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Sustainable management of non-timber forest resources

Note by the Executive Secretary

EXECUTIVE SUMMARY

If policy on sustainable management of non-timber forest resources (NTFRs) is to be implemented successfully, then recognition that there is no "one size fits all" policy is essential. Policies and their implementation practice have to be tailored to local ecological, economic, cultural and political circumstances. This complexity and the diversity of species used are supplemented by two other factors: firstly, the "catch-all" nature of the terms "non-timber forest resources" or "non-timber forest products" (NTFPs), which refer to all natural resources from forests apart from sawn timber. Secondly, the fact that NTFR conservation and use sit at the confluence of at least probably more Articles of the Convention on Biological Diversity than probably any other component of natural resource use.

In the past, plant and bushmeat use values to people have either been disregarded or, if taken into account, the emphasis has either been on the values of plants or wildlife, rather than both together. In southern African savannas where community-based natural resource management programmes have been developed, the emphasis has been on wildlife rather than plants, fungi or edible insects. In tropical forests, the opposite has tended to be true, with plant products taken into calculations of forest value, rather than animals. Whether NTFR or bushmeat use is considered from the perspective of local livelihoods or conservation, species loss through over-exploitation benefits neither local people nor conservation in the long term. When a conservation area becomes the focus of high-impact harvesting, over-exploitation also undermines the primary goal of any protected area: the maintenance of habitat and species diversity. If even monitoring shows that forest or woodland cover are not decreasing, what is happening beneath the canopy may be quite different: populations of high value, vulnerable plant and animal species can be disappearing due to species-specific over-exploitation. This situation is rarely taken into account in protected area management.

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The present review makes the following recommendations to the Subsidiary Body on Scientific, Technical and Technological Advice:

(a) To achieve a balance between conservation and sustainable use of non-timber forest resources and animals hunted for bushmeat, there is a need to consolidate protected area networks and establish and maintain corridors (Article 8a);

(b) Ecosystem-level planning and the management of harvested or hunted populations must take place through a process of consultation, which takes relevant scientific, local and indigenous knowledge into account. Ecosystem-level and harvested/hunted population management plans need to be developed with an understanding of the social, economic, ethical, religious and political factors that either encourage resource conservation or lead to resource depletion. Development and implementation of effective conservation and resource management plans may need legislative reform before managed use of non-timber forest resources provides an incentive for conservation as a form of land use (Article 8(k));

(c) Land-use planning and sitting of infrastructure (roads, new settlements) both need to take into account protected areas, their adjacent conservancies or co-management areas and the requirements for maintaining viable populations of valued, but vulnerable species. Legislative change, technical support and economic incentives for ecological restoration of wildlife corridors and for the control of invasive plant and animal species may be necessary for maintenance or re-establishment of viable populations of indigenous plant and animal populations;

(d) A folk taxonomy initiative should therefore be formed as a separate, new component within the current Global Taxonomy Initiative, which has been established as a means of promoting taxonomy and taxonomic tools for implementation of the Convention (Articles 7 and 12);

(e) Sustainable levels of harvest of popular, less-resilient plant and animal species need to be established and monitored as part of an adaptive management process. This can be achieved through creative partnerships between scientists and local resource-users and requires technical cooperation (Articles 18 and 25(c));

(f) Appropriate and economically viable monitoring systems should be developed and established at the landscape level (remote-sensing, aerial photograph analysis) and local level (indicator species) (Article 7):

(i) Integrate non-timber forest resource uses into forest inventory and management;

(ii) Conservation through cultivation or farming of wildlife which is economically viable and on a sufficient scale to take the pressure off wild stocks;

(iii) *Ex situ* conservation needs to be implemented for some high-value, high-vulnerability species (Article 9).

In summary, the complex, cross-cutting characteristic of sustainable management of NTFRs should not been seen as a problem. There is a great opportunity, given the political will, for implementation of measures that can make a major contribution to the three main objectives in Article 1 of the Convention on Biological Diversity and to human welfare.

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SUSTAINABLE MANAGEMENT OF NON-TIMBER FOREST RESOURCES

I. INTRODUCTION

1. The broad terms "non-timber forest resources" (NTFRs) or "non-timber forest products" (NTFPs) refer to natural resources collected from forests apart from sawn timber. Wickens (1991), for example, considered non-timber forest products to be *"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 utilised within the household, be marketed, or have social, cultural or religious significance"*. Chamberlain *et al. (1998)* provide a slightly more limited, yet still broad, definition: non-timber forest products are plants, parts of plants, fungi, and other biological material that are harvested from within and on the edges of natural, manipulated or disturbed forests. According to Chamberlain *et al*. (1998), NTFPs may include fungi, moss, lichen, herbs, vines, shrubs, or trees. Many different parts are harvested, including the roots, tubers, leaves, bark, twigs and branches, the fruit, sap and resin, as well as the wood. In this document, the term "non-timber forest resources" is mostly used.

2. Sustainable management of NTFRs sits at the confluence of more Articles of the Convention on Biological Diversity than probably any other component of natural resource use. A feature of sustainable management of NTFRs is the high diversity of species used (Articles 5, 6 and 7), the local and indigenous knowledge linked to those uses (Articles 15 and 8(j)) and the varying tenure arrangements and economic incentives for conservation (Article 11). In addition, NTFR trade networks are often complex, with serious impacts on species populations (Articles 3, 5 and 11), requiring innovative assessment, monitoring and conservation methods (Articles 7, 8, 9, 14, 16 and 18). NTFR use occurs across a wide spectrum of bio-geographic, ecological, economic, social and historical circumstances across (and within) different continents and vegetation types. Palms and bamboos for example, are among the most useful tropical plant resources, yet are poorly represented in Africa (1.7 per cent of palm species; 0.3 per cent of bamboo species) compared to other parts of the tropics. Differences across continents are equally evident when it comes to animals used as bushmeat: the absence of non-human primates in Australia, yet diversity of marsupials; the high diversity of bovid, ungulates and other large herbivores in Africa; or the occurrence of pangolins in Africa and Asia, but not South America all clearly influence the patterns of bushmeat use. Policies and their implementation therefore have to be tailored to local circumstances. Simplistic, "one size fits all" policies can do more harm than good and should be avoided.

3. The relevance of many Articles of the Convention on Biological Diversity and decisions by its bodies to NTFR use offers a great opportunity, given the political will, for implementation of measures that can make a major contribution to human welfare and the three main objectives in Article 1 of the Convention on Biological Diversity. In industrialized countries, NTFR use is often viewed as a marginal activity, though in reality the trade of these products provides significant economic benefits to many rural households and communities (Chamberlain *et al.* 2000). In many developing countries, the perception is quite the opposite. NTFRs are in daily use throughout the tropics, commonly providing resources crucial to people where no other social security is provided by the State. In a typical African country, only one person in ten has a formal job (*The Economist*, 2000) and economically important species provide a source of informal sector income. Edible wild foods (fruits, wild vegetables, fungi, bushmeat and insects) commonly provide dietary supplements (Cunningham and Davis, 1997). Fuelwood or charcoal, not electricity or oil, are the major source of household energy (Leach and Mearns, 1988). Nine out of ten people live in informally built houses; eight out of ten people consult traditional healers (Aké Assi, 1988).

4. The present paper will bring together the results of a literature study on the main impacts of harvesting NTFRs, and the causes of their unsustainable harvesting. Based on major findings, a number of proposals to address the negative effects of unsustainable harvesting of non-timber forest resources are presented. The document is based on the review prepared by the Center for International Forestry Research (CIFOR), commissioned by the Secretariat of the Convention on Biological Diversity.

II. THE IMPORTANCE OF NON-TIMBER FOREST RESOURCES AND WILDLIFE TO PEOPLE

5. In *terra firma* forest in Amazonia, for example, Prance *et al* (1992) recorded that 78.7 per cent of tree species were used by the Ka'apor and 61.4 per cent by the Tembe indigenous peoples. In their study of edible fruits sold in the market places of Iquitos in the Peruvian Amazon, for example, Vasquez and Gentry (1990) recorded over 57 wild-collected fruit species being sold. The diversity of medicinal plant species entering local or international markets is even higher. In Indonesia, Siswoyo *et al.* (1994) list 1,260 species of medicinal plants being sold, many wild-collected species from forests. In South Africa, 400-500 species are sold for traditional medicines, 99 per cent are wild harvested (Cunningham, 1988, 1991; Williams, 1996). In their study of market places in Mexico, Bye and Linares (1985) found that of the 114 species sold, 28 species were gathered from wild habitats, 52 species gathered from anthropogenic vegetation types, 32 species were domesticated and two species were non-domesticated species in cultivation.

6. The number of medicinal products found in temperate climates is staggering, as well. In Germany, Lange and Schippmann (1997) have documented 1,543 medicinal plant species, comprising 854 genera in 223 families in import or export trade, 70-90 per cent of which are primarily harvested from the wild (Lange, 1997). According to Farnsworth and Morris (1976), 25 percent of all prescription drugs dispensed in the United States over the last several decades have contained active ingredients extracted from higherorder plants. Foster and Duke (1990) catalogued more than 500 species native to eastern and central North America that are valued for their medicinal properties. In a report prepared by TRAFFIC North America (1999), at least 175 plant species native to North America are found in the non-prescription medicinal market in the United States and more than 140 medicinal plants native to North America are in international markets. In the Appalachian region of the United States, a region of global biodiversity importance, Krochmal *et al.* (1969) identify more than 150 medicinal plant species.

7. At the same time, a great many species are collected for other reasons, besides medicines or food. Emery (2001) found that rural households in northern Michigan of the United States collected 138 NTFRs for non-market motives. In British Columbia, Canada, more than 200 botanical forest products have been identified, many of which are used for decorative purposes (de Geus, 1995). Thomas and Schumann (1993) identify more than 50 species native to the United States that are harvested for the floral and greenery markets. In the Appalachian region of the United States, more than 30 species have been identified that are valued for decorative markets (Nelson and Williamson, 1970).

8. By contrast, most bush meat obtained by hunters in tropical forests comes from a relatively small number of large-bodied species, normally the larger ungulates and primates (Bennett & Robinson, 2000). Two species, the common woolly monkey and collared peccary make up 44 per cent of the wildlife biomass harvested by the Huaorani in Ecuador (Mena *et al.*, 2000). Similarly, in Sarawak, Malaysia, three ungulate species, bearded pig and two barking deer species, comprised 80 per cent of biomass hunted (Bennett *et al.*, 2000), although at least 26 mammal species, 12 bird species and 5 reptile species are regularly eaten. In Colombia, for example, Maracá Indians killed at least 51 bird species, including 10 hummingbird species (Ruddle, 1970) and the Sirionó Indians of Bolivia hunt 23 mammals species, 33 bird species and 9 reptile species. In the Central African Republic, hunters using snares capture 33 mammal species, 7 reptile species and 3 bird species (Noss, 2000) and in the Lobéké area of Cameroon, hunters took at least 36 animal species (Fimbel *et al.*, 2000).

Table 1: Important products derived from non-timber forest resources[1].

Category	Important products (lists not exhaustive)
Food products	Nuts. Brazil nuts, pine nuts, malva nut, walnuts, chestnuts Fruits. Jujube, sapodilla, ginkgo, bush mango Edible fungi. Morels, truffles and other mushrooms Vegetables. Bamboo shoots, reindeer moss, various "green" leaves, palm hearts,

Category	Important products (lists not exhaustive)
	wild onions (ramps) Starches. Sago Birds' nests Oils. Shea butter, babassu oil, illipe oil Sap and resin. Maple syrup, Birch syrup
Spices, condiments and culinary herbs	Nutmeg and mace, cinnamon, cassia, cardamom, bay leaves, oregano, etc.
Industrial plant oils and waxes	Tung oil, neem oil, jojoba oil, kemiri oil, akar wangi, babassu, oiticica and kapok oils. Carnauba wax.
Plant gums	Gums for food uses. Arabic, tragacanth, karaya and carob gums. Technological grade gums. Talha and Combretum gums.
Natural plant pigments	Annatto seeds, logwood, indigo.
Oleoresins	Pine oleoresin Copal, damar, gamboge, benzoin, dragon's blood, and copaiba oil. Amber
Fibres and flosses	Fibres. Bamboo, rattan, xateattap, aren, osier, raffia, toquilla straw products, cork, esparto, Erica and other broom grasses. Flosses. Kapok.
Floral greenery	Beargrass, boughs, Club moss, Galax leaves, Grape vine, Lycopodium, Mistletoe, Rhododendron, Salal, White birch bark
Vegetable tanning materials	Oak, mimosa, chestnut and catha/cutch.
Latex	Natural rubber, gutta percha, jelutong, sorva and chicle.
Insect products	Natural honey, beeswax, lac and lac-dye, mulberry and non-mulberry silks, cochineal, aleppo galls, kermes
Incense woods	Sandalwood, gaharu.
Essential oils	
Plant insecticides	Pyrethrum, Derris, Medang and Peuak Bong.
Medicinal plants	Around 5,000 to 6,000 botanical entering world market every year
Animals and animal products	Ivory, trophies, bones, feathers, butterflies, live animals and birds, bushmeat, etc.

[1] modified from Iqbal (1993) and Thomas and Schumann (1993).

9. Speaking of wildlife often disregards the important protein and food source of fish, shellfish and crustaceans. These resources are not just important as a subsistence resource, providing an important addition to the daily diet of many people living in or nearby forest streams or rivers, but also can provide important cash incomes (Rodríguez, 1992, 1998). Dynamics of aquatic resources are partially different from the forest and specific attention to this NTFR resource should be considered in the relevant thematic programmes of the Convention on Biological Diversity.

III. VALUES OF NON-TIMBER FOREST RESOURCES

A. Economic values

10. Despite the immense importance of non-timber forest plant resources, their value is rarely taken into account in land-use planning (see table 2). Nor are the economic values of these products and the services they provide rarely taken into account in assessing Gross Domestic Product (GDP). These omissions need to be corrected, as NTFRs make a particularly significant contribution to household

incomes of the rural poor. Rural people, moving from a subsistence lifestyle to a cash economy, have relatively few options for generating income. They can sell agricultural or pastoral produce, work for a cash wage in agriculture or industry, or sell retail goods in local or regional marketplaces. For the rural poor without land or livestock, harvesting of wild resources is a common option. Wild and naturalized plants provide a "green social security" to billions of people in the form of low-cost building materials, income, fuel, food supplements and traditional medicines. In some cases, the revenues earned with commercialised NTFRs are the only source of cash income, which increases the dependency of the people on those commercially interesting NTFR resources (van Andel, 2000).

11. Cash income from the sale of NTFRs can be very variable, however, even for the same resource category. Earnings vary from a few dollars for ad hoc sales to several thousand dollars per year. In rural Madhya Pradesh, India, for example, NTFRs provide 40-63 per cent of total annual income (Tewari and Campbell, 1996). Across seven study areas in southern Africa, wild plant resources contributed $194-$1,114 per household per year (Shackleton *et al.*, 2000). In general, returns to labour from NTFR sales are usually higher than the average local agricultural wage, with income usually higher for externally marketed products. Subsistence values are often also high, particularly for poorer rural households. In Zimbabwe, for example, Cavendish (1997) calculated that these subsistence ("non-market") values contributed 35 per cent of total household incomes.

12. In 1996, the estimated value of the global markets for all herbal medicines (cultivated and wild harvested) was approximately $14 billion (*Genetic Engineering News*, 1997). Europe was the largest market, representing one-half of the global trade. Asia commanded approximately 36 per cent of the global market. The estimated size of the North American market for herbal medicines in that year was approximately $4 billion. 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 (Brevoort, 1998, *Genetic Engineering News*, 1997)

13. *Panax quinquefolium* (American ginseng) is perhaps the most popular and valued medicinal herb exported from North America. This medicinal plant, which is native to the hardwood forests of eastern North America, has been exported primarily to China for more than 300 years. From 1993 through 1996, the volume of forest-harvested ginseng exported from the United States increased more than 175 per cent, from 69,000 kg to 191,500 kg (USDA, 1999). The export value ranged from $20.7 million to $30.47 million. At the same time, the volume of cultivated American ginseng exported in 1996 was approximately 674,000 kg, and valued at only $20,2 million. Forest-harvested ginseng typically commands a price 10 times that of cultivated ginseng.

Table 2: Examples of NTFR international trade values[2]

Products from NTFR	World's import (million US$)	Notes
Natural rubber	4,221.8	Tropical moist forest regions, from intensively managed plantations, agroforestry systems and natural stands (extractive reserves) of *Hevea brasiliensis*
Honey	206.5	Worldwide product from intensively or extensively managed and wild resources
Ginseng roots	389.3	Tropical or subtropical, both from wild and plantations
Gum Arabic	141.3	Tropical arid regions, mostly from wild or extensively managed natural stands of *Acacia senegal* and *A. seyal*
Rattan	118,987.0	Tropical rainforests, mostly from natural stands, few plantations in Asia

Products from NTFR	World's import (million US$)	Notes
Essential oils	319.4	Various regions, both from wild and cultivated resources
Cork	310.7	Mediterranean regions, from managed natural stands and plantations of *Quercus suber*
Mushrooms	206.5	Temperate and sub-tropical, both from wild and cultivated populations
Brazil nuts	44.3	Amazonian rainforests, from wild or semi-intensively managed natural stands of *Bertholetia excelsa*
TOTAL NTFR	11,108.7	

[2] modified from FAO (1995b) – original data from the database of the United Nations Conference on Trade and Development (UNCTAD)

B. Nutritional values

14. Starchy staple food from a few species of cultivated plants form the bulk of peoples food in the tropics - either rice, maize, sorghum or millet (Gramineae), cassava (Euphorbiaceae) or potatoes (Solanceae). In some parts of the tropics, the starchy staple foods are from sago palm (*Metroxylon sagu*), taro (*Colocasia esculenta*) or arrowroot *(Maranta arundiacea*). Bushmeat commonly provides an important protein source in the tropics and gathered plant foods an important source of dietary supplements to the starchy staple diet. Even where there has been a change from a hunter-gatherer lifestyle to pastoralism or agriculture, hunting and gathering remain important to a high proportion of rural households in African woodlands (Campbell *et al*, 1991; Cunningham, 1988a; Wilson, 1990) and tropical forests (Koppert *et al.*, 1993). Wild plant foods are well known from studies in Africa, Asia and Latin America to be a valuable source of these nutrients deficient in starchy staple diets, particularly nicotinic acid from wild spinaches (Santos-Oliviera and Carvalho, 1975), vitamin C from wild fruits (Quin, 1959; Wehmeyer, 1966) and protein from *Sclerocarya birrea*, *Schinziophyton rautanenii* and *Tylosema esculenta* seeds and edible insects (Quin, 1959). In Appalachian forests of the eastern United States, the native Americans depended on the greens and bulbs of *Allium triccocum* (ramps), which appear early in the spring, for much-needed vitamins after a long winter with no fresh vegetables.

C. Social and cultural values

15. The social and cultural values linked to foods and medicines are a reflection of the value placed on NTFR. Even airfreight is used to transport edible and medicinal plants, regionally or internationally to meet culturally driven demand. An estimated 105 tonnes of "bush plums" (*Dacryodes edulis*) and 100 tonnes of "eru" (*Gnetum africanum* and *G. buchholzianum*) leaves are exported, for example, from Cameroon, Congo, Gabon and the Democratic Republic of Congo as foods for West Africans living in France and Belgium (Tabuna, 1999).

16. Western and traditional medicines are based on very different and well-documented views of health and disease. Traditional medicine takes a holistic approach where disease or misfortune result from an imbalance between the individual and the social environment, while western medicine takes a technical and analytical approach. These different approaches to the causality of disease are one of the reasons why demand for traditional medicine continues in the urban environment, even if western biomedicine is available. Another reason is that western medical care is more expensive and very limited in remote rural areas.

17. International trade in Chinese traditional medicines, in kava (*Piper methysticum*) to expatriate Pacific islanders living in North America or the African medicinal plant khat (*Catha edulis*) to Somali

communities in Europe and North America are other examples. A recent survey amongst 70 Somali people in Liverpool, United Kingdom, for example, found that 43 per cent of men had used khat, with 39 per cent chewing it on a daily basis (Berry, 1996). Remarkably for a product in long-distance trade, the young leaves of *Catha edulis* need to be chewed while still fresh for maximum effect - and for this reason, the price of khat rapidly drops with time. As a result, the trade has to be highly organized to get leaves from the farm to the end-user as soon as possible

18. There is a deep-rooted cultural bond to NTFR collection and use. When the early European settlers immigrated to North America, they brought with them items essential to sustain their lives. When these stores were depleted, they looked to the local forest resources and learned from the Native Americans which plants were useful and how to use them. Much of the knowledge gained from Native Americans is the foundation of the herbal medicinal industry today. Many rural collectors can trace their bond to NTFR collecting back more than 400 hundred years. The knowledge that present-day collectors have about NTFRs could prove invaluable in developing appropriate management strategies.

IV. HARVESTING IMPACTS

19. For many products, harvesting takes place in landscapes changed by people due to farming, fire or livestock, even where human population densities are very low. In the Brazilian Amazon, for example, with an average human population density of about 1 person/km2, at least 11.8 per cent of *terra firma* forest is an anthropogenic result of swidden agriculture, human settlement and plant domestication (Balee, 1989, 1993). In all savanna systems, fire is a frequent source of disturbance (Scholes and Walker, 1993). By the time of European contact, most of Australia, with a human population far lower than Amazonia, was being deliberately burnt as a means of managing food production density (Latz, 1995). Direct use of resources is thus superimposed upon the effects of natural and/or anthropogenic disturbance. In some cases this enhances species populations and in others, diminishes them. Many species of bamboo, thatch-grasses (*Hyperthelia, Imperata, Cymbopogon*), edible leafy greens (Acanthaceae, Amaranthaceae, Capparaceae) and sources of bark fibre (Tiliaceae, Malvaceae) are often widely distributed, light demanding plants, whose populations increase in response to disturbance. Anthropogenic disturbance also occurs on smaller scales. Examples are the deliberate planting of useful species in forest patches or along paths, such as by the Kayapó in Amazonia (Posey, 1984), propagation of *Canarium* and *Landolphia* by Mbuti in the Ituri forest (Ichikawa, 1999), or the protection of valued species, replanting the tops of wild *Dioscorea* tubers, transplanting palm suckers, on a sufficiently systematic basis for this to be considered "rainforest management" (e.g.: Alcorn, 1981).

20. In the past, under subsistence demand, harvesting of plant-based NTFRs rarely resulted in species-specific over-exploitation. Now, rural communities in many parts of Africa, Asia, Central Europe and the Americas are increasingly concerned about losing self-sufficiency as their local wild populations of favoured, popular plant species are cut down or dug up, bundled or bagged and transported to far-away regional markets. Similar concerns apply to animals used for bushmeat, as the wildlife biomass of tropical forests is generally low. In Amazonia, for example, the protein intake of the Yuquí Indians dropped from 88 g to 44 g per person per day after large-scale invasions by colonists between 1983 and 1988 (Stearman, 2000). Wildlife hunting may be sustained, but only where human population densities are low (Bodmer *et al*, 1994). Based on a recent review of studies on hunting in tropical forest, Bennett and Robinson (2000) suggest that for people depending exclusively on wild meat, hunting may not be sustainable if human population densities >1 or 2 person/km2. Where people shift from subsistence to a cash economy, frequency and intensity of harvesting or hunting change rapidly, for example in response to commercial demand stimulated by increased access (e.g.: road construction for logging). The bushmeat trade (Bennett and Robinson, 2000), as well as some rattan, craft, horticultural and medicinal plant species, all provide examples of this situation (Cunningham & Milton, 1987; Donaldson, in press; Dransfield, 1981; Nantel *et al*, 1996).

21. Whether NTFR or bushmeat use is considered from the perspective of local livelihoods or conservation, species loss through over-exploitation benefits neither local people nor conservation in the long term. Unrestricted access to valued but vulnerable species may provide a high initial harvest, but this will merely be a temporary "bonanza", followed by loss of local self-sufficiency and higher effort or prices to get the species elsewhere. In most cases, habitat loss is the initial underlying cause of threat. Increasingly, however, species-specific over-harvesting of some plants and animals is becoming a significant factor as habitats shrink and demand for valued, but vulnerable species increases. Substantial proportions of some of the world's most useful plant families are currently threatened by either habitat loss or species-specific over-exploitation (or a combination of these two factors).

22. It is often assumed that NTFRs are sustainably harvested and that this "green social security" will always be available to resource users. This is not always the case. In many parts of the world, local people are losing access to valued plant and animal species, either through over-exploitation and habitat destruction or loss of access, as former harvesting areas are included within national parks or forest reserves. For all interest groups, whether resource users, rural development workers or national park managers, it is far better to have pro-active management and to stop or phase out destructive harvesting in favour of suitable alternatives before over-exploitation occurs, than to have the "benefit" of hindsight after resource depletion.

23. A problem is that little is known about the population biology, standing stocks or yields of most plant species that are harvested for non-timber forest products. Tropical forests, for example, are remarkably diverse, yet poorly studied by scientists. Many tropical species are not described and even less is known about the population biology or ecological interactions between species. Though temperate forest species may be better studied, for many temperate NTFRs little more is known than basic taxonomy and the geographic distribution. There is a general lack of knowledge about the reproductive biology, inventories, and sustainable yields. Even if encouraging new initiatives such as the Global Taxonomy Initiative were implemented tomorrow, we still need to find ways to prioritize NTFR species as components in the implementation of conservation and sustainable use plans.

24. Due to the diversity of forest ecosystems and NTFRs, our limited “scientific” knowledge and the ecological and taxonomic insights held by knowledgeable local and indigenous people, it is recommended that more use should be made of folk taxonomists. Where formally trained taxonomists are not (and are unlikely to become) available, local folk taxonomists can be remarkably effective. In India, for example, local people in selected areas are involved in “community biodiversity registers” (Gadgil, 1996; Ministry of Environment and Forests, 1997) in a process that documents biodiversity at a landscape level and the processes driving change. This experimental process is worth pursuing in other parts of the world.

25. The greatest contribution by folk taxonomists will probably be in the inventory and population biology of useful species such as edible or medicinal plants or animals. In Australia, where reptiles are commonly hunted for food, local folk taxonomy can be crucial at filling gaps in knowledge about reptile taxa (Baker and Mutitjulu Community 1992). Kinabalu Park in Sabah, Malaysia, with over 5,000 plant species has long been a famous site for botanical richness. This enabled a comparison of the number of palm species collected by professional botanists visiting Kinabalu from the 1850's onwards with those made by community-based collectors. In just 3 per cent of the time in which professional botanists were active, they were able to increase known palm genera by 82 per cent, species and intra-specific taxa by 65 per cent and the number of collections by 103 per cent (Martin *et al*, 2001). Traditional ecological knowledge can provide valuable information on stewardship practices for sustainable NTFR use (Emery, 2001a).

26. Vulnerability or resilience to harvesting is influenced by the level of demand and by common biological characteristics: life form (plants) or body size (animals), growth rate, reproductive biology, geographic distribution, habitat specificity, population density, etc. (Cunningham, 1991; 2001; Peters, 1983; Peters, 1994). 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 large, slow-growing, infrequently reproducing species.

27. The effects of harvesting on a plant population depend on what part of the plant is harvested and on the quantity, intensity and frequency of harvesting. Most harvesting has some effect, but extirpation is infrequent and extinction even more rare. It is usually a function of habitat destruction, coupled with commercial harvesting of restricted range species. The effect of harvesting is particularly acute when the roots, fruiting bodies or other reproductive organs are removed. With many medicinal plants, the roots are harvested, thus severely limiting reproductive capability. The barks of other medicinal plants are stripped from the live plant, increasing tremendously the likelihood of mortality. Although the response of individual plants is a useful guide to estimate harvesting 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.

28. Harvested populations, in turn, need to be viewed in terms of abundance, distribution and response to disturbance at the landscape level (Cunningham, 2001). A seemingly low impact use, such as harvesting of fruits for example, may have a high long-term impact on populations of some species, either because of long-term impact on seedling recruitment (Peters, 1994) or because fruit collection involves tree-felling. On the other hand, even if harvesting bark, roots or stems kills some individual plants, it may have little impact on the populations of fast-growing, fast-reproducing species. In Guyana, species-rich mixed forests contain more NTFR species than species-poor swamps. However, this diversity is not a prerequisite for economically viable and ecologically sustainable NTFR extraction. Low-diversity forests offer better opportunities for sustainable single-species extraction, as they are dominant in economically important species (van Andel, 2000).

V. UNDERLYING CAUSES

29. Forest and woodland fragmentation results in harvesting and hunting focused on the remaining source areas, including national parks (and even botanical gardens!!). In terms of people's harvesting, a decline in area covered by vegetation types with characteristic species associations is highly significant to conservation and resource management programmes. For this reason, understanding what drives deforestation (Kaimowitz and Angelsen, 1998) and resultant policy change are directly relevant to sustained use of NTFRs.

30. First, this represents a decline in wildlife species (Cuaron, 2000) and in the availability of plant species that was, or would have been, used by local people. Working in 2.7 million ha of southern Mexico and northern Guatemala, for example, Cuaron (2000) showed a declining trend in habitat availability for 32 (59 per cent) of the 54 wildlife species. Second, it means that the remaining blocks of vegetation become the focus for more frequent and intensive harvesting of high-value species, for both bushmeat (e.g., Fitzgibbon *et al.*, 1995) and plant products (e.g., Cunningham, 2001). Periodic assessment of the extent and rate of loss (or expansion) of habitat at a landscape level, using aerial photographs or satellite images, is a common, cost-effective way to monitor the success or failure of conservation programmes, but it does not give the full-picture. Forest or woodland cover may not change - but underneath the canopy populations of high value, vulnerable plant and animal species can be disappearing due to species-specific over-exploitation: the "empty forest" phenomenon described by Redford (1993) for wildlife. This situation is rarely taken into account in protected area management. For these reasons, monitoring on a large spatial scale needs to be combined with monitoring of a high-value "indicator" species at a population level to give a comprehensive picture.

A. Biological factors

31. Differences in climate, soil and vegetation type result in significant differences in the availability and use of NTFRs across tropical and temperate climates. Large areas of the tropics are covered by sandy,

nutrient-poor soils. Examples are *terra firma* forest in Amazonia; heath (kerangas) forests in Borneo; in south-central Africa, Zambesian dry evergreen forests on Kalahari sands (dominated either by *Cryptocephalum, Parinari excelsa* or *Marquesia macruora*); the monodominant *Gilbertiodendron dewevrei* forests in the Congo basin; and in eastern Africa, dry deciduous forests on coastal plain sands. In each case, the relatively low productivity of these forests, with consequently low carrying capacities for hunting communities, suggests that hunting may not even be sustainable where human population densities are less than 2 persons/km2 (Bennett and Robinson, 2000).

32. In the case of wild plant use, yields from wild populations are often over-estimated. Whether fruits, roots, bark or whole plants are involved, the potential yield from wild stocks of many species is frequently over-estimated, particularly if the effects of stochastic events are taken into account. As a result, commercial harvesting ventures based on wild populations can be characterised by a "boom and bust" situation, where initial harvests are followed by declining resource availability. In their work on American ginseng (*Panax quinquefolium*) in Canadian temperate forests, Nantel *et al* (1996) found the extinction threshold below 30-90 plants. The minimum viable population was estimated at 170 plants, but only a dozen populations were larger than 170 plants, so most cannot support any harvesting if they are to be maintained in the long-term. The low level of extraction required to ensure sustainable harvesting of wild populations of American ginseng (*Panax quinquefolium*) as well as wild leeks (*Allium triccocum*) in Canada (Nantel *et al*, 1996) and amla tree (*Phyllanthus emblica*) fruit in India (Shankar *et al*, 1996) suggests that, at current prices, sustainable harvest levels for these species were not an economic propositions for commercial gatherers.

B. Change in socio-economic factors

33. Transport systems are reaching further and further into remote, resource-rich regions, catalysing settlement and forest and woodland clearing. This results in the loss of supplies of wild-harvested species as habitat declines and trade in bushmeat and wild plant species increases. For these reasons, Wilkie *et al.* (2000) highlight the need, through coordinated land-use and infrastructure planning, to plan roads in a way that maximizes local and national economic benefits, while minimizing the negative effects that road construction has on biodiversity.

34. Improved transport networks strengthen the link between rural resources and urban demand. They also result in an influx of outsiders, frequently disrupting traditional resource tenure systems and increasing the scramble for economically valuable resources. As cities grow, the markets within them exert a stronger and stronger pull on rural resources. Over the past century, there has been an unprecedented flood of people moving from rural to urban areas. At present, the highest rate of urbanization, 6 per cent per year, is in sub-Saharan Africa. In South Asia, the rate is 4 per cent per year. Godoy and Bawa (1993) suggest that economic development "encourages rural to urban migration, lowers population growth, and supports more productive agriculture, all of which should decrease pressure on the forest as a source of livelihood". Since the 1960's, the growing demand from urban areas has catalysed NTFR trade, drawing in resources from rural areas to towns and cities, for favoured fuelwood, building materials, medicinal or edible wild fruit species. From first harvest to final sale, this trade in wild plants and bushmeat for local, national or regional consumption forms part of an informal sector "hidden economy". This informal sector trade continues to be very important in the cities of many developing countries, as the urban-rural divide is rarely clear-cut. As a result, urbanization has tended to increase rather than reduce the demand for wild plant resources, catalysing a commercial trade that stimulates over-exploitation.

35. International trade in NTFRs is more obvious, as middlemen link the informal sector to an export sector for which export or import records are sometimes kept. For example, around 500 people, mostly women, sell more than 700 tonnes of aguaje (*Mauritia flexuosa*) palm fruit each day in Iquitos (Padoch, 1988). Of the 700 full-time NTFR traders in the daily urban markets of Kumasi, Ghana, 90 per cent of whom were women, 100 traded in leaves of Marantaceae with the monthly demand for *Marantochloa* leaves exceeding $47,000. Of the 100 people, also mainly women, who traded in medicinal plants, 65

were full-time bushmeat traders, 50 traded smoked meat, 15 fresh traded bushmeat, selling an estimated 160 tons of meat/yr with an annual value of $209 000 and 25 were full-time basket traders, selling 1,000-5,000 baskets/month (FAO, 1995a). In Gabon, the bushmeat trade has been valued at $22 million/yr for informal markets and $3 million/yr from formal markets, with four tonnes of bushmeat entering Libreville monthly (Inamdar *et al.*, 1999).

36. A study of the segment of the floral industry that deals with forest-harvested greens in the Pacific Northwest of the United States found that processors purchased $47.5 million worth of conifer boughs and other floral greens (Schlosser, Blatner and Chapman, 1991). This segment contributed $128.5 million to the regional economy at the wholesale level in 1989, and supported more than 10,000 seasonal and permanent jobs.

37. The shift from subsistence use to commercial sale has important implications for resource management, as it results in larger volumes being harvested, a higher frequency and intensity of harvesting and often affects resource tenure. In some cases, commercial harvesting strengthens resource tenure and the incentive to conserve individual plants. Commercial sale of wild fruits such as *Sclerocarya birrea*, for example, maintains the incentive to conserve wild fruit-bearing trees in parts of Africa where development of a social stigma against gathering wild fruits as a food resource is undermining the "traditional" practice of conserving wild fruit trees. In others, the shift from subsistence use to commercial harvesting weakens resource tenure and undermines customary controls of resource use.

38. Although access to markets is a key factor in realizing economic values of NTFRs (Neumann and Hirsch, 2000), the ingenuity of people accessing markets if there is sufficient economic incentive should not be underestimated. The use of helicopters to (often illegally) transport the aromatic gaharu resins (*Aquilaria* trees) from remote South-East Asian forests to international markets is a good example (Momberg *et al*, 2000). If prices and profits are high enough, local traders will also make remarkable use of any transport network to get perishable species to the market. As road networks extend into more and more remote rural areas, so commercial harvesters or middlemen flow in, and favoured plant species flow out.

39. Local gatherers often get a low and highly variable price for unprocessed plant material at the start of these complex marketing chains, from rural gatherers harvesting wild species to urban consumers. Although income from *Prunus africana* bark sales is an important source of revenue to villagers in Madagascar, in some cases generating >30 per cent of village revenue, the price paid to collectors is negligible compared to middlemen (Walter and Rokotonirina, 1995). In Mexico, Hersch-Martinez (1995) found that medicinal plant collectors only received an average 6.17 per cent of the medicinal plant consumer price. In India, the extent by which the prices of NTFPs increased along the marketing chain from the point of collection varied from an increase of 50 per cent for *Decalepis hamiltonii* to 255 per cent in soapnut (*Acacia sinuata*) sales (Hedge *et al.*, 1996). On the basis of their study, Hedge *et al.* (1996) considered that one consequence of low prices to harvesters could be over-exploitation and, conversely, increased income through value-addition and processing could provide an incentive to decrease harvest levels. For this reason, for example, Shankar *et al.* (1996) have recommended an alternative flow of amla (*Phyllanthus emblica*) fruit in India from the forest source area to the Indian consumer, improving economic benefits to harvesters as a means of improving household income, while reducing over-harvesting of fruits. Their model is widely applicable, as is the Joint Forest Management (JFM) system developed for NTFR harvest and timber production in *Shorea robusta* forests in West Bengal, India, which has also been applied in Nepal (Hobley, 1996). Next to systems such as JFM, another important and potential fruitful system has been developed. Analogue Forestry, which was initially started in the home-gardens of Sri Lanka, has now been applied in numerous other countries and proven quite successful in combining biodiversity with NTFR production and harvesting (Senanayake and Jack, 1998; Mallet, 2000).

40. Low prices paid for medicinal plants, whether for local or export markets, often bear no relation to the real cost of resource replacement. Low prices also mean that few slow-growing species are

cultivated and that cultivation for profit is restricted to a small number of high-priced and/or fast-growing species.

C. Disappearance of cultural and religious values

41. The assumption tends to be that "economic development" means that electricity, kerosene or gas for lighting and household cooking is supplied at low cost to the majority of the urban population. However, this is often not the case in the shantytowns that sprawl around the rapidly growing cities of most developing countries. The cultural and economic importance of wild plants to urban people is a crucial factor, which also has to be taken into account. Common examples in many cities in Africa, Asia and Latin America are the sale of wild-collected medicines, chewing sticks, indigenous foods and bushmeats valued by urban people.

42. Cultural systems are even more dynamic than biological ones, and the shift from a subsistence economy to a cash economy is a dominant factor amongst all but the remotest of peoples. In many parts of the world, "traditional" conservation practices have been weakened by cultural change, higher human needs and numbers, and a shift to cash economies. There are an increasing number of cases where resources which were traditionally conserved, or which appeared to be conserved, are being over-exploited today. 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 for maize fields or coffee plantations, often on slopes so steep that sustainable agriculture is impossible. In other places, local human populations have decreased due to epidemic disease or even urbanization, with swidden agriculture only occurring on old secondary forest. While some resources are being over-harvested due to cultural and economic change, the majority are still used sustainably, and the impact on others has lessened because of social change. In the most extreme cases, "islands" of remaining vegetation, usually created by habitat loss through clearing for agriculture, then become focal points for harvesting pressure, and sites of conflict over remaining land or resources.

VI. RECOMMENDATIONS

1. **To achieve a balance between conservation and sustainable use of non-timber forest resources, there is a need to consolidate protected area networks and establish and maintain corridors (Article 8(a)) through:**

(a) Identification and legal protection of currently unprotected sites that are a priority for conservation of biological diversity and ecosystem processes and, where necessary, increase of the effectiveness of existing protected area management.

(b) Putting in place land-use mosaics favourable to the conservation goals of the adjacent protected areas. The form this takes will vary with social, political and economic circumstances, comprising conservancies, “land care” groups, multiple-use zones, co-management areas or indigenous production forests. Firm, mutually agreed and enforceable regulations need to be established.

(c) This should be planned on an ecosystem scale to create biological corridors for migratory species and maintain minimum viable populations of priority conservation species.

2. **Land-use and infrastructure planning (roads, new settlements) need to take into account protected areas, their adjacent conservancies or co-management areas and the requirements for maintaining viable populations of valued, but vulnerable species. These should not block migration routes, result in the destruction of high-priority conservation habitats or stimulate the over-exploitation of high-priority conservation species (such as rattan, medicinal plants or bushmeat) through unregulated commercial trade.**

3. **Ecosystem-level and harvested/hunted population management planning must take place through a process of consultation that takes into account relevant scientific, local and indigenous knowledge. This should recognize the role of cultural landscapes (with their botanical and cultural diversity) and include support to local or indigenous people trying to protect their biological and cultural heritage from external incursions, such as industrial logging, large dams or industrial-scale agriculture.**

4. **Development and implementation of effective conservation and resource management plans may need legislative reform before managed use of non-timber forest resources provides an incentive for conservation as a form of land use (Article 8 (k)). An example is the development of national legislation in Namibia that recognizes community rights to values derived from wildlife within co-managed conservancies. An example of the converse is the national legislation in Australia which denies indigenous people commercial access to indigenous species (birds, reptiles, marsupials), even where viable harvesting is possible as a more appropriate form of land use than sheep (ACIL Economics, 1997). In Côte d'Ivoire, wildlife hunting is registered as an illegal activity: poaching. This legislation hampers the development of regulations on wildlife management and many households in the vicinity of Taï National Park depend on the market trade of bushmeat. Therefore, it is recommended in this specific case to support the drawing up of the necessary conditions for the re-opening of hunting in Côte d'Ivoire (Caspary *et al*, 2001).**

5. **Legislative change, technical support and economic incentives for ecological restoration of wildlife corridors and for the control of invasive plant and animal species may be necessary for maintenance or re-establishment of viable populations of indigenous plant and animal populations.**

6. **Training: recognize and strengthen the role of local people in inventory, research, monitoring and impact-assessment processes, and management (Article 12):**

(a) A folk taxonomy initiative should be formed as a separate, new component within the current Global Taxonomy Initiative, which has been established as a means of promoting taxonomy and taxonomic tools for implementation of the Convention. Traditional ecological knowledge of local and indigenous peoples about the ecology and use of NTFR species needs to be documented, strengthened, respected, and developed. The role of local people in tropical taxonomy initiatives has also been recognized in Costa Rica (Janzen *et al.*, 1993) and Brazil, concentrating on the collection and cataloguing of wasps, beetles, vertebrate parasites and fungi specimens. A recent example of this, concentrating on insect pollinators, is the document prepared by Brazilian Ministry of the Environment as a contribution for the implementation of Decision III/11 of the Convention on Biological Diversity which established a work programme on the conservation and sustainable use of agricultural biological diversity (Dias, Raw and Imperatri–Fonseca, 1999).

(b) There is a great need for training (CBD Article 12(a)) of young professionals and the staff of agencies responsible for the management of NTFRs and wildlife resources to work effectively with the local harvesters and their communities, private owners and those working for commercial enterprises. This will require *technical and scientific cooperation* **(**Articles 18 and 25(c)).

(c) The role of local and indigenous people should not only be recognized in inventory, research, monitoring and impact assessment processes but also in the management itself. Cases in Colombia have proven that local indigenous management of natural resources, but also research, are quite successful (Rodríguez and van der Hammen, 1999).

7. **Appropriate and economically viable monitoring systems should be developed and established at the landscape level (remote-sensing, aerial photograph analysis) and local**

level (indicator species) (Article 7). Involvement of local people in this process, through both mapping and monitoring, should be considered, particularly for countries with limited numbers of trained personnel. Efficient systems for data storage, analysis and the return of results to local people must accompany this process.

8. **Integrate non-timber forest resources uses into forest management and land use planning: non-timber forest products need to be recognized by forest management agencies as natural resources and fully integrated into forest management planning and activities. NTFRs should receive similar attention in forest management as other natural resources, such as timber, minerals, and water. Silvicultural prescriptions need to be developed that consider and incorporate NTFRs. The opportunity for better coordinated inventory and management to avoid wastage should influence the choice of natural forest logging systems and how these influence NTFRs. Forest management planning needs to consider the implications of removing the canopy, due to logging, on understorey NTFRs. Although many tree species have multiple uses aside from timber, this is rarely taken into account in forest inventory or management. Exceptions to this are forest departments in Finland, which uses double-inventory methods to develop management plans for berry yielding shrubs and for edible mushrooms (Saastamoinen et al., 1998) and the Nepal Forest Department, which has recently included NTFRs in its five-year planning process (Wong, 2000). There is a great opportunity for SBSTTA to stress the need for inclusion of NTFRs in forestry planning processes, as logging impacts can have a far greater impact than harvesting on some NTFRs.**

9. **Conservation through cultivation or farming of wildlife, which is economically viable and on a sufficient scale to take the pressure off wild stock: wild harvest is not always the answer, particularly under high demand. While managed sustainable use of wild populations is theoretically possible in high species diversity systems such as forests, it requires such high inputs of money and manpower that exploitative use is likely to occur. Cultivation can be a cheaper and more practical option. If cultivation is to be a success in providing an alternative supply of over-exploited plant species, then plants have to be produced cheaply and in large quantity. 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 no input costs for cultivation. Prices therefore increase with scarcity due to transport costs, search time and the long-distance trade. At present, low prices (whether for local or international pharmaceutical trade) ensure that few species can be marketed at a high enough price to make cultivation profitable. 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. This is attained relatively easily in the case of medicinal species. The regional demand for *Scilla natalensis* (Liliaceae) in KwaZulu/Natal, South Africa, for example, was 300,000 bulbs/yr, which are at least 8 - 10 years old from the wild. On a 6 year rotation under cultivation at the same planting densities as Gentry *et al.* (1987) used for *Urginea maritima* (Liliaceae), 70 ha would be required (Cunningham, 1988). Due to their slow growth rates, the rotational area required for tree species would be far greater, with total area dependant on demand. Between 3200 and 4900 tonnes of *Prunus africana* bark are exploited annually for export to Europe. In ideal conditions, bark production rates of *Prunus africana* are similar of *Acacia mearnsii* plantations, which produce 28 tons/bark/yr from 12-year-old stands with 1,363 trees/ha. Before manufacture of the capsules, the bark extract is standardized to contain 13 per cent phytosterols (Mediherb, 1991). Twelve-year-old trees have about 50 per cent of the phytosterol content, so twice the current tonnage would presumably be required. If this is correct, then total annual world demand for *Prunus africana* bark could be produced by a total plantation area of 2,743 – 4,200 ha or a 12 year rotation of a total of 230 - 350 ha of trees felled and totally stripped of bark each year. In Côte d'Ivoire, farm propagation proved successful for Makoré (*Tieghemella***

***heckelii*) a local fruit tree. The study showed, however, that next to the biological, ecological and economic aspects, socio-economic aspects should also be taken into account. In the Taï region where the study took place, planting a tree was taboo for the farmers, as they believed that planting a tree was an act exclusively for God and that the planter was condemned to die before the tree became mature. Between 1969 and 1989 the first timed steps were set towards actual cultivation of forest fruit trees. The Makoré seed oil - used for making butter, soap and balm for hair and skin – was the primary motivation for 79 per cent of the farmers to domesticate the species. (Bonnéhin, 2000)**

10. **Raise awareness of importer, exporter, manufacturers and retail buyer: 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. Programmes that raise awareness about the "ecological footprint" of long-distance trade from developing to developed countries or certification programmes such as the Forest Stewardship Council (FSC) that may be applied to some NTFRs (Shanley et al., in press) are useful tools to achieve this goal. Note that next to the NTFR certification scheme of FSC, other certification schemes exist. Certifying the Environmental Management System (EMS) of a forest organization can be done according to international standards (ISA|O 14001/14004); however it does not lead to product labelling. The certification systems on organic agriculture such as the International Federation on Organic Agriculture (IFOAM) or the Organic Crop Improvement Association (OCIA) deal with NTFRs from human-altered vegetation types. Finally the Fairtrade Labelling Organization (FLO) focuses on socio-economic criteria of products including NTFRs. It is important to attune the different certification schemes so they mutually reinforce their processes and avoid potential conflicts (Maas and Ros-Tonen, 2001).**

11. ***Ex situ* conservation (Article 9 of the Convention on Biological Diversity): secure *ex situ* gene banks need to be developed. Commercially harvested, habitat-specific, phylo-genetically distinct genera are an important priority (e.g., Panax (6 species, all commercially harvested), Warburgia (4 species, all harvested) and Aquilaria (15 species, at least 7 of which are exploited for gaharu). Priority should be given to those plant species listed by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).**

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