Diversity in Forest Management: Non-Timber Forest Products and Bush Meat

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Introduction

This paper provides an overview of the complexity, practical and policy challenges that need to be faced in dealing with sustainable management of forests for non-timber forest products (NTFP). Conservation biologists, resource managers and policy makers are all faced by the high diversity of species used, the lack of knowledge about the biology of many harvested species, and the varying tenure arrangements for both land and resources involved. This is compounded by the fact that NTFP trade networks are often complex with serious impacts on species populations requiring innovative assessment, monitoring, and conservation methods. NTFP harvest and use occurs across a wide spectrum of biogeographic, ecological, economic, social, and historical circumstances across continents and vegetation types. Policies and their implementation, therefore, must to be tailored to local circumstances. Simplistic, "one size fits all" policies may do more harm than good and should be avoided.

Lack of clarity about the term "non-timber forest products" merely adds to these uncertainties.[1] "Non-timber forest products" often refer to natural resources collected from forests that are not sawn timber, which Wickens defined as "all the biological material (other than industrial round wood and derived sawn timber, wood chips, wood-based panel and pulp) that may be extracted from natural ecosystems, managed plantations, etc. and be utilized within the household, be marketed, or have social, cultural or religious significance."[2] Chamberlain et al. provide a slightly more limited, yet still broad, definition: "plants, parts of plants, fungi, and other biological material that are harvested from within and on the edges of natural, manipulated or disturbed forests."[3] The United Nations, Food and Agriculture Organization uses a slightly different term (non-wood forest products) that includes wild-harvested meat, but excludes all wood.[4] No matter which definition one chooses, the fact is that the natural resources from which these products originate are seldom fully included in forest management. In this paper we use the term "non-timber forest products" to generally include wild-harvested meat, though in certain context the two terms are separated to emphasize differences.

Although non-timber forest resources are recognized as valuable for people's sustenance, their economic value is rarely taken into account in forest planning or in assessing GDP.

Magnitude and Diversity

The importance of NTFP use to people from all corners of the world is evident in the enormity and variety of species collected for personal consumption and as a source of income. In northern Michigan, Emery found that rural households collected 138 NTFPs for non-market motives.[5] An indigenous group, the Iquitos of the Peruvian Amazon, sell more than 57 species of wild-collected fruit in local markets.[6] In British Columbia, Canada, de Geus identified more than 200 botanical forest products.[7] Thomas and Schumann identified more than 50 spe-

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cies native to the U.S. that are harvested for the floral and greenery markets.[8] The number of plant species used for medicinal purposes increases the magnitude tremendously (Table 1).

By contrast, most wild-harvested meat comes from a relatively small number of large-bodied species, typically ungulates and primates.[9] In Sarawak, Malaysia, three ungulate species make up 80% of hunted biomass[10] and approximately 26 mammal species, 12 bird species and five reptile species are regularly eaten. The Maraca Indians of Columbia are known to eat at least 51 bird species, including 10 hummingbird species regularly,[11] while in Bolivia the Sirionó Indians hunt 23 mammal species, 33 bird species, and nine reptile species. Hunters in the Central African Republic, capture 33 mammal species, seven reptile species, and three bird species.[12] Although often disregarded in discussions about the importance of wildlife, fish, shellfish and crustaceans, as well as insects, are important resources for daily diet as well as for cash income.[13]

Table 1.
The diversity of medicinal plant species, from tropical and temperate climates, in local or international markets.

Region or Country	Number of species
Indonesia[a]	1260
South Africa[b]	500
Germany[c]	1543
Eastern & Central North America[d]	500
North America[e]	175
Appalachia, USA[f]	150

Source:

[a] Siswoyo, E.A.M. Zuhud and D. Sitepu. 1994. "Perkembangan dan Program Penelitian Tumbuhan Obat di Indonesia" (Research Program on and Development of Medicinal Plants in Indonesia), pp. 161-300. In: E.A.M. Zuhud and Haryanto (eds). *Pelestarian Pemanfaatan Keanekaragaman Tumbuhan Obat Hutan Tropika Indonesia (Conservation and Use of Medicinal Plants' Diversity in Indonesia's Tropical Forests).* Bogor: Jurusan Konservasi Sumberdaya Hutan Fakultas Kehutanan IPB & Lembaga Alam Tropika Indonesia (LATIN).

[b] Cunningham, A.B. 1988. "Collection of Wild Plant Foods in Tembe Thonga Society: A Guide to Iron Age Gathering Activities?" *Annals of the Natal Museum* 29(2):433-446. Cunningham, A.B. 1991. "Development of a Conservation Policy on Commercially Exploited Medicinal Plants: A Case Study from Southern Africa. pp.337-358. In: Heywood. V., Synge, H. & Akerele, O. (eds.). *Conservation of Medicinal Plants*. Cambridge University Press. Williams, V.L. 1996. *The Witwaterrand Muti Trade.* Veld and Flora 82:12-14.

[c] Lange, D. and U. Schippmann. 1997. *Trade Survey of Medicinal Plants in Germany: A Contribution to International Plant Species Conservation.* Bundesamt fur Naturschutz, Bonn, Germany

[d] Foster, S. and J.A. Duke. 1990. *A Field Guide to Medicinal Plants: Eastern and Central North America.* Houghton Mifflin Co., New York. 366 pp.

[e] TRAFFIC North America. 1999. "Medicine from U.S. Wildlands: An Assessment of Native Plant Species Harvested in the United States for Medicinal Use and Trade and Evaluation of the Conservation and Management Implications." Unpublished report to the National Fish and Wildlife Foundation. TRAFFIC North America, World Wildlife Fund, Washington, DC. 21pp. + Appendices

[f] Krochmal, A., R.S. Walters, and R.M. Doughty. 1969. *A Guide to Medicinal Plants of Appalachia.* USDA, Forest Service Research Paper NE- 138. Northeastern Forest Experiment Station, Upper Darby, PA. 291 pp.

Value of NTFPs

People worldwide have been relying on non-timber forest products and wildlife for their nutritional needs much longer than for their economic desires. In some tropical places, sago palm *(Metroxylon sagu),* taro *(Colocasia esculenta)* or arrowroot *(Maranta arundiacea)* are primary sources of starchy staple foods. Wild-harvested meats commonly provide protein in peoples' diets, while wild plant foods are valuable sources of nutrients in diets predominated by starchy staples.[14] Wild plant foods are important "safety nets" in periods of shortage or poor harvest of main crops (e.g., wild sago for Dayak communities in Borneo).

Although non-timber forest resources are recognized as valuable for peoples' sustenance, their economic value is rarely taken into account in forest planning or in assessing Gross Domestic Product. NTFPs provide a "green social security" for billions of people in the form of building materials, income, fuel, food, and medicines. In some cases, revenues earned from NTFP commercialization are the only source of income for rural people.[15] Unfortunately, cash generated from the sale of non-timber forest products may vary tremendously, even for the same resource category.[16]

These omissions and misfortunes need to be corrected, as NTFPs make significant contributions to rural household incomes and a nation's productivity. At the same time, it is essential

to exercise great care in valuing non-timber forest resources to avoid over-optimistic assessments (e.g., the value of NTFPs are significantly greater than the value of timber) or over-pessimistic estimations (e.g., NTFPs only have real economic value in domesticated intensive context). Objective valuation studies involving and based on the preferences of local users probably are a first step in correcting omissions and misfortunes about NTFP values.[17]

In fact, some NTFP sectors have global economic impacts that have increased over time. In 2004, the global herbal medicine industry is valued at more than $60 billion, annually,[18] representing more than a four hundred percent increase since 1996.[19] While Europe was the largest market in 1996, representing one-half of the global trade, Asia commanded approximately 36 percent of the global trade. In 1998, the total retail market for medicinal herbs in the United States was estimated at $3.97 billion, more than double the estimate for North America in 1996.[20] No matter how these figures are presented, they represent significant contributions to national economies.

The economic values of wild-harvested foods and medicines are a reflection of the social and cultural values placed on non-timber forest products. Consumers' desire to enjoy NTFPs from their native countries is so great that airfreight is used to transport perishable edible and medicinal plants regionally and internationally. Immigrants from Cameroon, Congo, Gabon, and the Democratic Republic of Congo to France and Belgium import an estimated 105 tons of "bush plums" *(Dacryodes edulis)* and 100 tons of "eru" *(Gnetum africanum* and *G. buchholzianum)* leaves annually to meet their cultural desires to consume these edible products.[21]

Western and traditional medicines are based on very different and well-documented views of health and disease. These different approaches are one reason why demand for traditional medicine continues in urban environments even if western biomedicines are available. Two examples illustrate this: the export of kava *(Piper methysticum)* to expatriate Pacific islanders living in North America, and; the shipping of the African medicinal plant khat *(Catha edulis)* to Somali communities in Europe and North America. As the young leaves of *Catha edulis* need to be chewed while still fresh for maximum effect, and prices drop rapidly with time, the trade is highly organized to get leaves from the forest to the consumer.

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Throughout the world, there is a deep-rooted cultural bond to NTFP collection and use. Much of the knowledge found in the herbal medicinal industry today was passed through generations of native and indigenous people, Many rural collectors can trace their bond to NTFP collecting back many generations. The knowledge that present-day users and collectors have about NTFPs, which they gained from their ancestors, could prove invaluable in developing appropriate management strategies and conserving these valuable resources.

Cultural Values and Consequences

Cultural systems may be more dynamic than biological ones, and the shift from a subsistence to a cash economy is a dominant factor in changing how cultures interact with natural systems. In many parts of the world, "traditional" conservation practices have been weakened by cultural change, greater human demands and a shift to cash economies. There is increasing evidence of resources that were traditionally conserved, or appeared to be conserved, being overexploited. The people whose ancestors hunted, harvested, and venerated the forests that are the focus of enthusiastic conservation efforts are sometimes the people who are felling the last forest patches to plant agricultural crops. In extreme cases, "islands" of remaining vegetation, become focal points for harvesting and conflict for remaining resources. The cultural and economic importance of wild plants to urban people is a crucial factor which has to be taken into account.

For many products, harvesting takes place in landscapes changed by people due to farming, fire, or grazing, even when human population densities are low. In some cases, this may enhance species populations and in other cases may lead to their demise. Light demanding species whose populations actually increase in response to disturbance, including many species of bamboo, thatch-grasses, edible leafy greens and sources of bark fiber, are distributed widely. Anthropogenic disturbance also occurs on smaller scales, such as the deliberate planting of useful species in forest patches or along paths by the Kayapó in Amazonia[22] or the replanting of ginseng seeds by local diggers in Appalachia.[23] At the same time, much more research is needed to ascertain the long-term im-

pact of harvesting on NTFP populations and associated species.[24]

In the past, harvesting of plant-based NTFPs to meet subsistence demand rarely resulted in species-specific overexploitation. Now, rural communities in many parts of the world increasingly are concerned about losing self-sufficiency as local wild populations of NTFPs are harvested and transported to distant markets. Similar concerns apply to animals used for bush meat, as the wildlife biomass of tropical forests generally is low. For example, in Amazonia, the daily per person protein intake of the Yuquí Indians decreased 50 percent after large-scale incursions by colonists between 1983 and 1988.[25] Bush meat trade as well as some rattan, craft, horticultural and medicinal plant species all provide examples of commercial demand stimulated by increased access.[26] From the perspective of local livelihoods or conservation, species loss through overexploitation benefits neither local people nor conservation.

Road systems are reaching deep into remote, resource-rich regions.[27] Together with access along waterways,[28] these road systems increase the accessibility of timber and non-timber forest resources. As a result, stores of wild harvested plant and animal species are lost due to habitat loss from fire and farming, followed by increased harvesting of commercially valued species. Improved transport networks strengthen the link between rural resources and urban demand. They result in an influx of outsiders, frequently disrupting traditional resource tenure systems and increasing the scramble for economically valuable resources. As cities grow, markets exert stronger pressures on rural resources. Since the 1960's, increasing demand from urban areas has catalyzed NTFP trade, attracting resources from rural areas to towns and cities for fuel wood, building materials, medicines, and food. As a result, urbanization tends to increase the demand for wild plant resources, catalyzing a commercial trade that stimulates over-exploitation.

The shift from subsistence use to commercial sale has significant implications for resource management. It results in larger volumes being harvested, a higher frequency and intensity of harvesting and often affects resource tenure. In some cases, commercial harvesting may strengthen resource tenure and the incentive to conserve plants and animals. Commercial sale of wild fruits such as *Sclerocarya birrea,* for example, maintains the incentive to conserve fruit-bearing trees in parts of Africa where development of a social stigma against gathering wild fruits for personal consumption is undermining the "traditional" practice of conserving wild fruit trees.[29] In other cases, the shift from subsistence use to commercial harvesting weakens resource tenure and undermines customary controls of resource use.[30]

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Market dynamics affect the distribution of benefits and supply of raw materials. Local gatherers, the initial link in complex value chains, typically receive low and highly variable prices for unprocessed plant material.[31] Although a key factor to realizing the economic values of NTFP is access to markets,[32] peoples' ingenuity should not be underestimated.[33] If prices and potential profits are high enough, local traders will make remarkable use of any transport network to get perishable species to the market. Alternative value added strategies may improve the economic benefits to harvesters while reducing the potential of over-harvesting.[34]

Biological Consequences

Differences in climate, soil and vegetation type result in significant disparities in the availability and use of NTFPs. Whether harvests involve the fruits, roots, bark and/or whole plants, the potential yields from wild stocks of many species often are overestimated, particularly when stochastic events are considered. As a result, commercial harvesting ventures based on wild populations often are characterized by "boom and bust," where declining resource availability follows initial harvests. Nantel et al. argue that ginseng populations in Quebec, once the major source of wild ginseng for international markets, could not support any harvesting if they were to be maintained for the long-term.[35] The low level of extraction required to ensure sustainable harvesting of wild populations of American ginseng as well as wild ramps *(Allium tricoccum)* in Canada[36] and the fruit of the amla tree *(Phyllanthus emblica)* in India[37] suggests that at current prices, sustainable harvest levels for these species were not viable commercial propositions.

The resilience, or lack thereof, to harvesting is influenced by the level of demand and by common biological characteristics: life form or body size, growth rate, reproductive biology, geographic distribution, habitat specificity, population density, etc.[38] Harvesting of leaves, flowers or fruits (or eggs) from widely distributed, fast growing, fast reproducing species occurring at high densities in a range of habitats is obviously of less concern than the killing of species that are of limited distribution, slow growing, and reproduce infrequently.

Although the response of individual plants is a useful guide to estimate har-

vesting impact, it is crucial to avoid getting side-tracked when seeing destructive harvest at the individual level and to take into account geographic distribution, habitat specificity, growth rates, conflicting uses, reproductive biology and management costs.

Harvested populations need to be viewed in terms of abundance, distribution, and response to disturbance at the landscape level.[39] A seemingly low impact use, such as harvesting of fruits, may have a high long-term effect on populations, either because of the effect on seedling recruitment[40] or because fruit collection involves tree felling. On the other hand, even if harvesting bark, roots, or stems kills individual plants, it may have little impact on the populations if the species are fast growing and rapid-reproducers. Low-diversity forests offer better opportunities for sustainable single-species extraction, as they are dominated by economically important species.[41]

Forest fragmentation results in the harvesting of NTFPs and wild meat on the remaining source areas, including national parks, botanical gardens and other protected areas. A decline in forest area with desired species is highly significant to conservation and resource management.[42] Periodic assessment of the extent and rate of habitat change at a landscape level using aerial photographs or satellite images is a common, cost-effective way to monitor the impact of conservation programs. These assessments however, do not provide a complete picture of the situation. Although the forest canopy may not change, populations of high value, vulnerable plant and animal species below the canopy can be disappearing due to species-specific overexploitation. For a more comprehensive assessment, monitoring at a large spatial scale needs to be broadened to encompass more varied biological factors, including the monitoring of a high value "indicator" plant and animal species which are being overexploited selectively from seemingly intact forests, woodlands or grasslands.

Dealing with Uncertainty

A major problem with managing forests for NTFPs is that little is known about the population biology, standing stocks or yields of most plant species that are harvested.[43] Many tropical species have yet to be described and less is known about their population biology or ecological interactions with associated species. Though temperate forest species may be better studied, for many NTFPs little is known beyond basic taxonomy and geographic distribution. There is a general lack of knowledge about the reproductive biology, inventories, and sustainable yields. Consequently, we urgently need to draw on predictive ecological studies and applied ethnobotany to prioritize NTFP species as components of conservation and sustainable use plans.

Forest management agencies need to recognize the resources from which non-timber products are harvested and integrate them into forest management, monitoring, and infrastructure planning. Non-timber forest resources should receive similar attention in forest management as other natural resources, such as timber, minerals, and water. There is one major problem facing recent calls[44] for statistically rigorous NTFP inventories, however: prohibitively high economic and time costs.[45] One alternative is to reduce costs by including important NTFPs as part of multi-species inventories at the same time as timber inventories are carried out.[46] Another option is a participatory survey with local resource users coupled to inventories and monitoring focused on a few key species. Ecosystem level and population management planning must take place through a process of consultation that considers relevant scientific, local, and indigenous knowledge. Silvicultural prescriptions that consider and incorporate NTFPs need to be developed. Development and implementation of effective conservation and resource management plans may require legislative reform before managed use of the resources provides sufficient incentives for conservation as a form of land-use.[47]

To achieve a balance between conservation and sustainable use of non-timber forest products, protected area networks need to be expanded and enhanced. The wider matrix surrounding protected areas also needs consideration. Establishing and maintaining biological corridors to accommodate migratory species is an essential part of this that inevitably requires links with local communities. The ways in which this is implemented will vary with social, political and economic circumstances, such as conservancies, "land care" groups, multiple-use zones, co-management areas or indigenous production forests. Firm, mutually agreed upon and enforceable regulations need to be established.

Due to the diversity of forest ecosystems, the products collected, and limited "scientific" knowledge, the insights of knowledgeable local and indigenous people are extremely useful for resource management and conservation biology. In situations where formally trained taxonomists are not available, local folk taxonomists can be remarkably effective.[48] Traditional ecological knowledge of local and indigenous peoples about NTFPs needs to be documented, strengthened, respected, and developed.[49] The greatest potential contributions by folk taxonomists may be in the inventory and assessment of the population biology of useful plant and animal species.[50] Traditional ecological knowledge can provide valuable information on stewardship practices for sustainable NTFP use.[51]

Importers and consumers need to become aware of whether the products they consume are harvested sustainably

or not, and bear some responsibility for sustainable resource management. Programs that raise awareness about the "ecological footprint" of long-distance trade from developing to developed countries or certification programs (e.g., Forest Stewardship Council, Sustainable Forestry Initiative) that may be applied to some NTFP are useful tools to achieve this goal.[52] Certifying the environmental management system of a forest organization can be done according to international standards, however it does not lead to product labeling. Certification systems of organic agriculture such as the International Federation on Organic Agriculture or the Organic Crop Improvement Association deal with NTFP from human altered vegetation types. Finally, the Fairtrade Labeling Organization focuses on socio-economic criteria of products including NTFP. It is important to attune different certification schemes so they mutually reinforce their processes and avoid potential conflicts.[53]

Cultivation or ranching has to be economically viable to be successful in providing an alternative supply of over-exploited species. Slow growing, slow reproducing species that take a long time to reach harvestable maturity pose the greatest challenge but, from a conservation viewpoint, are the highest priorities. Most cultivation or wildlife farming will be competing with material harvested from the wild that is supplied to the market by commercial gatherers, who have incurred little or no input costs. Prices therefore increase with scarcity due to transport costs, search time, and the long-distance trade. Low prices for many wild harvested species mean that few species can be marketed at high enough prices to make cultivation of plants or ranching of wildlife profitable while large, viable wild populations still exist. A further risk is that if cultivation does not take place on a big enough scale to meet demand, it merely becomes a convenient bit of "window dressing" masking the continued exploitation of wild populations.

Building Professional Capacity and Awareness

Capacity-building in applied, interdisciplinary fields such as ethnobotany, ethnoecology, conservation biology, and forestry can make major contributions to better understanding and management of non-timber forest products, and urgently is needed. As Hamilton et al. point out with regard to ethnobotany, there is great opportunity for innovative contributions in these fields from trained professionals in developing countries.[54] Not only do trainees from developing countries have many advantages of language, social networks and personal knowledge of landscapes and resources, but also high quality work can be done with relatively little equipment compared with many other fields of science. Collaboration with ethnobotanists from industrialized countries can further assist this process. The internet now provides opportunities for professional "knowledge networks" and for scientists from developing countries to access research papers and colleagues on a scale never before possible or affordable.

Forest management agencies need to recognize the resources from which non-timber products are harvested and integrate them into forest management, monitoring, and infrastructure planning.

These networks can be invaluable tools to link individuals working on the same topic for purposes of comparison and contrast. Networks enable people to share their experiences of what works or fails and under what circumstances. Pullin and Knight point out the relevance of decision-making models in medicine and public health to conservation and resource management, which also are "crisis disciplines" where action often is required urgently in the absence of precise information.[55] They suggest that medical practice underwent an 'effectiveness revolution' through a defined learning framework and more recently[56] that conservation managers rarely make full or systematic use of available information. The same applies to NTFP harvest. Non-timber forest products use takes place in a complex set of circumstances; there is a great need to support similar learning processes across a range of forest systems. This is an opportunity trained young professionals and agencies responsible for managing non-timber plant and wildlife resources should grasp to work effectively with the local harvesters and their communities.

Conclusions

Unrestricted access to valued but vulnerable species may provide a high initial harvest, but will be merely a temporary "bonanza" followed by a loss of local self-sufficiency, increased harvesting efforts, higher prices for the final product and potential loss of biodiversity. Over harvesting of plants and animals is becoming a significant factor as habitats shrink and demand increases. Substantial proportions of some of the world's most useful plant families currently are threatened by habitat loss or overexploitation. Efforts urgently are needed to improve management and conservation of these species to ensure long-term sustainability of the cultural and biological systems that are affected.

As people shift from a subsistence to a cash economy, the frequency and intensity of harvesting or hunting changes rapidly. Often, it is assumed, falsely, that non-timber forest products are sustainably harvested and that this "green social security" will be available to resource users in perpetuity. In many parts of the world, people are losing access to valued plant and animal species through over-exploitation, habitat destruction, or loss as gathering areas are incorporated into national parks and forest reserves. For all interest groups, resource users, rural development workers or forest managers, it is far better to have pro-active management and to stop or phase out destructive harvesting in favor of suitable alternatives before over-exploitation occurs, than to have the "benefit" of hindsight after resources are depleted.

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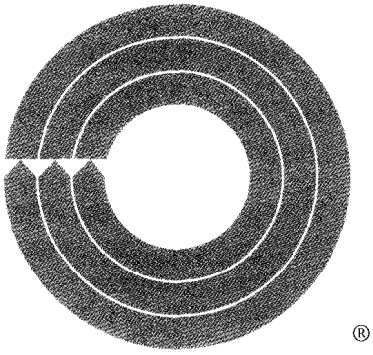

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