L.                 | S        | Hu  | Tooth ache                | Grind the seed & ponded by the leaves, put on infected tooth                          | Oral          |
|                                      | S        | L & R| Fungus                   | Grind the seed & mixed with water                                                     | Dermal        |
| Delonix elata (L.)                   | R        | Hu  | Asthma (respiratory complication) | Crushed the root part & mixed with honey, 1 cup of tea for 3 days                    | Oral          |
|                                      | R        | Ls  | Anthrax                   | Crushed the root part & mixed with water                                              | Oral          |
| Discopodium penninervum (Hochest.)   | L        | Hu  | Malaria                   | Crushed the leaves & mix with water                                                   | Oral          |
|                                      | L        | Ls  | Hemorrhoids               | Crushed the leaves & mix with water                                                   | Oral          |
|                                      | L        | Hu  | Common cold               | Chewing the leaves                                                                    | Oral          |
|                                      | L        | Ls  | Anthrax                   | Crushed the leaves & mix with water                                                   | Oral          |
| Dovalis abyssinica (A.Rich) Warb.    | L & Fr   | Hu  | Cold                      | Crushed & boiled the leaves & mix with water                                           | Oral          |
|                                      | L & Fr   | Ls  | Internal parasites        | Crushed & boiled the leaves & mix with water                                           | Oral          |
| Echinopes angustilobus S.moore       | L        | Hu  | Skin itching              | Crushed the leaves part & mixed with water, 1 lit. for 5 days                        | Oral          |
|                                      | L        | Ls  | Stomach blotting         | Crushed the leaves part & mixed with water, ½ litter for 2 days                      | Oral          |
| Ekebergia capensis Sparm             | B        | Hu  | TB                        | Crushed the bark & mixed with small amount of water                                   | Oral          |
| Embelia schimperi Vatke.            | Fr       | Hu  | Tap worm                  | Grind the dried fruit & mixing with Haganinia a. dried flower, ½ lit. for 1 month interval | Oral          |
| Erythrina abyssinica Lam.ex.Dc       | B & Fr   | Ls  | Eye disease               | Crushed the bark & mixed with water & apply 2-3 drops                                 | Optical       |
| Euclea schimperi (Dc) Dandy          | B        | Hu  | Tinea nigra               | Crushed the inner bark                                                                | Dermal        |
|                                      | R        | Hu  | Internal parasite         | Crushed the root part                                                                 | Oral          |
| Euphorbia abyssinica Gmel            | L        | Hu  | Diarrhea                  | Crushed the leaves party & mixed with water                                           | Oral          |
|                                      | L,B,R    | Ls  | Stomach blotting         | Crushed the dried all part of the plant, fumigant, for 2 days                       | Nasal         |
| Euphorbia depauperata                | R        | Hu  | Stomach ache              | Crushed the root, mixed with water, 1 cup of tea                                      | Oral          |
| Ficus thonnigii Blume                | L        | Hu  | Sudden sickness           | Crushed the leaves & mix with salt and water, ½ lit. for 2 days                      | Oral          |
| Galneria saxifrage (Hochest.) Bridson | L & B    | Hu  | Malaria, TB              | Crushed the bark, leaf & mix with water, 1 cup of coffee                              | Oral          |
|                                      | L & B    | Ls  | Anthrax                   | Crushed the bark, leaf & mix with water                                               | Oral          |
| Grewia ferruginea Hochst.Ex A. Rich  | B        | Hu  | Malaria, Diabetes         | Crushed the bark & mix with water                                                     | Oral          |
|                                      | B        | Hu  | Tooth ache                | Chewing the bark                                                                      | Oral          |
|                                      | B        | Ls  | Hemorrhoids               | Crushed the bark & mix with water, put on the infected body                            | Dermal        |
| Hagenia abyssinica (Bruce)J.Gmelinin  | Fl       | Hu  | Tap worm                  | Crushed the dried flower & mixed with (B)Croton m. and Embelia s. (S)1/2 cup of tea for 15 days interval | Oral          |
| Hypericum quartinianum A.Rich.       | L        | Hu  | Hemorrhoids               | Crushed the leaves & mix with water                                                   | Oral          |
| Scientific name                      | PU Use | Diseases               | Mode of preparation                                                                 | Route of Add. |
|-------------------------------------|--------|------------------------|-------------------------------------------------------------------------------------|---------------|
| **Juniprus procera**                | L      | Anthrax                | Crushed the leaves & mixed with Vernonia a. and water. ½ lit. for 5 days             | Oral          |
| Hochest. Ex. Endl.                  |        |                        |                                                                                     |               |
| **Justicia schimperiana**           | B      | Tooth ache             | Powder of the bark, mixed with Rumex nepalensis                                       | Oral          |
| (Hochst.ex Nees)                    |        |                        |                                                                                     |               |
| T.Anders.                           | L      | Common cold            | The leaves warm on fire and put on face                                              | Nasal, dermal |
|                                     | L      | Asthma                 | Leaf mixed with water                                                                 | Oral          |
|                                     | L      | Liver                  | Crushed the leaves & mixed with Croton m. leaves, for 7 days                        | Oral          |
|                                     | L      | Skin itching           | Crushed the leaves & wash their bodies 3-4 days                                     | Dermal        |
| **Jalanchoe petitiana**             | L      | Cough, common cold, swelling | Boiled the leaves & take 1 cup & warm the leaves on fire & put on the swelling part of the body | Oral & dermal |
| A.Rich.                             |        |                        |                                                                                     |               |
| **Lippia adoensis**                 | L      | Fever                  | Boiled the leaves & mixed with Ruta, Ocimum 2 twice daily ½ cup of coffee            | Oral          |
| Hochst ex.Walp.                     |        |                        |                                                                                     |               |
| **Maesa Lanceolata**                | L      | Headache               | Crushed the leaves & mixed with water,1cup of tea, for 1 day                        | Oral          |
| Forsk.                              |        |                        |                                                                                     |               |
| **Malva verticillatum**             | L      | Internal parasites     | Crushed the leaves & mixed with water, washing for 4 days                          | Dermal        |
| **Maytenus addat**                  | L      | Diarrhea               | Crushed the leaves & mixed with water                                               | Oral          |
| (Looes.)                            |        |                        |                                                                                     |               |
| **Maytenus arbutifolia**            | L      | Diarrhea               | Crushed the leaves & mixed with water                                               | Oral          |
| (A.Rich.) Wilczek                    |        |                        |                                                                                     |               |
| **Milletia ferruginea**             | B      | Skin itching           | Crushed bark & mixed with water                                                     | Dermal        |
| (Hochst.) Bakk.                     |        |                        |                                                                                     |               |
| **Mimusops kummel**                 | L      | Stomach ache           | Crushed the leaves & mixed with water                                               | Oral          |
| A.DC.                               |        |                        |                                                                                     |               |
| **Moringa stenopetala**             | L      | Blood pressure         | Boiled with water, taken 1cup of tea every 2 days                                   | Oral          |
| (Bok.f.) cuf                         |        |                        |                                                                                     |               |
| **Myrica salcifolia**               | B      | Prostate problem       | Crushed the bark & mixed with water                                                 | Oral          |
| A.Rich.                             |        |                        |                                                                                     |               |
| **Myrsine africana**                | S      | Stomach ache           | Seeds are crushed , mixed with water, tea spoon                                      | Oral          |
| L.                                  |        |                        |                                                                                     |               |
| **Myrsine melanophlous**            | B      | Stomach problem        | Crushed the bark & mixed with water                                                 | Oral          |
| (L.) R.Br.                          |        |                        |                                                                                     |               |
| **Nuxia congesta**                  | B      | Stomach                | Crushed the bark of Nuxia c. & Shifleria a. & boiling in the water, based on age for 5 days | Oral          |
| R.Br. ex Fresen                     |        |                        |                                                                                     |               |
| **Ocimium basilicum**               | L      | Stomach                | Crushed the leaves & mixed with water, cup of tea 2 days                           | Oral          |
| L.                                  |        |                        |                                                                                     |               |
| **Ocimium gratissimum**             | L      | Malaria, common cold   | Crushed the leaves & mixed with water, ½ tea spoon , for 1 day                      | Oral          |
| L.                                  |        |                        |                                                                                     |               |
| **Ocimium lamiifolium**             | L      | Stomach problem        | Crushed the leaves & mixed with water, 1tea spoon with coffee , for 2-3 day        | Oral          |
| Hochst.ex Benth.                    |        |                        |                                                                                     |               |
| **Ocimium lamiifolium**             | L      | Common cold            | Crushed the leaves & mixed with water, 3-5 drops                                    | Nasal         |
| Scientific name           | PU | Use          | Diseases                          | Mode of preparation                          | Route of Add. |
|---------------------------|----|--------------|-----------------------------------|----------------------------------------------|---------------|
| Ocimum urticifolium Roth. | L  | Hu           | Stomach problem, mich             | Crushed the leaves & mixed with water, ½ cup of coffee, for 2-3 day | Oral          |
|                           | L  | Hu           | Eye infection                     | Crushed the leaves & mixed with water, 2-3 drops | Optical       |
| Olea europea subsp.cuspidata L. | S  | Hu          | Wound                             | Warm the fresh stem on fire                   | Dermal        |
| Olinia rochetiana A.Juss. | L  | Hu          | TB                                | Crushed the Leaves , mixed with water         | Oral          |
|                           | L  | Hu          | Cold                              | Boiled Leaves , mixed with water, then wash all body | Dermal        |
| Opuntia ficus-indica (L.) Miller. | L  | Hu          | Fungus                            | Washing their hair by the sap of the leaves   | Dermal        |
| Plectranthus marrubatus   | R  | Hu          | Internal                          | Crushed the root, mixed with water            | Oral          |
| Phytolacca dodecandra L.  | R  | Hu          | Malaria                           | Crushed the root, mixed with water for 3 days | Oral          |
| Prunus africana (Hook.f)Kalkm | B  | Hu          | Prostate problem, tap worm, cold  | Crushed the bark & mixed with water            | Oral          |
| Psydrax schimperiana (A.Rich.) Bridson | R  | Hu          | Diarrhoea                         | Crushed root , mixed                          | Oral          |
| Plantago lanceolata L.    | L  | Hu          | Skin cut                          | Crushed the leaves and add 3-4drops on the skin | Dermal        |
|                           | L  | Hu          | Gastritis, cough                  | Crushed the leaves & take 3 times a day       | Oral          |
| Rhus tenuinervis Engl.     | L  | Ls          | Stomatis, cough                   | Crushed the leaves, mixed with water          | Oral          |
| Ricinus communis L.        | S  | Hu          | Wound                             | Grind the seed, put on the wound              | Dermal        |
| Rubus steudneri Schweinf.  | Fr | Hu          | Internal parasite                 | Crushed the fruit part, mixed with water      | Oral          |
| Rumex abyssinica Jacq.     | R  | Hu          | Ascaris                           | Crushed the root , mixed with small amount of water | Oral          |
| Rumex nepalensis Spreng.   | R  | Hu          | Tinea nigra                       | Crushed the root part & mix with salt, 2days interval until the fungus is removed | Dermal        |
| Ruta chalepensis L.        | L  | Hu          | Stomach problem                   | Chewing or boiled the leaves & mixed with coffee ot tea | Oral          |
| Salvia nilotica Juss.ex Jacq. | L  | Hu          | Skin etching                      | Crushed the leaves & rub the skin for 2-3 days | Dermal        |
| Senna sepptomolisis        | L  | Hu          | Snake bite                        | Chewing the Leaves, put on infected body      | Dermal        |
| Schefflera abyssinica      | B  | Hu          | Tooth ache                        | Chewing the bark of the plant                 | Oral          |
|                           | B  | Ls          | Anthrax                           | Crushed the bark & mixed with water           | Oral          |
| Sida rhombifolia L.        | R  | Hu          | Asthma & other respiratory complaints | Root powder is employed                      | Oral          |
| Senecio gigas Vatke        | L  | Hu          | Diarrhea                          | Crushed the leaves, mixed with water          | Oral          |
| Solansio myriochephalus Sch. Bip. | L  | Hu          | Internal parasite                 | Crushed the leaves, mixed with water          | Oral          |
| Solanum anguivi Lam.       | S&L | Hu          | Tuberculosis                      | Leaves & seed powder mixed with honey, tea spoon | Oral          |
| Solanum incanum L.        | Fr  | Hu          | Tonsillitis                       | By squeezing the fruit juice ,3fruit are enough for 3 days | Oral          |
| Solanum marginatum L.f.    | Fr  | Hu          | TB, cough, cold                   | Cooked the leaf & seeds, ½ cup of coffee for 3 days | Oral          |
| Scientific name         | PU Use | Diseases                           | Mode of preparation                                                                 | Route of Add. |
|-------------------------|--------|------------------------------------|--------------------------------------------------------------------------------------|---------------|
| *Spilanthes uliginosa*  | R & F  | Tooth ache                         | Chewing the root or the flower part of the plant                                     | Oral          |
|                         | L, B&  | Stomach ache                       | Crushed all parts, mixed with water                                                  | Oral          |
| *Stephania abyssinica*  | R      | Diarrhea                           | Root powder mixed with water                                                         | Oral          |
| (Dillon & A.Rich.)      |        |                                    |                                                                                      |               |
| *Syzygium guineense*    | L      | Cough, etching                     | Leaves boiled and taken 1 cup of tea and take a shower for two days accordingly       | Oral & Dermal |
| (wild.)Dc.              |        |                                    |                                                                                      |               |
| *Teclea simplicifolia*  | L      | Stomach                            | Crushed the leaves & mixed with water                                               | Oral          |
| (Engl.) Verdoorn.       |        |                                    |                                                                                      |               |
| *Teclea nobilis*        | L      | Tooth ache                         | Crushed and pounded the leaves & bark, put on infected tooth                        | Oral          |
| Del.                    | & B    | Wound                              | Crushed the leaves & put on wound                                                    | Dermal        |
|                         | L      | Stomach                            | Crushed the leaves & mixed with water, 1 cup of coffee                               | Oral          |
|                         | L      | Headache                           | Crushed the leaves & mixed with water, ½ cup of coffee for 1 day                     | Oral          |
|                         | L & B  | Stomach blotting                   | Crushed the leaves & mixed with water                                                | Oral          |
| *Urtica simensis*       | L      | Gastritis                          | Bold the leaves & take as a food                                                     | Oral          |
| Steudel                 |        |                                    |                                                                                      |               |
| *Urera hypselodendron*  | L      | Malaria, diarrhoea, TB,            | Boiling the leaves & mixed with water & Ruta, 1 glass for 2 to 3 days                | Oral          |
| (A.Rich)                |        | etching                            | Boiling the leaves & mixed with water, washing with 1 bucket, for 3 days             | Dermal        |
| *Vernonia amygdalina*   | L      | Anthrax, stomach blotting          | Leaves mixed with salt & water, 1 lit. for 1 to 3 days                               | Oral          |
| Del.                    |        |                                    |                                                                                      |               |
| *Vernonia urticifolia*  | L      | Stomach blotting                   | Crushed the leaves & mix with water, 1 lit for 2-3 days                              | Oral          |
| A.Rich                  |        |                                    |                                                                                      |               |
| *Withania somenifera*   | R      | Malaria                            | Crushed the root part of the plant                                                  | Oral          |
| (L.) Dunal in DC.       |        |                                    |                                                                                      |               |
|                         | R      | Stomachache problem                | Chewing the root part at early in the morning                                        | Oral          |
|                         | B      | Swelling                           | Bark powder mixed with butter(anti-inflammatory)                                    | Dermal        |
| *Ximenia americana*     | R      | Tooth ache                         | Chewing the bark of the root                                                        | Oral          |
| L.                      |        |                                    |                                                                                      |               |
| *Ziziphus spina-christi*| Fr     | Stomachache                         | Chewing the fruit                                                                    | Oral          |