

ORIGINAL ARTICLE

Management and Utilization of Wild Nutraceutical Plants: Implications in Diversifying Food sources and Traditional Health care systems in Lare Woreda, Gambella Regional State, Southwest Ethiopia

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ABSTRACT

The diverse wild Nutraceutical plants in Lare woreda of Gambella Regional State are known to have a huge potential in their overall socio-economic contribution to the community, especially in diversifying food sources and traditional health care systems. However, information on the management, processing and utilization of these plants are inadequate as they are not well studied. Therefore, this study was conducted with the objective of assessing the management and utilization aspects of the existing nutraceutical plants in the area. To that end, 120 households from three representative administrative Kebeles were selected and interviewed using semi-structured questionnaire. Other methods of data collection, which include focus group discussions, key informants interview, and preference ranking, were also employed in addition to the formal household survey. A total of 37 wild useful plant species belonging to 27 families and contributing to diversifying local food sources and health care systems (for treating both human and livestock diseases) were identified. These plant species belong to different habits, which include trees, shrubs, climbers, and herbs; and the communities can access them in different types of habitats (mainly, from dense woodland areas, open woodlands, road side plants and bush lands). Different threats encountered in the overall management of woodland vegetations consisting of these plants, which have resulted in the decline in their distribution, were also identified. These threats include frequent fire, agricultural land expansion and investment, fuel wood collection, timber collection and settlements. With regard to their processing and utilization, some of these plant parts are consumed raw, whereas some others are taken in the forms of juice as well as porridge. The different parts of the plants (fruits, leaves, seeds, roots/tubers, barks and stems) are used as sources of food and traditional medicines. As recommendations the study suggested that necessary management interventions, which can address the major threats identified, should be made in order to enhance the role of these plants. Environmental impact assessments associated with proposed conversions of major habitats of these plants into other land uses, such as agricultural investment and settlement purposes, should be conducted. Moreover, an all-inclusive and participatory management strategy that involves the local people in managements of these plants should be designed and implemented in order to address the major threats. Further studies on the chemical and nutritional aspects of these wild nutraceutical plants in the area are also required for designing more modern ways of their processing and utilization.

Key Words: Nutraceutical plants, Management, Utilization, Diversifying, Food, Healthcare

INTRODUCTION

Since the prehistoric time, man has always been dependent upon plants for his food, shelter and health (Mohamed and Mushtaq, 2004). As a result, the relationship between man and plants is as old as history of mankind and indigenous knowledge about the plants is as old as human civilization. Through their direct interaction with plant population through their culture, human populations have classified plants, developed attitudes and beliefs and also learned the use of plants. On the other hand, the plants themselves also impose limitations on humans. The fundamental issue of ethnobotany is, therefore, the dynamic relationship between human population, cultural values and plants.

Forests are generally used to provide a whole range of benefits including wildlife, wild edible fruit trees, medicinal plants, watershed protection, construction materials, fire wood, and spiritual values (Paul *et al.*, 2012).

Globally, mankind is dependent on widely cultivated plant species for food security and during the course of history, some 12000 plant species have been used as food among which only 2000 have been domesticated and about 150 are commercially cultivated (Godin *et al.*, 2014). It has also been argued in same source that about 30 species of plants have been identified to provide about 90% of the world's nutritional needs.

Especially, millions of people in developing countries depend on wild resources, for wild medicinal and edible plants. A food plant may be used for medicine, and to treat ill health or to maintain wellness. Hippocrates, 460-377 B.C. is, therefore, famously quoted to have said 'Let food be your medicine and medicine be your food' (cited in Oz, 2010). These kinds of plants having both food and medicinal values are now days categorized as Nutraceutical plants.

According to the World Health Organization (WHO) about 65-80% of the world's population in developing

countries depends essentially on plants for their primary healthcare due to poverty and lack of access to modern medicine (Tinde, 2006). Wild plants may be defined as those that grow spontaneously in self-maintaining populations in natural or semi-natural ecosystems and can exist independently of direct human action. Despite society's primary reliance on crop plants, the tradition of eating wild plants has not been completely disappeared. In many societies, a large number of wild edible plants are regarded as emergency or hunger gap or famine foods. Wild food plants, on the other hand, are accepted by rural communities through custom as appropriate and desirable (Godin *et al.*, 2014).

Ethiopia as a country with varied topography and a wide spectrum of habitats presenting a large number of endemic plants and animals, has been practicing consumption of these plants for various purposes; and the country has about 6000 higher plant species, of which about 10% are endemic (Hedberg *et al.*, 2009). Currently, there is a global outcry over food insecurity. This is worsened by the soaring food prices in which Ethiopia is not an exception. Each year, on the average, about five million people in Ethiopia have problems securing enough food for them and need assistance (Ethiopian Red Cross society, 2012). According to Getachew *et al.* (2000), factors that are often mentioned as the principal causes of inadequate growth in food production and increasing food insecurity are: inadequate and variable rainfall, soil degradation, conflict, poor transport infrastructure, land tenure problems, and poor storage facilities. Moreover, the limited and selective food sources used by the people, together with absence of efforts to diversify, are also additional problems.

Rural people of Ethiopia are endowed with a deep knowledge concerning the use of wild plants, some of which are consumed at times of drought, war and

other hardships. Elders and other knowledgeable community members are the key sources or 'reservoirs' of plant lore. Wild food consumption is still very common in rural areas of Ethiopia, particularly among children. Among the most common wild plant fruits consumed by children are, for example, fruits from *Ficus spp*, *Carissa edulis* and *Rosa abyssinica* can be mentioned (Guinand and Lemessa, 2001).

In addition to their food values, traditional medicinal practices are common in Ethiopia in which about 80% of the population in the country use plant based traditional medicine by indigenous knowledge as their major primary health care system (Kalayu *et al.*, 2013). Traditional knowledge of medicinal plants and their use by indigenous healers are not only useful for conservation of cultural tradition and biodiversity but also for community health care and drug development in the local people. Bekele *et al.* (2012) pointed out that adequate knowledge of traditional plants is available in Ethiopia. Their research result has revealed that traditional plants are not used only for their food and healthcare to human, but they are also used in diverse ways for treating livestock diseases.

According to Gambella Regional State, Bureau of Land Resources and Environmental Protection (GRSBoLREP), the regional state has rich natural resources particularly forest resources with diverse useful wild plants having substantial socio-economic significance in the region. These plants are well recognized by the communities for ensuring food security as well as in their traditional health care systems during both normal and hardship times. Despite the significance of these nutraceutical plants, their management (including the major threats for their conservation) and their utilization aspects have not been well studied. This study was, therefore, conducted with the objective of assessing the management and utilization of the

existing nutraceutical plants in Lare Woreda of Gambella region, located in southwestern part of Ethiopia.

MATERIALS AND METHODS

Description of the Study Area

The study woreda, Lare, is located in Gambella National Regional State (GNRS), which is one of the National Regional states of the Federal Democratic Republic of Ethiopia (FDRE) situated in the southwestern part of the country (Figure 1). The region is located between the geographical coordinates of 6°28'38" and 8°34" North Latitude and 33° to 35°11'11" East Longitude, which covers an area of about 34,063 km². It is bounded to the North, Northeast and East by Oromia National Regional State, to the South and Southeast by the Southern Nations, Nationalities and People's Regional State and to the Southwest, West and Northwest by the Republic of Sudan (BoLR., 2011).

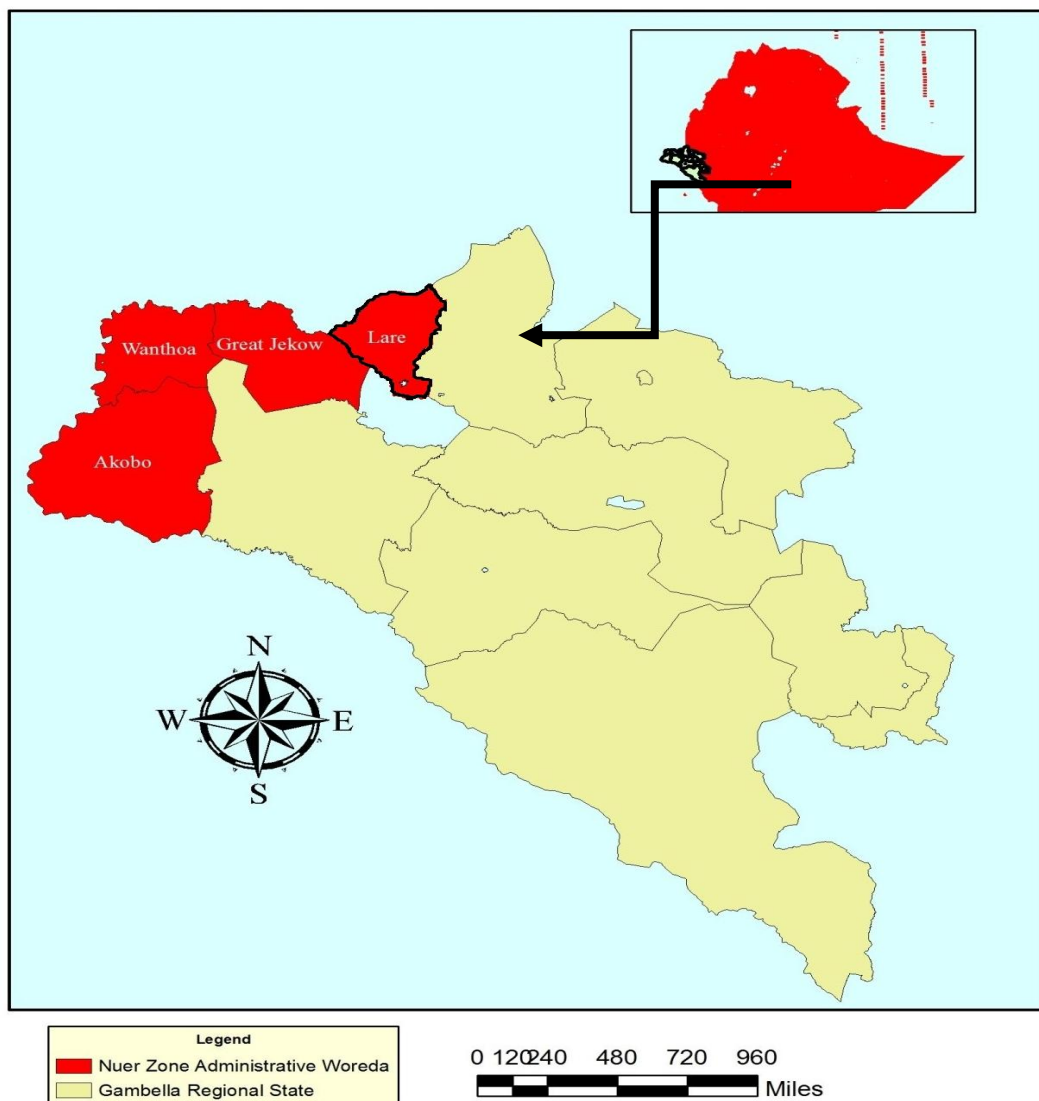
The annual rainfall of the Region in the lower altitudes varies from 900-1,500mm. At higher altitudes it ranges from 1,900-2,100mm. The region is endowed with a vast marginal land which is suitable for agriculture and other economic activities. The existing land use/land cover types of the region are identified as cultivated land, forest land, wood land, bush land, shrub land, grass land, bamboo, wet (marsh) land, etc. The major economic activities include mixed farming (both livestock rearing and crop production), fishing, hunting and wild food collection. Maize and sorghum are the major food crops grown in the area. The study was conducted in Lare District, which is one of the 13 Districts in Nuer Zone of Gambella Regional State. Lare is bordered on the south and east by the Anuak Zone, on the west by the Baro River which separates it from Jekow, and on the north by the Jekow River which separates it from South Sudan. A notable landmark is Gambella National Park, which occupies part of the area south of the Baro River.

The main categories of the livelihood of the people are agro-pastoral (livestock and crop production), fishing, hunting and wild food collection (GRSBoLR, 2011).

Lare is situated in the low lying plain and its agro-ecology is described as *Bereha*/extremely hot. The climate of the District is formed under the influence of the tropical monsoon from the Indian Ocean, which are characterized with high rainfall in the wet period from May to October and has little rainfall during the

dry period from November to April. The mean annual temperature of the District varies from 17.3°C to 28.3°C and annual monthly temperature varies throughout the year from 27°C to 38°C. The absolute maximum temperature occurs in Mid-march and is about 45°C and the absolute minimum temperature occurs in December and is 10.3°C. The annual rainfall of the District varies from 900-1,500mm with highest in July to September and lowest in November (GRSBoLR, 2011).

Figure 1. Location of the study District in Gambella Regional state of Ethiopia



Methods of Data Collection

A total of three representative rural Kebele Administrations, which are the smallest administrative units from the study Woreda or district (Bilimkun Kebele, Kutoch Kebele and Ngor Kebele) were selected purposively on the bases of their better vegetation cover and the ease of accessibility of their habitats. In addition, occurrence of famine and disease as well as presence of local traditional healers were also considered in identifying the specific study areas as the purpose of the study was to assess the management and utilization of the wild plants and their significance in food security and health care system of the area. Following a procedure by (Krejcie and Morgan, 1970), a total of 120 households (73 males and 47 females) from the three Kebeles were selected to take part in the household survey.

In order to gather the required data on the management and utilization of the wild nutraceutical plants, various socio-economic survey methods and ethnobotanical techniques were employed. These methods and techniques include semi-structured questionnaire for conducting household interview, Focus Group Discussion (FGD), pair-wise ranking, transect walk and key informants interview as well as situational analysis. Participants of FGD and key informant interviews were purposively identified from the community members on the basis of their age, traditional knowledge of the wild edible and medicinal plants and also their period of residence in the area. Accordingly, key informant interview with fifteen participants (five in each Kebele) and six FGDs (two in each Kebele) were conducted.

For the application of the aforementioned data collection methods, standard procedures followed by previous similar studies (Martin, 1995; Alexiades, 1996; Cotton, 1996; Mesfin Tadesse and Hedberg 1995; Edwards *et*

al., 1997; Edwards and Sileshi Nemomissa 2003) were followed. In addition, for the purpose of identifying scientific names of wild nutraceutical trees and shrubs (after their local names were identified by key informants, mainly by elder members of the community), an identification manual: 'Useful Trees and Shrubs of Ethiopia (Azene *et al.*, 2007)' was used. Methods of Data Analysis

Different methods of data analysis were employed for analyzing the various kinds of data and information gathered during the field work. The data collected using more formal procedures such as semi-structured questionnaire for household interview were fed into Excel worksheet and SPSS (Statistical Package for Social Science); and were analyzed by using descriptive statistics such as means, percentages and frequencies. On the other hand, data gathered through different informal social survey methods by employing various Participatory Rural Appraisal (PRA) tools like FGD, key informant interview, transect walk and other ranking techniques were synthesized and presented in tables, graphs and texts.

RESULTS AND DISCUSSIONS

Household Demographic and Socio-economic Characteristics

The sampled households were composed of both male and female headed households with a proportion of 73(60.8%) and 47(39.2%) respectively. The result shows that the proportion of female headed households in the area is much higher as compared to the overall national reality in Ethiopian context. The average family size of informants in the area was 7, and the average age of the sampled household head was 41.5 years with minimum of 24 and maximum of 60 years. About 29% of respondents did not attend formal education, with the remaining proportions of 31%, 23%, 13% & 4% having some educational

background from grade one up to diploma level (Table 1).

The large family sizes and the low level of education in the area are clear indications that there is increased

pressure and mismanagement of the forest resources from where the communities can access and utilize the wild nutraceutical plants.

Table 1. Educational Status of Respondents

S.No	Educational Status	Proportion of Respondents (%)
1	Illiterate	29
2	Grade 1-5	31
3	Grade 6-10	23
4	Grade 10-12	13
5	Diploma level	4
	Total	100

The respondents indicated during the study that the consumption of wild edible and medicinal plants is higher for households with lower levels of education. The main reason mentioned was that families with better educational profiles (especially the 4% with diploma level in the above table) have other options of livelihood; for example, they can secure government employment opportunities as compared with those having lower levels of education and those that are illiterate. This is in line with the finding of Tesfaye Awas (2007), which revealed that the increase of educational status decreases the use of and dependence on wild plants.

Household Wealth Status

Respondents in the area generally indicated that the wealth status of the majority of the households at the present time is poor as compared to that in the past (e.g. compared to 15 years back). According to respondents, the wealth status of households in the area can be described in terms of three wealth categories (Table 2). These categories include rich, medium and poor (subsistence level) wealth classes. The household wealth categorization is basically based on certain criteria in the specific context of the area. The criteria

mentioned by respondents were whether households practice crop production and possession of livestock or cattle heads.

Accordingly, rich households are those who practice crop production and possess more than 10 heads of cattle; medium households are those who practice crop production and possess 1-10 heads of cattle; and the poor households are those with 1 or less livestock head and are not usually involved in crop production. In addition, government employees belong to either the medium or rich households depending upon their income levels. It was mentioned during the study that one of the coping mechanisms for food shortage, especially for the poor households (representing the highest proportion as shown in Table 2) is to consume wild edible plants.

Table 2: Wealth Categories and Income Sources of Households (HHs)

S/N	Wealth status of HHs	N =	Percent
		120	
1	Rich	32	26.7
2	Medium	42	35.0
3	Poor/subsistence level	46	38.3
1	Crop Production	18	15.0
2	Livestock Production (LS)	37	30.8
3	Both Crop & LS	65	54.2

As shown in Table 2 the sources of income or wealth in the area were reported to come from crops production, livestock rearing and both crops production and livestock rearing with proportions of 15%, 30.8% and 54.2% respectively. This explains that, majority of farmers in the area practice both livestock and crop production as sources of their income while only few farmers practice only crops production as their income sources and means of livelihood. Moreover, respondents emphasized that the crop production in the area is not adequate and sustainable. This indicates that the wild edible plants in the surrounding vegetations have got supplementary roles as food sources, especially during times of food deficit from the main food crops.

identified during the study (Table 3). These plants belong to different habits including trees, shrubs, climbers and herbs with the proportions of 31.57%, 22.05%, 5.26% and 41.12% respectively.

Management of Wild Nutraceutical Plants

A total of 37 multipurpose wild plant species (including wild edible, wild medicinal and wild nutraceutical plants) belonging to 27 families and contributing to diversifying local food sources and traditional health care systems were

Table 3. List of Identified Plant Species and their Families

S/N	Scientific name	Family Name	Frequency (Spp/Family)	Proportion (%)
1	<i>Hygrophila auriculata</i>	Acanthaceae	1	2.7%
2	<i>Amaranthus spinosus</i> , <i>Celosia trigyna</i>	Amaranthaceae	2	5.4%
3	<i>Calotropis procera</i>	Asclepiadaceae	1	2.7%
4	<i>Balanites aegyptiaca</i>	Balanitaceae	1	2.7%
5	<i>Cadaba farinosa</i> , <i>Creteva adanonsii</i> ,	Capparidaceae	2	5.4%
6	<i>Diospyrus mespiliformis</i>	Ebenaceae	1	2.7%
7	<i>Flueggea virosa</i> , <i>Euphorbia tirucalli</i>	Euphorbaceae	2	5.4%
8	<i>Piliostigma thonningii</i> , <i>Tamarindus indica</i> , <i>Acacia furinesia</i> , <i>Senna obtusifolia</i>	Fabaceae	4	10.81%
9	<i>Ficus sycomorus</i> ,	Moraceae	1	2.7%
10	<i>Nymphae nuchalii</i>	Nymphaeaceae	1	2.7%
11	<i>Ximenia americana</i>	Olaceae	1	2.7%
12	<i>Portulaca oleraceae</i>	Portulacaceae	1	2.7%
13	<i>Ziziphus spina-christii</i>	Rhamaceae	1	2.7%
14	<i>Celtis toka</i>	Ulmaceae	1	2.7%
15	<i>Grewia abutilifolia</i>	Tilaceae	1	2.7%
16	<i>Adansonia digitata</i>	Bombacaceae	1	2.7%
17	<i>Scadoxus multiflorus</i>	Amaryllidaceae	1	2.7%
18	<i>Solanum incanum</i>	Solonaceae	1	2.7%
19	<i>Annona Senegalensis</i>	Annonaceae	1	2.7%
20	<i>Cissamplose mucronata</i> , <i>Stephenos abyssinica</i>	Menispermaceae	2	5.4%
21	<i>Chlorophytum tuberosum</i>	Anthericaceae	1	2.7%
22	<i>Strychnos spinosa</i>	Loganiaceae	1	2.7%
23	<i>Pyrenacantha kaurabassana</i>	Icacinaceae	1	2.7%
24	<i>Vernonia amygdalina</i> , Bull thistle(<i>Silybum mariacum</i>)	Asteraceae	2	5.4%
25	<i>Saba florida</i> , <i>Carissa spinarum</i> , <i>Acokanthera schimperi</i>	Apocynaceae	3	8.11%
26	<i>Mimosops kummel</i>	Sapotaceae	1	2.7%
27	<i>Sclerocarya birrea</i>	Anacardiaceae	1	2.7%
Total			37	100

It was reported during the study that these plants are consumed for multiple purposes in rural households. The plants are generally used for household consumption as well as for commercial purposes (or income generation) and thereby contribute to the households' socio-economic well-being. Among the identified plants, 47.36% are mainly used as food sources, especially through their fruits and leaves, 42.11% are purely used for medicinal purposes and 10.53% are used for both healthcare and food sources in the area as nutraceutical plant species.

Despite their socio-economic significance, the plants are facing various management threats. Through situational analysis conducted with respondents for comparing the present situation of wild nutraceutical plants with that in the past (10–20 years back), majority of them

(69.2%) indicated that availability of the plants and the overall status of vegetations in the area have declined through time. On the other hand, some respondents (30.8%) mentioned that they have no idea about any increase or decrease of these resources, which could most likely be attributed to the failure of these members of the community to understand changes taking place in their environment. According to the study, there are various threats to the vegetations in the area, which have contributed to the decline in the distribution of these valuable plants. The threats identified include frequent fire, agricultural land expansion and investment, fuel wood collection, timber collection and settlements, and recurrent drought/climate change. Pair-wise ranking was used for ranking the severity of these threats (Table 4).

Table 4. Pair-wise ranking of the Major threats of Nutraceutical plants

Threats in Rows	Threats in Columns					Score	Rank
	AI	FF	FW	TS	Dr		
Agricultural expansion and investments (AI)	--	FF	AI	AI	AI	3	2
Frequent fire (FF)	FF	--	FF	FF	FF	4	1
Fuel wood collection (FW)	AI	FF	--	TS	FW	1	4
Timber collection and settlement (TS)	AI	FF	TS	--	TS	2	3
Drought (Dr)	AI	FF	FW	TS	--	0	5

As can be seen from (Table 4) above, the three top ranking threats for sustainable management of the forest resource of the area in general and of the wild nutraceutical plants in particular are frequent fire, agricultural land expansion and investment activities, and timber collection and settlement.

The study on the management aspect of the wild nutraceutical plants in the area also went further into identifying the habitat types in which the plants are commonly found and accessed by the communities (Table 5). Accordingly, most of the respondents indicated that

they access the wild nutraceutical plants in the dense woodland areas or tree zones, which constitute the proportion of 64.2%, followed by open woodlands, road side plants and bush land with proportions of 25.83%, 15.8% and 13.33% respectively. On the other hand, according to some other studies (Getachew *et al.*, 2005 and Tigist *et al.*, 2006), some of these plants are also collected in the home garden after crops are harvested or in the left over field crops.

Table 5. Summary of Nutraceutical plants Distribution in different Habitat Types

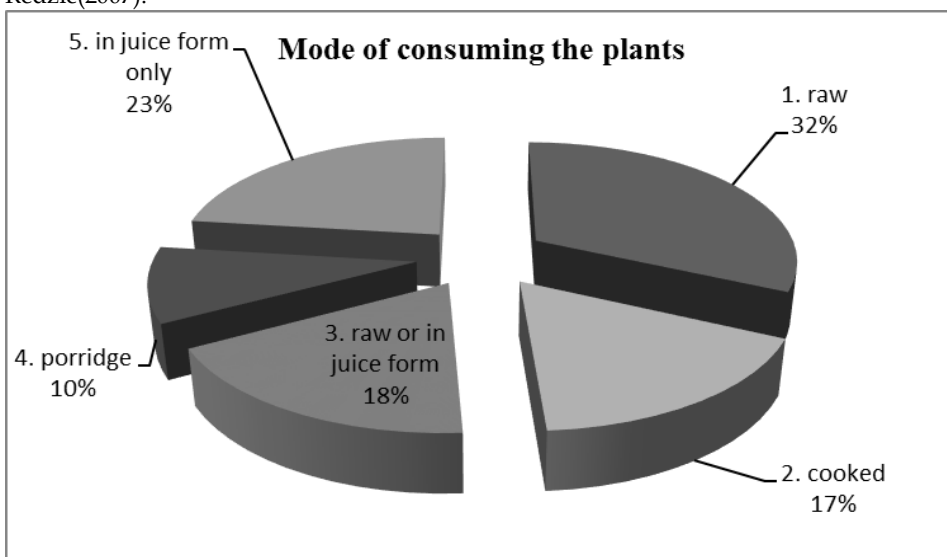
S/N	Habitat type	N = 120	Percent
1	Dense woodland areas or Tree Zone	32	64.2
2	Bush lands	16	13.33
3	Open Woodlands	31	25.83
4	Secondary forests	11	9.2
5	Grazing lands	12	10
6	Road sides	19	15.8

Tree zones are the dense woodland areas; while secondary forests are newly regenerating forests from degraded old forests.

Processing and Utilization of Wild Nutraceutical Plants

The study has identified different modes of consumption of the plants (Figure 2). Accordingly, 32% of the edible plant parts were reported to be consumed raw, 23% in juice forms, 18% has been used both as raw or in juice forms, 17% as cooked or boiled and only 10% as porridge. This research revealed that most of the edible plants such as *Ziziphus spina-christi*, *Tamarindus indica*, *Balanites aegyptiaca*, *Flueggea virosa*, *Celtis toka*, *Ficus sycomorus* are directly consumed as raw. Also *Tamarindus indica*, *Balanites aegyptiaca*, *Adansonia digitata*, were reported to be consumed in juice forms. Redzic(2007).

However, most of the edible leaves of the plants such as: *Creteva adansonii*, *Cadaba farinosa*, *Nymphae nuchalii*, *Amaranthus spinosus*, and *Portulaca oleracea* are consumed cooked/boiled. *Diospyros mespiliformis* fruits are pounded with local mills, cooked and eaten as porridge, but mostly during emergency time. The raw and fresh fruits consumption of most plants in the study area are in agreement with the findings of other research works by Guinand and Dechassa Lemssa (2000); Tigist Wondimu *et al*, (2006); and

**Figure 2.** Consumption Mode of different parts of Wild Nutraceutical plants

In addition to their preparation and mode of consumption, the different parts of the plants used for food and medical care were also identified during the study (Figure 3). Accordingly, it was reported that fruits, leaves, seeds, roots/tubers, barks and stems are the different parts used by local communities as food sources and traditional medicines. The most eaten parts for food are fruits followed by leaves with proportion of 28% and 25% respectively. Whereas rural people usually consume wild fruits on a regular basis, most leafy wild edible plants draw attention mostly during critical food shortages as in famine periods according to (Zemede Asfaw and Mesfin Tadese, 2001). In addition to this, parts used for medical care are stem, barks, seeds, leaves, roots and fruits of different plant species. Roots and leaves were reported high in

medicinal use followed by stem and barks among the mentioned plant parts. This reveals that the local people in rural areas have more knowledge in using plants in their surroundings. They know which is useful and which is toxic. This knowledge of plants, used to treat different human and livestock ailments by different parts of plants, is in agreement with research finding in Uganda by Godin *et.al.* (2014), which stated that the most frequent parts used for medicine are roots. Despite all these healing capabilities of these useful plants, some of them have negative effects to human, and it was indicated during the study that caution is needed for their use. Elders know them because of their experience about the plants in the area as compared to young men/women. Some of the negative effects as mentioned by respondents are poisons, cause abortion, allergic, and so on.

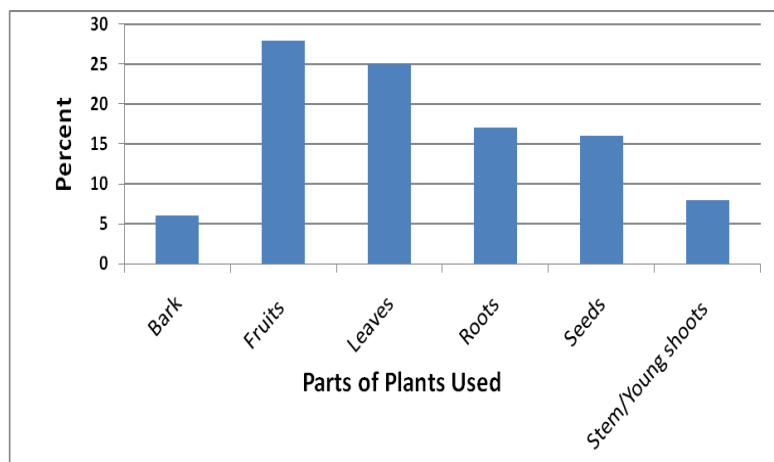


Figure 3. Different parts of Nutraceutical Wild plants for food sources and Health care

However, it was emphasized that majority of these plants are non-toxic, as they are growing in healthier natural ecosystems with less environmental pollution problems. Therefore, they have many positive effects in diversifying local food sources and health care systems as also reported by many scientists in other

parts of the world as well as in the country (Debela Hunde *et al.*, 2014).

Preference ranking was conducted with key informants on the five selected plants (Table 6), with their leaves being edible. The selection was made based on their taste as compared to other plants. The group discussion as well as key

informants' interview revealed that these plants have been used normally in supporting main meals of households. Even those families with good number of livestock consume them sometimes according to key formants. However, they are consumed more on daily basis by those who do not have domestic animals in order to support their main meals in the household.

Ten informants were selected for preference ranking of mentioned plants. Index was given and made available to the ten selected respondents. The values range from 1- 6, which represent less

tasty up to excellent or the most delicious ones recommended by informants. Each key informant was asked individually to name and give value to the selected species based on the plant taste status. According to the informants the wild green leafy plants have high nutritional composition, and preference by the local people. The results revealed that five top plant species are identified for their better taste quality and flavor by the local communities (Table 6). Among these, *Nymphae nuchalii*, *Amaranthus spinosus* and *Portulaca oleracea* were identified as top ranks of first to third respectively.

Table 6. Preference ranking on leaves of useful plants used as food supplements

Species	Respondents Selected(N = 10)										Scor ^e	Rank
	R ₁	R ₂	R ₃	R ₄	R ₅	R ₆	R ₇	R ₈	R ₉	R ₁₀		
<i>Amaranthus spinosus</i>	6	3	4	4	5	5	5	6	6	6	50	2
<i>Cadaba farinosa</i>	6	6	3	5	6	4	5	2	5	1	43	5
<i>Creteva adansonii</i>	6	5	3	4	6	6	4	3	4	5	46	4
<i>Nymphae nuchalii</i>	6	4	4	6	6	6	6	3	5	6	51	1
<i>Portulaca oleracea</i>	5	6	3	6	5	6	6	5	4	3	49	3

On the other hand, summary of the different plant species along with their parts identified for curing various human and livestock diseases are shown in

(Table 7). This medicinal use of the wild useful plants for curing both human and livestock diseases coincides with research reports by Damtew Bekele *et al.*, (2012); and Jasvinder, (2014).

Table 7. Major Medicinal Plants identified for curing both Human and Livestock Diseases

Type of ailments	Plants responsible	Part Used	Use for		N = 120		Proportion %	
			L.S	H	L.S	H	L.S	H
Malaria(head ache)	Tamarindus, reep	L, R, S		x		21		17.5
Coughing	Zizephus spinus-cr	R		x		10		8.33
Gastric	Chagiy, magak	R, L		x		26		21.7
Wounds	Adansonin digitata Thok, pilostigma thoningii	S	x	x	17	10	14.2%	5%
Constipation	Tangloar, thistle	Bull F, S	x	x	22	19	18,33%	15.3

Milk boost up	Tobow, Kooch	L	x	25	20.8%
Delayed umbilical cord	Clatropis procera, Toar	R, B	x	23	19.2%
Stopping adultery	Nhiany, Nomloy	R, L, St	x	16	13.33%
Serious illness	Nhiany	B, L	x	18	15%
Stomach ache	Puth, Miadol,	B, R	x x	13	10.8

L.S = Livestock, H = Human, L = Leaf, S = Seed, R = Root, F = Fruits, St = Stem

It has also been reported by FAO (2014) that the wild Nutraceutical plants have been studied by many scientists in different countries all over the world, and they are known for their contribution to diets and nutrition as well as for health care systems (especially, for sealing the gap of malnourishments). The significance of these plants as sources of traditional medicines is also in agreement with the findings of Bayafers Tamene *et al.* (2000); TilahunTeklehaymanot and Mirutse Giday (2010) in their studies conducted in southern Wello Chefa area and Debub Omo Zones of Ethiopia respectively.

As part of the social dimensions of the communities, the research revealed that wild useful plants collection, processing and utilization vary with gender (Figure 4). The majority of the respondents agreed that even though these plant species are consumed by all household members, they are largely collected and processed by women (56.7%), while men's role is very low with only (17.5%) proportion. Men are less interested in collecting these plants

fearing culture of dishonor in the community. Some of the respondents during the study mentioned that there is a traditional belief among the community members that if a man collects these wild foods, he can be regarded as a man ruled by his wife. Therefore, women are considered as the experts in collecting and processing these plants in the study district as compared to their male counterparts.

The above result on gender role coincides with the research result in Tanzania done by Kajambe *et.al*, (2000), which stated that women are the real experts on the collection, processing and preservation of non-wood forest products for the household foods. Peasant women know the nutritional needs of their families as well as the nutritive content of the wild foods they collect from the bush, since they are responsible for sustaining the livelihood of the family. This indicates how women still play great role in different household activities than men.

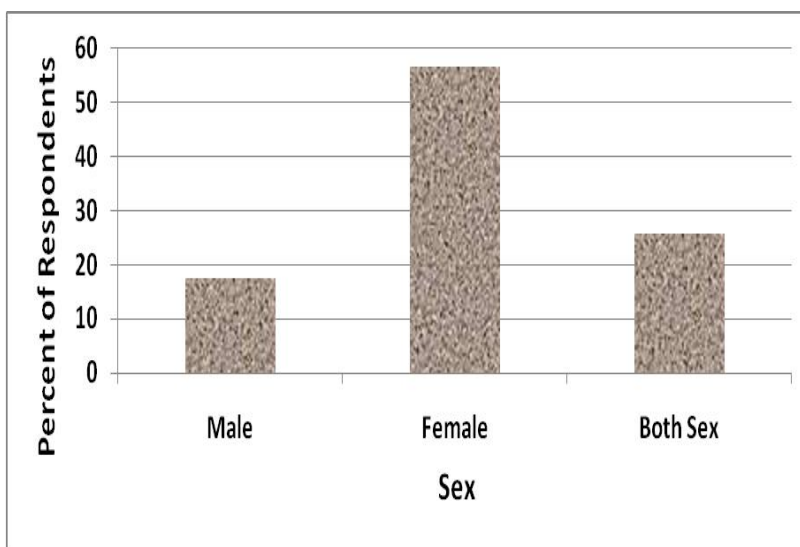


Figure 4. Gender Role in Useful Wild Plants Collection and Processing.

CONCLUSION AND RECOMMENDATIONS

This research work has generally identified 37 multipurpose wild plant species belonging to 27 families and having their own contributions in diversifying food sources and healthcare systems in the area. The plants belong to different habits including trees, shrubs, climbers and herbs. The study also revealed that knowledge about collection, processing and utilization as well as habitat distribution of these multipurpose plant species is still maintained among the study community. The preservation of such knowledge associated with the plants appears to be the result of continuous reliance of local communities on these useful plant species both during normal and food shortage periods. However, there is a decline in the distribution of some of these useful plant species through time. The decline in their distribution is due to the various threatening factors, which include frequent fire, agricultural land expansion and investment, fuel wood

collection, timber collection and settlements.

The study also identified the major habitat types or vegetations where the communities can access these useful plants. These habitat types are dense woodland areas, open woodlands, road side plants and bush lands. Generally, different parts of the plants: fruits, leaves, seeds, roots/tubers, barks and stems are used as sources of food and traditional medicines. As to their processing and utilization, some of these plant parts are consumed raw, whereas some others are taken in the forms of juice as well as porridge.

As recommendations or future lines of work, necessary management interventions should be made for addressing the various threats encountered by these useful wild nutraceutical plants in order to enhance their roles in the overall societal well-being in the area through diversifying food sources and healthcare systems, in addition to their other socio-economic roles. For example, as an attempt to minimize the conversion of woodland vegetations (consisting of the useful wild nutraceutical plants) into other land uses

such as commercial agriculture or other investment activities, it is necessary to undertake environmental impact assessments in order to assess the socio-economic and socio-cultural as well as environmental consequences associated with such conversions.

As some members of the community are not well aware of the changes in the distribution of these plants, it is necessary to work on community awareness creation activities about the decline in the distribution of these useful plants. In addition, it is also necessary to design and implement community-based and participatory management strategies for these plants in order to minimize the various anthropogenic pressures or threats of the resources. In connection with such participatory approaches, encouraging farmers and empowering them to protect and conserve the wild edible and medicinal plants through awareness creation and community sensitization schemes can be considered as parts of the required interventions for improving the management of these plants.

Further studies on the chemical and nutritional aspects of these wild nutraceutical plants in the area are also required for designing more modern ways of their processing and utilization apart from the locally designed processing and utilization systems. Moreover, domestication of some of these plant species under certain situations into the agro-ecosystems, especially those that can provide food during periods of food scarcity or famine in order to improve household food security can also be suggested as another option of enhancing their roles and improving their management.

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REFERENCES

- Azene Bekele-Tessema, Birnie A.Tengnas. 2007. Useful trees and shrubs for Ethiopia identification, propagation, and management for agricultural and pastoral Communities. Nairobi Regional Land Management Unit (RELMA), Sida.PP 474.
- Cotton, C.M. 1996. Ethno botany: Principles and Applications. John Wiley and Sons Ltd. Chichester, England. Cunningham, A.B .1996. Professional ethics and Ethno botanical Research. In; Alexiades, M.N. and Sheldon, J.W (eds).Selected guidelines for Ethno botanical research: A field manual network botanical garden, Bronx, New York, USA 19-51.
- CSA. 2007. Demographic and Health Survey of Ethiopia, Addis Ababa.
- Damtew Bekele, Zemedede Asfaw, Beyene Petros, Habte Tekie. 2012. Ethno botanical study of plants used for protection against insect bite and for the treatment of livestock health problems in rural areas of Akaki District, Eastern Shewa, Ethiopia.
- Debela Hunde Feyssa, Jesse T. Njoka, M. M. Nyangito, Zemedede A. 2014. Nutraceutical Wild Plants of Semiarid East Shewa, Ethiopia: Contributions to Food and Healthcare Security of the Semiarid People. A journal article in nutraceutical plants published in 2014.
- Debela Hunde Feyssa, Jesse.T. Njoka, Zemedede Asfaw, M.M.. 2014. Wild edible plants potential to enhance agro-biodiversity and resilience in a changing ecosystem..Afr. agric. For. J. 80(1), 7-15.
- Dechassa Lemessa. 1999. Prosperity Fades: Jimma and Illubabor Zones of Oromia Region. UN- EUE Field Mission Report, 5 to15 October 1999, Addis Abeba.
- Edwards.S; Sebsebe Demissew; Hedberg I (eds).1997. Flora of Ethiopia and Eriteria, (6), Hydrocharitaceae to Areaceae. The national Herbarium, Addis Ababa.
- Ephraim C. 2011. Cultivation and commercialization of indigenous fruit trees to improve household food security in dry regions of Buhara, Zimbabwe.
- Ertug, F. 2004. Wild edible plants of the Bodrum Area (Mugla, Turkey).Turkish Journal of Botany 28:161-174.
- Ethiopian Red Cross society, 2012. Disaster Risk Management and Food Security.
- FAO. 2014. Sustainable Natural Resources Management in Africa's Urban Food and Nutrition Equation 28 (2).
- Getachew Addis, Kelbessa Urga, Dawit Dikasso.2005. Ethnobotanical study of edible indigenous plants in some selected districts of Ethiopia. *Hum. Ecol.* 33(1):83-118.
- Getachew Olani. 2001. Food source diversification: potential to ameliorate the chronic food insecurity in Ethiopia. In Kenyatta C,Henderson A (eds). The potential of indigenous wild food.Workshop proceedings, Sudan.United for international Development.
- Godin Anywar, Hannington Oryem-Origa and M. K.M, 2014. Wild plants used as a nutraceuticals from nebbi district, Uganda European Journal of Medicinal Plants 4 (6): 641-660, 2014
- GRSBoLR. 2011. Gambella Regional State, Bureau of Land Resources and nvironmental Protection. Study on livelihood activities, forestcover and climate change in the multi-stake holder assessment with the coordination of Oromiya Regional State Land Resources and GIS group.
- Guinand Y and Dechassa Lemessa. 2000. Wild food Plants in Southern Ethiopia; Reflections on the role of 'famine foods' at the time of drought, UNEUE Survey, January 2000, Addis Ababa.
- Hedberg I, Edwards S (eds). 1995. Flora of Ethiopia and Eritrea, Volume 7, Poaceae

- (Gramineae). The National Herbarium - Biology Department - Science Faculty - Addis Ababa University - Ethiopia, and The Department of Systematic Botany - Uppsala University - Sweden, Addis Ababa and Uppsala.
- Jasvinder K.S. 2014. Nutraceuticals and functional foods: an innovative approach for management of lifestyle diseases.
- Kajambe, M.I. Mwendu, J.S. Mgoo, and H.R. 2000. Potential of Nonwood Forest Products in household food security in Tanzania: the role of gender based local knowledge.
- Kalayu Mesfin, Gebru Tekle, Teklemichael Tesfay. 2013. *Ethno botanical Study of Traditional Medicinal Plants Used by Indigenous People of Gemad District, Northern Ethiopia*.
- Kebu Balemie; Fassil Kebebew. 2006. Ethno botanical study of wild edible plants in Derashe and Kucha Districts, South Ethiopia. *J. Ethnobiol Ethnome* 2:53.
- Kent, M. and Coker .P. 1992. *Vegetation Description and Analysis: A Practical Approach*. John Wiley and Sons, London.
- Kothari C.R. 2004. *Research Methodology, Methods and Techniques*; University of Rajasthan, Jaipur India. Krejcie, R.V. and Morgan, D.W. 1970. Determining sample size for research activities. *Educational and Psychological Measurement* 30: 607-610.
- Martin, G.J. 1995. *Ethno-botany Method Manual*. World Wide Fund for Nature (International) Champain and Hail, Ltd, LndonUk, 268.
- Mesfin Tadesse and Hedberg I. 1995. *Flora of Ethiopia and Eritrea*, 2 (2). The National Herbarium, Addis Ababa.
- Mohamad Arshaq and M.A. 2004. ethno-botanical study of Gallyat for botanical demography and biological diversification.
- Oz, 2010. *Let Food be Your Medicine, and Medicine be your Food*.
- Paul Gatluak Puldeng, Debela Hunde Feyssa, Wubshet chala. 2012. Benefits Gained from Woodland Resource Uses: The Cases of Lare District, Gambella Regional state of Ethiopia.
- Redzic, S. J. 2006. Wild Edible Plants and Their Traditional Use in the Human Nutrition in Bosnia-Herzegovina. *Ecology of Food and Nutrition*. 45 (3): 189 - 232.
- Tena Regassa, Ensermu Kelbesa and Zemed Asfaw. 2014. *Ethno botany of Wild and Semi-Wild Edible Plants of Chelia District, West-Central Ethiopia*.
- Tesfaye Awas. 2007. *Plant Diversity in Western Ethiopia: Ecology, Ethno-botany and Conservation*. A dissertation presented for the Degree of Doctor of Philosophy; University of Oslo, Norway.
- Tigist Wondimu; Zemed Asfaw, Ensermu Kelbessa. 2006. Ethno-botanical study of food plants around Dheeraa town, Arsi, Ethiopia. *Sinet: Ethiop. Journal of science*. 29(1): 71-80.
- Tilahun Teklehaymanot, and Mirutse Giday. 2010. Ethno-botanical study of wild edible plants of Kara and Kewego semi pastoralist people in Lower Omo River valley, Dehub Omo Zone, SNNPR, Ethiopia. *Journal of Ethno-biology and Ethno-medicine* 2010, 6: 23.
- WHO. 2013. *The Role of Forests, Trees and Wild Biodiversity for Nutrition Sensitive Food Systems and Landscapes*.