Importance of wild foods to household food security in tropical forest areas

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Abstract

This article conducts a systematic literature review to analyze and consolidate empirical and/or theoretical evidence that shows the importance of wild foods for household food security in tropical forest areas. For these territories, forest plants, fungi and animals are not only important as a source of food, but also for generating community income. The main challenges related to wild foods are the negative effects on protection of species and the risks to human health when this food is consumed without testing for safety and nutrition. Once these challenges are met, wild foods can serve to bolster food security which can help to sustain territories in tropical forests.

Keywords Wild food · Household food security · Tropical forest areas

1 Introduction

Food and nutrition security have four dimensions: availability, accessibility, utilization and stability. At the local and national level, food availability is highly dependent on a sufficient amount of adequate food being obtained through production, import, storage and food aid (FAO 2011a). Accessibility refers to people having adequate resources to acquire food and a nutritious diet, considering, of course, that adequate supplies of food at the national and international levels do not necessarily lead to household food security (FAO 2011b). Utilization is the biological assimilation of food through a proper diet, drinking water, health and medical care, which meets all physical needs (FAO 2011b). Stability of food refers to maintaining availability, accessibility and utilization throughout time (FAO 2011b; Flores 2016).

At present, it is estimated that there are 795 million people in the world incapable of satisfying the necessary nutritional requirements to enjoy an active and healthy life. This is to say that approximately one in every nine people on the planet is undernourished. The majority of these people live in developing countries (FAO, FIDA and PMA 2015). The tropical forests in Latin America, the Caribbean, Africa and Asia are characterized by their complexity – the diversity of their species, short days, constant photoperiodicity, homogenous temperature, and the absence of thermal and hydrological stations (Whitmore 1983; Poorter and Bongers 1993; Lamprecht 1990). Approximately 800 million people live in these zones (Groom and Palmer 2012; Kashwan and Holahan 2014) of which 38% are undernourished (FAO, FIDA and PMA 2015). Fortunately, due to ancestral and traditional knowledge of the rural areas, which includes knowledge of the indigenous biodiversity of organisms that can be used as food, the percentage of undernourished is not likely to rise (Bennett 2002; Cole et al. 2014).

Wild foods include a set of edible products from different plant species, fungi and animals that have not yet been domesticated. Within this particular sgroup are cereals, tubers, vegetables, fruits, meats, eggs and others (Misra et al. 2013; Schulp et al. 2014; Termote et al. 2014; Erskine et al. 2015; Fa et al. 2015). Wild foods can constitute a source of nutrients that, when included in planning interventions to support food security (politics, plans, programs, and projects) could contribute to a reduction in the number of undernourished people

in tropical forest territories of developing countries. However, in order to have better possibilities of successfully including wild foods for inhabitants of those territories, it is necessary to increase the understanding of their importance and contribution to household food security.

This study, through a systematic literature review, seeks to recognize and consolidate theoretical and/or empirical evidence that demonstrates the importance of wild foods for household food security in tropical forest areas, in order to answer the following questions: (1) What is the importance of forest plants, fungi and animals for household food security in tropical forest areas? (2) What are the main challenges to including wild foods in interventions supporting household food security in tropical forest areas?

2 Methods

A methodological process was implemented in this study which included three steps; *1) identification and gathering of documents; 2) development of the criteria for including documents; 3) data analysis and structuring of research findings* (Labin 2008; Mavengahama et al. 2013).

2.1 Identification and gathering of documents

Scientific websites were consulted including: Web of Science™ Core Collection, BIOSIS Citation Index℠, BIOSIS Previews®, Current Contents Connect®, Derwent Innovations Index℠, Inspec®, MEDLINE®, y SciELO Citation Index (all of them linked to WEB OF SCIENCE), as well as some searches in Google Academic. Searches were done looking for key words in the document titles using terms such as; "*wild foods*", "*wild vegetables*", "*indigenous vegetables*", "*wild edible plants*", "*wild meat*", "*edible wild fruit*", "*Bush meat*". Each of the words was also searched in combination with the expression "*food security*". Limitations in terms of language, years of publication and knowledge area were not scheduled.

2.2 *Criteria for Including Documents*

The only documents that were included were papers published in journals reviewed by scholarly peer evaluators or books published by recognized authors and reviewed by recognized editors; studies with theoretical and/or empirical results which made it possible to answer at least to one of the questions defined for the research; and studies carried out in tropical forest zones.

2.3 Data analysis and structuring of research results

The documents were analyzed in detail to answer the two questions defined above. When it was necessary and expedient, contributions were made to the results based on the empirical experiences of the authors of this paper and/or knowledge gained during technical discussions in frequent meetings.

The results of the data analysis were presented according to geographical areas; Africa, Asia and Latin America and the Caribbean. These areas correspond with those used by FAO, FIDA and PMA (2015) in their report on world food insecurity. Figure 1 shows the countries included in the data analysis of the study.

3 Results

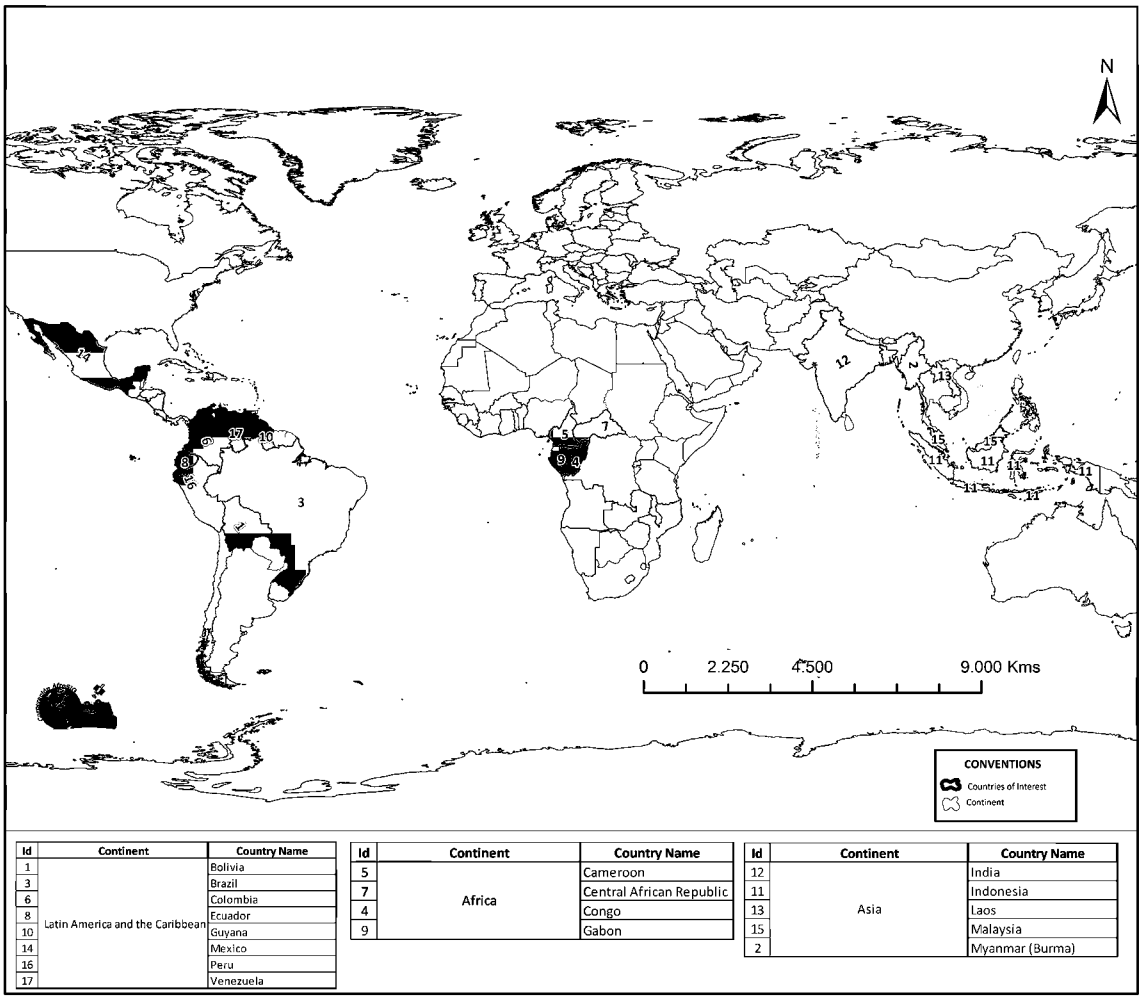
3.1 Importance of wild foods for household food security

The use of species of wild plants, fungi and animals in tropical forest zones, has grown from ancestral practices that favor household food security in these territories, especially in rural areas. Although the information about this issue is scattered, some studies from different knowledge areas (ethnobotany, ethnozoology, economic botany, agronomy, economy etc.), have shown scientific use of wild foods, not only as a source of nutrition, but also for generating economic income in various communities.

3.1.1 Use of wild plants and animals as food

Although there are ongoing studies and research on wild food at the community level in tropical forests, it is still difficult to confirm the direct contribution of wild foods to food security. However, many academics think that the contribution of wild food is significant (World Health Organization (WHO) 1992; Ntiamoa-Baidu 1995; Fa et al. 2003; Nasi et al. 2011; Fa et al. 2015). For example, many authors (Olatunbosum et al. 1972; Ajayi 1978; Prescott-Allen and Prescott-Allen 1982; Asibey 1987; Hladik 1987) cited by Fa et al. (2003) argue that in some African regions 90% of the animal protein consumed comes from wild animals.

As for tropical forests in Africa, it is estimated that in central Africa, Democratic Republic of Congo, Republic of Congo, Central African Republic, Cameroon, Gabon and Equatorial Guinea, wild meat, especially in rural areas, represents a vital element of the human diet. This is due to the close cultural ties between wild resources and the communities, and to the lack of dietary alternatives and financial limitations (Wilkie and Carpenter 1999; Fa et al. 2003; Ling and Milner-Gulland 2006; Fa et al. 2015). An example of this is



Id	Continent	Country Name
1	Latin America and the Caribbean	Bolivia
3		Brazil
6		Colombia
8		Ecuador
10		Guyana
14		Mexico
16		Peru
17		Venezuela

Id	Continent	Country Name
5	Africa	Cameroon
7		Central African Republic
4		Congo
9		Gabon

Id	Continent	Country Name
12	Asia	India
11		Indonesia
13		Laos
15		Malaysia
2		Myanmar (Burma)

Fig. 1 Countries included in the data analysis

in the Congo basin where it is estimated that approximately five million tons of wild animal meat are consumed each year, leading it to be considered an important source of many nutrients – especially proteins, vitamin B, iron and zinc (Nasi et al. 2011).

Wild plants, fruits and vegetables have been used for a long time as part of the traditional diet in diverse locations (Keatinge 2012). In Sub-Saharan Africa, in spite of official statistics indicating low-level consumption of vegetables, wild vegetables are frequently consumed in rural communities within the tropical forest zones (Kamga et al. 2013). Termote et al. (2012) Wild edible plants also provide multiple benefits to rural families in the Democratic Republic of Congo because they are used as important component in the household diet. The excess is commercialized for sale in urban centers.

The northeastern hotspot region of India in Asia has high biodiversity and many multiethinic communities that are highly dependent on wild plants as a source of food (Saha et al. 2014). Likewise, a study carried out in the Similipal Bioserve Reserve (Odisha, India) reported that wild plants are an important source of food, especially when food availability through other sources is not present. The high biodiversity of wild plants as a source of food is significant due to the difficulty of cultivating land and limitations of access to the conventional food trade (Misra et al. 2013).

Other studies have documented the use of different forest plant species (fruits and vegetables) and animals as a fundamental part of rural diets in Indonesia and India. These products are also important to the economic activity of these populations (Kayang 2007; Binu 2010; Narayanan et al. 2011; Chandra et al. 2013; Luskin et al. 2014).

In many rural tropical forest areas in Latin America, such as in Colombia, Bolivia, Ecuador, Brazil, Peru and Mexico, wild species (plants and animals) are the main food source and contributor to household food security, especially in territories that are difficult to access from populated centers and/or the conventional food trade (Van den Eynden et al. 2003; Tejada et al. 2006; Asprilla-Perea and Hinestroza 2011; Pauro et al. 2011; Asprilla-Perea et al. 2012; Martínez-Pérez et al. 2012; Cruz et al. 2013; Álvarez 2014; Cruz et al. 2014; Grados and Peláez 2014; Bortolotto et al. 2015).

In the Amazon, wildlife is the major source of animal protein for the population's daily diet (Robinson and Redford 1991; Townsend 1996; Bodmer et al. 1997; Robinson and Bennett 2000; Townsend and Rumiz 2003; Tejada et al. 2006). Animal protein is consumed not only due to cultural preferences, but because that meat is the most accessible and sustainable source of protein (Fa et al. 2003). According to Fa and Brown (2009) domestic livestock can be more expensive due to their low productivity in tropical areas.

3.1.2 Generating incomes

Commonly in tropical forest areas, wild foods generate family income by occasional sale of diverse species of forest plants, fungi and animals. The economic resources from these sales are generally used for household subsistence.

In African countries such as Equatorial Guinea, Gabon and the Democratic Republic of Congo, scientific evidence demonstrates that commercial hunting can generate increases in family income (Brown 2003; Brown and Williams 2003). It is supposed that greater household income contributes to household food security in these territories (Coad et al. 2010; Kümpel et al. 2010; Termote et al. 2012; Vega et al. 2013).

For rural communities that inhabit tropical forest territories in Latin America, especially in Colombia, wild foods play a fundamental role in generating economic income at the household level – particularly to satisfy their primary need for food, children's education and healthcare (Matallana and Lasso 2012). Activities include frequent hunting and the sale of meat and other sub-products derived from fauna (eggs), or from fruits, fungi and vegetables that are used in such homemade products as condiments, juices, marmalade, ice-cream and biscuits. The money gained from these sales is generally used to complement the household diet (for foods which are not produced by the family) or for the acquisition of school uniforms, utilities and other products necessary for the education of children and young people. Equally, the economic income obtained through the commercialization of wild foods is frequently used to pay for medical consultations and treatment at hospitals, public health centers or the ancestral medicine system that, for many communities in this region, is the only option.

3.2 Wild foods as a resource for planning interventions to support food security: Main challenges

In spite of the wide cultural ties between wild species and the human diet in tropical forest territories, it is likely that their consumption occurs due to diverse problems. The scientific community's main concerns relate to the negative effects indiscriminate use of the resources places on the conservation of biodiversity in the area, and the possible risks to human health because of the lack of assessment of nutritional and health benefits.

3.2.1 Negative effects for the conservation of biodiversity

As mentioned above, the inhabitants from tropical areas have long been obtaining food from the jungles. However, from an ecological point of view, several researchers are concerned that the excessive use of natural resources may lead to the extinction of certain species.

Several studies conducted in Africa, Latin America and the Caribbean also demonstrate concern over the excessive use of plants, fungi and wild animals that leads to a reduction in their populations, local extinction and the fragmentation of their habitat in the both the medium and long term. These can directly affect the functioning of ecosystems and people's livelihood. (Robinson and Bennett 2000; Peres 2001; Fa and Peres 2001; Bennett and Rao 2002; Fa et al. 2005; Laurance et al. 2006; Gardner et al. 2006; Wright and Muller-Landau 2006; Fa and Brown 2009). Similarly, Cullen et al. (2001) state that over-exploitation is the main reason for local extinction, which then negatively affects the balance of the ecosystem. According to Fa et al. (2003) there is strong empirical evidence that wildlife is threatened with extinction due to unplanned human interventions. It is widely agreed that such extinctions will cause serious consequences for future generations (Fa et al. 2003; Ziegler 2010).

3.2.2 Possible risks for human health

The use of plants, fungi and wild animals as dietary products is commonly not due to governmental food security policies but due to ancestral traditions of the community – which have their own sociocultural way of consuming and eating food. The scientific community has two main concerns. First, they are concerned about possible diseases being transmitted by handling and eating wild food. Thirty-five new infectious diseases among humans have been reported in the last decade (Karesh et al. 2005) and many of them supposedly result from collecting and consuming plants, fungi and wild animals (Feng et al. 1999; Leroy et al. 2004; Bell et al. 2004). Second, the lack of studies on their nutritional value, such as protein content, fats and minerals of the wild food means that an imbalance of nutrition is not identified or corrected and, as a result, people may not be consuming a good diet (Pandey et al. 2006; Keatinge 2012; Asprilla-Perea et al. 2012; Kamga et al. 2013).

3.3 Research needs for the adequate inclusion of wild foods in food security planning

The cultural and ancestral importance of plants, fungi and animals found in the diet of the inhabitants of tropical forests,

leads to recognition of the potential of this resource for planning policies, plans, programs and projects to support food security, which may be pertinent and sustainable for these territories. However, it is necessary to carry out diverse scientific research studies that confront the challenges the topic presents. The principal research needs that have been identified are related to seven areas: (1) Increase the number of studies about the recognition and documentation of traditional use of wild species in the diets of communities who inhabit tropical forest territories. (2) Know the pattern of use of wild life in the diets of communities in tropical forest areas, with special emphasis on the relationships among species, culture and territory. (3) Identify the motivation for consuming this type of food, which will enable evaluation of whether the communities prefer to continue consuming wild foods in spite of other options. (4) Identify the nutritional value of the food which has been used by these communities. (5) Identify the value of the biological assimilation of these foods and their associated risks to human health. (6) Generate scientific knowledge about the best alternatives for sustainable exploitation in each case in each particular territory. (7) Assess the impact of the inclusion of wild foods in food security interventions.

4 Conclusions

In all tropical forest areas of Africa, Asia, Latin America and the Caribbean, forest plants, fungi and animals are a source of food that contributes to household food security using ancestral practices and biodiversity. In the rural communities of these areas, wild foods are used as the main alternative to animal proteins, cereals, tubers, vegetables and fruits, and in urban zones they are important in complementing conventional foods (contributing to availability). Also, wild foods contribute to household food security by generating income from activities such as hunting, gathering, harvesting and/or cultivating plants, fungi and animals. These activities are of vital importance for the subsistence of many communities (contributing to access).

The inclusion of wild foods in the planning of food security interventions would make these interventions more pertinent and sustainable owing to the opportunities for articulating policies, programs and projects with ancestral uses of wild food. These interventions could also be more sustainable because they would reduce dependency on conventional foods that in many cases are difficult to produce, have high costs, or are generally not consumed due to cultural resistance. These aspects have great relevance to the lack of sustainability of some publicly financed projects or cooperation projects when the project funding stops. Nevertheless, in order to increase the successful possibilities of the inclusion of wild foods in the interventions aimed at supporting food security, it is necessary to carry out diverse scientific and technical research studies to confront the still pending challenges in this matter.

Despite the evidence which demonstrates the contribution wild foods make to household food security in tropical forest areas, challenges exist, limiting their inclusion in policies, programs and projects to reduce the number of undernourished people in these areas. These challenges are related to the negative effects on the conservation of biodiversity due to unplanned extractive practices, and the possible risks to human health because of lack of nutritional and health assessments of the foods. The first challenge can be addressed through ensuring sustainable strategies which permit the estimation of the abundance and density of the wild food population subject to consumption. These include projection of sustainability; measuring the impact generated by the extraction on the natural population and exploring the possibilities for crop cultivation or animal breeding. The second challenge can be met by decision makers of these territories to implement systematic, multidisciplinary studies that document the nutritional potentials of the foods used ancestrally and their value as alternatives to conventional foods, as well as their safety for human consumption.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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