Research Article **IJFNR (2017) 1:9**

International Journal of Food and Nutrition Research
(ISSN:2572-8784)

Nutraceutical Wild plants and their Socio-economic Contributions to Households in Lare Woreda, Gambella Regional State, Southwest Ethiopia

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ABSTRACT

An ethno botanical study was conducted in Lare woreda (district) of Gamella Regional State of Ethiopia with the objective of identifying the existing nutraceutical plant species having various socio-economic significances for households in the area. The study has given special emphasis on assessing the roles of these plants in diversifying food sources and healthcare of the local communities. In addition, other socio-economic benefits of the identified plant species to the rural households were also studied. 120 households from three representative administrative Kebeles were selected and interviewed using semi-structured questionnaire. In addition to household interview, other methods such as focus group discussions, key informants interview, preference ranking, and matrix scoring and ranking were also employed. Thirty seven plant species belonging to 27 families, along with their multiple household benefits were identified. Fabaceae family, which is represented by four species accounted for the largest proportion of these plants followed by Apocynaceae represented by three species. These plant species belong to different habits, which include trees, shrubs, climbers, and herbs with proportions of 31.57%, 22.05%, 5.26% and 41.12% respectively. The multiple household benefits of the plants include their use as wild food sources (especially during seasons of food deficit from the main food crops); as traditional medicines for treating both human and livestock diseases; as well as for other purposes such as fuel wood, construction materials, agricultural tools/implements, provision of shade, handcrafts or furniture making. Frequent fire, agricultural land expansion and investment activities, and timber collection and settlement are the major threats encountered in sustainable management of these valuable plants. Therefore, there is a need to design and implement an all inclusive and community-based management strategies in order to ensure their sustainable management and thereby enhance their socio-economic contributions to the communities.

Keywords: Ethno botanical; Nutraceutical; Socio-economic; Food and Healthcare

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How to cite this article:
Lim et al.,. Nutraceutical Wild plants and their Socio-economic Contributions to Households in Lare Woreda, Gambella Regional State, Southwest Ethiopia. International Journal of Food and Nutrition Research, 2017; 1:9.

eSciencePublisher
eSciPub LLC, Houston, TX USA.
Website: http://escipub.com/

1. INTRODUCTION

Forests and trees are direct sources of food, cash income and a range of subsistence benefits for millions of people worldwide (FAO, 2013). Forests are also sources of everything for the rural people, because they earn most of their livelihoods from these resources. The forest resource generally provides wild foods, medicines and other edible fruits, bush meat, water sources, housing materials, shade, recreation, shelters, and serve as sacred areas in many cultures (FAO and WHO, 2013).

Trees and shrubs contribute to food security directly in the form of fruits, seeds and other edible parts or indirectly by maintaining and restoring soil fertility and water resource which subsequently increase agricultural production. Indigenous trees/shrubs are good sources of fodder in dry land areas as grasses dry out in a short period of time due to short rainy season (Guyassa *et al.*, 2014). Forest provides rural people food during the time of food shortage and when crops fail to sustain the lives of the given peoples living in certain area or when the natural hazards, such as floods and drought hit the environment. Under such occurrences, the options of those living adjacent to forests are to diversify their livelihood to find means of survival by collecting wild foods, edible fruit trees, or other nutraceutical plants found in the wilds (FAO and WHO, 2013).

The term nutraceutical was coined from “nutrition” and “pharmaceutical” in 1989 by Stephen DeFelice, MD, the founder and Chairman of the Foundation for Innovation in Medicine (FIM), in Cranford, New Jersey, United States of America. The definition of nutraceutical can thus be summarized as “any non-toxic food extract supplement that has scientifically proven to have health benefits for both disease treatment and prevention”. It has been generally stated that the health promoting effects of nutraceutical and other functional foods are likely due to biochemical and cellular interactions, which together promote the overall health of an individual (Dlamini *et al.*, 2010).

The most direct way in which forests and trees contribute to food security is through contributions to diets and nutrition (FAO, 1992). Forest foods, such as wild leaves, fruits, roots, tubers, seeds, nuts, mushrooms, saps, gums, and forest animals and their products, such as eggs and honey supplement the foods produced by agriculture and obtained from other sources. Forest foods can assist in coping with seasonal food shortages and shortages due to extreme weather events, natural disasters, human made conflicts and other shocks (FAO, 2013).

From a nutritional perspective, forests and trees offer sources of many micronutrients commonly lacking from diets in developing countries and which have important health and developmental functions (Vinceti *et al*., 2013).

The contribution of local plant foods to reducing health risks has always been recognized as part of the local knowledge which forms a greater part of the complex cultural system. Research has shown that many edible plants are rich in specific constituents, referred to as phytochemicals that may have health promoting effects (Dlamini *et al*., 2014). The major plant-derived chemical groups now recognized as having potential health promoting effects, at least under some circumstances, are the flavonoids, alkaloids, carotenoids, pre- and pro-biotics, phytosterols, tannins, fatty acids, terpenoids, saponins and soluble and insoluble dietary fibers. These phytochemicals have the potential to be incorporated into foods or food supplements as nutraceuticals (Dlamini *et al*., 2014).

Gambella National Regional State of Ethiopia, specifically Lare Woreda (the study district for the present research) has got huge potential for nutraceutical plants having various socio-economic contributions to local communities. These plants can supplement the available food crops and can also substantially contribute to traditional medicine sources for treating both human and livestock diseases. However, no adequate scientific studies have been conducted in the area for generating the required empirical evidences. Therefore, this study was undertaken with the objective of assessing the existing nutraceutical plants and their socio-economic contributions to households in Lare Woreda of Gambella region, situated in southwestern part of Ethiopia.

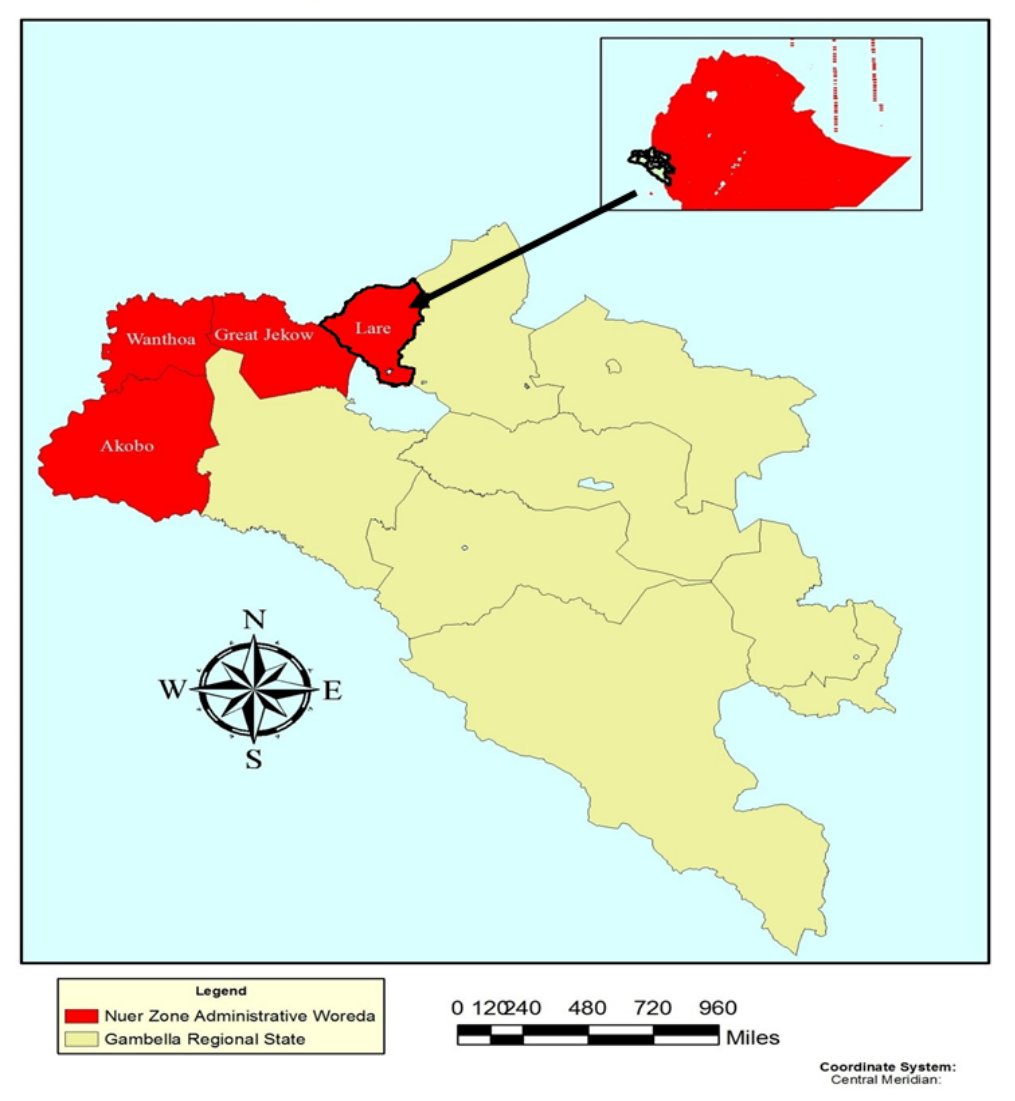

Figure 1. Map of the study District in Gambella Regional State of Ethiopia

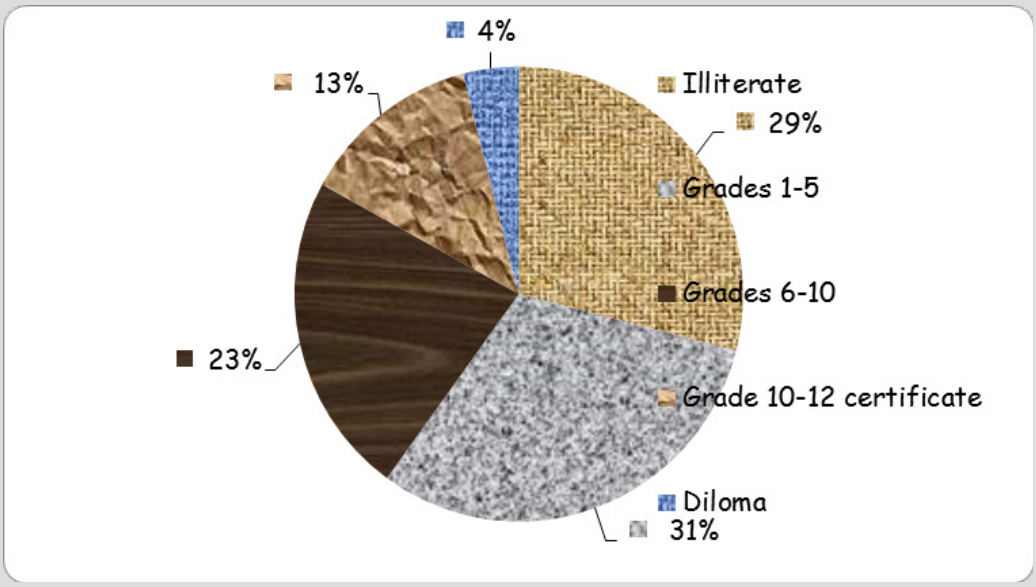

Figure 2. Educational Status of the Respondents

2. MATERIALS AND METHODS

2.1 Description of the Study Area

Gambella National Regional State (GNRS) is one of the National Regional states of the Federal Democratic Republic of Ethiopia (FDRE) located in the southwestern part of the country (Fig. 1). It is located between the geographical coordinates of 6º28′38" to 8º34″ North Latitude and 33º to 35º11′11″East Longitude, which covers an area of about 34,063 km^2. The Region 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, and others.

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 specifically conducted in Lare Woreda, which is one of the 13 Woredas of Gambella Region. Part of the Nuer Zone, Lare is bordered on the south and east by the Anuak Zone, on the west by the Baro River which separates it from Jekow district, and on the north by the Jekow River which separates it from South Sudan. According to the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), this Woreda has a total population of 31,406, of which 16,145 are men and the remaining 15,261 are women.

2.2 Methods of Data Collection

Three representative Kebele Administrations 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. Kebele Administration is the smallest administrative unit under a bigger umbrella of district or Woreda (which is a more broader unit with a number of Kebele Administrations under it). Following a procedure by (Krejcie and Morgan, 1970), a total of 120 respondents (73 males and 47 females) from the three Kebeles were selected to take part in the study using different methods.

Various socio-economic survey methods and ethno-botanical techniques were employed for gathering data on the available nutraceutical plants and their socio-economic contributions to rural households in the study area. These methods and techniques include semi-structured questionnaire for conducting household interview, Focus Group Discussion (FGD), pair-wise ranking, matrix scoring and ranking, transect walk and key informants interview.

Based on the ethno-botanical information obtained from respondents, specimens with their vernacular names were collected for further identification of their scientific names using different trees and shrubs identification manuals of Eritrea and Ethiopia. Useful Trees and Shrubs of Ethiopia (Azene *et al*., 2007) and other Flora books of Ethiopia and Eritrea were used for this purpose.

2.3 Method of Data Analysis

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. Other 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.

3. RESULTS AND DISCUSSIONS

3.1 Household Demographic and Socio-economic Characteristics

Table 1. Wealth Categories and Income Sources of Households (HHs)

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

Table 2. List of Identified Plant Species and their Families

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

Among the sampled households, 73(60.8%) were male and 47(39.2%) were female household heads. The average family size of informants in the area was 7, and the average age of the sampled household head was 41.5 with minimum of 24 and maximum of 60 ages. About 29.2% of respondents did not attend formal education, with the remaining proportions of 30.8%, 22.5%, 13.3% & 4.2% having some educational background from grade one up to diploma level (Fig. 2).

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 nutraceutical plants.

3.1.1 Household Wealth Status and Income Sources

According to respondents, the wealth status of households in the area can be described in terms of three wealth categories (Table 1). These categories include rich, medium and poor (subsistence level) wealth classes. It was indicated during the study that the household wealth categorization is basically based on certain criteria in their own context. The criteria mentioned 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. It was mentioned during the study that one of the coping mechanisms for food shortage, especially for the poor households is to consume wild edible plants.

As shown in (Table 1) above, 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 explained that, most sources of income have been practicing livestock and crop production with some few farmers practicing only crops production. However, 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.

3.2 Ethno botanical information of Identified Plants

A total of 37 nutraceutical plant species belonging to 27 families were identified during the study. The list of these plant species together with their families are indicated in (Table 2). The reported plants consumed for food and medical care belong to different life forms or habits. Accordingly, 31.57% were trees, 22.05% were shrubs, 5.26% were climbers, and the remaining 41.12% were herbs. The study indicated that most fruits (as food supplements) are collected from trees than from shrubs and other life forms. This is in agreement with research done by Assegid Assefa and Tesfaye Abeba (2011), which stated that fruits are harvested mostly from trees than shrubs, but disagrees with the report from Tilahun Teklehaimanot and Mirutse Giday, (2010), Kebu Balemie and Fassil Kebebew, (2006), which discovered that wild edible materials are mostly collected from shrubs. Among the families reported, Fabaceae was found to have the highest species, which are 4 species (10.81%) followed by Apocynaceae family consisting of three species (Table 2).

3.3 Socio-economic Roles of Nutraceutical Plants in Households and their Major threats

It was reported during the study that nutraceutical plants in the area are consumed for multiple purposes in rural households (Table 3). 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.

In addition to the roles of nutraceutical plants

Table 3. Seasonal Availability, Life forms, Habitat Types and Uses of Nutraceutical Plants

S/N	Plant Species		Month of collection	Habitat	Life form	Uses of plant
	Scientific Names	Local Name				
1	*Acacia farinesia* L.(Wild)	Kuech	J, Ju, Aug, S	Shl, Op,	T	3
2	*Acokanthera schimpera* (A. DC.) Schweinf)	Kooch	All months	Ros, Shl, Op	Sh	3
3	*Adansonia digitata* (L.(baobab)	Gaayneen	J F M	Tz, Op	T	5
4	*Amaranthus spinosus* (Linn)	Diong	Ma J Ju N	Hg, Op, Ros	H	4
5	*Annona senegalensis* (Per)	Thok	D, J, Aug	Op, Tz,	T	2,3
6	*Balanites aegyptiaca (*L).Delile	Thow	N, D, J, F	Tz, Ros, Op	T	3,4,5,6
7	*Cadaba farinosa* (forssk*)*	Net	N, D, Ma, J, Ju, S	Shl,Tz, Op,Ros	sh	3
8	*Calotropis procera* (Aiton).W.T.Aiton	Pack	All moths	Ros, Hg,Shl	sh	3
9	*Carissa spinarum (*L)	Chagiy	Ap, Ma, J Ju Aug	Shl, Ros, Op	Sh	x
10	*Celosia trigyna* (L)	Magak	M, J Ju Aug	Ros, Hg, Op	H	x
11	*Celtis toka*(Forssk)	Riek	J, Ju, Aug	Tz, Op,	T	3,4,5,
12	*Chlorophytum tuberosum* Roxb).Baker	Toar	All months	Hg, Shl, Op	H	x
13	*Cissamplose mucronata* (Lam)	depgany	Ma, J, Ju, Aug, S, O	Shl, Op, Ros, Tz	C	4
14	*Creteva adonsonia* (DC)	Kech	Ma, J, J, Aug	Tz, Ros, Op, Shl	Sh	3,4,5,6
15	*Diospyrus mespiliformis*	Minychol	D,J,	Tz, Op,	T	5,6
16	*Euphorbia tirucalli*.(L)	Tobow	All months	Shl, Op,	T/sh	5
17	*Ficus sycomorus* (L)	Gnop	Ap, M, J,	Op,Shl, Tz, Rs	T	3,4,5
18	*Flueggea virosa* (Wild).Voigt	Waak	N, D, J,	Shl, Op, Tz	Sh	3,4,6
19	*Grewia abutilifolia (*Wild)	Poor	J, Ju, Aug	Shl, Op, Tz,	Sh	3,4
20	*Hygrophila auriculata* (Schumach*)*	Thiel	Ja, F M	Op, Ros,Shl	H	3,4

21	*Mimosops kummel* (L)	Puth	All months	Ros, Op, Shl	Sh	3,4
22	*Nyhmpae nuchalii* (L)	Key	N D Ma J Ju	SW	H	x
23	*Piliostigma thonningii* (Schum.) Milne-Redh	Gnoany	Ma,	Shl, Op	T/Sh	4
24	*Portulaca oleraca*.(Linn)	Woor/lumk.	M, J Ju	Op,Hg	H	x
25	*Pyrenacantha kaurabassana* (Bail)	Miadol	All Months	Op, Ros	Sh/H	x
26	*Saba Florida* (Bojer.Pichon)	Nhiany	All Months	Ros, Op, Shl	Sh	x
27	*Scadoxus multiflorus* (Martyn).Raf.	Lew	O, N, D, J	Op, Tz, Shl, Tm	T	x
28	*Sclerocarea birrea*(A. Rich.) Hochst	Kamel	J, Ju	Tz, Op	T	5
29	*Senna Obtusifolia*.(L)	Miaar	N D Ma J, Ju Aug S O	Op, Ros, Shl	Sh	x
30	*Silybum mariacum (*L.Gaertn)	Yong	Ma, J Ju N D	Ros, Hg	H	x
31	*Solanum incanum*.(L)	Tangloar	N D Ja J Ju	Op, Shl, Ros, GrL	H	3
32	*Stephania abysinica* .Dill. & Rich.)Walp.	Mene/kolpiow	All months	Shl, Op	Cl	4
33	*Strychonos Spinosa.* (L)	Kot	Ma J Ju Aug S	Shl, Op, Ros	Sh	3
34	*Tamarindus indica* (L)	Koat	M, J, Ju, Aug, S,	Op, Ros, GrL	T	5
35	*Vernonia amygdalina*.(Del)	Nomloy	All months	Op	Sh	x
36	*Ximenia Americana* (L)	Woleng	D, J, F	Tz, Op, Shl	Sh	3,4
37	*Ziziphus spina-christii* (Willd) Desf.	Buaw	N, D, J	Tz, Ros, Op	T/Sh	3,4,5,6

Habitat Types: Tz = Tree zone, Ros = Road side, Op = Open Woodland, Shl = Shrub land, Hg = Home garden, Sec = Secondary forest, GRI = Grazing land
Life forms/Habits: T = Tree, Sh = Shrubs, C = Climber, H = Herb
Months of the Year; J = January, **F =** February, **M =** March, **Ap =** April, **Ma =** May, **J =** June, **Ju =** July, **Aug =** August, **S =** September, **O =** October, **N =** November, **D =** December
Uses of Plants: 1= Food, 2= Medicine, 3= Fuel wood, 4= Construction & Agricultural tool, 5= Shade, 6= Handcrafts or Furniture making, X= None

as food sources and their medicinal values, it was indicated during the study that they have got other socio-economic significances in terms of supplying various local products and environmental services. These products and services include fuel wood, construction materials, agricultural tools/implements, provision of shade, handcrafts or furniture making. Generally, the plant species locally used for various socio-economic purposes are summarized in (Table 3).

In addition to the substantial socio-economic contributions of the wild nutraceutical plants in the area, the study has also identified various human-induced or anthropogenic factors threatening the sustainable management of the plants and the overall forest resources in which these plants are distributed. Accordingly, the reported threats by respondents include: frequent fire, agricultural land expansion and investment activities, timber harvesting and settlement in the forest, and fuel wood collection.

3.3.1 Seasonal Availability, Life forms and Habitat types of Nutraceutical Plants

The study has shown that the edible plant parts are gathered from the wild at different times of the year. Some are collected in 'Bega' ('May' in Nuer Language, which means dry season), and others are collected 'Kiremt' ('Ruel' and Tot' in Nuer, which means rainy season). Because of their fruiting time variability and seasonal availability, more of the wild edible plant parts are gathered and consumed from December to March and May to July. While, the smallest number of wild edible leafy plants were gathered in November and in September as the amount of rain fall decreases during this time. This depends up on the climatic condition and adaptation of these useful plants in the study area. Most of green leafy nutraceuticals are available only during rainy season and when humidity is available whereas edible fruits from trees as well as shrubs flowered almost during and after rainy periods. In addition to the mentioned growth forms, vegetative parts were reported by informants to be harvested after rain fall stopped. The period of their harvest was said to be "Jiom" in Nuer, means beginning of dry season, mostly starting from the end of October up to December. Thus, this result indicates that the local people exactly know when the wild edible plants produce their edible parts in their surroundings.

Generally, as the fruiting and ripening seasons of the wild fruits appear to vary among the different localities due to climatic and ecological variations, this research also revealed the same finding which has been observed to exist in the area as reported by informants. Some species ripe at narrow ranges of time such as *Grewia abutilifolia, Ziziphus spina-christii* and many other more, which flower from October and ripe early in November to December; others stay longer at fruiting (eg. *Tamarindus indica, Balanites aegyptiaca*), flower starting from May and July respectively, and *Tamarindus indica* produces un-ripe fruits from July which were reported to be eaten as a snack as well as treating malaria ailments, according to respondents.

Some plant fruits also ripe twice per annum for instance *Ficus sycomorus*. As a result of this, some fruits are available almost throughout the year as compared to the plants used for their leaves, and the majority of them ripe from December to January and a few produce fruit in November. This variation of seasonal availability of the edible plants was reported as advantageous to the local community in the area. This was because, there are seasons in which the main food crops in the area are not adequate, so that, local people turns or support their small available food with these plants. Two bad or hardship seasons were mentioned by informants, "Jiom" (beginning of dry season) and "Ruel" (beginning to mid of rainy season). At these periods, especially starting from November to January in jiom season and May to June in on set of rainy season people go to river side and up land of Lare for the purpose of preparing their field crops to sow new upcoming food crops. During these periods, it was mentioned that the main cultivated food crops are exhausted or nearly goes empty. At this time edible fruits and vegetative parts of nutraceutical plants are consumed too much, according to respondents. This coincides with the finding of Getachew Olani (2001) which stated that most parts of Ethiopia face challenge of food shortage from July to September, the time stored crops go empty and newly sown ones are unready to help.

Table 4. Summary of Nutraceutical plants Distribution in different Habitat Types

S/N	Habitat type	N = 120	Percent
1	Dense woodland areas or Tree Zone	3 2	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 forest areas; while secondary forests are newly regenerating forests from degraded old forests.

Table 5. Matrix Scoring and ranking of the Major Nutraceutical Plant Species

Criteria/Use	Plant Species preference Scoring & ranking								score	ranks
	1	2	3	4	5	6	7	8		
Edibility	4	4	3	4	2	4	2	4	27	1
Medicine	1	3	1	0	0	0	0	3	8	7
Fuel wood	3	0	0	2	2	0	4	4	15	4
Construction	4	0	0	2	3	0	3	4	16	3
Agricultural tool	4	0	0	1	1	0	0	4	10	6
Furniture	3	1	1	0	2	4	2	0	13	5
Shade	3	4	4	4	4	2	0	1	22	2
Total	22	12	9	13	14	10	11	20		
Rank	1	5	8	4	3	7	6	2		

Major Plant species Ranked: 1 = *Balanite aegyptica*, 2 = *Tamarindus indica*, 3 = *Ceiba pantandera*, 4 = *Celtis toka*, 5 = *Ficus sycomurus*, 6 = *Diospyrus mispiliferia*, 7 = *Fluegea virosa*, 8 = *Ziziphus sphinus-cristii*.

Table 6. Medicinal Plants and their parts for curing both Human and Livestock Diseases

Type of ailments	Plants responsible	Parts 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		8.3
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, Bull thistle	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, B=Bark

Most of the respondents indicated that they access the 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 (Table 4). On the other hand, some are also collected in the home garden after crops are harvested or in the left over field crops, which is in agreement with other studies by (Getachew *et al.*, 2005 and Tigist *et al.,* 2006).

1.1.2 Local People's Species Preference of Nutraceutical Plants

Species preference of Nutraceutical Plants by members of local communities was assessed by using matrix scoring and ranking (Table 5). The scoring and ranking were done on the bases of certain desirable criteria identified by respondents for evaluation of the major Nutraceutical Plants known in the area to have multiple socio-economic purposes. Accordingly, 7 use criteria with five values given from 0-4 (0= not used, 1= least used 2= good, 3= very good 4=excellent) were used.

The top ranked plants were *Balanites aegyptica* with first rank, followed by *Ziziphus sphinus-cristii* and *Ficus sycomurus* with second and third ranks respectively.

Different parts of Nutraceutical Plants having medicinal values for curing ailments of both human and livestock were also identified during the study (Table 6). For instance, it was mentioned by respondents that roots of *Ziziphus sphinus cristii* are believed to heal coughing; while roots of C*lotropis procera* and C*hloropytum tubersome* are reported to be used for removing the delayed umbilical cord from the domestic cows. In addition, seed and fruits of *Solanium inocanum* are traditionally used to heal constipation. This indicated that local people heavily rely on these plants for traditional medicines as they are cheap and easily accessible, which is in agreement with the findings of (Bayafers *et al*. 2000; and Tilahun and Murtise, 2010) in the studies conducted in certain parts of Ethiopia: Northern Wello, Chefa area and South Omo Zone respectively.

4. CONCLUSION AND RECOMMENDATIONS

The study has generally identified 37 nutraceutical plant species having multiple socio-economic purposes in the rural households. The plants have got different life forms or habits as trees, shrubs, climbers, and herbs. The different parts of these plants such as fruits, leaves, roots and stems are used as wild food sources and traditional medicines (for treating both human and livestock diseases); as well as for serving various household needs.

The different habitat types or vegetation types from where the communities access and utilize the nutraceutical plants were also identified during this study. These habitats are dense woodland areas or tree zones, open woodlands, bush lands, secondary forests, grazing lands and road side plants. Moreover, the study also clearly indicated that the time of harvesting and frequency of use of these plant species vary depending on fruiting times variability and also variability in the seasonal availability of their different products. As the availability and harvest of these plants match with seasons of serious food shortage from stored major crops when the newly grown crops are also not ready for harvest, the wild edible plant species are the alternative food sources (especially for the poor members of the community in the study area).

Despite such well recognized socio-economic significances of the nutraceutical plants in the area, there are various human-induced or anthropogenic factors threatening the sustainable management of these plants and the overall forest resources considered to be the potential sources of the plants. Frequent fire, agricultural land expansion and investment activities, timber harvesting and settlement in the forest, and fuel wood collection were identified as the major threatening factors.

In order to address the major threats identified and thereby enhance the socio-economic contribution of the nutraceutical plants, different recommendations in connection with the threats are required as future lines of work. Forestry and environmental protection professionals, as well as other concerned natural resources experts should take part in environmental impact

assessments associated with any investment activities proposed in the area. The existing regional (Woreda) decision makers and NGOs should design an all-inclusive and participatory management strategy that involves the local people in managements of these plants in order to minimize the anthropogenic pressures or threats of the resources.

Chemical and nutritional aspects of the nutraceutical plants need to be studied further in the area for better consumption in addition to local traditional food sources and healthcare services. Moreover, it is necessary that the use and management of these plants are integrated with the agricultural development activities in order to create the desired level of harmony among the activities.

Under certain situations, domestication of the species, which are known to have high socio-economic and cultural as well as environmental importance into the agro-ecosystems, especially those that provide food during periods of food scarcity or famine in order to improve household food security can also be suggested as another option.

In addition, encouraging farmers to protect and conserve edible and medicinal wild plants through awareness creation and community sensitization schemes can also be considered as parts of the required interventions for improving the management of these plants.

ACKNOWLEDGEMENTS

The authors are grateful to Jimma University, College of Agriculture and Veterinary Medicine (JUCAVM) and Gambella Agricultural Research Institute (GARI) for their financial support and for the overall facilitation of the research work.

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