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EDITORIAL: Forests, biodiversity and food security

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Abstract

The Center for International Forestry Research and World Agroforestry (CIFOR-ICRAF) harnesses the power of trees, forests and agroforestry landscapes to address the most pressing global challenges of our time biodiversity loss, climate change, food security, livelihoods and inequity. CIFOR and ICRAF are CGIAR Research Centers.

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EDITORIAL: Forests, biodiversity and food security

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Forests are a considerable source of biodiversity and, as such, are inextricably linked to people's food security, nutrition and health in a number of fundamental ways. While previous work has examined the links between forests and human health, much of the focus has been on the contributions of forest biodiversity to plant based pharmacopoeias, the correlations between forests and disease and more recently between forests and physiological well-being (Anyonge *et al.* 2006, Colfer 2008, Colfer *et al.* 2006, Karjalainen *et al.* 2010, Nilson *et al*. 2011, Olson *et al.* 2010, Wilcox and Ellis 2006). Building on existing work examining the relationships between forest, food security and human nutrition (Pimentel *et al*. 1997, Falconer 1990, Hoskins 1990, Johns and Maundu 2006, Vinceti *et al.* 2008) this special issue contains a set of papers that explore these linkages and their implications. The contributions range in perspective from global overviews of the role of forest biodiversity in agriculture and food security, the health impacts of forest use on women, to regional comparisons analyzing bush meat consumption and trade in Amazonia and the Congo, and the effects of sedentarisation on nomadic tribes in Borneo and West Africa. Two case studies offer detailed examination of the causes and consequences of changing patterns of forest use within Tanzania and Cameroon. Furthermore, payment for environmental services (PES) is examined as one potential tool to promote conservation while improving livelihoods in Chinantla, Mexico.

Forests in the broader food security framework

The most widely used definition of food security states that: "Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. Household food security is the application of this concept to the family level, with individuals as the focus of concern" (FAO 2003).

Broader than other definitions, which often place heavy emphasis on calories with little attention to other components of food essential to health, this definition emphasises that access to food is as important as food availability. Food security is therefore often linked to the ability to purchase as well as produce food, and to avoid or offset both chronic (long term and persistent), cyclical and transitory food insecurity (where a particular shock leads to food shortage or sudden rise in prices) (see Sunderland this issue). Food-insecure households may live where there is enough food, but they lack income or 'entitlements' (production, trade, labour or transfer-based) to get it. Food-insecure people may live in food-secure households, due to household preferences or gender or age discrimination (Pinstrup-Andersen 2009). The FAO definition also emphasises that food security includes nutrition security; access to food which ensures adequate macro- and micronutrient intake without excessive intake of calories, fats or refined sugars.

Forests contribute to food security in many diverse ways including through its protective environmental role and provision of ecosystem services (Ferraro and Hanauer 2011). This stresses the importance of forest cover in: maintaining the soil and water base that underpins sustainable agriculture; providing habitats conducive to the biological interactions that maintain crops and livestock; and in mitigating impacts of climate change and extreme weather events at the landscape scale (Seymour 2011, Sunderland this issue). The Millennium Ecosystem Assessment also highlights the contributions of these ecosystem services to human health and well-being (http://www.millenniumassessment.org/en/Synthesis.aspx).

Forests, food and health

Probably the majority of rural households in developing countries, and a large proportion of urban households, rely on forest products to meet some part of their food, nutritional, health and livelihood needs.

Although forest foods seldom provide staple items of diets, and rarely make up the majority of items in the diet (by number or volume), for many rural people they supplement what is available from agriculture and other resources, in three main ways:

- Forests provide a diversity of healthy foods, high in micronutrients and fibre and low in sodium, refined sugar and fat;
- Products from forests are often culturally valued, integral to local food systems and food sovereignty, and;
- They help households fill seasonal and other cyclical food gaps and act as a 'safety net' or 'buffer' in times of shortages due to drought, crop failure, illness or other kinds of emergency or external shock.

Forests are crucial in maintaining the biodiversity that underpins crop and livestock agriculture and are an undervalued repository of food and other resources that play a major role in food security and human health (Sunderland, this issue).

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The sale of fuelwood or charcoal from clearance of forest or bush fallow, in order to create new land for crop agriculture, has been shown to be a well established practice whereby young and migrant farmers assemble capital to create new farms in the forest zone across West Africa. Low barriers to entry, and the fact that many of these production, processing and trading activities are open to participation by women as well as men, can make these trades widely accessible.

Fuel wood, essential for cooking in many rural food systems, must not be over looked in a discussion of food security. Many rural and forest communities in developing countries rely exclusively on fuel wood, having no alternative cooking fuel readily available. Improperly cooked food can be unsafe and lead to illness which can worsen nutritional status. Limited fuel wood access causes many families to alter what they eat, often leading to decreased legume / bean consumption, and associated protein and micronutrients. Shrinking access to firewood near the home often means women have less time for other activities that ensure the food security and health of their families (Wan *et al*. this issue). In addition to the well established links between firewood use and respiratory disease, Wan *et al*. (this issue) note a number of other, often overlooked issues. These include the high risks to pregnant women from the arduous work of carrying heavy fuelwood loads which can contribute to reproductive-related illnesses and still births. Cultural restrictions regarding women's intake of certain foods can also erode their nutritional status, leading to a greater susceptibility to life threatening diseases such as malaria. Finally, lack of control over their reproductive health contributes to increased population pressure on forests, thus undermining other conservation efforts.

Many forest-based income generating activities are seasonal, either because certain crops can only be gathered at certain times of year, or because of seasonal fluctuations in availability of labour. Many activities therefore decline in agricultural and planting seasons, or are phased to take advantage of slack periods in the agricultural calendar. Others are governed by seasonally induced cash needs, such as school fees, chronic or unexpected illness, the need for income to buy food during the 'hungry period' between harvests, to purchase seed stock or other inputs needed for the next cropping season, or to generate the working capital that women traders need for business activities (Arnold 2008).

There is increasing evidence from numerous regions that many forests products are particularly important to more vulnerable members of a community. Vinceti and colleagues (2008) reported that "people at risk of food insecurity, or hunger or malnutrition, generally have the highest degree of reliance on forest products for income and food". Wan *et al*. (this issue) highlight the fact that due to gendered division of labour women are more dependent on many forest products, especially firewood and wild food plants than men. Women may also be more vulnerable when changes in forest management or deforestation alter their access to forest products. Forest foods have also been suggested to provide a "safety net" in times of food scarcity and uncertainty (Colfer *et al.* 2006, McSweeney, 2004, Powell *et al.* 2010, Vinceti *et al.* 2008, Sunderland, this issue).

The shift from hunting to agriculture and resultant dietary changes

The shift from hunting to farming and the correlated sedentary lifestyle accompanying agriculture is considered one of the major epidemiological transitions in the history of mankind (Dounias and Froment, this issue, Popkin 2001). According to Dounias and Froment, the abundance of meat is a sign of health and well being; shortage is associated with "meat hunger" a condition which saps strength and vitality not only of the hunter but of the whole community. Cultures reliant on hunting often use associated collectivist social regulations for sharing food and mutual aid that generally disintegrate in sedentary communities which become increasingly individualistic and opportunistic.

In the shift to sedentarisation, diets in many rural areas of developing countries have become heavily based on starchy staples such as maize or cassava, with low intake of animal sources foods (meat, eggs, milk, etc.) (Stephenson *et al.* 2010). Low intake of such foods can result in inadequate intake of protein and inadequate intake and low bioavailability of many micronutrients as well (Murphy and Allen 2003).

The hunting, consumption and trading of bushmeat in West Africa and Latin America that is examined in the paper by Nasi *et al*. (this issue) illustrate several features of changing dietary patterns. Bushmeat remains the principal source of animal protein in many tropical forested landscapes, and especially in the Congo and Amazon basins with vulnerability to hunting depending upon habitat and species With low barriers to entry, and requiring labour inputs that can be easily reconciled with the agricultural cycle, trading bushmeat is easily incorporated into livelihoods that are more secure if based on a range of activities (Brown and Williams 2003, Nasi *et al*. this issue). In the Congo and Amazon basins as well as Chinantla, Mexico, many of the frequently hunted species are secondary forest species or agricultural pest species with high reproductive capacity (Ibarra *et al*. and Nasi *et al.* this issue). While bushmeat is an important commodity in West Africa, it is far less commonly sold in Amazonian markets, due in large part to the widespread prevalence of cattle ranches and consequent availability of beef for a broad swath of society (Nasi *et al.* this issue). In the East Usambara Mountains of Tanzania, Powell *et al*. (this issue) found that households who lived in close proximity to the forest were more likely to use foods from the forest, and those who did consumed more animal source foods. While hunting is dominated by men, the processing and trading is predominantly carried out by women. Though bushmeat forms an important part of their diets, recent studies in West Africa have found that income from bushmeat sales was particularly important for the poorest households, and was often given higher priority by them than their own consumption (De Merode *et al*. 2003).

Changing dynamics of forests, food and human health

The papers included in this special issue, and indeed the broader forest and conservation literature in general, highlight that relationships between forests and people's food security

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and health are far from static. A few of the important drivers for change include: forest cover loss and environmental change from agricultural expansion (Nasi *et al*. this issue, Powell *et al*. this issue, Sunderland, this issue); socio-cultural changes (Dounias and Froment this issue, Laird *et al*. this issue); and changes in income, market access and market integration (Ibarra *et al*. this issue, Jamnadass *et al*. this issue).

Forest cover and environmental change:

In many regions worldwide, diminished access to wild foods occurs as deforestation increases and forest cover becomes more distant from settlements. In some regions, natural forest cover is being replaced with plantations, tree crops or farm trees, which provide less diverse dietary inputs than foods sourced from forests. With 30–40% of available global land converted to agriculture, and human population expected to reach nine billion by 2050, expansion of industrial agriculture could lead to irreversible loss of plants and animal life and associated ecosystem services fundamental to human survival.

Drawing upon this scenario, Sunderland (this issue) distinguishes between intensive, industrial agriculture which has resulted in a drastic loss of wildlands and ecosystem services, and traditional farming systems which often enhance biodiversity and food security through multi-functional landscapes. Synthesizing a wealth of environmental, agricultural and socio-political literature, this paper argues that protected areas have led to limited outcomes for either food security or biodiversity conservation, and that more integrated approaches need to be vigorously pursued. An argument is made not only from a conservation perspective, but from a human health angle; in developing countries up to 80% of populations rely on biodiversity for primary health care and wild-harvested meat provides 30–80% of protein intake for many rural communities (Nasi *et al*. this issue). In addition, deforestation disrupts protective functions of biodiversity, altering the subtle balance among vectors and parasites in humans and animals and dramatically increasing the burden of transmissible diseases (Dounias and Froment, this issue).

Depletion of forest resources may also be a consequence of sustained heavy local use of forest foods, or forest products harvested to generate household income. Populations of some animals hunted for bushmeat can plummet with heavy hunting, though other smaller bushmeat species can prove resilient and even increase. Moreover, some may also become more abundant as the forest cover is opened up and altered from forest to fallow and farm bush (Nasi *et al*. this issue). Roadways, while opening up avenues for people to sell forest goods, can lead to rising rates of deforestation, unsustainable off-take of high value forest goods and decreased reliance on forest goods by locals.

Powell *et al*. (this issue) examine the relationship between people's dietary diversity and forest cover and use in a mountain area in Tanzania. Although most of the wild foods in the diet were collected on farm land, villagers consuming wild foods from forest areas were found to have better diets. The amount of forest cover within a 0.5–2 km radius of the house was strongly associated with the likelihood of forest food use, suggesting that use seemed to be conditioned by both availability and access to (in terms of time and user rights) forest areas.

Social and cultural change

Several of the papers in this issue explore social and cultural aspects of changing relationships between forests and human health. The subsistence and life-way transitions associated with sedentarisation described by Dounias and Froment (this issue) provide an example of major rearrangements in social and cultural structures, which are permanently altering peoples relationships with forests. Examples from West Africa and Borneo chronicle the impact which drastic alterations of forest ecosystems have had on forest-reliant hunter gatherers. The authors describe the "mis-adaptation" which indigenous groups suffer including nutritional disorders, phycho-cultural ill-being, discrimination, erosion of collectivity and mutual aid and mental diseases. They note, "declining diets and increasing illnesses are symptomatic warnings of these ecological and socio-cultural mis-adaptations that former hunter-gatherers currently pay to achieve their share of modernity"

Laird *et al*. compare and contrast established practices of resource management and use by indigenous and other long established populations with those practiced by migrant newcomers, in a well endowed area in the Mount Cameroon region in West Africa. Their findings show that indigenous livelihoods draw upon management of a broader range of habitats and species than migrants, and have a much greater use of forest products in the subsistence component of their livelihoods, due to their superior knowledge of the resource.

Decline in use of forest food can also occur due to decline in knowledge about its use. As children spend more time in school, rather than in the fields and the bush, opportunities to learn about wild foods are reduced. A move to a more settled lifestyle is a widespread change that can separate people from knowledge about the food sources they used to be familiar with. Poorer knowledge about which plants can be consumed, and which cannot, constrains people's use of these foods even when the latter are still available and important for dietary balance. Vinceti *et al*. (2008) report that "the erosion of traditional knowledge about forest biodiversity has been observed to affect food choices considerably and to lead to dietary simplification and negative repercussions on human health".

Income, market access and market integration:

Forest products also widely form a major source of income for rural households with which to purchase foods or the inputs they need for agricultural production. In many situations use of forest foods and income is changing, often significantly. Reduction or changes in the role that forest food plays in household nutrition may be due to penetration of rural markets by other food products, changing tastes or cultural attitudes, or decreased availability. The latter may reflect physical shortage of the product as the resource becomes depleted, or changes in

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the availability or allocation of a household's supply of labour so that its members have less time to gather wild foods and fuelwood. Increasing pressure on women's time is a frequently cited factor in this respect (e.g. Wan *et al*. in this issue), as is the major impact that HIV/AIDS has had on labour availability in households, in particular in Africa. Both Wan et al. and Sunderland's review of the literature indicate that increased equity for rural women can lead to improved livelihood outcomes as women are responsible for over 50% of the food grown worldwide and serve as repositories of knowledge regarding nutrition and general health.

Jamandass *et al*. (this issue) advocate strongly for the need for small-scale African farmers to have better access and integration in local, national and international market systems. The authors suggest that the enhanced income from market integration and the sale of fruits and other tree crops could make important contributions to food security and health in Africa and other developing countries. However, market integration has not always been found to improve food security and nutrition (Belcher *et al.* 2005, Dewey 1989, Kennedy 1989, Kuhnlein and Receveur 1996). Ibarra *et al*. (this issue) describe changes in the local Chinantla food system that occurred after the initiation of Payment for Environmental Services (PES) program. They report that since the initiation of the hunting ban, local people have replaced wild animal source foods with purchased animal source foods. Their economic valuation suggests that the cost of purchased meat is in fact greater than the payment received though PES. Moreover, cessation of hunting has lead to increased pest damage to agricultural crops. The authors suggest various pathways though which involvement on the PES program is leading to the disintegration of the traditional agricultural and food systems.

Consequences of changing dynamics

Although changes to the dynamic relationships among forests, biodiversity, food security and human health are as complex and varied as the forests and cultures of the globe, the papers presented herein suggest that many current changes are placing the food security and health of forest people in jeopardy. An emerging theme is that changes in forest use often lead to a transition in local people's diets; away from traditional and unprocessed foods high in fibre and micronutrients towards a diet with more processed foods, high in salt, refined sugar, simple carbohydrates and fat. Such nutrition transitions lead to increasing rates of obesity and chronic, nutrition-related diseases including cardiovascular disease and type II diabetes mellitus (often further burdening populations still suffering from micronutrient malnutrition and high rates of infectious diseases) (Kuhnlein and Receveur 1996, Popkin 2001, Popkin and Gordon-Larsen 2004). Evidence of the complexity and severity of nutrition transitions is seen in the fact that all over world one finds households with both overweight individuals and undernourished individuals (in some contexts, overweight individuals are more likely to be micronutrient deficient for some micronutrients) (Doak *et al.* 2004, Doak *et al.* 2000, Garrett and Ruel 2005). As Sunderland (this issue) notes "wheat, rice and maize alone account for more than 50% of the global energy intake". Food security is often a result of unequal distribution of food, resulting in as many overweight individuals globally as are malnourished: "Such inefficiencies are particularly problematic as much of this agricultural production is at the expense of biodiversity and the wider environment" (Sunderland this issue).

Ibarra and colleagues (this issue) note that the potential negative health outcomes of changing forest use in the Chinantla are associated with increased reliance on outside food sources, increased consumption of processed foods and the loss of the health benefits of traditional and culturally important forest and wild foods. Powell and colleagues (this issue) suggest possible explanations for the limited use of forest foods and substantial reliance on purchased foods (even in a very rural forested landscape in one of the poorest countries in Africa). They note that, given the nutrient profile of many forest foods (especially fruit, mushrooms and vegetables), high in phytochemicals, micronutrients and fibre, low in salt, fat and simple sugars – the maintained use of these foods could help to mitigate the progression and consequences of the nutrition transition. The trade-offs between faunal conservation, bush meat consumption and sale, and food security and nutrition are further complicated in the context of the nutrition transition.

Managing forests for food

Within the broad framework of approaches proposed by FAO and IFPRI in order to address food security issues (Løvendal and Knowles 2005, Hoddinot 1999) there are two main areas where initiatives specifically directed at the ways in which forests relate to food security have been concentrated. One is that of strengthening local access to and control over forest resources which the poor draw upon for food and other inputs. The other focuses on increasing the nutrition and health related content and impact of forest and tree resources accessible to the needy.

A large literature attests to the problems that have attended many initiatives to give poor users *effective* control over use of forest resources on which they depend. In addition to the well known problems arising from different interests among richer and poorer users, there can also be increasing conflict between user and conservation priorities. Ibarra *et al*. (this issue) examine the consequences of a programme of community conservation and payments for environmental services (PES), in an area in Mexico. This study argues that the resulting changes in traditional resource management have had negative impacts on crop yields, fallow cycles, and meat consumption – with adverse consequences for people's dietary diversity and local environmental knowledge and skills.

Jamnadass *et al*. (this issue) address aspects of another central approach to better managing the resource, that of assisting users to improve tree stocks that they grow at the farm and community level. The paper, which is based on the experience of the World Agroforestry Centre (ICRAF), reviews key interventions that have been developed to enable improvement of yield, quality and delivery in farmer domestication of indigenous fruit trees. Other work in this area

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underlines the need to also focus on how well the qualities of particular fruit species match actual nutritional needs in the areas where the trees are to be grown (Frankenberger *et al*. 2005).

CONCLUSIONS

As the papers in this special issue show, forests are a major repository of food and other resources that play a crucial role in food security. In addition, maintaining diversity in agricultural production systems leads to increased resilience to shocks particularly in the context of a changing climate. Traditional knowledge held by traditional farmers is a valuable source of practices and techniques which have produced centuries-old resilient and diverse production systems

Forest foods are particularly important in coping with cyclical (seasonal) shortages, and transitory shortages due to drought, illness or other external shocks, and are less likely to provide solutions to chronic long term food shortages. As such, forest foods and income are widely important in helping the poor cope with poverty (poverty alleviation), but are less likely to provide them with a pathway out of poverty (poverty reduction).

Improved tenure and access rights to forest resources, particularly for women, could support more sustainable resource management for food security. In addition, women's rights to reproductive health care and education can ease population pressures on forests thereby supporting broader conservation efforts.

Exchange between agricultural and forestry governmental agencies and educational institutions can help to promote improved and holistic efforts toward conservation to continue to bridge the current yawning gap between agriculture and biodiversity in forested landscapes. This needs to be based on the premise of a broad holistic definition of food security such that researchers and practitioners in forestry and conservation can find more common ground with those working in more traditional agricultural fields to combine efforts and work together towards achieving biodiversity conservation, sustainable food production and human health.

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