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Full Length Research Paper

Seasonal availability and consumption of wild edible plants in semiarid Ethiopia: Implications to food security and climate change adaptation

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Quantitative ethnoecological analysis of seasonal availability and implication to food security of wild edible plants (WEPs) was conducted in Boosat and Fantalle districts of semiarid east Shewa, Ethiopia from October, 2009 to September, 2010. Semistructured interview, focus group discussions, key informants discussions, seasonal record of fruits abundance were used to collected data on gathering and consumption of WEPs to cope with food shortage and adapt to climate change. Collected data was summarised into frequency tables, graph and qualitatively described under each subtopic. Thirty seven WEPs were identified for use as human food, and livestock feed and other multipurpose uses. About 24.3 % of WEPs were locally marketed, 75.7% were not marketed. All wild fruits were not included in official production system in the study area. It has indicated the underutilized existing potential of WEPs. Wild edible plants were preferred by local people of the study area not only for their food value, but also for their availability during dry seasons and shortage of food, potential for dryland agrobiodiversity and multipurpose to human wellbeing, livestock and environmental services they provide. Pairwise ranking by key informants was in agreement with direct matrices ranking for multiple uses of WEPs. The pairwise ranking, market survey and participant observations, community preference has confirmed the real potential of top seven priority WEPs species for dryland agrobiodiversity and agroforestry. Hence, these WEPs can be potential for dryland agrobiodiversity and agroforestry, to enhance people's livelihoods in semiarid areas. This result can shed light on further research and promotion work on WEPs utilization and management.

Key words: Wild, edible plants, seasonal, availability, food security, use, management.

INTRODUCTION

Wild edible plants (WEPs) are available as food source for humans and animals. Wild edible plants availability varies by seasons (Asfaw, 2006; Asfaw, 2009). Indigenous people are endowed with knowledge of seasonal availability of WEPs and implications to climate change adaptations. The available information on the seasonal availability and their contribution to climate change adaptation was poorly documented in Ethiopia.

Ethnobotany of Ethiopia's WEPs is also patchy that consists of listing of plant names without details on their use and management (Balaemie and Kebebew, 2006; Teketay and Eshete, 2004). Increased acculturation, mobility and displacement of indigenous communities, diminishing biodiversity, due to population pressure and climate change also led to a decline in use of WEPs and conveyance of associated knowledge (Asfaw, 1997; Fantahun et al., 2009). The crucial role these plants play in transhumants and settled farmers communities of east Shewa, Ethiopia, paucity of knowledge among scientists and policy makers about traditional knowledge were

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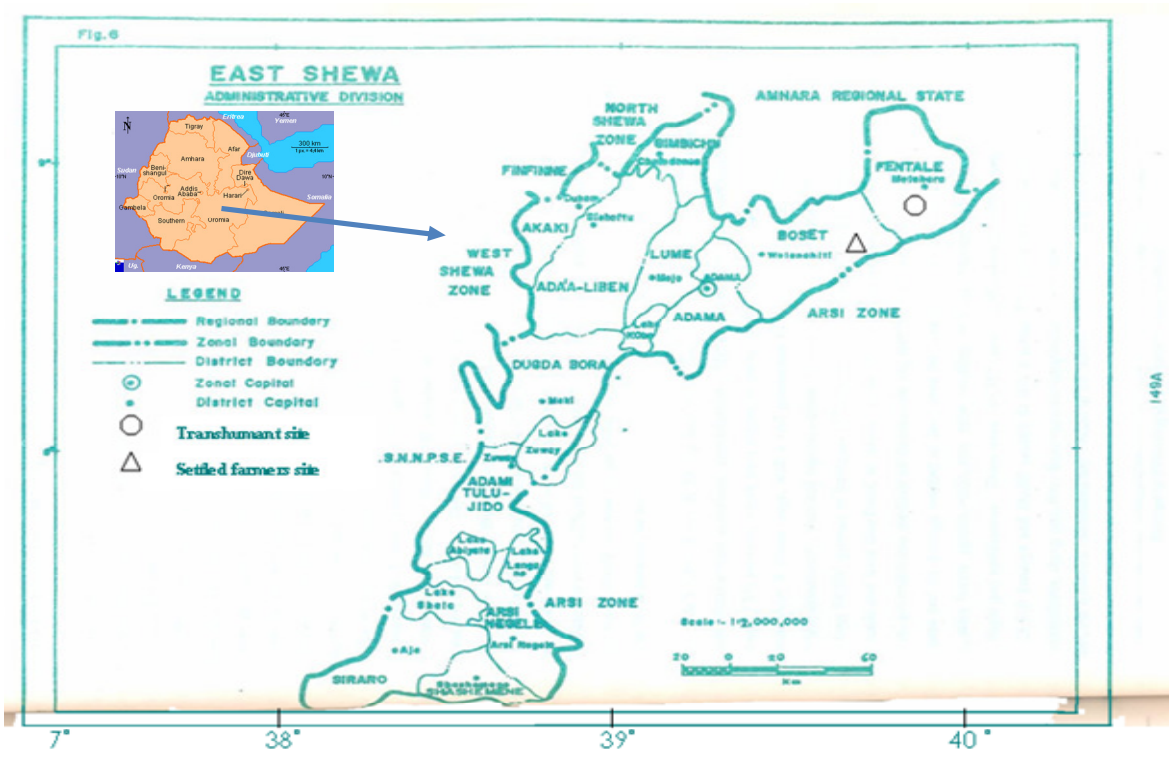

Figure 1. Map of the study area showing Fantalle and Boosat districts of east Shewa, adapted from BPED (2000).

potential risks, the plants were disappearing before their role is recognized.

Given climate change, level of poverty and environmental degradation there is high risk of biodiversity loss at large scale. Under such circumstances, knowledge and skills of uses and nutritious climatically adapted WEPs will be irreversibly lost. Given the impeding climate change, WEPs are expected to provide options for screening species that are likely to be best adapted to climate change and means of sustenance. Thus, it needed research attention to add new knowledge to science and hence, increase awareness on use and management WEPs by transhumants and settled farmers in semiarid areas of east Shewa, Ethiopia. The specific objectives were to: 1) identify seasonal availability of WEPs and preferences in semiarid east Shewa, 2) analyse their contribution to food security of transhumants and settled farmers and 3) determine prioritized list of WEPs for inclusion in dryland agrobiodiversity and agroforestry

MATERIALS AND METHODS

Study area

The study was conducted in the semiarid part of east Shewa in Fantalle and Boosat (whereas- administrative level equivalent to district in Ethiopia) located between 7°12' to 9°14'N latitudes and 38°57' to 39°32'E longitudes in the northern part of Great East African Rifty Valley in Ethiopia (Figure 1) from October, 2009 and September, 2010. The area lies in the Somalia-Maasi Center of plant endemism (White, 1983) described as the Acacia-Commiphora woodland vegetation type by Demissew and Friis (2009). The climate of the area is harsh with erratic and variable rainfall. The highest mean annual rainfall of semiarid east Shewa was 171.05 mm and lowest is 23.04 mm. The highest mean monthly rainfall 243.11 (July and August) and the lowest mean monthly rainfall was, 5.78 mm November. The main rainy season is from June to September known as GANNA (KIREMT) in Oromo and Amaharic languages and low rainfall from February to May known as AFRASA (BELG). The highest mean maximum temperature is 36.73°C in June and the lowest (31.24°C) in December. Economic activities of the area can be described as the agropastoral type with Boosat district marked with mixed agriculture of livestock and crop production (BPED, 2000; BDFED, 2009). Fantalle wereda is livestock production with transhumant and rudimentary crop agriculture practiced in favourable years. The vegetation of the area includes many WEPs. However, the vegetation is declining due to the effects of anthropogenic factors and climate change. This has affected both natural resources and the livelihoods of people in the study area.

Methodology

Six study sites were selected based on topographic variations and watershed alignment. Accordingly, Diglau Tiyo, Tri Bireti and Xadacha form Boosat, Galcha, Qobo and Dheebiti from Fantalle districts (Cook and Stubbendieck, 1986). Informants were selected randomly by the use of village registrar based on difference in lifestyles of people. Key informants were selected by the help of development workers and community leaders (Martin, 1995; Cotton,

Table 1. Seasonal availability of WEPs in Boosat and Fantalle districts.

Scientific name	Local name	Famliy	Flowering and fruiting months											
			Ja	F	Ma	A	M	Ju	J	Ap	S	O	N	D
Acacia senegal (L.) Willd.	Saphansa adi	Fabaceae	+	+	+	+	+	+	0	0	+	+	+	+
Acacaia seyal Del.**	Wacu	Fabaceae	+	+	+	+	+	0	0	o	+	+	+	+
Acacia prasinata Schweinf**	Dodoti	Fabaceae	+	+	+	+	+	0	0	0	0	0	+	+
*Acacia tortolis(*Forssk.*)***	Xadacha	Fabaceae	+	+	+	+	+	0	0	0	+	+	+	+
B. aegyptiaca(L.)Del.	Baddanno	Balanatiaceae	+	+	+	+	+	0	0	0	+	+	+	+
Bercemia discolor(klotzsch)Hemsl.	Jajjaba	Rhamnaceae	0	0	0	0	+	+	+	+	+	+	+	+
Carissa spinarum L.	Agamsa	Apocynaceae	+	+	+	+	+	0	0	+	+	+	+	+
Celitis toka (Forssk.)Hepper and Wood**	Matoqoma	Ulmaceae	+	+	+	0	0	0	0	0	0	+	+	+
Combretum molle R.Br. ex G. Don*	Birecha	Combretaceae	+	+	+	0	0	+	+	+	+	0	0	0
*Commmiphora africana(*Arich.)Engl.	Hamessa	Buraseraceae	0	0	0	0	0	0	0	0	+	+	+	+
Commmiphora schimperi(Berg.)Engl.**	Challnaka	Buraseraceae	+	+	+	+	+	+	+	+	+	+	+	+
Cordia africana Lam.**	Wdecha	Boranginaceae	+	+	+	+	+	+	0	0	0	+	+	+
Cordia monica Roxb./*Cordia ovalis* R.ex DC.	Mendhero	Boraginaceae	0	+	+	+	0	0	+	+	+	+	+	0
Cordia sinensiss Lam.**	Leedii	Boraginaceae	0	+	+	+	0	0	0	0	0	+	+	+
*Dobera glabra(*Forssk.)poir.**	Ade	Salvadoraceae	0	0	0	0	+	+	+	+	0	0	0	0
Eulea racemosa Murr.susp.schimperi(A.Dc.)White	Mi'essa	Ebenaceae	+	+	+	+	0	0	+	+	+	+	+	+
*Flueggea virosa(*Willd)Voigl.	Kecacule	Rhamnaceae	0	+	+	+	0	+	+	+	+	0	0	0
Ficus vasta Forssk.**	Qilxu	Moraceae	+	+	+	+	+	+	+	+	+	+	+	+
Ficus sycomorus L.	Oda	Moraceae	+	+	+	+	+	0	0	0	0	+	+	+
Ficus thonningi Blume.*	Dambi	Moraceae	+	+	+	+	+	0	0	0	0	+	+	+
G.flavescens A. Juss.	Amurjii	Tiliaceae	+	+	+	+	+	0	0	0	+	+	+	+
Grewia bicolor A.Juss.	Harorecha	Tiliaceae	0	+	+	+	0	0	+	+	+	+	+	+
Grewia schweinfurthii Burret	Mudhegurre	Tiliaceae	+	+	+	+	+	0	0	0	+	+	+	+
Grewia tenax (Forssk.)Vahl.	Eka fila	Tiliaceae	+	+	+	+	+	0	0	0	+	+	+	+
Grewia villosa Willd.	Ogomdi	Tiliaceae	+	+	+	+	+	0	0	0	+	+	+	+
Lantana camara L.	Midhaan dubara	Verbenaceae	+	+	+	+	+	+	+	+	+	+	+	+
Meriandra benegalensis Benth.	Hadha toke	Lamiaceae	0	+	+	+	0	0	+	+	+	+	+	+
Myrica salicifolia Hochst ex.A.Rich	Biiqa	Loganiaceae	0	+	+	+	0	0	0	0	+	+	+	0
Opuntia ficus- indica	Hadami	Cactaceae	+	+	+	+	0	0	0	0	+	+	+	+
Permna resinosa (schimperi)(Hochest)Schauer.	Urgecha	Lamiaceae	0	+	+	+	+	+	+	+	+	+	+	0
Rhus natalensis Krauss *	Dabobecha	Anacardiaceae		+	+	+	0	0	+	+	+	+	0	0
Rumex nervosus Vhal.	Dhangago	Polygonaceae	+	+	+	+	+	+	+	+	+	+	+	+
Salvadora persica	Riga Ilkani	Salvadoraceae Wall.	0	0	0	0	0	+	+	+	+	+	+	+
Sterculia africana(Lour.)Fiori	Qararu	Sterculiaceae	+	+	+	+	+	+	+	0	+	+	+	+
*Tamarindus indica*L	Rooqa	Fabaceae	+	+	+	+	0	0	0	0	+	+	+	+

Table 1. Contd.

X. americana L.	Hudha	Olacaceae	0	0	+	+	+	+	+	0	+	+	+	0
Z.spina-christi(L.)Desf.	Qurqura Mi'o	Rhamnaceae	+	+	+	+	+	0	0	0	+	+	+	+

**=in Fantalle district only; *=in Boosat district only ; J, F,Ma,Ap,M,Ju,J,A,S,O,N,D= Months from January to December respectively, Or= Oromo language (local name of all plants is given by this same language).

1996). Guided transect walks along six study sites was conducted to identify availability of WEPs by ethnoecological methods (Martin, 1995; Cotton, 1996). Seasonal inventory was conducted to record abundance of WEPs in the study districts. In the beginning list of WEPs in two districts were obtained by semistructured interview of 120 randomly selected informants and guided field walks with key informants. After obtaining informant consensus on the list of WEPs, once every month for 12 months, the researchers visited the study sites for a week to observe and record multipurpose WEPs identified with key informants field walk. Record was taken as present (+) when wild plant was observed with flowers and fruits in the specified month (0) for absence in the data sheet against each month to get data on seasonal availability of WEPs. Finally, the record was re-displayed to key informants from each district and consensus was obtained for the recorded data. Following *in situ* identification of WEPs, voucher specimens were collected to verify the identification at National Herbarium, Addis Ababa University, Ethiopia. Key informants pair wise ranking of the most available WEPs was done, following procedures of Martin (1995), Cotton (1996) and IIRR (1996).

Data analysis

Data from interviews and seasonal records of WEPs availability were quantitatively analysed by SPSS version 16 and summarized into frequency tables in percentages. Graph was plotted for seasonal distribution of WEPs. Chi-square tests were performed for the mean difference of IK between two districts, plant species related information were summarized in tables, percentages and ranked. Jaccard's coefficient of similarity was calculated for species use similarity between transhumant and settled farmers. JCS= c/c+b+a, where, a= number of species found only in habitat A (settled farmers), b= is number of species found only in habitat B (transhumant), c= number of species in habitat A and B. Finally, JCS was multiplied by 100, in order to obtain the percentage species composition similarity between the transhumant and settled farmers area (Ladio et al., 2006) comparison between cultures. Voucher specimens were collected, properly identified and deposited at National Herbarium, Addis Ababa University, Ethiopia.

RESULTS

Wild edible plants used as food

A total of 37 WEPs were identified for food and other multipurpose uses in semiarid, east Shewa, Ethiopia. These WEPs were adapted to specific seasons of the year (Table 1). According to informants, this was common before 3 decades. Informants explained that, in early times there was clearly defined seasonal availability of WEPs with fruiting and ripening time. They have indicated that currently, there is decreasing tendency of observing clearly defined seasonality of some WEPs, such as *Dobera glabra*. Key informants ascribed it to shortage of rain water; they called it jijirama qilensaa, which means climate change in Oromo language. However, they still know the fruiting and ripening time of some WEPs (Table 1).This has enabled them to use the plants for household food, livestock feed, income generation and medicine all over the year.

Balanities aegyptiaca, *Ziziphus spina-christi*, *Ximenia americana* and *Grewia* spp were identified as all season WEPs, producing fruits during dry and short rain seasons and abundantly growing in dry seasons. Respondents informed that bonas gannas lalisa means evergreen and productive in winter and summer seasons in Oromo language. *Grewia tenax* produce fruits during April to June known as badheesa in Oromo language and is named famine plant called beela baalesa in Oromo language. *Grewia* spp gives fruit in July to September main rainy season called hagaya in Oromo language. When there is shortage of food from farm managed crops *Grewia schweinfurthii* produce fruits and edible by animals and from children to adults. They are wet season WEPs. The WEPs species identified by present study, demonstrated a large body of knowledge passed from one generation to another, reflecting the presence of a rich lore in semiarid east Shewa. Local people had good knowledge of wild fruit species, including their time of fruiting and ripening. There is considerable overlap in ripening among the different species, both within and between localities, resulting in year-round fruit availability.

Species use composition in transhumant and settled farmers land use systems

Twenty-five (67.57%) of WEPs were commonly identified by both transhumants and settled farmers. The species composition similarity coefficient was 0.7. Eight (8.11%) and 9 (24.32%) of WEPs were used only by transhumants and settled farmers respectively (Table 2).

Table 2. Species use similarity between transhumant and settled farmers for WEPs and Jaccard's Coefficient of Similarity (JCS).

Use categories of plants	Total no. of spp. identified	Total no. of WEPs reported by:			JCS	Percentage similarity in species used by A and B
		Transhumants A	Settled farmers B	Both A and B		
WEPs	37	34	28	25	0.7	70

Seasonal availability of wild edible plants in the study area

Two of 70 and 75 year old key informant from Qobo study site explained that, *D. glabra* germinate and mature when there is rain only. They also indicated that, this plant did not give good fruit since the time known as the year of nabi known as bara nabyi in Oromo language which was 48 years ago when there was sever hunger and people has survived partly eating its fruits and other plants fruits. The year was also known as amata ade in Afaan Oromo language the year of *D. glabra* and it was famine year bara beela in Oromo language. *X. americana* ripen twice (September to November and March to July). Key informants explained that, it needs small rain to flower and fruit.

Key informants explained that, the time/ season and frequency of harvesting vary from plant to plant depending on the availability of edible plants and parts. It varied from place to place due to ecological and climatic conditions. For example *X.* and best collected for consumption within 1 to 2 months time. On the other hand, some weedy vegetables such as *Amaranthus caudatus* and chemerda (local name) were available only on seasonal basis. They were available during main rain and short rainy seasons July and September, or short rain February to April respectively. But harvesting of WEPs depends on availability of food in local people's stock. Sometimes these species were also available in irrigated fields even during dry season. Hence, production of WEPs need to know their seasonal availability. Cross tabulation analysis of interview administered to 120 informants using SPSS Version16 indicated that, WEPs were available throughout all seasons of the year for people to use. *Z. spina*-christi, *B. aegyptiaca*, and *Grewia* spp. were most available in all seasons (Table 3).

The most commonly used and preferred WEPs by the community for their dry season availability were *Z. spina*-christ *B. discolor*, *G. flavescnse*, *B.* aegyptiaca, *X. Americana, Grewia* spp (Table 4).This indicated that people use these WEPs in all the seasons. It also implies their drought resistance characteristics and their contribution to community food. Hence, there exists biological security to livelihood of people in semiarid east Shewa. Field inspections in 4 seasons of the year and focus group discussions with key informants were conducted to verify the interview data. Discussants unanimously (100%) agreed with the list of plants and seasons (Table 5) and identified additional WEPs. The WEPs were verified by researchers field inspection. *X. americana* and *Grewia* spp were listed less. From informants response and field inspection this was ascribed to the rarity of *X. americana* in the vegetation of the study area. *Grewia* spp. was good in abundance in the area. *Grewia villossa*, *G. tenax* and other WEPs were used but it become difficult to harvest the fruits due to browsing effect specially camels and goats

Seasonal availability of wild edible plants from researcher's 12 month field record

Seasonal record of the availability of WEPs indicated that their availability varied in months and seasons. They were most abundant from February to April in short rainy season afrasa (belg) and dry season boana (bega) in Oromo and Amharic languages respectively (November to January) and less abundant in main rainy season, ganna (kiremt) (June to August). Number of species recorded ranged from 30 to 31; 24 to 31 and 13 to 16 species respectively for the seasons (Figure 2). Why main rainy season were less abundant may pose a challenge to researchers and readers. This may be because, plants accumulate energy, water for the dry season growth and development and become ready for flowering and fruiting after main and in short rainy seasons.

Periods of consumption of WEPs by different age groups

An interview response of 120 transhumants and settled farmers has shown that people consume WEPs at normal time to supplement their diets and to cope with times of food shortage. However, there is significant variation between the time of consumptions (P= 0.000). In settled farmers area of Boosat districts consumption at normal time is higher than transhumant of Fantalle. In*americana* produce edible parts between twice transhumant pastoralists consumption of WEPs in both normal time and times of food shortage were relatively higher than settled farmers (Table 6). Chi-square (χ^2) values for 3 categories of consumption

Table 3. Responses of informants for seasonal availability of WEPs (N=120).

Districts of respondents		Seasons of availability/abundance				Total
		Autumn	Spring	Summer	Winter	
Boosat	Frequency	20	14	18	8	60
	% of total	16.7	11.7	15.0	6.7	50.0
Fantalle	Frequency	7	29	23	1	60
	% of total	5.8	24.2	19.2	0.8	50.0
Total	Frequency	27	43	41	9	120
	% of total	22.5	35.8	34.2	7.5	100.0

Autumn = September, October, November: Spring = March, April, May; Summer = June, July, August; Winter = December, January, February.

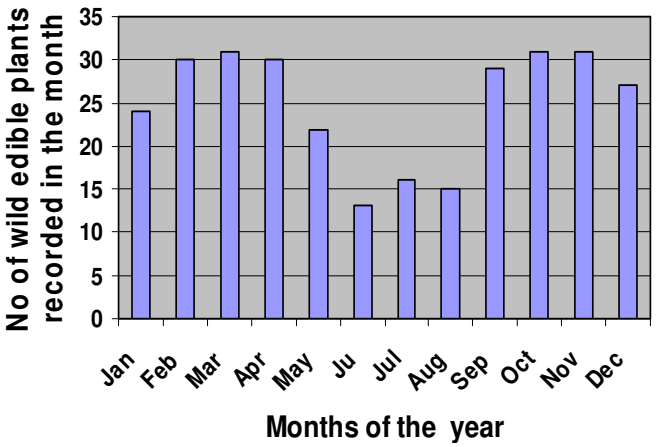

Figure 2. Seasonal availability of WEPs.

periods has significant variation (P<0.05). This indicated that WEPs consumption become part of the normal diet and time of food shortages. The year round availability and an increased consumption habit signifies the contribution of WEPs to households' food security.

Marketability and price of wild edible plants and socioeconomic implications

Marketability

Three rounds market survey, focus group discussions and participatory observation in local markets at Metahara, Addis Ketema in Fantalle district; Welenchiti and Bole in Boosat district in dry and wet seasons survey to assess marketability of WEPs fruits has revealed that majority of the WEPs (75.7%) in east Shewa were not marketed. It has been found that 24.3% were widely marketed from the wild harvest. This demands the integration of these products in dryland agrobiodiversity or agroforestry to properly utilize the potential. One of the reasons for less marketability of WEPs mentioned by key informants was little production available from unmanaged wild pool due to livestock pressure and agricultural expansion and increased selective consumption of WEPs by urban people. These are indications for a need for awareness creation on use and management of WEPs.

Market chain and price of wild edible fruits and seeds

Two routs of market chains of WEPs in east Shewa were identified. Transhumants and settled farmers collect wild fruits from the wild. The two chains identified were: 1) transhumants and settled farmers sell fruits directly to retailers in the formal markets for cheap; 2) retailers-town people get profit by selling to consumers in towns in better price. From market assessment it was observed that people consume fruits of *B. discolor*, *Z. spina*-christi, *X. americana* and others (Table 7). Fruits of these plants were observed in the market and in actual collecting practice by local people and by the researcher during this study.

Focus group discussions made with transhumant and settled farmers have revealed that, the abundance of wild edible fruits is decreasing but the price is increasing than earlier years. From market survey and interaction made with business residents in the study area at local markets showed that, the price of fruits of WEPs such as *Z. spina*-christi, *X. americana* has increased from time to time, that is from 0.10 cents 15 years, to 0.25 cents ten years back. 2 years before data collection and during the research, the average price of WEP fruits rose to 0.50 Ethiopian cents per 10 g.

Gender dimension and division of labour of use and management of WEPs

According to key informants' response, children and

Table 4. Largely available WEPs in the different seasons (N=120) by districts.

District of the respondent		List largely available WEPs in the above seasons							Total
		B. aegyptiaca	*Z.spina*-christi	*X.americana*	*B. discolor*	*Permena recinosa*	*G. flavescnse*	*Grewia* spp	
Boosat	Frequency	8	14	1	4	3	23	7	60
	% of total	6.7	11.7	0.8	3.3	2.5	19.2	5.8	50.0
Fantalle	Frequency	4	30	5	6	4	9	2	60
	% of total	3.3	25.0	4.2	5.0	3.3	7.5	1.7	50.0
Total	Frequency	12	44	6	10	7	32	9	120
	% of total	10.0	36.7	5.0	8.3	5.8	26.7	7.5	100.0

*= *G.villossa* and G. tenax, χ =19.264, df=6, P=0.004 at 5% probability.

women were believed to carry the responsibilities of collecting, preparing and serving the family food in the past. The present study has revealed that, all household members participate in collecting, preparing for home consumption, managing and selling WEPs to maximize household income and food. This was confirmed by 50 and 34.17% informants' from Boosat and Fantalle respectively (Table 8). However, there were still prevailing attitudes in the community in favour of the still prevailing more responsibility on women and children. All WEPs reported were edible by inhabitants in the area. In normal circumstances they were mostly eaten by children. *G. tenax* and *G. villosa* are mostly eaten by children even today. But all respondents know their edibility. Gender category in eating WEPs was not common. But *Lantana camara* was reported to be eaten by girls and named as midhaan dubara, which means females crop in Oromo language. The edibility of *L. camara* was relatively less in pastoral land uses system. Some people also showed their negative perception for its edibility. Hence, study on chemical composition including toxicity of the edible fruit of *L. camara* for future use and management is left for research. Currently, there was an observed trend by households to maximize the management and utilization of WEPs both directly as human and livestock food, income generation and environmental services.

DISCUSSION

Potential contribution to food security

Seasonal food shortages, when household stocks were empty and the new crop were still in the field were common times to dowel on collecting, selling and consuming WEPs in the study area. Addis (2005) and Fantahun et al. (2009) indicated that, it last from July to September in the Northern part of Ethiopia. Many wild fruits that ripen at this time (Figure 2), are therefore important back ups of household food. Generally, the year-round availability of fruits of different species within and across the study areas provides supplementary food and nutrition and presents an opportunity for trade if properly supported by extension services. Balmeie and Kebebew (2006) gave an account of seasonality in general but did not deal with species seasonal abundance. These could be basic motives for local people to conserve wild fruit species and encourage their domestication.

Implication of seasonal availability of WEPs to human well being and environmental integrity

Thirty six WEPs identified were used as food by semi arid people of east Shewa. They increase diversity of income, food, and healthcare system. Hence, increase biological insurance for food and local healthcare system being year round available. They also satisfy the need of local material, spiritual and cultural needs. They can increase resilience of ecological niches contribution to environmental integrity. Contribute to the continued existence of dryland agroforestry. These in turn maintain multiple uses of WEPs. It also sustains existence of biocultural heritage which include indigenous knowledge, indigenous people's confidence on natural resources as their own property. In general priority, WEPs have

Table 5. Seasonal availability of wild edible plants.

Species abundantly available		Seasons of availability of WEPs				Total
		Autumn	Spring	Summer	Winter	
B. aegyptiaca	Frequency	2	2	5	3	12
	% of total	1.7	1.7	4.2	2.5	10.0
Z. spina-christi	Frequency	12	18	13	1	44
	% of total	10.0	15.0	10.8	0.8	36.7
X. americana	Frequency	0	3	2	1	6
	% of total	0.0	2.5	1.7	0.8	5.0
B. discolor	Frequency	2	6	2	0	10
	% of total	1.7	5.0	1.7	0.0	8.3
Permina recinosa	Frequency	2	2	3	0	7
	% of total	1.7	1.7	2.5	0.0	5.8
G. flavescense	Frequency	5	11	13	3	32
	% of total	4.2	9.2	10.8	2.5	26.7
Grewia spp.	Frequency	4	1	3	1	9
	% of total	3.3	0.8	2.5	0.8	7.5
Total		27(22.5%)	43(35.8%)	41(34.2%)	9(7.5%)	120(100.0%)

X^2 =20.253, df =18, P=0.319.

potential for value addition and industrial processing for. better use (FAO, 1999; Gamado et al., 2005). They can also be used for rehabilitation of degraded lands. They can serve as shade, mulch to the soil thereby enhancing soil microbial activities and biodiversity. In turn this will enhance productivity of the area.

Fruiting calendar and innate resilience of WEPs to climate change adaptation

All WEPs identified by the present research were available in dry seasons, either for human and livestock feed. This was proven by field exploration and key informants explanations. It has indicated the innate resilience of wild species to water stress environments, which often missed in exotic species, makes them important for transhumant and settled framers. Key informants explained that, seasonal variation of rain has affected the fruiting time and fruit harvest. But since most of the plants were drought resistant, they were found producing some fruits, though not like during sufficient rain. If some management inputs including the provision of little water, during dry seasons can be done, it can bean advantage over some regular crop which need relatively higher amount of water and management inputs to be productive. Hence, integrating both productions can enhance production and food security.

People are also living in fragile environment (rangelands). As population increases, resources degradation increases and decrease in carbon fixation to vegetation and increase in surface CO_2, with decrease in land cover; climate is also changing from time to time. Therefore, since people cannot continue migrating to other places because of shortage of land. Instead of inhabiting new areas, they cope with climate variability and change by using vegetation of the area for multiple uses. One of this can be consumption of WEPs which were climatically adapted. Not only by using them as they are found, but also enhancing their productivity availability by putting appropriate managerial practices, such as dryland agroforestry, home garden, live fences. Promoting riverine vegetation could be an available opportunity with irrigation.

Effect of consumption patterns and processing by local people

Focus group discussions and interaction made with households has shown that, WEPs can contribute to people's livelihood and food security, but cannot significantly replace conventional agricultural products.

Table 6. Times of consumption of WEPs by different age groups.

Times of consumption	Adult				Children				Adult and children			
	Bos	Fen	Tot	%	Bos	Fen	Tot	%	Bos	Fen	Tot	%
Famine/Drought	3	3	6	5	6	8	14	11.7	4	2	6	5
Normal time to supplement	27	3	30	25	33	5	38	31.7	32	5	37	30.8
Normal and drought	30	54	84	70	21	47	68	56.7	24	53	77	64.2
Total	60	60	120	100	60	60	120	100	60	60	120	100
Mean+SEM				2.65±0.052				2.45±0.064				2.59±0.054
χ				26.057				30.858				31.291
P				0.000				0.000				0.000
df				2				2				2

Local people were observed using fresh fruits. The current consumption pattern of WEPs enabled getting high nutritional value from the plants without altering the chemical nature of fruits. The consumption of WEPs for biological security of food sources was attested by Wube (2009). But unprocessed fruits also have impact on their palatability. It has been indicated that processing these foods will add value to their palatability and add charisma to the consumers. This was due to technological gaps to enable people process and add value to these wild products and generate adequate income, to support their livelihoods than the way they use now. Hence, extension service needs to integrate to the general development plan. The WEPs were managed by Boosat and Fantalle people due to multipurpose uses (food, forage to livestock, medicinal, wood and other environmental services). These uses should be promoted and supported by appropriate extension services to obtain sufficient economic and environmental benefits from WEPs. Promotion of sustainable utilization of WEPs could be an alternative to reduce food shortage in semiarid Africa (Jens et al., 2002; Asfaw and Taddesse, 2001). Hence, earlier studies support the present focused findings as the existence of high potential of WEPs to food security.

The danger of focusing on high yielding verities as a sole solution to food security

Ethiopia is an important center of diversity for many domesticated crops (Harlan, 1969). The country is also a reservoir to ancient farming systems, farmers' varieties of many crops and rich plant lore. Harlan (1969) estimated that, Ethiopia is a center of diversity to 38 crops, which were later reduced to 11 (Zohary, 1970; cited in Asfaw and Tadesse, 2001). However, the crop diversity is in constant threat of being irreversibly lost, due to replacement of the farmers varieties by improved cultivars. Under such precarious situation, the indigenous knowledge associated with the plants can be lost irreversibly. The situation is compounded by acculturation, modernization and lack of full understanding on the benefit of the indigenous wild fruits and associated indigenous knowledge to the present and future generations. Indigenous knowledge faces another threat of disregard, through rapidly shifting dietary habit of the rural community from traditional dishes that constitute indigenous food sources. These situations exacerbate food shortage and increase the rate of malnutrition. To avert the problem, there is a need to focus on the available and ecologically beneficial food sources including the underutilized WEPs. Narrowing down of food sources has a potential threat to sustainable crop production in view of the impeding climate change and emergence of new virulent pathogens. Diversifying food sources through the use of ecologically adapted crops including WEPs, contribute to the fight against food insecurity and malnutrition and help to adapt to climate change

Comparison of farm wild fruits and farm managed crops

Average market price of marketed WEPs was less than that of farm crops (Table 7). This does not indicate that farm crops were cheaper than WEPs. It can be the reverse, if inputs of production and time required managing the farm crops are

Table 7. Price of WEPs compared with equivalent farm crops in local markets.

No	WEPs in local market	Average prices in Ethiopian Birr per Kg				Remark
		Wild fruits	*Sorghum bicolor*	*Zea mayse*	*Eragrostis teff*	
1	*B.aegyptiaca*	2.00	5.30	3.20	9.00	Less marketed
2	*Z.spina*-christi	2.50	5.30	3.20	9.00	Most preferred fruit
3	*X.americana*	2.25	5.30	3.20	9.00	Fruits were rare
4	*B.discolor*	2.00	5.30	3.20	9.00	Fruits were rare
5	*G.flavescense*	1.75	5.30	3.20	9.00	Mostly for hh use
6	*G. tenax*	2.50	5.30	3.20	9.00	Fruits were rare
7	*G. vilossa*	2.50	5.30	.20	9.00	Fruits were rare
8	*Grewia schweinfurthii*	2.25	5.30	.20	9.00	Fruits were rare
9	*Opuntia ficus indica*	2.00	5.30	3.20	9.00	Popular

hh=household.

Table 8. Division of labour and gender dimension in collecting, managing and utilization of WEPs.

Management type	Responses	Husband		Total	Wife		Total	Boys		Total	Girls		Total
		District			District			District			Districts		
		Boos	Fen		Boos	Fen		Boos	Fen		Boos	Fen	
Collect	Yes	25	27	52	39	20	59	53	43	96	43	28	71
	No	35	33	68	21	40	61	7	16	23	17	32	49
Collect prepare for consumption and manage	Ye	8	22	30	41	21	62	32	30	62	39	19	58
	No	52	38	90	19	39	58	28	30	58	21	41	62
Preserve and store	Yes	6	12	18	30	26	56	12	15	27	6	15	21
	No	54	48	102	30	34	64	48	45	93	54	45	99
Selling	Yes	3	5	8	52	29	81	45	6	51	42	31	73
	No	57	55	112	8	31	39	15	54	69	18	29	47
Decision making on issues of WEPs	Yes	11	41	52	33	16	49	23	5	28	23	13	36
	No	49	19	68	27	44	71	37	55	92	37	47	84
Mange money	Yes	25	2	27	37	22	59	8	10	18	4	0	4
	No	35	58	93	23	38	61	52	50	102	56	60	116

calculated. The WEPs do not require input and are cheaper, accessible and affordable. In spite of an increase in the utilization of wild fruits, processing and value addition were not improved, being an outstanding area that needs emphasis in development plans. This also needs further policy and local level awareness creation, to really value WEPs to improve their uses and enhance their conservation for sustainable utilization. Otherwise when the price remain little, a large amount of harvest from the wild will be required to get more money and this can threaten the wild population and become a challenge to conservation.

CONCLUSIONS

The year round availability of wild edible fruits in the study area provided supplementary food and nutrition. This has also provided an opportunity for local trade to generate income to households. It could be strong motive for local people to conserve wild fruit species and encourage their domestication as dryland agrobiodiversity and agroforestry; live fence and in area closure of pasture (kalo) areas. This in turn improves their contribution to food security by direct consumption as food and enhancing livestock production.

RECOMMENDATIONS

The preferred WEPs at community level should be given development attention in light of dryland agrobiodiversity and agroforestry by complementing local knowledge and modern practices. If properly mobilized, use of traditional technologies and farming practices wild edible plants can enormously contribute to the ecological balance and economic resilience of people. It is therefore, necessary to use the documented WEPs, and properly use the indigenous knowledge surrounding before irreversibly lost. Policy enhancement is recommended to properly utilize and manage the existing potential of WEPs.

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