



# Wild useful plants with emphasis on traditional use of medicinal and edible plants by the people of Aba'ala, North-eastern Ethiopia

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## ABSTRACT

**While plants can provide multiple uses, overlapping between food and medicine is quite well known in traditional societies. The aim of this study was to document and assess the conservation status of traditional wild useful plants and the associated knowledge in Aba'ala district. Data were collected from 24 informants in six study sites. Methodology included semi-structured interviews, group discussion, and market survey. The data were analyzed through use values, ranking and comparison. In total, 58 species belonging to 28 families and 46 genera were collected and preserved. Most of these species were used as traditional herbal medicine (24 species), followed by nutraceutical and edible plants (10 species each) and other traditional values (14 species). Shrubs accounted for the highest number (31 species). Thirty-four species were used against 26 human and livestock ailments and leaves took the lead. Fruits were the most frequently used edible parts. The majority of the plants were used for other purposes aside from food and medical practices. Most of the plant knowledge is held by traditional healers and pastoralists. The findings inform that conservation action is needed in the multipurpose plant species since they are found in short supply.**

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## INTRODUCTION

Traditional societies throughout the world hold wealth of indigenous knowledge (IK) which has been built up during prolonged interactions with the natural world, and which remains fundamental to their physical, spiritual and social interests (Agrawal and Agrawal, 2015; Anderson, 2007; Cotton, 1996; Berkes, 1999; Getahun, 1976). This vital dependency of people on plants was primarily started by domestication (Martin, 1995). Traditional medicinal and wild edible plants (WEPs) are among the most important ones for peoples' lives (Abebe and Ayehu, 1993; Asfaw and Tadesse, 2001). However, in a rapid phase of globalization, many cultural landscapes and untouched wild vegetation are being modified for the purpose of development. The introduction of potassium mining is well known in Ethiopia's Northeastern Danakil

Depression since early 1990 (Allana's Potash Project, unpublished report of 2012). Despite it is being engaged in bringing much needed progress, globalization may undermine the traditional use of wild plants and the associated IK (Giday and Teklehaymanot, 2013; Matthew, 1996; Tesfay and Tafere, 2004; UNESCO, 2011).

Pastoral mode of living is the dominant form of economic activity in semi-arid environs. To cope up with drought, the pastoral communities have developed ethnobotanical knowledge in use and management of wild plants (Tefay and Tafere, 2004). In some remote areas of our country including Afar, the uses of wild plants knowledge have not been well studied and documented (Seifu, 2004). Although IKs are passed to

generation by the word of mouth, they are fragile and are likely to be lost when communities emigrate, undergo cultural changes or through alteration of the local ecology and drought. According to UNECA and ANRS (1998), the dramatic changes and erosion of natural resources management in northern Afar is further compounded by the rising human population and recurrent drought. Thus, there is a need for proper documentation and evaluation of such scattered ethnobotanical knowledge of the biological resources in order to reserve it for posterity. The main objectives of the present study were to compile IK of wild useful plants with emphasis on traditional use and management of medicinal and WEPs in Aba'ala district, North-eastern Ethiopia.

## MATERIALS AND METHODS

### Description of the study area

The present study was conducted in Aba'ala district, administrative centre of Zone 2, Northern Afar. It lies approximately between 13° 15' and 13° 30' N latitude and 39° 39' and 39° 55' E longitude about 50 km east of Mekele town. According to the Ethiopian population census undertaken by CSA (2007), Aba'ala has a total population of 37,963, of whom 20,486 are men and 17,477 women; with an area of 1,188.72 km<sup>2</sup>. The district consists of flat plains occasionally interrupted by few undulating hills and a series of elongated ridges (Tsegaye et al., 1998). The area received a semi-arid type of bi-modal rainfall pattern with an average of 422 mm annual rainfall. The main rainy season is falling in the months of July to August (*Karma*) and the short rainy season occurs in April to May (*Gila*). Rainfall intensity is usually high leading to high runoff volume, and this coupled with high evaporation rate makes the available rainfall insufficient for crop production. The agro-pastoral societies in the study area thus, depend highly on the floodwater coming from Tigray highland to produce dry land crops (Tsegaye et al., 2000). This traditional practice has long history in the area. However, currently it is difficult to use the floodwater as previous ones because of loss of huge forests which divert the flood into multiline of farmlands. Agro-ecologically, the area is chiefly lowland dominated by sandy soil in texture developed from alluvial deposits (Tsegaye et al., 2000). Crops (for examples: Teff (*Eragrostis tef*), barley (*Hordeum vulgare*), chick pea (*Cicer arietinum*), sorghum (*Sorghum bicolor*), wild foods (For examples: *Berchemia discolor*, *Cordia monoica*, *Cordia sinensis*, *Dobera glabra*, *Grewia schweinfurthii*, *Grewia tenax*, *Salvadora persica*) and livestock production (mixed farming) and off-farm sources are generally the main economic activities and key parameters for both agro-pastoral and pastoral livelihoods in the district.

### Materials used

Plant specimens were collected, pressed, and dried by using herbarium equipments, which were supported by Photo Camera and GPS data. Further determinations and confirmations were made by using taxonomic keys of the Flora of Ethiopia and Eritrea and comparison with previous authentic specimens. Then, the determined and labelled voucher specimens were deposited at the National Herbarium (ETH), Addis Ababa University (Appendix 1).

### Ethnobotanical methods

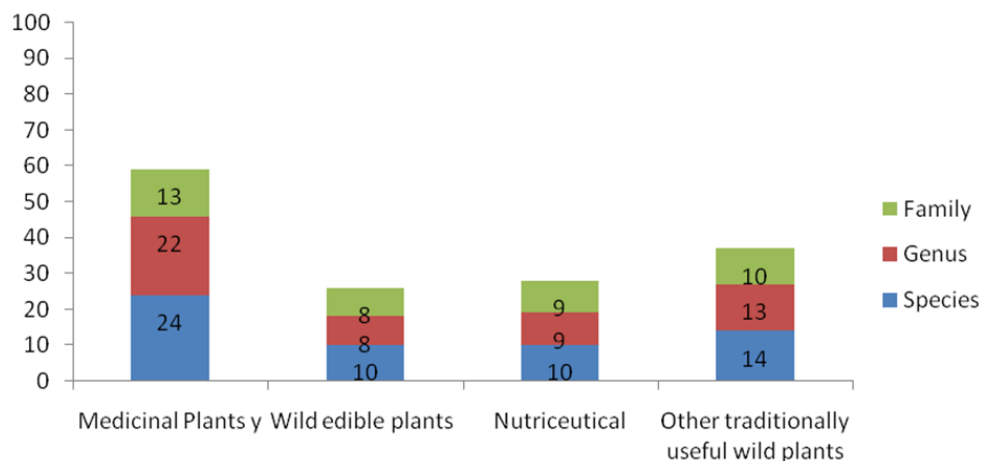
Prior to any contact with the local people, the purpose of this study was introduced to the local administrative leaders. Once they granted permission to proceed, the researcher approached individuals for participation. Purposive sampling method was used and six representative or kebeles sites (kebeles: the smallest administrative system next to district) consisting of both agro-pastoralists (Irkudi, Hidmo and Wuhdet) and pastoralists (Atkelu, Galaiso and Wossema) within the district. Ethical approach and consensus appraisal were given the first prominence before informant selection. In total, 24 informants, of whom 18 were selected systematically while six key informants were selected by purposeful sampling based on the recommendations of elders and local authorities with equal number in each six sites.

Ethnobotanical information on traditional wild useful plants was collected through semi-structured interviews and focus group discussion following checklist questionnaires. The group discussion was done before and during ethnobotanical data collection with informants.

All the discussions and interviews were conducted in Afar language with the help of translator and Amharic for Amharic speakers. The questionnaire mainly addressed plant local names, habitat, time and frequency of collection, parts used, mode of preparation, trends in abundance, impacts of threats and conservation action of traditional wild useful plant in general and medicinal and WEPs in particular.

In addition to direct observation, the guided field walk was performed with the help of local guides, who were interviewed about all aspects of traditional wild useful plants. The plant species were recorded with their local and botanical names. Market surveys were undertaken at the town of Aba'ala (formerly called Shiket). Different herbal drugs and wild edibles were recorded through direct observation and by interviewing traders, vendors and consumers.

The collected data were analyzed using descriptive statistics. Preference ranking was conducted to rank five medicinal plants (MPs) against wound. In paired



**Figure 1.** Taxonomic diversity and use categories of multipurpose plants in the study areas.

comparison, six key informants were asked to choose the top five wild plants for edible fruits based on their taste qualities. The number of pairs for each was calculated by applying the formula:

$$\text{Number of pairs} = \frac{n(n-1)}{2},$$

where  $n$  is the number of items. Direct matrix ranking was used to compare seven multipurpose wild useful plants and six principal threats. Use value was conducted for trees and shrubs which had more than seven use values (Uvs). It was calculated as:

$$UV_s = \frac{\sum U_{is}}{n}$$

for the use-value attributed to a particular species ( $s$ ) by one informant ( $i$ ),  $n$  - stands for total number of informants and  $\Sigma$  - denotes to summation.

## RESULTS AND DISCUSSION

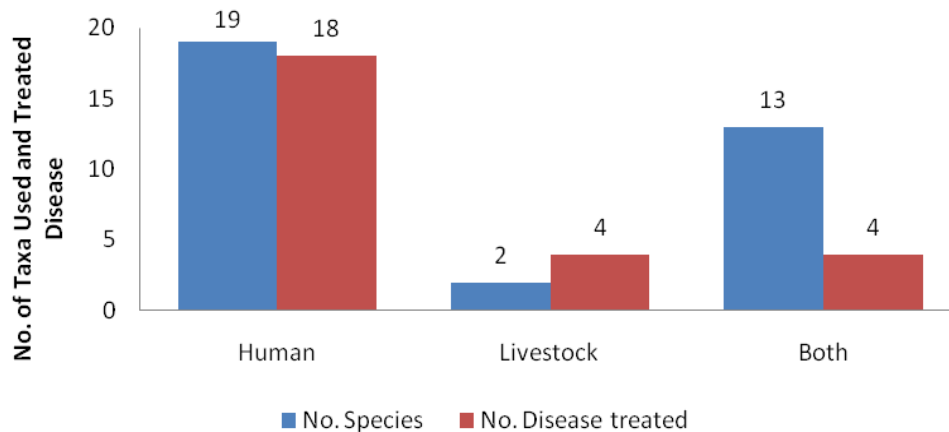
### Plant species diversity

In total, 58 plant species belonging to 46 genera and 28 families were documented (Appendix 1). Although the study district is an arid land with poor plant cover which is aggravated by a continued deforestation and degradation, a good number of wild useful plants are being used in the study area to various purposes.

Figure 1 depicts that the sum of all genera and families are more than 100% because many of genera and families have more than one species in different use categories. This could reveal that relatively more dependence of people on medicinal plants than wild food and other services. One of the possible motive could be they are easily accessible mainly from the wild ecological habitat. Regarding to plant families diversity, the family Fabaceae was the top dominant with seven species

followed by Capparidaceae, Euphorbiaceae and Solanaceae with five species each. Asteraceae and Boraginaceae were the third dominant families (equally contributed three species). The other eight families contributed two species and the remaining 13 families were represented by one species each. In line with the present study, the family Fabaceae came up with high number of species in other studies made in northwestern Ethiopia (Chekole et al., 2015) and Capparidaceae was also represented by greater number of species in other district of Afar (Giday and Teklehaymanot, 2013). In contrast to the present study, Rosaceae and Asteraceae were the most representative families in Bologna, Italy (Sansanelli and Tassoni, 2014). The results of this study prove that people tend to use preferably the plants that are easily available to them. As was affirmed by other studies (Della et al., 2006), the more common a plant species is in an area, the greater is the probability of its popular use.

Regarding to habit diversity, the highest plant habit was exhibited in shrubs (31 species), followed by trees (15) and herbs (13). This could be due to shrubby species in the area that better adapt to arid conditions as compared to plants of other habit forms. This is in line with other studies (Giday and Teklehaymanot, 2013). In terms of woody plant biodiversity, studies have shown that herbaceous plant species distribution is scanty (Friis et al., 2010). This low plant diversity is a reflection of the low rainfall for the region as well as extremely high temperatures (IBC, 2008). Vegetation of the study area consists of *Acacia-Commiphora* woodland and bush land (Friis et al., 2010; IBC, 2008; Tsegaye et al., 1998:37). Among the *Acacia* species *A. etbaica*, *A. oerfota*, *A. tortilis*, *A. mellifera* and *A. nilotica* are widely observed in the study sites. Besides, *Salvadora persica*, *Balanites spp.*, *Comphora sp.* *Aloe camperi* and others are



**Figure 2.** Proportion of treatment of ailments of human, livestock and both.

scattered in the acacia dominated woodland. Though Aba'ala and its environs are characterized by semi-desert climatic condition, plants belonging to the *Capparidaceae* and *Salvadoraceae* families like *Cadaba rotundifolia* and *Dobera glabra* are ever green shrubs which are flourishing in the area.

### Medicinal plant uses

About 34 (58.6%) species were used by the local communities as sources of both nutraceutical and MPs (Table 1). These species were used against 26 human and livestock ailments. Figure 2 shows that the highest proportion (19 species; 56%) went to those used against human ailments. In most cases there are several plant species used to treat specific ailments, which was considered important to increase the strength and effectiveness of the remedies. Use of a combination of different MPs to treat the ailments was also a common practice in Ethiopia (Meragiaw and Asfaw, 2014) and other country (Grønhaug et al., 2008).

Plant parts used and methods of preparation of ethnomedicinal plant remedies.- Aba'ala people used different plant parts to treat many ailments of which leaf took the lead (44.2%). The common use of leaf for preparation of remedies could partly be due to the relative ease of finding and simplicity of preparation of this part. Leaves were shown to be the most commonly utilized parts in other findings elsewhere in Ethiopia (Tamene et al., 2000; Giday et al., 2009) and in India (Muthu et al., 2006). In Aba'ala, milk products, salt, honey, coffee, food and water are some additives used by healers when preparing remedies to improve the taste and ointments of MPs. After estimating doses, different routes of administration were used. The most commonly employed route of administration was oral (45.1%),

followed by dermal (39.2%) (Table 2).

Conditions and applications of prepared MPs.- The most frequently cited conditions of plant remedies were fresh forms, which accounted for 62.7%, followed by dry and fresh together (19.6%) and dry only (17.7). Fresh forms were more favoured and considered to be strong and healthy whereas the local people stored dry remedies only for future use for some ailments. Other studies conducted elsewhere also showed the wider use of fresh conditions (Giday et al., 2009; Hailemariam et al., 2009). The majority of prepared remedies were taken by eating and sucking (internal application, 45.2%) followed by creaming and tying (external application, 33%). Most remedies were prepared and used immediately after harvest.

Importance and use values of MP species.- Preference ranking of five MPs that were reported as effective for treating wound showed that *Calotropis procera* came in the first rank and followed by *Datura stramonium* and *Solanum incanum* and rests are given in Table 3.

In the community, some of the MP species were more popular and recognized as more effective remedies than others as shown in Table 3. From this table, it could be understood that the most chosen species are usually the most effective ones for being used against a particular ailment. Thus, the preferences of some MPs more than others prove the reliability and continuity of the ethnomedicinal information obtained from the local people.

### Wild edible plant uses

In total, 20 species including nutraceutical wild plants were documented as WEPs (Table 4). Table 4 depicts that half of the WEP species are shrubs (10 species) and half of them are trees (10 species). Fruits were the most

**Table 1.** Method of preparation and application of MPs used against human and livestock ailments.

S/N	Scientific name	Pu	Uf	Disease treated	Ra	Cp	Method of preparation and application of MPs
1	<i>Acacia etbaica</i>	Sb	HI	Wound/Swelling	D	D	Ground the inner stem barks and pasted the powder with butter on swelled neck of the bull and wounded parts of human.
2	<i>Acacia mellifera</i>	Sb	HI	Bleeding	D	F	Pasted the stem barks with butter on the bleeding part
3	<i>Acacia oerfota</i>	Sb	H	Cough	O	Fd	Poured the inner part of the stem bark on boiled milk and drunk it until recovery
		L	H	Swelling of Breast	D	D	Collected soil around root bark and mixed up with pound leaf and water to cream the breast.
4	<i>Acacia tortilis*</i>	Sb	H	Toothache	O	F	Chewed the inner parts of the stem bark and absorbed the liquid
		F	H	Internal parasites	O	D	Ground seed is mixed with water and drunk with a cup of coffee
5	<i>Aerva javanica</i>	R	H	Against Snake bite	O	Fd	Chewed and absorbed its watery part either before or during snake bite.
6	<i>Aloe camperi</i>	La	HI	Bleeding	D	F	Pasted the latex for blood clotting purpose.
		L	H	Malaria	O	F	Squeezed the juice in a small size of coffee cup 'Fingal' and taken alone
		L	H	Conjunctivitis	Op	F	Squeezed three drops of leaf in to the infected eye
7	<i>Argemone mexicana</i>	Se	L	Swelling, Wound	D	D	Ground seed mixed up with butter and creamed the neck of oxen for three consecutive days
		La	H	Impetigo (Chirt)	D	F	Crushed and squeezed out the latex to cream the affected part.
8	<i>Balanites aegyptiaca*</i>	R	L	Skin ulcer/anthrax	D	Fd	The root of the plant is pounded with small amount of root of <i>Cissus quadrangularis</i> and then soaked in water for an hour or two. It is decanted and administered intranasal.
9	<i>Balanites rotundifolia*</i>	L	H	Malaria; asthma; cough	O	F	Pounded and squeezed by adding water is taken by a cup of tea for children and a cup of water for elders for three consecutive days.
		L	HI	Wound	D	F	Crushed and pounded is pasted on the injured parts
		L	H	Piercing by thorns	D	F	Squeezed leaf is pasted on part pierced by thorns/spines with the help of needle
10	<i>Boscia coriacea</i>	L	H	Common Cold	N	F	Inhaled the aroma of chewed leaf by inserting half part of it into nose
		S	H	Evil spirit	D	D	Burned the stem and fumigated, especially for women during birth time.
11	<i>Cadaba rotundifolia</i>	L	H	Bloating/Diarrhea	O	F	Crushed and pounded with water to drink the concoction
12	<i>Calotropis procera</i>	La	H	Hemorrhoids/wound	D	F	The latex is creamed on the wounded or injured part to dry up the infected part
		La	H	Piercing by sharper	D	F	The latex is creamed on part pierced by sharpen material With the help of needle
13	<i>Capparis tomentosa</i>	R	H	Evil Spirit(Sickness)	N	D	The root is chopped and placed on the fire and inhaled the smoke
14	<i>Cissus quadrangularis</i>	R	L	Skin ulcer/Anthrax	N	F	See <i>Balanites aegyptiaca</i>
15	<i>Cordia africana*</i>	L	H	Diarrhea	O	F	Pound and squeezed the leaf by adding drop of water, drunk the concoction by a cup of coffee, especially for babies in a small amount of drops is enough.
16	<i>Cucumis ficifolius</i>	R	H	Jaundice (Yewuf)	O	D	Powdered root is mixed with water in one tea glass and then drunk

Table 1. Contd.

S/N	Scientific name	Pu	Uf	Disease treated	Ra	Cp	Method of preparation and application of MPs
17	<i>Datura stramonium</i>	L	H	Emergency illness, Cough	N	F	Roasted the leaf on metal plate and inhaled the smoke by adding cool water on the roasted leaf and as same time closed the eyes.
18	<i>Euphorbia schizacantha</i>	La	H	Circumcision	D	F	Creamed the foreskin of male organ to remove it in uncircumcised men.
19	<i>Flueggea virosa</i>	L	H	Stomach pain	O	F	Chopped and pounded leaf homogenized in water and one Coffee glass is drunk once in the morning before breakfast.
20	<i>Grewia tenax</i> *	L	HI	Bleeding/ cutting	D	F	Bound the pounded leaf on injured part.
21	<i>Jatropha sp.</i>	L	H	Malaria	O	F	Crushed and homogenized in water to be drunk
22	<i>Kleinia odora</i>	Sb	H	Abdominal problem	O	Fd	Chopped and pounded with pestle and mortal to drink it.
23	<i>Lantana camara</i> *	W	HI	Repellent of pests	D	F	Growing of plants as a living fence to repel insects like ticks
24	<i>Maerua oblongifolia</i>	L	HI	Stomachache	O	F	Crushed and homogenized in water to be drunk in order to facilitate digestion.
		L	H	Abdominal problem	O	Fd	Crushed and pounded to drink it.
25	<i>Melia azedarach</i>	L	H	Cough	O	F	Pound leaf is mixed up with water and then drunk the concoction
		L	H	Febrile illness	O	F	Same administration like that of cough patient.
26	<i>Nicotiana glauca</i>	L	H	Wound	D	F	Crushed and pounded leaf is pasted on the wounded parts
		L	L	Cattle lice	D	F	Mixed up the pounded leaf with cattle urine and then creamed.
		S	H	Febrile illness	N	D	The stem bark is chopped and placed on the fire and inhaled the smoke
27	<i>Olea europaea</i> subsp. <i>cuspidata</i> *	L	HI	Wounding	D	Fd	Crushed and ground leaf is pasted on the wounded part.
28	<i>Opuntia ficus-indica</i> *	L	H	Swelling	O	F	Crushed and ground leaf is mixed up with water and then drunk.
29	<i>Phyllanthus ovalifolius</i>	R	H	Against snake bite	O	Fd	Washed and cleaned root parts were chewed
30	<i>Salvadora persica</i> *	S	H	Antibacterial	O	Fd	Used for tooth brush to clean it and fight against any pathogenic microbes
		R	H	Headache	N	F	Ground and homogenized in a cup of water and then taken through nose with straw.
		F	H	Common cold	O	F	Patients have eaten ripe fruit until recovery
31	<i>Solanum incanum</i>	R	L	Swelling	D	F	Crushed and pasted on infected part
		R	H	Stomachache	O	F	Chewed a clean root and absorbed the liquid
32	<i>Terminalia brownii</i>	Sb	H	Abdominal bloating	O	Fd	Crushed and homogenized in water to be drunk
		Sb	L	External parasites	D	F	Crushed and homogenized in water for washing the infected part.
33	<i>Withania somnifera</i>	L	H	Febrile illness	O	F	Pound the leaf, mixed in water and drunk its concoction
		R	H	Evil spirit	N	D	Crushed and placed on fire to sniff the smokes, typically for children
34	<i>Ziziphus spina-christi</i> *	L	H	Dandruff (Forefor)	D	F	Washed the infected part with the leaf and shoots of this species.

[\*: Nutraceutical plant species; for authorities to scientific names refer Table 2; Uf-Used for (L, livestock; H, human; HI, the same preparation and disease), Cp: condition of preparation (F, fresh; D, dried; Fd, fresh and dried), Ra: route of administration (D, dermal; Op, optical; N, nasal; O, oral), Pu: plant parts used (R, root; S, stem; Sb, stem bark; L, leaf; F, fruit; Se, seed; La, latex; W, whole parts)].

**Table 2.** Frequency of plant parts used and route of administration of MPs

Plants parts	Frequency	Percentage	Route of administration	Frequency	Percentage
Leaf only	23	44.2	Oral	23	45.1
Root only	10	19.2	Dermal	20	39.2
Fruit only	2	3.8	Nasal	7	13.7
Seed only	1	2.0	Optical	1	2.0
Whole plant	1	2.0			
Latex only	5	9.6			
Stem only	3	5.7			
Stem bark only	7	13.5			
Total	52	100.0	Total	51	100.0

**Table 3.** Preference ranking for MPs against wound.

Plant species that treat febrile illness	Key informants (Coded K <sub>1</sub> to K <sub>6</sub> ) with the ranks they gave						Total	Rank
	K <sub>1</sub>	K <sub>2</sub>	K <sub>3</sub>	K <sub>4</sub>	K <sub>5</sub>	K <sub>6</sub>		
<i>Acacia etbaica</i>	1	1	1	1	1	2	7	4 <sup>th</sup>
<i>Aloe camperi</i>	2	5	2	3	4	1	17	3 <sup>rd</sup>
<i>Calotropis procera</i>	5	4	5	4	3	5	26	1 <sup>st</sup>
<i>Datura stramonium</i>	4	2	3	5	2	4	20	2 <sup>nd</sup>
<i>Solanum incanum</i>	3	3	4	2	5	3	20	2 <sup>nd</sup>

**Table 4.** Category of wild edible and nutraceutical plants, mode of consumption and parts used.

S/N	Scientific name	Family	Ha.	Pu	Mode of consumption	Category
1	<i>Acacia nilotica</i>	Fabaceae	T	Fruit, silvery latex (gum)	Roasted fruit for coffee; Chewed the gum and absorbed the liquid	Elders; Children
2	<i>Acacia tortilis</i> *	Fabaceae	T	Fruit	Roasted fruit for coffee	Elders
3	<i>Balanites aegyptiaca</i> *	Balanitaceae	T	Fruit, Glue	Raw, ripe fruit, eaten; the glue serve as gum	All
4	<i>Balanites rotundifolia</i> *	Balanitaceae	S	Fruit	Raw, fruits become ripe for eating	Women
5	<i>Berchemia discolor</i>	Rhamnaceae	T	Fruit	Raw, ripen, eaten	All
6	<i>Carisa spinarum</i>	Apocynaceae	S	Fruit	Raw, fruits become ripe for eating	All
7	<i>Cordia africana</i> *	Boraginaceae	T	Fruit	Raw, ripen, eaten	All
8	<i>Cordia monoica</i>	Boraginaceae	S	Fruit	Raw, ripen, eaten	All
9	<i>Cordia sinensis</i>	Boraginaceae	S	Fruit	Raw, ripen, eaten	All
10	<i>Dobera glabra</i>	Salvadoraceae	S	Fruit, seed	Raw, cooked seed	All
11	<i>Ficus sur</i>	Moraceae	T	Fruit	Raw, ripen, eaten	All
12	<i>Ficus vasta</i>	Moraceae	T	Fruit	Raw, ripen, eaten	Children
13	<i>Grewia schweinfurthii</i>	Tiliaceae	S	Fruit	Raw, ripen, eaten	Children
14	<i>Grewia tenax</i> *	Tiliaceae	S	Fruit	Raw, ripen, eaten	All
15	<i>Lantana camara</i> *	Verbenaceae	S	Fruit	Raw, ripen, eaten	Children
16	<i>Mimusops laurifolia</i>	Sapotaceae	T	Fruit	Raw, ripen, eaten and unripe one preserved.	All
17	<i>Olea europaea</i> subsp. <i>cuspidata</i> *	Oleaceae	T	Leaf	Washed and dried leaf is boiled with water to drink as a tea	All
18	<i>Opuntia ficus-indica</i> *	Cactaceae	S	Fruit	Raw, ripen, eaten	All
19	<i>Salvadora persica</i> *	Salvadoraceae	S	Fruit	Raw, ripen, eaten	All
20	<i>Ziziphus spina-christi</i> *	Rhamnaceae	T	Fruit	Raw, ripen, eaten	All

[\*\*, Serve as wild food only; for authorities to scientific names refer to Appendix 1].

**Table 5.** Results of paired comparison of top five wild edible fruits.

Plant species that have edible fruits	Key informants (coded K <sub>1</sub> to K <sub>6</sub> ) with the ranks they gave						Score	Rank
	K <sub>1</sub>	K <sub>2</sub>	K <sub>3</sub>	K <sub>4</sub>	K <sub>5</sub>	K <sub>6</sub>		
<i>Mimusops laurifolium</i>	1	4	4	3	3	4	19	2 <sup>nd</sup>
<i>Cordia sinensis</i>	2	3	3	1	5	3	18	3 <sup>rd</sup>
<i>Dobera glabra</i>	3	2	2	4	2	2	15	4 <sup>th</sup>
<i>Grewia schweinfurthii</i>	4	1	0	2	1	1	9	5 <sup>th</sup>
<i>Opuntia ficus-indica</i>	5	5	5	5	4	5	29	1 <sup>st</sup>

**Table 6.** Other traditional useful plant species other than wild food and medicinal plants.

S/N	Scientific name	Family	Main uses of other traditional useful plant species
1	<i>Barleria argentea</i>	Acanathaceae	Fodder for all livestock
2	<i>Capparis cartilaginosa</i>	Capparidaceae	Fodder for all livestock
3	<i>Caralluma acutangula</i>	Asclepiadaceae	Latex serves as shampoo for washing and cleaning purpose
4	<i>Comiphora shimperi</i>	Burseraceae	Timber, house construction, furniture, and farm implement
5	<i>Comiphora sp.</i>	Burseraceae	House construction, furniture, and farm implement
6	<i>Cupressus lusitanica</i>	Cuperaceae	Construction, furniture, fuels, chopping stem serve as resin and available in the market place
7	<i>Dracaena ombet subsp. ombet</i>	Dracaenaceae	Leaves serve for putting food; deep boring stem for milk containers and beehives
8	<i>Euphorbia tirucalli</i>	Euphorbiaceae	Basketry and house construction
9	<i>Indigofera articulata</i>	Fabaceae	Fodder for all domestic animals, beauty of female nails
10	<i>Lycium shawii</i>	Solanaceae	Fodder for all livestock, farm tools, typically during threshing time
11	<i>Sansevieria ehrenbrgii</i>	Dracaenaceae	Cordage for income generation, basketry materials, fodder
12	<i>Senna italica</i>	Fabaceae	Fodder, as a cosmetics for girl's nails, firewood
13	<i>Tarconanthus camphoratus</i>	Asteraceae	Construction, charcoal and firewood
14	<i>Ximania struarium</i>	Asteraceae	Fodder for all, construction of house

widely used parts (82.7%), followed by latex (8.7%). Leaf and seed parts follow with 4.3% each. These have been reported to be eaten raw (81.0%); roasted (9.6%); cooked and boiled with 4.7% each. In other studies, the whole parts of most herbaceous plants were consumed (Pardo-de-Santayana et al., 2007). Paired comparison among five important wild edible fruits shows that *Opuntia ficus-indica* and *Mimusops laurifolium* were placed in the first and second ranks (Table 5). This is in agreement with another finding in Cheffa, Wello (Tamene et al., 2000). The reasons for appreciation of one species over the other, as said by most informants were easiness to process, nutritional value and taste during consumption.

#### Multipurpose plants and use values of trees and shrubs

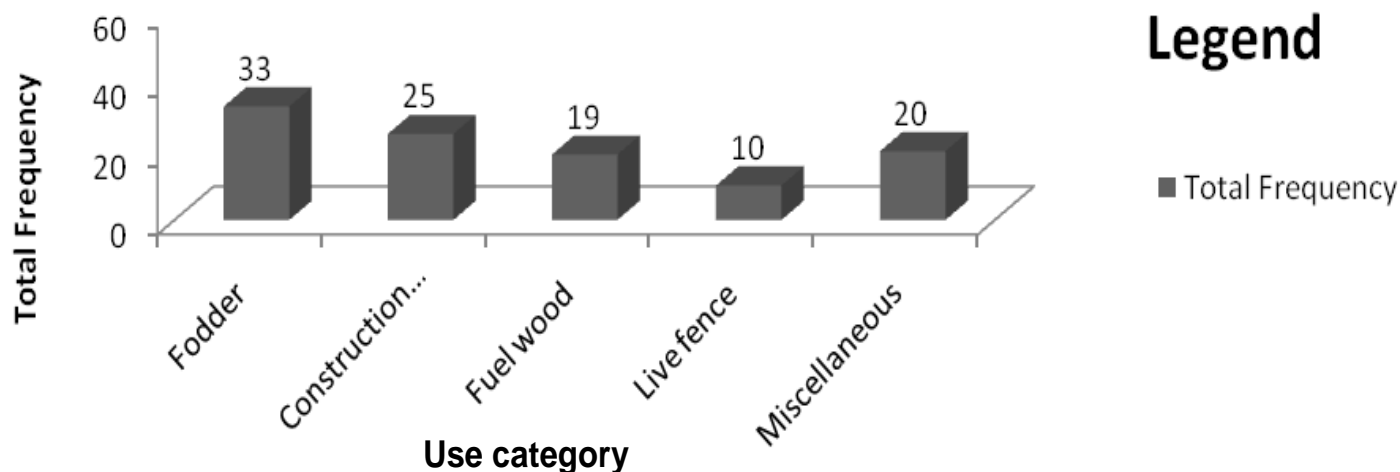
The finding indicated that the local people of Aba'ala were largely dependent on plant resources for various purposes. Within the diverse uses of such resources,

firewood, fodder, construction, farm tools, fences, cash income, furniture and spiritual fulfillment other than the wild food and medicinal plants uses (Table 6). Most of the species including medicinal and WEPs discussed herein were used for multiple purposes other than wild food and traditional medicine. Multiple use analysis shows that fodders were the most frequently mentioned uses (33) while the live fences category was the least reported (10) (Figure 3).

The trees and shrubs commonly used by local communities in Aba'ala district for multiple uses and their corresponding use values, ranks of their preferences and their various uses (medicine, fodder, food, construction and farm implements, fuels, fences (live or dry), tooth brush and shading was calculated. Among the listed 13 plant species, *Olea europaea* subsp. *cuspidata* and *M. laurifolia* were ranked first and second respectively in their diverse use values (Table 7).

Use diversity analysis shows that among the seven multiuse plants, *M. laurifolia* and *Ziziphus spina-christi* were ranked 1<sup>st</sup>, followed by *Balanites rotundifolia* and the others having successive lower values (Table 8).





**Figure 3.** Proportion of other uses of the ethnomedicinal plant species.

**Table 7.** Use values of the most important trees and shrubs with seven or more use categories.

Name of species	Use category	No. of informants	Use citations	Use value	Rank
<i>Acacia etbaica</i>	9	19	49	5.4	6 <sup>th</sup>
<i>Acacia mellifera</i>	9	15	76	5.1	9 <sup>th</sup>
<i>Acacia nilotica</i> ssp. indica	9	20	106	5.3	7 <sup>th</sup>
<i>Acacia oerfota</i>	9	23	57	6.3	3 <sup>rd</sup>
<i>Acacia tortolis</i>	10	16	70	4.4	10 <sup>th</sup>
<i>Balanites aegyptiaca</i>	9	18	95	5.3	7 <sup>th</sup>
<i>Balanites rotundifolia</i>	10	24	149	6.2	4 <sup>th</sup>
<i>Berchemia discolor</i>	8	21	49	6.1	5 <sup>th</sup>
<i>Dobera glabra</i>	8	22	50	6.3	3 <sup>rd</sup>
<i>Mimusops laurifolia</i>	8	21	148	7.1	2 <sup>nd</sup>
<i>Olea europaea</i> ssp. cuspidata	11	18	147	8.2	1 <sup>st</sup>
<i>Salvadora persica</i>	9	22	114	5.2	8 <sup>th</sup>
<i>Ziziphus spina-christi</i>	9	23	141	6.1	5 <sup>th</sup>

**Table 8.** Results of direct matrix ranking of multipurpose wild useful plants.

Plant species	Main Uses Category					Total	Rank
	Medicine	Wild food	Construction and farm tools	Charcoal and fire wood	Fodder and shading		
<i>Acacia nilotica</i> subsp. Indica	4	3	4	7	7	25	3 <sup>rd</sup>
<i>Balanites aegyptiaca</i>	3	4	5	5	5	22	4 <sup>th</sup>
<i>Balanites rotundifolia</i>	7	4	5	5	5	26	2 <sup>nd</sup>
<i>Cadaba rotundifolia</i>	2	0	2	2	3	9	6 <sup>th</sup>
<i>Mimusops laurifolia</i>	0	7	7	6	7	27	1 <sup>st</sup>
<i>Salvadora persica</i>	6	5	3	3	4	21	5 <sup>th</sup>
<i>Ziziphus spina-christi</i>	5	6	6	4	6	27	1 <sup>st</sup>

[Use values ranges 0 to 7: 7, Excellent; 0, no use].

**Table 9.** Results of direct matrix ranking of factors threatening to useful plants.

Threats	Key informants (coded K <sub>1</sub> to K <sub>6</sub> ) with the total scores and rank						Total	Rank
	K1	K2	K <sub>3</sub>	K <sub>4</sub>	K <sub>5</sub>	K <sub>6</sub>		
Agricultural expansion	4	5	2	2	6	6	25	3 <sup>rd</sup>
Charcoal and firewood	5	3	3	3	5	2	21	4 <sup>th</sup>
Construction and farm tools	6	4	5	4	4	5	28	1 <sup>st</sup>
Infrastructure and investment	1	1	1	1	1	1	6	6 <sup>th</sup>
Over grazing and browsing	2	2	4	6	3	3	20	5 <sup>th</sup>
Drought	3	6	6	5	2	4	26	2 <sup>nd</sup>

The degree of abundance of wild useful plant species considering their current status were reported as 24 (41.4%) sparse, 17(29.3) common and rare with equal number of plant species based on informants perception and direct field observation in the wild. The results of use values of 13 species (Table 7) and data matrix ranking seven species (Table 8) show that most wild plants were over-exploited for multiple uses. This goes to in line with other findings (Abebe and Ayehu, 1993; Cotton, 1996; Hamilton, 2003). Thus, conservation strategy is needed in the area to save these species from further reduction or total extinction due to unsustainable use and over-exploitation.

#### Marketable some useful plant products at Aba'ala town

Local vendors and consumers reported that most of the wild useful plants were bought for various use values such as, medicines, spices, condiments, foods, fumigants, tooth-brush, cultural and spiritual aspects. These species included *Comiphora* sp., *O. ficus-indica*, *Kleinia odora*, *O. europaea* subsp. *cuspidata*, *Cupressus lusitanica*, *Z. spina-christi*, *M. laurifolia* and *S. persica*.

#### Threats to and conservation status of traditional useful plants

The threats resulted mainly as of human activities. The level of impacts varied from site to site. Among these activities, construction and farm tool materials were ranked 1<sup>st</sup>, followed by drought and agricultural land expansion (Table 9).

It came out clearly from the study that threats facing useful wild plants in their habitat were both anthropogenic and natural factor, which were having detrimental effects on useful wild plants. This finding is in agreement with other studies conducted elsewhere in Ethiopia (Asfaw and Tadesse, 2001; Kelbessa et al., 1992: 35-55; Tamene et al., 2000), which indicated that the threats

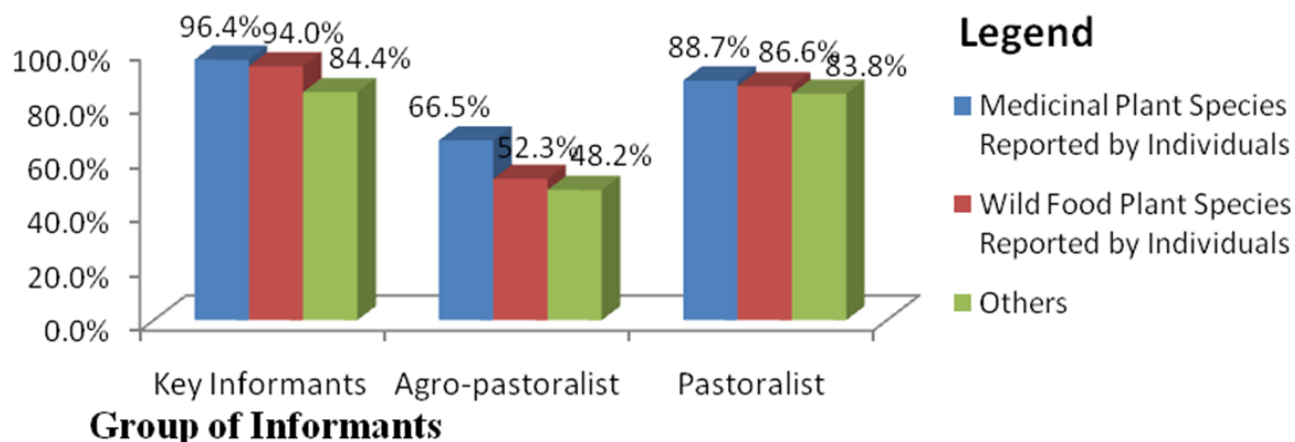
mentioned in Table 9 are major ones contributing to loss of biodiversity in general and useful wild plants and the associated knowledge in particular.

Some of the wild edible plants are not only used as seasonal food but their seeds are also stored for longer time. The stored seeds of *D. glabra* are typically very important famine foods during periods of food shortage in the study area. In the study area, there was a nursery area which is mainly assisted by Mekele University for the propagation of this highly water stress resistant and famine food plant species. The seedlings were distributed to the communities for cultivation in their home gardens. This type of activity may help the local community to get additional food source and income which may help them to ensure food security.

#### Transfer systems and variation of IK among age groups

IK of different age groups was compared with respect to the names and the respective uses of multipurpose plants. The results show that the age groups above 45 years reported the highest proportion of multipurpose plants names and uses. The majority of traditional healers (66.7%) kept the knowledge with them and selected family members for the sake of secrecy while others (33.3%) transferred their IK to other persons. The findings of Giday et al. (2009) reported that the first born boys were usually favoured. The secrecy of IK on medicinal practices could be one of the reasons for the unevenly distribution of IK of MPs in Ethiopia among community members (Asfaw and Tadesse, 2001; Giday et al., 2009).

The sample sizes of the three groups of informants were six key informants, nine agro-pastoralist, and nine pastoralists. The results show that key informants were more knowledgeable on MP species (96.4%), followed by pastoralists (88.7%). However, concerning agro-pastoralist the least results were recorded in all the three aspects (Figure 4). This may be due to agro-pastoralist



**Figure 4.** Variations of IK on three groups of plants among three groups of informants.

are more dependent on crops. On the pastoralists' side, there is frustration of agricultural expansion that reduces vegetation which harbours wild useful plants.

According to the findings of many researches (Agrawal and Agrawal, 2015; Meragiaw and Asfaw, 2014; Pardo-de-Santayana et al., 2007), the fragility of the IK of the local communities is in the face of escalating anthropogenic and natural pressures. The way forward calls for in situ conservation and putting the IK in to practice in order to mitigate the impeding problems facing the plants is critical.

## Conclusion

The results of the study undertaken on traditional wild useful plants indicate that the Aba'ala people have a good IK with diverse plant resource utilization modes. Although the local people rely chiefly on wild plants for healthcare needs and food security, there were also other traditional useful plants. MPs were relatively the most widely used to treat about 26 human and livestock ailments and a significant number of the MPs (32.7%) were cited for human ailments. Likewise, the WEPs also have played significant roles both at normal time and during food gap. Various ethnobotanical analytical tools showed that the people preferred to some species over the others in treating ailments, taste qualities, and other uses. However, most of the wild vegetation in the area is exposed to many threats. While there are these major threats in the area, some of the knowledgeable local people have tried to cultivate the most commonly used plants in home gardens as live fences and shade trees and at edges of farmlands upon noticing they are being threatened in the wild vegetation. The ethnobotanical knowledge varied among key informants, pastoralists and agro-pastoralist. Most plants knowledge is held by traditional healers and pastoralists. Whereas, agro-

pastoralists are the least knowledgeable in all the three plant groups and this is one of the negative consequences of agricultural expansion. The findings in general indicate that pastoralist living system provided an opportunity to improve the restoration of useful plants and proved to be advantageous to biodiversity conservation and in reducing environmental degradation in Aba'ala. For better diversity of wild plant species in general and medicinal and WEPs in particular, conservation actions need to be particularly directed to multipurpose plant species which are presently in short supply.

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## Appendix

Appendix 1. List of traditional wild useful plants collected in the study areas.

S/N	Scientific name	Local name (Afar and Tigrigna)	Family	Ha	Use	Hab.	Spp. Abu	GPS Data	Specimen No.
1	<i>Acacia etbaica</i> Schweinf.	...../Siraw	Fabaceae	T	Md	Al	Com	1469 m; 13°22.637'N, 039°46.326'E	MM332
2	<i>Acacia mellifera</i> (Vahl.) Benth.	Merka'arto	Fabaceae	S	Md	Wd	Com	1115 m; 13°15.517'N, 039°50.450'E	MM305
3	<i>Acacia nilotica</i> (L.) Willd. ex. Del. subsp. <i>indica</i> (Benth.) Brenan	Keselto	Fabaceae	T	Wf	Al	Com	1436 m; 13°22.628'N, 039°46.647'E	MM327
4	<i>Acacia oerfota</i> (Forssk.) Schweinf.	Garmoyita/Ajo	Fabaceae	T	Md	Wd	Com	1469 m; 13°22.637'N, 039°46.326'E	MM318
5	<i>Acacia tortilis</i> (Forssk.) Hayne	A'abto	Fabaceae	T	Nu	Wd	Com	1115 m; 13°15.517'N, 039°50.450'E	MM309
6	<i>Aerva javanica</i> (Burm.f.) Juss ex Schullt	Odayla/Oyila	Amaranthaceae	H	Md	Wd	Rare	1469 m; 13°22.637'N, 039°46.326'E	MM310
7	<i>Aloe camperi</i> Shweinf.	Ureita /Ere	Aloaceae	S	Md	Wd	Com	1469 m; 13°22.637'N, 039°46.326'E	MM333
8	<i>Argemone mexicana</i> L.	Hedehara	Papaveraceae	H	Md	Fl	Com	1469 m; 13°22.637'N, 039°46.326'E	MM324
9	<i>Balanites aegyptiaca</i> (L.) Del.	Uda/Bedeno	Balanitaceae	S	Nu	Hgw	Com	1491 m; 13°21.368'N, 039°45.015'E	MM317
10	<i>Balanites rotundifolia</i> (Van Tieghem) Blatter	Alayaito	Balanitaceae	S	Nu	Wd	Com	1469 m; 13°22.637'N, 039°46.326'E	MM345
11	<i>Barleria argentea</i> Balf. f.	Nagaadh (Som)	Acanthaceae	H	Oth	Wd	Rare	1115 m; 13°15.517'N, 039°50.450'E	MM302
12	<i>Berchemia discolor</i> (Klotzsch) Hemsl.	Katoyta	Rhamnaceae		Wf	Wd	Spa	990 m; 13°34.951'N, 039°55.182'E	MM326
13	<i>Boscia coriacea</i> Pax.	Orkori (Orom)	Capparidaceae	S	Md	Wd	Spa	1115 m; 13°15.517'N, 039°50.450'E	MM307
14	<i>Cadaba rotundifolia</i> Forssk.	Adangelyto	Capparidaceae	S	Md	Wd	Com	1115 m; 13°15.517'N, 039°50.450'E	MM301
15	<i>Calotropis procera</i> (Ait) Ait.f.	Galayaito/Gida	Asclepiadaceae	S	Md	Al	Com	1115 m; 13°15.517'N, 039°50.450'E	MM300
16	<i>Capparis cartilaginea</i> Decne.	Laloyta/ayehada	Capparidaceae	S	Oth	Hg	Rare	1115 m; 13°15.517'N, 039°50.450'E	MM306

## Appendix 1. Contd.

S/N	Scientific name	Local name (Afar and Tigrigna)	Family	Ha	Use	Hab.	Spp. Abu	GPS Data	Specimen No.
17	<i>Capparis tomentosa</i> Lam.	.../Arengema	Capparidaceae	S	Md	Wd	Rare	1491 m; 13°21.368'N, 039°45.015'E	MM346
18	<i>Caralluma acutangula</i> (Decn.) N.E. Br.	Uramo	Asclepiadaceae	H	Oth	Wd	Spa	990 m; 13°34.951'N, 039°55.182'E	MM360
19	<i>Carissa spinarum</i> L.	..../Agam	Apocynaceae	S	Wf	Wd	Spa	1491 m; 13°21.368'N, 039°45.015'E	MM328
20	<i>Cissus quadrangularis</i> L.	Musruuga/Kumteta	Vitaceae	H	Md	Wd	Com	1115 m; 13°15.517'N, 039°50.450'E	MM304
21	<i>Comiphora schimperi</i> (Berg.) Engl.	Ado'adi	Burseraceae	T	Oth	Wd	Spa	1469 m; 13°22.637'N, 039°46.326'E	MM322
22	<i>Comiphora</i> sp.	Ado'adi	Burseraceae	S	Oth	Wd	Spa	990 m; 13°34.951'N, 039°55.182'E	MM356
23	<i>Cordia africana</i> Lam.	..../Awhi	Boraginaceae	T	Nu	Hg	Rare	1491 m; 13°21.368'N, 039°45.015'E	MM330
24	<i>Cordia monoica</i> Poxb.	Laem-mederto	Boraginaceae	S	Wf	Wd	Spa	1241 m; 13°16.243'N, 039°49.729'E	MM355
25	<i>Cordia sinensis</i> Lam.	Mederto	Boraginaceae	S	Wf	Wd	Rare	1469 m; 13°22.637'N, 039°46.326'E	MM337
26	<i>Cucumis ficifolus</i> A. Rich.	...../Ranbo	Cucurbitaceae	H	Md	Al	Rare	1491 m; 13°21.368'N, 039°45.015'E	MM331
27	<i>Cupressus lucitanica</i> Mill.	Sirida/Serida	Cupressaceae	T	Oth	Hg	Rare	1241 m; 13°16.243'N, 039°49.729'E	MM354
28	<i>Datura stramonium</i> L.	Fafaho/Medafe	Solanaceae	H	Md	Wd	Spa	1491 m; 13°21.368'N, 039°45.015'E	MM344
29	<i>Dobera glabra</i> (Forssk.) Poir.	Gersayto	Salvadoraceae	S	Wf	Wd	Com	1115 m; 13°15.517'N, 039°50.450'E	MM303
30	<i>Dracaena ombet</i> Kotschy and Peritsch subsp. ombet	Esayrto	Dracaenaceae	T	Oth	Wd	Spa	1083 m; 13°32.166'N, 039°53.307'E	MM347
31	<i>Euphorbia schizacantha</i> Pax	Ta'ar	Euphorbiaceae	S	Md	Wd	Rare	1469 m; 13°22.637'N, 039°46.326'E	MM334
32	<i>Euphorbia tirucalli</i> L.	Elbayito	Euphorbiaceae	S	Oth	Hg	Spa	1469 m; 13°22.637'N, 039°46.326'E	MM357
33	<i>F1ueggea virosa</i> (Willd.) Voigt.	Rabraba/Harmazo	Euphorbiaceae	S	Md	Wd	Com	1115 m; 13°15.517'N, 039°50.450'E	MM308

## Appendix 1. Contd.

S/N	Scientific name	Local name (Afar and Tigrigna)	Family	Ha	Use	Hab.	Spp. Abu	GPS Data	Specimen No.
34	<i>Ficus sur</i> Forssk.	Sublaito/Shagla	Moraceae	T	Wf	Hg	Rare	1491 m; 13°21.368'N, 039°45.015'E	MM315
35	<i>Ficus vasta</i> Forssk.	Sublaito/Daro	Moraceae	T	Wf	Hg	Rare	1491 m; 13°21.368'N, 039°45.015'E	MM342
36	<i>Grewia schweinfurthii</i> Burret	Ditayito/titayito	Tiliaceae	S	Wf	Wd	Spa	1241 m; 13°16.243'N, 039°49.729'E	MM352
37	<i>Grewia tenax</i> (Forssk.) Fiori	Hidayto	Tiliaceae	S	Nu	Wd	Spa	1083 m; 13°32.166'N, 039°53.307'E	MM323
38	<i>Indigofera articulata</i> Gouan.	Hinayaito	Fabaceae	H	Oth	Wd	Rare	1083 m; 13°32.166'N, 039°53.307'E	MM339
39	<i>Jatropha</i> sp.	Atori	Euphorbiaceae	S	Md	Wd	Spa	1469 m; 13°22.637'N, 039°46.326'E	MM340
40	<i>Kleinia odora</i> (Forssk.) DC.	Be'araro	Asteraceae	S	Md	Wd	Spa	1469 m; 13°22.637'N, 039°46.326'E	MM359
41	<i>Lantana camara</i> L.	Dat'hara/Tselim	Verbenaceae	S	Nu	Hg	Com	1469 m; 13°22.637'N, 039°46.326'E	MM314
42	<i>Lycium shawii</i> Roem. and Schult.	Araro	Solanaceae	S	Oth	Wd	Spa	1115 m; 13°15.517'N, 039°50.450'E	MM335
43	<i>Maerua oblongifolia</i> (Forssk.) A.Rich.	Datahara/ Suluha	Capparidaceae	S	Md	Wd	Spa	990 m; 13°34.951'N, 039°55.182'E	MM351
44	<i>Melia azedarach</i> L.	Limo	Meliaceae	T	Md	Hg	Spa	1469 m; 13°22.637'N, 039°46.326'E	MM320
45	<i>Mimusops laurifolia</i> (Forssk.) Friis	Yealelito	Sapotaceae	T	Wf	Wd	Rare	1083 m; 13°32.166'N, 039°53.307'E	MM348
46	<i>Nicotiana glauca</i> Graham	.../Chergid	Solanaceae	S	Md	Wd	Spa	1469 m; 13°22.637'N, 039°46.326'E	MM343
47	<i>Olea europaea</i> L. subsp. cuspidata	Wegerto	Oleaceae	T	Nu		Rare	1241 m; 13°16.243'N, 039°49.729'E	MM358
48	<i>Opuntia ficus-indica</i> (L.) Miller	Qolqol/Beles	Cactaceae	S	Nu	Al	Spa	1469 m; 13°22.637'N, 039°46.326'E	MM316
49	<i>Phyllanthus ovalifolius</i> Forssk.	Kotuu (Orom)	Euphorbiaceae	H	Md	Wd	Spa	1491 m; 13°21.368'N, 039°45.015'E	MM338
50	<i>Salvadora persica</i> L.	Adayaito	Salvadoraceae	S	Nu	Wd	Com	1115 m; 13°15.517'N, 039°50.450'E	MM313

## Appendix 1. Contd.

S/N	Scientific name	Local name (Afar and Tigrigna)	Family	Ha	Use	Hab.	Spp. Abu	GPS Data	Specimen No.
51	<i>Sansevieria ehrenbergii</i> Schweinf, ex Baker	Ye'ayto	Dracaenaceae	H	Oth		Spa	1115 m; 13°15.517'N, 039°50.450'E	MM325
52	<i>Senna italica</i> Mill.	Hinayaito	Fabaceae	H	Oth	Fl	Spa	1491 m; 13°21.368'N, 039°45.015'E	MM336
53	<i>Solanum incanum</i> L.	Angule	Solanaceae	S	Md	Wd	Rare	1469 m; 13°22.637'N, 039°46.326'E	MM329
54	<i>Tarhonanthus camphoratus</i> L.	...../Awh	Asteraceae	S	Oth	Wd	Com	1469 m; 13°22.637'N, 039°46.326'E	MM341
55	<i>Terminalia brownii</i> Fresen.	Wiebo	Combretaceae	S	Md	Wd	Rare	1083 m; 13°32.166'N, 039°53.307'E	MM349
56	<i>Withania somnifera</i> (L.) Dunal in DC.	Abalto/Agol	Solanaceae	S	Md	Hg	Spa	1115 m; 13°15.517'N, 039°50.450'E	MM319
57	<i>Xanthium strumarium</i> L.	Sada/Bangi	Asteraceae	H	Oth	Wd	Com	1115 m; 13°15.517'N, 039°50.450'E	MM321
58	<i>Ziziphus spina-christi</i> (L.) Desf.	Qusura/kushra	Rhamnaceae	T	Nu	Al	Spa	1469 m; 13°22.637'N, 039°46.326'E	MM311

[Use categories (Md, medicinal uses; Wf, wild food uses; Nu, nutraceutical; Oth, other uses), Ha-Habit/growth forms (S, shrub; H, Herb; T, tree), Hab-Habitat (Hg, home garden; Wd, Wild; Al, All), species abundance and distribution (Rare, too sparsely distributed; spa, sparsely distributed; Com, commonly distributed)].