Ethnobotany of Wild and Semi-wild Edible Plants of Konso Ethnic Community, South Ethiopia

Getachew Addis, Zemede Asfaw and Zerihun Woldu

Research

Abstract

This paper presents the knowledge on wild/semi-wild edible plant species (WEPS) of Konso ethnic community of southern Ethiopia. Ethnobotanical information was collected through focus group discussions, observations, interviews, and preference ranking. A total of 154 edible parts were recorded from 127 plant species in which fruit (71), leaves (35) and tubers/roots (18) accounted for the major edible parts. Fruit of *Opuntia ficus-indica* L., and leaves and young shoots of *Leptadenia hastata* Vatke were most sought after. Excessive harvesting and acquisition of land for crop cultivation is currently threatening *Canthium pseudosetiflorum* Bridson, *Hyphaene thebaica* (L.) Mart., *Ficus sycomorus* L. and *O. ficus-indica*, among others. Wise use of these plant species would ensure their sustainable availability and local food sovereignty.

Introduction

Ethiopia is an important center of diversity for many domesticated crops (Harlan 1969). It is also a reservoir of ancient farming systems, farmers' varieties of many crops and the associated ethnobotanical knowledge. However, the crop diversity is threatened through replacement of existing farmers' varieties with improved cultivars. Agricultural expansion and deforestation also threaten local ecosystems. These situations exacerbate local food shortages and aggravate widespread malnutrition in the country. There is a need to focus on available and ecologically adapted food sources including the wider pool of underutilized edibles in the wild-domesticated continuum. Ethiopia's aspirations to create healthy and productive environments, and food secure communities could well be supported by the wide array of diversity in wild/semi-wild edible plants.

Information related to wild edible plants is mainly transferred through word of mouth. There are trends of increasing acculturation, mobility, displacement of communities, introduction and use of new crop varieties, diminishing biodiversity, and shifts in dietary habits of rural communities. Lack of understanding of the benefits that accrue from indigenous knowledge for present and future societies leads to the exacerbation of the multifaceted environmental degradation and food insecurity.

Despite diverse uses of plants by communities in remote parts of southern Ethiopia, effort to collect and document knowledge and practices surrounding wild edibles is limited (Abbink 1993, Getahun 1974, Guinand & Lemessa 2001, Soromessa & Demissew 2002, Wassihun *et al*. 2003). On the other hand, some other efforts made so far (Addis et al. 2005, Asfaw & Tadesse 2001, Luelekal *et al*. 2011, Teketay *et al*. 2010, Wondimu 2007) have either been on a review nature and/or cross sectional. This leaves very limited studies (Balemie & Kebebew 2006, Feyssa *et al*. 2011, 2012, Mengistu & Hager 2008, Ocho *et al*. 2012) that focus on the ethnobotany of wild/semi-wild edible plants of a particular ethno-lingusitic community. Ethnobotanical information documented without plant voucher specimens is incomplete. Earlier studies had problems with experimental design including

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site selection criteria and use of appropriate quantitative tools. The objective of the present study was to conduct ethnobotanical studies on wild and semi-wild edible plant species (WEPS) in the Konso (Xonso) ethnic community of southern Ethiopia.

Methods

Study area and community

This ethnobotanical study was conducted in Konso Wereda (district) of south Ethiopia following reconnaissance surveys conducted between February and March 2005. Konso Wereda is located about 600 km south of Addis Ababa. The selection of Konso for this study was influenced by reported presence of indigenous knowledge and practice on WEPS, high botanical diversity and rich indigenous practices in natural resource management. Five rural **kebeles** (lowest government administrative structure) were selected for the study following a stratified sampling method. The administrative town was preferentially included to represent an urban setting. The stratification variables were agro-ecological zones and fair distribution of study ***kebeles*** (Figure 1).

Konso Wereda ranges in altitude from 650 to over 2650 masl. It has an annual rainfall from 771 to 921 mm with maximum precipitation being received from March to May and a short rainy season from September to November (Official unpublished data of Ethiopian Metrological Agency 2008). The population of the Konso ethnic community was estimated to be 219,004, the majority of whom (211,498) dwell in the rural parts (Population Census Commission 2008).

The Konso community is maintaining indigenous knowledge of plants, and local cultural identities remain intact. The United Nations Educational, Scientific and Cultural Organization (UNESCO) recently included the “Konso Cultural Landscape” in its list of World Heritage sites in recognition of its importance as a global heritage and practice landscape. The settings of traditional practices include terraced step land, with use of irrigation, water harvesting, mulching, polyculture farming and agroforestry harboring diverse plants, integrated crop-livestock mixed farming system, and use of wild plant resources. This mixture is likely unique to Konso. Despite having a well developed agricultural system, recurrent drought, and intermittent food shortages and famine threaten the livelihoods of the people.

Ethnobotanical data collection and analysis

Research was conducted in a series of prolonged field trips that included collection of qualitative and quantitative data and herbarium specimens from October 2005 to May 2008. Permission was first obtained from Konso Wereda and **kebele** administrative offices to conduct the study. Prior informed consent was also obtained from each participant and only those who consented to the request and expressed interest in the research participated in interviews and/or discussions. The study involved different data collection tools. Plant voucher specimens of most WEPS were collected with the help of knowledgeable local participants and translators. The vouchers were identified and deposited at the Addis Ababa University National Herbarium (ETH). Since WEPS are widely used by the Konso community, we expected that their ethnobotanical knowledge would be documented with guided field interview, focus group discussions and household interviews. We hypothesized that knowledge would be evenly distributed across the studied **kebeles**.

Guided field interviews involved a combination of observation, discussion, and interviewing key informants and other local people along the walk focusing on the availability, use and management of WEPS. Participants were chosen for focus group discussions (FGD) based on their knowledge on plant use. In each **kebele**, one FGD was conducted consisting of five to seven individuals representing community elders, religious/spiritual leaders, knowledgeable persons, and other men and women in the community (including youth, cow herders, and school boys). The FGD was conducted using pre-tested semi-structured discussion guidelines being directed by the researcher and assisted by a trained translator. Household interviews were conducted with 51 participants of all age groups and both genders selected from the five rural **kebeles** based on a quota sampling method (Bruce *et al*. 2008) to obtain proportional representation. A pre-tested, structured data collection format containing open- and close-ended questions was used. Individual interviews were conducted to document community level ethnobotanical knowledge and were checked for congruence against FGD results.

A checklist of WEPS was prepared for each **kebele** based the results FGD and individual interviews. The checklists were open for inclusion of other species suggested by the participants. The plant specimen was displayed when a WEPS had more than one local name, shared the same name with other species, did not have a local name, or was not known by the participant, in order to ensure that the same plant was being discussed.

Interviews with each of the participants were conducted consecutively in three different events during September and October 2007, January and February 2008 and April and May 2008 to ensure consistency. Principal coordinate analysis (PCoA) with Jacard similarity index (JI) was used to calculate degree of similarity, and difference in composition (Höft *et al*. 1999), of the WEPS among the **kebeles** in Konso. The Jacard similarity index was calculated based on presence and absence data of individual WEPS in each **kebele** as JI = a/a+b+c, where a is the number of species shared by, or common to, any compared pair of the **kebeles**, and b and c are the number of

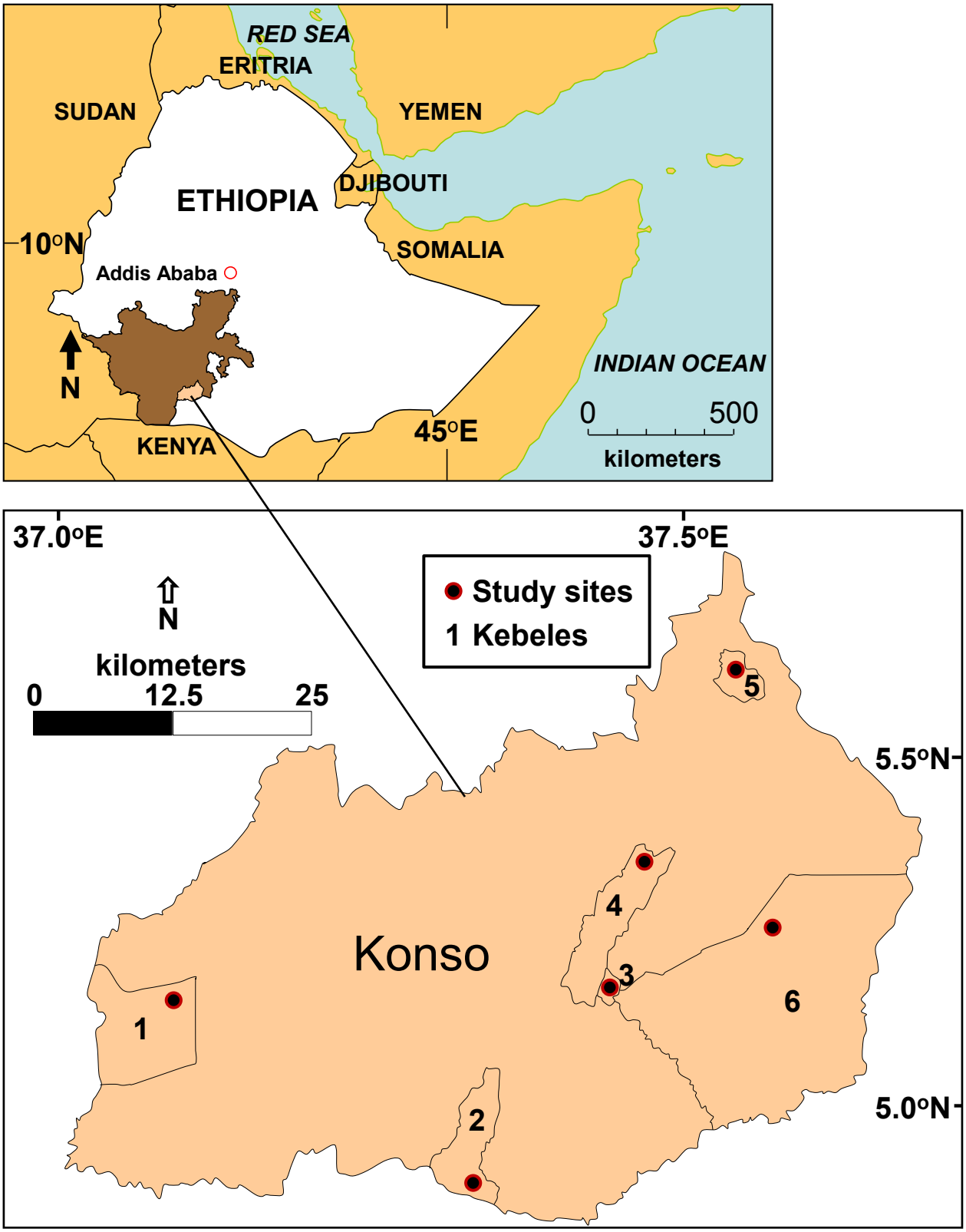

Figure 1. Konso Wereda in Ethiopia. Study area **kebeles**: (**1**) Mesoya, (**2**) Gesergiyo, (**3**) Karate Town, (**4**) Doketu, (**5**) Addis Gebre, (**6**) Jarso.

WEPS reported solely in one of the compared groups (b for one group and c the other).

Initially, checklists of all WEPS that were mentioned as edible by the FGD participants in the respective sites (which was also open for additional information) were prepared. The overall knowledge of participants about uses of the mentioned and/or displayed edible plants was later administered using a semi-structured data collection format for the first event (level I). Based on the specific uses cited by the participants in the first level, WEPS of three or more uses were short listed for further study (level II and III). Accordingly, 20 to 30 plant species that scored the highest use values in the first event (Hoffman & Gallaher 2007) were selected in each **kebele**. Preference of the community for WEPS was analyzed with multiple use criteria. In the present investigation, informant consensus or use value analysis (Phillips & Gentry 1993a) and direct matrix ranking (Martin 1995) were used to analyze degree of importance of the short-listed plants in the respective sites. The use value of the WEPS was recorded from the responses of 48 (among 51) participants who appeared to participate in at least two of the three events.

Specific uses of emic categories were reclassified into broad etic use groups to obtain locally defined functional groups for better data presentation. Etic use categories were adopted from literature sources (Hoffman & Gallaher 2007, Lucena *et al*. 2008, Phillips & Gentry 1993a,b) and modified to accommodate the emic categories such as agricultural tool, fence and income generation that do not conceptually fall into the etic categories available in the literature. The etic categories included in the present study were construction, forage, agricultural tool, household utensil, technology, fuel, medicine, fence and others. To estimate the use value of each species, the following equation was employed as suggested by Phillips and Gentry (1993a,b): UVis = ∑(Uis/nis), where UVis = use value by each participant, Uis = the number of uses (etic category) mentioned by informant i, and nis = the number of events for species s with the participant. The overall use value of each species (UVs) was calculated as UVs = ∑(UVis/ns), where ns = the number of participants.

Direct matrix ranking (Martin 1995) was employed as a group exercise by the FGD participants to know the degree of preference based on multipurpose criteria on the plants. Eight use categories were used as criteria for degree of preference of six to eight short listed WEPS. The use categories common to all the study sites included edibility, medicine, construction, household use, agricultural tool, fuel wood, forage and income generation. Although plants for fencing was one of the major uses of edible wild plants, it was not included as a criterion due to requirement of least selective harvest. The candidate plants were short listed using the FGD in each site. After preparing the matrix, the plants were ranked from the highest (most preferred) to the lowest number (least preferred).

Preference of plants for different uses or subjects of interest (variables) was also estimated using paired comparison (Martin 1995). Five to ten plants were selected by the participants of the FGD for each of the different variables viz. taste of fruits and leafy vegetables, monetary income through selling of any plant part and scarcity of the plant. The matrix of all possible combinations of plants was prepared using local names for each variable. All possible pairs as well as order within each pair were randomized and made available to the participants. Five participants from each **kebele** (total of 25) were randomly selected for the pairwise comparison. The participants were asked one at a time to choose one from all possible pairs of plants for each of the variables. The final score was obtained by adding the scores and ranking them. Results for each edible plant in each **kebele** and capital town were totalled to produce ranked data at **kebele** or capital town level. The grand totals for each edible plant from the five rural **kebeles** and capital town were taken as the overall preference for each variable.

The relative importance in marketability of the edible parts was also estimated using fidelity level (FL) index (Friedman *et al*. 1986) as FL = (Ip/Iu) × 100, where Ip = number of informants who independently mentioned marketability of the plant part and Iu = total number of informants that mentioned the same plant as edible. Abundance level of each WEPS under the current situation was also studied using a modified availability index (Pieroni 2001). The index expresses personal evaluation by the participants of plant abundance. An index value of “4” was applied to very abundant plant species, “3” for abundant, “2” for occasional, “1” for rare and “0” for not existing any more in the area.

Excel (2003), SPSS (2004), and PAST (Hammer & Harper 2006) were used for data entry, organization and analysis.

Results

Ethnobotanical knowledge on WEPS

The wild and semi-wild edible plant species

One hundred thrity-seven WEPS were identified in the study area (Table 1). One hundred twenty-two were identified to the species level, 5 were identified to generic level, and the remaining 10 were recorded only by their local names. The 127 plants included seven exotic and two endemic species (*Amorphophallus gomboczianus* Pic.Serm. and *Barleria longissima* Lindau) to Ethiopia. Shrubs and trees constituted 62%, herbs 28% and vines 10%.

Although there was some variation in consumption of WEPS among the **kebeles**, the similarity was striking. Results of the PCoA on presence/absence data of 127 species consumed in the study area superimposed by the

Table 1. Wild and semi-wild edible plants of Konso Wereda ethnic community in Ethiopia. NS = Local name not specified. Edible part(s): Leaf (leaves or juvenile apex), Fruit (fruit exocarp or whole fruit and mature or immature), Root (roots, rhizomes, or tubers), Flower (flowers, nectar), Gum (gum, latex), Bark (root or stem bark), AP (aerial parts). Preparation: (**A**) Eaten raw, (**B**) Boiled, (**C**) Porridge, (**D**) Boiled into a decoction, (**E**) Roasted or fried, (**F**) Bread, injera, (**G**) Juiced, (**H**) Beverage, (**I**) Spice, condiment, or flavor, (**J**) Subsequent roasting & boiling, and (**K**) Subsequent wilting and boiling, porridge. Exotic species

Family Scientific name [Vouchers]	Afa Konso name	Habit	Edible part(s)	Preparation									
				A	B	C	D	E	F	G	H	I	J	K
Acanthaceae														
Asystasia gangetica (L.) T. Anderson [GA-K124-2005, GA-H70-2007]	**Atolleta**	Herb	Leaf		X		X							
Barleria longissima Lindau [GA-K14-2005]	**Bichbichat**	Shrub	Flower	X										
Justicia calyculata Deflers [GA-K172-2005, GA-H69-2007]	**Kurkuncha**, **Randolla**	Herb	Leaf		X		X							
Justicia flava (Forssk.) Vahl	**Honnona**	Herb	Leaf		X									
Justicia ladanoides Lam. [GA-K153-2005]	**Qira**, **Qirqira**	Herb	Leaf		X									
Amaranthaceae														
Amaranthus angustifolius Lam. var. *graecizans* Thell. [GA-K35-2005, GA-H13-2007]	**Rasuta**	Herb	Leaf		X		X							
Amaranthus hybridus L. [GA-K38-2005]	**Pasa**	Herb	Leaf		X									
			Seed			X			X		X			
			AP								X			
Celosia argentea L. [GA-K27-2005]	**Torchata**, **Torcha**, **Horbaita**	Herb	Leaf		X									
Celosia trigyna L. [GA-K84-2005, GA-H169-2007]	**Torchata**, **Torketa**	Herb	Leaf		X									
Digera muricata (L.) Mart. [GA-K130-2005, GA-H146-2007]	**Torchata**, **Torcha**, **Torqeta**	Herb	Leaf		X									
Anacardiaceae														
Lannea rivae (Chiov.) Sacleux [GA-K195-2005]	**Orittatta**	Tree	Leaf		X									
			Root	X										
Lannea schimperi (Hochst. ex A. Rich.) Engl. [GA-K26-2005]	**Oraiyta**	Tree	Fruit	X										
Lannea triphylla (Hochst. ex A. Rich.) Engl. [GA-K175-2005, GA-H193-2008]	**Orritta**, **Orittata**	Tree	Fruit	X										
			Root	X										
Rhus natalensis Bernh. [GA-H56-2007]	**Kabutayta**	Shrub	Fruit	X						X				
Rhus ruspolii Engl. [GA-K208-2005]	**Pichi oraya**, **Picha oraya**	Shrub	Fruit	X						X				
Rhus vulgaris Meikle [GA-K194-2005, GA-H107-2007]	**Bicha Oraya**	Shrub	Fruit	X						X				
Sclerocarya birrea (A. Rich.) Hochst. [GA-K11-2005, GA-H18-2007]	**Paatta**, **Paatta-aguta**	Tree	Fruit	X						X				
Annonaceae														
Uvaria acuminata Oliv. [GA-K265-2008, GA-H19-2007]	**Qormera**	Shrub	Fruit	X										
Apocynaceae														
Acokanthera schimperi (A. DC.) Benth. & Hook. f. [GA-K56-2005]	**Lawa**	Tree	Fruit	X										

Family Scientific name [Vouchers]	Afa Konso name	Habit	Edible part(s)	Preparation									
				A	B	C	D	E	F	G	H	I	J	K
Blyttia fruticulosa (Decne.) D.V. Field [GA-K62-2005]	**Lamtta**	Shrub	Fruit	X										
Buckollia sp. [GA-K152-2005]	**Marssa**	Vine	Root	X										
Buckollia volubilis (Schltr.) Venter & R.L. Verh. [GA-K151-2005, GA-H140-2007]	**Lomba**	Vine	Root	X										
Carissa spinarum L. [GA-K20-2005]	**Akamitta**	Shrub	Fruit	X		X								
Ceropegia sp. [GA-K268-2008]	**Kurteta**	Vine	Root	not specified										
Leptadenia hastata Vatke [GA-K21-2005]	**Xeyla**	Shrub	Leaf		X		X				X			
			Fruit	X										
			Gum	X	X		X							
			Coma	X										
Pachycymbium laticorona (M.G. Gilbert) M.G. Gilbert [GA-K59-2005]	**Pappaqa**, **Baqbaqa**, **Pappaqa**, **Parapaqa**	Herb	Stem	X										X
Pentarrhinum insipidum E. Mey. [GA-K199-2005, GA-H164-2007]	**Kokordota**, **Kordota**	Vine	Leaf		X		X				X			
Tacazzea sp. [GA-K189-2005]	**Tombolasha**	Shrub	Root	X										
Araceae														
Arisaema flavum (Forssk.) Schott [GA-K266-2008]	**Litota**	Herb	Root	X										
Amorphophallus gomboczianus Pic.Serm. [GA-K267-2008]	**Paganna**, **Pakanna**	Herb	Root			X			X					
Arecaceae														
Hyphaene thebaica (L.) Mart. [GA-K123-2005]	**Kunchula**	Tree	Fruit	X							X			
Asparagaceae														
Asparagus africanus Lam. [GA-K144-2005]	**Hinkarta**, **Hingarta**	Shrub	Root	X										
Asparagus scaberulus A. Rich. [GA-K245-2007, GA-H189-2007]	**Erkakta**	Shrub	Fruit	X										
			Root	X										
Asphodelaceae														
Aloe sp.	**Arkayta**	Shrub	Flower	X										
Asteraceae														
Launaea intybacea(Jacq.) Beauverd [GA-K79-2005, GA-H110-2007]	**Hankolayta**	Herb	Leaf		X		X							
Boraginaceae														
Cordia africana Lam.	**Ottayta**	Tree	Fruit	X										
Cordia monoica Roxb. [GA-K177-2005, GA-H78-2007]	**Toloqota**, **Tole etta**, **Tolohota**, **Tonta**	Tree	Fruit	X										
Cordia sinensis Lam. [GA-K162-2005, GA-H67-2007]	**Madertta**	Tree	Fruit	X										
Ehretia cymosa Thonn. [GA-K212-2005]	**Borborrissa**	Tree	Fruit	X										

Family Scientific name [Vouchers]	Afa Konso name	Habit	Edible part(s)	Preparation									
				A	B	C	D	E	F	G	H	I	J	K
Burseraceae														
Commiphora habessinica (O. Berg) Engl. [GA-K134-2005, Ga-H204-2007]	NS	Tree	Root	X										
			Stem	X										
Commiphora kataf (Forssk.) Engl.[GA-K68-2005]	**Kahatta-ata**	Tree	Leaf		X		X							
Commiphora terebinthina Vollesen [GA-K228-2005]	**Kahatta-timma**	Tree	Root	X										
Cactaceae														
Opuntia ficus-indica (L.) Miller	**Qulqualita**, **Papaldotta**	Shrub	Fruit	X										
Capparidaceae														
Boscia coriacea Pax [GA-K225-2005]	**Karkarota**, **Qarqarota**, **Hurhurota**	Tree	Fruit	X										
Maerua subcordata (Gilg) DeWolf [GA-H21-2007]	**Pa-ata sheka**	Shrub	Fruit	X										
Cleomaceae														
Cleome gynandra L. [GA-K114-2005, GA-H22-2007]	**Ketota**, **Kornia**	Herb	Leaf		X		X							
Combretaceae														
Combretum aculeatum Vent. [GA-K136-2005]	**Kignfirda**	Shrub	Seed	X										
Convolvulaceae														
Ipomoea coscinosperma Hochst. ex Choisy [GA-K247-2005]	**Songoderderta**	Herb	Leaf		X		X							
Ipomoea sinensis (Desr.) Choisy [GA-K147-2005]	**Horbaia**, **Hossohorbaia**	Herb	Leaf		X									
Cucurbitaceae														
Citrullus lanatus (Thunb.) Matsum. & Nakai [GA-K263-2007]	**Blass**	Vine	Fruit	X										
Coccinia abyssinica (Lam.) Cogn. [GA-K223-2005]	**Aamola**, **Hamola**, **Poteta-Karata**	Vine	Leaf		X									
			Fruit	X										
Coccinia grandis (L.) Voigt. [GA-K200-2005, GA-H25-2007]	**Lacheta**	Vine	Leaf		X		X							
			Fruit	X										
Cucumis dipsaceus Ehrenb. ex Spach [GA-K34-2005, GA-H58-2007]	**Hashupata**	Vine	Leaf		X		X							
Kedrostis pseudogijef (Gilg.) C. Jeffrey [GA-K18-2005, GA-H147-2007]	**Essatta**	Vine	Leaf		X		X							
			Fruit		X		X							
Cyperaceae														
Cyperus bulbosus Vahl [GA-K23-2005]	**Hinkicha**, **Heqeyata**	Herb	Root	X										
Ebenaceae														
Euclea divinorum Hiern [GA-K5-2005, GA-H42-2007]	**Maqayita**	Shrub	Fruit	X						X				
Euphorbiaceae														
Flueggea leucopyrus Willd. [GA-K4-2005]	**Chalanchalota**, **Hebeta**	Shrub	Fruit	X										

Family Scientific name [Vouchers]	Afa Konso name	Habit	Edible part(s)	Preparation										
				A	B	C	D	E	F	G	H	I	J	K
Fabaceae														
Acacia senegal (L.) Willd. [GA-K131-2005, GA-H127-2007]	**Pohitata**	Tree	Gum	X										
Crotalaria incana L. [GA-K258-2007, GA-H161-2007]	**Entarta shilako**	Herb	Leaf	X	X									
Parkinsonia aculeata L. [GA-K164-2005]	**Kunto-barbarie**	Tree	Seed	X										
Piliostigma thonningii (Schumach.) Milne-Redh. [GA-K1-2005]	**Kota karita**	Tree	Fruit	X										
Rhynchosia alluaudi Sacl. [GA-K206-2005, GA-K31-2005]	**Holla**	Shrub	Leaf										X	
Senna obtusifolia (L.) H.S. Irwin & Barneby [GA-K210-2005]	**NS**	Shrub	Seed	X										
Senna singueana (Delile) Lock [GA-H120-2007]	**Hanqarara**	Shrub	Seed	X										
Tamarindus indica L. [GA-K117-2005]	**Rokohta**	Tree	Fruit	X						X				
			Flower	X										
Tylosema fassoglensis (Kotschy ex Schweinf.) Torre & Hillc. [GA-H159-2007]	**NS**	Vine	Seed	X										
Vachellia hockii (De Wild.) Seigler & Ebinger [GA-K12-2005]	**Chaqenti**, **Chehchehta**	Tree	Gum	X										
			Bark	X										
Vatovaea pseudolablab (Harms) J.B. Gillett	**Kulia kurappo**	Vine	Root	X										
Vigna sp. [GA-K205-2005]	**Shirshira**	Herb	Leaf		X									
			Root	X										
Lamiaceae														
Hoslundia opposita Vahl [GA-H16-2007]	**Timwarwarsha**, **Timwarwarsha**, **Segenata**	Shrub	Fruit	X										
Ocimum forskolei Benth. [GA-K163-2005]	**Kurutatita, Kurittatita**	Herb	Leaf				X							
			Flower				X							
Premna resinosa (Hochest.) Schauer [GA-K143-2005, GA-H93-2007]	**Dodoatteta**	Shrub	Fruit	X										
Malvaceae														
Corchorus olitorius L. [GA-K171-2005]	**Mulugaya**	Herb	Leaf		X									
Corchorus tridens L. [GA-K182-2005, GA-H185-2008]	**Oloqloqota**, **Hachota**	Herb	Leaf		X		X							
Grewia balensis M.G. Gilbert & Sebsebe [GA-K222-2005]	**Dawaita**	Shrub	Fruit	X										
Grewia bicolor Juss. [GA-H63-2007]	**Daiyta**, **Dahita**, **Dawaita**	Shrub	Fruit	X			X			X				
Grewia erythraea Schweinf. [GA-K202-2005]	**Chaqlessa**	Shrub	Fruit	X										
Grewia ferruginea Hochst. ex A. Rich. [GA-K216-2005, GA-H108-2007]	**Daieta-Damale**, **Kocheta**	Shrub	Fruit	X										
Grewia flavescens Juss. [GA-K221-2005, GA-H79-2007]	**Daiyta-arba**	Shrub	Fruit	X										

Family Scientific name [Vouchers]	Afa Konso name	Habit	Edible part(s)	Preparation									
				A	B	C	D	E	F	G	H	I	J	K
Grewia lilacina K. Schum. [GA-H139-2007]	**Kocheta**	Shrub	Fruit	X						X				
Grewia mollis Juss. [GA-K204-2005, GA-H129-2007]	**Daiyta**	Tree	Fruit	X										
Grewia tenax (Forssk.) Fiori [GA-K168-2005, GA-H124-2007]	**Chaqlessa**, **Daiyta**, **Horma-Daiyta**, **Daieta-Konso**	Shrub	Fruit	X										
Grewia trichocarpa Hochst. Ex A. Rich. [GA-K252-2007]	**Dawaita**, **Daiyta**, **Ahawteta-Daiyta**	Shrub	Fruit	X						X				
Grewia velutina (Forssk.) Lam. [GA-K219-2005, GA-H65-2007]	**Dayita**, **Ahawteta-Daiyta**, **Dayita**, **Horma-Daeyta**, **Dawaita**	Tree	Fruit	X			X			X				
Grewia villosa Willd. [GA-K121-2005]	**Qoffissa**, **Offissa, Hoppissa**, **Ogomteta**	Shrub	Fruit	X						X				
Sterculia africana (Lour.) Fiori [GA-K108-2005, GA-H187-2008]	**Qawreta**	Tree	Seed	X				X						
Menispermaceae														
Chasmanthera dependens Hochst. [GA-K270-2008, GA-H128-2007]	**Sorta-Arba**	Vine	Fruit	X										
Molluginaceae														
Corbichonia decumbens (Forssk.) Exell [GA-K142-2005]	**Mocholo**	Herb	Leaf		X									
Moraceae														
Dorstenia barnimiana Schweinf. [GA-K197-2005]	**Kuritata**	Herb	Root	X										
Ficus abutilifolia (Miq.) Miq. [GA-K249-2007]	**Hobanhobata**	Tree	Fruit	X										
Ficus glumosa Delile [GA-K232-2005, GA-H35-2007]	**Halota**, **Tinaita**	Tree	Fruit	X										
Ficus ingens (Miq.) Miq. [GA-K207-2005]	**Tinaita**	Tree	Fruit	X										
Ficus platyphylla Delile [GA-K196-2005, GA-K250-2007]	**Rerumma**, **Leiya**	Tree	Fruit	X										
Ficus sur Forssk. [GA-K248-2007]	**Heleta**	Tree	Fruit	X										
Ficus sycomorus L. [GA-K257-2007]	**Hillteta**	Tree	Fruit	X					X					
Ficus thonningii Blume [GA-H32-2007]	**Tinaita**, **Chaqerta**	Tree	Fruit	X										
			Gum	X										
Ficus vasta Forssk. [GA-K3-2005]	**Leiya**	Tree	Fruit	X										
Myrtaceae														
Syzygium guineense (Willd.) DC. [GA-K13-2005]	**Tukuma**	Tree	Fruit	X										
Oxalidaceae														
Oxalis corniculata L. [GA-K244-2005]	**Melgissa**	Herb	Flower	X										
			Seed	X										
Passifloraceae														
Adenia ellenbeckii Engl. [GA-K97-2005]	**Qaqula**	Herb	Leaf		X		X							

Family Scientific name [Vouchers]	Afa Konso name	Habit	Edible part(s)	Preparation										
				A	B	C	D	E	F	G	H	I	J	K
Adenia venenata Forssk.	**Nama**	Vine	Leaf		X									
Papaveraceae														
Argemone mexicana L.	NS	Herb	Seed									X		
Phyllanthaceae														
Bridelia scleroneura Müll. Arg. [GA-K203-2005, GA-K8-2005]	**Dayita-arba**	Tree	Fruit	X										
Poaceae														
Sporobolus pyramidalis P. Beauv. [GA-K220-2005]	**Kurbata**	Herb	Seed			X			X					
Polygonaceae														
Oxygonum sinuatum (Hochst. & Steud. ex Meisn.) Dammer [GA-K174-2005]	**Mororoqissa**, **Kabeta**	Herb	Leaf		X		X							
Portulacaceae														
Portulaca oleracea L.	**Laha**	Herb	AP			X	X							X
Portulaca quadrifida L. [GA-K75-2005]	**Maraeitta**, **Mecheritta**	Herb	AP			X	X							X
Rhamnaceae														
Berchemia discolor (Klotzsch) Hemsl. [GA-K71-2005]	**Qananta**	Tree	Leaf		X									
			Fruit	X										
Ziziphus abyssinica Hochst. ex A. Rich. [GA-K214-2005, GA-H17-2007]	**Kobtta**	Tree	Fruit	X										
Ziziphus mucronata Willd. [GA-K111-2005]	**Kobta**	Tree	Fruit	X										
Rubiaceae														
Canthium pseudosetiflorum Bridson [GA-H39-2007]	**Mayeta**	Shrub	Fruit	X										
Gardenia ternifolia Schumach. & Thonn. [GA-K15-2005]	**Brmaiyta**	Tree	Fruit	X										
Psydrax schimperiana (A. Rich.) Bridson [GA-K189-2005, GA-H113-2007]	**Kahelta**	Shrub	Fruit	X										
Tarenna graveolens (S. Moore) Bremek. [GA-H190-2007]	**Hadaita**	Shrub	Fruit	X										
			Root	X										
Vangueria madagascariensis J.F. Gmel. [GA-K255-2007, GA-H29-2007]	**Mudukanta**, **Mudukanta**, **Dimbliksha**	Shrub	Fruit	X			X							
Rutaceae														
Zanthoxylum chalybeum Engl. [GA-H54-2007, GA-H186-2008]	**Kettata**	Tree	Leaf				X							
			Fruit				X							
Salvadoraceae														
Dobera glabra (Forssk.) Poir. [GA-K118-2005]	**Karssata**	Tree	Fruit	X										
			Seed		X	X								
Salvadora persica L. [GA-K161-2005]	**Ateta**	Shrub	Fruit	X						X				
Santalaceae														
Osyris quadripartita Salzm. ex Decn. [GA-K28-2005]	**Wato**	Shrub	Fruit	X										

Family Scientific name [Vouchers]	Afa Konso name	Habit	Edible part(s)	Preparation										
				A	B	C	D	E	F	G	H	I	J	K
Sapotaceae														
Mimusops kummel Bruce ex A.DC. [GA-K269-2005]	**Tulukanta**, **Tuleta**	Herb	Fruit	X										
Solanaceae														
Physalis peruviana L. [GA-K55-2005]	**Hawteta**, **Shawa**, **Luketa karma**	Herb	Fruit	X										
Solanum americanum Mill. [GA-K157-2005, GA-H12-2007]	**Chankanchankota, Kahakaha**	Herb	Leaf		X		X							
			Fruit	X										
Typhaceae														
Typha domingensis Pers. [GA-K53-2005, GA-H30-2007]	**Kaylampa**	Herb	Root	X					X					
			Pollen	X										
Verbenaceae														
Lantana trifolia L. [GA-K11-2005, GA-H165-2007]	**Bunita burayo**, **Punita burayou**	Shrub	Fruit	X										
Ximeniaceae														
Ximenia caffra Sond. [GA-K80-2005, GA-H14-2007]	**Hinkiketa**	Shrub	Fruit	X										
Zygophyllaceae														
Balanites aegyptiaca (L.) Delile [GA-K52-2005]	**Hankalta**, **Hangalta**	Tree	Leaf		X									
			Fruit	X										
			Flower		X									
Balanites rotundifolius (Tiegh.) Blatt. [GA-K110-2005]	**Kuteta**, **Patana**	Tree	Fruit	X						X				
			Seed		X	X								

Minimum Spanning tree is presented in Figure 2. The scatter plot accounted for 92.1% gof (goodness of fit). The minimum spanning tree depicted two groups; Mesoya and Jarso lying between 540-1530 masl, and Addis Gebere, Doketu and Keserkio lying between 1450-1980 masl.

Edible plant parts and preparation for consumption

Multiple parts are consumed in about 1/4 of species in Table 1. 46% eaten were fruits, 23% leaves and juvenile shoots, 12% roots/rhizomes/tubers, and 8% seeds. Moreover, 55% are consumed raw (Table 1).

Community preference for taste of fruits and leafy vegetables of WEPS

While most species are consumed in all **kebeles**, only a few are specific to a single **kebele** or a single informant. The pattern of consumption of each plant has also varied with availability or scarcity of food. Some plants were consumed under normal conditions even during glut while some others were consumed during food scarcity and acute food shortage. When food shortage gets severe, people tend to consume plants that have less acceptable taste under normal conditions. Preference for taste of fruits in the study

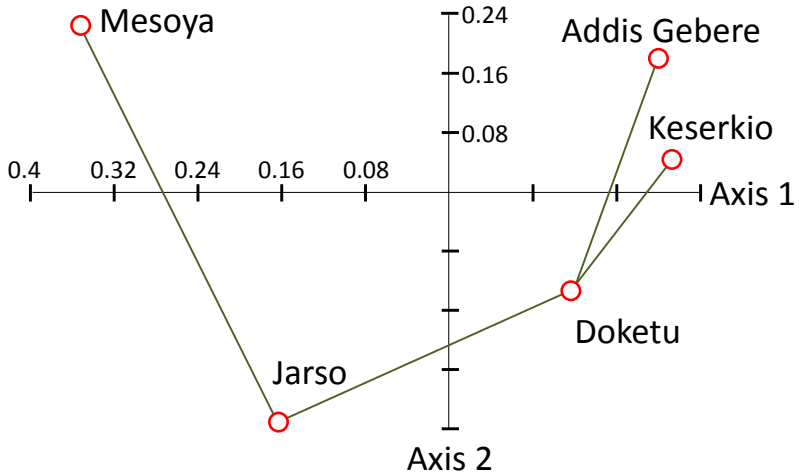

Figure 2. Ordination of principal coordinates as a scattergram of the study kebeles connected by their minimum spanning tree as defined by the first and second coordinates on presence/absence of wild and semi-wild edible plant species.

area is presented in Table 2. *Opuntia ficus-indica* (L.) Mill. ranked highest across the entire study area although it was only highest within two **kebeles**. *Opuntia ficus-indica* grows in areas of higher slopes which are more vulnerable to soil erosion. It was observed that the plant is effective in preventing soil erosion. Paired comparison of green leafy vegetables (GLVs) in each study site also revealed that *Leptadenia hastata* Vatke is highest total ranked but only highest ranked in one **kebele** (Table 3).

Dietary safety of wild and semi-wild edible plant parts

Of the 154 edible parts recorded, 29% were mentioned as unsafe for all, or vulnerable social groups such as pregnant women, children and the elderly either during the processes of collection and preparation or during consumption. Eye irritation, which in the worst case may lead to blindness during harvesting of *O. ficus-indica*, skin and mouth irritation by *A. gomboczianus*, reversible joint paralysis due to consumption of *Justicia ladanoides* Lam. were the major adverse effects mentioned by the informants. *Amaranthus angustifolius* var. *graecizans* Thell., *Ficus vasta* Forssk., *Ximenia caffra* Sond., *Balanites aegyptiaca* (L.) Delile (leaf), *Corchorus tridens* L., *Dobera glabra* (Forssk.) Poir. (seed) and *Tamarindus indica* L. were also mentioned in their order of significance for causing health problems, mainly in the form of abdominal pain and diarrhoea. It was also reported that children eating large fruit

Table 2. Pooled summary of pairwise ranking based on taste of fruits in Konso Wereda ethnic community **kebeles** in Ethiopia. Note: Fruit of plants with the highest preference score are the most preferred in the respective **kebeles**, and rank is for overall preference by the Konso total community. (-) Edible plant not selected for comparison in the respective **kebele**.

Plant	Study kebeles						Total score	Rank
	Addis Gebere	Doketu	Keserkio	Jarso	Mesoya	Karate (Capital)		
Balanites aegyptiaca (L.) Delile	-	8	-	16	-	-	24	21
Balanites rotundifolius (Tiegh.) Blatt.	-	47	-	54	35	-	136	5
Berchemia discolor (Klotzsch) Hemsl.	-	27	18	58	-	28	131	6
Blyttia fruticulosa (Decne.) D.V. Field	-	-	25	-	-	25	50	13
Canthium pseudosetiflorum Bridson	-	60	-	12	-	-	72	10
Carissa spinarum L.	34	-	16	-	-	12	62	11
Cordia africana Lam.	-	-	-	-	32	-	32	19
Ficus sycomorus L. subsp. *sycomorus*	24	-	-	-	-	-	24	21
Ficus thonningii Blume	-	34	59	-	64	22	179	4
Ficus vasta Forssk.	54	50	82	-	-	27	213	3
Grewia erythraea Schweinf.	-	-	-	55	26	-	81	8
Grewia tenax (Forssk.) Fiori	-	-	-	-	26	-	26	20
Grewia velutina (Forssk.) Lam.	-	-	26	-	-	13	39	17
Grewia villosa Willd.	-	-	-	45	15	-	60	12
Mimusops kummel Bruce ex A. DC.	26	-	-	-	17	-	43	16
Opuntia ficus-indica (L.) Mill.	48	60	73	68	-	37	286	1
Physalis peruviana L.	45	-	-	-	-	-	45	14
Rhus natalensis Bernh.	34	-	-	11	-	-	45	14
Sterculia africana (Lour.) Fiori	-	29	46	41	-	12	128	7
Uvaria acuminata Oliv.	-	-	-	-	38	-	38	18
Vangueria madagascariensis J.F. Gmel. var. *madagascariensis*	72	45	45	-	60	3	225	2
Vangueria madagascariensis J.F. Gmel. var. *abyssinica* (A. Rich.) Puff	-	-	60	-	-	19	79	9
Ximenia caffra Sond.	23	-	-	-	-	-	23	23

Table 3. Pooled summary of pairwise ranking based on taste of green leafy vegetables in Konso Wereda ethnic community **kebeles** in Ethiopia. Note: Leafy vegetables with the highest score are the most preferred in the respective **kebeles**, and rank is for overall preference by the Konso community. [-] edible plants not selected for comparison in the respective **kebele**.

Plant	Study kebeles						Total score	Rank
	Addis Gebere	Doketu	Keserkio	Jarso	Mesoya	Karate (Capital)		
Adenia ellenbeckii Engl.	-	42	-	38	-	-	80	9
Amaranthus angustifolius var. *graecizans* Thell.	54	64	35	11	16	30	210	4
Amaranthus hybridus L.	-	54	40	29	32	17	172	5
Asystasia gangetica (L.) T. Anderson	-	-	-	-	34	-	34	15
Balanites aegyptiaca (L.) Delile	-	32	-	34	-	-	66	11
Celosia argentea L.	24	-	-	40	-	29	93	8
Celosia trigyna L.	24	-	36	-	-	-	60	13
Corchorus olitorius L.	-	-	-	-	63	-	63	12
Corchorus tridens L.	63	59	23	77	-	26	248	2
Digera muricata (L.) Mart.	-	-	36	40	-	-	76	10
Justicia flava (Forssk.) Vahl	31	40	-	48	26	-	145	6
Kedrostis pseudogijef C. Jeffrey	50	7	33	-	32	10	132	7
Leptadenia hastata Vatke	51	61	49	66	46	20	293	1
Pachycymbium laticorona (M.G. Gilbert) M.G. Gilbert	-	39	-	-	-	-	39	14
Pentarrhinum insipidum E. Mey.	15	-	-	-	-	10	25	16
Portulaca quadrifida L.	64	52	47	17	31	9	220	3
Solanum americanum Mill.	8	-	-	-	-	-	8	17

with slimy pericarps such as *Sclerocarya birrea* (A. Rich.) Hochst., and occasionally *X. caffra* can block the respiratory channel, resulting in suffocation and death. Under certain circumstances, locally prescribed antidotes are given to individuals who suffer from the adverse effects of consuming unsafe WEPS.

Marketing of WEPS

Many of the WEPS consumed raw are eaten outdoors (in agricultural fields, during cattle keeping and travelling). GLVs and some other parts that require processing such as root of *A. gomboczianus*, seed of *D. glabra*, *Sterculia africana* (Lour.) Fiori and *Amaranthus hybridus* L. are brought home for preparation prior to consumption. There are also marketable WEPS which are mostly collected by children, and sometimes mothers.

Interviews (n=51) based on a prepared checklist of WEPS in each **kebele** revealed that 54 edible plant parts are available in the market, 33 of which were mentioned by two or more participants. Edible parts with the highest five FL values are *L. hastata* (96%), *Balanites rotundifolius* (Tiegh.) Blatt. (63%), *Berchemia discolor* (Klotzsch) Hemsl. (61%), *T. indica* (49%) and *B. aegyptiaca* (fruit) (47%). Paired comparisons of short listed marketable edible plant parts showed *L. hastata* as the most marketable WEPS (Table 4). Generally, the FL and paired comparison showed the same highly marketable edible plant parts but lack complete congruence in ranking. The study further revealed that selling of WEPS increases during food scarcity.

Cultural importance of WEPS

The study showed that WEPS have many uses other than food and that knowledge of uses varies among social groups. Males had significantly better knowledge of plant uses for construction, agricultural tools, technology and household uses, while females are more knowledgeable about fuel wood ($P < 0.05$). However, when age groups are considered, there was no significant difference ($P > 0.05$) of uses for food, construction, fuel, animal feed, agricultural tool, technology and medicine among the participants. Furthermore, comparison based on gender showed no significant variation in knowledge between males and

Table 4. Pooled summary of pairwise ranking based on cash earning of the edible parts in Konso Wereda ethnic community **kebeles** in Ethiopia. Note: Edible plant parts with the highest score are the most preferred in the respective **kebeles**, and rank is for overall preference by the Konso community. [-] edible plant not selected for comparison in the respective **kebele**.

Plant	Part used	Study kebeles						Total score	Rank
		Addis Gebere	Doketu	Keserkio	Jarso	Mesoya	Karate (Capital)		
Amaranthus hybridus L.	seed	32	-	8	6	-	11	57	11
Balanites aegyptiacus (L.) Delile	fruit	-	20	-	25	-	19	64	7
	leaf	-	18	-	-	-	13	31	13
Balanites rotundifolius (Tiegh.) Blatt.	fruit	-	34	-	33	9	20	96	4
Berchemia discolor (Klotzsch) Hemsl.	fruit	-	55	24	53	-	40	172	2
Blyttia fruticulosa (Decne.) D.V. Field	fruit	-	-	26	-	-	-	26	16
Carissa spinarum L.	fruit	9	-	-	-	-	-	9	18
Corchorus olitorius L.	fruit	-	-	-	-	61	-	61	9
Digera muricata (L.) Mart.	leaf	-	-	-	-	30	-	30	14
Ficus platyphylla Delile	fruit	-	-	40	-	-	-	40	12
Ficus vasta Forssk.	fruit	-	-	47	-	-	11	58	10
Leptadenia hastata Vatke	leaf	35	67	58	55	65	41	321	1
Mimusops kummel Bruce ex A. DC.	fruit	24	-	-	-	4	-	28	15
Portulaca quadrifida L.	aerial part	40	40	-	11	-	-	91	5
Sterculia africana (Lour.) Fiori	seed	-	-	41	-	32	13	86	6
Tamarindus indica L.	fruit	-	25	20	19	16	27	107	3
Vangueria madagascariensis J.F. Gmel. var. *madagascariensis*	fruit	22	19	-	-	-	21	62	8
Ximenia caffra Sond.	fruit	-	-	-	-	10	-	10	17

females on use of plants for food, animal feed, medicine and fence.

A total of 17 multipurpose WEPS were identified from all the rural **kebeles**. Direct matrix ranking of selected wild and semi-wild multiple use plants (Table 5) shows the most preferred for multiple uses in order of their importance in Konso. Moreover, among 49 short listed WEPS, *Grewia velutina* (Forssk.) Lam. (6.0), *Ficus sycomorus* L. subsp. *sycomorus* (5.6), *Cordia africana* Lam. (5.0), *Ziziphus mucronata* Willd. (4.6), *B. rotundifolius* (4.2) and *Cordia sinensis* Lam. (4.1) scored the highest use values. *Grewia velutina* has the highest use value in three (Addis Gebere, Doketu and Jarso **kebeles**) and *C. africana* in two (Keserkio and Mesoya) **kebeles**. *Ficus sycomorus* also stood third in four and fourth in one **kebele**. The study further showed that the average values of the response of the different age groups though not statistically significant ranged from 4.2 to 4.7. However, use value of the selected plants mentioned by males (4.66) was significantly higher ($P < 0.05$) than females (4.31).

Traditional medicinal use of WEPS

Thirty-five of 127 WEPS were reported to be useful for treating different human ailments. Fifty-one plant parts from the 35 WEPS were reported to have medicinal use. Of these plant parts, 66.7% were identified as nutraceuticals (used as food and medicine). *Corchorus olitorius* L. was mentioned by 40 of 61 interviewed participants, *A. hybridus* by 23 of 335 and *C. tridens*, *O. ficus-indica* and *C. africana* by 41, 33 and 25 of 274 participants, respectively, as useful to treat diarrhoea (**sererota**). All of the medicinally useful parts were also edible (nutraceuticals). Seven of the 127 WEPS were also mentioned as medicine for livestock.

Habitats and abundance of WEPS

Most of the 127 scientifically identified WEPS occur in two or more habitats: woodland/wooded grasslands (67%), agricultural fields (43%), bushlands (35%) and riverine/dry river beds (26%). Fences, home-gardens, fallow

Table 5. Direct matrix ranking of 17 edible wild plant species on eight use criteria in Konso Wereda ethnic community **kebeles** in Ethiopia. [-] not reported; Highest total score is most used among compared plants.

Edible wild plant species	Rank	Total score	Broad use category (etic category)							
			Edibility	Medicine	Construction/ Building	Furniture (household use)	Agricultural Tools	Fuel Wood	Fodder	Income Generation
Cordia africana Lam.	1	202	24	24	27	31	25	19	22	30
Grewia velutina (Forssk.) Lam.	2	201	23	-	31	15	39	36	37	20
Ficus sycomorus L.	3	159	24	-	27	36	-	18	20	34
Rhus natalensis Bernh.	4	111	13	7	11	-	18	24	20	18
Cordia sinensis Lam.	5	75	8	-	13	-	15	14	12	13
Berchemia discolor (Klotzsch) Hemsl.	6	71	14	-	13	0	13	12	11	8
Balanites aegyptiacus (L.) Delile	7	65	14	8	4	10	4	9	11	5
Ziziphus mucronata Willd.	8	50	5	-	14	-	4	10	12	5
Hyphaene thebaica (L.) Mart.	9	46	5	-	7	12	5	5	-	12
Dobera glabra (Forssk.) Poir.	10	41	11	-	-	14	-	4	4	8
Ficus vasta Forssk.	11	30	8	-	6	6	-	2	4	4
Tamarindus indica L.	12	29	3	7	-	4	5	3	4	3
Mimusops kummel Bruce ex A. DC.	13	28	4	-	3	5	5	5	3	3
Bridelia scleroneura Müll. Arg.	14	21	2	-	5	-	4	6	2	2
Uvaria acuminata Oliv.	15	15	8	-	3	-	-	4	-	-
Lannea rivae Sacleux	16	14	1				5	3	1	4
Sterculia africana (Lour.) Fiori	17	13	8	-	-	-	-	1	3	1

lands, rocky/stony areas, roadsides, forests, grasslands and forest margins also harbor 18% or fewer WEPS each. The WEPS are found in different levels of abundance as expressed by AI. WEPS AI ranged between 1 and 4, with 2.4 as the mean. Among the 123 WEPS on which participants reflected their view on abundance status, only 16% were reported to be very abundant (3 < AI < 4), 45% were abundant (2 < AI < 3), 37% were occasionally found (1 < AI < 2), and 2% were rare (AI = 1). Based on AI values and observation during the field visits by the principal investigator, *Bridelia scleroneura* Müll. Arg. (only one plant observed), *Canthium pseudosetiflorum* Bridson, *Ficus ingens* (Miq.) Miq., *Ficus platyphylla* Delile, *Ficus sur* Forssk., *F. sycomorus* subsp. *gnaphalocarpa* (Miq.) C.C. Berg, *F. vasta*, *Mimusops kummel* Bruce ex A. DC., *Syzygium guineense* (Willd.) DC. subsp. *guineense*, *S. birrea*, and *Ziziphus abyssinica* Hochst. ex A. Rich. were the most threatened plant species in the study area. Most of these plants are trees suffering from destructive harvesting for multiple uses.

The pairwise ranking on WEPS has indicated the threat which some of the species are facing if the trend of their decline remains unabated. Table 6 presents results of the pairwise comparison on scarcity of 21 WEPS. Factors that may influence the scarcity of the WEPS were largely anthropogenic. Among the short listed plants for paired comparison by the FGD participants, *C. pseudosetiflorum* is the most threatened. The result of the availability index value also indicates the same trend. Further discussion with the participants showed preference and selective logging for house construction of *C. pseudosetiflorum* as the main cause for the threat. A related Konso saying **Mayeta messelle orottitta mana**, reflects prolonged use of the plant for house construction. The plant is still the best choice for making trusses. Previously, *O. ficus-indica* was also very abundant but since relatively recent times, the plant is being uprooted to acquire more land for crop cultivation. Distribution of *O. ficus-indica* is now limited to wasteland areas. Use of the hollow trunk of *Hyphaene thebaica* (L.) Mart. for beehives, branches and leaves for household uses, as well as agricultural expansion to extreme lowland areas where the plant naturally grows are the main reasons for scarcity of the plant. Trunks of F. *sycomorus*, which is vulnerable to destructive harvesting, are preferred for making "**toma**/**tomeda**" utensils used to prepare a local beverage (**cheqa**).

Table 6. Pooled summary of a pairwise ranking based on degree of scarcity in Konso Wereda ethnic community **kebeles** in Ethiopia. Note: Edible plant parts with the highest score are the scarcest WEPS in the respective **kebeles**, and rank is for overall preference by the Konso community [-] edible plant not selected for comparison in the respective **kebele**.

Scientific/local name	Study kebeles							
	Addis Gebere	Doketu	Keserkio	Jarso	Mesoya	Karate (Capital)	Sum	Rank
Balanites rotundifolius (Tiegh.) Blatt.	1	12	-	-	-	-	12	16
Berchemia discolor (Klotzsch) Hemsl.	-	-	-	-	-	4	4	19
Bridelia scleroneura Müll. Arg.	21	-	-	-	-	-	21	12
Dobera glabra (Forssk.) Poir.	-	11	-	-	-	-	11	17
Canthium pseudosetiflorum Bridson	30	37	38	27	-	4	136	1
Ceropegia sp.	-	-	-	22	-	-	22	11
Cordia sinensis Lam.	-	-	-	-	32	-	32	6
Ficus sycomorus L.	-	-	22	-	26	4	52	4
Flueggea leucopyrus Willd.	-	-	21	-	-	7	28	8
Grewia velutina (Forssk.) Lam.	-	-	-	-	20	3	23	10
Hyphaene thebaica (L.) Mart.	-	-	36	-	22	0	58	3
Lannea rivae Sacleux	-	-	-	19	-	-	19	13
Mimusops kummel Bruce ex A. DC.	10	-	-	-	-	-	10	18
Opuntia ficus-indica (L.) Mill.	21	48	-	20	-	-	89	2
Pentarrhinum insipidum E. Mey.	-	-	26	-	-	-	26	9
Rhus natalensis Bernh.	-	23	7	-	-	12	42	5
Syzygium guineense (Willd.) DC. subsp. *guineense*	14	-	-	-	-	-	14	15
Tamarindus indica L.	-	-	26	-	-	5	31	7
Ximenia caffra Sond.	-	19	-	-	-	-	19	13

Discussion

The 137 WEPS consumed in Konso are also documented as edible in other parts of Ethiopia (Abbink 1993, Addis *et al*. 2005, Asfaw & Tadesse 2001, Balemie & Kebebew 2006, Feyssa *et al*. 2011, 2012, Getahun 1974, Guinand & Lemessa 2001, Lulekal *et al*. 2011, Ocho *et al*. 2012, Woube 1995, Wondimu 2007, Wondimu *et al*. 2006) and elsewhere in Africa (Lepofsky *et al*. 1985, Maundu *et al*. 1999, Ogle & Grivetti 1985a,b,c,d, Zinyama *et al*. 1990) and Asia (Gopalan *et al*. 1989). According to Wondimu (2007), the dryland areas of Ethiopia alone host 287 edible wild plant species. The studies made so far on wild edible plants of Ethiopia provide good indications of the presence of a larger aggregation of plants (e.g., herbs, trees, shrubs, climbers, creepers) with edible parts (e.g., fruits, leaves, roots/tubers, seeds). The present study presents a large proportion of these plant species from a limited area. It can therefore be inferred that further ethnobotanical studies in less studied parts of Ethiopia would add more species to the list. A complete database for Ethiopia could be built through a series of such studies.

Among the wild edible fruits, *O. ficus-indica* was the most preferred (with regard to taste) in Konso. The fruit of *O. ficus-indica* is available for consumption throughout the year and its index of ingestion compared to other WEPS is high (Addis 2009). Moreover, it is rich in its carbohydrate and protein contents (Tegegne 2001). However, consumption of *O. ficus-indica* is usually limited to children (Addis 2009). Problems associated with harvesting and preparation/peeling of the fruit cover due to its prickly trichomes, and destruction of the plant to use the land for agriculture have affected its consumption. The use of *O. ficus-indica* in northern Ethiopia is showing an increasing trend as a result of support by modern processing and packaging technologies. Expanding the cultivation and use of this plant in Konso would be a sensible undertaking. The highly drought resistant nature of the plant also makes the fruit preferable in areas where there is inadequate and erratic rainfall, as in Konso.

All wild GLVs have high indexes of ingestion as compared to fruits, which is directly associated with filling qualities and better nutritional composition (Addis 2009). In Konso, wild GLVs are part of household menus but with varying

degrees of consumption depending on the season (availability of the GLVs and level of conventional food stocks). The present study indicated that *L. hastata* is the most preferred wild GLV in terms of its taste. The plant provides leaves throughout the year but its palatability varied with seasons. Moreover, it is known for causing stomachaches. Hence, it is suggested to conduct acute and possibly sub-chronic and chronic toxicity studies before recommending it for wider use.

If advocacy work is conducted about benefits of underutilized GLVs and supported with food technologies, it could be possible to promote selected WEPS as part of the food habits of rural and urban inhabitants of Konso. The use of GLVs as part of main dishes or supplements by the population helps to alleviate malnutrition. Moreover, intake of GLVs by adults and elders in particular should be encouraged in order to prevent age related degenerative diseases. GLVs may be good sources of antioxidants which prevent excess flow of pro-oxidants that are known to interfere with the normal human physiology in the body and lead to various degenerative diseases (Bendich 1994, Buri 1997, Krinsky 1993, Zaman *et al*. 1992). Vegetables rich in antioxidants are known to enhance immunity against infectious diseases (West *et al*. 1989) and suppress human immunodeficiency virus (Garewal *et al*. 1992). Promotion for a wider use of ecologically adapted WEPS can also assist in improving food security under impending threats of climate change.

GLVs mostly pass through different household processing such as drying and wilting under shade, wilting with direct sun light and blanching of GLVs are common practices. Processing of GLVs has benefits and drawbacks in terms of storage, organoleptic properties, and nutritional and biomedical importance (Addis 2009, Addis *et al*. 2009, Cano *et al*. 1997). For example, blanching for a short duration prevents enzymatic spoilage of GLVs and increases bioavailability of nutrients and other plant ingredients of biomedical importance. However, drying (sun drying in particular) and deep boiling of GLVs is detrimental to some nutritional plant ingredients of biomedical importance (Addis 2009, Addis *et al*. 2009). Experience from northern Ethiopia shows that there is a possibility of processing the fruit of *O. ficus-indica* in the form of juice and jam. Adoption of such practices in Konso can contribute to food security and improving livelihoods of local people through marketing, and maintaining the plant which is under threat. It is therefore recommended to invest in development of food technologies to increase sensory acceptability and obtain optimum food value.

The study showed that some WEPS can cause health problem(s) if consumed excessively. In the Konso and other communities elsewhere in Ethiopia (Addis *et al*. 2005) complain about constipation that results from ingesting *O. ficus-indica* in large amounts. Prior to promotion for wider use of the fruit, it would be advisable to study the cause of constipation and design mitigating mechanism(s). In Konso, the fruit is also used to treat diarrhoea caused by excessive consumption of wild GLVs. Excessive consumption of *Justicia ladanoides* leaves results in reversible paralysis. Detailed investigation is required to identify the responsible phytochemical and physiological mechanism(s) which lead to this symptom and the prolonged effect of consumption of the plant and possible mechanisms for detoxification. Seeds of an invasive exotic weed, *Argemone mexicana* L., are known to affect human health even causing death (Babu *et al*. 2007), have been found to be eaten in some parts of Konso. There is need to raise awareness of possible detrimental effects of ingesting plant parts that are not commonly known and experience about safety is lacking.

Many wild GLVs are also mentioned to cause diarrhoea. Leafy vegetables may have natural laxative properties resulting in relaxation of the intestines. This prevents prolonged storage of the stool in the large intestine with consequent prevention of water absorption and softening of the stool. As the amount of leafy vegetable increases, appearance of the stool changes into a fluid form which leads to complaints as an unwanted diarrheal effect. The problem may be exacerbated whenever there are low food stocks and the community tends to resort to free and locally available GLVs. It is, therefore, advisable to balance the intake with cereals and pulses whenever possible. Change in normal physiological conditions (other than laxative properties) due to ingesting the vegetables and subsequent health problems cannot be ruled out but requires further study of individual edible plant parts.

Medicinally important WEPS frequency of citation for particular ailments varied by species. Although plants with higher citations for a particular ailment are most likely to be biologically active (Giday 2007, Trotter & Logan 1986), citation of plants by few or even one individual should not be ignored. The knowledge associated with medicinal plants in most parts of Ethiopia is a public domain but some may require specialization, and hence people are supposed to look for traditional healers for specific or severe health problems. Study of nutraceutical benefits (e.g., antioxidant properties) of selected edibles and advocating positive results can expand the range of WEPS consumption in urban areas where change in dietary habits has led to increases in the prevalence of chronic health problems in Ethiopia (ACIPH & MIRT 2010).

Although most of the 127 identified WEPS occur abundantly in Konso, some such as, *A. gomboczianus*, which is endemic to Ethiopia, are categorized as critically threatened in the country (Ensermu Kelbessa, personal communication) and require focus of protection and propagation. The extended food supermarket, traditional concept and practice in Konso such as tolerating *A. gomboczianus* in agricultural fields and home-gardens to use the edible tuber when required is an important strategy for conser-

vation and sustainable use of the plant. According to Cunningham (2001), most harvesting practices have effects on plant populations but with different degrees of threat to each species. Effects of harvesting on sustainability of plant populations depend upon type of plant part harvested and quantity, intensity and frequency of harvesting. Accordingly, edible plant parts can be grouped into lower-impact that included leaves, flower and fruits, and higher impact including bark, roots, stems, and whole plant depending on the level of resilience to harvesting. Furthermore, sustainability of harvest of each edible part can be subdivided according to the biology of the plant species. For example, species that are common and fast growing ruderals such as *A. hybridus*, *A. angustifolius* var. *graecizans*, *Solanum americanum* Mill. and *Portulaca quadrifida* L. are less vulnerable to damage due to harvesting the whole plant while perennial plants such as *F. sycomorus* and *H. thebaica* could be eliminated if more sensitive parts of the plant are selectively harvested. In the present study, 68% of the edible plant parts are fruits and leaves. These plant parts have low-impact on vulnerability of the plant to harvesting. Moreover, biology of the plant species with edible parts categorized under higher-impact use, such as root of *Arisaema flavum* (Forssk.) Schott, *A. gomboczianus* and *Cyperus* spp. have highly sustainable harvests and they are only occasionally consumed. Plants such as *Commiphora* spp., *Dorstenia barnimiana* Schweinf., *Ipomoea marmorata* Britt. & Rendle and *Asparagus* spp. of higher-impact use are seldom used at low frequency and intensity. Therefore, harvesting impact of the edible wild plant parts is of less concern to sustainability of the plant species. The threat to many of the WEPS, mainly trees and shrubs, emanates from their multiple uses other than food, largely associated with deforestation for various purposes such as use of land for agriculture (Addis 2009). Attitudes of ownership or stewardship towards plants are likely to be reduced with increasing ownership of land and agricultural expansion.

Generally, germplasm collection, multiplication, characterization and evaluation as well as giving priority to tree and shrub species that are affected by over exploitation and destruction would help in the conservation of the WEPS. Seed germination and propagation studies on WEPS would also contribute to their promotion and conservation. The need for investigating nutritional profiles and antinutritional factors that impair nutrients and safety of the edibles has become eminent to increase the consumption level of the WEPS in both the urban and rural settings.

Conclusions and Recommendations

This study showed that acceptance and preference of WEPS by the community, ecological benefit they offer and safety vary among species. It is therefore suggested to promote WEPS in a step-by-step manner taking the elites in the first line and subsequently bringing the others into the pipeline. Priority actions should mainly be directed to safety of the WEPS. After understanding safety, plants with better cumulative characteristics (e.g., cultural acceptance for consumption, sustainability, harvesting values, gastronomic and organoleptic properties, nutritional composition, tolerance to adverse environmental conditions, multiplicity of uses, ecological benefits and ease of production/collection) can be used as criteria for priority setting. Accordingly, the WEPS are categorized into three priority levels considering the time and work needed for promotion along with suggested actions. In the first line of action, elites can be selected directly from the wider pool of the WEPS for utilization. Based on multiple criteria, *S. americanum*, *A. hybridus* and *O. ficus-indica* are suggested to be considered for promotion as source of vegetables, grain, and fruit, respectively. In order to improve production and food value of these species, study of cultivation, storage and preservation, increasing sensory acceptability, and breeding activities are suggested. Plants that are commonly consumed by the communities but identified to have relatively low sensory acceptability and/or claimed to have some side effects are suggested in the second line of promotion. Leafy vegetables such as *A. angustifolius* var. *graecizans*, *L. hastata*, *P. quadrifida*, *B. aegyptiaca*, *Adenia ellenbeckii* Engl., *Coccinia grandis* (L.) Voigt., *C. olitorius* and *C. tridens* and tubers of *A. flavum* and *A. gomboczianus* are suggested. In addition to the suggested actions explained above, dietary counselling, acute and chronic toxicity studies are required prior to recommending for promotion. In the third line of action, WEPS of better safety, public acceptance, food value and medicinal values as well as ease of propagation may be selected for promotion following more wide study.

This work could be used to prioritize plants and design conservation strategies. Although most harvesting methods of edible parts do not pose much threat to WEPS, destructive collection of selected tree and shrub species for other uses has threatened their survival. This study implicates the possibility that stands of *C. pseudosetiflorum*, *O. ficus-indica*, *H. thebiaca* and *F. sycomorus* among others are decreasing and if this is happening it is due to selective harvesting or their removal to use the land for agriculture. We therefore propose implementing appropriate management and rehabilitation practices, and look for sustainable alternative technologies which can prevent loss of the plants. It should therefore be a priority to identify areas for in-situ conservation in Konso and to encourage preservation of traditional protected areas.

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