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Indigenous Utilization and Management of Useful Plants in and around Awash National Park, Ethiopia

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Abstract

An ethnobotanical study in and around Awash National Park with special emphasis on useful plants was conducted from September 2014 to August 2015. The study was aimed at documenting the indigenous knowledge of people on utilization and maintenance of cultural significance useful plants in their pastoral areas. Sixty-two useful plants belonging to 49 genera and 31 families were collected and identified from the study area. Most of plants investigated in the area have multiple uses which accounted to 54 species (87% of total plants). Totally, five useful plant categories were identified, including 35 medicinal species, 22 wild edible species, 39 forage species, 17 species for cosmetics and beauty and 45 species used for construction, fuel and firewood. In preference ranking of medicinal plants, *Acacia negrii* was ranked first followed by *Acacia senegal* to treat wound. Analysis of direct matrix ranking on multiple uses of seven species revealed that *Boswellia microphylla, Ziziphus spina-christi* and *Balanites aegyptiaca* were reported to be the most important and intensively used species in the community. Informant consensus factor analysis showed that construction, fuel and charcoal (72%) and wild edible plants (71%) had high informant agreement. In plant species level, informant consensus was higher for *Rostraria cristata* which was cited by 91.9% used for forages followed by *Grewia villosa* (72.5%) and *Lawsonia inermis* (62.9%) for different cosmetics in the society. In and around the Awash National Park, useful plants were facing threats in their natural habitats from various human activities. Population pressure followed by drought and agricultural expansion was found as the major threatening factors. The urgent actions are needed to conserve such vital plant resources. Further analysis of pharmaceutical and nutritional values of plants should be evaluated to optimize their wise use in the future.

Introduction

The history of indigenous people depending on plants and utilization, physical and social environment shapes plant use and plant-human interaction. Ethnobotany is the study of this plant human interrelationship embedded in dynamic ecosystem of natural and social components [1-4]. The role of plants reflects their biological and physical properties. The natural, anthropological, environmental and genetic factors limited responses of plants to human's need. In the beginning, plant use was restricted to food, medicine and shelter, but later human beings have explored the potential of plants for a number of other purposes. Hence, human's dependency on plants has increased both directly and indirectly [2].

Human beings depend mainly on plants and to a less extent on animals for the basic requirements of their existence [3]. The indispensable dependence of humans on plants for their livelihoods primarily started with domestication and can be dated back to ten thousand years ago [4]. The collection of useful plants around homes must have gradually lead to small scale plants, whose continued intensification resulted in the emergence of full scale agriculture in gardens and fields [5]. Studying the relationship between people and plants and the significance of plant use knowledge towards the wellbeing of the community is extremely important [4,6].

Ethiopia is the home of amazing system of indigenous knowledge that supports people to survive under adverse environmental conditions, famine and poverty [7]. The country is also diverse in climatic conditions, topographic and edaphic variation that enable occurrence of a wide range of vegetation from tropical rain and cloud forests to the desert scrubs [8]. Awash National Park is found in arid and semi-arid environment which is faced many problems from drought, population and livestock pressures. Two ethnic peoples (Oromo and Afar) live surrounding the Park and frequently compete on utilization of plant resources, which posed many problems on plant resources in the park as well as in the surrounding area before documentation on the importance of useful plants. Most previous studies in the site have been focused on plant diversity, composition and structure [9,10]. Therefore, it is very needed to document the local knowledge of communities on useful plants for the conservation and management of plant species in and around Awash National Park.

Materials and Methods

Description of the study area

Awash National Park is located at 9°20'N and 40°20'E. It is in the lowlands of Ethiopia at 215 Km North-East of Addis Ababa, covering an area of 756 Km^2. The climatic condition of the park is arid and semi-arid, with an average annual rainfall of 620 mm.

The park serves as home of Ethiopia's largest *Beisa oryx* population and is the second most important critical area, where some endangered, endemic and migratory bird species live. The presence of

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Figure 1: The Awash National Park, the surrounding Afar and Oromo tribes.

unique botanical features including Doum palm and riverine forests make the park attractive. The park is also characterized by unique landscape scenery and geological features including Fentale Crater, Ilala Sala plains and grasslands, Hot spring area and the gorge which represent an important income and food source for local communities. The Filwuha hot springs are important for curing illnesses such as malaria, the oldest educational museum and the lodges inside have diverse and unique ethnic/cultural features, including the Seats for Gada system and the Belaadas in Afar, an ideal place of a training site for ornithologists, primatologists and archaeologists and vital watering points for livestock, including Hakaki and the hot springs [11].

Socioeconomic of the two ethnic peoples

The park is surrounded by two regions; namely Afar (Awash Fantale district) and Oromia (Fantale district) regions (Figure 1). The Karrayyu and Ittu clans of Afan Oromo speakers found to the South and South West of the Park. The Karrayyu Oromo are pure pastoralists whereas the Ittu Oromo are agro-pastoralists. The Afar tribes are located at the North (Debene Clan) and East (Waima clan) of the park [12]. Pastoral agriculture is practiced mainly at an elevation below 1,500 m a.s.l. with annual rainfall of below 450 mm.

In the arid zone, nomadic and semi nomadic pastoral livestock production depend on camels and goats as important components. In the semi-arid, semi-nomadic or semi-sedentary zone, livestock production is practiced. The major components of the livestock production are cattle and sheep, although camels and goats are found. Both water and range development is important element to improve livestock production here. Low moisture is the major production constraint particularly in the arid zone. In this zone, there is a high potential for irrigated agriculture, especially for production of fiber crops, sugar cane, oil seeds, horticultural and forage crops can be produced.

Data collection and identification methods

Ethnobotanical data were collected from four Kebeles in the surrounding areas of Awash National Park. The ethnobotanical data collection was based on semi structured interviews, field observation, preference and direct-matrix ranking [4,13]. A total of 60 informants (42 male and 18 female) were involved in the interview. In which, 15 key informants were identified by following systematic method of informant selection [4,13] and other informants were selected randomly [13].

Preference ranking for five medicinal plants was analyzed to understand people perception on identification of efficacy plants. Direct matrix ranking for seven multiple uses of plants was analyzed to determine the main cause for overharvesting of the respective plants [4,13]. Identification of useful plant specimens collected from the study area was performed using taxonomic keys and Flora of Ethiopia and Eritrea [14-21] and deposited in Samara University.

Data analysis

Ethnobotanical data were entered into excel spreadsheet and ethnomedicinal uses and taxonomic groups were analyzed using descriptive statistics.The level of homogeneity between information provided by different informants was calculated using the Informants' Consensus Factor (ICF) [22]. It is calculated as:

$$ICF = \frac{Nur - Nt}{(Nur - 1)}$$

Where, *N*ur is the number of use reports from informants for a particular plant-usage category and *N*t is the number of species that are used for that plant usage category for all informants. Values range between 0 and 1, where "1" indicates the highest level of informant consent. In this study, five use categories for all informants reported frequently were chosen and consensus factors were calculated.

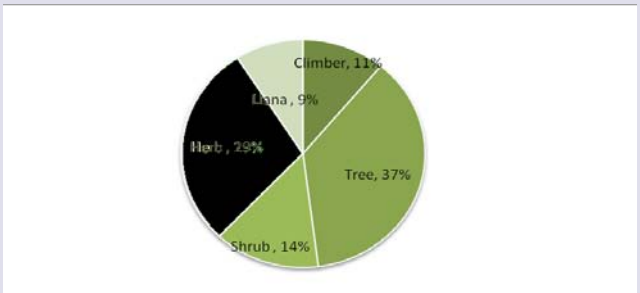

Figure 2: The proportion of growth habit of medicinal plants.

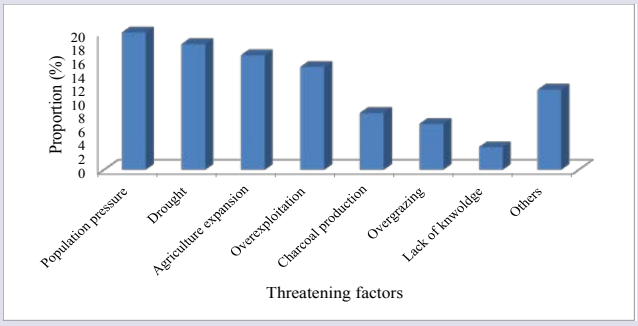

Figure 3: Threatening factors to useful plants.

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Use value of useful plants

Species importance was estimated by using use value analysis [23]. In the use value analysis, the plants were categorized into three classes, no use, minor use, and major use. The use value scores assigned to these classes were, 0, 0.5, and 1 respectively [23]. The plant use value was analyzed to evaluate the importance of each plant species to the ethnic people and calculated as the average use value of the species using the following formula:

$$Uvis = \frac{\sum Uis}{nis}$$

Where, Uvis = the use value (Uv) attributed to a particular species (s) by one informant m (i); ΣUis = summation of all the uses mentioned in each event by the informant; nis = total number of events in which that informants give information on the species.

Results and Discussions

Taxonomic diversity

A total of 62 useful plant species belonging to 49 genera and 31 families were collected and identified from the study area. The family Fabaceae represented the highest number of species 11 species (18%), followed by Malvaceae and Solanaceae each with 5 species (8%), Acanthaceae with 4 species (6.4%), Asclepiadaceae and Cucurbitaceae each with 3 species (4.8%), Capparidaceae, Lamiaceae, Moraceae, Poaceae, Rhamnaceae and Tiliaceae each with two species. The growth form distribution showed that majority of the species were trees (35.5%, 22 species) followed by shrubs (25.8%, 16 species), herb (24%, with 15 species). Others were liana and climbers. More woody species recorded in the sites were because of higher adaptation of these plant species in the harsh environment than that of herbaceous species.

Major use categories and informant consensus factors

The result of the study showed that five major use categories of plants were recorded. From major use categories, 35 medicinal species which were used to the treatment of human, cattle, goat, sheep and camel ailments; 22 wild edible species, 39 forage species, 17 cosmetics and beauty and 45 species used for construction, fuel and firewood (Table 1) were identified and documented on the base of their uses. The diversity of useful plants in the area was less compared with other regions [24-26]. This might be due to factors like over-exploitation and other environmental problems. The level of homogeneity between information provided by different informants was calculated using the Informants' Consensus Factor [22]. Five reported use categories were frequently chosen and consensus factors were calculated (Table 1).

Table 1: Major use categories and their informant consensus factor (ICF).

Major Use Category	Families	Genera	Species	Use citation	ICF
Medicinal plants	20	30	35	92	0.63
Health and cosmetics	12	15	17	33	0.50
Wild edible plants	15	17	22	73	0.71
Forage species	21	33	39	125	0.69
Construction, fuel and charcoal	26	34	45	157	0.72

Forage plants

The Awash National Park is a national park that surrounded by pastoralists' people, who use a variety of habitats and plant species for their livestock feed. They utilize the surrounding area in a grazing mechanism. Thirty nine (62.9%) useful plants were used for forage, being distributed in 21 families and 33 genera. More than half (61%) of forage species belong to Poaceae, Fabaceae, Acanthaceae, Solanaceae, Tiliaceae, Capparidaceae, Cucurbitaceae, Malvaceae and Moraceae. The most important livestock feeds were documented, including trees 17 (43%), shrubs 9 (23%), herb 10 (26%), climber 2 (5%), liana 1(2.5%) species (Table 2). This was comparable with plant biodiversity of Borana Pastoralists [25] and higher in species number of forages with other regions [27]. This indicated that the knowledge of the people on the forage plants and their uses vary from lowland to highland. In the lowland area, pastoralists' life depends on livestock production that utilized more forage species than sedentary agro-pastoralists.

Some forage plants, such as *Rostraria cristata*, *Solanum campylacanthum* and *Polypogon viridis* were highly utilized plants for livestock feed. *Rostraria cristata* was perceived as the best grass that tended to increase milk production and it was also the most available grass type. The survey result from informants indicated that availability of pasture area has declined from time to time. The main reasons were increasing animal and human population, droughts, encroachment of pasture lands by invasive, especially *Prosopis* sp. high protection of national parks for wildlife protection and insecurity resulting from conflicts with other pastoral communities [28].

Medicinal plants

A total of 35 species (56.5% of the useful plants) belonging to 20 families and 30 genera were identified as medicinal plants (Table 3). Roots and Leaves were most frequently used parts followed by stems and fruits. Of the total medicinal plants, 23 species (66%) were used as human medicine, five species (15%) as livestock medicine and the remaining seven species (20%) for treating both human and livestock ailments. These medicinal values attributed medicinal plants to be significant use category in the study area as similar studies have shown with other pastoralist in Ethiopia [24-26]. Medicinal tree species were accounted to the highest proportion being representing with 13 species (37 %) followed by herbs (10 sp., 29 %), shrub (5 sp., 14 %), climbers (4 sp., 11%) and lianas (3 sp., 9 %) (Figure 2).

The result agreed with other study on medicinal plants in Ethiopia [25]. As most of people living in the rural area particularly in pastoralists' had limited accessibility of modern medicine, traditional medicine might play highly important ways of ailment treatments. Such conditions had been forced pastoralists to depend on utilization of medicinal plants that might support to discover new products for modern medicine. However, availability of medicinal plants was declining in an alarming rate due to overexploitation and conflicts on the natural resource. In addition, uses of plant root parts for medicinal purpose suggested being another major problem in pastoralists as similar study has reported [29].

Preference ranking

Preference ranking of five medicinal plants that reported as

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Table 2: List of forage plants utilized by the pastoralists (Key: DGK means codes of plant specimen numbers).

Scientific name and Specimen No.	Used for	Parts used	Utilization
Acacia negrii (DGK-01)	Goat, cattle	Fruits	Directly feeding matured fruits
Delonix elata (DGK-11)	Camel, goat, cow	Leaves	Directly browsing
Acacia etbaica (DGK-02)	Cow, goat	Leaves, fruits, stem	Directly browsing
Balanites aegyptiaca (DGK-09)	Camel, goat, cow	Leaves, fruits	Directly browsing/prepared for hay
Withania somnifera (DGK-12)	Cow, goat	Leaves	Directly grazing
Sida ovate (DGK-13)	Almost all	Leaves, fruits	Directly grazing
Grewia sp. (DGK-14)	Cow	Fruits	Directly browsing
Grewia villosa (DGK-15)	Cow	Leaves	Directly browsing/prepared for hay
Neuracanthus polyacanthus (DGK-16)	Cow, goat	Leaves, fruits	Directly browsing/prepared for hay
Barleria proxima (DGK-10)	Camel, goat	Leaves	Directly grazing/ prepared for hay
Sida collina (DGK-17)	Cow, goat	Leaves, fruits	Directly grazing/ prepared for hay
Cucumis ficifolius (DGK-18)	Camel, goat	Leaves	Directly browsing prepared for hay
Capparis tomentosa (DGK-19)	Camel	Fruits, leaves	Directly browsing
Cadaba rotundifolia (DGK-20)	Cow	Leaves	Directly browsing
Cucurbita feotid (DGK-21)	Goat	Leaves	Directly browsing
Solanum incanum (DGK-22)	Goat	Leaves	Directly browsing
Solanum tettense (DGK-23)	Almost all	Leaves	Directly grazing
Lawsonia inermis (DGK-24)	Cow	Leaves	Directly grazing
Berchemia discolor (DGK-25)	Goat	Leaves, fruits	Directly grazing
Polypogon viridis (DGK-26)	Cow, camel	Leaves, fruits	Directly grazing/prepared for hay
Combretum aculeatum (DGK-27)	Goat	Leaves	Directly browsing
Solanum campylacanthum (DGK-28)	Goat	Leaves, fruits	Directly browsing
Ziziphus spina-christi (DGK-29)	Camel, goat	Fruits	Directly browsing
Acacia asak (DGK-07)	Camel, goat	Leaves, fruits	Directly browsing
Boswellia microphylla (DGK-30)	Cow, goat	Leaves	Directly browsing
Ficus capreaefolia (DGK-31)	Almost all	Leaves, fruits	Directly browsing and as hay
Apodytes dimidiate (DGK-03)	Camel	Leaves	Directly browsing
Rostraria cristata (DGK-32)	Cow, camel	Stem, leaves	Directly grazing/prepared for hay
Celtis africana (DGK-33)	Almost all	Fruits, leaves	Directly browsing
Lantana trifolia (DGK-34)	Goat, camel	Fruits	Directly browsing and as hay
Bersama abyssinica (DGK-35)	Goat	Leaves	Directly grazing and as hay
Fagonia schweinfurthi (DGK-36)	Goat, camel	Leaves	Directly grazing and as hay
Ficus sycomorus (DGK-37)	Almost all	Leaves, fruits	Directly browsing and as hay
Oxygonum sinuatum (DGK-38)	Almost all	Leaves and stem	Directly grazing
Tamarindus indica (DGK-39)	Camel, goat	Leaves, fruits	Directly browsing and as hay
Acacia senegal (DGK-04)	Almost for all	Leaves, fruits	Directly browsing
Ximenia americana (DGK-40)	Camel	Fruits	Directly browsing
Acacia oerfota (DGK-05)	Almost for all	Leaves, fruits	Directly browsing
Peristrophe paniculata (DGK-41)	Camel, Goat	Leaves, fruits	Grazing

effective for treating different kind of wounds was conducted after selecting 15 key informants. The informants were asked to compare the given medicinal plants based on their efficacy, and to give the highest number ten for the medicinal plant which they thought the highest effective in treating wounds and the lowest number one for the least effective plant in treating wounds As shown in Table 4 below, *Acacia negrii* was scored the highest mark and ranked first indicating that it is suggested to be the most effective in treating wound followed by *Acacia senegal*. Ethnobotanical investigations done elsewhere in Ethiopia also reported that *Acacia senegal* has been used for different

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Table 3: List of medicinal plants and their indigenous utilization.

Scientific name	Used for	Ailments treated	Parts used	Conditions for usage		Route of administration	Preparation, application and dosage
Acacia negrii (DGK-01)	Calf	Over milk lactation	Root		Dry	Oral	Drinking the calf by crushing the root
	Camel	Over milk drinking	Root	Fresh		Oral	Drinking the child camel by crushing and chewing the root
	Human	Anti-inflammatory	Leaves		Dry	Dermal	Dried, crushed leaves attached to wound part
		Injuries by spine and gun	Leaves	Fresh		Dermal	Leaves are squeezed with water and pasted on the wound and tied with clothes to prevent flow of blood and healing of the wound.
Balanites aegyptiaca	Human	Snake bite	Root	Fresh		Oral	Fresh roots are crushed, squeezed with water and one liter is drunk orally
		Madness	Root	Fresh		Oral	Roots are crushed and few squeezed is given orally due to burning
		Malaria	Leaves		Dry	Oral	Crushed fresh small amount leaves mixed with water or butter
		Typhus	Root	Fresh		Oral	Roots are crushed and boiled in water until forms foam then three liters are given to camels.
	Goat	Eye problem	Root	Fresh		Oral	Roots are crushed, diluted in water and then stirred to form foam so that three liters are given
	Camel	Anthrax	Fiber		Dry	Oral	The death of cattle by the case of anthrax, its meat is boiled with fibers and washed then eaten as a food. This prevents death of humans.
		Eye problem	Root	Fresh		Dermal	Roots are crushed and one liter squeezed is given orally
Zehneria anomala (DGK-42)	Human	Accidental tiredness of children	Leaves	Fresh		Oral	Fresh leaves are squeezed with water and one spoon is given orally.
Grewia villosa	Human	Stomach ache	Fruits		Dry	Oral	Fruits are crushed and diluted in water and given orally
Delonixelata (DGK-43)	Human	Tonsillitis	Root	Fresh		Oral	Chewing and swallowing only the chemical
		Tooth ache	Root	Fresh		Oral	Used as tooth brush
		Snake bite	Root	Fresh		Oral	Chewing of the roots
Azadirachta indica (DGK-06)	Human	Malaria Dysentery	Leaves	Fresh		Oral	Fresh leaves are crushed and squeezed with water and filter then one cup is given orally.
Acacia etbaica (DGK-02)	Human	Wound (Dhitto)	Leaves		Dry	Dermal	Tied on the wound
Sida urens (DGK-44)	Cow	Injury	Root	Fresh		Dermal	Leaves are crushed and creamed on the wound
Parthenium hysterophorus (DGK-45)	Human/child	Diarrhea	Stem	Fresh		Oral	Crushing the whole part and one cup is given orally
	Human (adult)	Stoma ache	Root	Fresh		Oral	Root is chewed directly Roots are crushed and soaked in water and one can is given but have high bitter taste
Senna petersiana (DGK-47)	Human	Wound Snake bite	Root	Fresh		Oral	Crushed and filtered, then drinking
Acacia senegal (DGK-04)	Human	Prevent bleeding	Fibers	Fresh		Dermal	Fibers are tied to injured parts
		Blotting	Resin	Fresh		Oral	Resin is directly swallowed

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Leucas martinicensis (DGK-47)	Human	Spider disease	Root, leaves		Dry	Dermal	Crushing the root and dilute with water then ting on skin
		Herpes zoster	Leaves	Fresh		Dermal	Leaves are roasted on the hot objects, crushed powders mixed with fat then creamed on the wound
Capparis tomentosa (DGK-19)	Human	Febrile	Leaves	Fresh		Dermal	Fresh leaves are boiled, cooled and then washing of the body
		Anthrax	Leaves	Fresh		Oral	Leaves are crushed and squeezed with water and one cup is given
Fagonia schweinfurthii (DGK-36)	Human	Influenza	Leaves,stem		Dry	Dermal	Fumigating with it Powder dilute and wash by it
		Jaundices	Root	Fresh		Oral	Crushed, boiled and filtered, three cup i.e morning, day and night Root fumigating
		Hepatitis	Stem		Dry	Oral	Filter and drink as tea
	Cow Calf Goat	Eye problem	Leaves Root	Fresh		On eye	Crushed fresh small amount leaves mixed with water or butter
Withania somnifera (DGK-12)	Human	Febrile	Root, stem		Dry	Dermal	Crushing the whole plant part and fumigating with it
		Refusing to feed milk the child by mother	Root	Fresh		Dermal	Washing the breast with this dilute
		Madness	Root, stem		Dry	Dermal	Washing the whole body by its dilute or fumigating
		Accidental stomach pain	Root	Fresh		Oral	Roots are directly chewed
	Cow	Hepatitis Diarrhea Refusing to feed milk the calf by cow	Root, whole part		Dry	Oral Dermal	Roots are crushed and squeezed and one liter is given. Roots are crushed and fumigant
Tamarindus indica (DGK-39)	Human	Malaria	Fruits	Fresh		Oral	Fruits are crushed, soaked in water for 12 hrs at night
Boswellia microphylla (DGK-30)	Human	Jaundice	Fiber Bark	Fresh		Oral	Fibers are crushed and one cup of squeezed is given orally
Cissus aphylla (DGK-48)	Cow /Calf	Anthrax	Root, stem		Dry	Dermal	Crushed dried plant is fumigated
	Goat	Snake bite	Root		Dry	Oral	Roots are crushed and squeezed within small cup are given orally and roots are squeezed and creamed on the injured parts
Calotropis procera (DGK-49)	Cow	Gland swelling	Leaves		Dry	Dermal	Crushed dried plant is fumigated
	Calf	Anthrax	Root, stem	Fresh		Oral	Crushed, boiled and filtered drinking
Sida ovate (DGK-13)	Human	Diarrhea	Leaves	Fresh		Oral	Crushed and diluted, one cup is given orally
Cucurbita feotid (DGK-21)	Human	Devil sprit (Budda)	Root	Fresh		Oral/ Dermal	Crushed, boiled and filtered, simply drinking or adding on skin
Cadaba rotundifolia (DGK-20)	Human	Common cold	Leaves	Fresh		Oral	Crushed, boiled and filtered drinking
		Wound	Root		Dry	Dermal	Roots are crushed and pasted on the wound
Cucumis ficifolius (DGK-18)	Human	Snake bite	Root	Fresh		Oral	Crushed and filtered drinking
Solanum incanum (DGK-22)	Human	Wound curing	Fruits		Dry	Dermal	Crushed and attach on it
Ximenia americana (DGK-40)	Human	Jaundice	Fiber	Fresh		Oral	Fibers are crushed and soaked in water and then one can is drunk but very powerful

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Solanum campylacanthum (DGK-28)	Human	Abnormal activities	Stem	Fresh		Dermal	Crushed and added to fire then fumigated
	Camel	Cough	Fruits		Dry	Oral	Drinking the child camel by adding with salt
Prunus africana (DGK-56)	Human	Gonorrhea	Root	Fresh		Oral	Roots are crushed, diluted in water and one bottle is drunk
		Impotency	Root	Fresh		Oral	Fresh roots are crushed and soaked in water and then one cup is drunk.
	Camel	Jinni/devil sprit/ abnormal activities	Stem		Dry	Dermal	Crushed and added to fire then fumigated
Prosopis juliflora (DGK-49)	Human	Dysentery	Root	Fresh		Oral	Roots are crushed and soaked in water and then filter and drink one cup of dilution.
Oxygonum sinuatum (DGK-38)	Sheep	Swelling of neck	Leaves		Dry	Oral	Crushed, boiled drinking them
Ziziphus spina-christi (DGK-29)	Human	Chest	Fruits	Fresh		Oral	Eating the fresh fruit
		Bone fracture	Leaves and fibers		Dry	Dermal	Dried leaves and fibers are crushed together and tied on the injured parts
			Fruits	Fresh		Oral	Eating the fresh fruit
		Corpse from decaying	Leaves	Fresh		Dermal	Leaves are crushed and diluted in water then used for washing of corpse
Tacazzea conferta (DGK-50)	Goat	Breast swelling	Root, stem		Dry	Oral	Crushing, diluting then drinking
Jasminium grandiflorum (DGK-5)	Human	Leg wound due to snake bite	Root	Fresh		Oral	Crushed, boiled and filtered, then taken with water
Solanum tettense (DGK-23)	Human	Constipation	Root		Dry	Oral	Roots are crushed, diluted in water and one cup is given orally
Crossandra mucronata (DGK-52)	Human	Flies prevention	Leaves		Dry	Dermal	Fumigant to prevent flies

Table 4: Preference ranking of five medicinal plants used to cure wounds.

Medicinal plants	Key Respondents															Total score	Rank
	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_{10}	R_{11}	R_{12}	R_{13}	R_{14}	R_{15}		
Cadaba rotundifolia	7	10	6	4	8	3	10	7	8	7	5	6	7	5	6	99	3rd
Ziziphus spina-christi	3	7	9	5	5	5	4	6	5	4	8	10	6	7	8	92	5th
Acacia senegal	8	5	10	6	6	4	3	5	4	9	6	8	9	10	7	100	2nd
Acacia negrii	10	7	6	7	9	8	5	8	10	8	7	9	10	6	4	114	1st
Senna petersiana	4	8	5	7	10	6	6	3	6	5	9	3	4	8	10	94	4th

('R_{1-15} are respondents /informants; from R1-8 for Oromo/ R9-15 for Afar pastoralists;
the values 1 = least used to cure wounds, 10 = highly used to cure wound.

ethnomedicinal purpose [25]. Further pharmacological test of the species against wound curing might reveal promising results.

Wild edible plants

The result of the study revealed that 22 wild edible species (35.5%) belonging to 17 genera and 15 families were documented in the site (Table 5). This indicated that the study area has potential source of wild edible species. Fabaceae had the highest proportion of edibles with seven species, followed by Rhamnaceae and Tiliaceae accounted two species respectively. Most of the identified species were reported to be edible elsewhere in Ethiopia and in other countries of Africa. For example, of the species recorded in this study, eight species were documented elsewhere in Ethiopian lowlands [25]. Most plant parts were eaten directly in fresh forms. Out of total edible plants, nine species were commonly used in both ethnic groups. The Oromo (Ittu and Kereyyu) tribes affirmed that 10 (45%), and Afar (Wa'ema and Debene) 3 (14%) of the 22 edibles species in the study area. Utility of these species over wider areas among different communities

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Table 5: List of wild edible plant species with their used parts and way of preparations.

Local name	Scientific name	Parts used	Preparation and consumption
Ajoo	*Acacia etbaica*	Latex	Fresh resin is swallowed
Adachaa	*Acacia negrii*	Latex	Fresh resin is swallowed
Wangayoo	*Acacia oerfota*	Fruits	Unripe fruits are eaten
Addado	*Acacia senegal*	Latex	Fresh resin is swallowed
Wacho	*Acacia seyal*	Latex	Fresh resin is swallowed
Manqeroo	*Apodytes dimidiata*	Fruits	Ripen fruits are eaten
Bedeno	*Balanites aegyptiaca*	Fruits	Unripe fruits are eaten
Jejjeba	*Berchemia discolor*	Fruits	Ripen fruits are eaten
Leeddi	*Boswellia microphylla*	Fruits	Ripen fruits are directly eaten
Metekoma	*Celtis africana*	Fruits	Ripen fruits are eaten directly
Hiwak	*Crossandra mucronata*	Fruits	Unripe fruits are eaten
Oda	*Ficus sycomorus*	Fruits, latex	Eating unripe fruits and mastication of latex
Dheekkaa	*Grewia* sp.	Fruits	Both ripen and unripe fruits are eaten
Dogomdii	*Grewia villosa*	Fruits	Unripe fruits are eaten
Midhandurbaa	*Lantana trifolia*	Fruits	Both ripen and unripe fruits are eaten
Adde	*Olinia rochetiana* (DGK-53)	Fruits	Unripe fruits are eaten
Domaa	*Phoenix reclinata* (DGK-54)	Fruits	Both ripen and unripe fruits are eaten
Killaa	*Polypogon viridis* (DGK-55)	Fruits	Unripe fruits are eaten
Garuwyto	*Sida collina*	Fruits	Unripe fruits are eaten
Roka	*Tamarindu sindica*	Fruits	Both ripen and unripe fruits are eaten
Huddaa	*Ximenia americana*	Fruits	Both ripen and unripe fruits are eaten
Qurqura/kusra	*Ziziphus spina-christi*	Fruits	Both ripen and unripe fruits are eaten

Table 6: List of plant species used for cosmetics and beauty.

Scientific name	Parts used	Preparation and application
Cyperus Rigidifolius (DGK-57)	Bulb	The bulbs are dried and fumigated to house for good smell
Capparis tomentosa	Stem	Dried and fumigated to whole body specially for female
Senna truncate (DGK-58)	Branches	Directly brushing of teeth
Balanites aegyptiaca	Bark	Fumigating it to the whole bed
Delonix elata	Branches	As Body lotion
Boswellia microphylla	Stem, Branches	Fumigant to have good smell of the houses or women
Tamarindus indica	Fruits, leaves	Dried, crushed, soaked in water to be used as lotion
Lawsonia inermis	Leaves	To color the hand
Sida collina	Bark	Hair beauty for freezing like shampoo, especially for male
Olinia rochetiana	Bark, leaves	Fumigating the fresh for house or bed
Ziziphus spina-christi	Leaves	Leaves are crushed and creamed on the hairs or body to make smooth and shiny
Berchemia discolor	Stem	For young female as stem bath
Solanum campylacanthum	Stem	Sliced stem by fumigating like as steam bath
Solanum incanum	Fruits	Crushed fruit to mix it with water to wash their legs
Grewia villosa	Fibers, Bark	Crushed fibers soaked in water and form foam so that wash of hair with this.
Grewia sp.	Bark	Fibers are crushed, soaked in the water and form foam so that wash of hair
Fagonia schweinfurthii	Whole plant	Steam bath

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Table 7: Plant uses for construction, charcoal and firewood and others.

Scientific name	Utilization
Acacia negrii	Production material of chair, spoon, traditional dish
Olinia rochetiana	Traditional house construction
Acacia etbaica	House construction
Cryptostegia grandfloria (DGK-59)	House construction
Leucas martinicensis (DGK-60)	Roof of traditional house
Balanites aegyptiaca	The roof material of traditional house construction
Datura stramonium (DGK-61)	Protection from termite
Senna petersiana	Fence
Grewia sp.	Best stick for camel keepers
Grewia villosa	For material of farm production
Barleria proxima	Fence of goat and camel room
Sida tenuicarpa	House construction
Sida rhombifolia	Door of traditional house
Capparis tomentosa	Fence
Cadaba rotundifolia	Sticks for men
Lawsonia inermis	Washing died people with it
Ximenia americana	Thick stick for adults, Cultural pray Wood of diggers, House construction
Berchemia discolor	Headboard, House construction especially roof
Senna truncate	Farming material
Crossandra mucronata	House construction
Combretum aculeatum	Bed sheet
Polypogon viridis	Bed sheet, roof
Ziziphus spina-christi	Religious purpose/pray especially for Afar people Raw material of chair, spoon, cultural dish
Acacia asak	For cultural gatherings
Boswellia microphylla	For stick of women during praying and wedding ceremony
Ficus capreaefolia	As stick, farming material production
Apodytes dimidiata	Mainly charcoal production
Rostraria cristata	House roof; Agricultural equipments; Charcoal production Cosmetics (leaves) as hinna for hair; Honey production
Phoenix reclinata	Leaves as bed sheet, as sign of peace during ceremonies
Prunus africana	Stick during cultural ceremonies
Lantana trifolia	As ornamental for young women
Bersama abyssinica	As fence or Door of cultural house
Celtis africana	Highly used for traditional house construction and fencing
Azadirachta indica	Wind break, shadow
Ficus sycomorus	House making
Prosopis juliflora	Agricultural equipments, fuel-charcoal
Sida tenuicarpa	Used during harvesting cereals
Cyperus rigidifolius	As bed sheet, and during cultural day in house
Tacazzea conferta	Ornamental, fence of irrigation land
Jasminium grandiflorum	House connector
Peristrophe paniculata	Door for animal fence
Ipomoea cairica (DGK-62)	Ting of different part of house
Acacia senegal	Traditional house construction
Acacia seyal	Fence
Acacia oerfota	Traditional house construction and fuel wood

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Table 8: Direct matrix ranking of multipurpose uses of plants.

List of plant species	Use categories					Total Rank	
	Food	Medicine	Forage	Cosmetics	Miscellaneous Uses		
Boswellia microphylla	1	5	2	4	5	17	2nd
Ziziphus spina-christi	5	4	3	2	4	18	1st
Acacia negrii	2	3	4	1	3	13	6th
Balanites aegyptiaca	3	4	3	2	4	16	3rd
Ximenia americana	5	1	3	2	1	12	7th
Acacia senegal	4	3	4	1	3	15	4th
Ficussycomorus	4	1	4	1	5	15	4th

(*1-5 stands for average value given by informants, 1 means less use and 5= high use).

Table 9: Use value of frequently reported species of major categories.

Species	Medicinal	Cosmetics	Forage	Wild edible	Others
Lawsonia inermis		39 (0.6)			
Grewia villosa	22 (0.61)	45 (0.63)			
Rostraria cristata			57 (0.3)		
Fagonia schweinfurthii	34 (0.03)				
Senna petersiana	26 (0.36)				
Solanum incanum			28 (0.4)		
Ziziphus spina-christi				25 (0.15)	
Balanites aegyptiaca				25 (0.15)	
Acacia negrii					22 (0.1)
Acacia oerfota					25 (0.2)

indicated the existence of common knowledge across a range of subsistence groups of different culture and geographic areas. Analysis of the results indicated that majority of the recorded edible species were consumed in fresh without ripening or processing (Table 5).

The informants asserted that edible fruit bearing species such as *Ziziphus spina-christi* and *Ximenia americana* were highly prized by individuals in all age groups. The reasons for appreciation of one species over the other, assumed to be easiness to eat, nutritional value and taste during consumption. In addition to food value, the identified species were marketable and provided the opportunity to supplement household income. This was observed in the study areas where various wild edible plants were sold at local market like fruits of *Ziziphus spina-christi*. The utilization of these species might gradually lead to the fading away of indigenous knowledge associated with the species and thus poses danger on poorer people who have relied on these cheap and relatively easily accessible food plants. Hence, many efforts need to promote the uses of these wild edibles through genetic and nutritional studies.

Health, cosmetics and beauty

The investigated 17 plant species have been commonly used for beauty and health purposes. Out of these, 13 species (62%) accounted to woody plants including trees, liana and shrubs (Table 6). Plants, which were used as laundry and cleansing, fumigation, fragrance and aromatic characters of the area, were documented. For example, the bulbs of *Cyperus rigidifolius* were collected from underground, pounded, and mixed with butter to make a local perfume to take care of their hairs (Table 6).

Traditional fumigation and perfuming was a way by which female pastoralists use the smoke of some good-smelling aromatic species for cleaning their bodies and clothes. This traditional fumigation has advantages to clean bodies and make good smell which may be equivalent to modern perfumes. The most common species used for fumigations/cleansing include *Cyperus rigidifolius*, *Boswellia microphylla* and *Solanum campylacanthum*. Some species of plants in the area were used as hand lotion or coloring (e.g. *Lawsonia inermis*), body lotion (e.g. *Delonix elata*), steam bath *(Fagonia schweinfurthii*) that suggested to directly cleaning their skin in addition to perfuming. The most common type of cosmetics in the area were those plant species used for hair beauty and cleansing, such as *Sida collina*, *Ziziphus spina-christi* and *Grewia villosa* (Table 6), which were mostly prepared from fibers by crushing and soaking in water and using the foam to wash hair. These kinds of activities with similar species were reported from elsewhere [25,26,30].

Plant uses for construction, fuel and charcoal

Different types of plant species have multiple values for uses of fuel, construction and charcoal production. Forty-five species belonging to 26 families, and 34 genera were recognized from the area (Table 7). Out of these, woody plants (tree, shrub, and liana) comprised 37 species (82%), indicating that the woody plants were utilized more for different purposes than herbaceous plants in these categories. This showed that the Afar and Oromo ethnic people still depend on plant materials for house construction and other purpose. Furthermore, pastoralists depend on woods to make utensils for food preparation, containers (e.g. for farming material), and others (Table 8).

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Use value of useful plants

The use value was analyzed to evaluate the importance of each plant species to the ethnic people and calculated as the average use value of the species (Table 9). Such plants were intensively utilized by the pastoralists, and thus species availability might tend to decrease and finally lead to local extinction. If these excessive or unsustainable harvesting practices continue, plant species may be put at risk. For example, *Boswellia microphylla*, one of the most highly affected plants for different uses, is now restricted to the top of mountains in distribution.

As indicate above in Table 9, the frequently reported useful plants were analyzed for their informant's consensus factor from each category. In this study, *Rostraria cristata* was cited by 91.9% of the informants for forage followed by *Grewia villosa* (72.5%) and *Lawsonia inermis* (62.9%) usage for different cosmetics in the society. From different ethnobotanical categories different levels of cultural consensus were recognized. Use value was the highest in the category of cosmetics for species *Grewia villosa* (0.63) and followed by *Lawsonia inermis* (0.6). This analysis indicated that people highly depend on certain number of species for major uses than other species, and some species of those with higher use value were well known within the ethnic groups. Therefore, further study on the chemical content and their management should focus on species commonly used in the ethnic groups.

Threatening factors of useful plants

The respondents from both ethnic groups indicated that different factors played to threaten useful plants in their area (Figure 3). The result of the study showed that population pressure (20%), drought (18.3%) and agricultural expansion (16.7%) were the major threatening factors to useful plants. Threatening factors of useful plants were recognized as environmental condition such as drought and anthropogenic factors. Anthropogenic factors played the dominant role in surviving of plant species in the site. Human demands for sources of food, medicine, shelter, cosmetics, construction, charcoal production and forage for livestock resulted in overexploitation and overgrazing of plants. The majority of plants used for livestock feed revealed that overgrazing played dominant factor in the study areas.

The results of the study showed that multiple utilizations of plants were recorded as the threatening factors similar to other previous studies in Ethiopia [31,32]. Therefore, most of the plant species in the areas have been facing lack of priorities for conservation especially the useful plants (medicinal, edible, forage plants). However, some farmers have started management of very few plants such as *Ziziphus spina-christi* and *Balanites aegyptiaca* in their farmlands. This showed that such management and acquisition of economic benefits from species might promote local peoples' interest in conservation and maintenance of such local important plants.Such experiences should be exchanged with other local people to motivate conservation and management habit in the area.

Conclusions and Recommendations

The result of the study revealed that 62 useful plant species were found having vital roles in subsistence wellbeing to the society which was reflected by presence of five major use categories. The key products harvested from useful plants were edible parts, traditional medicine, forage, cosmetics and other miscellaneous benefits. The majority of products were found from woody species which were dominant useful plant components in the study area. The survival status of some useful species particularly in herbaceous plant species has declined.

The major threatening factors for useful plants were recognized from environmental condition such as drought and anthropogenic activities. Anthropogenic activities took the dominant role and exerted many pressures on plant resources. Multiple uses of plants for charcoal production; forage uses and construction purpose made useful plants to be at risk conditions. These demand an urgent attention to conserve such vital resources. The rising awareness on utilization of plants in sustainable manner and minimization of conflicts in both ethnic groups might be promising solutions to reduce threatening factors. Therefore, conservation and management of useful plants should be regulated in collaboration and participation of local communities, districts, park reserves and federal administration.

A rich heritage of indigenous plant use and knowledge was recognized in almost similar manner in both ethnic groups. However, awareness rising for highly knowledgeable elders needed to avoid erosion of the indigenous knowledge and to ensure sustainable and preservation of indigenous knowledge for future generation. Supporting the present investigation, pharmaceutical and nutritional value of plants should be further evaluated to optimize their use in the future. It is recommended that further studies in other ethnobotanical plant use categories should be conducted to capture the entire plant diversity that needs conservation priorities.

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