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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 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, 31species 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 "Arake" 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 7^0 13' 58.8" N to 7^0 29' 24.4" N and 38^0 43' 10.9" E to 38^0 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 16-25^0 C and rainfall varies between 500-1500 mm.

2.1.2 Vegetation

The natural vegetation of the area has beed 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 Pruns africana.* Furthermore,understory species include *Brucea antidysenterica*, *Cassipourea malosana*, *Lepidotrichilia volkensii*, *Maytenus spp*., and *Vepris dainellii*, *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 tor 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 uses 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 general), 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 tress 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 homegradens 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 pereceived 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 importany 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 olearcea, 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 olearcea 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 olearcea 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). Verenonia 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 Isa 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 diffrences among healers for treating the same kind of health problem by applying different dossages 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 healers 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 *Millettia 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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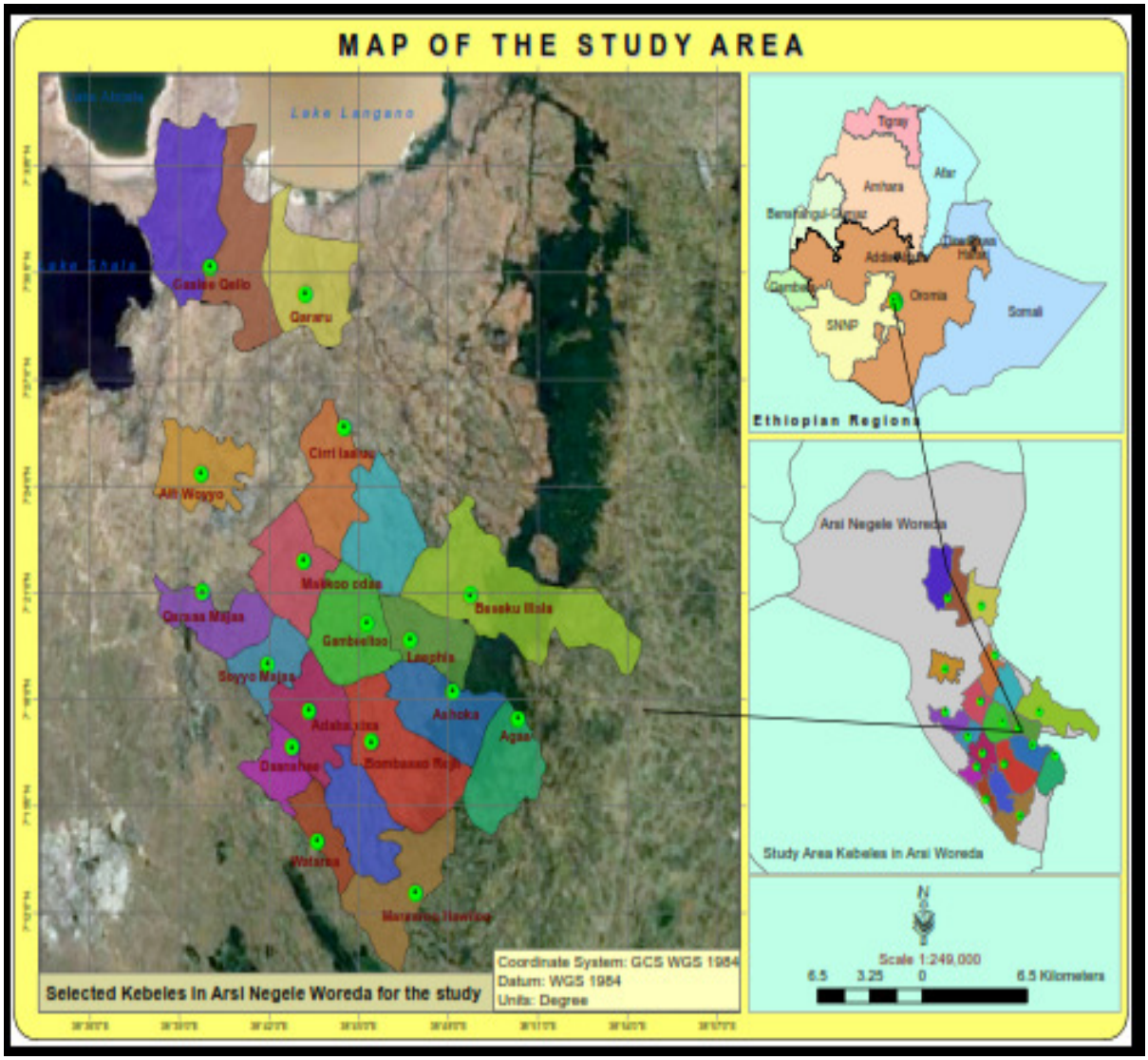

Figure1. Map of Ethiopia showing regional states and the study area

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.

	Respondent									
List of medicinal plants	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	Total	Rank
Podocarpus falcatus	5	3	6	5	7	7	6	5	44	3
Croton macrostachyus	6	5	7	6	5	6	5	5	45	2
Hagenia abyssinica	3	4	4	3	5	3	2	1	25	4
Maesa lanceolata	4	2	3	2	2	2	4	4	23	5
Syzgium guineense	2	4	1	4	3	3	1	3	21	6
Shifleria abyssinica	1	5	2	1	1	1	3	2	16	7
Vernonia amygdalina	7	7	6	6	6	5	7	6	50	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 wood	Forage	Const-ruction		
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

	Respondent								Total	Rank
List of medicinal plants	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8		
Allophylus abyssinicus	3	3	2	2	1	2	1	3	17	5
Balanites aegyptica	3	3	4	2	3	4	3	2	24	4
Carissa spinarum	4	3	4	3	2	3	4	2	25	3
Syzgium guineense	4	4	4	3	4	4	3	4	30	2
Ximenia americana	4	4	4	4	4	4	4	4	32	1

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

Scientific Name	No. of informants	%	Rank
Ocimum lamiifolium	19	11	2
Moringa stenopetala	13	9	6
Croton macrostachyus	17	12	4
Artemisia rehan	15	10	5
Olea europea subsp.cuspidata	11	8	8
Ruta chalepensis	20	14	1
Vernonia amygdalina	18	13	3
Hagenia abyssinica	12	8	7
Withania somenifera	10	7	9
Prunus africana	11	8	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

Table10. Major threats to medicinal plants inNagelle Arsi District, Oromia, Ethiopia.

Threats	Respondent										T^*	R^*	%
	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_{10}			
Agricultural Expansion	5	4	5	5	5	4	4	4	5	4	45	2	20.36
Deforestation	6	6	6	6	5	6	6	5	5	5	56	1	25.33
Fuelwood and Charcoal	3	5	4	4	3	3	4	5	5	4	40	3	18.09
Over exploitation	4	4	5	4	3	3	4	4	3	5	39	4	17.64
Overgrazing	2	2	3	2	3	2	2	3	3	2	24	5	10.85
Drought	2	3	2	2	1	2	1	1	2	1	17	6	7.69

T^* = Total and R^* = Rank and R1 to R10 are respondents 1 to 10.

Appendix1. 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* Hochst.ex Benth.	FABACEAE	Laaftoo	MBGH-084	T
2	*Achyranthes aspera* L.	AMARANTHACEAE	Darguu	MBGH-026	H
3	*Acokanthera schimperi* (A.DC) Schweinf.	APOCYNACEAE	Qaraaruu	MBGH-070	S
4	*Podocarpus falcatus* (Thunb.)R.B ex.mirb	PODOCARPACEAE	Birbissa	MBGH-005	T
5	*Agave sisalina perrine* perrine ex. Engl.	AGAVACEAE	Qachaa	MBGH-064	H
6	*Ajuga integrifolia* Buch.-Ham. ex D. Don	LAMIACEAE	Harmmaguusaa	MBGH-103	H
7	*Allium sativum* L.	ALLIACEAE	Qullubbi adii	MBGH-105	H
8	*Albizia gummifera* (J.F.Gmel.) C.A.Sm.var	FABACEAE	Qarcacee	MBGH-035	T
9	*Allophylus abyssinicus* Hochst.ex Benth.	SAPINDACEAE	Hirqamuu	MBGH-010	T
10	*Aloe spp.*	ALOACEAE	Hargiisa	MBGH-008	H
11	*Amaranthus caudatus* L.	AMARANTHACEAE	Urgoo harree	MBGH-027	H
12	*Amaranthus spinosus* L.	AMARANTHACEAE	Raafuu harre	MBGH-074	H
13	*Apodytes dimidata* E.Mey.ex .Arn	ICACINACEAE	Odaa baddaa	MBGH-038	T
14	*Artemisia rehan* Chiov.	ASTERACEAE	Ariitii	MBGH-080	H
15	*Asparagus africanus* Lam.	ASPARAGACEAE	Sariitii	MBGH-034	S
16	*Balanites aegyptica* (L.) Del.Dc.	BALANITACEAE	Badana	MBGH-055	T
17	*Bersama abyssinica* Fresen.	MELIANTHACEAE	Korqaa	MBGH-017	T
18	*Brassica olearcea* var. Capitata L.	BRACICACEAE	Danqalee	MBGH-037	H
19	*Brucea antidysentrica* J.F Miller	SIMAROUBACEAE	Ciirotaa	MBGH-023	T
20	*Buddleja polystachya* Fresen.	LOGINACEAE	Bulchanaa	MBGH-090	S
21	*Calpurnia aurea* (Ait.) Benth.	FABACEAE	Ceekataa	MBGH-013	S
22	*Capparis tomentose* Lam.	CAPPARIDACEAE	Hunxuxii	MBGH-095	L
23	*Carissa spinarum* L.	APOCYNACEAE	Agamsa	MBGH-040	S
24	*Celtis africana* Burm.f.	UIMACEAE	Amalaqaa	MBGH-002	T
25	*Clematis simensis* Fresen.	RANUNCULACEAE	Fitii	MBGH-046	C
26	*Clerodendrum myricoides* (Hochst.) R.Br.ex vatke	VERBENACEAE	Marachissa	MBGH-048	S
27	*Cordia africana* Lam.	BORGINACEAE	Wodessa	MBGH-096	T
28	*Coriandrum sativum* L.	APIACEAE	Dimbelal	MBGH-105	H
29	*Croton dichogomas* Pax	EUPHORBIACEAE	Ulee foonii	MBGH-056	S
30	*Croton macrostachyus* Hochst.	EUPHORBIACEAE	Mokoniisa	MBGH-019	T
31	*Cynoglosum lanceolatum* Forssk.	BORGINACEAE	Maxxannee	MBGH-024	H
32	*Cyphostemma adenocalule* (Steud.ex A.Rich) Desc.ex Wild & Dr	VITACEAE	Gaalee	MBGH-057	C
33	*Datura stramonium* L.	SOLANACEAE	Banji	MBGH-069	H
34	*Delonix elata* (L.)	FABACEAE	Harangama	MBGH-104	T
35	Discopodium penninervum (Hochest.)	SOLANACEAE	Maraaroo	MBGH-083	S
36	*Dovalis abyssinica* (A.Rich.)Warb.	FLACOURTIACEAE	Dhangangoo	MBGH-094	S
37	*Echinopes angustilobus* S.moore	ASTERACEAE	Anishookalaa	MBGH-039	S
38	*Ekebergia capensis* Sparm	MILIACEAE	Oononnuu	MBGH-052	T
39	*Embelia schimperi* Vatke.	MYRSINACEAE	Qaanquu	MBGH-018	S
40	*Erythrina abyssinica* Lam.ex.Dc	FABACEAE	Woleenaa	MBGH-009	T
41	*Euclea schimperi* (Dc) Dandy	EBENACEAE	Mi'eessa	MBGH-060	T
42	*Euphorbia abyssinica* Gmel	EUPHORBIACEAE	Adaamii	MBGH-082	T
43	*Euphorbia depauperata*	EUPHORBIACEAE	Gurii	MBGH-036	H
44	*Ficus thonningii* Blume	MORACEAE	Dambii	MBGH-031	T
45	*Galneria saxifrage* (Hochest.) Bridson	RUBIACEAE	Korolla	MBGH-088	S
46	*Grewia ferruginea* Hochst.Ex A. Rich	TELIACEAE	Dhoqona	MBGH-071	S
47	*Hagenia abyssinica* (Bruce)J.F.Gmelin	ROSACEAE	Heexoo	MBGH-051	T
48	*Hypericum quartinianum* A.Rich.	HYPERICACEAE	Garanbaa	MBGH-081	S
49	*Justicia schimperiana* (Hochst.ex Nees) T.Anders.	ACANTHACEAE	Dhummuugaa	MBGH-066	S
50	*Juniperus procera* Hochst. ex Endl.	CUPPRESSACEAE	Hidheessa	MBGH-102	T
51	*Kalanchoe petitiana* A.Rich.	CRASSULACEAE	Hancuuraa	MBGH-016	H
52	*Lippia adoensis* L.	VERBENACEAE	Sokorruu	MBGH-063	S
53	*Maesa Lanceolata* Forssk.	MYRSINACEAE	Abayyi	MBGH-011	T

No.	Plant Name	Family Name	Local Name (Afaan Oromoo.)	Code	Growth Habit
54	*Malva verticillatum* L.	MALVACEAE		MBGH-075	H
55	*Maytenus addat* (Looes.)	CELASTERACEAE	Kombolcha	MBGH-073	T
56	*Maytenus arbutifolia* (A.Rich.) Wilczek	CELASTERACEAE	Kombolcha	MBGH-077	T
57	*Milletia ferruginea* (Hochst.) Bakk.	FABACEAE	Dadatuu/ Birbiraa	MBGH-042	T
58	*Mimusops kummel* A.DC.	SAPOTACEAE	Olaati	MBGH-059	T
59	*Moringa stenopetala* (Bok.f.) cuf	MORINGACEAE	Moringaa	MBGH-100	T
60	*Myrica salcifolia* A.Rich.	MYRICACEAE	Qamoo	MBGH-102	T
61	*Myrsine africana* L.	MYRSINACEAE	Xeexee/Abeyee	MBGH-095	S
62	*Myrsine melanophlous* (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	Bassobilaa	MBGH-028	S
65	*Ocimum gratisimum* L.	LAMIACEAE	Cabbicha	MBGH-098	S
66	*Ocimum lamiifolium* Hochst.ex Benth.	LAMIACEAE	Qoricha michii	MBGH-012	S
67	*Ocimum urticifolium* Roth.	LAMIACEAE	Cabbicha	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	Qulqualii	MBGH-061	S
71	*Plectranthus marrubatus*	LAMIACEAE	Qoricha michii/Damakasee	MBGH-072	H
72	*Phytolacca dodecandra* L Her.	PHYTOLACCACEAE	Handoodee	MBGH-030	L
73	*Prunus africana* (Hook.f)Kalkm	ROSACEAE	Sukkee	MBGH-001	T
74	*Psydrax schimperiana* (A.Rich.) Bridson	RUBIACEAE	Gaalloo	MBGH-050	T
75	*Plantago lanceolata* L.	PLANTAGINACEAE	Gorxobii	MBGH-106	H
76	*Rhus tenuinervis* Engl.	ANACARDIACEAE	Qolasaa	MBGH-097	S
77	*Ricinus communis* L.	EUPHORBIACEAE	Qoboo	MBGH-029	S
78	*Rubus steudneri* Schweinf.	RUBIACEAE	Goraa	MBGH-089	S
79	*Rumex abyssinica* Jacq.	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 septromolisis*	FABACEAE	Ajaawaa	MBGH-047	S
84	*Shiffleria abyssinica*	SAPOTACEAE	Gatamee	MBGH-003	T
85	*Sida rhombifolia* L.	MALVACEAE	Chifirigi	MBGH-033	H
86	*Senecio gigas* Vatke	ASTERACEAE	Agadena	MBGH-022	H
87	*Solansio myriocephalus* Sch. Bip.	ASTERACEAE		MBGH-091	S
88	*Solanum anguivi* L.	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 uliginosa* SW.	ASTERACEAE		MBGH-032	H
92	*Stephania abyssinica* (Dillon & A.Rich.). Walp.	MENISPERMACEAE	Kalaalaa	MBGH-015	C
93	*Syzgium guineense* (willd.)Dc.	MYRTACEAE	Baddeessaa	MBGH-006	T
94	*Teclea simplicifolia* (Engl.) Verdoorn.	RUTACEAE	Hadheessaa	MBGH-007	T
95	*Teclea nobils* Del.	RUTACEAE	Hadheessaa	MBGH-108	T
96	*Urtica simensis* Steudel	URTICACEAE	Doobii	MBGH-014	S
97	*Urera hypselodendron* (A.Rich)	URTICACEAE	Haliilaa	MBGH-053	S
98	*Vernonia amygdalina* Del.	ASTERACEAE	Ebicha	MBGH-004	S
99	*Vernonia urticifolia* A.Rich	ASTERACEAE	Reejii	MBGH-099	S
100	*Withania somenifera* (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

Appendix2. Medicinal plants used for treating human and livestock diseases in Nagelle Arsi District, Oromia, Ethiopia. PU: Parts used, L: Leaves, R: Root, B: Bark, Fr: Fruit, F: Flower, Hu: Human, Ls: Livestock

Scientific name	PU	Use	Diseases	Mode of preparation	Route of Add.
Acacia abyssinica Hochst.ex Benth.	R	Hu	Swelling	Crushed the root part and put on the swelling part of the body	Dermal
Achyranthes aspera L.	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 watet, 1 cup of coffee	Oral
	R	Ls	Internal parasite	Crushed the root part and mixed with salt 1 litter for 3 days	Oral
Acokanthera schimperi (A.DC) Schweinf.	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	Ls	Anthrax	Crushed the leaves and root part & mixed with water for 7days 1 litter	Oral
Podocarpus falcatus (Thunb.) R.B ex..mirb	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
Agave sisalina perrine ex. Engl.	L	Hu	Hemorrhoids, cancer	Crushed the leaves & mixed with water	Oral
	L	Ls	Anthrax	Crushed the leaves & mixed with salt for 5days	Oral
Ajuga integrifolia Buch.-Ham. ex D. Don	R	Hu	Internal parasites	Crushed the root part & mix with water 2tea spoon 1 day	Oral
Albizia gummifera (J.F.Gmel.) C.A.Sm.var	L & R	Hu	Hemorrhoids, Liver	Crushed the leaves ,roots & mixed with water ½ cup of tea	Oral
	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 cure	Oral
	BL	Hu	Malaria	The bulb boiled with honey for 7 days	Oral
Allophylus abyssinicus (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
	L	Ls	Sudden sickness	Crushed the leaves and take sap & mix with water, 1lit. for 1-2days	Oral
Amaranthus caudatus L.	S & L	Hu	Diarrhea	Grind the seed or crushed the leaves & mixed with *Allium s.*	Oral
Amaranthus spinosus L.	S	Hu	Diarrhea	Crushed the leaves & boil with water	Oral
Apodytes dimidata E.Mey.ex .Arn	B	Hu	Stomach ache, cough	Crushed & boild the bark part & mixed with milk	Oral
Artemisia rehan Chiov.	L	Hu	Evil eye	Crushed the leaves, fumigate	Nasal
Asparagus africanus Lam.	R & L	Hu	TB, cough, wound	Crushed the root part & mix with water 2tea spoon 7 day Crushed the leaves and put on the wound	Oral & dermal
	R	L	Anthrax, black leg	Crushed the root part & mix with water 1cup of tea 5 day	Oral
Balanites aegyptica (L.) Del.Dc.	L	Hu	Malaria	Crushed & boiled the Leaves part & mix with water 1cup of tea for 5 day	Oral

Scientific name	PU	Use	Diseases	Mode of preparation	Route of Add.
	L	Ls	Anthrax	Crushed the Leaves part & mix with water 1cup of tea 7 day	Oral
Bersama abyssinica Fresen.	B	Hu	Cough	Crushed the Leaves part & mix with water	Oral
Brassica olearcea var. Capitata L.	S	Hu	Amoeba, common cold	Grind the seed & mix with water. 3tea spoon 2 tims a day	Oral
Brucea 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 (Ait.) 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 3litters for ox	Oral
Capparis tomentose Lam.	R	Hu	Internal parasites	Root is dried & powdered mixed with water 3 tea sppon for 3 days	Oral
	L	Hu	Tooth infection	Leaf of *Capparis tomentose* & *Carisa 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	Oal
	B & R	Ls	Anthrax	Crushed the Bark, root part and mixed with water	Oral
Celtis africana Burm.f.	B	Hu	TB	Crushed & Boild the bark,1cup of tea for 3days	Oral
Clematis simensis Fresen.	R	Hu	Fever	Crushed the root part and mixed with water	Oral
	R	Ls	Internal parasites, Anthrax	Crushed the root part and mixed with water	Oral
Clerodendrum myricoides (Hochst.) R.Br.ex vatke	R	Hu	Liver, Diarrhoea cancer	Crushed the root part and mixed with water 1 cup of tea for 7days for liver, 3days diarrhea, 7days for cancer	Oral
	R	Hu	Tonsilites	Crushed the root part & mix with water, ½ cup of coffee for 1day	Oral
	R	Ls	Anthrax, black leg	Crushed the root part & mixed with water, 1lit. for 5days	Oral
Cordia africana Lam.	L	Hu	Stomach problem	Boil the leaves & taken for 3days 1cup of coffee	Oral
	R	Ls	Internal parasite	Crushed the root part & mixed with water, 1lit. for 3days	Oral
Coriandrum sativum L.	L	Hu	Malaria	Crushed the Leaves & mixed with water, 1 cup of tea for 3to 5days	Oral
	L	Ls	Anthrax	Crushed the Leaves & mixed with water, 1 litt. For 5days	Oral
Croton dichogomas Pax	L	Hu	Malaria, amoeba, TB	Crushed the Leaves & mixed with water	Oral
	L	Ls	Anthrax	Crushed the Leaves & mixed with water	Oral
Croton macrostachyus Hochst.	L	Hu	Liver	Crushed the leaves & mixed with water, ½ cup of coffee, for 7days 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
	B	Ls	Internal parasites	Crushed the leaves & mixed with water, 1lit. for 1day	Oral
Cynoglosum lanceolatum Forssk.	L & R	Hu	Cold, headache	Crushed the leaves and root & mix with water, for 1cup of tea until the disease is cured	Oral

Scientific name	PU	Use	Diseases	Mode of preparation	Route of Add.
	L & R	Ls	Hemorrhoids	Crushed the leaves and root & mix with water then put on the infected part of the body, age is factor	Dermal
	L & R	Ls	Anthrax	Crushed the leaves and root & mix with water	Oral
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	Hu	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, 1lit. for 5days	Oral
Discopodium penninervum (Hochest.)	L	Hu	Malaria	Crushed the leaves & mix with water	Oral
	L	Hu	Hemorrhoids	Crushed the leaves & mix with water	Dermal
	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 & boil the leaves & mix with water	Oral
	L & Fr	Ls	Internal parasites	Crushed & boil the leaves & mix with water	Oral
Echinopes angustilobus S.moore	L	Hu	Skin itching	Crushed the leaves part & mixed with water, for one week	Dermal
	L	Ls	Stomach blotting	Crushed the leaves part & mixed with water, ½ litter for 2days	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 *Hagainia 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 thonningii 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	Hu	Hemorrhoids	Crushed the bark & mix with water, put on the infected body	Dermal
	B	Ls	Anthrax, cough	Crushed the bark & mix with water	Oral
Hagenia abyssinica (Bruce)J.F.Gmelin	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	Crused the leaves & mix with water.	Oral

Scientific name	PU	Use	Diseases	Mode of preparation	Route of Add.
	L	Ls	Anthrax	Crused the leaves & mix with *Vernonia a*. and water. ½ lit. for 5 days	Oral
Juniprus procera Hochest. Ex. Endl.	B	Hu	Tooth ache	Powder of the bark, mixed with *Rumex nepalensis*	Oral
Justicia schimperiana (Hochst.ex Nees) T.Anders.	L	Hu	Common cold	The leaves warm on fire and put on face	Nasal, dermal
	L	Hu	Asthma	Leaf mixed with water	Oral
	L	Hu	Liver	Crushed the leaves & mixed with *Croton m*. leaves, for 7days	Oral
	L	Ls	Skin itching	Crushed the leaves & wash their bodies 3-4 days	Dermal
Kalanchoe petitiana A.Rich.	L	Hu	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
	L	Ls	Anthrax	Crushed the leaf ,mixed with *Phytolacca dodecandra*	Oral
Lippia adoensis Hochst ex.Walp.	L	Hu	Fever	Boild the leaves & mixed with Ruta, Ocimum 2 twice daily ½ cup of coffee	Oral
	L	Ls	Internal parasites	Boild the leaves & mixed with *Ruta c., Ocimum l.* leaves 1 litter for 3 days	Oral
Maesa Lanceolata Forssk.	L	Hu	Headache	Crushed the leaves & mixed with water,1cup of tea, for 1 day	Oral
	L	Ls	Mastitis	Crushed the leaves & mixed with water, washing for 4 days	Dermal
Malva verticillatum L.	L	Hu	Internal parasites	Crushed the leaves & mixed with water	Oral
Maytenus addat (Looes.)	L	Hu	Diarrhea,	Crushed the leaves & mixed with water	Oral
Maytenus arbutifolia (A.Rich.) Wilczek	L	Hu	Diarrhea,	Crushed the leaves & mixed with water	Oral
Milletia ferruginea (Hochst.) Bakk.	B	Hu	Skin itching	Crushed bark & mixed with water	Dermal
Mimusops kummel A.DC.	L	Hu	Stomach ache	Crushed the leaves & mixed with water	Oral
Moringa stenopetala (Bok.f.) cuf	L	Hu	Blood pressure	Boiled with water, taken 1cup of tea every 2 days	Oral
	L	Ls	Anthrax	Crushed the leaves & mixed with water	Oral
Myrica salcifolia A.Rich.	B	Hu	Prostate problem	Crushed the bark & mixed with water	Oral
Myrsine africana L.	S	Hu	Stomach ache	Seeds are crushed , mixed with water, tea spoon	Oral
Myrsine melanophlous (L.) R.Br.	B	Hu	Stomach problem	Crushed the bark & mixed with water	Oral
Nuxia congesta R.Br. ex Fresen	B	Hu	Stomach	Crushed the bark of Nuxia c. & Shifleria a. & boiling in the water, based on age for 5 days	Oral
	B	Ls	Anthrax	Crushed the bark of Nuxia c. & Shifleria a. & boiling in the water, 1lit. for	Oral
Ocimum basilicum L.	L	Hu	Stomach	Crushed the leaves & mixed with water, cup of tea 2 days	Oral
Ocimum gratisimum L.	L	Hu	Malaria, common cold	Crushed the leaves & mixed with water, ½ tea spoon , for 1 day	Oral
	L	Ls	Anthrax	Crushed the leaves & mixed with water, ½ liter , for 1 day	Oral
Ocimum lamiifolium Hochst.ex Benth.	L	Hu	Stomach problem,	Crushed the leaves & mixed with water, 1tea spoon with coffee , for 2-3 day	Oral
	L	Hu	Common cold	Crushed the leaves & mixed with water, 3-5 drops	Nasal

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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 Her.	R	Hu	Malaria	Crushed the root, mixed with water for 3 days	Oral
	R	Hu	Rabies	Crushed root , mixed with *Justicia schimperiana* & water	Oral
Prunus africana (Hook.f)Kalkm	B	Hu	Prostate problem, tap worm, cold	Crushed the bark & mixed with water	Oral
	B	Ls	Internal parasite	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	Stomach blotting	Crushed the leaves, mixed with water	Oral
Ricinus communis L.	S	Hu	Wound	Grind the seed, put on the wound	Dermal
	S	Hu	Stomach ache	Grind the seed for laxative property	Oral
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
	R	Hu	Internal parasite	Crushed the root part & mix with	Oral
Ruta chalepensis L.	L	Hu	Stomach problem	Chewing or boiled the leaves & mixed with coffee ot tea	Oral
Saliva nilotica Juss.ex Jacq.	L	Hu	Skin etching	Crushed the leaves & rub the skin for 2-3 days	Dermal
Senna septromolisis	L	Hu	Snake bite	Crushed 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
	L	Hu	Wound	Crushed the leaves & put on the infected part	Dermal
Solansio myriocephalus 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 SW.	R & F	Hu	Tooth ache	Chewing the root or the flower part of the plant	Oral
	L, B& r	Hu	Stomach ache	Crushed all parts, mixed with water	Oral
Stephania abyssinica (Dillon & A.Rich.). Walp.	R	Hu	Diarrhea	Root powder mixed with water	Oral
Syzgium guineense (willd.)Dc.	L	Hu	Cough, etching	Leaves boiled and taken 1cup of tea and take a shower for two days accordingly	Oral & Dermal
Teclea simplicifolia (Engl.) Verdoorn.	L	Hu	Stomach	Crushed the leaves & mixed with water	Oral
Teclea nobils Del.	L,& B	Hu	Tooth ache	Crushed and pounded the leaves & bark, put on infected tooth	Oral
	L	Hu	Wound	Crushed the leaves & put on wound	Dermal
	L	Hu	Stomach	Crushed the leaves & mixed with water, 1 cup of coffee	Oral
	L	Hu	Headache	Crushed the leaves & mixed with water ½ cup of coffee for 1 day	Oral
	L & B	Ls	Stomach blotting	Crushed the leaves & mixed with water, *Vernonia a.*1 lit. for 1 to 2 days	Oral
Urtica simensis Steudel	L	Hu	Gastritis	Boild the leaves & take as a food	Oral
Urera hypselodendron (A.Rich)	L	Hu	Internal parasite	Crushed the leaves & mixed with water	Oral
Vernonia amygdalina Del.	L	Hu	Malaria, Diarrhoea, TB,	Boiling the leaves & mixed with water & Ruta, 1glass for 2 to 3days	Oral
			Etching	Boiling the leaves & mixed with water,washing with 1buckt, for 3days	Dermal
	L	Ls	Anthrax, stomach blotting	Leaves mixed with salt & water, 1 lit. for 1 to 3 days	Oral
Vernonia urticifolia A.Rich	L	Ls	Stomach blotting	Crushed the leaves & mix with water, 1 lit for 2-3 days	Oral
Withania somenifera (L.) Dunal in DC.	R	Hu	Malaria	Crushed the root part of the plant	Oral
	R	Hu	Stomache problem	Chewing the root part at early in the morning	Oral
	B	Hu	Swelling	Bark powder mixed with butter(anti-inflammatory)	Dermal
	R	Ls	Anthrax	Crushed the root part of the plant	Oral
Ximenia americana L.	R	Hu	Tooth ache	Chewing the bark of the root	Oral
Ziziphus spina-christi (L.) Desf.	Fr	Hu	Stomach ache	Chewing the fruit	Oral