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REVISITING THE PARADIGM AND THE PARADOX OF NON-TIMBER FOREST PRODUCTS HARVEST: PERSPECTIVES IN THE CONTEXT OF AGRICULTURE EXPANSION

Ana Carolina O. Neves[1], Dimitri Fazito[2] and G. Wilson Fernandes[1]*

[1] Universidade Federal de Minas Gerais (UFMG), Avenida Presidente Antônio Carlos, 6627, Instituto de Ciências Biológicas, Departamento de Biologia Geral, Laboratory of Evolutionary Ecology & Biodiversity. Belo Horizonte, MG, Brazil. CEP: 30161-970.
[2] Universidade Federal de Minas Gerais (UFMG), Avenida Presidente Antônio Carlos, 6627, Faculdade de Filosofia e Ciências Humanas, Departamento de Ciências Sociais. Belo Horizonte, MG, Brazil. CEP 30161-970.
E-mails: ananeves@gmail.com, fazito@cedeplar.ufmg.br, gw.fernandes@gmail.com

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Non-timber forest products (hereafter, NTFP) are useful substances, materials and commodities harvested in managed plantations or natural ecosystems, except for wood and its derivatives, including a myriad of products such as seeds, flowers, fruits, leaves, roots, bark, latex, resins, silk, feathers, leather, fur and other non-wood products (Wickens 1991). They have been harvested by human populations for subsistence use and trade over thousands of years (Ticktin 2004). They contribute in important ways to the livelihoods and welfare of populations living in and adjacent to forests (*e.g.*, Terra Brasilis 1999, Schmidt *et al.* 2007, Almada *et al.* 2013). Also, millions of people living in urban areas consume or deal such products.

By the end of the last century, the harvest of NTFP was widely accepted as a conservation paradigm, because it was an economic alternative to deforestation by logging, agriculture and livestock, while it would allow biodiversity conservation and income generation for rural populations (Peters *et al*. 1989, Nepstad & Schwartzman 1992). In a seminal paper, Peters *et al.* (1989) showed that the potential long-term economic returns from forests managed for NTFP was greater than the net returns from timber or forest conversion to agriculture. They provided not only biological, but economic and social justification for tropical forest conservation. According to the advocates of such paradigm, in the long run, the economic returns from forests managed for NTFP are greater than the net returns from timber or forest conversion to agriculture; poverty and deforestation can be reduced by means of the use and trade of NTFP, since poverty in forest communities is at the same time cause and effect of deforestation; and finally, populations that depend on natural resources tend to adopt their sustained management, so they can be used in the long term (Neuman & Hirsch 2000).

From the 1990's onwards, the harvest of NTFP became targeted by criticism, turning into a socio environmental paradox. It was shown to have usually negative ecological impacts at the level of individuals, populations, communities or ecosystems (Ticktin 2004, Fernandez *et al.* 2012), besides not being able to reduce poverty in many cases. Moreover, as the demand of successful products increases, they may become overexploited or be replaced by domesticated or synthetic alternatives (Homma 1992).

However, how the success and failures of NTFP should be considered in the actual scenario of fast land conversion, and specially the growing food demand, with expansion and intensification of agriculture (Laurance *et al.* 2014)?

The growing demand of food and agriculture expansion

The human population reached 7 billion in 2011 and is expected to reach 10.8 billion in 2100, with the greatest increases in tropical developing nations (UN 2013). By 2050, global food needs are expected to rise by 70-110% (Tilman *et al.* 2001) and agriculture will be more intensified in the tropics, mainly in South America and Sub-Saharan Africa (Tilman *et al.* 2001, Laurance *et al.* 2014).

If the present trend is to continue, society will rely mainly in large-scale industrial agriculture to supply its need of goods. Large-scale industrial agriculture is an intensive system of food production that was born with the Green Revolution and has been growing since the decades after World War II together with the human population and the rising per-capita consumption (Source: Wikipedia). Now it dominates much of the farmlands in the world. It have large environmental and social passives, because it is based on monoculture, large farm size, mechanization and high need of external inputs such as energy, fertilizers, water, herbicides and pesticides (see Altieri 1998, 2009). Also, it is dominated by large corporations and wealthier farmers, and has negative impacts on public health, food quality and traditional rural livelihoods (see Altieri 1998, 2009).

Behind the transformation of natural landscapes into agriculture, relies the conversion of multifunctional landscapes into monofunctional landscapes (*i.e.* crops), with the loss of usually many ecosystem services (MEA 2005). Such widespread land use transformation have confined most of the world's diversity (be it in biology, wildlife, ethno-linguistic groups and other minorities) and pushed it into the last remaining areas that were not reached by global market routes (Monjeau 2010). In this century, the expansion of cultivated areas, as well as those areas exploited for timber and other raw materials, will strongly compete for space with wildernesses that sustain the world's diversity and provide other key resources for the maintenance of life in the planet. Intensified conflicts between food production and nature conservation are predicted for the next decades (Dobrovolsky *et al*. 2011, Laurance *et al.* 2014), such as rising competition for space, fertile soil and water for irrigation, as well as due to the indirect impacts of agriculture on natural resources, such as pollution by pesticides, eutrophication, desertification, erosion and loss of biodiversity.

Land-sparing vs land-sharing

There is a current debate about how to meet rising food demand at the least cost to biodiversity, regarding the strategies of 'land-sparing' vs 'land-sharing'. Land-sparing focus on sparing land for nature by using high-yielding farming methods intensified by technology, combined with protecting natural habitats from conversion into agriculture (Phalan *et al.* 2011, Lawrence *et al.* 2014).

Land-sharing integrates both food production and nature conservation on the same land, by using wildlife-friendly farming practices and multifunctional landscapes (Phalan *et al.* 2011, Laurence *et al.* 2014). Examples are some forms of agroforestry and agroecological systems, which are stable and genetically rich ecosystems that need low investment in machinery, energy and external inputs, and have low impact on ecosystem services (*e.g.*, soil and water provision, biodiversity protection; Altieri 1998, 2009). NTFP harvest may also be included amidst such activities, since they share many characteristics and agroecology is typically practiced by NTFPs harvesters as an alternative source of income.

There is controversy about the success of these two alternatives regarding nature conservation. In a study that investigated densities of bird and tree species across gradients of agricultural intensity in southwest Ghana and northern India, Phalan *et al.* (2011) found that land-sharing favored widespread generalist bird species, while land-sparing favored narrowly endemic forest-dependent species. However, they concluded that future land-use strategies based on land sparing are likely to support higher populations of most of the studied species and minimize their risk of extinction compared to land-use strategies based on wildlife-friendly farming.

Other researchers replied Phalan *et al.* (2011) study with criticism, advocating that much of land conversion in the tropics is relatively recent, so it is possible that the large number of species found in forested fragments may be there because their populations have not yet reached equilibrium after deforestation of the adjacent matrix (Godfray 2011). Furthermore, the study done by Phalan and co-workers was done in broadly similar tropical environment. More studies are needed in other habitats, such as tropical grasslands and savannahs, where some types of agricultural landscapes are more similar to the original vegetation matrix (Godfray 2011). Fisher *et al.* (2011) argued that this approach may fail to consider social and ecological complexities

and the fact that the livelihoods of rural people depend on local ecosystems. Also, many countries are not able to effectively protect areas, but do have a long record of sustainable land sharing (Ranganathan *et al.* 2008, Persha *et al.* 2011). Other points of criticism are that vast regions with low rainfall and shallow soils are only suitable for non-intensive use and could not hold intensified agriculture (see Dorrough *et al.* 2007). In addition, many vegetation types occur only on productive soils that are also highly suitable for agriculture. Many species rely upon these vegetation types, which would be treated by expanding agriculture (CGIAR 2014). Finally, it is foolhardy that intensification of agriculture and yield increases might simply allow the expansion of farming into all available lands (Macedo *et al.* 2012).

Reconciling the paradigm and the paradox of NTFP

How could the harvest of NTFP be considered in the present and future? We propose it to be analyzed in a multiple decision scenario, where human population and its goods demand are skyrocket growing, and industrial-agriculture is spreading and being intensified, at the pace that natural habitats and diversity (including human) are being lost.

First, for the sake of fairness, the success and failures of areas managed for NTFP harvest should not be compared to integral protected areas, whose main aims are to protect nature (*i.e.*, the geological and geomorphological features of a region, its biodiversity and ecosystem processes), and where human uses are usually restricted to spiritual, scientific, educational and recreational visitation (IUCN 2015, MMA 2015). Rather, areas managed for NTFP harvest should be compared to other productive areas (designated to produce food/raw materials) or sustainable use areas (whose main aim is to support livelihoods through the sustainable and diversified use of forest resources by traditional native populations; MMA 2015). Let us not forget that NTFP arose as a paradigm as an *alternative to conversion of forest* by logging, agriculture and livestock (Peters *et al.* 1989, Nepstad & Schwartzman 1992), and not as an *alternative to pristine areas*.

Second, NTFP harvest is aligned with the idea of multifunctional landscapes, which can provide, simultaneously to food and raw materials, ecosystem services such as sedimentation control, flood prevention, carbon storage, existence values and biodiversity storage (MEA 2005).

Third, NTFP harvest should be considered in the actual scenario of fast land conversion for food production (Laurance *et al.* 2014). In comparison to large-scale industrial agriculture, NTFP harvest and other "non-intensive" ways to produce food have a much smaller environmental passive *per area* as regards biodiversity, ecosystem services and chemical/energetic balance (i. e. the crop return per unit of nutrients and calories invested). In the landscape scale, the advantages of land-sharing vs land-sparing should be evaluated considering the regional conditions, as there is still controversy about their success regarding nature conservation.

Finally, NTFPs harvest add human dimension to nature conservation, by preserving the very diversity of humankind and considering traditional cultures' millenary interaction with nature. They preserve and strengthen a number of small landholders and poor rural people that depend on local ecosystem services, and contribute to avoid migration to cities. Also, NTFP and its counterparts are aligned with the idea of food and raw-materials sovereignty and ecologically based production systems. Food sovereignty is defined as "The right of each nation or region to maintain and develop their capacity to produce basic food crops with the corresponding productive and cultural diversity. (…) It emphasizes farmers' access to land, seeds and water while focusing on local autonomy, local markets, local production-consumption cycles, energy and technological sovereignty, and farmer-to-farmer networks." (Altieri 2009).

When planning for landscape use, one must consider all the costs and benefits of the available options, in absolute and comparative terms. After Fischer *et al.* (2011), "Social and ecological complexities must not be an afterthought in analyses about food and biodiversity, because they fundamentally alter the outcome." Beyond this debate, one must not forget that much of the hunger problem is not caused by lack of food, but by food waste and limited access to food (UN 2013). In the

end, any activity related to food production will only delay and not avert biodiversity loss, unless global society can limit its consumption.

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