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Assessment of Wild Vegetable Diversity and their use in Western Burkina Faso

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Abstract

Wild vegetables, although very important in the human diet, are poorly documented in Burkina Faso. Consequently, their potential is largely untapped. The overall objective of this study, conducted in villages in the Kou River basin, was to identify wild vegetables and compile an inventory of the main vegetable species along the Kou River. We conducted individual surveys in five villages along the Kou River with 180 people. We recorded each species name in local languages and, when possible, showed the interviewer a sample. Technicians from the CNRST reference herbarium identified the species. We calculated relative knowledge (Cr), level of appreciation (PA), and monthly frequency of consumption (Fc), as well as the Shannon and Piélou indices. By age, 37.22% of respondents were 35-45 years old. Of the women surveyed, 79.44% were married, and 60% of households had between 4 and 8 children. A total of 43 vegetable species were identified, including 22 herbaceous species and 21 woody species. Diversity is moderate (H' = 3.1). Based on the Cr, PA, and FC values, 8 species are known, 7 species are appreciated, and 4 species are heavily consumed by the population in the study area. Vegetables are foraged in the bush (47%), and 26% are available year-round. Leaves are the most commonly consumed parts. The well-known, popular, and widely consumed vegetables are *Senna obtusifolia, Corchorus olitorius, Bombax costatum, Vitex doniana, Alternanthera repens, Ceratotheca sesamoides, Ceratotheca sp., Gynandropsis gynandra, Ipomoea aquatica, and Melochia corchorifolia*. This study shows potential. We need to deepen our understanding of these vegetables and promote their use to increase their contribution to local populations' resilience to climate change.

Keywords: Kou basin; Non-Timber Forest Product; Spontaneous vegetable; Ethnobotany; wild edible plant

Introduction

Edible wild species are important dietary supplements and sources of livelihood for rural households in West Africa [1-2]. Researchers have identified and described several edible species. In Burkina Faso, researchers have identified more than 350 edible species [2]. Overall, the potential of these edible plants remains largely untapped. In fact, only 5.9% of these species are listed among the major crops [3]. This potential demonstrates that: "Nature is a great banquet where humans persist in consuming the same species over and over again." In other words: "Nature offers an immense variety of edible plants, yet humans limit themselves to a narrow range of species."

Among neglected food species, this study focuses on wild vegetables

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(WW). Vegetables are essential for diversifying diets and providing trace elements. They supply vitamins, minerals, dietary fiber, and numerous beneficial phytochemicals [4-5]. According to FAO [3], an annual consumption of 146 kg of vegetables and fruits per person is necessary to prevent noncommunicable diseases. In sub-Saharan Africa, this consumption remains low or is underestimated [6]. If consumption remains at this level, even by 2030, sub-Saharan Africa will still be far from the 146 kg per person per year standard [7]. To bridge this gap, it is possible to turn to wild vegetables, which remain little known and underutilized by local populations and in statistical databases.

Efforts are underway to document the potential of wild vegetables in Africa [8-9-10-11-12-13-14]. Despite these findings, local knowledge of wild vegetables remains limited, as does their domestication. In Burkina Faso, a few wild vegetable species (*Amaranthus spp.; Corchorus spp.; Gynandropsis gynandra,* etc.) have been documented, and domestication trials are underway. However, most are still harvested in the wild. Furthermore, no reference document (catalog) exists on these wild vegetables in Burkina Faso.

In addition to being underutilized, local species are threatened by climate change and habitat destruction [15–16]. Furthermore, rapid sociocultural transformation in African societies threatens the preservation of knowledge about the local species consumed. The trend toward abandoning traditional foods based on local species, which are considered outdated [17–18], will break the chain of knowledge transmission about these species.

To preserve this potential, there is an urgent need to document indigenous knowledge about these vegetables within the various ethnic communities of Burkina Faso to create a reference database that could serve as a source for dietary diversification. With this in mind, the present study aims to explore the potential of wild vegetables in local food systems in western Burkina Faso. The objectives were: (i) to assess the floristic diversity of wild vegetables; (ii) to evaluate the level of consumption of each wild vegetable; and (iii) to assess the spatio-temporal distribution of the various wild vegetables in the area.

Materials and Methods

Study area

The study was conducted in five villages (Darsalamy, Koumi, Kokorowé, Nasso, and Diarradougou) and in a farming hamlet (Sossogona), which is administratively part of the village of Nasso. All of these villages are located along the Kou River between 11°18'57" and 11°30'24" north latitude and between 4°22'02" and 4°27'03" west longitude (Figure 1). According to Fontès et al. [19], the area belongs to the South Sudanese phytogeographic region. The average annual rainfall over the past ten years is 1,139.36 mm [20]. The main watercourse is the Kou River, which is a tributary of the Mouhoun River. The Kou River is vital to Bobo-Dioulasso's drinking water supply. The area is home to the Kou and Dindéresso protected forests, where more than 200 plant species have been recorded [21-22].

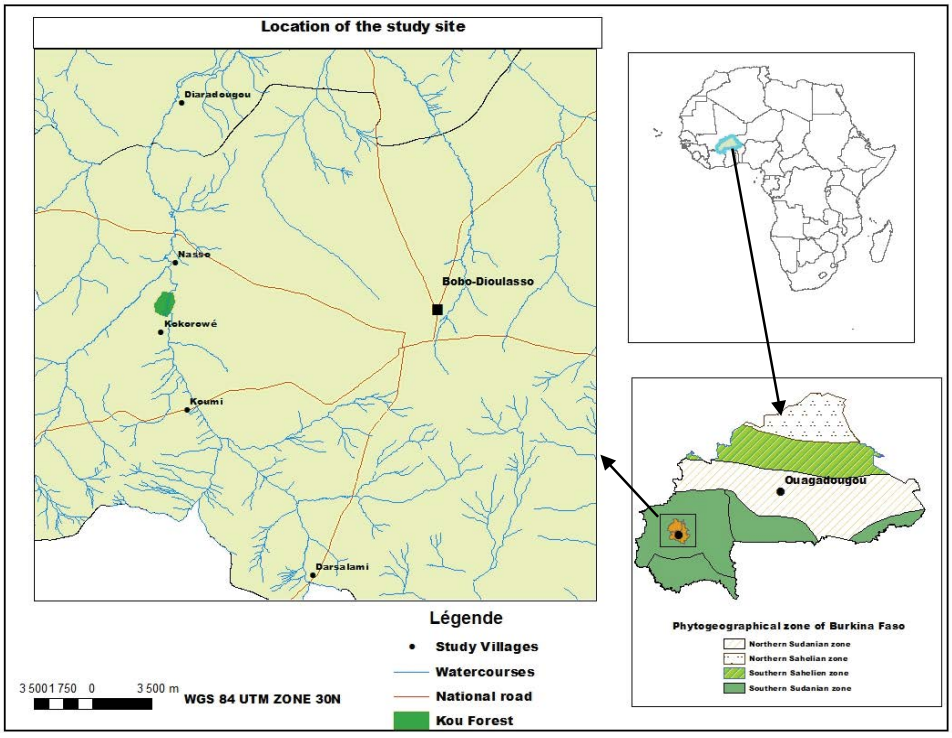


Figure 1: Map of the study area.

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The Bobo constitute the majority ethnic group. They coexist with the Dioula, Tiéfo, Peulh, Mossi, and others. According to Ministère de l'Administration Territoriale [23], nearly 10,000 people lived in these villages. Socioeconomic activities include agriculture, livestock raising, the exploitation of forest and wildlife resources, ecotourism, handicrafts, and small-scale trade [24-25].

Data collection

Data collection used the "snowball" approach. This survey method has participants recommend others to interview, who in turn recommend others. The guide introduced the interviewer to the first person to be interviewed. The survey was conducted among women. An individual survey form was used to administer the questionnaire [26]. Respondents were at least 25 years old, as they are expected to have more knowledge about edible wild vegetables than those under 25 [27]. We selected women because, during the preliminary survey, men clearly acknowledged that the use of wild vegetables was primarily the domain of women. We surveyed 180 people. The main topics covered in the questionnaire were: (i) the local name of the species; (ii) knowledge of the vegetables; (iii) the parts used; (iv) the area of occurrence; (v) threats; (vi) periods of availability; (vii) level of appreciation; etc.

Using vernacular or local names, the researchers conducted a guided field trip to collect and identify the scientific name of each species. However, some species known to rural populations could not be found in the study area. Consequently, these species could not be identified.

Data analysis

The survey questionnaire was created in Sphinx to facilitate data entry. An Excel spreadsheet was used to enter, encode, and clean the data. This data was used to calculate diversity indices and to assess the level of knowledge, appreciation, and frequency of consumption for each species.

- **Shannon Index and Pielou's Evenness Index**

The Shannon-Weaver index (H'), combined with the Pielou evenness index (E), was used to estimate the diversity of citations in the LSAs. According to Ali et al. [28], the Shannon-Weaver diversity index ranges from 0 bits to 4.5 bits. When H' approaches 0, individuals belong to a single species or a small number of species. For H' < 2.5, diversity is low; for 2.5 < H' < 4, diversity is moderate; and for H' > 4, diversity is high. Evenness ranges from 0 to 1. When (E) approaches 0, a small number of species are dominant. It approaches 1 when species are evenly distributed. These indices are calculated using the following formulas:

$$H' = -\sum_{i=1}^{s}\left(\frac{n_i}{N}\right) x \ln\left(\frac{n_i}{N}\right)$$

Where H' = Shannon index, ni = number of individuals of each vegetable, and N = $\sum$ ni.

$$E = \frac{H'}{\ln(S)}$$

Where H' = Shannon-Weave index r; S = total number of vegetable varieties.

- **Relative knowledge of wild vegetables**

The questions asked during the surveys were: (i) Which wild vegetables had you heard of before? (ii) Which of these vegetables are you familiar with? The answers allowed us to assess the LSA's relative knowledge (Cr). According to Ehile et al. [12], it is the ratio of the number of women familiar with the species (n) to the total number of respondents (N).

- **Level of appreciation of wild vegetables**

The appreciation percentages (PA) were calculated for each vegetable as the ratio of the number of households that appreciate the species (n) to the total number of households surveyed (N).

- **Frequency of consumption of wild vegetables**

Consumption frequency (CF) refers to the average number of times a species is consumed per month per household [29]. It is the sum of the ratio of the number of times the species is consumed to the number of people surveyed (Table 1).

Table 1 : Equations for estimating the use of wild vegetables.

Formulas	Threshold values
$Cr(\%) = \frac{n}{N} x\ 100$	Cr= relative Knowledege, n = number of respondents who are familiar with the species; N = total number of respondents.For 75 ≤ Cr ≤ 100, these vegetables are well known; 50 ≤ Cr ≤ 75, known vegetables; 25 ≤ Cr ≤ 50, little-known vegetables; and 00 ≤ Cr ≤ 25, less-known
$PA = \frac{n}{N} x\ 100$	PA : appreciation, n = number of respondents who know the species; N = total number of respondents Vegetables are highly appreciated when 50 ≤ PA ≤ 100%, moderately appreciated when 25 ≤ PA ≤ 50%, and not very appreciated or not appreciated at all when 0 ≤ PA ≤ 25%,
$FC = \frac{\sum fi}{N}$	FC = Consumption frequency fi = number of times a household consumes the vegetable in a month; N = number of respondents.FC: Low: ≤ 10 times/month; FC: Medium: 11 to 20 times/month; FC: High: > 20 times/month

Results

Socio-demographic structure of population

The survey included 180 women from 5 villages and one farming hamlet. By age, 37.22% of respondents were between 35 and 45 years old, and those over 75 were the least numerous (7.78%). By marital status, 79.44% of the women surveyed were married, and 2.2% were single. The results also show that 60% of the respondents had between 4 and 8 children (Table 2).

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Table 2: Demographic characteristics of respondents.

Respondents by village (%)	Darsalamy	19.44
	Diarradougou	20
	Kokorowé	20
	Koumi	20.56
	Nasso	8.89
	Sossogona	11.11
Age group (%)	[25 to 35[	15.56
	[35 to 45[	37.22
	[45 to 55[	15.56
	[55 to 65[	12.78
	[65 to 75[	11.11
	Over 75	7.78
Marital status (%)	Single	2.22
	Married	79.44
	Widowed	18.33
Number of children (%)	[0 to 4[	28.33
	[4 to 8[	60
	Over 8	11.67

Diversity of wild edible vegetables

The local population identified 73 species using local languages. Of these 73 species, only 43 were found and identified (Table 3). Twenty-two of these species were herbaceous (*S. obtusifolia, C. olitorius, G. gynandra, M. cochorifolia, etc.),* and 21 were woody *(C. pentendra, B. costatum, V. doniana, Celtis toka*, etc.). The Shannon-Wiener diversity index is moderate (H' = 3.1), while the Pielou evenness index is high (E = 0.87). The parts of the plants that are sought after are the leaves, stems, flowers, and fruits (Figure 4). Most vegetables are sought after for their leaves (*Melochia corchorifolia, Annona senegalensis, Balanites aegyptiaca, S. obtusifolia, Solanum incanum*, etc.). Some species are sought for their flowers *(Bombax costatum, Ceiba pentandra, Hymenocardia acida*, etc.). Other species are sought for their fruits and/or seeds (*Parkia biglobosa*). The remainder are sought either for their flowers (*Bombax costatum, Ceiba pentandra, Hymenocardia acida,* etc.) or for their fruits.

Table 3: List of vegetables surveyed and the parts used.

Name Scientific	Parts Used	Name Scientific	Parts Used
Acacia macrostachya Rchb. ex DC.	Fr	*Leptadenia hastata* (Pers.) Decne.	Fe
Afzelia africana Smith ex Pers.	Fe	*Melochia corchorifolia* L.	Fe
Alternanthera repens (L.) Link	Fe, Tg	*Nymphaea lotus* L.	Fr
Amaranthus hybridus L.	Fe, Tg	*Ocimum gratissimum* L.	Fe
Amaranthus sp	Fe, Tg	*Parkia biglobosa* (Jacq.) R. Br. ex G. Don	Fr
Annona senegalensis Pers.	Fe	*Piliostigma thonninghii* Schumach.	Fe
Balanites aegyptiaca (L.) Delile	Fe	*Portulaca oleracea L.*	Fe, Tg
Boerhavia diffusa L.	Fe	*Pterocarpus santaloides* L'Hér. ex DC.	Fe
Bombax costatum Pellegr. and Vuillet	Fl	*Sclerocarya birrea* A. Rich.	Fe
Ceiba pentandra (L.) Gaertn.	Fl, Fe	*Securidaca longipedunculata* Fresen.	Fl
Celtis toka (Forssk.) Hepper	Fe	*Senna obtusifolia* L.	Fe
Ceratotheca sesamoides Endl.	Fe, Tg	*Solanum nigrum* L.	Fe Fr
Ceratotheca sp	Fe	*Sterculia setigera* Del.	Fl, Fr
Cissus adenocaulis Steud. ex A. Rich.	Fe	*Strychnos spinosa* Lam.	Fe
Corchorus olitorius L.	Fe	*Tamarindus indica* L.	Fl
Corchorus tridens L.	Fe	*Vernonia amygdalina* Del.	Fe
Ficus platyphylla Del.	Fr	*Vigna sinensis* L.	Fe
Gynandropsis gynandra (L.) Briq.	Fe, Tg	*Vitex doniana* Sweet.	Fe
Hibiscus asper Hook. f.	Fe	*Zanthoxylum zanthoxyloides* Lam.	Fe
Hibiscus cannabinus L.	Fe	*Ziziphus mauritiana* Lam.	Fe
Hymenocardia acida Tul.	Fl		
Ipomoea aquatica Forssk.	Fe, Tg		

Legend: Le = leaf, St = stem, Fl = flower, Fr = fruit

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Areas of occurrence and period of availability of vegetables

Vegetables are harvested primarily in three areas. 46.83% of vegetables (B. costatum, V. doniana, A. africana, etc.) are harvested in the bush. 29.75% of vegetables (G. gynandra, Portulaca oleracea, C. olitorius, Hibiscus asper) are harvested in the fields surrounding the huts, and 23.42% of vegetables (M. cochorifolia, V. sinensis) are harvested along the banks of the Kou River (Figure 2). Regarding availability, 37% of vegetables are available only during the dry season, 37% only during the wet season, and 26% during both seasons (Figure 3).

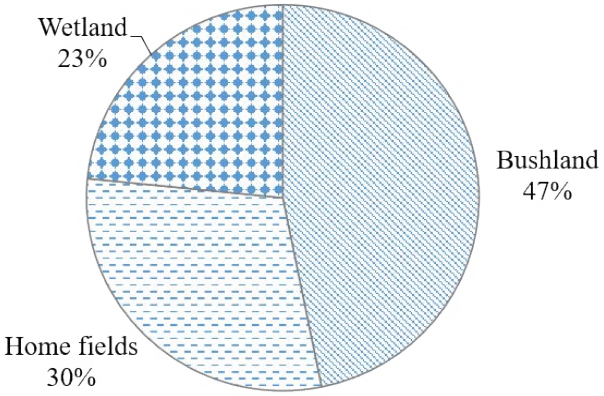


Figure 2: Areas where vegetables are grown.

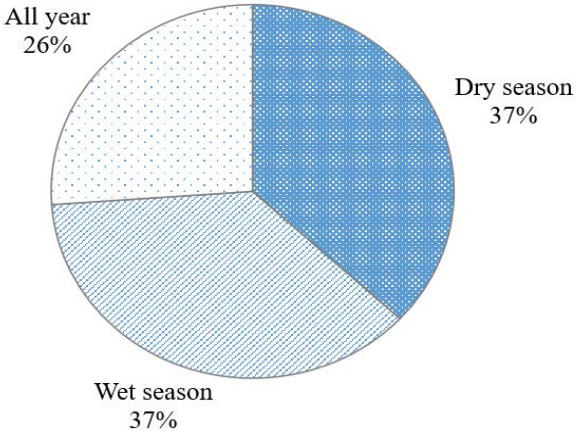


Figure 3: Periods when vegetables are available.

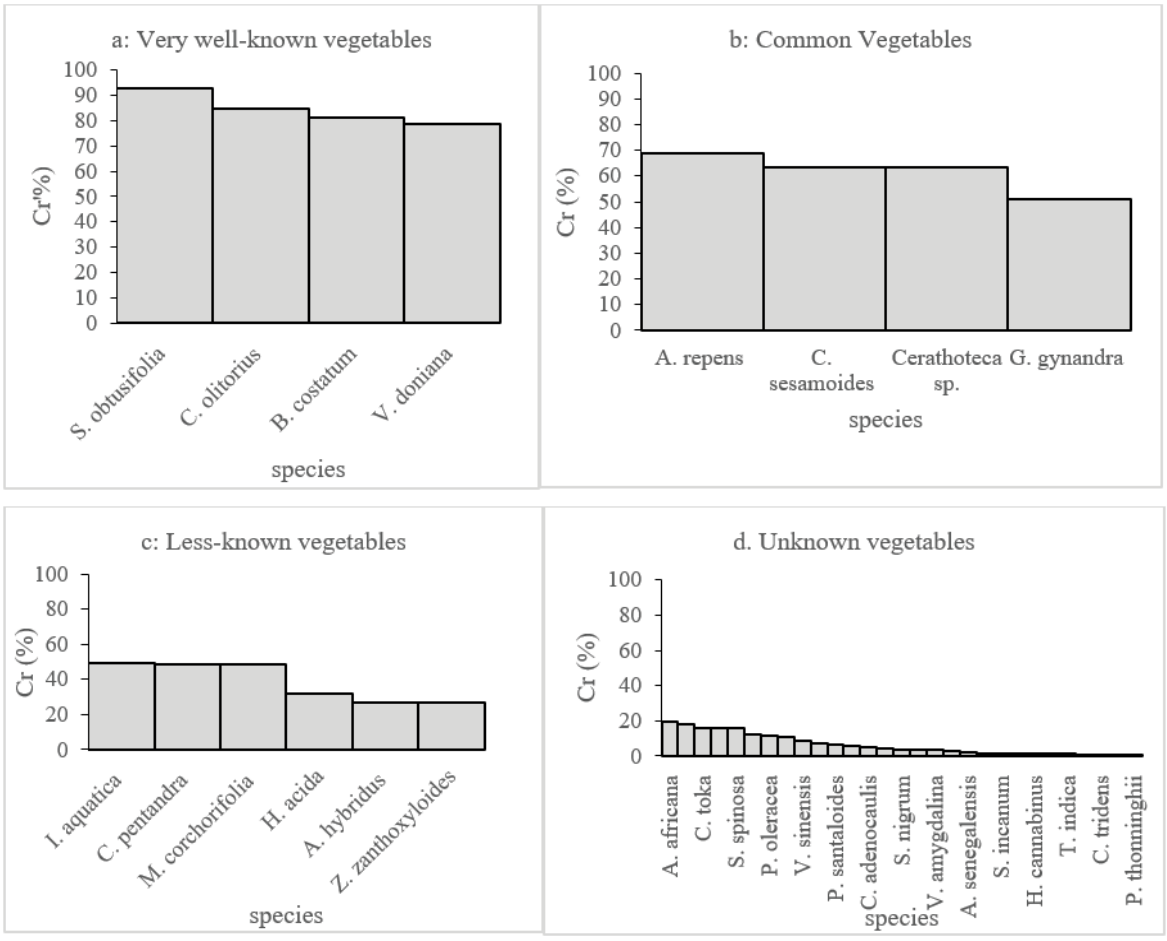


Figure 4: Levels of relative knowledge among the population.

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Relative knowledge

Several vegetables were mentioned by respondents. Four of these vegetables (*S. obtusifolia, C. olitorius, B. constatom, and V. doniana*) are very well known to the population (Figure 4a). Four other LSA species (*A. repens, Ceratotheca sp., C. sesamoides, and G. gynandra*) are known to the population (Figure 4b). Six vegetable species (*Z. zanthoxyloides; H. acida, I. aquatica;* etc.) are little known (Figure 4c). The rest of the vegetables that is, the majority of those surveyed are unknown to the local population (Figure 4d).

Level of appreciation

Appreciation levels vary by species. The most appreciated vegetables in the study area (Figure 5a) are *S. obtusifolia, C. olitorius, A. repens,* etc. Those moderately appreciated include *G. gynandra, M. corchorifolia, I. aquatica,* etc. (Figure 5b). The remaining vegetables, that is, the majority of the 43 species surveyed, are not highly valued by the population in the study area.

Frequency of vegetable consumption

Four vegetable species are widely consumed in the study area. These are S. *obtusifolia, C. olitorius, G. gynandra, and A. hybridus* (Figure 6a). The vegetables shown (Figure 6b), including *M. corchorifolia, B. costatum, C. sesamoides, V. doniana,* etc., have an average household consumption frequency ranging from 20 to 10 days per month. These species are consumed moderately by the population in the area. In contrast, certain species are used only occasionally, with a monthly frequency of use of less than 10 days per month (Figure 6c). These include, among others, *C. toka, C. adenocaulis, S. spinosa, V. amygdalina, V. sinensis, H. asper, and Z. zanthoxyloides, etc.*

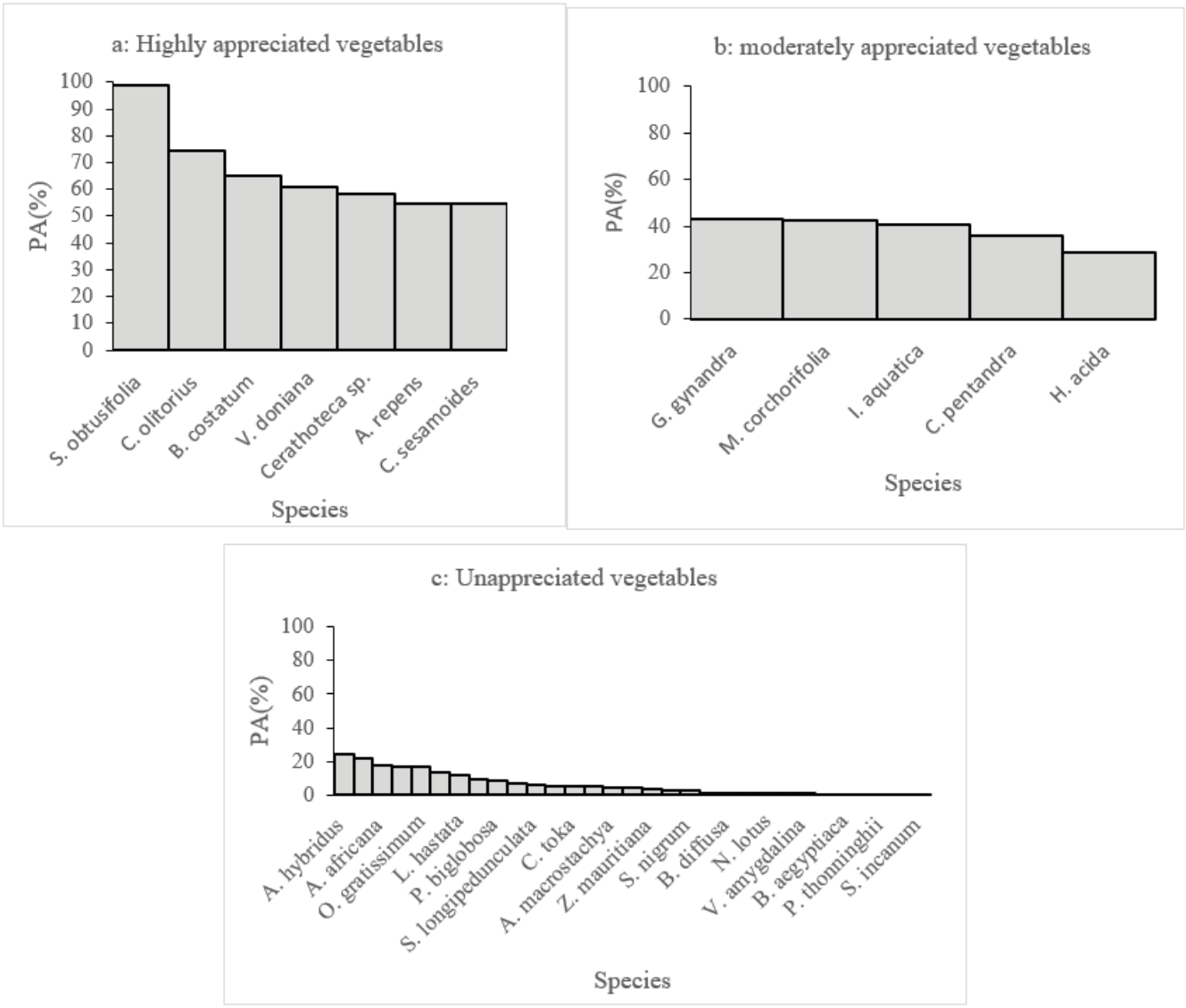


Figure 5: Level of appreciation of spontaneously eaten vegetables.

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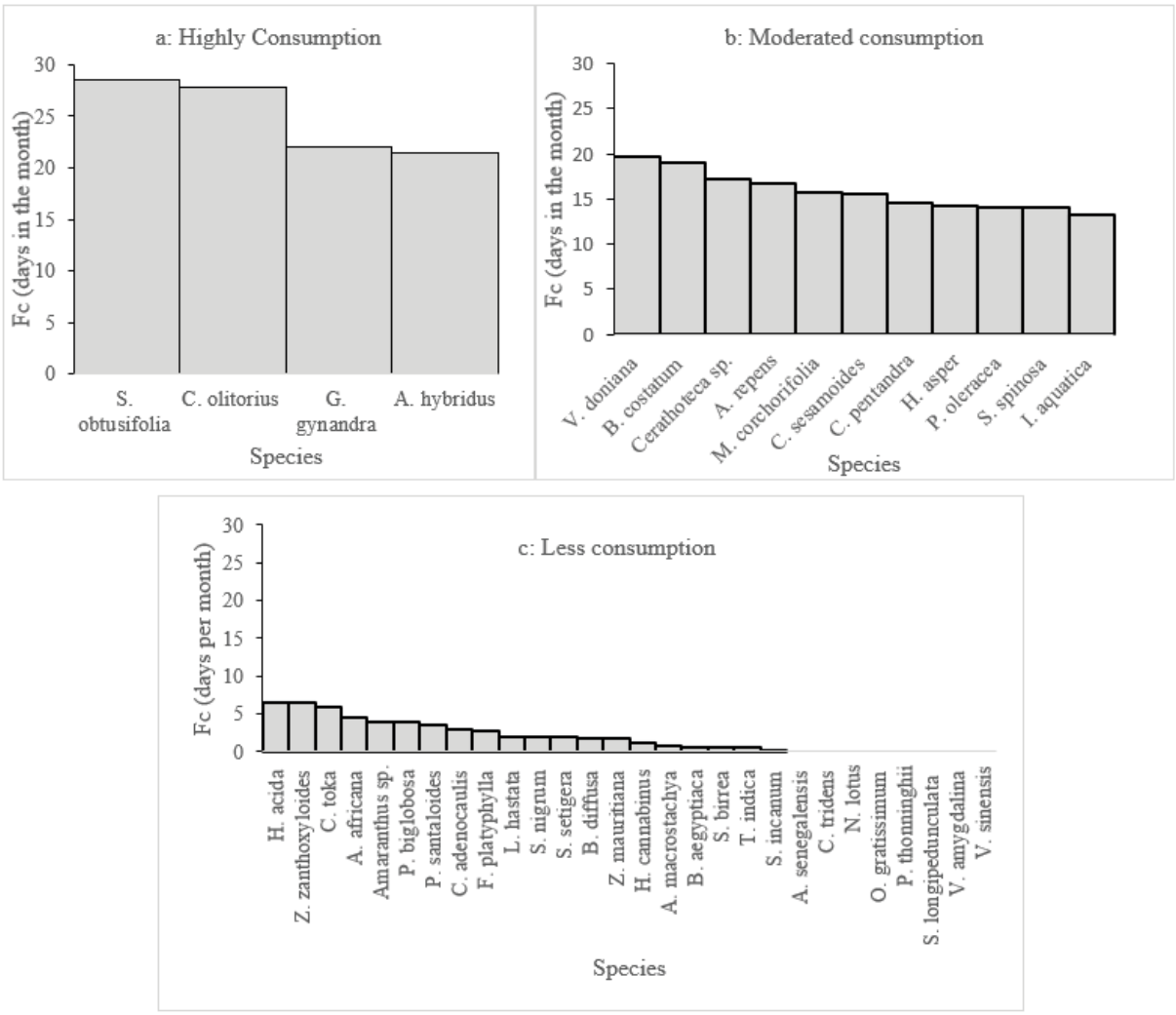


Figure 6: Monthly frequency of consumption of wild vegetables.

Elite wild vegetables

Combining the average values of the calculated parameters relative familiarity, appreciation, and monthly consumption frequency identifies ten vegetable species that are well known and frequently used by the local population in the study area (Table 4). These vegetable species consist of two woody species (*B. costatum and V. doniana)* and eight herbaceous species *(S. obtusifolia, C. olitorius, I. aquatica, A. repens, C. sesamoides, M. corchorifolia, G. gynandra*).

Discussion

Socio-demographic profile of respondents

The survey included women aged 25 and older. 37.22% of the women surveyed were in the 35–45 age group. Additionally, 60% of the women surveyed had between 4 and 8 children. These women play a significant role in household life. In rural African households, men are responsible for grain production. However, women gather vegetables for sauces [30]. Thus, women are particularly skilled at identifying species, recognizing habitats, choosing the best times for foraging, and mastering the culinary uses of wild vegetables [31]. The more these women know about vegetables, the more they contribute to household life by diversifying diets in poor households, especially when resources are limited and households are larger. The reliance on traditional vegetables is even more pronounced. Although this study does not directly demonstrate it, it notes, in line with [32–33], that household size significantly affects the consumption of native vegetables. These results show that women have the best knowledge of wild vegetables. From the perspective of producing a catalog of neglected vegetables, their contribution will be essential to its success.

Diversity and spatio-temporal distribution of wild vegetables

The study area is home to 43 species. Leaves are the most commonly used plant parts. The Shannon index (3.1 bits) and Pielou's evenness index of 0.87 indicate moderate and evenly distributed diversity. The nearly balanced presence of 22

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herbaceous and 21 woody species suggests complementary use of short-cycle plants and perennials, as seen in several studies where wild vegetables come from herbs, shrubs, and trees alike, depending on habitats and uses [34-35-36]. The fact that only 43 of the 73 species mentioned in local languages were actually found indicates that some vegetables have disappeared or have become very rare in the study area. Older individuals likely mentioned them because they may have used them at some point. The average and well-distributed diversity indicates that all the women surveyed were familiar with several vegetable species. This is a positive sign and suggests that vegetable knowledge is present in the study area. Studies in countries neighboring Burkina Faso show that the number of vegetable species used varies by region and ethnic group. For example, [29] identified 39 vegetable species in Côte d'Ivoire, [12] identified 10 vegetables, and [37] recorded 86 species in Niger.

The predominance of bush-gathered vegetables indicates that populations still rely heavily on natural or semi-natural environments, as in other regions where wild edible plants are collected in forests, fallow lands, ruderal areas, fields, and riverbanks. However, the significant proportion sourced from household gardens suggests protection or the beginning of semi-domestication of these wild vegetables. That only 26% of vegetable species are available year-round suggests that certain vegetables depend heavily on the seasons. During the rainy season, wild herbaceous vegetables grow in fields and the bush, where people harvest them for consumption. In contrast, during the dry season, people more commonly harvest the leaves, flowers, and fruits of woody vegetables. This spatial and temporal use contributes to conservation, as heavily used or repeatedly harvested species may be most vulnerable to depletion, destructive pruning, or poor regeneration [38].

Use of wild vegetables

People in the area harvest more vegetables for their leaves, reflecting their preference for leafy greens typically used as meal accompaniments. These findings corroborate those of several authors in West Africa [39-13-40]. In many rural diets, leafy vegetables provide essential micronutrients and help bridge food gaps during lean seasons. However, the local population's limited knowledge of these vegetables limits their potential. Of the 43 vegetable species identified, only 8 are known, 7 are appreciated, and 4 are consumed frequently. Thus, the region's vegetable diversity is underutilized. People concentrate their consumption on a limited core of so-called "elite" species [41-42]. Furthermore, increasing access to urban markets and exotic vegetables is changing dietary patterns and exacerbating younger people's lack of interest in foraged species [17]-[18]. This situation has implications for knowledge transmission, which elders are expected to ensure. Given the study area's proximity to the city of Bobo-Dioulasso, easy access to certain exotic produce likely affects consumption of wild vegetables. Compounding this urbanization are climate change and activities that degrade ecosystems and, consequently, the habitat of these species, which are highly beneficial to the population.

The observed scarcity of several wild vegetable species may be explained by climate change and habitat degradation from agricultural land clearing and herbicide use ([41]-[43]-[44]). Lacking formal protected status, these undomesticated resources are subject to overexploitation and acute spatial decline. Despite this knowledge loss regarding wild vegetables, ten species were classified as elite vegetables in the region. These species contribute significantly to dietary diversification and enhance the population's resilience to climate variability.

Conclusion

This study on the food potential of wild vegetables in western Burkina Faso identified 43 wild vegetable species: 22 herbaceous and 21 woody. Leaves are the most commonly consumed parts. These wild vegetables grow in the bush (47%), in fields near huts (30%), and along the Kou River (23%). The Cr (%) values show that four wild vegetable species are very well known (*S. obtusifolia, C. olitorius, B. constatom, and V. doniana). The seven most popular wild vegetable species include S. obtusifolia, C. olitorius*, and *A. repens*. The species most heavily consumed in the area are: *S. obtusifolia, C. olitorius, G. gynandra, and A. hybridus*. This study reveals that the study area has significant potential for wild vegetables. This potential remains underutilized because wild vegetables are still harvested only by hand. Knowledge of these wild vegetables is also being lost, and certain species are disappearing in the area.

To increase the contribution of wild vegetables to the human diet, it is necessary to conduct agronomic trials on the identified elite wild vegetable varieties; continue research and identification of wild vegetable species not yet found in the area; and raise public awareness of their importance. Wild vegetables represent a resource offered by nature; humans should not deprive themselves of utilizing them to improve their diet.

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