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Research Article

Assessment of Edible Woody Plants' Diversity, Their Threats, and Local People's Perception in Borecha Woreda of Buno Bedele Zone, Southwestern Ethiopia

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Edible woody plants play an essential role in ensuring the food and livelihood security of communities. However, the management practice and diversity of those plants are declined, particularly in an urbanizing world, due to a lack of traditional awareness among the people. This research identified edible woody plants' diversity, their threats, and local people's perception in Borecha woreda of Buno Bedele Zone, southwestern Ethiopia. Data on edible woody plants were gathered through interviews with 105 households (67 men and 38 women) between the ages of 21 and 90. Structured and semistructured questionnaires were used to obtain the data from informants. The collected data were analyzed using descriptive statistics in Statistical Package for the Social Sciences (SPSS) software. Results showed significant differences ($P < 0.05$) between the number of edible woody plants reported by age and literacy level of respondents. Forty-three species of edible woody plants, belonging to 34 genera and 24 families, were identified. Fruits (79.1%), roots (14%), leaves (2.3%), stems (2.3%), and seeds (2.3%) were identified as the edible parts of these plants. Fruits are the most edible plant part usually consumed fresh without cooking in the study area. The identified plants have a variety of growth forms: shrubs (49%), trees (37%), and lianas (14%) respectively. The most common plant growth forms in the study site were shrubs. In the study area, agricultural expansion, overharvesting, and lack of natural regeneration were the major threats to edible woody plants. In the study area, cutting for constructions was the primary hazard to edible woody plants. In situ and ex situ conservation strategies and efforts of plantation practices in the agricultural landscape are needed for sustaining the edible woody plants in the study area.

1. Introduction

Over 7000 plant species are known to be edible worldwide; according to various studies, trees provide 14 of the top 100 most nutritious foods in the world [1, 2]. Indigenous fruit trees traditionally contribute to food and nutrition security, health, and income generation of rural communities in sub-Saharan Africa, particularly in dry lands where cultivation of exotic fruit species is often not possible [3].

Various tree-sourced foods have traditionally been consumed by rural people who either gather them from the wild or grow them in agroforestry systems [4]. Increasing the diversity of trees can improve access to nutritious foods and improve the nutritional status of humans [5]. For example, *Moringa oleifera Lam.*, which is rapidly growing in sub-Saharan Africa, is rich in high values of iron and vitamin A and can improve nutritional status of local communities [6]. *Syzygium guineense (Willd.)* subsp. *afromontanum and Ziziphus mauritiana Lam.* contain high macronutrients, minerals, and vitamin C, which play an important role in improving the nutritional status of rural communities [3].

Edible woody plants (EWPs) have been used for food, medicine, fiber, and other purposes since ancient times. Currently, such plants supplement fill the food gap during

times of food scarcity, ensuring food and livelihood security for countless families and societies all over the world [7]. Rural Ethiopians rely on edible woody plants for survival, particularly during droughts and famines, as well as other disasters and crises. Edible woody plants are high in nutrients such as proteins, vitamin B2, and vitamin C and can be used to supplement traditional plant-based human diets. In some rural areas, they are used to supplement staple foods, fill seasonal food shortages, and provide emergency food during famines [8]. Management systems and biodiversity of those plants are endangered, particularly in an urbanizing world, due to a lack of traditional awareness among people; this is a vital point that requires additional consideration [9]. While both developing and developed countries consume those plants to some degree, there are also strong signs of a rapid decline in local awareness and management practices.

Over 413 edible plant species are gathered and consumed by local people in Ethiopia [10]. The largest number of EWP species in Ethiopia is fruit-bearing trees [11]. Even if those plant species are readily available, in the country, only 5% of them are used as a food source [12]. This is due to a scarcity of ethnobotanical knowledge in terms of their nutritional study, usage, taxonomy, variety, recording, and domestication [13]. Furthermore, lack of traditional knowledge and negative insight towards edible woody plants exist in the community; most of them are being underutilized in Ethiopia. *Adansonia digitata* L., *Tamarindus indica* L., and *Ziziphus mauritiana Lam.* are some of the underutilized species in Ethiopia [14]. This study therefore fills the gaps by identifying households' expectations, conventional expertise, management problems, and consumption of edible woody plants in the study area.

2. Materials and Methods

2.1. Description of the Study Area. The study was conducted in Borecha woreda, which is located in Buno Bedele Zone, Oromia National Regional State, Ethiopia. It is located between 8° 10′ 30″ and 8° 32′ 30″ north latitude and 36° 25′ 30″ and 36° 53′ 0″ east longitude, at an altitude of 1392–2580 m.a.s.l. and located at a distance of 507 km from Addis Ababa in the southwestern direction [15]. Borecha is bordered by Didessa woreda in the east, by Bedele woreda in the west, by Jimma zone in the north, and by Gechi woreda in the south. Mountains, dissected plateaus, hills, plains, gorges, and valleys make up the topography of the study area.

Borecha woreda has a total population of 104,712 (64350 males and 40362 females) and has 34 kebeles, a small administrative unit in Ethiopia [16]. Most of the community is native to the woreda, and Afaan Oromoo is spoken as a native and common language in the woreda.

Cultivation of staple crops (maize and sorghum), oil crops (groundnut and sesame), cereal crops (wheat, barley, teff, bean, and pea), and cash crop (coffee), bee keeping, and animal rearing are the common socioeconomic activities in the study area [17].

According to long-term meteorological data (2010–2018), the area has a unimodal rainfall pattern, with an average annual rainfall of 1360 mm. The rainy season lasts from April to September, with June, July, and August being the wettest months. The mean minimum and maximum air temperatures are 13.6°C and 28.9°C, respectively, and the climate in the woreda is humid and warm to hot. The woreda's 34 kebeles are categorized into three agroecological zones: three Dega kebeles, twenty Woyina Dega kebeles, and eleven Kola kebeles [17].

The vegetation in the study area is made up of moist montane forest ecosystem, with mixed coffee and moist forest in the highlands. The major woody plant species are *Coffea arabica, Cordia africana, Croton macrostachyus, Erythrina brucei, Galiniera saxifraga, Ilex mitis, Maytenus senegalensis, Pouteria adolfi-friederici, Rothmannia urcelliformis, Sapium ellipticum, Syzygium guineense,* and *Teclea nobilis* [18].

2.2. Methodology

2.2.1. Informant Selection Techniques. Based on the information obtained from the Borecha woreda agricultural office with the assistance of local administrators and elders, three kebeles were purposively selected based on the existence of edible woody plants. The sample size of household interviews and key informants was determined proportionally based on the number of households of the kebeles. Key informants were randomly selected from the study site by using information and recommendations from the respective local kebele administrators, development agents, and knowledgeable elders. The semistructured interview questions were written in English and then translated into Afaan Oromo language, which is the local language and interviewed with prepared questionnaires to collect data on the edible woody plants in the site.

2.2.2. Determining Sample Size. To collect edible woody plant species used by men and women, a total of one hundred five household interviews were conducted in three kebeles (Table 1). The sample size was determined using Cochran's sample size formula. $n = z\ 2p(1-p)N\ e\ 2(N-1) + p(1-p)z\ 2$, where n = sample size, N = total households, z = confidence level (95%), e = margin of error (5%), p = proportion of population, and $q = 1 - p$.

2.3. Data Collection. The semistructured interview, focus group discussion, guided field observation, and interview with key informants were applied to obtain ingenious knowledge of the local people on edible woody plants. The households in a village were selected for interviews based on the abundance of fruit trees and edible woody plants in their agricultural farm lands and home garden agroforestry. A simple random sampling technique was employed by tossing the coin to select specific households, if the head is selected and the tail is not selected [19]. At each study site, focus group discussions (FGDs) were held with eight to twelve peoples. The participants of the FGD were purposively selected based on their experiences with the help of kebele administrators and development agents.

Table 1: Number of household interviews of the study area.

Kebeles	Total HHs	Key informants			HH interviews			Total
		Male	Female	Total	Male	Female	Total	
T/getema	480	3	2	5	28	15	43	48
Birkicha	330	2	1	3	18	14	32	35
G/hora	195	2	—	2	14	6	20	22
Total	1005	7	3	10	60	35	95	105

Edible woody plant specimens cited by informants during interviews were recorded and collected for identification. Preliminary identification was conducted in the field, and plants not identified in the field were recorded, collected, numbered, pressed, dried, and identified at the Ethiopian Biodiversity Institute Herbarium.

2.4. Data Analysis. The data collected were entered in an Excel spreadsheet and organized for statistical data analysis. Traditional knowledge dynamics on the use and management of edible woody plants by gender (male and female), aged (21–44 years) and (45–90 years), and literacy (at least primary education) were compared using a *t*-test at the 95% confidence level using the Statistical Package for the Social Sciences (SPSS) software.

3. Results and Discussion

3.1. Indigenous Knowledge on Edible Woody Plants. The knowledge and practices on the use and management of edible woody plants were recorded during interviews, guided fieldwork, and individual discussions. The differences in indigenous plant knowledge by gender, age, educational level, and wealth status were also considered. Statistically, there was no significant ($P > 0.05$) difference in the number of edible woody plants reported by males and females. Although there is no significant difference ($P = 0.102$) statistically, male informants in the study area used more edible woody plants (3.28 ± 0.454) than women (2.15 ± 0.504) (Table 2). This is because of their everyday activities, which are mostly undertaken in the field, and, thus, males are more familiar with woody food plants. This result is in agreement with the findings reported by Lulekal et al. [20], who studied ethnobotany of medicinal plants in Mana Angetu District, southeastern Ethiopia.

However, significant differences ($P < 0.05$) were observed between the number of edible woody plants reported by senior respondents (over 45 years old) and young to middle-aged respondents (21–44 years old) and the literacy of respondents.

The significant difference ($P < 0.05$) in the average number of edible woody plants reported by different age groups in this research indicates that indigenous knowledge on the use and management of edible plants is still stronger among the elderly (4.46 ± 0.502) than the younger generation (2.25 ± 0.439). This significant difference ($P = 0.001$) reveals the generational gap and the decline of indigenous knowledge on edible woody plants and the down of generations. This finding is in line with the finding of Molla et al. [21], who reviewed the edible woody plants in Ethiopia and their potential to combat food insecurity.

In terms of respondents' educational status, the majority of respondents were illiterate. During the survey, the respondents stated that households with lower levels of education consume more edible woody plants. The main argument given was that families with higher educational profiles (especially those with college/university degrees, as seen in the chart above) had more prospects for employment opportunities including government jobs, which may help them to have better income to purchase their daily food demands, while those with lower levels of education or those who are illiterate do not have such options specially during off season or during the scarcity of food. People who were illiterate had significantly ($P = 0.001$) more knowledge of edible woody plant species (4.25 ± 0.501) than those who were literate (2.43 ± 0.423). This finding agrees with the finding of Lim et al. [22], who found the nutraceutical wild plants and their socioeconomic contributions to households in Lare woreda, Gambella Regional State, southwest Ethiopia.

3.2. Edible Woody Plants Consumed in the Study Area. A total of 43 edible woody plant species belonging to 34 genera and 24 families were used as edible plants in the study area. Rutaceae and Rosaceae families had a higher number of edible woody plants of 12 (28%) and 6 (14%) species, respectively, followed by Rubiaceae and Myrtaceae families with each of them having 3 (7%) species, Anacardiaceae, Cucurbitaceae, Dioscoreaceae, Moraceae, and Musaceae with each of them having 2 (4.7%) species, and Annonaceae, Apocynaceae, Araceae, Boraginaceae, Caricaceae, Celastraceae, Euphorbiaceae, Flacourtiaceae, Lauraceae, Myrsinaceae, Olacaceae, Poaceae, Sapotaceae, Simaroubaceae, and Solanaceae families represented by 1 (2.3%) species each (Table 3). The same result was reported by Tesfaye et al. [23], who reported a total of 53 traditionally used anticancer plants, belonging to 30 families, were identified as medicinal plants used by traditional healers to treat cancer symptoms in eleven districts in Ethiopia.

3.2.1. Growth Forms of Edible Woody Plants. The growth forms of edible woody plants in the study areas were dominated by shrubs 21 (49%) and trees 16 (37%), and the least ones were lianas 6 (14%) (Figure 1). This finding agrees with the finding of Atnafu et al. [24] who found that the growth forms of wild edible plants were dominated by trees followed by shrubs. Likewise, Demise [25] reported that wild edible plants were dominated by trees (30.4%) and shrubs (26.1%) followed by herbaceous forms (21.7%) in Adola District, southern Ethiopia.

Table 2: Educational status, age, and gender of informants.

Parameters	Informant groups	N	Mean ± SD	t-value**	P value
Gender	Male	67	3.28 ± 0.454	1.658	0.102
	Female	38	2.15 ± 0.504		
Age	Young members	40	2.25 ± 0.439	−10.269	0.001*
	Senior members	65	4.46 ± 0.502		
Literacy level	Illiterate	65	4.25 ± 0.501	−10.423	0.001*
	Literate	40	2.43 ± 0.423	1.658	

*95% confidence level and 105 number of respondents (N).

Table 3: Identified edible woody plants.

Scientific name	Family name	Frequency (species/family)	Percentage (%)
Rhus glutinosa A. Rich	Anacardiaceae	2	4.7
Mangifera indica L.			
Annona senegalensis Pers	Annonaceae	1	2.3
Carissa spinarum L.	Apocynaceae	1	2.3
Colocasia esculenta (L.) *Schott*	Araceae	1	2.3
Cordia africana L.	Boraginaceae	1	2.3
Carica papaya L.	Caricaceae	1	2.3
Maytenus addat + (Loes)Sebsebe	Celastraceae	1	2.3
Coccinia abyssinica (Lam.) Cogn	Cucurbitaceae	2	4.7
Cucurbita pepo L.			
Dioscorea abyssinica Hochst	Dioscoreaceae	2	4.7
Dioscorea schimperiana Kunth			
Manihot esculenta Crantz	Euphorbiaceae	1	2.3
Flacourtia indica (Burm.f.) Merr	Flacourtiaceae	1	2.3
Persea americana Mill	Lauraceae	1	2.3
Ficus sur Forssk	Moraceae	2	4.7
Ficus vasta Forssk			
Ensete ventricosum Welw	Musaceae	2	4.7
Musa × paradisiaca L.			
Embelia schimperi Vatke	Myrsinaceae	1	2.3
Psidium guajava L.	Myrtaceae	3	7
Syzygium guineense (Willd.) subsp.*guineense*			
Syzygium guineense (Willd.) subsp. *afromontanum*			
Ximenia americana L.	Olacaceae	1	2.3
Saccharum officinarum L.	Poaceae	1	2.3
Prunus persica L.	Rosaceae	6	14
Rubus steudneri Schweinf			
Malus sylvestris Miller			
Rosa abyssinica R.Br. ex Lindley			
Rubus apetalus Poir			
Rubus steudneri Schweinf			
Galiniera saxifraga	Rubiaceae	3	7
Rytigynia neglecta (Hiern) Robyns			
Vangueria apiculata K. Schum			
Citrus aurantium L.	Rutaceae	6	14
Casimiroa edulis La Llave			
Citrus aurantifolia (Christm) Swingle			
Citrus medica L.			
Citrus reticulata Blanco			
Citrus sinensis (L.) Obs			
Mimusops kummel A	Sapotaceae	1	2.3
Kirkia burgeri Stannard	Simaroubaceae	1	2.3
Physalis peruviana L.	Solanaceae	1	2.3
Total	24	43	100

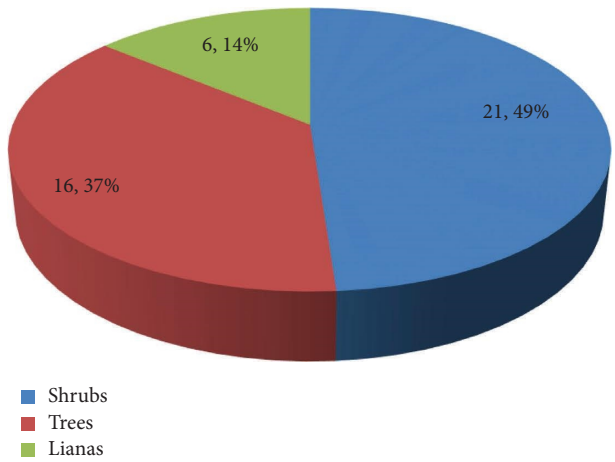

Figure 1: Growth forms of EWPs.

Table 4: Edible parts of woody plants.

S/N	Parts used	Number of species	Percentage (%)
1	Fruit	34	79.1
2	Root	6	14
3	Leaf	1	2.3
4	Seed	1	2.3
5	Stem	1	2.3
	Total	43	100

Table 5: Pairwise ranking of the major threats of edible woody plants.

Threats in rows	Threats in columns					Score	Rank
	AE	OH	Lnr	Cv	Fr		
Agricultural expansion (AE)	—	OH	Lnr	AE	AE	2	3rd
Overharvesting (OH)		—	OH	OH	OH	4	1st
Lack of natural regeneration (Lnr)			—	Lnr	Lnr	3	2nd
Cultural value (Cv)				—	Cv	1	4th
Fire (Fr)					—	0	5th

3.2.2. Woody Plant Parts Consumed in the Study Area. Fruit, root, seed, leaf, and stem were the most commonly consumed edible woody plant components. In the study area, five different components of edible woody plants were identified. Fruits (79.1%) were the most commonly consumed, followed by tubers/roots (14%) and leaf, seed, and stem (each having 2.3%, respectively) (Table 4).

3.3. The Major Threats to Edible Woody Plants. The major threats to sustainable management of the edible woody plants of the study area are overharvesting (OH), lack of natural regeneration (Lnr), agricultural expansion (AE), and cultural value (Cv). Each of these factors contributes differently to the decline in abundance (Table 5).

According to the respondents, most of woody edible trees available at their maturity stage and their availability at sapling and seedling are rare. So, selective cutting of these species without replacing, especially *Syzygium guineense (Willd.) DC,* for its quality and longevity for house construction, is the other factor of threat to the edible woody plants in the area. This is supported by the report of Belay [26] who found indigenous woody plants are threatened by overexploitation, lack of natural regeneration, lack of management, low availability of saplings for planting, climate change, and expansion of croplands. Likewise, Kitessa [27] reported agricultural expansion as the major threat to woody plants in the Jimma Zone of southwestern Ethiopia.

4. Conclusion and Recommendation

This research identified 43 edible woody plants belonging to 34 genera and 24 families, in the agricultural landscapes of the study area. The fruits of *S. guineense (Willd.) DC.* subsp. *afromontanum, S. officinarum, C. abyssinica, C. medica, C. pepo, S. guineense (Willd.) DC.* subsp. *guineense, M. indica,* and *C. papaya* were sold in local markets.

These plants have substantial contributions in diversifying food for human consumption, improving the nutritional status and diversifying income sources. The woody plants occur in a variety of habits or growth forms of trees, shrubs, and lianas, occurring mainly as shrubs. The

results showed that the local communities have knowledge about the collection, processing, and utilization of these multipurpose plant species. The components of plants consumed as food sources include fruits, leaves, seeds, roots/tubers, and stems.

These plant species are utilized by the community during food shortages and under normal situations. Agricultural land expansion, overharvesting, cutting for constructions, and lack of natural regeneration are factors threatening sustainable utilization of the plant species. In situ and ex situ conservation strategies and efforts of plantation practices in the agricultural landscape are needed for sustaining the edible woody plants in the study area.

Data Availability

The data supporting the current study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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