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Original Research

Ethnobotany of Wild and Semi-Wild Edible Plants of Chelia District, West-Central Ethiopia

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Abstract

This study was aimed at carrying out ethnobotanical investigation of wild and semi-wild edible plants (WSWEPs) involving documentation and analysis of the associated indigenous knowledge in Chelia District, West-Central Ethiopia. Semi-structured interviewing, direct matrix ranking, focus group discussions (FGDs), and guided field walks with informants were employed to collect qualitative and quantitative data. A total of 58 WSWEPs species classified into 48 genera and 30 botanical families were documented. The Moraceae with five species (16.66%) and Asteraceae with four species (13.33%) were the most represented families with high number of wild edible plant species. However, *Urtica simensis* (Urticaceae) (74.3% of informants), *Chionanthus mildbraedii* (Oleaceae) (68.4% of informants), *Carissa spinarum* (Apocynaceae) (66.1% of informants) and *Ficus sur* (Moraceae) (65.3% of informants) were the highly cited wild food plants. Most of the WSWEP species were shrubs represented with 21 species (36.20%) followed by trees and herbs with 18 species each (31.03% each) and liana with one species (1.72%). About 13.33% of the WSWEPs of Chelia District were endemic to Ethiopia. The average number of WSWEPs reported by women was more than that reported by men, and similarly senior members of the community also reported significantly higher numbers of edible species than younger members ($P<0.05$). The key informants reported significantly higher mean number of edible species of WSWEPs than the general informants ($P<0.05$). Women (80.1 ±1.6%) and children (76.1 ±2.3%) were the major gatherers followed by men (13.2±2.4%) and all household members (12.9 ±1.3%). The majority of respondents (77.4 ±2.1%) reported that WSWEPs were consumed by all household members followed by women (23.1± 2.2%), elders (15.8 ±2.3%), children (19.4 ±1.6%) and men 8.2±2.1%). Most inhabitants predominantly consumed fruits (40%) and fresh leaves (17.5%) followed by shoots (12.5%). Based on multipurpose criteria, *Cordia africana, Vepris dainellii* and *Chionanthus mildbraedii* were the most commonly used multipurpose species. Forests were the major reservoirs contributing 19 species (18%) of WSWEPs followed by woodland and disturbed bushland adding 28 species (17%) and river banks contributing 26 species (16%). Our analysis also showed that agricultural expansion was identified as a major threat to WSWEPs followed by overgrazing and fuelwood collection in the study area. In light of our findings, we recommend further research on the possibility of adapting, growing and intentionally managing some of the commonly consumed WSWEPs as well as on the toxicity and nutritional composition of these plants to ensure safety of consumption and economic benefits.

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INTRODUCTION

From immemorial times, people have depended on plants or plant parts to satisfy their hunger and meet their nutritional requirements. Utilization of wild and semi-wild edible plants (WSWEPs) as a food source is an integral part of the culture of indigenous people around the world (Tilahun Teklehaymanot and Mirutse Giday, 2010). WSWEPs provide staple and supplementary foods, as well as cash income to local communities, thus favouring food security. However, WSWEPs are largely ignored in land use planning and implementation, economic development, and biodiversity conservation (Uprety *et al*., 2010). Local people, from their own experience, know about the importance and contribution of WSWEPs to their daily diet, as well as being aware of the possible health and environmental hazards (Diress Tsegaye *et al*., 2007).

Many at risk populations in developing countries are deficient in iodine, iron, and vitamin A, making them more vulnerable to illness, fatigue, blindness, and memory loss and increasing the possibility of mental retardation among their children. This is true also in the case of Ethiopia

mainly due to cereal based food habit, which largely affects children in most parts of the country. Supplementation, food fortification, dietary diversification, nutrition education and food production are strategies that have been developed to reduce these micronutrient deficiencies and have, for the most part, demonstrated positive, though uneven, results (Workneh Ayalew *et al*., 1999). On the other hand, it has been reported that wild edible plants are the cheapest source of vitamin A, C, minerals and fiber but still people fail to consume enough to meet their nutrient requirements due to lack of knowledge in the nutritional value and production of those vegetables in the easiest way (Dandena Gelmesa, 2010).

WSWEPs have been a focus of research for many ethnobotanists in recent decades. Currently, there is renewed global interest in documenting ethnobotanical information on neglected WSWEPs (Bharucha and Pretty, 2010). Since traditional knowledge on WSWEPs is being eroded through acculturation and the loss of plant biodiversity along with indigenous people's knowledge and their cultural background, promoting research on wild food plants is crucial in order to safeguard this information for future societies (Zemede Asfaw, 2009).

A considerable array of literature is available worldwide on WSWEPs ethnobotany with an emphasis on field surveys and documentation, to cite but a few: Amare Getahun (1974); Zemede Asfaw and Mesfin Tadesse (2001); Pieroni *et al*. (2002); Ertug (2004); Reyes-Garcia *et al*., (2005); Kebu Balemie and Fassil Kibebew (2006); Tardio *et al*. (2006); Arenas and Scarpa (2007); Rashid *et al*. (2008); Fentahun Mengistu and Hager (2008); Aryal *et al*. (2009); Zemede Asfaw (2009); Mirutse Giday *et al*. (2009); Tilahun Teklehaymanot and Mirutse Giday (2010); Paul *et al*. (2011); Assegid Assefa and Tesfaye Abebe (2011) and Getachew Addis *et al*. (2013). Moreover, research on nutritional value and health benefits of WSWEPs has been reported by Grivetti and Ogle (2000); Ohiokpehal (2003); Heinrich *et al*. (2005); Termote *et al*. (2009, 2010), De Caluwé (2010); Beluhan and Ranogajec (2010); Debela Hunde Feyssa *et al*. (2011); Ermias Lulekal *et al*. (2011); Mahapatra *et al*. (2012); Hegazy *et al.* (2013) and Getachew Addis *et al*. (2013). Despite the wide utilization of WSWEPs in Ethiopia, ethnobotanical information regarding local knowledge of these plants is very scanty. Available research information on Ethiopian WSWEPs represents only about 5% of the country's Districts indicating the need for further ethnobotanical research addressing unexplored regions of the country (Ermias Lulekal *et al*., 2011). Hence, the current study was aimed at carrying out ethnobotanical investigation on WSWEPs and subsequent documentation of indigenous knowledge associated with these plants in Chelia District of West-Central Ethiopia.

MATERIALS AND METHODS

Description of the Study Area

The study was conducted in Chelia District, Western Shewa Zone of Oromia Regional State, Ethiopia (Figure 1). According to the 2012 national census report (CSA, 2012), the human population of the District is 182, 262 of which 91,255 are males and 91,007 are females. The District has a total area of 920.63 Km^2 and 198.0 people live per square kilometer of the District (CSA, 2012) and is divided into 21 rural and three urban kebeles (the lowest administrative unit in Ethiopia). The study District lies approximately between latitudes 9^0 02` and $9^0$ 01` North and longitudes 37^0 25` and 37 $^0$16` East. The District receives a maximum mean annual rainfall ranging between 157.2 mm and 185.1 mm whereas the lowest mean annual rainfall was 13.5 mm recorded in January. The lowest mean temperature over twenty three years was 9.0ºC recorded in December, and the highest was 24.41ºC recorded in February (Fig. 2). Chelia District covers highland and semi-highland areas with altitudes ranging from1300 to 3060 m.a.s.l. (CWARDO, 2013).

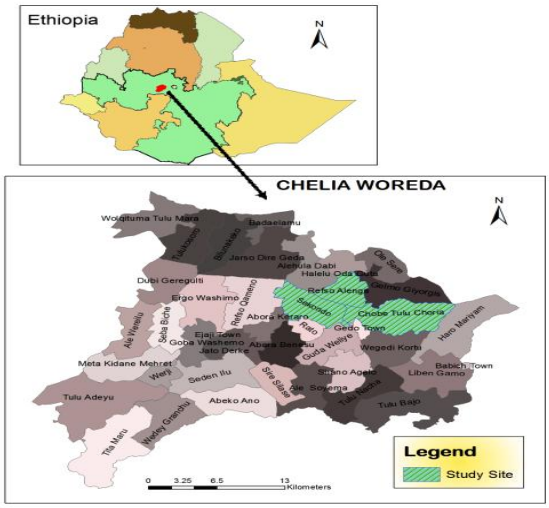
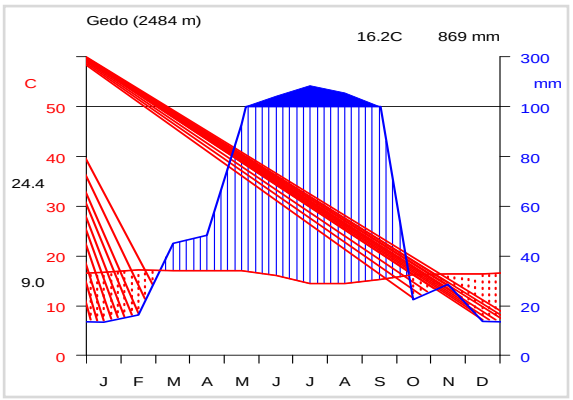


Figure 1: Map of Ethiopia showing Regions and the geographical location of Chelia District



Data Source: NMA (2013)

Figure 2: Clima diagram showing rainfall distribution and temperature variation from 1991-2013 at Gedo Metrological station.

People of Chelia District and their Economic Activities

The majority of the inhabitants overwhelmingly rely on subsistence agriculture, which is dominated by the cultivation of grain crops and animal husbandry. However, despite their neediness, the people have strong principles and are proud of their culture, religion, ethnicity and identity. The majority of the inhabitants belong to the Oromo ethnic group (97.57%) followed by Amhara (1.82%) and others (2.43%). Protestant Christianity is the dominant religion (85%), followed by Orthodox (32%), Traditionalist (5.48%), Muslim (5.28%), Catholic (2.02%) and others 0.08% (CSA, 2007). The illiterate population (unable to read and write at five years of age and older) make 59.8% of the total population of the same age group in the District. The literacy status of the population of the District was 40.2 (CSA, 2007).

Site Selection and Sampling

The study District and three kebeles (hereafter study sites) (Sokondo, Rafso Alanga and Chobi Tulu Chori) were selected following purposive sampling method. The selection of these study sites was influenced by the fact that they had better vegetation cover and because they near to urban centers (Figure 1). A total of 290 households (HHs) (192 male headed and 98 female headed HH; age range of the HH heads were between 26 and 90 years old; 105 were between 26–44 whereas 185 were ≥ 45 years old) from the three sites were chosen for the HH survey following the method described by Krejcie and Morgan (1970). According to this source, for a finite population, a representative sample size can be calculated using the equation:

$$\text{Sample size}=X^2\,NP(1-P)/\,C^2(N-1)+X^2P(1-P)$$

Where: X^2= A constant value of 3.841 (the square of the Z value of 1.96 for 95% confidence level); N= the population Size; *P*=The population parameter of 0.5 and C=A 95% confidence interval (0.05), a probability that the samples represent the population

To select 290 HHs, first a total unordered list of 1179 HHs was received from the three study sites (kebeles' Registrars) and using systematic random sampling method where every 4th HH was chosen for inclusion in the sample starting from 3rd HH in the list. Only one member of the HH was asked to participate in the research. Twenty (eleven women and nine men) HHs/informants were identified as key informants using purposive sampling methods based on their knowledge of plant use. The key informants were nominated by elderly and knowledgeable people in the community. The list has no order in order to ensure random selection of individual HHs except the 3rd one.

Method of Data Collection and Analysis

The ethnobotanical study was carried out in six different field trips made between 15 October 2011 and 9 March 2014 to the study sites. Qualitative and quantitative data and plant specimens were collected based on methods given by Martin (1995); Cotton (1996); and Alexiades (1996). Accordingly, semi-structured interviewing, direct matrix ranking, focus group discussions (FGDs), and guided field walks with informants were employed.

Prior to administration of the questionnaire, conversations with the informants were held with the assistance of local authorities (development & health agents and Farmers' association representatives) to elaborate the objectives of the study and build on trust with the common goal to document and preserve the knowledge on WSWEPs. Objectives and methods were approved in all study sites and concerned government offices and letters of permit were sought. Oral consent of each interviewee to be interviewed and photographed was necessary were also sought.

Interviews and discussion issues (a pre-tested structured data collection format containing open- and close-ended questions) were prepared in English in advance and translated into *Afan Oromo* (language of the study community). Then it was administered to each identified informant directly by the first author (hereafter the researcher) in a face-to-face interview and run independently for each informant and then completed. Interviews varied in duration according to the degree of knowledge of WSWEPs of each interviewee. Interviews took place in the place of respondents' choice, this being their homes and some times in the field. Interviews addressed issues regarding the name, age, sex, level of education, occupation, religion and ethnicity of informants. Moreover, informants were asked to name the WSWEPs they gather, the main gatherers, the parts consumed, preparation, main consumers and consumption pattern, habitat/collection niches of the species, degree of management (wild/cultivated), other uses of WSWEPs, existing threats and traditional conservation practices (if any) following the methods used by Cotton(1995); Alexiades (1996); Balick and Cox (1996). All semi-structured interviews were followed by independent guided field walk which involved a combination of observation, discussion, and interviewing key informants and other local people along the walk focusing on the availability, use and management and the practical identification of WSWEPs in the natural setting. In addition, three FGDs consisting of eight to ten individuals were used to prove the reliability of the data collected through semi-structured interviews as recommended (Alexiades, 1996).

Data on use diversity of multipurpose WSWEPs were evaluated by direct matrix ranking exercise as described in Cotton (1996) that involved fifteen key informants (eleven men and four women). The same key informants also participated in a preference ranking exercise in the manner recommended by Martin (1995) to identify perceived threatening factors of WSWEPs in the area.

Data on informants' backgrounds and WSWEPs used in Chelia District were entered in an Excel spreadsheet software (Microsoft Corporation, 2007) and organised for statistical analysis. Traditional knowledge dynamics on use of WSWEPs by men and women, young to middle aged (20–44 years) and elderly (45–90 years); literate (completed at least primary education) and illiterate; knowledgeable (key) and general informants were compared using two-tailed t-test and one way ANOVA at 95% confidence level between means using MINITAB Release 14.13.0. statistical package. Descriptive statistics were also applied to identify the number and percentage of species, genera and families of WSWEPs used, their growth forms, proportions of parts harvested, modes of preparation and consumption patterns, habitat, main gatherers and consumers in the same manner as described by Agea *et al*. (2011).

RESULTS

Taxonomic Diversity of WSWEPs

A total of 58 WSWEPs species were gathered and consumed in the study area. These belong to 48 genera and 30 families. The family Moraceae was represented by the highest number of species (five species, 16.66%) followed by Asteraceae that contributed four species (13.33%). Acanthaceae, Commelinaceae, Cucurbitaceae, Lamiaceae and Rosaceae that were represented by three species each (10%). Eleven of the remaining families were represented by two species each (6.66% each) and the last remaining twelve families were represented by one species each (3.33% each) (Figure 3). However, based on frequency of individual plant citation (FPC), *Urtica simensis* (Urticaceae) was accorded the highest value (74.3%) followed by *Chionanthus mildbraedii* (Oleaceae) (68.4%), *Carissa spinarum* (Apocynaceae) (66.1%) and *Ficus sur* (Moraceae) (65.3%) (Table 1).

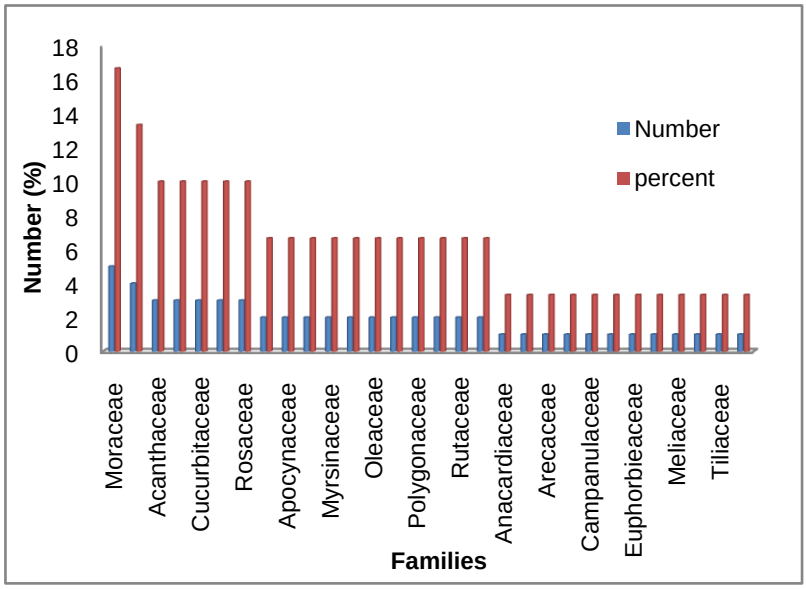


Figure 3: Taxonomic diversity of WSWEPs of Chelia District

Hence, 60% of the families were represented by more than one WSWEPs. Identified growth forms of WSWEPs indicated that 21 species were shrubs (36.20%) were dominant than trees and herbs which were represented by 18 species each (31.03% each) and liana was represented by a single species (1.72%). Of the 58 WSWEPs, have been found to be endemic to Ethiopia while one is near endemic, occurring in one of the neighboring countries, Eritrea (Table 1).

Table 1: Habit, habitat, parts used, collection, preparation, mode of consumption, and other local uses of WSWEPs of Chelia District

Plant name (scientific)	Family	Local name	Hb	Ha	Parts used	Collection, preparation and modes of consumption	OLU	FPC (%)	VN
Acacia abyssinica Hochst. ex Benth.	Fabaceae	laftoo	T	5,7	Gum/exudates	Raw gum chewed by children for being tasty	Tk , Co,Tm Fu,Sd,	12.5	TR037
Acanthus polystachius Delile	Acanthaceae	kosoruu	Sh	2,9	Inflorescences	The nectars from flowers sucked by children	Fu , Tm	23.2	TR006
*Acanthus sennii** Chiov.	Acanthaceae	kosoruu	Sh	2,9,6	Inflorescences	The nectars from flowers sucked by children	Fu , Tm	18.9	TR213
Acokanthera scbimperi (A. DC.) Schweinf.	Apocynaceae	qararuu	Sh	5,3	Fruit	Ripe fruit eaten raw	Fu, Co, Tm , Bf	9.4	TR156
Amaranthus caudatus L.	Amaranthaceae	Eyasu	H	6,9	Seeds, young shoots	Seeds were used as famine food (historical) and also they are used in making local beer (tella), young shoot is cooked & used as vegetables	Tm, Bf	8.7	TR029
Artemisia abyssinica Sch. Bip. ex A. Rich.	Asteraceae	Kodoo	H	2,6.9	Leaves	Leaves commonly boiled with milk to improve milk quality	Tm , Cr	5.6	TR104
*Bidens pachyloma** (Oliv. &Hiern.) Cuf.	Asteraceae	kello	H	2,9	Shoots	Young shoot & leaves chopped, cooked & eaten as vegetables (Famine food)	Tm , Fo	16.3	TR265
Bridelia micrantha (Hochst.) Baill.	Euphorbieaceae	Rigaa arba	T	3,5	Fruits	Ripe fruit eaten raw		21.1	TR078
Canarina abyssinica Engl.	Campanulaceae	xuxoo	H	5,7	Fruits	Ripe fruit eaten raw	Tm , Bf	5.9	TR045
Carissa spinarum L.	Apocynaceae	agamsa	Sh	4,7	Fruits	Ripe fleshy fruit eaten raw	Tm , Co	66.1	TR314
Chionanthus mildbraedii (Gilg & Schellenb.) Stearn	Oleaceae	Karra Wayyuu	Sh	5	Fruits	Ripe fruit eaten raw	Fu, Co, Tm , Bf	68.4	TR267

Commelina africana L.	Commelinaceae	holagabis	H	6,9	Bulbs	Underground bulb eaten raw by children		11	TR065
Commelina benghalensis L.	Commelinaceae	holagabis	H	2,6,9	Roots, tubers	Roots and tubers are cooked as root vegetables during food shortage		9.2	TR098
Cordia africana Lam.	Boraginaceae	wodessa	T	5,7	Fruits	Ripe fleshy fruit eaten raw	Co, Tk, Fu, Bf	21.5	TR109
Cucumis ficifolius A.Rich.	Cucurbitaceae	hiddi hooloo	Li	2,6	Roots	Root extract used in local honey-wine (mead=tej) to make beverage more intoxicating	Tm	8.1	TR208
Cyanotis barbata D.Don	Commelinaceae	_	H	2,6	Corms	Underground corm eaten raw by children		4.2	TR076
Cyathula uncinulata (Schrad.) Schinz	Amaranthaceae	maxannee	H	2,6,9	Leaves	Shoots & leaves are chopped, cooked & eaten as vegetable (famine food)	Tm	12.1	TR159
Dovyalis abyssinica (A. Rich.) Warb.	Flacourtiaceae	koshimii	T	1,2,3,7	Fruits	Ripe fleshy fruit eaten raw	Co , Tm	56.7	TR301
Ekebergia capensis Sparrm.	Meliaceae	somboo	T	5	Fruits	Fleshy fruit eaten by children rarely	Fu, Co, Tm	9.6	TR317
Embelia schimperi Vatke	Myrisinaceae	hanquu	Sh	2,6,7	Fruits	Fleshy ripe fruit eaten raw	Tm , Fu	43.2	TR039
Ensete ventricosum (Welw.) Cheesman	Musaceae	warqee	H	5	Fruits , stems	Fleshy fruit eaten raw	Tm	38.1	TR085
Festuca abyssinica Hochst. ex A. Rich.	Poaceae	garbu dadde	H	2,9	Fruits	Fruits eaten as snack	Fu, Co, Tk, Tm	13.9	TR173
Ficus ingens (Miq.) Miq.	Moraceae	qilinxo	T	1,5,7	Fruits	Fruits eaten raw	Fu, Co, Tk, Tm	33.1	TR209
Ficus sur Forssk.	Moraceae	harbu	T	5,7,8	Fruits	Ripe fruits are eaten raw	Fu, Co, Tk, Tm	65.3	TR086
Ficus sycomorus L.	Moraceae	odaa	T	5,7,8	Fruits	Ripe fruits eaten raw	Fu, Co, Tk, Tm	61.2	TR132
Ficus thonningii Blume	Moraceae	dambi	T	5,7,8	Fruits	Ripe fruits eaten raw	Fu, Co, Tk, Tm	21.7	TR221
Ficus vasta Forssk.	Moraceae	qilxu	T	5,7,8	Fruits	Ripe fruits eaten raw	Fu, Co, Tk, Tm	43.6	TR066
Flacourtia indica (Burm.f.) Merr.	Flacourtiaceae	Hudhaa	Sh	5,3	Fruits	Ripe fruits eaten raw	Tk, Co,Fu, Tm	51.1	TR069
Girardinia bullosa (Steudel) Wedd.	Urticaceae	dobii	H	2,3,9	Leaves	Leave cooked & eaten as vegetable (in earlier times)	Tm	17.2	TR143
Grewia ferruginea Hochst. ex A. Rich.	Tiliaceae	Laanqessaa	Sh	5,7	Fruits	The ripe fruits eaten raw	Fu ,Co, Tm	9	TR275
Guizotia scabra (Vis.) Chiov.	Asteraceae	hadaa, tuufoo	H	2,6,9	Young-leaves, tenders	Leave & tender shoots cooked & eaten as vegetable (in earlier times)	Tm	8.7	TR088
Ilex mitis (L.) Radlk.	Aquifilaceae	mi'eesa	T	5,7	Twigs	Twigs used as toothbrush/chewed to relieve thrust	Fu ,Co, Tm	31	TR079
Justicia schimperiana (Hochst. ex Nees) T. Anders.	Acanthaceae	dhuumuga	Sh	2	Nectars	The nectar from flowers sucked by children	Lv , Fu, Bf	23.1	TR145
*Lipia adoenesis** Hochst. ex Walp.	Verbenaceae	kussayee	Sh	2,6	Leaves	Leaves used as condiments in spice preparation	Fu, Tm, Fm	22.7	TR202
Momordica foetida Schumach	Cucurbitaceae	_	H	3,7	Fruits	The pulpy coverings of the seeds eaten by herders	Tm	7.5	TR064
Myrsine africana L.	Myrsinaceae	qacaama	Sh	5	Fruits	The ripe fruits eaten raw	Tm	6.5	TR101
Ocimum urticifolium Roth	Lamiaceae	anchabii	Sh	3,7	Leaves	The leaves used as condiments & spice	Fu, Tm, Fm	26.7	TR305

Olea europaea L. subsp. *cuspidata* (Wall. ex G.Don) cif.	Oleaceae	ejersa	T	5,7	Fruit, Leave	The leaves used as condiments in local drinks; ripe fruits eaten raw and used to extract oil.	Sd, Fu, Co, Tm, Cr	17.4	TR060
Peponium vogelii (Hook.f.) Engl.	Cucurbitaceae	Bukee sexana	H	3,7	Fruits	Cooked fruit used to be eaten in time of famine	Tm	4.7	TR210
Phoenix reclinata Jacq.	Arecaceae	meexii	T	5,7,8	Fruits, shoots, buds	The fleshy ripe fruits eaten raw; young shoots and buds eaten as vegetables (cooked)	Sd , Cr, Tm, Tk	58.9	TR320
Rhamnus prinoides L'Herit.	Rhamnaceae	geshe	Sh	3,5,7	Leaves , branch, stem	To flavor traditional alcoholic drinks (tella, tej & areke)	Tm	61.2	TR039
Rhamnus staddo A.Rich.	Rhamnaceae	Qadida	Sh	5,7	Leaves	Leaves are dried and used to flavor areke & tej (local drink)	Tm , Fm	21.6	TR099
Rhus vulgaris Meikle	Anacardiaceae	dabobessaa	T	5	Fruits	Ripe fruits eaten raw		13.1	TR118
Ritchiea albersii Gilg	Caparidaceae	dhakacabsi	Sh	5	Fruits	Ripe fruits eaten raw	Fd, Co	15.3	TR203
Rosa abyssinica Lindley	Rosaceae	qaqawwee	Sh	1,3,4,7	Fruits	Ripe fruits eaten raw	Fo , Bf, Tm	57.5	TR311
Rubus apetalus Poir.	Rosaceae	gora	Sh	3,4,7	Fruits	Ripe fruits eaten raw	Tm	61.3	TR222
Rubus steudneri Schweinf.	Rosaceae	gora	Sh	3,4,7	Fruits	Ripe fruits eaten fresh & raw	Tm, Bf	64.2	TR199
Rumex abyssinicus Jacq.	Polygonaceae	mooqmoqii	H	2,4,9	Roots , tenders, shoots	The tender shoots eaten fresh & raw by children (famine food), roots are used to refine butter & to prepare local tea	Tm	43.4	TR077
Rumex nervosus Vahl	Polygonaceae	dhaangagoo	Sh	2,4,9	Inner part of Stem, leaves , tender shoots, roots	Young tender shoots, leaves & inner part of stem eaten fresh & raw mostly by children, root used as condiments	Bf , Fu, Tm	12.5	TR132
Satureja punctata (Benth.) Briq.	Lamiaceae	xossinyii	Sh	3,4,6	Leaves & Inflorescence	Used to improve quality of milk	Bf, Tm	42.6	TR324
Sporobolus africanus (Poir.) Robyns & Tournay	Poaceae	murii	H	3,4,6	Grains	The grain powdered and baked to make bread or injera like teff during famine		9.5	TR376
Syzygium guineense (Willd.) DC. supsp *afromontanum*	Myrtaceae	badessaa	T	5,7,8	Fruits	Ripe fruits eaten fresh & raw	Sd , Bf, Fu, Co, Fm, Tm	69.2	TR190
Syzygium guineense (Willd.) DC. supsp *guineense*	Myrtaceae	gossu	T	5,7,8	Fruits	Ripe fruits eaten fresh & raw	Sd , Bf, Fu, Co, Fm, Tm	65.4	TR265
Teclea nobilis Del.	Rutaceae	hadhessa	T	5,7	Fruits	Ripe fruit eaten raw	Fu, Co, Tm	59.2	TR174
Thymus schimperi Ronniger	Lamiaceae	xosinyii	H	3,4,6	Leaves	Dried leaves used as tea	Tm	48.9	TR055
Urtica simensis Steudel	Urticaceae	gurgubee	H	2,3,6,9	leaves & young shoots	The leaves & young shoots cooked & eaten as vegetables	Tm	74.3	TR091
Vepris dainellii (Pichi-Serm.) Kokwaro	Rutaceae	hadhessa	T	5,7	Fruits	Ripe fruit eaten raw	Fu, Co, Tm , Bf	58.7	TR194
Vernonia amygdalina Del.	Asteraceae	eebicha	Sh	3,5,7	Leaves & twigs	Leaves & twigs used as condiments in preparation of local alcoholic drinks	Fu, Fo, Co, Lv, Bf	23.5	TR223

Hb=habit (T= tree, H=herb, Sh=shrub, Cl=climber, Li=liana); Ha=habitat (1= mountain slopes, 2= field margins & roadsides, 3= forest margins and clearings, 4= forest openings and thicket, 5= forests, 6= margins of arable land and pastures, 7= woodland and disturbed bushland, 8= river banks, 9= wastelands); OLU=other local uses (Fu =fuel/energy, Co=construction, Tm=traditional medicine, Tk=technology, Cr=ceremonial, Fo= fodder, Fm=fumigant, Sd=shade, Bf= honey beeforage, Lv=live fence); FPC=frequency of plant citation; VN=voucher number; **Bold**=endemic to Ethiopia.

Ethnobotanical Knowledge of the Community on WSWEPs

The average species number of WSWEPs reported by women was more than those reported by men and the difference was significant (P<0.05). Similarly, there was a significant difference (P<0.05) in the number of WSWEPs reported by senior members of the community (45–90 years old) compared to those reported by young to

middle aged members (20-44 years); key informants and general informants, illiterate and literate informants (Table 2). More number of WSWEPs was reported by the elderly (≥ 45 years old) and key informants than the young and general informants.

Table 2: Statistical test of significance, t-test, on average number of reported WSWEPs among different informant groups in Chelia District

Parameters	Informant groups	n	Mean ± SD	t -value**	df	*P*–value
Gender	Men	192	3.27 ± 0.14	-57.71	174	0.000*
	Women	98	4.35 ± 0.16			
Age	Young member	105	2.54 ±0.13	−130.83	263	0.000*
	Senior members	185	4.87 ± 0.17			
Literacy level	Illiterate	174	4.69 ± 0.15	35.62	215	0.000*
	Literate	116	3.97 ± 0.18			
Experience (Informant category)	Key informant	20	5.97 ± 0.17	74.21	19	0.000*
	General informant	270	3.14 ± 0.05			

*Significant difference (*P*<0.05); ** t(0.05) (two tailed), df = degree of freedom, n = number of respondents

Main gatherers and consumers of WSWEPs in the study District

Women (80.1±1.6%) and children (76.1±2.3%) were the major gathers followed by men (13.2±2.4%) and all household members (12.9±1.3%). The majority (77.4± 2.1%) reported that WSWEPs were consumed by all household members (Table 3). Other respondents who differed from those who said that WSWEPs were consumed by the entire household indicated that women (23.1± 2.2%), elders (15.8 ±2.3%) and children (19.4 ±1.6%) were the main consumers as opposed to men 8.2±2.1%) (Table 3).

Parts consumed and food use categories of WSWEPs

The major parts of WSWEPs widely consumed in Chelia District are indicated in figure 4. Most inhabitants predominantly consume fruit (40%) and fresh leaves (17.5%) followed by shoots (12.5%).

Table 3: Frequency of citation of the main gatherers and consumers of WSWEPs in Chelia District

	Frequency of Citations (%)			
Variables	**Sokondo (±SEM)**	**Rafso Alanga (±SEM)**	**ChobiTulu Chori (±SEM)**	**Overall mean (±SEM)**
		Main gatherers		
Women	82.3 (1.4)	78.5 (1.2)	79.6 (2.1)	80.1 (1.6)
Men	13.6 (2.2)	14.3 (1.4)	11.8 (3.1)	13.2 (2.4)
Children	77.4 (3.1)	76.3 (2.1)	74.7 (1.2)	76.1 (2.3)
Any household member	14.1 (1.2)	11.4 (2.3)	13.3 (0.7)	12.9 (1.3)
		Main consumers		
Women	24.5 (2.5)	23.1 (1.3)	21.7 (2.1)	23.1 (2.2)
Men	8.3 (1.6)	7.1 (0.9)	9.3 (1.5)	8.2 (2.1)
Elders (old aged)	17.3 (2.2)	15.6 (1.8)	14.5 (1.4)	15.8 (2.3)
Children	18.4 (2.0)	19.5 (0.4)	20.3 (1.1)	19.4 (1.6)
Any household member	76.8 (3.2)	78.1 (1.9)	77.5 (1.3)	77.4 (2.1)

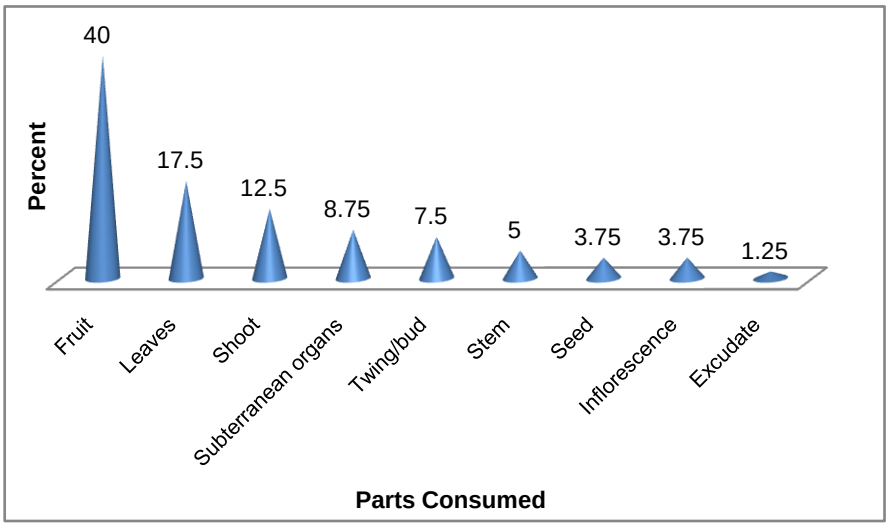


Figure 4: Parts of WSWEPs commonly consumed in Chelia District

The majority of the reported WSWEPs were consumed as fruits, either fresh or dried (48.3%) and the leafy vegetables were consumed mainly cooked or boiled (15.2%) followed by use for seasonings (12.1%). The latter includes uses as spices and condiments too. The other consumption patterns or food use categories include: uses in local alcoholic drink preparation, made into bread/injera/porridge, tasty sugar consumed from flowers, as herbal tea, use of subterranean organ raw or cooked, and consumption of tasty exudates (Figure 5). Moreover, about 65% of WSWEPs in the study area were consumed raw (Table 1).

Cultural importance and Informant consensus of WSWEPs

Matrix ranking of the multipurpose WSWEPs under eight use categories (etic categories) of twelve short listed WSWEPs gave wild food category in the first rank followed by fuelwood and medicine. *Cordia africana* asumed the first rank as a multipurpose species followed by *Vepris dainellii* and *Chionanthus mildbraedii* (Table 4).

Habitats and conservation prospectus of WSWEPs

Forests were the major reservoirs (18%) of WSWEPs followed by woodland and disturbed bush land (17%) and river banks (16%) and other are shown in figure 6.

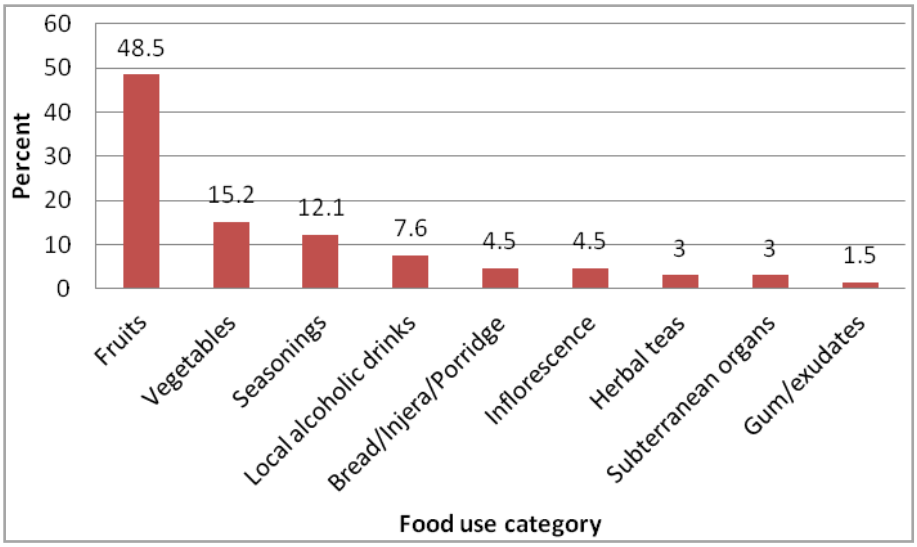


Figure 5: Food use categories of WSWEPs of Chelia District

Table 4: Average DMR score of fifteen key informants for twelve WSWEPs with additional uses besides food value based on use criteria (5 = best; 4 = very good; 3 = good; 2 = less used; 1 = least used and 0 = no value)

No.	Wild and semi-wild edible plants	Broad use category (Etic category)									
		Wild Food	Medicine	Construction/Building	House hold Furniture	Farm implements	Fuel wood	Fodder	Honey Bee Forage	Total	Rank
1	*Acacia abyssinica*	2	4	3	2	3	5	1	3	23	6
2	*Acokanthera scbimperi*	2	5	2	0	1	3	1	3	17	10
3	*Chionanthus mildbraedii*	4	3	4	2	3	5	1	4	26	3
4	*Cordia Africana*	3	4	4	5	4	4	0	5	29	1
5	*Ficus sycomorus*	5	3	3	4	3	3	0	0	21	8
6	*Ficus sur*	5	3	2	3	1	4	0	0	18	9
7	*Olea europaea* L. subsp. *Cuspidata*	2	4	5	3	3	4	1	3	25	5
8	*Phoenix reclinata*	4	3	0	0	0	0	0	4	11	12
9	*Syzygium guineense*	4	2	4	1	4	5	0	5	25	4
10	*Vepris dainellii*	4	3	4	3	4	4	2	4	27	2
11	*Urtica simensis*	5	3	0	0	0	0	1	4	13	11
12	*Vernonia amygdalina*	3	4	2	0	0	5	3	5	22	7
	Total	43	41	33	23	26	42	10	40		
	Rank	1	3	5	7	6	2	8	4		

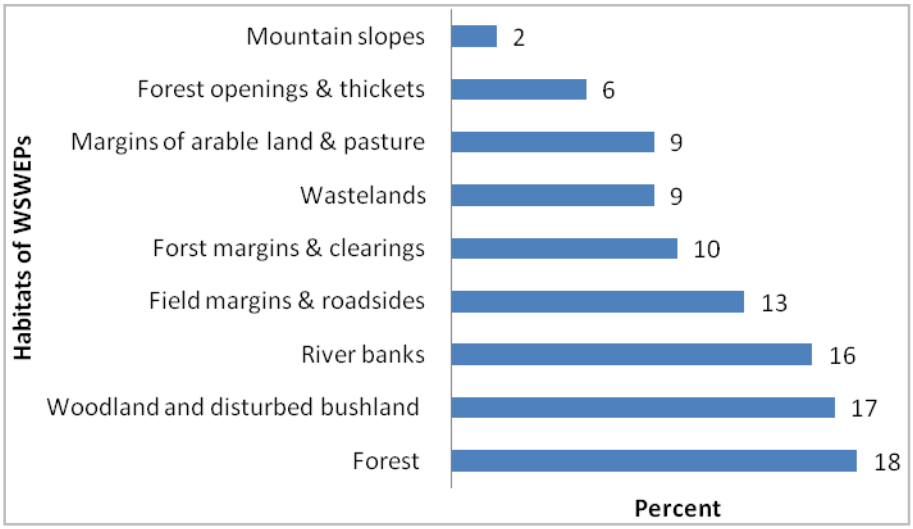


Figure 6: Proportion (%) of WSWEPs vs habitat types (collection niches) of Chelia District

We also assessed the ethnoecological knowledge on threats to WSWEPs and conservation concerns. Preference ranking of factors considered as threats to WSWEPs in Chelia District indicated that agricultural expansion was identified as a major threat to WSWEPs followed by overgrazing and fuelwood collection (Table 5).

Table 5. Preference ranking of factors considered as threats to WSWEPs in Chelia District

Factors considered as Threats to WSWEPs	Informants labelled A to O																
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Total	Rank
Fuel wood collection	5	4	5	4	3	3	4	5	6	5	3	4	3	4	5	63	3
Drought	2	3	1	1	1	1	2	2	1	1	1	1	2	1	1	21	5
Selective harvesting	3	2	3	4	6	4	3	3	2	3	6	2	4	5	2	52	4
Over-stocking/grazing	4	6	4	4	5	6	5	4	5	3	4	3	5	4	4	66	2
Agricultural expansion	6	5	6	5	4	5	6	6	4	4	5	5	6	3	5	75	1
Fire hazards	1	1	1	3	2	1	1	1	3	1	1	6	1	1	3	21	5

Scores in the table indicate ranks given to factors considered threats to WSWEPs based on their local perceptions.
The highest number (6) is given for the most threatening factor and the lowest number (1) for the least threatening factor of WSWEPs

DISCUSSION

Commonly consumed WSWEPs in Chelia District

A fairly high number of WSWEPs were documented from the study area. There was enough evidence that local communities in this District very often interact with their environment and make use of these WSWEPs to meet part of their dietary requirements.

Moraceae and Asteraceae were families that contained more numbers of edible taxa with five and four species respectively. This could be related to the fact that most of the *Ficus* spp. Found in the Moraceae family are edible including elsewhere (Hegazy *et al*., 2013) and the family Asteraceae is the most diverse family in Ethiopia; and thus there is higher probability of encountering edible species of these two families. The reason behind the fact that samma (*Urtica simensis*) was cited by most informants (74.5%) followed by kara wayu (*Chionanthus mildbraedii*) (68.4%) and agamsa (*Carissa spinarum*) (66.1%) could indicate the popularity of these wild edibles in the area. It was found that samma (an endemic species to Ethiopia) has high nutritional value compared to many green leafy vegetables commonly cultivated and consumed in Ethiopia (Eskedar Getachew Assefa *et al*., 2013). The same source showed that the protein and mineral contents of this species were exceptionally high which makes this vegetable an inexpensive but high quality nutrition source especially for the poor segment of the population where malnutrition is prevalent. Moreover, kara wayu and agamsa were among the indigenous wild fruits that play a vital role in the livelihoods of many rural communities in Ethiopia.

The total number of species, 58, of WSWEPS reportedly consumed in this study is lower than some of those reported from other studies within Ethiopia and elsewhere. Getachew Adiis *et al*. (2013) reported 137 edible species used by the Konso ethnic community in Southern Ethiopia. Elsewhere, a total of 122 wild edible plants used in Poba Reserved Forest (Assam), India, belonging to 89 genera under 52 families were reported by Pegu *et al*. (2013). Uprety *et al*. (2012) reported 81 wild food plants used by indigenous communities and Aryal *et al*. (2009) reported 85 uncultivated food plants used by Chepang people both in Nepal. One hundred eight eight wild species were reported by Lentini and Venza (2007) from an island in Sicily and 90 species of wild vegetables in Inner Mongolia (China) were reported by Wujisguleng and Khasbagen (2010). Similarly, Ali-shytayeh *et al*. (2008) recorded 100 wild plant species distributed across

70 genera and 26 families in Palestine (West Bank) and Ju *et al*. (2013) documented 168 wild edible plant species in 116 genera and 62 families used by Tibetans in Shangri-la region, Yunnan, (China) and Nedelcheva (2013) reported 88 wild edible plants used by local communities in Bulgaria and Redzic (2006) reported 308 wild food plants belonging to 76 families consumed in Bosnia Herzegovina. The possible explanation for these differences could be the differences in local biota diversities and local traditions for instance, rain fed subsistence agriculture is the custom in the study area and erosion of the traditional knowledge on use of WSWEPs could also be another possible reason.

The result, however, is comparable closely with that of Kebu Balemie and Fassil Kebebew (2006) who documented 66 edible plant species belonging to 54 genera and 34 families in Derashe and Kucha Districts in Southern Ethiopia and Agea *et al*. (2011) who recorded 62 WSWEPs from Matunda and Kiryandongo sub-countries of Kibanda country in the Bunyoro-Kitara Kingdom (Uganda).

Main Gatherers and Consumers of WSWEPs in the District

In the study area, WSWEPs were exclusively collected by women and children. Earlier reports in Northern Ethiopia by Barnett (2001) considered that the gathering of WSWEPS was undertaken mainly by women and children. Elsewhere in Africa, Agea *et al*. (2011), Vainio-Mattila (2000), and Gullick (1999) in Uganda, Tanzania and Sudan respectively reported the collection of WSWEPs dominated by women and children in the respective local communities. Hence, the important roles of women and children as far as gathering of WSWEPs is concerned should not be underestimated.

The study also indicated that WSWEPs are largely consumed by all household members rather than either by men, women or children alone. This practice could indicate the importance of these edible plants in the household diet as a whole. This practice may also have far reaching implication in food crisis mitigation and dietary diversification resulting in health benefits to balance the community's practice of cereal based food habit as is true elsewhere in Ethiopia.

Relationship between Sex, Age and Knowledge of WSWEPs

A two-tailed t-test comparison of the knowledge of WSWEPs between men and women informants showed a significant difference ($P<0.05$). Women informants of the District reported more WSWEPs on average (4.35±0.16) better than men (3.27±0.14). Thus, the results indicated that women are more knowledgeable than men on use of WSWEPs which could relate to the gender role stereotype in the study community and elsewhere (Agea *et al*., 2011). Generally, gender based differences in WSWEPs knowledge can be derived from experience and degree of cultural contact with food plants.

Similarly, the significant difference on mean number of WSWEPs reported by different age groups compared in this study indicated that indigenous knowledge on use of WSWEPs is still strong with elderly people (4.87±0.17) than in the younger generation (2.54±0.13) in contrast to the studies by Tigist Wondimu *et al*. (2006) and Fentahun Mengistu and Hager (2008) where younger generations were more knowledgeable of WSWEPs in Northern Ethiopia. The fact that adults have a wider knowledge acquisition than children might explain declining parental transmission of WSWEPs species knowledge by the former to the later. In other words, the observed strongly significant difference ($P=0.000$) showed the gap between generations and the decline of indigenous knowledge on WSWEPs down generations. This could be attributed to the impact of modernization (including urbanization and advent of formal education) and the very poor system of sharing indigenous knowledge on WSWEPs to the younger generation. The result calls for an effort to close the observed generation gap through continuous professional support and training of local communities with an aim of preserving their traditional WSWEPs knowledge & practices through systematic documentation.

The other significant difference ($P=0.000$) observed between key and general; and literate and illiterate informants could relate to the impact of age-old experience and maximum degree of knowledge acquisition of WSWEPs in the former, and impact of modernization in the latter case. That is, elderly members are very much linked with the natural forest and if that is the case they may have retained the ancestral knowledge but the younger people may be going out to towns and education so that they have reduced contacts with the natural forest. This result is contrasted with the finding by Fentahun Mengistu and Hager (2008) where education is not the important factor responsible for variation of knowledge of WSWEPs.

Main Parts Consumed and Consumption Pattern

Fruits, leaves and shoots were the most reported plant parts consumed by the households in the study area. The preference of fruits to other plant parts could be attributed to ease of preparation and consumption pattern. Most fruits were often consumed raw as snacks for instance between meals while collecting fuel wood or herding. The preference of leaves and shoot could be related to the fact that they are frequently harvested in relatively large quantities, prepared and consumed by the entire members of the households. Elsewhere, in line with the current study Reddy *et al*. (2007), Agea *et al*. (2011), Termote *et al*. (2008) and Nedelcheva (2013) reported the higher preference of fruits and leaves by the indigenous communities in India, Uganda; DR Congo and Bulgaria respectively.

In the present study, WSWEPs were predominantly consumed as fruits (ripe fruits eaten as snacks) and cooked leafy vegetables in main dishes. Other important consumption pattern in the study area includes use as seasonings, in preparation of local alcoholic drinks and as components of bread or porridge. The current consumption of the WSWEPs in the main meal in Chelia District reflects the growing importance of these plants in the diet of households of the people as is also evident in indigenous communities elsewhere (Agea *et al*., 2011).

Cultural Importance and Informant Consensus of WSWEPs

The output of a direct matrix ranking exercise showed highest values/ranks for a number of multipurpose WSWEPs of the study area including *Cordia africana, Vepris dainellii* and *Chionanthus mildbraedii*. The result indicates that these plants are exploited more for their non-food uses than for reported food values.

Overharvesting of multipurpose WSWEPs species for construction materials, household furniture, farm implements and fuelwood purposes were found the responsible factors aggravating depletion of the species in the area. Thus, the result calls for an urgent complementary conservation action to save the fast eroding multipurpose WSWEPs plant species of the area. Getachew Addis *et al*. (2013) also reported the same pattern of highest exploitation of WSWEPs for uses other than their food values in south Ethiopia.

Threats and Conservation Concerns of WSWEPs and their Habitats

The habitats of these valuable WSWEPs were increasingly threatened by continued destruction of natural vegetation. The fact that most WSWEPs have multipurpose uses, posed a big threat to their existence due to destruction of their habitats and overharvesting.

Most of the 58 scientifically identified WSWEPs occur in two or more habitats. Forest (18%) is the major reservoir of WSWEPs followed by woodland and disturbed bush land (17%), riverbanks (16%) and field margins and roadsides (13%) among others (Fig. 6). This indicates the necessity of conserving woodlands and bush lands and riverbanks in addition to forests in order to ensure sustainable use and conservation of these resources.

The preference ranking exercise helped to identify the most threatening factors of WSWEPs in the area. Accordingly, agricultural expansion, over-stocking/grazing and fuelwood collection scored highest values and were found to be the most threatening factors. Ethnobotanical investigation done in Ethiopia (Kebu Balemie and Fassil Kebebew, 2006; Debela Hunde Feyisa *et al*., 2011; Getachew Addis *et al*., 2013) and elsewhere Ali-Shtayeh *et al*. (2008) also reported similar pattern of threat factors to WSWEPs and associated traditional knowledge.

CONCLUSIONS

In the study area, about 58 WSWEPs belonging to 48 genera and 30 families were reported as being consumed. The most commonly cited plants were *Urtica simensis, Chionanthus mildbraedii, Carissa spinarum* and *Ficus sur*. More number of species per family was reported for the Moraceae and the Asteraceae.

Traditional knowledge of WSWEPs is directly proportional to the age of the respondents in that senior members had more knowledge of WSWEPs than younger people. Regardless of their age, women knew more number of WSWEPs than men. The illiterate and key informants were respectively superior to the literate and general informants in having local knowledge of WSWEPs. Women and children were the main gathers of WSWEPs followed by men and all household members. There were more WSWEPs that were consumed by all household members than those consumed only by women, elderly, children and men. Fruits, leaves and shoots were the most predominantly consumed plant parts in the study area and fruits followed by leafy vegetables were most frequently consumed.

Cordia africa and *Vepris dainellii* were reported as multipurpose species followed by *Chionanthus mildbraedii* and *Syzgium guineense*. The main threats to WSWEPs in the District were reported to be agricultural expansion and overgrazing followed by fuelwood collection and selective harvesting and that overharvesting, superimposed on the other factors, may interfere with the sustainability of these resources. The most gathered WSWEPs were from wild habitats and this calls for urgent research on the possibility of adapting, growing and intentionally managing some of the commonly consumed WSWEPs such as *Urtica simensis, Chionanthus mildbraedii, Carissa spinarum* and *Ficus sur*. Furthermore, further research on the toxicity and nutritional composition of the reported WSWEPs is recommended to ensure safety of consumption.

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