

## Research Article

# The Use and Management Practices of Medicinal Plants by Shinasha Tribe in Metekel Zone, Northwest Ethiopia

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• Ethnobotany; Fidelity level index (FLI); Indigenous knowledge; Informant consensus factor (ICF); Medicinal plants; Metekel; Shinasha people

## Abstract

The present study entitled "The use and management practices of medicinal plants by Shinasha people the most marginalized ethnic groups in Metekel Zone, Northwest Ethiopia" was an ethnobotanical study aiming to summarize and analyze the current knowledge of the Shinasha people on the medicinal properties of local plant species. This study is based on a survey involving a total of 99 informants (aged 20 and above). Data from the survey was analyzed following analytical tools for ethnobotanical methods as preference ranking, direct matrix ranking, paired comparison were performed and medicinal use value, fidelity level index and informant consensus factor were calculated. The study concludes that of 65 medicinal plants recorded, 48% are used for treatment of human maladies and 22% for livestock treatment. These medicinal plants include mainly *Clusia abyssinica* Jaub. and Spach, *Cordia africana* Lam., *Croton macrostachyus* Del., *Solanum nigrum* L., *Datura stramonium* L., *Justicia schimperiana* (Hochst. ex Nees) T. Anders., *Ximenia americana* L., *Sida schimperiana* Hochst. ex. A. Rich., *Kalanchoe pinnatifida* A. Rich., *Clematis hirsuta* Perr. and Guill., *Gardenia ternifolia* Schumacher & Thonn., *Paeonia urens* Scav., *Dichrostachys cinerea* L., *Grewia ferruginea* Juss., *Stereospermum kunthianum* Cham., *Portulaca quadrifida* L. Etc. Majority of the plants used were herbs and the parts used was the leaf. Moreover most of the prepared remedies were administered to the patient orally in the form of drink. *Justicia schimperiana* and *Nicotiana glauca* have high fidelity level index (FLI). *Bersama abyssinica* was the most preferred plant species for the treatment of snake bite and *Withania somnifera* for evil eye. Direct matrix ranking showed *Cordia africana* as the most utilized multipurpose plant species. The study area possesses diverse natural vegetation. However, its environment is under serious threat mainly due to agricultural expansion, free grazing, wildfire, timber logging etc. Hence, intensive awareness creating on the use and management systems, sustainable utilization of medicinal plants and their in-situ and ex-situ conservation should be recommended.

## ABBREVIATIONS

AAU: Addis Ababa University; BGRS: Benshangule Gumuze Regional State; CSA: Central Statistical Agency; EBI: Ethiopia Biodiversity Institute; FLI: Fidelity Level Index; HIV/AIDS: Human Immune Virus/ Acquired immunodeficiency syndrome; ICF: Informant Consensus Factor; IK: Indigenous Knowledge; IUCN: International Union for Conservation of Nature; MaSL: Meter above Sea Level; NMAWACBD: National Meteorological Agency Western Amhara Center of Bahir Dar ; UK: United Kingdom; UNESCO: United Nations Educational, Scientific and Cultural Organization; UV: Use Value; WHO: World Health Organization

## INTRODUCTION

In all part of the world traditional medicinal plant practices formed the basis of health cares for both human being and animal before the advent of modern medicine. In Ethiopia, people have been using traditional medicine to treat both human and animal disease for generations. Traditional medicine is still widely practiced in rural area where modern medicine and services available [1]. Traditional medicinal plants are also used for various purpose in addition their medicinal values such as a forage, firewood, spices, construction, food, cosmetics, clothes, shelter

for human habitats for wild animals and insects. Furthermore, medicinal plants play significant role in maintaining ecosystem stability, export accommodation and as fumigant [2].

Traditional herbal remedies can also be used as scientific resources to develop a new drug which are safe. It is also effectively cheapest and environmental sound. Many of today's wonderful drugs were initially discovered through the study of traditional medicine [1]. There are large number of moderate to high value of medicinal plants herbs and species existing in the world. However, of the existing medicinal herbs species only small percent are treated [2,3].

Availability of medicinal plant has been affected by a dramatic decrease of native vegetation due to agricultural expansion, deforestation, fire, and overgrazing drought, tread of charcoal, firewood, introduction of alien invasive species and urban associated development. Globally the estimates of medicinal plant species range from 35,000-50,000 and out of this about 4, 000-6,000 species have entered the world market of medicinal plants [4]. There are a number of Ethiopian medicinal plants which have undergone scientific investigation. Ethiopia has a high diversity of plant and animal due to its varieties in climate and topography. The use of medicinal plants for primary healthcare needed has

been practiced by local population across the world for centuries and still existing in their life style at present.

The cultural indigenous knowledge of medicinal plant in Ethiopia is unevenly distributed among each community members. People in different location with different religion and culture back ground have their own specific knowledge about the use of plants which in the part has generally entered wide circulation in the country. The knowledge about the use of plants is largely oral, however, Ethiopians ancient church practices have documented some knowledge as inscribed as medico religious written in "Geez" manuscripts of 16<sup>th</sup> c 5 [5]. Medicinal plants obtained from wild habitats are found in different natural ecosystems of the forests, grasslands, woodlands, wetlands, in field margins and garden fences, as weeds and in many other microhabitats from where they are harvested when the need arise [3].

Plantations of medicinal plants can be made in degraded and degrading areas. There are many medicinal plants of Ethiopia that have good properties for land rehabilitation and erosion control which could be planted in different agro ecological settings. In-situ and ex-situ conservation strategies work well when they complement one another since what is not achievable by one method is backed by the other method. In addition to this scheme that would enable sustainable use of medicinal plants and the associated indigenous knowledge should be developed with the best practice of benefit sharing [3].

Maintain health through traditional medicine in general and utilization of medicinal plant in particular is almost as old as the history of man kinds. This is true in Ethiopia 80% of the population still relies on the plant to prevent and cure various health problem [2]. The current plant use trend in Metekel Zone shows that the environment is facing problems of resource depletion and loss of indigenous knowledge like other areas of the country.

Thus, intensive ethnobotanical research plays a vital role to draw information on plants and related indigenous knowledge for conservation and sustainable utilization. Like many other parts of the country, there is a limited ethnomedicinal research and documentation carried out in Metekele Zone. This study therefore, aimed at documenting indigenous knowledge on use and management of medicinal plants by herbalists to treat human and livestock ailments as well as assessing of the existing threats to these medicinal plants in Metekel Zone of Northwest Ethiopia.

## MATERIALS AND METHODS

### Description of the study area

The study was conducted in selected sites of three neighboring districts (woredas) in the northwestern part of Ethiopia; Bullen, Dibatie and Dangur that administratively belong to the Metekel Zone of the Benishangul-Gumuz Regional State (Figure 1). The Shinasha people are among the indigenous inhabitants in the Benishangul-Gumuz Regional State. The majority of Shinashas inhabit rural areas in the Metekel zone: mainly in Wonbera, Bullen, Dibatie and Dangur districts. According to 1994 census, the population of the Shinasha people was estimated to be about 32,000. Their language belongs to the greater Omotic language

family. Areas occupied by the Shinashas range from highlands to lowlands. They are close neighbors of the Gumuz, Agew-Awi and Oromo socio cultural groups. Their livelihood depends on subsistence agriculture. They mainly cultivate maize, sorghum, tef and beans. In the lowland area, oil crops such as linseed, niger seed, castor oil tree and sunflower are cultivated. They also raise livestock such as cattle, donkeys, sheep and goats.

### Informant selection

For the survey, a total of 99 informants constituted of professional healers and knowledgeable farmers with the ages of 20 and above were selected with the assistance of local elders and interviewed.

### Data collection and analysis

Ethnobotanical data were collected from October 2017 to November 2017 mainly through individual interviews with the informants. Most of the interviews were carried out in Shinashigna language. During interviews, data regarding ailment treated, local name of the plant used, its part/parts harvested, mode of preparation and administration were gathered. Besides, information related to cultivation practice and abundance of the claimed medicinal plants was collected. Voucher specimens for most of reported medicinal plants were collected and deposited at the Ethiopian Biodiversity Institute after proper identification. The specimens were identified by Dereje Mosissa (botanist) who is the author of this article.

### Ethnobotanical data Analysis

The Ethnobotanical data collected was analyzed following survey and analytical tools for ethnobotanical methods which are Informant's preference ranking, descriptive statistic (SPSS v21), and direct matrix ranking and paired comparisons conducted following [6-8].

### Preference ranking

Preference ranking was conducted following Martin [7], for eleven most important medicinal plants used in treating snake biting (Table 1), as traditional healers treat it usually. Ten informants were selected to identify the best preferred medicinal plant species for treatment of snake biting. Each informant was provided with eleven medicinal plants reported to cure this disease with leaves of medicinal plant used being paper tagged name and asked to assign the highest value (5) for the most preferred species, against this illness and the lowest value (1) for the least preferred plant and in accordance of their order for the remaining one of each species was summed up and the rank for each species was determined based on the total score. This helped to indicate the rank order of the most effective medicinal plants used by the community to treat the disease

### Direct matrix ranking

Direct matrix ranking was done following Martin & Cotton [6,7], in order to compare multipurpose use of a given species and to relate this to the extent of its utilization versus its dominance. Based on information gathered from informants, nine multipurpose plant species were selected out of the total medicinal plants and nine use diversities of these plants were

listed for ten selected key informants to assign use values to each species (Table 2).

The nine use-values include medicinal, fodder, food, fire wood, construction, charcoal, fencing, and furniture making. 10 key informants were chosen from 20 key informants depending on their activities during interview to conduct this activity and each key informant was asked to assign use values (5 = best, 4 = very good, 3 = good, 2 = less used, 1 = least used and 0 = not used). Accordingly, each key informant; use values for the nine multipurpose medicinal plant species, average value of each use-diversity for a species was taken and the values of each species were summed up and ranked.

### Paired comparison

Paired comparison can be used for evaluating the degree of preferences or levels of importance of certain selected plants/parts of plants [8]. A list of the pairs of selected items with all possible combinations is made and sequence of the pairs and the order within each pair is randomized before every pair is presented to selected informants and their responses recorded and total value was summarized. In this study, ten informants to indicate the efficacy and popularity of nine medicinal plants species used to treat evil eye and rank was made based on the report of the informants (Table 3). As traditional healers treat evil eye and no treatment is provided by modern clinics, the local informants are endowed with the knowledge of eye vile treatment.

### Medicinal use value

The use value (UV), a quantitative method that demonstrates the relative importance of species known locally was calculated using the following formula.

$UV = \Sigma U/n$  where: UV = use value of a species; U = number of citations per species;

n = number of informants [9].

### Fidelity level Index

Fidelity level index quantify the importance of a given species for a particular purpose in a given cultural group [10]. The relative healing potential of individual medicinal plants used against human or livestock ailments using an index called Fidelity Level Index (FLI) based on the proportion of informants who agreed on the use of a given medicinal plant against a given ailment category.

The formula for FLI is given as  $FL\% = I_p / I_u \times 100$ , where  $I_p$  is the number of informants who independently indicated the use of a species for the same major ailments and  $I_u$  is the total number of informants who mentioned the plant for any major ailment [10].

### Informant consensus factor

Informant consensus factor (ICF) was calculated for categories of ailments to identify the agreements of the informants on the reported cures using the formula used by [9] and [11]. ICF was calculated as follows: number of use citations for each ailment (nur) minus the number of species used (nt) for that ailment,

divided by the number of use citations for each ailment minus one (Table 8).

$ICF = nur\_nt / nur\_1$  Where:

ICF: Informant consensus Factor,

Nur: number of use citation

Nt: number of species used.

## RESULTS AND DISCUSSION

### Shinasha People Land Form Classification

The shinasha people in Metekel Zone divide land form into four main types:-

**Kinedkesha:** Land not used for grazing land or agricultural activities.

**Daawa:** Mountain area characterized with higher altitude and covered with vegetations e.g. *Acacia abyssinica*, *Carissa spinarum*, *Clusia abyssinica*, *Ximenia caffra* and *Combretum collinum*.

**Juwana:** Meaning level-land that serves especially for grazing but it also serves for cropping. It is cultivable or cultivated land for growing different crops.

**Gooha:** Refers to valley landform that does not serves grazing and agricultural activities but sometimes for grazing on the slopes because of the low level.

### Shinasha people Vegetation Classification

The local people also have techniques of classifying vegetation into three main types:-

**Chaka or Deniya:** This type of vegetation is with densely populated plant species and composed of a range of larger trees, where many wild animals stay. In the study area, some local people communities call it Chaka and others refer to it as Den. This type of vegetation has declined in the study area because of agricultural expansion and plant species like *Acacia abyssinica*, *Cordia africana*, *Croton macrostachyus*, and *Gardenia ternifolia*.

**Miti k'aawunotsi:** Open woody and shrub land with patches of trees, bushes, shrubs and herbaceous species. It is common near agricultural margins and mountain escarpments. Plant species like *Rhus glutinosa*, *Dispcopodium penninervum*, *Dichrostachscinerea* and *Ocimum utisinamum* are found.

**Jewanatsi mooc'a:** Refers to an area covered by grass and serves especially as grazing land

### Shinasha people soil classification

The local people classify soil based on soil characteristics such as color of the soil, fertility of the land, and other criteria. The following four soil types have been identified by local people:-

**Eezi shawa:** This soil type refers to black soil and with better fertility and production in contrast to other soil types. The people use this soil to grow crops like *Eragrostis tef*, *Allium sativum*, Ground net, *Zea mays*, *Allium cepa*,

**Geeraa'a:** Mix of both red soil and black soil type suitable for crop production (for examples *Guizotia abyssinica* and *Eragrostis teff*).

**Bir shaawa:** This soil is red soil type; it is less fertile in comparison to the black soil. But, it can enable to grow crops of various types by applying fertilizer. The people use this soil to grow crops like *Brassica carinata*, *Mangifera indica*, *Capsicum annum*, and *Zea mays*.

**Naas'e shaawa:** This type of soil is white soil which is not suitable for crop production.

### Ethnomedicinal Plant species used by Shinasha People in the study area

In the study area a total of 65 medicinal plant species 62 genera and 39 families were gathered and documented that are used for the treatment of human and livestock ailments. From these, 48 (73.8%) species were used as human medicine, 1 species only (1.54%) as livestock medicine and the remaining 16 species (24.62%) were used for treating both human and livestock ailments (Figure 2). Of these 65 medicinal plants studied, 48 species were gathered from the wild and 17 species from home garden. This result indicates that the local communities mostly depend more on medicinal plants collected from the wild than those from home garden.

In the study family Fabaceae stood first dominant 7 (10.76%) followed by Asteraceae, Euphorbiaceae and Cucurbitaceae four (6.13%) species and next family, Combretaceae three species and other families consist of one representative species in each. In the same way, other ethnobotanical studies also confirmed the abundance of medicinal plant species in Fabaceae family.

### Medicinal Plant Habit, Habitat, Part(s) Used and Preparation Rout of administration both in human and livestock ailments

**Habit of medicinal plant in the study area:** The result shows that analysis of growth forms of medicinal plants revealed that herbs constitute the largest category 24 (36.9%) followed by tree 18 (27.69%), 16 (24.61%) shrub and 7 (10.76%) Climbers were recorded (Figure 3). The record of the highest number of herbs medicinal plant species in the study could be dominated. **This may be due to their relative better abundance, accessibility in nearby areas as compared to other life forms**, there is presence bimodal rainfall and extended availability of moisture and herbs can grow everywhere compared to other plant habits.

This Habit distribution of medicinal plants has also been previously reported by some researchers [11-14,19,22-30].

**Habitats and abundance of medicinal plants in the study area:** In this study area medicinal plants were collected from various habitats including wild and home garden. As the result shows that most of the medicinal plants used by the communities were collected from wild 48 (73.86%) and home garden 17(26.15%). This finding is in line with the general patterns seen in most medicinal plants inventories such as that of [13,20-27,31-36].

In a similar way, people in the study area have less effort to cultivate medicinal plants in their home gardens rather go to the nearby or far places and harvest the plants. The local people cultivate some popular medicinal plants in their home garden for the purpose of medicine such as *Allium sativum*, *Ocimum lamiifolium*, *Rhamnus prinoides* and *Nicotiana tabacum*.

This and field observation during data collection clearly confirmed that some traditional healers do not have interest to grow in their home garden some plant species that are used to treat specific ailments in order to keep the secret of their medicinal value. This means that most of the medicinal plants found in the home gardens are those also known to have other uses particularly as food.

**Medicinal plant parts used to treat both human and livestock ailment in the study area:** The result of the survey showed that various parts of medicinal plants resources were employed to prepare remedies by local practitioners. The most widely used plant part for the preparations of remedy were leaves, which accounted for 28.06% followed by roots (14.06%), seed (10.39%) bark (9.39%) bulb (6.25) and others (Figure 4). In this study, leaves are the most frequently utilized part of plant organs; it was ease of accessibility to leaves explains their frequent inclusion in most of the preparations. Additionally, leaves are the main photosynthetic organs in plants, and photosynthesize are translocate to other parts, such as the root, stem, fruit, and seed. These can act as toxins for protection of predators and some are of medicinal value to humans.

On the other hand, the results of the study showed that harvesting of roots has great impact on the plants and leads to the dearth of the medicinal plants. Fortunately, the plant parts which are mostly used for the preparation of the remedies in the study area were leaves and harvesting of leaves has less impact on the plant than harvesting of roots. Similarly, various studies in Ethiopia were reported [13,20,22,25-27,31-36].

### Method of preparation

The result that shows the preparation of medicinal plant for human and livestock of local community employs various methods of preparation of traditional medicines for different types of ailments. The preparations vary based on the type of disease treated and the actual site of the ailment. The principal methods of plant parts remedy preparation forms were reported to be through crushed, which accounts for 15 (23.07%), followed by pounded 13 (20%), squeezing 10 (15.4%), chewing 7 (10.71%), crashing and pounded 5 (7.7%), cocking 4 (6.15%), eating 3 (4.61%), smoke/burning 3 (4.61%) crushed squeezed 2 (3.07%), pounded squeezed 2 (3.07%) and pounding powder 1 (1.5%) respectively (Figure 5). Based on the informants' information the most popular method of preparation of remedy in the study area was crushing. Similarly, various research findings mentioned crashed as the primary method of preparation in traditional plant medicine [12,23,26,34].

### Route of administration

There are various routes of administration of traditional medicinal plants prepared products by the local community. The major routes of administration in the study area are oral, dermal, nasal, anal, tide; ear and fumigated. People of the study area mostly administer traditional medicine orally. Oral accounts 38 (58.46%) followed by dermal 5 (7.69%), oral and dermal 6 (9.23%) and others (Figure 6). Due to them may indicate the higher prevalence of internal ailments in the study area. However, the dose should be given in great care in the oral system than in the dermal since it might cause other severe internal problems.

Similarly, various research findings mentioned oral application as the primary route of administration in traditional plant medicines. This fact was documented by different authors in the other part of Ethiopia [13,20,22,25-27,31-36].

### Application

The prepared traditional medicines are applied in a number of methods, drinking accounted for the largest 23 (35.38%), followed smoking 11 (16.76%) creamed and snaffling 7(10.76%) and others (Figure 7). Internal ailments were commonly treated by making the patient drink herbal preparations; tooth infection were treated by crushing and put on the remedial plant part on the tooth surface; skin infections such as ringworm were treated by painting herbal preparations on an infected skin.

Some plants do have different applications for different disease types. This preparation is used for different diseases by diverse application techniques. For instance, putting the leaves on tooth surface is used to cure toothache, and to tie on swollen body part is used to cure swelling. Similar results were reported elsewhere in Ethiopia by the researchers [11,13,14,17,23].

### Conditions of preparation of herbal remedies

The results showed that herbal remedies are prepared using fresh material 45 (69%), while 8 (12%) were used in the case of dried plant material and 21 (18.46 %) in both condition. (Figure 8). The informants in the study area prefer fresh plant materials (69%) to prepare effective and efficient remedies due to the fact that, most of the bioactive phytochemicals are retained in fresh plant materials as compared to dry ones. Although frequent collection of fresh plant materials in dry seasons has a devastating influence on the conservation statuses of medicinal plants, it is common to use fresh plant materials for the preparation of remedies.

In addition to that they believe that using fresh materials increases efficacy compared with the dry one. This is because of the fact that the content or ingredients may be lost or reduced when the plants became dry. Similarly, various studies in Ethiopia were reported.

### Medicinal plants used to treat human ailments in the study area

The 48 of ethnomedicinally important plant species that are used to treat 57 human ailments recorded in three districts. These plants belong to 46 genera and 28 families. Family Fabaceae contributed 7 species, Astraceae 3 species, Combretaceae 3 species, Euphorbiaceae, Bignoniaceae species, Amaranthaceae, Rubiaceae, Alliaceae, Cucurbitaceae, Olaceaceae, Lamianaceae, Polygonaceae, Ranunculaceae, Rutaceae and Solanaceae comprises represented by 2 species each and the rest 15 families comprises 1 species each.

Some of the medicinal plants recorded are also used as remedies in other parts of Ethiopia. Fisseha Mesfin documented 30 plant species [37], Endalew Amenu, 25 plant species [14], Moa Megersa, 78 species [19], and Demek Amsalu and Haimanot Achameleh, 12 plant species 37 [12]. The dominance of family Fabaceae for the treatment of human diseases was reported in other researches [12,14,19,29].

### Major human ailments and plant species used by local people

Though more than 57 different diseases of humans were recorded as human health problem that are treated by 48 plant species (Table 1), one species can treat a single disease or a number of diseases. The practitioners of the area commonly diagnose each health problem by an interview and visual inspection of the patient.

These shows large numbers of diseases have got solution by traditional medicine in Metekel Zone compared to different investigations in Ethiopia. For example, 47 human ailments treated by 48 plant species; 77 plant species used to treat 49 ailments of humans; 78 plant species that used to treat 65 ailments of humans and 80 plant species that used to treat 49 ailments of humans.

According to the informants the largest number of species was used to treat snake biting, which is treated with 11 species. This disease is common in the area because most people engage in living the farmland as a result their men are susceptible to the snake biting; the next is eye vile is treated by 9 species. Amoebae, toothache, febrile illness and wound each disease are treated by 7 species and malaria, stomach ache common cold, retained placenta and abdominal pain each disease are treated by 5 species. In addition to these, the practitioners were also visited more for diseases like gastritis, eye problem, hemorrhoids, athlete foot and others. The local community prefers traditional healers for such diseases rather than modern medication (Table 12).

### Habitat, habit, plant part used, methods of preparation, rout of administration and application of human medicinal plants in the study area

From the medicinal plants that are used for human ailments, 36 species were collected from the wild vegetation and 12 species from home gardens. These indicated that the local people obtain medicinal plant species from wild vegetation than home gardens. This result agrees with the works of different authors. This indicated that the practice of cultivation of medicine plants for their medicinal purpose in home gardens of most of the country is low although many plants are cultivated for other purposes, mainly for food. In a similar way people in the study area have less effort to cultivate medicinal plants in their home gardens rather go to the nearby or far places and harvest the plants.

### Habit of medicinal plants used

In the study area there are many habits of medicinal plant those are herb, shrub, tree and climber. The result shows that analysis of growth forms of medicinal plants revealed that herbs constitute the largest category 19 (39.58%) followed by tree 11 (22.92%), 12 (25.00%) shrub and 6 (12.50%) Climbers were recorded (Figure 9). The record of the highest number of herbaceous medicinal plant species in the study could be attributed to the fact that their presence in most parts of the study area is the bimodal rainfall and extended availability of moisture. Similar habit distribution of medicinal plants has also been reported by some researchers [13,20,22,25-27,31-36].

## Plant part used to treat human ailments

The result of the survey showed that various parts of medicinal plants resources were employed to prepare remedies by local practitioners. From the total plant parts used for remedy preparation the leaves and the roots were the most commonly used plant parts in the preparation of remedies. The most widely used plant part for the preparations of remedy were leaves, which accounted for 10 (20.85%) followed by roots 8 (16.66%), seed 6 (12.50%) bark 4 (8.33%) bulb 4 (8.33) and others (Figure 10).

The greater number of traditional remedy preparations found from leaf parts of medicinal plant species had a better accessibility during field collection, ease of preparation, and effectiveness due to bioactive components in their parts. In the same way, the detailed reason for leaves as the most potential sources of traditional remedy preparation was suggested by various studies. In my study, similar studies in other parts of Ethiopia reported and documented that leaf part are the most commonly used medicinal plant parts followed by root [13,20,22,25-27,31-36].

## Method of preparation

The result concerning the preparation of medicine for human, the local communities employ various methods of preparation of traditional medicines for different types of ailments. The preparations vary based on the type of disease treated and the actual site of the ailment. The principal methods of plant parts remedy preparation forms were reported to be through crushed, which accounts for 16 (33.33%) followed by pounded 9 (18.75%), squeezing 7 (14.58%), chewing 5 (10.42%), crashing and pounded 4 (8.33%), cocking 3 (6.25%), eating 1 (2.08%), smoke/burning 1 (2.08%) crushed squeezed 1 (2.08%), pounded and squeezed 1 (2.08%) and pounding powder 1 (2.08%) respectively (Figure 11). The most dominant method of preparation is crushing. The informants have various skills associated with remedy preparation. They tend to apply mixing of different plants. The result showed that the majority of remedies were prepared from single plant species and few are prepared from different, Solvents and additives which is a combination of medicinal plants, was used to treat a disease. Similar researchers of medicinal plant species method of preparation are reported from different parts of the country by [13,26,27,35].

## Route of administration

There are various routes of administration of traditional medicinal plants prepared products by the local community. The major routes of administration in the study area are oral, dermal, nasal, anal, tide; ear and fumigated. People of the study area mostly administer traditional medicine orally. Oral accounts 25 (52.08%) followed by dermal 6 (16.67%), fumigated 4 (8.33) oral and dermal 2 (4.17%) and others (Figure 12). This could be due to the high prevalence of gastrointestinal and dermatological ailments in the study area (Table 10).

Predominance of oral and dermal routes of herbal drug application in the study area could be because of high prevalence of gastro-intestinal and skin related problems in the area. Intra cutaneous application of remedial preparation could also be attributed to the fact that it minimizes the chance of intoxication

by drugs than when it is administered orally. In addition, both oral and dermal routes permit rapid physiological reaction of prepared medicines with the pathogens and increase its curative power. In connection to this, reports showed that oral and dermal route of administration of remedies found to enhance the physiological reactions of remedies with the pathogens that in turn increase the healing power of the medication. This fact was documented by different authors in the other part of Ethiopia [13,20,22,25-27,31-36].

## Dosage of Medicinal Plants used in human ailments

People of the study area used various units of measurement and the duration of administration to determine the dosage. Local units such as finger length (e.g., for bark, root, stem), different measuring materials (e.g. spoon, coffee cup, tea cup and glass cups) and numbers (e.g. for leaves, seeds, fruits, bulbs) were used to estimate and fix the amount of medicine. But, these measurements are not accurate enough to determine the precise amount. For medicinal plants that are taken topically they do not have clear cut dosage [19,26,31,39,40-42]. We have also discussed lack of precision and standardization as one drawback for the recognition of the traditional healthcare system.

Although the most of remedies were reported to have no serious adverse effective in some case vomiting and temporary inflammations are occurred. These could be attributed to low toxicity of the remedies preparation of medicinal plant species used by traditional healer in the study area. However, the toxicity of some medicinal plant and the potential to do harm is a common complaint among those who would like traditional medicine to be standardized. It is commonly believed that traditional practitioner either does not know the strength of their own medicine or does not bother to fit doses to the size or the body weight of the patient [44]. However, it is that some traditional healers do give different dosage and frequencies of application depending on age sex pregnancy and other condition or the medicinal itself on such difference. However, from the interview made during the study, it was found that there was disagreement among the healers concerning the dosage system used. For example, some informants suggested that two or three glass of the squeezed from *Justicia schimperiana* is used to treat, snake bit, malaria, stabbing pain and toxic substance while some suggested that only one glass is enough for the same problem. Although the measurements used to determine the dosages are not standardized and doses given depend on the age, physical appearances and health conditions; that is, children are given less dose than adults, physically strong individuals take more dose than weak individuals depending on the type of disease. Though such prescription difference was practiced, still the amount prescribed by healers for both children and adults might not conform to the standard prescriptions as in modern medical literature.

The absence of any adverse effects of traditional medicines after administration were also more frequently mentioned by the traditional healers but some of the preparations were reported to have some adverse effects like diarrhea, headic, abdominal pain and vomiting. The traditional healers indicated that they use antidotes for the adverse effects of some traditional medicines like eating cooked teff flour and honey, drinking boiled coffee,

"yedoro" wote" milke "ergo" suger after taking the medicine. For instance, the use of *Euphorbia abisanica* for the treatment of gonorrhoea, the sanp is collected mixed with "teff" powdered and backed and then eaten before any food for 3 days. During that diarrhoea follows, as an antidote the local healers ask the patient to drunk boiled coffee.

In addition to the use of *Jatropha curcas* for the treatment of Rabbis, one seed are pounded, powdered, mixed with milk then the filtrate the solution is drunk. During that diarrhoea and vomiting follows, as an antidote the local healers ask the patient to drunken borede and milk. In addition to the use of *Nicotina tabacum* for the treatment of snake bit, one leaf is pounded, powdered, mixed with water then the filtrate the solution is drunk. During that vomiting follows, as an antidote the local healers ask the patient to drink milk.

### Application

The prepared traditional medicines are applied in a number of methods, drinking account the largest that account 12 (25.00%), followed by smoking 10 (20.83%), sniffing 7 (14.58%), dropping 5 (10.42%), painting 4 (8.33) swallowing 3 (6.25) eating 2 (4.17) put on 1 (2.08) tide 1 (2.08) washing accounts 2 (4.17) burshing 1 (2.08)% (Figure 13). Internal ailments were commonly treated by making the patient drink herbal preparations; tooth infection were treated by crushing and put on the remedial plant part on the tooth surface; skin infections such as ringworm were treated by painting herbal preparations on an infected skin.

### Medicinal plants used to treat livestock health problems

A total of 17 medicinal plants species were collected and identified in the study area. Those medicinal plants are used for treat 15 livestock health problems. They are grouped in 16 genera and 16 families. Family Euphorbiaceae is 2 species and Asteraceae, Moranceae Scrophariaceae, Tiliaceae, Solanaceae, Acanthaceae, Meliaceae, Cucurbitaceae, Myrsinaceae, Asparagaceae, Boraginaceae, Brassicanaceae, Rutaceae, Rubiaceae and Rhamnaceae comprise 1 species each. 12 species are obtained from the wild and 5 species from home gardens. More species for livestock treatment have obtained from the wild. This shows that the practice of local community is less for cultivating livestock remedies in home gardens. As most informants agree even though the areas do have high number of livestock population the local people do have low knowledge of ethno veterinary important medicinal plants compared to human treatment. Mostly they use clinics for the treatment of their livestock.

### Major livestock ailments and number of plant species used by local people

In comparison to human diseases livestock diseases are treated with a few number of plant species in the study area. A total of 15 livestock ailments and 17 medicinal plant species are identified in the area (Table 11,13). Common diseases affecting livestock health's in the study area are Coccidiosis and Bloating which is treated by 3 species, Retained placenta and leech by 2 plant species, the remaining disease are treated by 1 species each .

This finding is in agreement with the study of different authors; livestock problems were reported by different scholars [12,14,44-46].

### Habits

The habits of medicinal plants that are used for ethnoveterinary health problem are trees comprises 7 species, herbs 5 species, shrub 4 and climbers 1 species (Figure 14). In this study trees like *Ficus vasta*, *Grewia ferruginea*, *Melia azedarach* and *Cordia africana* herb species like *Asparagus africanus*, *Carduuss schimperia* and *lepidium sativum* were used for the treated livestock ailments in the study area. This finding agrees with the work of [13, 22,25-27,31-36]. In this result trees are the dominant habits for the treatment of livestock ailments. This indicates unlike that of human medicine the local community uses more tree species for livestock health treatment.

### Plant part used for livestock ailments

The plant parts used for livestock health treatment in the area are leaves that account 10 (58.82%), root 2 (11.76) bark, seed, snap, leaf and climber and the whole part together account 1(5.88) %, (Figure 15). Like that of human medicine leaves again the most harvested plant part of remedy preparation for livestock ailments. The finding that leaves followed by roots to be the most harvested plant parts used for ethnoveterinary remedy preparation in the study area might be associated with traditional beliefs in different communities that existence of adequate active principles in these parts for treating various ailments and leaves are easily available. This finding agrees with the work of [13,22,25-27,31-36].

### Method of preparations for livestock ailments

The local people use different forms of remedy preparations to treat livestock diseases. The technique of preparations used involved, crushing 10 (58.82%), pounded 3 (17.65%) and pounded and squeezing 2 (2.11%), squeezing and fumigated in each 1 (5.88%). Crushing is followed by pounded (Figure 16).

The dominant mode of ethnoveterinary medicinal plants remedy preparation is through crushing and steeping plant part(s) in cold water and giving the resulting infusion to the target animal under question to drink. In agreement with these results, use of cold infusion in herbal remedy preparation has also been reported from other cultural groups. This finding is similar to other researcher [13,15,11,46,47,27,41].

### Route of administration for livestock ailments

There are various routes of administration of traditional medicinal plants prepared products by the local community. The major routes of administration in the study area are oral, dermal and fumigated. In the study area oral administration is the dominant route with 64.71% followed by dermal (17.65 %) and fumigated (5.388) (Figure 17).

Similar results were obtained [12,13,44,46]. That indicates the higher prevalence of internal ailments in the study area.

### Dosage of livestock ailments

Plant based remedies are the first-choice weapons for the

livestock healthcare demand of the local community, partly because of their affordability and accessibility as compared to modern medicine in the study area. Yet, lack of standard dosage and precise measurement are the common drawbacks of traditional herbal medicines [12,46]. According to the responses of the informants in the study area, the dose of remedies as well as frequency of administration varies depending on the age, size and type of animal treated.

Relatively smaller amount of plant remedies (measured using “finjal, tassa, birchiko”, etc.) were prescribed for sheep, goat, dog, etc., on the other hand “faga and jog” were used to tailor the dose required for larger animals such as cow, ox, horse, donkey, etc. In addition, some remedies were administered once, while others were given until cure. Inconsistencies of doses have also been reported in similar studies conducted elsewhere in the country [47,11,35].

When livestock's were given with their feed along with different types of ingredients like salt, “injera” (traditional Ethiopian flat bread prepared from *Eragrostistef* flour) flour, milk, and so forth, in the area. Similar findings are also reported from other regions of the world. The use of these vehicles might be due to their enhancing potential of taste (i.e., minimize discomfort) and reduce adverse effects such as vomiting and diarrhea, and enhance the efficacy and healing conditions.

### Application

Application of ethnoveterinary medicinal plants involve drinking 11 (64.71%), creamed 3 (17.65%), washed 2 (11.76%) and fumigated 1 (5.88%) (Figure 18). The most common method of ethnoveterinary medicinal plants involves drinking. This may be also, based on the nature of the disease and the preparation taken by water and salt. Similarly, various research findings mentioned oral application as the primary route of application in traditional plant medicines [19,46,44]. That indicates the higher prevalence of internal ailments in the study area. For example, if the whole part of *Pavenia urens* pounded and squeezed with seed of *Allium sativum* pounded given orally to chickens it can treat to the animal from the coccidiosis. The leaf of *Melia azedarach* Crushing then mixed with water drink during morning time then will treat from whitcholera.

### Solvents and additives

Some of the remedies are taken with different additive and solvents, the solvent used is water. The additives include butter, honey, milk, sugar, ‘teff’ flour, boiled coffee or tea, “Yedoro wote,” hyena liver,” bordee” and meat (Table1). These additives have importance in reduction of pain, to get better taste and reduce adverse effects such as vomiting and diarrhea and enhance the efficacy and healing conditions as explained by informants.

For example, the seed of *Coffea arabica* is roasted, crushed, powdered and boil and the filter one cup of tea, mixed with a few drop of oil then drink for treatment of diarrhea. The roots *Justicia schimperiana* is crashed powdered and mixed with the honey and drink one glass for 3-5days for treatment of stabbing pain. The whole part *Clematis hirsuta* is pounded powder and mixed with butter and creamed affected part until recover for 5 days to treat wound.

## Sources and Transferring of Indigenous knowledge

**Sources of Traditional knowledge practices:** The highest number of traditional medicinal plant knowledge gained was from Father 45 (45.4%), followed by 20 (2.02%) form Mother and 15 (15.1%) form Uncle 10 (10.1%) from Brother, 8 (8.08%) from Sister 6 (6.06) from Neighborhood and 5 (5.05%) form Friend (Figure 19). The great majority of respondents (90%) reported that most of their knowledge was received from their family members and friends secretly by oral. The secret practices of traditional medicines came from their ancestors. Similarly, various studies in Ethiopia were reported [26,27,34,41,35] (Figure 11).

### Transferring knowledge of traditional medicinal plants

Ranking of most important medicinal plants: According to the survey, knowledge transfer of medicinal plants follows vertical transfer to the most selected family member orally with great secrecy. The findings of the study showed that as people become older and older their knowledge of traditional medicine becomes better and better. Most of the informants were elders that indicated the trend of transferring knowledge is usually at old age.

The highest number for the ways of transferring knowledge on traditional medicinal plants by elder son who received 56 (56.5%) votes followed by the elder daughter 12 (12.1%), for the brother 10 (10.1%) for the sister 7 (7.07%) for the not to all 5 (5.05 %) for all went to known 4 (4.04%) to all the member of my family 3 (3.03%) and other to fried 2 (2.02%) (Figure 20). Therefore most way of indigenous knowledge transfer in the study District was by word of mouth to a family member (especially to an elder son). Similar findings were reported for other communities in Ethiopia [19,46,44].

### Preference ranking

Preference ranking for eleven medicinal plants to treat snake biting (Table 2) made by ten informants showed that *Bersama abyssinaca* ranked first and hence is the most effective medicinal plant to cure snake biting. *Myrsine melanophloeos*, *Nicotianatabacum*, *Justicia schimperiana* and *Allium sativum* are the 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> respectively.

### Direct matrix ranking

Direct matrix ranking was performed to assess the relative importance each of the plant. The result of the direct matrix ranking showed that *Cordia africana* stood first in being the most multipurpose medicinal plant followed by *Gardenia ternifolia*, *Eucalyptus globulus*, *Myrsine melanophloeos*, *Croton macrostachyus*, *Acacia abyssinica*, *Ximenia caffra*, *Bersama abyssinaca* and *Jatropha curcas* was the least (Table 3).

### Paired comparison

A paired comparison made to determine the most preferred medicinal plants among the 9 species that were used to treat eye vile in the study area, the responses of ten key informants, showed that Ranked *Withania somnifera* first followed by *Gardenia ternifolia* (Table 4). Therefore, this result indicated that



*Withania somnifera* is the most preferred while *Clausena anisata* is the least favored over the other plant species cited in treating eye vile.

Threatened and factor threatening medicinal plants in the study area

### Threatened medicinal plant in the study area

The ranking of 9 medicinal plants based on the degree of threats was conducted using 10 key informants (Table 5). The results indicated that is *Asparagus africanus* and *Myrsine melanophloeos* the most threatened medicinal plant species in the study area followed by *Withania somnifera* (L.) and *Bersama abyssinaca* and the least threatened one is *Glinus lotoides* L. This may be the agricultural expansion and deforestation was the major medicinal plant treats.

### Factors threatening medicinal plants in the study area

The cause of threats to medicinal plants can be generally grouped into natural and human induced factors. However, as reported in this study most of the causes for the threats to medicinal plants and the associated indigenous knowledge are the anthropogenic factors such as deforestation due to over exploitation of plants for different uses including charcoal making, population pressure, fire wood collection, household construction, overgrazing, cutting and burning of plants to create new agricultural expansion lands and urbanization.

Informants ranked agricultural expansion, fire wood and population pressure as the most serious threat to the medicinal plants followed by medicinal purpose and charcoal collection is lower levels of threats by the other factors (Table 6). Similar study was reported by different scholars [34,35,37,46,49,50,51,]. As expected agricultural expansion is the main cause for loss of medicinal plant because of the community in the study area depend on mixed agriculture as the main economic activity that haven family to support with income realized from the sale.

This showed that, there are different threats to medicinal plants such as agricultural expansion fire wood collection and others. Furthermore, the negative impact of deforestation on medicinal plants was also reported [11].

In this study, the information gathered from the key informants was indicated that the treats of medicinal plants increase from time to time in study area. The agricultural expansion and deforestation was the major medicinal plant treats. The finding was in line with other findings [2]. This might be due to continuous agricultural expansions, deforestation and draught in addition to lack attention towards the medicinal plants. The plants are disappeared because of rapid socioeconomic, environmental and technological changes and as a result of the loss of cultural heritage under the guise of civilization [2,15].

### Management and Conservation of Medicinal Plants

At this moment natural habitats of medicinal plants in the study area are highly affected by factors mentioned above. The local people in the study area have brought only about 48 and 17 species of the total collected medicinal plants under wild

and home garden. As a result many medicinal plants are under serious threats. So the local people should be conserve medicinal plant in-suit and ex- suit management style.

Those mines that forty eight medicinal plants that are collected in the wild by conserve in-suit conservation method and the reaming seventeen medicinal plants that conserve by ex-suit conservation method. According to the informant information generally, there are some conservation measures that have been under taken around the world aimed at protecting threatened medicinal plant species from further destruction by create awareness for the user local people for the use and management of medicinal plant in study area.

Some authors clarify that home gardens can be refuge for wild species that are threatened in the wild by deforestation and environmental changes. Concerning this there is a report that home gardens are being used as informal experimentation plots for new varieties and exotic species [52].

Medicinal plants are also left as remnants of trees, shrubs and herbs in and around agricultural fields due to their uses as forage, fuel wood, timber, and construction, spiritual and ritual needs. Protecting such multi-purpose plant species by agropastoralists in their localities is evidence for the existence of traditional conservation practices in the area. But this has to be strengthened to safeguard these natural resources. Of the species purposely maintained in home gardens in the country, about 6% are primarily cultivated for their medicinal values [52].

Informants also reported that the healers know time and processes of gathering, and storing medicinal plants. It is once a year that some medicinal plants are collected and preserved. *Lepidium sativum*, *Cucurbita pepo*, *Jatropha curcas* and *Ocimum basilicum* seed, leaf, fruit or root are harvested, dried and preserved in roof corners or outside house, and dried parts are powdered and stored in different containers like pots, bottles or tied with clothes and used when needed.

The study indicated that many of the informants who have knowledge on traditional medicine usage give priority to the immediate use of the medicinal plants than to its sustainable future uses, as a result their harvesting style is destructive. However, some plants has protected for their spiritual and cultural purposes. Thus, these places are good sites for the protection of the medicinal plants since cutting and harvesting are not allowed in such particular areas. This was indicated that a good practice for the conservation of medicinal plants through cultivation [34].

### Informant consensus factor (ICF)

All cited human and livestock diseases were categorized into 7 categories: namely, sense organs diseases, animal and insect biting disease, digestive system disease, reproductive system diseases, cultural disease, respiratory disease, intestinal and parasitic infection, and derma. These diseases are categorized based on nature of disease, conditions that cause, place of attack, symptoms and sign of disease (Table 7). Disease categories with relatively higher (ICF) values were: intestinal and parasitic infection related diseases (0.89), dermal diseases (0.87) Sense organs diseases (0.83), and Cultural diseases (0.73). This may

indicate the common occurrence of these diseases so that more number of people exchanging information and agree on plant species that can be used to treat these diseases than the rest.

The medicinal plants that are presumed to be effective in treating a certain disease have higher ICF values. On the other hand, the rest of disease categories had ICF value of lower suggesting that these diseases are either rare in the study area or are treated only by the healers with little information passed to other general public [53,54].

### Fidelity level Index (FLI)

Fidelity level (FL) quantifies the importance of a species for a given purpose. Hence, fidelity level values were calculated for commonly used individual medicinal plants against the following ailments: *Justicia schimperiana* (against snake biting and Rabbits), *Nicotiana tabacum* L (against leech), *Asparagus africanus* (against retained of placenta), *Croton macrostachyus* (against eye vile), *Stereospermum kunthianum* (Tonsil, scorpion biting) *Momordica foetida*. (Against Bleeding during delivery), *Myrsine melanophloeos* (against blackleg) *Euphorbia abyssinica* (against Hemorrhoid, gonorrhea), *Paveonia urens* (against Rheumatic, tooth ache) and *Protulaca sp* (against Gastritis). The fact that these medicinal plants had the highest FL values which could be an indication of their good healing potential (Table 8).

### Medicinal use value

While some plant species are known to treat a single ailment, some others may be used for multiple of health problems. Medicinal use value is a quantitative method that demonstrates the relative importance of species known locally. Some species that were cited for more than one ailment were selected and their use value was calculated.

Results of use value computation for these species showed that *Croton macrostachyus* and *Carissa spinarum* had the highest use value (Table 9). The informant consensus values also indicated that the people share the knowledge of the most important medicinal plant species to treat the most frequently encountered diseases in the community.

Moreover, most medicinal plant species have least use values in the study area, which could not mean that they are less effective to treat ailments. This is because the few effective medicinal plant species are reported by one or two healers. In this case, the knowledge is very secret. This suggests that these species are used to treat many ailments. For example, *Croton macrostachyus* was reported to treat ailments such Amoeba, evil eye, febrile illness, wound, prevent snake, skin infection and malaria.

On the other hand was *Carissa spinarum* L. reported to treat snake biting, ascarises, malaria, gonorrhea, Amoeba, febrile illness and diarrhea. *Justicia schimperiana* was reported to treat ailments such as snake biting, antitoxic, stabbing, malaria, rabbits and typhoid's *Stereospermum kunthianum* was reported to treat ailments such as scorpion biting, retained plasta, gastritis, tosile, snake biting and stomachache

### CONCLUSION

Northwestern area of the country in general and Metekel Zone in particular is the zone in BGRS which is rich in medicinal

plant species and the associated indigenous knowledge. In this study 39 family, 62 genera and 65 medicinal plant species were recorded. Of these, 48% were used to treat human maladies and 18% for livestock. The majorities of these medicinal plant species were obtained and collected 48 from wild, 17 from home garden.

Analysis of growth forms of these medicinal plants that herbs constitute the largest category 24 (36.9%) followed by tree 18 (27.69%) shrub 16 (24.61) and climber 7 (10.76%) plant species. Herbal remedies are prepared from fresh materials 45 (62.23 %) and dried plant materials 8 (12.30 %) and in both condition 18 (18.46%). In the study area, 72 ailments were reported (57 for human and 15 for livestock) which are being treated by traditional medicinal plants of the area.

Leaves were the most frequently used plant parts followed by roots for preparation of human and livestock remedies. Most of the medicinal plants are administered orally (54.4%) and followed dermal (7.69). The most widely used method of preparation was crashed (23.07%), Pounding (20%), squeezed (15.4%), chewing (10.7%) crushed pounded, cocking, smoking eating of the different medicinal plant parts.

The shinasha people of Metekel Zone are rich with indigenous knowledge in using, conserving and managing plant resources in general and medicinal plants in particular. They have a wide knowledge in using plants for various purposes such as for medicine, food, household utensils, fodder, fuel, construction, etc.

This knowledge is transferred from elders to youngsters entirely through oral traditions and personal experiences. But this way of knowledge transmission will lead to distortion of the original knowledge or total disappearance of the practice

The major threats to medicinal plants and the associated knowledge in the study area are mainly agricultural expansion, firewood collection, population pressure, over gathering, urbanization, household tool construction, charcoal production and medicinal purpose. Therefore, use and management system awareness rising should be made among the healers so as to avoid erosion of the indigenous knowledge and to ensure its sustainable use.

### RECOMMENDATIONS

**Based on the results of the study, the following recommendations are forwarded**

- Local people of all areas in the country must be taught of growing medicinal plants in home gardens mixing with crops in the farm lands and live fences
- Indigenous people of the study area in particular and of the region in general should be involved in conservation and management plans of plant resources.
- The local people need supports through awareness raising education on the sustainable utilization and management of plant resources.
- Encouraging Government institutions and NGOs to participate in conservation of medicinal plants, support local medicines and provide incentives to farmers for

cultivation of medicinal plants in home gardens.

- The regions administration must involve in awareness creations on traditional healers to transfer their knowledge to the next generation without secrecy.
- Medicinal plants like *Asparagus africanus*, *Myrsine melanophloeos*, *Withania somnifera* *Bersama abyssinaca* and *Glinus lotoides* are highly threatened and should be given priority for conservation.
- Educating people to protect and enclose ritual and spiritual areas with higher distribution of medicinal plants in the locality.
- Supporting the activities of plantations of medicinal plants in degraded and degrading areas through forming youth association in the countryside to make them beneficial from the product of the plantations.
- Planting of multipurpose plants is beneficial E.g., *Cordia africana*, *Croton macrostachyus*, *Gardenia ternifolia*, *Eucalyptus globulus*, *Myrsine melanophloeos*, *Acacia abyssinica*, *Ximenia caffra*, *Bersama abyssinaca* and *Jatropha curcas*.

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