The Role of Wild and Semi-wild Edible Plants in Household Food Sovereignty in Hamer and Konso Communities, South Ethiopia

Getachew Addis, Zemede Asfaw and Zerihun Woldu

Research

Abstract

A survey was conducted to investigate incidence of food shortage and coping mechanisms, knowledge, consumption attitudes and practices, and conservation and management of wild and semi-wild edible plant species (WEPS) by Hamer and Konso communities of Ethiopia. Irrespective of their social and economic strata, all study participants reported consumption of WEPS in which increasing frequency, quantity and number of species consumed during food scarcity. More WEPS were consumed during famine that had lower sensory acceptability, poor cooking quality, and inflicted some kind of health problems. *Leptadenia lancifolia* (Schumach. & Thonn.) Decne. was the most preferred WEPS sought after during food deficiency by both communities. Ninety-three WEPS are managed by both communities mainly in the vicinity of human settlements and farmlands. The Konso community demonstrated long established cultural practices of conserving, managing and using WEPS. Planning for promotion, sustainable use and conservation of WEPS should take note of knowledge and practices of local communities on account of the key roles they would play in food security-sovereignty initiatives.

Introduction

Narrowing down of food sources by promoting high-yielding varieties through agricultural practices is a potential threat to sustainable crop production in view of the impeding climate change. Existing evidence indicates increase in pathogenicity and/or emergence of new virulent pathogens due to warming up of the climate (Anderson *et al*. 2004, Brasier 1996). Studies by Brasier (1996) showed that *Phytophthora cinnamomi* causes more severe root rot on oak at higher temperatures. Diversifying food sources through the use of ecologically adapted crops, including selected recruits from among the wild edible species, would contribute to the fight against food insecurity and malnutrition. This is the right route towards food-secure communities targeting food sovereignty where communities could maintain their traditional foods while producing or collecting them at their own convenience. Research in different parts of Africa has shown that wild plant and animal species are quite extensively used both in times of food glut and during acute food shortage (Ogle & Grivetti 1985a, Zinyama *et al*. 1990). Mostly, women and children routinely go out into the field and forests to collect a variety of leaves, roots and tubers, seeds, and fruits. When food is plentiful, many societies usually use these plants as side dishes, as relishes accompanying the main meals, or as snacks in between meals (Lepofsky *et al*. 1985, Ogle & Grivetti 1985d, Zinyama *et al*. 1990). Many studies show that a number of the wild edible plants supply a considerable amount of required nutrients (Addis *et al*. 2013, Maundu *et al*. 1999).

A limited number of studies have reported on use of wild plants in the Ethiopian diet (Addis *et al*. 2005, Asfaw &

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Tadesse 2001, Balemie & Kebebew 2006, Feyssa *et al*. 2012, Getahun 1974, Guinand & Lemessa 2001, Lulekal *et al*. 2011, Mengistu & Hager 2008, Ocho *et al*. 2012, Soromessa & Demissew 2002, Woldu *et al*. 2006, Wondimu *et al*. 2006). Utilization of wild plants for food varies with age and gender, time of the day, seaso,n and available food stock. The number of species and plant parts used for food by all age and gender groups increases at times of famine or food shortage resulting from domestic conflicts. Monks, nuns, and hermits of monasteries in isolated rural Orthodox Churches in Ethiopia supplement their diet with plant resources obtained from the wild (Getahun 1974).

The knowledge, tradition, and opportunity of using wild plants as supplements to dietary intakes have been described for some communities. The collection, documentation, and dissemination of indigenous knowledge on WEPS have been limited to a few ethnic groups in Ethiopia. Inventories of wild edible plants are mostly available in the major languages such as Amharic, Oromo, and Tigre (Addis *et al*. 2005, Feyssa *et al*. 2012, Wondimu *et al*. 2006). There are few or no documents on indigenous knowledge and practice with wild and semi-wild edible plant species (WEPS) in the remote parts of southern Ethiopia where their use is even more prominent both at times of glut and food deficiency. Therefore, there is a need to study and to augment the knowledge base, practices, and attitudes of the communities towards use of WEPS; the local coping mechanisms against intermittent food scarcity and famine in these areas; and sustainable use and conservation of plants in general and WEPS in particular. Ethiopia's aspirations to create healthy and productive environments, and communities enjoying food security as well as food sovereignty could be realized through effective application of indigenous knowledge and practices. The present investigation was mainly designed to study the management practices, and the scale and conditions of wild/semi-wild plant consumption in two communities (Hamer and Konso) of southern Ethiopia.

Study Area and Methods

Study areas and people

A reconnaissance survey was conducted between February and March 2005 to select study sites. Accordingly, Hamer and Konso **woredas** (districts) were selected based on existing vegetation types, natural resource management, indigenous knowledge, and practices associated with conservation and use of wild plants. The majority of the inhabitants in these **woredas** are of the Hamer and Konso ethnic communities.

Hamer **woreda** is located between 4°31' to 5°28' N and 36°9' to 36°53' E at an altitudinal range of 381 to 2084 meters above sea level (masl) (Figure 1). The annual rainfall ranges between 480 mm in the extreme lowland to 827 mm at Dimeka (capital town of the **woreda**) which may be higher in more elevated parts. The population of Hamer is estimated at 46,129, of whom 98.6% reside in rural areas (Population Census Commission 2008). The majority from the Hamer community sustain their life mainly through cattle raising supplemented by a little cereal crop production and collection of wild edible plants. Livestock and their products are sources of cash for immediate use, food, and prestige in the community. The Hamer are patrilin-

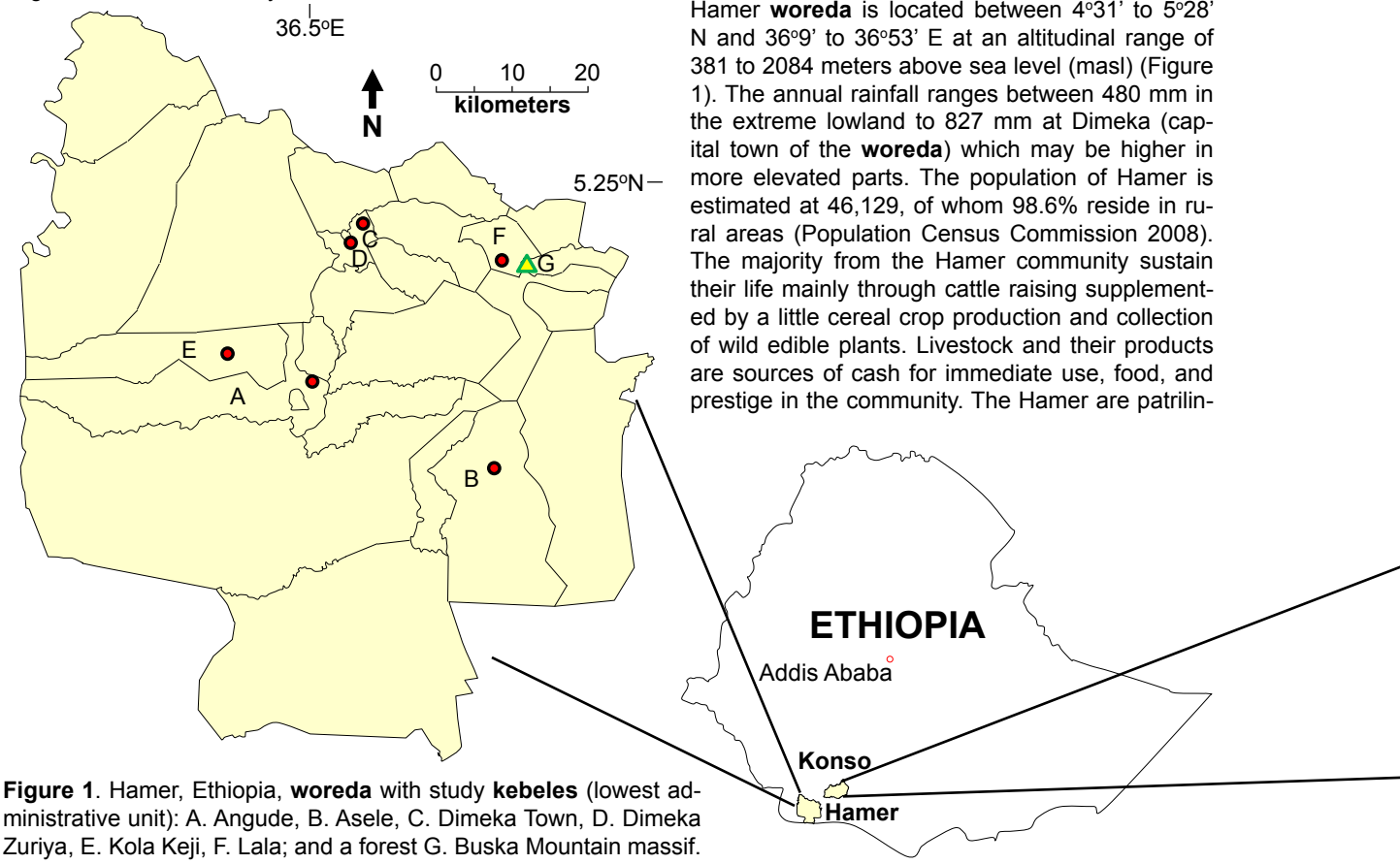

Figure 1. Hamer, Ethiopia, **woreda** with study **kebeles** (lowest administrative unit): A. Angude, B. Asele, C. Dimeka Town, D. Dimeka Zuriya, E. Kola Keji, F. Lala; and a forest G. Buska Mountain massif.

eal, but the heavier burden of family responsibility falls on women. Hamer social events such as Ivan-Gadi (dancing throughout the night), Ekuli-Bula (bull jumping rituals for adolescent males), to qualify for marriage, and using colored clay paste mixed with butter for cosmetic purposes are their important cultural displays. During marriage arrangements, the bride is allowed to consume only animal products (meat, milk, and blood) for months without any contact with the groom until the approval of the elders. The Hamer communities have maintained their culture for generations, but now-a-days there is more and more exposure to the outside world given the improved access and increasing flow of tourists.

Konso **woreda** is located between 5°15' to 5°30' N and 37°15' to 37°30' E and lies between 650 to 2650 masl (Figure 2). The **woreda** has an annual rainfall ranging from 771 to 921 mm with a pronounced bimodal pattern. According to the 2007 national census of Ethiopia, the population of the Konso community was 219,004, the majority of whom (211,498) dwell in the rural parts and depend on subsistence agriculture (Population Census Commission 2008). Most of the Konso villages are strategically situated on higher ground for lookout and defense. The villages usually include a part called **mora** (central place), which is used for social gatherings, cultural proceedings, and informal education. Older highland villages around Karate (capital town of Konso **woreda**) are surrounded by intricate concentric walls with only one main entrance. There are walled narrow lanes connecting the individual houses. Fences made of stone walls overtopped with wood separate homesteads. The newer lowland villages are not surrounded by the intricate walls. The Konso are hardened by the challenges of the vagaries of life such as shortage of land, recurrent drought, and ethnic conflicts. They have effectively managed and changed these challenges into opportunities for development of traditional technologies which transformed the inhospitable Konso terrain into a remarkable landscape of stone terraces, agroforestry, soil fertility management, and water harvesting and storage systems. They have invested more for delayed, but sustained, environmental returns than on immediate benefits. This was the major reason for the recognition of the "Konso Cultural Landscape of Ethiopia" as a UNESCO World Heritage Site. The agroforestry and mixed cropping system that includes growing cabbage trees, **haleko** [*Moringa stenopetala* (Baker f.) Cufod.], to ensure food security at all times is peculiar to Konso and a few other communities in southern Ethiopia.

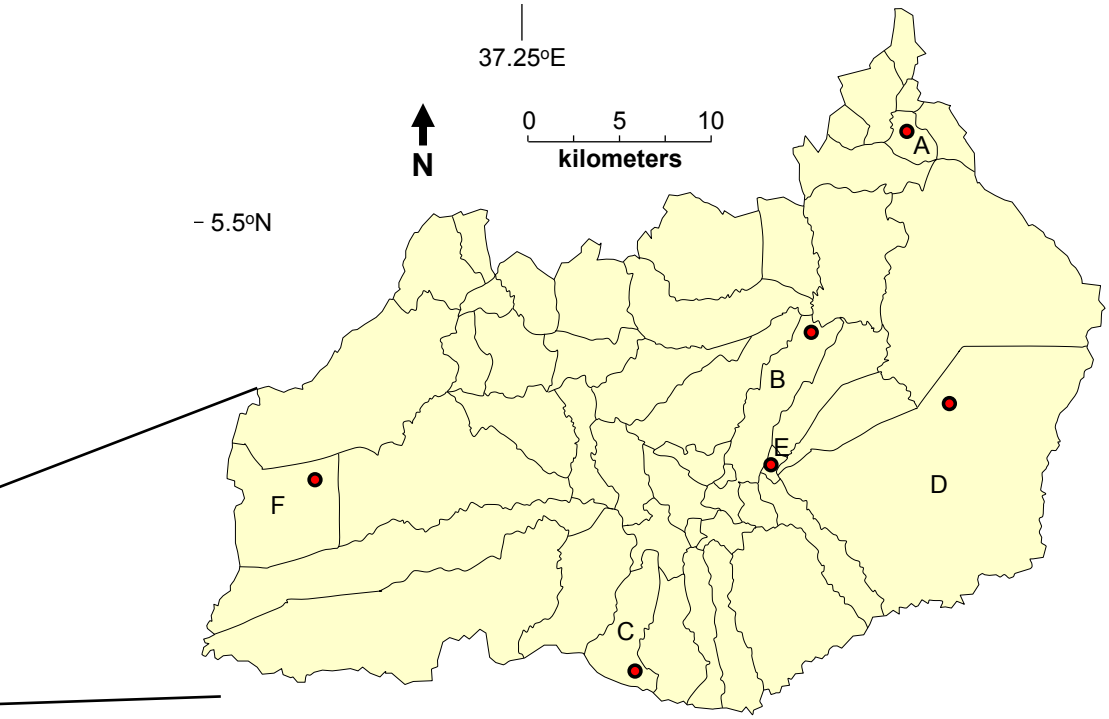

Figure 2. Konso, Ethiopia **woreda** showing study **kebeles** (lowest administrative unit). A. Addis Gebre, B. Doketu, C. Gesergiyo, D. Jarso, E. Karate Town, F. Masoya.

Methods

Hamer and Konso communities were purposely selected for the study due to their rich indigenous knowledge on wild edible plants, botanical diversity in the area, and exemplary practice in natural resource management (Foerch 2003 and personal observation). In addition to the respective capital towns, five rural **kebeles** from each **woreda** were selected for the study using agro-ecological characteristics for stratification. There was no baseline study made in the two **woredas** in the area of interest. Therefore, 50% expected proportion of wild plant consumption (to obtain the maximum sample size), 95% confidence interval, and 5% margin of error were assumed to determine the sample size required for the study. Sample size calculator for population survey of STATCALIC program, EPi-Info Version 3.3.2, January 2005, was used to compute the sample size with the following single proportion formula:

$$n = \frac{Z^2 (P (1 - P))}{d^2}$$

Where n = sample size, Z = 1.96 for 95% confidence level, d = 5% margin of error and P = 50% WEPS consumption rate.

Using the above assumption rate, the sample size was estimated to be 384. Considering design effect of 1.5 to ac-

count for the multistage nature of sampling and 10% non-response rate, the final sample size required for the study was 635. Considering the rural (90%) to urban (10%) distribution of the population, 63 (9.4%) of the households were selected from the capital towns and 607 (90.6%) from the 10 rural **kebeles**. The sample size gives 80% power to detect differences in subgroup analysis. In the multistage sampling, the primary sampling units were **kebeles** and secondary sampling units were households. The households were first selected by stratifying into villages. A village was then selected from each **kebele** or the capital town using lottery method. Households from both ethnic groups in the selected villages were visited until the required number of interviews was completed. Individuals aged 15 years and above were invited for the interview with the assumption that individuals above this will have acquired indigenous knowledge and are capable of conveying their knowledge on WEPS and related issues. In the rare case where a house was closed or resident(s) were not willing to participate, the next neighbor was visited. Similarly, if the village was short of the number of households required, the nearest adjacent village was included.

A pre-tested structured data collection tool was administered containing open, and close-ended questions on socio-demographic characteristics, how long the individual has lived in the area and economic status, occurrence of food scarcity, and indigenous strategies for coping with food shortage and famine. Wild plant consumption, status and management of plants with particular emphasis on edibles, and their opinion about future prospects of wild edible plants were included in the questions. The principal investigator was assisted by a university graduate who was given a short training on this specific data collection technique. Interviews were conducted using the respective native languages in the **woredas**. A trained high school graduate native speaker of the respective **woredas** assisted in the translation of the responses. Voucher plant specimens of the WEPS and their vernacular names were collected with the help of knowledgeable local participants and the translator. The specimens were identified using standard procedures and deposited at the National Herbarium (ETH) of Addis Ababa University.

Consumption pattern of WEPS was recorded in three consecutive seasons, viz. during relatively maximum crop stock (September and October), dry (January and February) and rainy months (April and May). One hundred and one participants (10 or 11 from each **kebele**) were reselected among the participants considered earlier based on a quota sampling method to obtain proportional representation from the rural **kebeles**. Only a few failed to participate in the three visits. The information collected with those who appeared in all the three visits was considered for the analysis. A combination of 24-hour focused dietary recall (Neuhouser *et al*. 2000) and 48-hour recall of food intake (Smith & Gee 1979) methods were used. The checklist of WEPS which was extracted from the focus group discussions (FGD) was used to study household consumption in the **kebeles**. The participants were interviewed about whether one or more of the family members consumed the WEPS within the past 48 hours. Once the consumption level was established, the relative importance of each plant as food in each season and across all the three seasons was estimated using a fidelity level (FL) index (Friedman *et al*. 1986) as $FL = (I_p/I_u) \times 100$, where I_p is the number of informants who independently mentioned consuming the species and I_u is total number of informants who mentioned the plant as edible. Diversity of the WEPS consumed at different seasons of the year was also compared using Shannon-Wiener diversity index as used by Begossi (1996) having the formula of Diversity = $\sum p_i \ln p_i$ (ln = log to the base e), where p_i is proportion of the number of citations for edibility per species.

Paired comparison (Martin 1995) was used to establish the preference of wild plants eaten by people during food scarcity. FGD consisting of five to seven participants were conducted in each of the **kebeles** and capital towns with a short list of five to ten WEPS used during food scarcity and famine for the pairwise comparison. Ten participants from each rural **kebele** and five from each of the capital towns were involved for the preference ranking. All possible pairs as well as order within each pair were randomized and made available for choice to the participants. The participants were interviewed individually and asked to choose one from all possible pairs of plants presented to them. 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 get ranked data at **kebele** and capital town level. A grand total for each edible plant from five rural **kebeles** and the capital town in each **woreda** was taken as the overall WEPS preference used during food scarcity/famine by the community.

Data entry and analysis

Data were entered, cleaned and organized using Microsoft ® Excel 2003. The data were exported to Statistical Package for Social Sciences (SPSS) version 12.0 for Windows for further analysis depending on the nature of the data. Socio-demographic distribution, descriptive statistics, t-test and analysis of variance (ANOVA) with multiple comparison test using a least significant difference (LSD) procedure were used to analyze the data. Significant difference was declared if $P < 0.05$.

Ethical considerations

Permission was obtained from the respective **woreda** and **kebele** administrative offices to conduct the study. Consent was also obtained from each local participant after explaining the objectives, procedures, outcomes, and benefits of the study. Privacy during data collection and confidentiality of the information were maintained.

Results

Socio-demographic characteristics of households and study participants are summarized in Table 1. A total of 706 households were visited of which 357 were from Hamer and 349 were from Konso **woredas**. Among the homes visited, 22 (6.2%) of Hamer and 14 (4%) of Konso were either closed, abandoned, or family members were not willing to participate. Hence, a total of 670 households (335 from each **woreda**) participated in the study. From each study **kebele**, 58 to 66 households were interviewed. About half (48.2%) of the participants were females. The age of the study participants ranged from 16 to 83 years, and the majority had not received formal education (88.1%) and follow traditional religion (56.9%).

Transfer of traditional knowledge associated with wild edible plants

It was found that the knowledge associated with edibility and related information on WEPS is generally in the public domain both in Hamer and Konso with both direct and indirect ways of transfer. The knowledge flow from elders to children and its enrichment thereafter is directly conveyed through observation, imitation, free flow of information among community members, history telling, and myths. Songs and riddles in Hamer and sayings in Konso are the main indirect ways of knowledge transfer. Descriptions of the wild edible plants including origin, nomenclature, morphology, habit and habitat, plants in use during traditional ceremonies, use diversity, and preferences are also transferred through folklore. For example, **butmbro** (*Hoslundia opposita* Vahl) is a desired food for children in Hamer. The children sing "**butmburo lale nana gelgena garo tone**", which is emically defined as, "we eat **butmburo** to the extent that even a drop of saliva is prevented from escaping". The Konso also say "**aka halota mine daka kara titeta**" implying, stick to something you adore, as **halota** (*Ficus glumosa* Delile) does on rocky areas (associating plant ecology with human behavior). Appreciating diversity of use and preference for **ottayta** (*Cordia africana* Lam.), they also sing "**orabo kanon ottayta a waka dashen esheta**" (**ottayta**, a blessing from God even more important than children).

Table 1. Socio-demographic characteristics of study participants (n = 670) in Hamer and Konso, Ethiopia **woredas**.

Variables	Hamar		Konso		Total	
	Number	Percent	Number	Percent	Number	Percent
Residence						
Rural	298	89	309	92.2	607	90.6
Semi-urban	37	11	26	7.8	63	9.4
Gender						
Male	154	46	169	50.4	323	48.2
Female	181	54	166	49.6	347	51.8
Age (years)						
15 – 24	40	11.9	27	8.1	67	10
25 – 34	108	32.2	106	31.6	214	31.9
35 – 44	83	24.8	97	28.9	180	26.9
45 – 54	48	14.3	53	15.8	101	15.1
> 55	56	16.7	52	15.5	108	16.1
Religion						
Orthodox Christians	4	1.2	25	7.5	29	4.3
Protestant Christians	26	7.8	234	69.9	260	38.8
Followers of traditional belief	305	91	76	22.7	381	56.9
Educational status						
Don't read and write	314	93.7	276	82.4	590	88.1
Read and write	1	0.3	12	3.6	13	1.9
Elementary (1 – 6)	7	2.1	28	8.4	35	5.2
Secondary (7+)	13	3.9	19	5.7	32	4.8
Household family size (Mean)	5.48		6.87			

Consumption patterns of WEPS in Hamer and Konso communities

The household survey showed that all participants in Hamer and Konso consume WEPS without difference in social and economic status. Ninety-five percent of Hamer (n = 333) and 97% of Konso (n = 329) participants acknowledged the actual contribution of the WEPS in the household diets and strongly recommended their continued use and further promotion.

The annual climatic calendars (mainly rain) for Hamer and Konso were similar. During the main rainy season (Leae in Hamer, Liyaadda Katanna in Konso), which stretches from April to June, sowing, weeding, and pest control are major agricultural activities accomplished in both communities. The secondary dry season, Suni (Hamer) and Liyaadda Masana (Konso) stretches from July to September. In this season, pest control and crop harvesting is practiced. During the short rainy season, Gidiberg (Hamer) or Liyaadda Hakayta (Konso) which extends from October to December, secondary tilling of sorghum takes place in Konso. The primary dry season, Bona (Hamer) and Liyaadda Bona (Konso) extends from January to February in which crop harvesting from the secondary tilling (Konso) and land preparation for cultivation in both areas are the major activities. Food consumption patterns and food stock availability during the study year of both communities were highest during Gidiberg/Liyaadda Hakayta, with lean periods during Bona/Liyaadda Bona and lowest during Leae/Liyaadda Katanna.

The number of WEPS and degree of consumption varied from one season to another. In Hamer, the total number of edible parts of the WEPS consumed during the previous 48 hours was 11, 41, and 72 during the short rainy season (n = 50), dry season (n = 57), and primary rainy season (n = 42), respectively (Table 2). In Konso, the number of edible plant parts used during the short rainy season (n=51), dry season (n = 55), and main rainy season (n = 47) were 14, 30, and 53, respectively (Table 2). Diversity of the edible plant parts consumed during the three seasons in Hamer were estimated using Shannon-Wiener diversity index and found to be 2.22 during the short rainy

Table 2. Fidelity level for consumption of WEPS based on 48-hour recall on the basis of pre-prepared checklist of emic season categories in Hamer and Konso, Ethiopia.

Scientific name	Voucher Number	Edible part	Hamar Fidelity Level (%)				Konso Fidelity Level (%)			
			Gidiberg	Bona	Leae	Mean	Liyaadda Hakayta	Liyaadda Bona	Liyaadda Katanna	Mean
Acacia hockii De Wild.	GA-K12-2005	Gum	0	4	0	1				
Acacia senegal (L.) Willd.	GA-K131-2005, GA-H127-2007	Gum	0	47	43	30				
Acacia seyal Delile	GA-H46-2007	Gum	0	14	10	8				
Adenia ellenbeckii Harms	GA-K97-2005	Leaf	0	0	5	2	0	4	17	7
Adenia venenata Forssk.	None	Leaf					0	0	2	1
Aloe sp.	None	Nectar	0	0	7	2				
Amaranthus graecizans L.	GA-K35-2005, GA-H13-2007	Leaf	0	0	17	6	2	0	11	4
Amaranthus hybridus L.	GA-K38-2005	Leaf					2	2	34	13
		Seed					0	7	0	2
Angolluma laticorona (M.G. Gilbert) Plowes	GA-K59-2005	Stem					0	16	17	11
Asystasia gangetica (L.) T. Anderson	GA-K124-2005, GA-H70-2007	Leaf	0	0	7	2	0	0	2	1
Balanites aegyptiaca (L.) Delile	GA-K52-2005	Fruit	0	0	2	1	0	20	2	7
		Leaf	0	26	7	11	0.0	6	4	3
Balanites rotundifolia (Tiegh.) Blatt.	GA-K110-2005	Seed	0	9	24	11				
		Fruit					0	22	2	8
Berchemia discolor (Klotzsch) Hemsl.	GA-K71-2005	Fruit	0	0	21	7	0	0	9	3
		Leaf	0	7	2	3				

Scientific name	Voucher Number	Edible part	Hamar Fidelity Level (%)				Konso Fidelity Level (%)			
			Gidiberg	Bona	Leae	Mean	Liyaadda Hakayta	Liyaadda Bona	Liyaadda Katanna	Mean
Boscia salicifolia Oliv.	GA-H28-2007	Fruit	0	18	5	7				
Buckollia volubilis (Schltr.) Venter & R.L. Verh.	GA-K151-2005, GA-H140-2007	Tuber	0	2	5	2				
Bullockia pseudosetiflora (Bridson) Razafim., Lantz & B. Bremer	GA-H39-2007	Fruit	0	0	2	1				
Cadaba farinosa Forrsk.	None	Leaf	0	5	0	2				
Carissa spinarum L.	GA-K20-2005	Fruit	0	9	19	9	0	0	4	1
Celosia anthelminthica Asch.	GA-H131-2007	Leaf	0	0	7	2				
Celosia argentea L.	GA-K27-2005	Leaf					8	0	15	8
Celosia trigyna L.	GA-K84-2005, GA-H169-2007	Leaf					0	0	2	1
Chasmanthera dependens Hochst.	GA-K270-2008, GA-H128-2007	Fruit	0	2	0	1				
Coccinia grandis (L.) Voigt	GA-K200-2005, GA-H25-2007	Fruit	0	0	5	2				
		Leaf	0	0	5	2				
Commelina benghalensis L.	GA-H63-2007	Leaf	0	0	45	2				
Commelina foliacea Chiov.	GA-H202-2007	Leaf	2	0	24	9				
Commelina imberbis Ehrenb. ex Hassk.	None	Leaf	0	0	7	2				
Commiphora confusa Vollesen	GA-H87-2007	Root	0	0	14	5				
Commiphora kataf (Forssk.) Engl.	GA-K68-2005	Leaf					0	2	4	2
Commiphora terebinthina Vollesen	GA-K228-2005	Root					0	0	2	1
Corallocarpus schimperi (Naud.) Hook.f.	GA-H198-2007	Leaf	0	0	2	0				
Corchorus olitorius L.	GA-K171-2005	Leaf					10	0	13	8
Corchorus tridens L.	GA-K182-2005, GA-H185-2008 GA-H143-2007	Leaf	0	0	10	3	0	0	34	11
Corchorus trilocularis L.										
Cordia africana Lam.	None	Fruit					0	22	4	9
Cordia monoica Roxb.	GA-K177-2005, GA-H78-2007	Fruit	0	4	7	4	0	13	4	6
Cordia sinensis Lam.	GA-K162-2005, GA-H67-2007	Fruit	0	5	5	3	0	9	11	7
Crotalaria polysperma Kotschy	GA-H145-2007	Leaf	0	0	7	2				
Cucumis dipsaceus Ehrenb. ex Spach	GA-K34-2005, GA-H58-2007	Leaf	0	0	10	3	0	0	2	1
Cucumis kirkbridei Ghebret. & Thulin	GA-H135-2007	Leaf	0	0	2	1				
Cyperus bulbosus Vahl	GA-K23-2005	Bulb					0	0	2	1
Delonix regia (Hook) Raf.	GA-H121-2007	Seed	0	7	10	6				

Scientific name	Voucher Number	Edible part	Hamar Fidelity Level (%)				Konso Fidelity Level (%)			
			Gidiberg	Bona	Leae	Mean	Liyaadda Hakayta	Liyaadda Bona	Liyaadda Katanna	Mean
Digera muricata (L.) Mart.	GA-K130-2005, GA-H146-2007	Leaf					0	0	4	1
Diospyros abyssinica (Hiern) F. White	GA-H44-2007	Fruit	0	9	0	3				
Dobera glabra (Forssk.) Juss. ex Poir.	GA-K118-2005	Fruit	0	4	0	1				
		Seed	2	2	17	7				
Dorstenia barnimiana Schweinf.	GA-K197-2005	Tuber					0	0	2	1
Ehretia cymosa Thonn.	GA-K212-2005	Fruit					0	0	4	1
Erythrococca abyssinica Pax	GA-H158-2007	Fruit	0	0	5	2				
Ficus glumosa Delile	GA-K232-2005, GA-H35-2007	Fruit	0	2	0	1	0	2	0	1
Ficus platyphylla Delile	GA-K196-2005, GA-K250-2007	Fruit					2	4	0	2
Ficus sur Forssk.	GA-K248-2007	Fruit					2	0	0	1
Ficus sycomorus L.	GA-K257-2007	Fruit	0	14	12	9	2	13	6	7
Ficus thonningii Blume	GA-H32-2007	Fruit					4	7	6	6
Ficus vasta Forssk.	GA-K3-2005	Fruit	0	2	2	1	0	6	0	2
Flueggea leucopyrus Willd.	GA-K4-2005	Fruit					0	0	9	3
Garcinia livingstonei T. Anderson	GA-H20-2007	Fruit	0	2	0	1				
Grewia arborea (Forssk.) Lam.	GA-H82-2007	Fruit	0	0	2	1				
Grewia erythraea Schweinf.	GA-K202-2005	Fruit	0	0	31	10	0	0	19	6
Grewia lilacina K. Schum.	GA-H139-2007	Fruit	0	0	2	1				
Grewia mollis Juss.	GA-K204-2005, GA-H129-2007	Fruit	0	0	2	1				
Grewia tenax (Forssk.) Fiori	GA-K168-2005, GA-H124-2007	Fruit	0	2	5	2	0	0	13	4
Grewia velutina (Forssk.) Lam.	GA-K219-2005, GA-H65-2007	Fruit	0	2	17	6	0	4	6	3
Grewia villosa Willd.	GA-K121-2005	Fruit	0	0	14	5	0	0	6	2
Hoslundia opposita Vahl	GA-H16-2007	Fruit	0	0	17	6				
Hydnora abyssinica A. Br.	GA-H95-2007, GA-H96-2007	Fruit	0	0	19	6				
Ipomoea biflora (L.) Pers.	GA-K147-2005	Leaf	0	0	2	1				
Ipomoea marmorata Britt. & Rendle	GA-H163-2007	Tuber	0	5	2	3				
Justicia calyculata Deflers	GA-K172-2005, GA-H69-2007	Leaf	0	0	2	1				
Justicia flava (Vahl) Vahl	None	Leaf					4	0	15	6
Justicia ladanoides Lam.	GA-K153-2005	Leaf					0	0	11	4

Scientific name	Voucher Number	Edible part	Hamar Fidelity Level (%)				Konso Fidelity Level (%)			
			Gidiberg	Bona	Leae	Mean	Liyaadda Hakayta	Liyaadda Bona	Liyaadda Katanna	Mean
Kedrostis foetidissima (Jacq.) Cogn.	GA-H132-2007	Leaf	0	0	21	7				
Kedrostis leloja (Forssk. ex J.F. Gmel.) C. Jeffrey	GA-H199-2008	Leaf	0	0	2	1				
Kedrostis pseudogijef (Gilg) C. Jeffrey	GA-K18-2005, GA-H147-2007	Leaf	0	5	14	7	2	7	17	9
Lannea rivae (Chiov.) Sacleux	GA-K195-2005	Root					0	0	2	1
Lannea triphylla Engl.	GA-K175-2005, GA-H193-2008	Root	0	0	21	7				
Lantana trifolia L.	GA-K11-2005, GA-H165-2007	Fruit	0	0	2	1				
Launaea intybacea (Jacq.) Beauverd	GA-K79-2005, GA-H110-2007	Leaf	2	0	17	6	0	0	6	2
Leptadenia lancifolia (Schumach. & Thonn.) Decne.	GA-K21-2005	Leaf	10	53	38	34	14	31	28	24
Maerua angolensis DC.	GA-H162-2007	Leaf	2	33	24	20				
Maerua subcordata (Gilg) De Wolf	GA-H21-2007	Fruit	0	0	7	2				
Mimusops kummel Bruce ex A.DC.	GA-K269-2005	Fruit					2	0	0	1
Moringa stenopetala (Baker f.) Cufod.	None	Leaf	2	25	7	11				
Nymphaea nouchali Burm. f.	GA-H126-2007	Seed	0	2	0	1				
Ocimum forskolei Benth.	GA-K163-2005	Leaf					0	0	4	1
Opuntia ficus-indica (L.) Mill.	None	Fruit					0	2	6	3
Oxygonum sinuatum (Hochst. & Steud ex Meisn.) Dammer	GA-K174-2005	Leaf					0	0	2	1
Parkinsonia aculeata L.	GA-K164-2005	Seed					0	0	2	1
Pentarrhinum insipidum E. Mey.	GA-K199-2005, GA-H164-2007	Leaf	2	0	7	3	0	2	6	3
Portulaca oleracea L.	None	Aerial part					0	0	4	1
Portulaca quadrifida L.	GA-K75-2005	Aerial part	4	0	0	1	6	9	17	11
Premna resinosa (Hochest.) Schauer	GA-K143-2005, GA-H93-2007	Fruit	0	0	5	2				
Pupalia micrantha Hauman	GA-H71-2007	Leaf	0	0	2	1				
Rhus natalensis Bernh. ex C. Krauss	GA-H56-2007	Fruit					0	2	0	1
Rhus ruspolii Engl.	GA-K208-2005	Fruit					0	2	0	1
Rhus vulgaris Meikle	GA-K194-2005, GA-H107-2007	Fruit	0	2	0	1				
Rhynchosia minima (L.) DC.	GA-H75-2007	Leaf	0	0	10	3				

Scientific name	Voucher Number	Edible part	Hamar Fidelity Level (%)				Konso Fidelity Level (%)			
			Gidiberg	Bona	Leae	Mean	Liyaadda Hakayta	Liyaadda Bona	Liyaadda Katanna	Mean
Salvadora persica L.	GA-K161-2005	Fruit	0	4	0	1				
Schlechterella abyssinica (Chiov.) Venter & R.L. Verh.	GA-H205-2007	Tuber	0	12	17	10				
Sclerocarya birrea (A. Rich.) Hochst.	GA-K11-2005, GA-H18-2007	Fruit	0	5	12	6	0	0	4	1
Solanum americanum Mill.	GA-K157-2005, GA-H12-2007	Leaf	6	0	19	8	2	2	6	3
Sterculia africana (Lour.) Fiori	GA-K108-2005, GA-H187-2008	Seed	0	16	5	7	0	9	0	3
Tamarindus indica L.	GA-K117-2005	Fruit	0	35	19	18	0	4	2	2
Vangueria madagascariensis J.F. Gmel. var. *abyssinica* (A. Rich.) Puff	None	Fruit					0	2	0	1
Vangueria madagascariensis J.F. Gmel. var. *madagascarensis*	GA-K255-2007, GA-H29-2007	Fruit	0	14	2	6	0	6	0	2
Vigna sp.	GA-K205-2005	Leaf					0	0	2	1
Ximenia americana L.	GA-H43-2007	Fruit	0	5	5	3				
Ximenia caffra Sond.	GA-K80-2005, GA-H14-2007	Fruit	0	44	67	37	0	11	17	9
Zanthoxylum chalybeum Engl.	GA-H54-2007, GA-H186-2008	Fruit	0	32	17	16				
Ziziphus mucronata Willd.	GA-K111-2005	Fruit	4	25	10	13	0	0	4	1
Ziziphus spina-christi (L.) Willd.	None	Fruit	4	14	21	13				

season, 3.33 in the dry season, and 4.04 in the main rainy season. Similarly, diversity of consumed edible plant parts in Konso during the short rainy season was 2.48, it was 3.2 in the dry season, and in the main rainy season it was 3.71. In both communities, diversity of WEPS which were actually consumed was highest during the main rainy season and followed by the dry season. The total number of edible plant parts consumed during the three seasons was 84 in Hamer and 64 in Konso and yields a diversity index of 4.22 and 4.12, respectively.

Further investigation conducted on green leafy vegetables showed that they were important components of the diet for households during the three seasons in both communities. In Hamer, a significant difference was found in the number of vegetables consumed during the different seasons, and in consumption among the seasons in the order of main rainy season > dry season > short rainy season. In Konso, the number of vegetables consumed during the main rainy season was significantly higher than the short rainy season and dry season. There was no significant difference among the different age groups and between males and females on the number of vegetables consumed in either community.

The fidelity level values calculated for the WEPS consumed by the Hamer community in each of the seasons are presented in Table 2. The overall mean FL value of the three seasons showed that *Ximenia caffra* Sond. (fruit), *Leptadenia lancifolia* (Schumach. & Thonn.) Decne. (composite of tender leaf, juvenile shoot, and flower), *Acacia senegal* (L.) Willd. (gum), *Maerua angolensis* DC. (tender leaf), and *Tamarindus indica* L. (fruit pulp) had the highest FL values in their order of magnitude. Among the leafy vegetables, *L. lancifolia* has the highest FL value in all three seasons. In Konso, edible plants with the highest five FL values were vegetables (Table 2). *Leptadenia lancifolia*, *Amaranthus hybridus* L., *Corchorus trilocularis* L., *Portulaca oleracea* L., and *Portulaca quadrifida* L. had the higher FL values in order of magnitude. During highest food stock and lean period, *L. lancifolia* was the most consumed wild plant, whereas *A. hybridus* and *C. trilocularis* were the most consumed plants during the lowest food stock.

Contribution of WEPS in coping with household food insecurity

All household participants in Hamer and Konso (n = 670) have experienced recurrent food shortages, of which 96% and 88%, respectively, have reported incidence of famine at least once in their lifetime. In Hamer, participants between 15 and 24 years of age reported significantly lower incidence of famine compared with older age groups. The variation between the genders was not significant. Participants aged between 25 and 34 years reported lower incidence of famine as compared with the lower age (15 to 24) and higher age groups in Konso. Moreover, females reported significantly higher incidence of famine than males. Konso was similar to Hamer with a general increasing trend in the number of reports on famine incidence as the age of participants increased.

Different coping mechanisms which were used to alleviate food shortage and famine were mentioned by both communities. Most participants who reported incidence of famine in the past used two or more coping mechanisms to alleviate the challenge. In Hamer (n = 335), majority of the participants (97.5%) mentioned government food assistance, consumption of WEPS (94.7%), and selling assets (91.3%) as the major coping strategies. Loans and assistance from others who have better food stocks (12.7%) and hunting wild animals (9.3%) were also mentioned. Among the 293 participants in Konso who reported severe food shortage in the past, 96.2% mentioned WEPS, 93.2% government food assistance, 67.9% selling assets, 40.3% obtaining assistance from community members, and 28.7% from other sources of income including working as laborers as main coping strategies.

The number of WEPS that were consumed at times of food shortage and famine increased both in magnitude and number of species as compared with periods of relatively better food reserves. As the food shortage gets more severe, plant parts that are less preferred in taste, exhibit poor cooking quality, and/or could have undesirable side effects were consumed. For instance seed of *Dobera glabra* (Forssk.) Juss. ex Poir. (with poor cooking quality and taste), leaf of *Launaea intybacea* (Jacq.) Beauverd, and root of *Lannea triphylla* Engl. (poor taste) were foods used at times of famine by both communities. Generally, preference of WEPS consumption during periods of food shortages depended upon multiple of factors such as accessibility, good return on harvesting effort, stomach fill, taste, safety, inducing loss of appetite, and indigestibility for relatively longer duration which temporarily suppresses the feeling of hunger.

A summary of pairwise comparisons of consumption preference during periods of food scarcity among short listed WEPS by FGD participants in the **kebeles** and capital towns of Hamer (Table 3) and Konso (Table 4) are presented. The overall results of the pairwise comparison

Table 3. Pooled summary of pairwise ranking based on importance in edibility of WEPS during food scarcity and famine in the study **kebeles** in Hamer, Ethiopia. Edible plant parts with the highest score are the most preferred in the respective **kebele**. '-' = plant not selected for comparison in the respective **kebele**.

Scientific name	Study kebeles						Total score	Rank
	Asele	Lala	Dimeka-Zuriya	Angude	Kola Keji	Dimeka Town		
Leptadenia lancifolia (Schumach. & Thonn.) Decne. (Leaf, shoot apex, & flower)	44	72	53	69	79	37	354	1
Balanites rotundifolia (Tiegh.) Blatt. (Seed)	74	43	36	25	31	29	238	2
Balanites aegyptiaca (L.) Delile (Leaf)	-	57	43	37	66	20	223	3
Boscia salicifolia Oliv. (Leaf)	-	77	59	-	-	19	155	4
Maerua angolensis DC. (Leaf)	-	70	49	-	-	28	147	5
Dobera glabra (Forssk.) Juss. ex Poir. (Seed)	49	-	-	33	48	8	138	6
Sterculia africana (Lour.) Fiori (Seed)	-	33	-	23	38	-	94	7
Berchemia discolor (Klotzsch) Hemsl. (Leaf)	-	-	-	47	27	-	74	8
Ximenia caffra Sond. (Fruit)	-	-	-	49	25	-	74	8
Moringa stenopetala (Baker f.) Cufod. (Leaf)	65	-	-	-	-	-	65	10

Scientific name	Study kebeles						Total score	Rank
	Asele	Lala	Dimeka-Zuriya	Angude	Kola Keji	Dimeka Town		
Grewia villosa Willd. (Fruit)	14	-	21	-	-	18	53	11
Tamarindus indica L. (Fruit pulp)	-	-	11	18	9	13	51	12
Nymphaea nouchali Burm. f. (Seed)	51	-	-	-	-	-	51	12
Salvadora persica L. (Fruit)	20	28	-	-	-	-	48	14
Rhus vulgaris Meikle (Fruit)	-	40	-	-	-	-	40	15
Ziziphus spina-christi (L.) Willd. (Fruit)	-	-	-	-	37	-	37	16
Grewia arborea (Forssk.) Lam. (Fruit)	29	-	-	-	-	-	29	17
Meyna tetraphylla (Schweinf. ex Hiern) Robyns (Fruit)	-	-	-	23	-	-	23	18
Vangueria madagascariensis J.F. Gmel. var. *madagascarensis* (Fruit)	-	18	-	-	-	-	18	19
Lannea triphylla Engl. (Root)	-	-	8	-	-	8	16	20
Cordia sinensis Lam. (Fruit)	14	-	-	-	-	-	14	21
Rhus natalensis Bernh. ex C. Krauss (Fruit)	-	11	-	-	-	-	11	22

Table 4. Pooled summary of pairwise ranking based on importance in edibility of WEPS during food scarcity and famine in study **kebeles** in Konso, Ethiopia. Edible plant parts with the highest score are the most preferred in the respective **kebele**. '-' = plant not selected for comparison in the respective **kebele**.

Edible plants	Study kebeles						Total score	Rank
	Addis Gebre	Doketu	Geser-giyo	Jarso	Masoya	Karate Town		
Leptadenia lancifolia (Schumach. & Thonn.) Decne. (Leaf, shoot apex and inflorescence)	40	71	55	43	40	27	276	1
Portulaca quadrifida L. (Aerial part)	78	55	55	31	22	31	272	2
Amaranthus hybridus L. (Seed)	44	-	65	23	65	33	230	3
Sterculia africana (Lour.) Fiori (Seed)	-	28	25	23	48	20	144	4
Ficus vasta Forssk. (Fruit)	38	31	55	-	-	17	141	5
Dobera glabra (Forssk.) Juss. ex Poir. (Seed)	-	48	-	30	43	10	131	6
Angolluma laticorona (M.G. Gilbert) Plowes (Aerial part)	-	44	48	-	21	17	130	7
Balanites aegyptiaca (L.) Delile (Leaf)	24	53	16	17	-	19	129	8
Opuntia ficus-indica (L.) Mill. (Fruit)	35	29	35	-	-	14	113	9
Ficus sycomorus L. (Fruit)	31	-	-	-	35	-	66	10
Amorphophallus gomboczianus Pic.Serm. (Root)	-	-	-	43	-	-	43	11

Edible plants	Study kebeles						Total score	Rank
	Addis Gebre	Doketu	Geser-giyo	Jarso	Masoya	Karate Town		
Carissa spinarum L. (Fruit)	39	-	-	-	-	-	39	12
Kedrostis pseudogijef (Gilg) C. Jeffrey (Leaf)	31	1	-	-	6	-	38	13
Hyphaene thebaica (L.) Mart. (Fruit)	-	-	6	-	-	1	7	14

showed that *L. lancifolia* was the most preferred species in both communities.

Management and conservation of WEPS

According to the FGD and household study participants, management and conservation of WEPS in Hamer and Konso have focused on human settlement areas, live fences, home gardens, farmlands (Figure 3), farm margins, wastelands, and forest habitats. Individuals, community leaders, and the community at large are vanguards of the endeavor. The established agroforestry system developed through many years of experience, live fences, and tolerated and cultivated plants around the **mora**, the sacred forests owned by the community and the traditional leaders all made Konso a reservoir of botanical diversity and useful plants. The responsibility shouldered by a traditional leader through empowerment by the community as a guardianship has so far kept Buska Mountain massif forest in Hamer in a relatively intact state.

The Hamer and Konso have more interest in WEPS for management and conservation of plants with multiple uses than plants with minor and unspecialized utility. From our discussions with the FGD participants, we were made to understand that the Hamer community are close to, and dependent on the environment, and their perception of conservation and management of the botanical diversity is generally holistic. They believe every plant species is created for the well being of humans and its availabil-

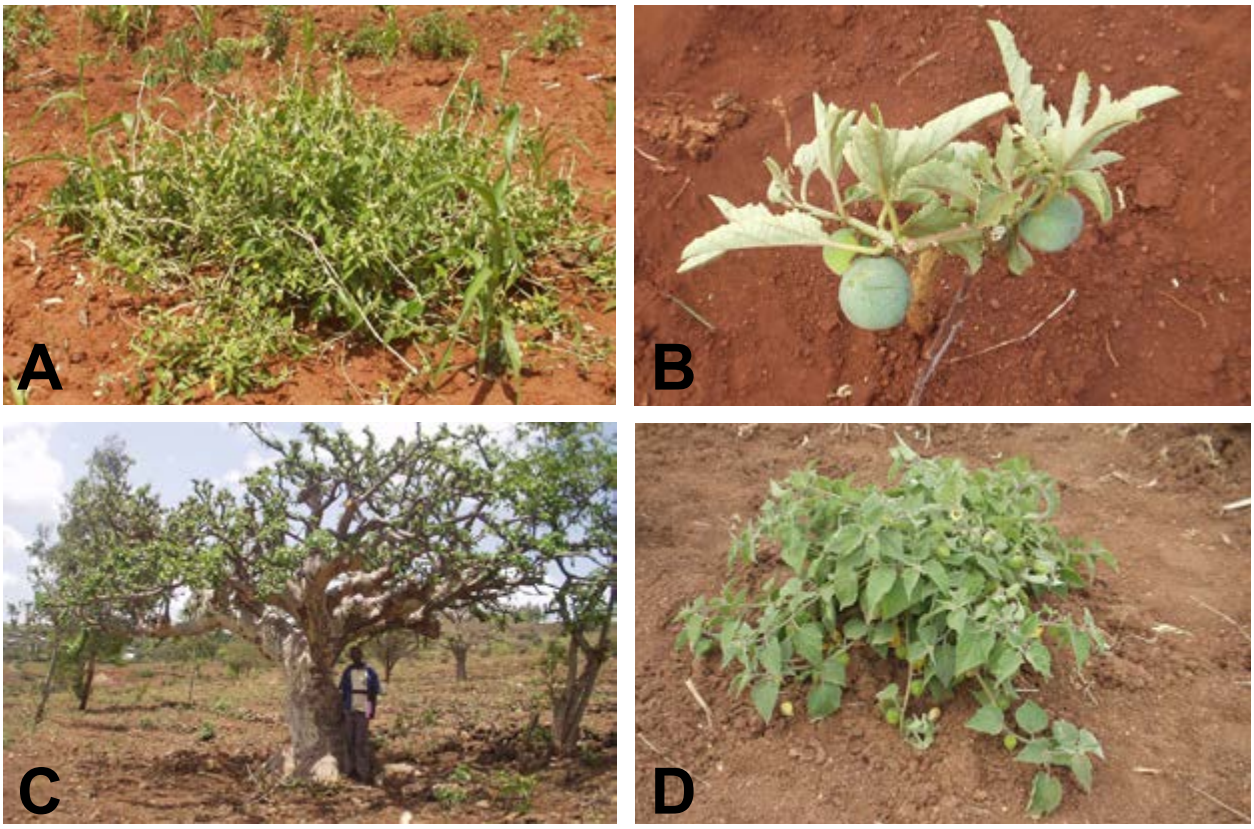

Figure 3. Some wild edible plant species managed in agricultural fields of Konso, Ethiopia, demonstrating the wild-cultivated continuum of edible plants. **A**. *Leptadenia lancifolia* (Schumach. & Thonn.) Decne., **B**. *Adenia ellenbeckii* Harms, **C**. *Sterculia africana* (Lour.) Fiori, **D**. *Physalis peruviana* L.

ity is vital for life. However, from our observations during walks, weeding of cultivated fields is common for the benefit of crops. On the other hand, the Konso have a well established farming system which is developed through years of experience. They have developed specialized knowledge that is attached to the use of selected plants in their daily activities and considered only a few plant species as weeds or a nuisance. Some WEPS are highly recommended for future protection and management and some other species are not liked for various reasons, and hence, eradication of some noxious species was highly recommended by the participants (Table 5). Male and female participants recommended management of selected WEPS with a mean plant citation of 7.2 and 5.0, respectively (the difference is not statistically significant). Trees including *Ficus sycomorus* L., *Cordia africana* Lam., *Ficus vasta* Forssk., *Syzygium guineense* (Willd.) DC. subsp. *guineense*, *Grewia velutina* (Forssk.) Lam., and *Hyphaene thebaica* (L.) Mart. were the most important species having multiple and specialized uses and are recommended for management in Konso (Table 5). The participants also recommended the need for eradication of 33 WEPS, mostly herbaceous weeds. Females cited an average of 3.7 and males 5.8 WEPS for eradication, the latter group recommending significantly higher number of species for eradication. Among the WEPS, *L. intybacea*, *Vigna* sp., *Oxygonum sinuatum* (Hochst. & Steud ex Meisn.) Dammer, *Amaranthus graecizans* L., *Celosia trigyna* L., *Justicia ladanoides* Lam., *Celosia argentea* L. and *Cyperus bulbosus* Vahl were the top eight species condemned for eradication. Survival of these and other species in natural habitats was not opposed but their noxious weedy nature in agricultural fields has developed hatred and thus they are condemned.

Table 5. Wild and semi-wild edible plants suggested to be managed in some form for different purposes in Konso, Ethiopia.

Scientific name	Participants interviewed	Participants' suggestion		
		Naturally survive (%)	Wiped out (%)	Tolerated & managed (%)
Acacia hockii De Wild.	21	95	0	5
Amaranthus hybridus L.	50	90	4	6
Angolluma laticorona (M.G.Gilbert) Plowes	42	95	0	5
Balanites aegyptiaca (L.) Delile	41	71	0	29
Balanites rotundifolia (Tiegh.) Blatt.	49	84	0	16
Berchemia discolor (Klotzsch) Hemsl.	32	66	0	34
Blyttia fruticulosa (Decne.) D.V. Field	12	67	0	33
Boscia salicifolia Oliv.	10	90	0	10
Bridelia scleroneura Müll.Arg.	6	83	0	17
Bullockia pseudosetiflora (Bridson) Razafim., Lantz & B. Bremer	33	88	0	12
Carissa spinarum L.	40	63	0	38
Commiphora kataf (Forssk.) Engl.	6	83	0	17
Commiphora terebinthina Vollesen	2	50	0	50
Corchorus olitorius L.	9	89	0	11
Cordia africana Lam.	45	40	0	60
Cordia monoica Roxb.	46	96	0	4
Cordia sinensis Lam.	42	93	0	7
Dobera glabra (Forssk.) Juss. ex Poir.	49	63	0	37
Ehretia cymosa Thonn.	24	83	0	17
Euclea divinorum Hiern	29	97	0	3
Ficus glumosa Delile	10	70	0	30
Ficus ingens (Miq.) Miq.	7	86	0	14
Ficus platyphylla Delile	10	80	0	20
Ficus sur Forssk.	11	91	0	9

Scientific name	Participants interviewed	Participants' suggestion		
		Naturally survive (%)	Wiped out (%)	Tolerated & managed (%)
Ficus sycomorus L. subsp. *gnaphalocarpa* (Miq.) C.C. Berg	9	22	0	78
Ficus sycomorus L. subsp. *sycomorus*	51	39	0	61
Ficus thonningii Blume	30	90	0	10
Ficus vasta Forssk.	40	50	0	50
Flueggea leucopyrus Willd.	41	90	2	7
Grewia damine Gaertn.	9	89	0	11
Grewia erythraea Schweinf.	38	95	0	5
Grewia velutina (Forssk.) Lam.	51	59	0	41
Hyphaene thebaica (L.) Mart.	20	60	0	40
Justicia ladanoides Lam.	21	43	52	5
Kedrostis pseudogijef (Gilg) C. Jeffrey	44	93	0	7
Lantana trifolia L.	30	93	0	7
Leptadenia lancifolia (Schumach. & Thonn.) Decne.	51	92	0	8
Mimusops kummel Bruce ex A.DC.	14	64	0	36
Opuntia ficus-indica (L.) Mill.	42	79	10	12
Pentarrhinum insipidum E. Mey.	18	56	39	6
Physalis peruviana L.	22	96	0	5
Psydrax schimperiana (A.Rich.) Bridson	11	82	0	18
Rhus natalensis Bernh. ex C. Krauss	41	88	0	12
Rhus ruspolii Engl.	18	78	0	22
Salvadora persica L.	17	94	0	6
Sclerocarya birrea (A. Rich.) Hochst.	41	76	2	22
Sterculia africana (Lour.) Fiori	50	76	0	24
Syzygium guineense (Willd.) DC.	7	57	0	43
Tamarindus indica L.	39	85	0	15
Vangueria madagascariensis J.F. Gmel. var. *abyssinica* (A. Rich.) Puff	15	87	0	13
Vangueria madagascariensis J.F. Gmel. var. *madagascariensis*	33	88	0	12
Ximenia caffra Sond.	51	88	4	8
Ziziphus mucronata Willd.	48	85	0	15

All participants in Hamer (n = 335) and 297 (89.5%) in Konso (n = 332) recognized that there is some kind of effort on conservation of botanical diversity in their area. A majority of the participants in Hamer (296 or 88.4%) know of conservation efforts made by individuals from the community, and 39 (11.6%) of the participants were also aware of conservation efforts by the government. Among the 297 participants in Konso who knew about conservation efforts in their area, 59.6% recognized conservation efforts by individuals and 40.4% by both individuals and government, the latter focusing on community education. Reports on conservation of WEPS using the same participants showed similar results in both communities. Actual management practices for edible species by the participants themselves were also investigated. Among the total, 94.3% Hamer and 88.7% Konso participants perform some kind of management practice on one or more WEPS (Table 6). A total of 93 species were mentioned as managed by two or more participants in Hamer (73 species) and Konso (48 species). Most of the WEPS in both communities have multiple uses.

Table 6. Wild and semi-wild edible plants mentioned (frequency) as being managed in some form by two or more household study participants in Hamer (n=316) and Konso (n=297), Ethiopia.

Scientific name	Frequency		
	Hamer	Konso	Total
Acacia senegal (L.) Willd.	11	0	11
Acacia seyal Delile	2	0	2
Adenia ellenbeckii Harms	20	9	29
Amaranthus graecizans L.	52	24	76
Amaranthus hybridus L.	0	22	22
Amorphophallus gomboczianus Pic.Serm.	0	13	13
Angolluma laticorona (M.G. Gilbert) Plowes	0	5	5
Balanites aegyptiaca (L.) Delile	42	30	72
Balanites rotundifolia (Tiegh.) Blatt.	39	29	68
Berchemia discolor (Klotzsch) Hemsl.	42	55	97
Blyttia fruticulosa (Decne.) D.V. Field	0	3	3
Boscia coriacea Graells	13	0	13
Boscia salicifolia Oliv.	16	0	16
Bullockia pseudosetiflora (Bridson) Razafim., Lantz & B.Bremer	3	13	16
Buckollia volubilis (Schltr.) Venter & R.L. Verh.	2	0	2
Cadaba farinosa Forrsk.	3	0	3
Carissa spinarum L.	8	9	17
Celosia anthelminthica Asch.	3	0	3
Celosia argentea L.	0	3	3
Celosia trigyna L.	2	0	2
Coccinia grandis (L.) Voigt	6	0	6
Commelina benghalensis L.	22	0	22
Commelina foliacea Chiov.	12	0	12
Commelina imberbis Ehrenb. ex Hassk.	29	0	29
Commiphora africana (A. Rich.) Endl.	22	0	22
Commiphora habessinica (O. Berg) Engl.	0	2	2
Corchorus olitorius L.	0	46	46
Corchorus trilocularis L.	2	20	22
Cordia africana Lam.	2	93	95
Cordia monoica Roxb.	0	21	21
Cordia sinensis Lam.	132	81	213
Crotalaria incana L.	2	0	2
Cucumis dipsaceus Ehrenb. ex Spach	3	0	3
Delonix regia (Hook) Raf.	4	0	4
Digera muricata (L.) Mart.	0	2	2
Diospyros abyssinica (Hiern) F. White	11	0	11
Dobera glabra (Forssk.) Juss. ex Poir.	46	35	81
Ehretia cymosa Thonn.	0	14	14
Erythrococca abyssinica Pax	2	0	2
Euclea divinorum Hiern	2	0	2
Euclea racemosa L.	2	0	2
Ficus glumosa Delile	5	4	9
Ficus platyphylla Delile	0	14	14
Ficus sycomorus L.	43	128	171
Ficus thonningii Blume	2	22	24
Ficus vasta Forssk.	7	51	58
Flueggea leucopyrus Willd.	0	10	10
Garcinia livingstonei T. Anderson	2	0	2
Grewia erythraea Schweinf.	57	9	66
Grewia flavescens Juss.	2	0	2
Grewia velutina (Forssk.) Lam.	84	38	122
Grewia villosa Willd.	119	13	132
Hoslundia opposita Vahl	19	0	19
Hydnora abyssinica A. Br.	22	0	22
Ipomoea marmorata Britt. & Rendle	2	0	2
Justicia calyculata Deflers	7	0	7
Justicia flava (Vahl) Vahl	0	22	22
Justicia ladanoides Lam.	0	5	5
Kedrostis foetidissima (Jacq.) Cogn.	6	0	6
Kedrostis pseudogijef (Gilg) C. Jeffrey	15	6	21
Lannea humilis (Oliv.) Engl.	7	0	7

Scientific name	Frequency		
	Hamer	Konso	Total
Lannea rivae (Chiov.) Sacleux	0	3	3
Lannea triphylla Engl.	13	0	13
Lantana trifolia L.	0	2	2
Launaea intybacea (Jacq.) Beauverd	50	0	50
Leptadenia lancifolia (Schumach. & Thonn.) Decne.	55	72	127
Maerua angolensis DC.	48	0	48
Maerua subcordata (Gilg) De Wolf	16	0	16
Meyna tetraphylla (Schweinf. ex Hiern) Robyns	20	0	20
Ocimum forskolei Benth.	0	3	3
Olea europaea L.	3	0	3
Opuntia ficus-indica (L.) Mill.	0	6	6
Oxygonum sinuatum (Hochst. & Steud ex Meisn.) Dammer	2	0	2
Pappea capensis Eckl. & Zeyh.	4	0	4
Pentarrhinum insipidum E. Mey.	3	2	5
Physalis peruviana L.	0	2	2
Portulaca quadrifida L.	61	46	107
Psydrax schimperiana (A. Rich.) Bridson	0	17	17
Rhus natalensis Bernh. ex C. Krauss	20	8	28
Rhynchosia minima (L.) DC.	11	0	11
Salvadora persica L.	5	0	5
Schlechterella abyssinica (Chiov.) Venter & R.L. Verh.	8	0	8
Sclerocarya birrea (A. Rich.) Hochst.	3	0	3
Solanum americanum Mill.	46	0	46
Sterculia africana (Lour.) Fiori	4	36	40
Tamarindus indica L.	36	5	41
Uvaria leptocladon Oliv.	4	0	4
Vangueria madagascariensis J.F. Gmel.	24	28	52
Vepris glomerata (F. Hoffm.) Engl.	4	0	4
Ximenia caffra Sond.	71	32	103
Zanthoxylum chalybeum Engl.	4	0	4
Ziziphus mucronata Willd.	48	8	56
Ziziphus spina-christi (L.) Willd.	82	0	82

Discussion

Social norms, beliefs, and taboos have their own merits and demerits in biodiversity conservation. The Konso perceive that **leiya** (*F. vasta*) brings ground water to the surface. Due to this perception, people in dry land areas have developed positive attitudes towards the plant which in turn contributes to its conservation. Anyone who is found cutting **leiya** is socially outcast and sometimes punished in terms of physical and monetary forms by the Konso. In Hamer, the same plant (**wombo**) is also considered as one's own son. The trees are mostly owned by individuals, and anyone who attempts to cut even a little of the live part must expect a harsh response from the owner. Elders bless their adored ones under **wombo** trees while the person to be blessed is holding a live root of the plant. There is also a taboo attached to cutting any live part of **wombo**. Cutting any live part of **wombo** is believed to result in amputation of body parts. Unfortunately, a close relative of **wombo** named **ata** (*Ficus thonningii* Blume) doesn't have the same prestige. According to the participants from Hamer, the community believes that **ata** is a shelter for evil spirits and its growth around residential homes is not considered healthy for the inhabitants. As a result, there is a tendency to eradicate **ata** seedlings that grow in the vicinity of residential areas. This action may give room for the growth of the plants that the people want to have around their homes.

Without any exception, all of the study participants from Hamer and Konso consume plant parts of wild and semi-wild origin. Although the household sample size for each community (n = 335) will have less precision to generalize for each sub group (ethnic groups), the study reflected that WEPS are important parts of the diet in Hamer and Konso communities (Table 2). Consumption of WEPS is also a common practice in other African countries (Maundu *et al*. 1999, Ogle & Grivetti 1985a,b,c,d, Zinyama *et al*. 1990) and elsewhere in Ethiopia (Addis *et al*. 2005, Asfaw & Tadesse 2001, Feyssa *et al*. 2012, Getahun 1974, Ocho *et al*. 2012, Soromessa & Demissew 2002, Woldu *et al*. 2006). The Swazi community of Swaziland is reported to have greater annual consumption of wild plants over

domesticated ones (Ogle & Grivetti 1985b,c). The use of green leafy vegetables as part of the main dish or supplement should be considered to prevent flaring up of age related degenerative diseases. In addition to bridging the gap of food scarcity, adding variety to the meal, and nutritional benefit, WEPS are good sources of antioxidants which prevent excess flow of pro-oxidants that are known to disturb normal human physiology and cause various ailments (Addis 2009). If proper advocacy work is conducted on the benefits with the support of food technology, it could be possible to promote selected WEPS in the food habits of the rural and urban communities of Hamer and Konso, their adjacent areas, and the wider Ethiopia.

Consumption patterns and levels of WEPS

The pattern and level of consumption of wild edibles at a given time are influenced by different factors. Ecological factors such as altitude, rainfall, and moisture among others determined availability and distribution of WEPS. Similar to study findings in Swaziland (Ogle & Grivetti 1985b,c,d), richness of WEPS at a given time and place influenced the level of their consumption in the study communities. The level of wild edible plant intake concomitantly increases as the food stock dwindles, and this is analogous to what happens in Sub-Saharan Africa (Fleuret 1986, Ogle & Grivetti 1985c,d) including Ethiopia (Addis *et al*. 2005, Asfaw & Tadesse 2001, Getahun 1974, Rahmato 1988). In Swaziland, green leafy vegetables of wild origin are frequently used during early periods of the rainy season when only a few domesticated edibles are available (Ogle & Grivetti 1985c,d). By so doing, the wild green leafy vegetables provide variety to the diet and supply essential nutrients which otherwise may be in short supply during the season. The same is true for Hamer and Konso communities where they consume a wide variety of WEPS during the main rainy months of April and May. During these months, the crop stock is at its lowest level of the year while on the other hand, wild and semi-wild green leafy vegetables are abundant and available for consumption as alternatives. Although richness of the WEPS (green leafy vegetables in particular) during the short rainy season (September and October) is relatively better than the dry season, their consumption at household level was relatively lower. This could be attributed to the highest level of food stock at household level during the calendar year. This is in agreement with previous study results in Ethiopia (Addis *et al*. 2005, Asfaw & Tadesse 2001, Getahun 1974) and Swaziland (Ogle & Grivetti 1985c,d). In May and June, the most frequently used leafy vegetable in Konso (*M. stenopetala*) is also highly infested with pests thereby affecting consumption of the leaflets and aggravating food deficit (Addis 2009). Luckily, wild green leafy vegetables are available at maximum cover in the same months and are used as alternatives. The lowest level of food stock and the highest diversity of WEPS (mainly herbs) in Hamer and Konso are the most likely conditions that lead to highest level of their consumption during the main rainy season. To explain the life strategies of these communities, the concept of the extended "supermarket" could be motivated. This means that Hamer and Konso communities rely on plants from domesticated and wild landscapes so that plants that are domesticated, encouraged, and tolerated in and around gardens and farmlands and wild edibles, assembled in as their main traditional strategies used to bridge such gaps and cope with food shortages and famine.

Community perception and practices associated with WEPS

Preference ranking for use of WEPS during food scarcity showed that edible plant parts which are not perishable and/or collected from perennial rather than annual plants are mostly preferred, particularly during the dry season. Among the WEPS, assorted vegetable from leaves, tender stems, and flowers of *L. lancifolia* was most preferred (also preferred for its taste) by both communities during food deficiency. Analogous with previous reports from Zambia (Scudder 1971) and elsewhere in different parts of Ethiopia (Addis *et al*. 2005, Kloos & Lidtjørn 1993), edible wild plant parts of lesser sensory acceptability, questionable safety for health and life, and with poor cooking quality were reported as being part of the meal during food scarcity in Hamer and Konso.

Although there was a common understanding and belief that WEPS are important to bridge gaps of food deficiency and as food supplement, some individuals in both communities consider the use of WEPS as a sign of underdevelopment and poverty. This is a serious threat to conservation and consumption of wild edible plants. The prevailing environmental degradation coupled with the residual negative impressions on use of WEPS can be detrimental to the indigenous communities and beyond. The communities might forgo their identity if their indigenous knowledge is lost under the present precarious environmental conditions and the ensuing threats. The current conflicting relationship between increasing human population and dwindling natural resources both in Hamer and Konso is becoming a challenge to food security in the communities. Therefore, precautionary measures should be taken as today's widely used domesticated crops might succumb to the change in environmental factors such as climate change and/or emergence of more virulent pathogens. To prevent this scenario, continuity of the extended farm and natural supermarket concept of using the domesticated-wild continuum of edible plants needs to be promoted. This will encompass not only food security but also food sovereignty and nutritional security.

Food sovereignty values of WEPS

Wild and semi-wild edible plants (including those generally considered as weeds) found in Hamer and Konso, which are ecologically adapted to the changing climate,

might ultimately emerge as preferred food crops in the future. A similar conclusion was implied by Harlan Harlan (1975) and Poehlman (1987). The importance of WEPS to the local people needs to be seen in the light of ensuing interest towards creating livelihood security that simultaneously warrants food and nutrition sovereignty of the society.

Addressing the threats and prospects for scaling up the use and conservation of WEPS

Among the diverse wild flora used for food, many (herbs in particular) can easily be promoted. Fast germination, growth under trace moisture, and completing their life cycle within a relatively short duration as well as their weedy habit of growing in disturbed habitats, including residential areas and agricultural fields, are opportunities that would facilitate quick adaptation. Therefore, it would be appropriate to create awareness in the communities on climate change and ensuing threats anf the benefits of tolerating, cultivating, and using wild edibles sustainably to fulfil nutritional requirements, maintain human health, maintain genetic diversity of potential new crops, and keep healthy environment. Local governments and community-based organizations can therefore contribute to public awareness about the benefits of the indigenous practices in general and promotion of WEPS in particular.

Under the present circumstances, harvesting impact (Cunningham 2001) of the edible wild plant parts is of less concern to sustainability of the plant species. Furthermore, the extended use of plants of different habitats in Hamer and Konso in their annual food calendar has an important role in conservation of WEPS. People restrain themselves from eradicating WEPS from their gardens, agricultural fields, and other habitats considering that they will need them any time in the future. The main threat to wild edible plants is deforestation for more agricultural land. In Hamer in particular, lifestyle is changing rapidly from pastoral to agro-pastoral systems with varied environmental and social consequences and threats. Attitudes of stewardship of plants are likely to be reduced in favor of land ownership and agricultural expansion in Hamer and in some parts of Konso.

The study showed that certain wild plants are preferred for edibility than others and received special attention by Hamer and/or Konso communities. *Moringa stenopetala*, *L. lancifolia*, *B. aegyptiaca*, *Adenia ellenbeckii* Harms, *P. quadrifida*, *M. angolensis*, *Boscia salicifolia* Oliv., and *B. rotundifolia* are managed by the communities mainly for dietary consumption. Certain tree and shrub species are preferred to others and receive more protection and management (mainly by the Konso community) not only because they are edible but also because of the different attributes related to their cultural significance, multiplicity of use at household level, and marketability for different purposes. These species apparently have potential to contribute in lowering food insecurity and are suggested to be promoted both within and beyond the studied communities. We could consider propagating them in managed agro-ecosystems.

It was also found that social norms, beliefs, and taboos have merits and demerits in biodiversity conservation. Similar with the present study findings, indigenous communities elsewhere in Asia view two closely related plant species (having similar purposes) as culturally different, which had subsequent impact on conservation endeavour on the respective species (McClatchey *et al*. 2005). This indicates that multipurpose values of a plant may not necessarily guarantee its conservation. The conservation and management of a species is influenced by the cultural values and perceptions of the communities concerned.

Generally, the Hamer community has holistic approaches of tolerating and protecting plants from destruction irrespective of undesired qualities of some plants. Females in Konso are more tolerant than males of plants of no direct benefit and even of noxious weeds. The gender-associated tolerance could be due to the close association of females with food procurement and using plants for medicinal purposes. Women in Konso play a higher role in the conservation of biodiversity and transfer of knowledge in their family and community. Such environmental friendly views need to be considered in conservation and promotion strategies in Konso and other communities. Exchange of cultural practices in biodiversity conservation and transfer with the neighboring Hamer can complement each other's established knowledge and promote holistic conservation of the biodiversity and ecosystems.

Conclusions

Wild and semi-wild edible plants are an integral part of the diet in the Hamer and Konso communities. However, inclusion of WEPS in the diet of both communities depends on acceptability of plants for consumption, seasonality, and level of food stock at household level. Scale and variety of WEPS consumed increases as the level of food stock dwindles. At times of famine, plants of lower preference, poor cooking quality, and higher risk of health hazards are included in the diet. Actual and potential utilization of WEPS become possible when the plants are sustainably used and conserved. Hamers have a holistic view of conserving biodiversity while the Konso prefer to manage selected plants, mostly emphasizing those with multiple uses. Male members of the Konso community generally despise weeds (mostly herbs) as they consider them nuisances in agricultural fields and therefore opt for their eradication while women are more tolerant to plants including those which do not have direct immediate benefits. However, lessons can be drawn from the entire landscape management practices in Konso in which many wild species are simultaneously managed. Such

practices can also be promoted to other areas in Ethiopia and elsewhere through careful examinations of the cultural attitudes and appreciations of the community towards WEPS in view of the impeding climate change and its ensuing threats as well as the food security and food sovereignty drives apparent with individual and national development agendas.

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