


REVIEW

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Addressing constraints in promoting wild edible plants' utilization in household nutrition: case of the Congo Basin forest area

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Abstract

It is worth raising the question, why are wild edible plants (WEPs) which are rich in diverse nutrients and widely abundant underutilized despite the increasing rate of undernourishment in poor regions? One reason is that their culinary uses are not quantified and standardized in nutrition surveys, and therefore, they are not properly included in household diet intensification and diversification across regions and cultures. Active steps are needed to bridge this gap. This paper outlines the constraints to including WEPs in nutritional surveys as the lack of standard ways of food identification of diverse WEPs, lack of specific food categorization and therefore difficult dissemination across regions and cultures. As a way forward, a functional categorization of 11 subgroups for WEPs is introduced and discussed. In labeling these sub-food groups, the paper advocates that more WEPs food items and culinary uses should be enlisted during household nutrition surveys. Food researchers could then capitalize these enlisted species and disseminate them to promote diverse food use of WEPs in other regions where they exist but are not utilized as food.

Keywords: Culinary uses, Dietary diversification and intensification, Food groups, Food items, Functional categorization, Identification, Wild edible plants

Background

In 2015, increasing rates of undernourishment continue to remain a sad reality in most of sub-Saharan Africa [1]. For instance, the Cameroon Humanitarian Needs Overview (HNO) report of June 2015 stated that the food security and nutrition situation in Cameroon has deteriorated with a 300% increase in food insecurity between 2012 and 2014. Food insecurity is driven on the one hand by limited access to nutrient-rich foods and on the other hand by high levels of poverty, limited accessibility to diverse diets and social insecurity. Taking the case of accessibility to nutrient-rich foods and diet diversity, there exists a wide range of naturally existing food sources like wild edible plants (WEPs) that are underutilized in most poor communities either due to ignorance, shame or misconception about these foods [2–5]. Overall,

local people make use of 7000 plant species for food and other uses [6, 7]. Therefore, WEPs play an important role in diets and nutrition among rural communities in many countries. However, the nutritional value awareness and culinary uses of most groups of WEPs are still limited to specific cultures and regions. For instance, Jaenicke [7] notes that of the many thousands of plant species in the world, only 150 species are used and commercialized on a global scale. Over 95% of human plant protein comes from only 30 crop species and only 10 species and species clusters make up 90% of international trade worldwide. In rural areas, WEPs constitute the widest available and accessible sources of fruits, vegetables and mushrooms which are nutrient-rich foods [8, 9].

The question is “why do the food uses of many WEPs continue to remain localized despite the increasing rate of undernourishment in poor regions?” In this paper, it is hypothesized that this is because their role has not been quantified and not counted in nutrition surveys making it difficult for their intensification and diversification in culinary uses across regions and cultures. This reduces

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the visibility of WEPs, with implications for policies that protect and promote this resource as well as policies that promote food security and nutrition concerns. Active steps are needed to bridge this gap. This article discusses how WEPs could be better captured in food security and nutrition surveys in the Congo Basin area and further included in evaluating household food intake and food consumption patterns. It argues that formally incorporating WEPs categories in household nutritional surveys will enable rural dwellers to enlist more types of WEPs in food surveys stating how they are used. This will make the products gain more popularity and will enable nutritionists and extension staff to research, document and promote the food uses of diverse species in other regions where they exist but are not used as food. It will also promote the documentation of culinary ways of utilization and their dissemination so that programs and policies can be better targeted for diet diversification.

The paper originates from practical field experience on implementing a household nutrition survey wherein in free listing food items, some women were slandered by other participants because they wanted to enlist traditional vegetables among food items. Even with explanations, these local categories were not mentioned until special categories were created for them and another special session organized to sensitize them before they were mentioned even though, in a mocking way. After this introduction, this paper presents the importance of WEPs in the nutrition of people living in poverty in developing countries. Next it discusses how and why WEPs are not included in nutrition surveys and the problems and issues this causes. Subsequently, it confers what would be required to include WEPs in surveys and discuss and present food group categories that can be used to include them in household national surveys.

Why WEPs are important when thinking of undernourishment in poor regions

WEPs and micronutrient intake

Micronutrient deficiency as a global health problem affects about two billion people and also occurs in people who are overweight or obese [10, 11]. As stated by FAO [10] “malnutrition in all its forms—under nutrition, micronutrient deficiencies, and overweight and obesity—imposes unacceptably high economic and social costs on countries at all income levels” and therefore recommends that nutrition should be a central aspect of food security. A study of 154 women in Brazil by Leão and dos Santos [11] showed that insufficient intake of vitamin A was associated with a high frequency of being overweight in 82.8% of participants. As well, 75% of inadequate serum levels of β -carotene in 41.7% of individuals of both sexes were assessed with class III

obesity. Vitamin C intake was adequate in only 20% of the population studied, and in another study conducted with adults of the municipality of Rio de Janeiro who had metabolic syndrome, vitamin C intake was insufficient in 93% of the population [11]. Childhood malnutrition is a cause of death for more than 2.5 million children every year [12]. The terms “undernourishment” and “hunger” have been interpreted as referring to a continued inability to obtain enough food, that is, a quantity of food energy sufficient to conduct a healthy and active life. Malnutrition is a consequence and cause of hidden hunger which refers to vitamin and mineral deficiencies, or micronutrient deficiencies [12]. Somebody who suffers from hidden hunger is malnourished, but may not sense hunger and thus lacks some essential micronutrients. Wild vegetables can be rich in vitamins, carotenoids, iron and other minerals, and in addition, wild fruits are rich in vitamins A and C [4, 13–15]. Promoting the use of WEPs is useful not only for fighting malnutrition in poor communities but also in rich countries with poor micronutrient intake.

According to [16], wild leafy vegetables constituted the only source of micronutrients for the majority of resource-poor farmers from Ezigeni community in South Africa. Similar demonstrations were made by Delang [17] in Thailand and Ambé [18] in Côte d’Ivoire. As well, limited food access, coupled with other stressors like war, worsens the situation of food in security and intensifies hunger. This adversity can be attenuated by the use of WEPs [19–21]. Loek and Maxwell [3] found that there is a margin of improvement in the dietary intake of households in the Democratic Republic of Congo (DRC) because of the consumption of WEPs. Their study suggested that those with greater intake of WEPs ate more food, showed higher levels of energy and vitamin A, vitamin C, vitamin B6 and calcium.

Vegetables and fruits have been reported to be the most important sources of micronutrients because of their high concentrations in minerals and vitamins. Put together, with the exception of Kenya, no country in sub-Saharan Africa reached half of the WHO/FAO recommended quantity of fruits and vegetables consumption of 400 g/person/day or 146 kg/capita/year [15]. Although richer households spent more on fruits and vegetables, putting all countries together, more than 70% of households failed to reach the recommended minimum consumption level and considering just the last five countries, more than 90% of households failed to meet this minimum [15]. Since WEPs include a large group of fruits and vegetables [15, 17, 22], they are a good prescription for most households in sub-Saharan Africa (both rural and urban) to respond to the low intake of micronutrient-rich foods.

The high availability of scarce micronutrients in WEPs is protective against chronic diseases [18, 20] and can help in weight loss [23, 24]. Present research suggests that *Irvingia gabonensis* is the only ingredient that has been proven to regulate the leptin hormone often blamed for rising rates of obesity [23] and this has led to the formulation of a weight lost pill called Africa mango pure [25]. In Cameroon, *Irvingia gabonensis* was established to induce a decrease in weight of $2.91 \pm 1.48\%$ ($p < 0.001$) after 2 weeks and $5.6 \pm 2.7\%$ ($p < 0.001$) after 1 month [24]. In another experiment with *Irvingia gabonensis* after 10 weeks, significant differences were observed in decrease in body weight and waist circumference between the placebo and experimental groups (95.7 vs. 85.1 kg, $p < 0.01$) and (101.1 vs. 88.1 cm, $p < 0.05$), respectively. Body fat decreased over time in both groups but the experimental group lost significantly more body fat (6.3%, $p < 0.05$) compared to the placebo group (1.9%) [23].

By providing some essential nutrients, WEPs can contribute to the food security of vulnerable or rural communities and promote a balanced diet [18, 20, 26] in urban communities. Prolonged illness cause people to lose their appetite and eat in smaller quantities leading to hunger. Many WEPs have strong medicinal and appetizer properties. For example, *Acalypha indica* is cited for increasing the appetite of people and the treatment of some diseases [21]. Other plants especially spices can serve as preventive medicine, stimulants and appetizers [17, 19, 20, 27]. In addition, many spices increase food quality, taste and flavor, thereby arousing the desire to eat more and therefore promoting food intake in sufficient quantity [27].

The Congo Basin forest, constituting 18% of the world's tropical forests, harbors 400 mammal species and more than 10,000 plant species a significant proportion of which contribute in the diet and household food security of over 75 million people across 150 ethnic groups [28]. After the Rio Convention in 1992, forestry debates gained prominence with many countries enacting and implementing stronger legislation, and applying many good practices in the forestry sector [28–30]. Even so, forest and woodland cover are diminishing, forest-based livelihoods, especially food security, are threatened, and poverty is increasing. Above all, the livelihoods of forest people are vulnerable and unclear to policy makers and development planners [4, 29]. A possible reason for threats on forest-based livelihoods could be because of the limited understanding of the value of forests for food security and other daily uses [31]. As well, although forest foods like WEPs are readily available, cost-effective and nutritionally safe to forest people, forest foods of plant origin are less capitalized in household surveys and nutritional studies. Thus, unlike conventional foods, WEPs

have not received sufficient attention in policy analysis and, from researchers to promote their valuation in food security and nutrition.

Main roles of WEPs in local diets, food security and nutrition

The designation “wild plants” refers to non-cultivated plants gathered from wild and agricultural landscapes [4, 32]. Categories of wild plants here after denoted WEPs include vegetables, fruits, pulses, legumes, nuts, seeds and mushrooms [6, 33]. Historically, wild plants and animals have been important dietary components for most societies and the species and styles of use have evolved in response to local contexts, preferences and cultures. Thus, WEPs are not only consumed locally but also in urban spaces and even across borders [34]. A review of the state of research on non-timber forest products (NTFPs) including WEPs in Cameroon by Ingram and Schure [6] noted that of some 3000 plant species identified 181 were being sold in city markets.

WEPs are particularly beneficial in local diets because they constitute many species [6, 26] which are often nutritionally superior to domesticated species [11, 16, 35, 36], are available from wild and semi-domesticated environments with limited or no production or management inputs [19] and do make significant contributions in the food security requirements in forested areas such as the Congo Basin [14, 37]. WEPs play four distinct roles in local diets, food security and nutrition (Fig. 1) following the similar classification for NTFPs generally presented by Shackleton and Shackleton [37].

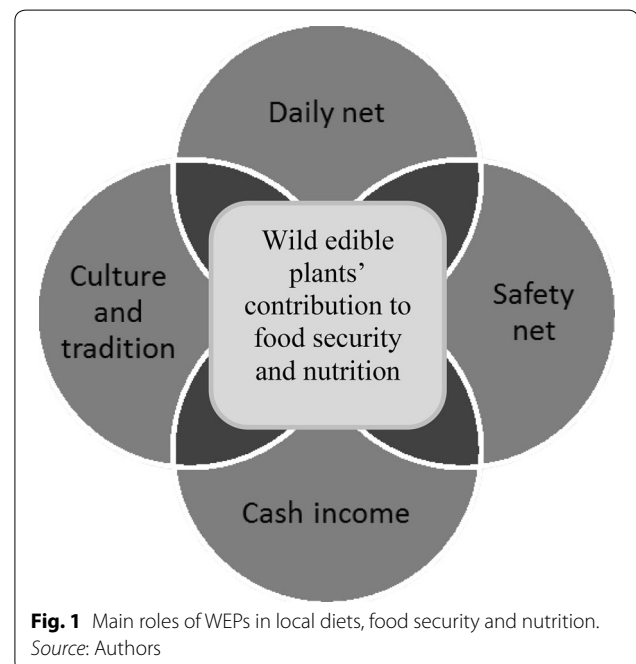


Fig. 1 Main roles of WEPs in local diets, food security and nutrition.
Source: Authors

The first is the daily net function, which encapsulates the daily use and contribution of WEPs to household food needs. It also represents cash saving as WEP are collected for free, which allows scarce cash resources to be directed at other household needs. In Belarus, wild plants used as fruits and vegetable between 1883 and today are still significantly important in the lifestyles of many people. Some have been abandoned or are extinct but new or alternative species, have been documented [35]. Approximately 120 WEPs species are used per community in both industrialized and developing countries [13]. The mean use of wild foods by local communities in 22 countries of Asia and Africa is 90–100 species per location [13]. Aggregate country estimates can reach 300–800 species (e.g., India, Ethiopia, Kenya, Cameroon, DRC, South Africa, Madagascar) [4–6, 13, 14, 26, 35]. In all these cases, subsistence agriculture or markets provide for staple foods like grains, roots, tubers, banana and plantains, while wild gathering provides vegetables, fruits, nuts and oils [4, 14]. Because of the wide use of WEPs, most people have knowledge about them and in some regions have developed various management strategies for them [32] including maintaining them in home gardens and farms. WEPs also contribute to biodiversity conservation and later improve on agricultural production as was the case of rice farmers in Thailand [32] and cocoa farmers in Cameroon [22].

The second contribution of WEPs is as safety nets during times of shock or adversity [32, 37–39]. The most well known of these are famine foods when rains, and consequently crops, are unexpectedly low [19, 38] and also the seasonal shortfall during what is termed the “hunger season” [13, 19, 38, 40]. However, WEPs are used in times of other shocks, such as retrenchment which reduces household cash income, death of a breadwinner or loss of crops to pests [13, 39]. The livelihood and food security of smallholder land users is often at risk from unpredictable harvests, land degradation and climate change [5, 13, 30]. In such instances, some underutilized species, such as wild yams are harvested and consumed [6]. Although such safety nets use is irregular and hard to predict, it can be crucial to maintaining food diversity and security during times of hardship. In some instances, such periods can be prolonged such as during wars or conflicts [41], major economic adjustment programs such as in Timor-Leste [19] or multi-year famine [39, 40].

The third dimension is the use of WEP to generate cash income through small-scale trade [36, 37]. This strategy is an indirect contribution to food security and nutrition as the cash earned allows households to purchase other important foods in short supply, perhaps proteins or staples. Alternatively, the cash earned may be used in education or hygiene initiatives or the purchase of agricultural

inputs for the forthcoming farming season, all of which also add to food security outcomes. There is widespread trade of WEPs in local and urban markets throughout sub-Saharan Africa [6, 31, 40].

The fourth role is their importance in local culture. While the nutritional outcomes of food security are key for physical and cognitive performance, the widely accepted [12] definition of food security includes the vital element of food preferences. Preference is a function of individual taste, exposure and well as what is culturally accepted or avoided. Given that many forest communities have used WEP for millennia, it is not surprising that they are highly preferred and deeply embedded in local culture via stories, recipes, traditions, taboos, ceremonies and celebrations [13, 17]. However, despite this embeddedness, both the taste and culture of WEPs evolve through exposure to new foods, recipes, contexts and social pressures and norms [2, 17, 31]. Additionally, WEPs have other functions, such as improving the taste and quality of food [27] which increases the palatability and intake of other foods, such as staples or proteins.

Strengths and weaknesses of past studies on WEPs

There are many papers on the use of WEPs by local people [4, 14, 37]. Reading through these papers, it turns out that although many issues are discussed around food security; nutrition and undernourishment has rarely been a central focus of these studies and projects. Therefore, many studies develop isolated information for understanding some WEPs and peoples’ styles of utilization. But, what is less reckonable is the contribution of WEPs to household and individual food security. This is because, many, but not all, of the studies are conducted from an ethnobotanical approach rather than from a nutritional approach. As such, they simply list species used, where they are harvested and maybe estimates of frequency of use [4, 14, 22, 37]. However, this is insufficient to bring clear evidence on food intake, the quality and nutritional impacts of WEPs on household nutrition since the information generated does not tell if wild foods contribute to the overall diet and whether they ensure food security.

On their part, nutritional studies and food consumption surveys hardly include WEPs in food listings [15, 42] and in final household food security analysis [43]. One reason could be that WEPs present many similar categories like conventional foods and are often packed into the same food groups. However, in field surveys, they are often disregarded or because they have a local-based consumption pattern which is often not standardized and are relegated in some communities or associated with poverty and misery [2, 5, 17]. As such, household members easily list the cultivated species which are known

and fit clearly into food group categories. On the part of interviewers, because the food list is often long, they easily sideline the unlisted species or limit their food listing to the ten most important food items in each category [19, 21]. The tendency is that with no clear food group categories for WEPs, they are not listed by interviewers. Thus, a possible constraint in promoting WEPs contribution to food security is the lack of suitable product development and categorization.

Constraints to promoting WEPs contribution to food security

The first constraint is the failure to adequately differentiate WEPs from the broader all-embracing concept of NTFPs. NTFP is a catch-all term that can refer to a variety of edible and non-edible forest resources such as mushrooms, berries, leaves, bark, fiber and fuelwood. A particular subgroup of NTFPs is the array of edible species collected from wild and semi-domesticated lands by societies throughout the world, both developing [44] and developed [17], including both urban [6, 34] and rural. These products of plant origin are commonly referred to as WEPs. Many of the NTFP studies that report on the use of forest resources generally include valuable work on WEPs. Efforts have been made to inventory and document most (if not all) edible NTFPs in the forested areas of Central Africa [6, 45]. Pene [45] undertook a literature review on the state of knowledge of the nutritional content of edible NTFPs in Central Africa. Some analysis has been made on the food composition of some key NTFPs and their contribution to human nutrition [36]. Other analyses have been made on the processing and marketing of NTFPs [36] and their potentials to contribute to household income and transboundary trade [17, 31]. Tata et al. [29] produced an overview of NTFP policies in Central Africa (see Box 1 for a summary case

of Cameroon) which highlighted the limits of the NTFP regulatory framework in the region, including food security concerns.

Box 1 brings out two main constraints. It shows the increasing and progressive attention given to NTFPs by the national government in Cameroon and other regional programs of central Africa. But because the aspect of food security outcomes and nutrition has not been central in past thinking and debates, it was only after the year 2010 that the government started laying some emphasis on the domestication of WEPs in a more targeted perspective by creating a special program for this within the Ministry of Agriculture for this. Even so, most WEPs are still not considered in food statistics and household consumption surveys [15, 19, 45] and other aspects of food security are still lacking like their inclusion into appropriate food groups for potential capturing in food consumption studies [27, 42]. This suggests that present efforts on WEPs are being driven for product development for income not for household consumption, whereas the two are ultimately necessary for addressing food security in poor communities with the latter being even more necessary because it depends solely on the households' local capabilities.

The third constraint is that while WEPs are often considered as a “free” food source (other than the costs of labor to collect them), sufficient supply is not always assured [6, 16, 18]. Therefore, the uses of WEPs vary from place to place with several being used frequently, others less frequently and some only in times of drought or as famine foods [6]. Although some individual WEPs are often consumed in small quantities [27], the large array of species and frequency of consumption can create a significant impact on human nutrition. Ingram and Schure [6] surveyed more than 300 edible fruits in Central Africa, while Matig et al. [46] described the usage

Box 1 Major peaks in the NTFP regulatory framework in Cameroon

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- 1994: Adoption of the forestry law n° 94/01 of 20 January published in 1995 with multiple articles on operating conditions and the sale of special forest products
- 1995: Adoption of a new forestry code with a section on the inter-ministerial commission whose missions are to attribute and withdraw permits on the exploitation of special forest
- 1998: Articles 43–46 of decree N° 98/345 of December 21, 1998, on the organization of MINEF which creates the sub-department of non-timber forest products completing decree no. 97/205 of September 07, 1997, on the organization of the government
- 2002: Decision N°1739/A/MINEF/SG/DPT/SDNL/SSS of 8 may 2002 on the creation of a National Syndicate on NTFPS in Cameroon
- 2005: National strategy for forest and wildlife control in Cameroon a document which set diverse measures of control in the forest area and the wildlife zone;
- 2005: A manual on the exploitation and marketing of non-wood forest products in Cameroon developed by SNV—what was commonly used by the sub-department of Non-Timber Forest Products
- 2005: Decentralization of the sub departments of NTFPs by creating regional services in charge of the promotion and processing of NTFPs
- 2006: Circular n° 0131/LC/MINIOF/SG/DF/SDAFF/SN of March 20, 2006, relative to the procedures of attributing and follow-up of small forest exploitation permits
- 2008: Sub-regional guideline on NTFPs of plant origin in Central Africa by FAO, GTZ and COMIFAC
- 2009: Appointment of a committee for the amendment of the forestry law which is currently ongoing
- Since 2010: Appropriation of NTFPs activities especially edible plants by the Ministry of Agriculture and Rural Development in Cameroon. Creation of many domestication programs and development platforms for WEPs especially *Gnetum* spp.
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of 74 fruit species from forests in Cameroon and van Dijk [44] identified over 200 plants used as food in the Dja area of the Humid Forest zone of Cameroon. With these figures, the spectrum of WEPs, including mushrooms, is sufficiently broad to contribute to food security even if individual species contribute in very small amounts. However, because they are many and used in small quantities, in conducting food consumption studies, respondents and interviewees often focus on conventional foods and end up neglecting these species in the survey. An important weakness has been the error of trying to understand and fit food group categories of diets of the Congo Basin to the Western context which are different. In the Western world, most food items have been clinically examined and attributed a corresponding food group. This is not the case in the Congo basin area where people depend and feed on a lot of traditional foods.

Finally there are anti-nutritional, cultural, ethnic and organoleptic considerations that hinder the consumption of some WEPs [26, 31]. To this, there is need to development and disseminate more robust processing ways that will eliminate anti-nutritional elements in some WEPs. This is the case of wild yams that are boiled for at least 5–7 h before consumption by indigenous people in the Congo basin forest area. As reported by Pene [45], processing and consuming WEPs vary with community knowledge about the species and how these products can be prepared. Whereas some species are reported non-consumable in some communities in other regions it is considered a great food value. This is the case of caterpillars greatly cherished and consumed in DRC yet hardly consumed in Cameroon's and Gabonese forest areas. For instance, in Cameroon, some farmers in the forest areas are extracting oil from the seeds of *Irvingia* spp. [24]. This inspired the work on the use of *Irvingia* oil for weight loss [23]. As well, the usage of WEPs for medicinal purposes varies from one community to another depending on their traditional

beliefs and knowledge about the species and ways of processing [21].

Steps to maximizing the contribution of WEPs in addressing undernourishment: Creating functional categories for targeting WEPs in nutritional surveys

To better situate WEPs in food and nutrition security debates, it is important to understand the sociocultural dynamics around food use and dietary patterns (Box 2).

These different food regimes in Box 2 include a variety of WEPs used in different ways depending on ethnic group, knowledge about the species, social status and availability of the species. From these regimes, we consider the food use of WEPs in the Congo Basin to fall within three main categories—(1) soups and sauces, (2) staples and wraps and (3) vitamins, snacks and appetizers. These categories are important for situating respondents during interviews and for prompting. However, they are still too broad to capture WEPs in food consumption surveys. Thus, we have further identified and described 12 subgroups as described in Box 3 for positioning WEPs in food consumption surveys.

In Box 2 it is important to note that pulps and condiments are mainly thickeners, thus make up the main constituent in the sauce and used to increase quantity. This is the case of *Irvingia* spp., *Aframomum* sp. and many others. On the other hand, spices are flavorers and include categories like *Ocimum gratissimum* and *O. canum*. Of particular attention in this categorization is the group of wraps (Marantaceae family and banana leaves) which are not captured anywhere in the literature in Central Africa to contribute to food security. Yet all steamed dishes are prepared using these leaves and a major food for forest people (Baton de manioc in Cameroon, Gabon and Equatorial Guinea; and Chikwangue in DRC and Congo) is prepared using these wraps. Ongoing field interviews in Cameroon suggest that at least 90% of households had

Box 2 Sociocultural dynamics of food use and dietary patterns in the Congo Basin area

In the Congo basin area, whole meals are prepared and consumed in three forms. Firstly are steamed dishes from a variety of food items. Most steamed dishes are often traditional meals or meals cooked during food scarcity and could be a whole meal, a sauce or a staple. Secondly is a porridge which is a mixture of staples with sometimes vegetables and oils and many ingredients, all cooked in one pot. These are in most cases foods during hard times although some cultures have this as main meals. Thirdly are a complement (staple) and a sauce which is the most common form. The staple can be a cereal, root, tuber or plantain/banana boiled or a cooked paste established from the grinding or pounding these main staples. These are accompanied by a sauce which is often a soup (meaning a combination of thickeners (paste from nuts, grains, vegetables, seeds, etc.) and spices), a stew, a vegetable or a pudding. Sauces are intended to help increase the palatability of staples, and therefore, from the traditional perspective, different sauces have been identified to go with different staples

Here, it is important to understand that in most cases vegetables are served as a sauce to accompany the staple not on its own or as a side dish. Since sauces are often more expensive than staples, eating vegetables without a staple or as a side dish is considered like wasting resources, a luxury or inappropriate feeding although with modernization this is becoming more and more acceptable. In case of scarcity, a number of different vegetables are combined and cooked in one pot and/or some thickeners could be added to it to increase the quantity depending on the staple food and the household size

Snacks and appetizers also exist although in a typical village context they also serve as hungry time food. These include grilled and roasted food items like nuts, roots and tubers, plantains, wild fruits, leaves, dried nuts and grains

Box 3 Explaining subgroups for positioning WEPs in food consumption surveys

Category 1: Soups and sauces

1. Uncultivated vegetables from the forest: This will include leaves, young shoots and herbs used in large quantities for food preparation to accompany staples
2. Pulps and condiments: These are all forms of pulps/paste/powder in which WEPs were used as a main constituent in the diet or added to the meal/sauce as a thickener or substantial part of the sauce
3. Spices: These are substances added to food in small amounts of <5% volume of the pot being prepared, and often used mainly for flavor and taste
4. Mushrooms: These are all undomesticated fungi collected from the wild for consumption
5. Oil: These are extracted from forest seeds traditionally

Category 2: Food staples and wraps

1. Starchy roots: This includes all staple foods from the forest like wild yams
2. Wraps: These are fresh *Marantaceae* spp. or banana leaves used fresh for bundling various pastes and sometime spiced meat and fish before they are put in the pot for cooking. Most traditional food and staples are prepared using these wraps and therefore wraps, although not directly eaten, are indispensable in the acquisition of especially most consumed staples in households

Category 3: Vitamins, snacks and appetizers

1. Stimulants: These are leisure foods items taken for excitement or as a habit
2. Appetizers: These are food items or combination of foods that are eaten to increase appetite and subsequently food intake. Although small and scarce, this food group is very important in this area especially because people typically have just one course in a meal even children, nursing mothers and sick people
3. Wild fruits: These are fruits from uncultivated sources. It is important to distinguish this category from general fruits since fruits also present many categories of food items like vegetables
4. Drinks: These are saps from palm and raphia
5. Sugars and sweeteners: These are plant nectars/honey used as sweeteners in food

“baton de manioc” in their houses at the time of interviews and 80% think that the leaves of *Marantaceae* contribute not just to the packaging of food but also to the taste and flavor of food as well as provides vitamins to the food (watch out for our future publication for more details). Furthermore, all interviewed households and community members say there is no alternative packaging not even banana leaves for baton de manioc other than *Marantaceae* spp. leaves because they enrich the cassava paste nutritionally, providing a special form, taste and flavor to that food. There are no scientific data to (dis)prove this claim based on local knowledge. From Wikipedia, the free encyclopedia, two Mexican species of the *Marantaceae* family have flowers that are cooked and used as vegetables. From the West Indies, there is a variety from the *Marantaceae* family known as sweet corn root and has an edible tuber.

Another important category includes wild fruits, uncultivated vegetables and mushrooms. Although many studies exist on mushrooms and their nutritional facts, they are hardly captured in household nutritional and food consumption surveys. This is the same for wild fruits and uncultivated vegetables which are not captured in food consumption surveys maybe because generally the list of fruits and vegetables are often very long.

The data in Box 2 could be used first, independently to study the contribution of WEPs to household or individual food consumption patterns. Secondly, it can also be adapted and used in overall household food consumption studies thus adapting food groups as presented by Stadlmayr et al. [42] to include wild sources and appending some specific food groups peculiar to WEPs in the list (Table 1).

If the food group categories in Box 2 and Table 1 are considered in nutrition surveys, data will be more complete and will reflect the reality of the food security situation of forest-dependent people. Furthermore, it will provide more evidence on the rate at which people exploit many forest resources and use them as food. Finally, it will provide more tangible arguments for the ongoing efforts to capitalize the contribution of forests and wild foods in food security and nutrition.

Conclusion and recommendations

Ongoing scenarios on food deprivation and dietary inadequacy suggest that malnutrition and food security are more than just having food and thus require more in-depth investigation into the diversity and use of food items, knowledge about foods and dietary practices and habits. Wild edible plants (WEPs) are of particular importance in this context because, they are naturally existing foods and therefore could contribute in enhancing the food security situation in a nutritionally safer way. However, limited data on household consumption patterns and use of forest products make it difficult to appreciate the contribution of forest products to food consumption patterns and food intake. Therefore, WEPs culinary uses have remained localized. There is a need to standardize the use patterns in order to promote WEPs for diet diversification and intensification. One step toward this which has been elaborated in this paper is the need for a functional categorization of the different food items of WEPs into existing food group categories so that programs and policies can be more targeted. The constraints in including WEPs in nutritional surveys have been identified as being (1) the compactness of WEPs

Table 1 Standard food group and subgroups for WEPs. Source: Adapted from [33, 35, 42, 45, 46]

Group	Food group	Sub group for WEPs
Group 1	Cereals and grain products	
Group 2	Starchy roots, tubers, and banana/plantain	Staples from the forest like wild yams and other wild roots
Group 3	Grain legumes and legume products	
Group 4	Nuts and seeds	Pulps and condiments from the forest
Group 5	Vegetables and vegetable products	Uncultivated vegetables from the forest
Group 6	Fruits	Wild fruits
Group 7	Sugars and syrups	Honey and other natural sweeteners from the forest
Group 8	Meats, poultry, and insects	Bushmeat
Group 9	Eggs	Eggs from wild birds
Group 10	Fish and shellfish	
Group 11	Milk and milk products	
Group 12	Oils and fats	Oil from forest products
Group 13	Beverages/drinks	Drinks from forest products
Group 14	Miscellaneous	Spices from the forest Stimulants Appetizers Wraps Mushrooms

into the concept of NTFPs. Hitherto, NTFPs are not yet sufficiently classified and categorized in ways that can foster proper understanding and development of individual products. Therefore, WEPs classification is simply being diluted in this already sophisticated concept; (2) the lack of proper product development and categorization; (3) WEPs are many and used in small quantities; therefore, in conducting food consumption studies, respondents and interviewees often focus on conventional foods and end up neglecting these species in the survey and thus in food security and nutritional analysis.

As a way forward to addressing these constraints, a functional categorization of subgroups was brought out to highlight WEPs in existing food groups categories. The added groups were those of wild yams and other wild roots, wraps, pulps and condiments from the forest, uncultivated vegetables from the forest, wild fruits, honey and other natural sweeteners from the forest, bushmeat, eggs from wild birds, oil from forest products, drinks from forest products, spices from the wild, stimulants and appetizers, and mushrooms.

While we are not attempting to say these products can resolve the problems of food insecurity in poor regions, it is thought that they can make meaningful contributions in addressing the problems of undernourishment if thoroughly surveyed and promoted. By using these sub-food group categories in household nutrition surveys, more WEPs items will be enlisted. Furthermore, people will be more aware of the importance of these food items in food security and would use them more freely and more frequently in household diets. As well, it will

be easier to carry out food consumption surveys and to appreciate the contribution of forests and wild resources to household diets and food security which is an emerging focus of forestry research in recent times. Researchers and respondents will be edified in identifying various food items and food use categories in food consumption surveys which is quite difficult to do at the moment. Therefore, it will be possible for food system researchers to document and characterize the culinary uses of WEPs which can be subsequently systematized in a way that could be shared within other communities where the food products may exist and are not used as food.

A main recommendation will be for funding to be allocated toward the operationalization of these sub-food groups and the launching of a regional survey to inventory WEPs and document the culinary uses of the species. The results will be exchanged between participating communities. Finally, extension programs should be increased up to promote the food use of local species found in the participating communities that were not traditionally consumed.

Abbreviations

COMIFAC: Central African Forests Commission; DRC: Democratic Republic of Congo; FAO: Food and Agricultural Organization of the United Nations; GTZ: German Development Cooperation; HNO: Humanitarian Needs Overview; MINEF: Ministry of Environment and Forestry; NTFPs: non-timber forest products; SNV: Netherlands Development Organization; WHO: World Health Organization; WEPs: wild edible plants.

Authors' contributions

PI initiated this manuscript under the supervision of CS who guided the entire write-up of the manuscript. As experts working on NTFPs in Central Africa for

more than 15 years now, AD and CT criticized the original proposal that led to this manuscript and did additional investigations to verify the proposals being raised. They provided important literature and doubled checked that we explored all existing literature on WEPs in order to properly back up the findings. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

Consent for publication

All the authors and institutions concerned have approved their consent for the publication of this work.

Declaration

We the authors hereby declare that with the exception of references consulted which have been duly cited and acknowledged, the work presented is true and original.

Ethical approval and consent to participate

In a large sense, this study did not require an ethical approval but since it involved reporting on ways of food utilization which is an important component of people's cultures and traditions, some guidelines were observed. First, the research proposal was presented to Rhodes University and met with the ethical clearance of this learning institution. Since field work was to be implemented in Cameroon, it was further presented to the Institute of Agricultural Research for Development (IRAD) and also followed the ethical approval for carrying out research in Cameroon. On the field, consent to participate was requested from the villages heads for each village to participate and from the individuals in case of personal information and participation.

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