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Appendix 4.3.2

ENVIRONMENTAL DIMENSIONS OF NON-WOOD FOREST PRODUCTS

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INTRODUCTION

This paper considers the environmental merits of non-wood forest products (NWFPs), and the potentials and constraints in their realization. It also identifies the environmental dimensions of NWFPs and provides broad guidelines for incorporating environmental considerations in NWFP management and utilization.

The increasing demand for NWFPs and the disappearance of forest ecosystems have prompted an important decision by many countries to protect the existing forest ecosystems, especially those of tropical forests which have high levels of biological diversity.

NWFPs are more amenable for sustainable harvesting and use than wood products; they tend to have greater environmental benefits, including conservation of biodiversity, if carefully managed; they provide improved possibilities for "eco-ventures" covering small-scale NWFP-based enterprises, supply of genetic materials, buffer zone management, wildlife and wilderness-based tourism; they support upland community needs and welfare. Probably NWFPs are more vulnerable to mismanagement than wood. Sound forest management is the key for their sustainable and successful management.

Development, including development of NWFPs, is considered important to improve people's welfare. Development is hardly ever linked with the disutility of many resources. In fact, however, development produces both useful products and "wastes" or "disutility". The benefit to the communities of useful products are emphasized, while the cost and risk to the communities of "wastes" or "disutilities" are de-emphasized.

Development is usually linked to the economy and environment is usually related to ecology. In the modern world, both are supposed to be linked to the market mechanism governing supply and demand of any commodity ? goods and services. Evidently, both words ? economy and ecology ? signify a confined and limited space. However, in our world, like in a house, everything is internal and its resources are limited and interrelated. It is somewhat of a paradox that economy and ecology came to be thought of as antithetical.

This paper is meant only to serve as a basis for discussion and to stimulate ideas and suggestions. Environmental implications of NWFPs pervade all other topics discussed at this consultation. Several specific to resource management are addressed in the paper by Reis on Resource Development.

GENERAL BACKGROUND

The relationship between humans and forests has culminated at various times in wood shortages of great political and economic importance, and which led ultimately to the development of forestry as a scientific discipline. Early attempts to conserve and sustain wood supplies were largely unsuccessful, and natural forests are still quickly disappearing. Natural forests are being converted to commercial plantation forests to produce more wood of "better" quality.

Natural forests also provide many NWFPs vital to local communities. Increased medicinal and industrial knowledge has also recognized the importance of NWFPs to support new medicines, new molecules and genes to engineer new products.

Terminology

NWFPs generally include tangible products other than timber, fuelwood and charcoal derived from forests or woody plants. The purpose of a discussion on NWFPs is the inclusion of these products in planning and managing forestry activities. This will promote investment to improve NWFPs and the output of non-wood products can be planned along with wood products.

Both plantation and natural forests can produce NWFPs. In fact, some plantation forests are developed specifically to produce NWFPs, including: pine and rubber plantations for producing resin; cinnamon plantations for producing bark; *myristica* plantations for producing nutmeg; and *schleichera* plantations to host insects for lac production. Another "product" is forest-based recreation and hunting.

We can divide NWFPs among two categories: (1) tangible products, i.e. flora and fauna, and (2) intangible products provided by the existence of forests in a certain area, e.g. a stable hydrological system, erosion control, scenic beauty, climatic regulation, and biodiversity.

Environmental Aspects

The environmental values of NWFPs have a direct correlation to the type of forest from which they are harvested. In natural forests, where diversity is generally much greater than in plantation forests, the environmental value of NWFPs is much higher since these products are part of the forest ecosystem where every component, living and non-living, of the forest relates to each other. The roles of NWFPs in the forest ecosystem, include nutrient supply for other living organism in the forests, regeneration of the forest itself and the maintenance of forest habitat quality.

Commodity Values

NWFPs are no longer "minor forest products" but major products of great socio-economic value. They are harvested not only from natural forests, but also from areas under similar use and plantations. They may be part of woody plants such as bark, gum, leaves, fruits, oils, and flowers, or they may be part of the forest ecosystem, such as wildlife or grass. Some of the NWFPs are intangible, for example, recreational facilities.

NWFPs have a broader base of production than timber. In many countries, timber can only be harvested from production forests, while NWFPs can be harvested from all forests, whether plantation, protected forests or nature reserves.

New NWFPs are being developed continuously, such as medicines and other chemicals, genetic materials of flora and fauna to improve agricultural productivity. Availability of some of these new products depends on the existence of natural forest habitat and its exploitation poses another threat to the sustainability of the forest.

Sustainability

The term *sustainability* has different meanings for different people. In the context of forests, sustainability means the ability of each generation to maintain and pass on to the next generation a stock of forest resources no less productive, protected and utilizable than what it inherited, including natural forests and other sensitive ecosystems. Just as sustainability of NWFPs depends on the sustainability of forests, the sustainability of forests will depend on the way that NWFPs are harvested.

Sustainability of forest production, including NWFPs, requires management. Since NWFPs in many countries have traditionally been considered by-products, their production has not been managed at all. It has been a "hunter and gatherer" type activity and its sustainability is questionable.

To improve the sustainable management of NWFPs, more knowledge is needed, especially of forest ecology and the ecology of NWFPs, that is, the role of plant and animal matter in the intricate and interrelated ecological system. An understanding of the role of NWFPs in the forest ecosystem is essential to understand the impacts of exploitation on the environment.

The criteria and methodology of NWFP management can be developed most quickly through an understanding of the sustainable relationship between the forest and the indigenous communities living in the forests.

ENVIRONMENTAL ROLES OF NWFPs AND IMPACTS OF THEIR EXPLOITATION ON THE ENVIRONMENT

In the forest ecosystem, biotic and abiotic factors are linked together in an intricate relationship, supporting and enriching each other. Biotic components such as plants, insects, mammals, and birds, are linked in the cycles of energy, nutrients, water, and material. Many other cycles also link biotic factors with abiotic factors such as water and soil. NWFP resources play a part in these relationships.

Energy Cycles

Forest productivity is closely related to the foliage or leaf area of the vegetation. In this respect, leaf and other biomass may be considered as NWFPs and an important component of the energy cycle in the forest ecosystem.

By the beginning of the 1980s, it became apparent that biomass was about to make a comeback as a significant contributor to national energy budgets in developed countries, although developing countries have never escaped from this dependency. With the real possibility of a world shortage of wood in the next few decades, wood appears to be about to regain some of its historic importance as a major factor in human cultural evolution.

Nutrient Cycles

The dynamics of chemical nutrients in terrestrial ecosystems can be identified with one or more of the following three cycles: the geochemical cycle, involving the input and loss of nutrients from a particular ecosystem; the biogeochemical cycle, involving the intake, storage and loss of nutrients from plants within an ecosystem, including the movement of nutrients through grazing and detritus-trophic-webs; and the biochemical cycle, involving an internal redistribution of nutrients within organisms that permit them to satisfy some of their nutritional requirements for new growth from within their own nutrient capital. Dead leaves

and litter, for example, may be considered NWFPs or fertilizer, but they also form an important component of the biogeochemical cycle of the forest ecosystem.

Various mechanisms have evolved to conserve and store nutrients within an ecosystem. Plants on uncolonized mineral substrate will gradually remove available nutrients from the mineral layers and transfer them to the living plant biomass with a surface accumulation of decomposing organic matter. Atmospheric inputs also accumulate within the ecosystem. Trees are particularly well adapted to accumulate nutrients from the geochemical cycle into a tight biogeochemical cycle, and in time a forest may be able to live in virtual nutritional independence of the underlying mineral layers. This important phenomenon permits reasonably productive forest growth on exceedingly nutrient-poor mineral substrates, and is a major reason why forests are such a successful form of vegetation.

In managing ecosystems, the biogeochemical mechanisms responsible for sustainable production must be identified and conserved. Over the past 2,000 years, and especially in the past 50 years, humans have disturbed nutrient cycles on an ever increasing scale. In many areas the nutrient reserves that have taken centuries, or even millennia, to accumulate have been dissipated. Natural processes remain fully capable of rebuilding these reserves in time, but generally too slowly for human purposes. To continue life as we know it will require that we conserve available nutrients by maintaining biogeochemical cycles intact. Thus nutrient management will become as important in NWFP forestry as it is in agriculture.

Shoot and root systems are especially active nutrient absorbers for plants. Shoots actively absorb CO_2, O_2, H_2O, NH_4^+, SO_4^+, and roots absorb P, Si, B, Na, K, Mg, Ca, Fe, Cu, Mn and Mo (Isermann, 1980). However, many shoots and roots are also important NWFPs harvested by mankind. In traditional communities those materials are used for foods, medicines, and animal feeds. Harvesting shoots, roots, and fruits is, in effect, harvesting the nutrients of the trees and the forests.

Genetic and Evolutionary Aspects

Ecosystems are specialized biogeochemical systems that have evolved to trap, concentrate, and accumulate energy. Each has become specialized in competing, surviving, and reproducing itself in particular types of physical-biotic environments, but is also capable of adaptation to changing conditions. This ability arises from the natural variation in morphology, physiology, and behaviour present in all natural populations of organisms. As condition change, different genotypes within the population become the best adapted and are favoured by natural selection. In this way species evolve. Consequently, harvesting wild species from the forests may have some profound impacts on the evolutionary pathways of the forests.

Biodiversity

Biological diversity, or biodiversity, encompasses the variety and abundance of plants, animals, and microorganism as well as the ecosystems and ecological processes to which they belong. Biodiversity is usually considered at three levels: genetic, species, and ecosystem diversity. Genetic diversity is the total genetic information contained in the genes of an individual organism. Species diversity refers to the variety of living organisms. Ecosystem diversity relates to the enormous diversity of habitats and biotic communities, as well as to the variety of ecological processes within ecosystems (MacNeely *et al.*, 1990).

Biological diversity is more than just the sum of species numbers. It encompasses the variety and variability of genes, species and ecosystems where they occur. Most of the world's biodiversity is located in the tropics, and some 40 to 90 percent of the world's species live in tropical forests (Raven, 1988; Myers, 1980; Reid and Miller, 1989).

With its wide range of natural habitats, and rich plant and animal resources, Indonesia has been recognized as a major world centre for biological diversity. Although it covers only 1.3 percent of the Earth's surface, the country harbours about 10 percent of all flowering plants species, 12 percent of the world's mammal species, 16 percent of the world's reptile and amphibian species, 17 percent of all bird species and more than a quarter of all marine and freshwater fish species. This rich biodiversity can be attributed to the fact that Indonesia spans two major biogeographical realms, Indomalaya and Australasia.

Remarkably little is known about species diversity in quantitative terms. Estimates of the earth's total number of species range from 2 million to 100 million, of which fewer than 1.5 million have been named. And only a small fraction of these have been considered for their economic value (Reid, 1992). Reid and Miller (1989) among others, have estimated that 5 to 10 percent of these species are presently being lost each decade, a rate not seen since dinosaurs died out 65 million years ago. Population growth and climatic changes could accelerate such extinctions even beyond these figures.

Biological diversity in forest ecosystems produces an enormous variety of NWFPs; they vary from forest type to forest type. Plantation forests tend to have lower biodiversity than natural forests. The tropical rain forest has the highest biodiversity among all types of forest.

Some argue that biodiversity is valuable because it is the raw materials of further evolution; or alternatively, it is the evolution of biodiversity which gives a value to what is essentially a random process. Biodiversity is seen as an important source of therapeutic drugs. One of the most frequently cited examples is that of rosy periwinkle, a tropical forest plant which yields an extract used for treating leukaemia (Lee, 1993).

Efforts to conserve and sustainably use bio-resources face enormous challenges. Population increases and the improvement of community welfare require more land and forests to be cleared for cultivation, for housing and for infrastructure. The effect of human activity on biodiversity depletion has been profound. Some estimates suggest the loss of as much as 90 percent of the genetic diversity of the biosphere that existed in human history (Vida, 1978).

In the past 25 years Indonesia has launched many efforts to conserve bio-resources in their natural habitats as well as in captivity. The objective of *in situ* conservation in Indonesia is to set aside 10 percent of representative habitats as nature reserves. Currently, there are 125.5 thousands sq.km (6.6 percent of terrestrial habitat) already under nature reserves. Including new planned nature reserve areas, 189.9 thousands sq.km (9.8 percent of terrestrial habitat) will become nature reserves within the next 5 years.

MAJOR ENVIRONMENTAL ISSUES

Anomaly of the Market Mechanism

The market mechanism is a regulatory instrument in the economy. The well-functioning market will manage resources efficiently. Abundant resources will command a lower price and no justification to be conserved and managed carefully. However, resources that are not part of anyone's environment or for whatever reasons remain outside the domain of markets cannot benefit from careful management and conservation that goes with increasing scarcity. Unfortunately, resources without a price lack a scarcity and value register and hence they are inevitably overused, wasted and degraded since their zero price communicates a message of abundance or economic insignificance.

Considering the economic theory and market function in efficient resource management, why is there the degradation of natural resources and environment in many parts of the world? One possible explanation is that natural resources have never been in the marketplace, but

have always been open-access resources (everybody's and nobody's property). The price of such resources communicates a message of abundance or economic insignificance.

Considerations of Sustainable Development

There are hundreds of definitions of sustainable development, ranging from a very conservative to very liberal. The most conservative one suggests that sustainable development is development with no damage to resources and the environment. A less conservative one suggests development to be with no damage whatsoever to the functioning of the natural ecosystem. A liberal one proposes that sustainable development is development without reduction of the future productive capacity of the economy, including possible substitution of natural resource depletion by new man-made resources.

Sustainable development seems to be related to specific products or benefits derived from specific resources and it means different things to different people with different interests. As a result of this ambiguity, many policy-makers consider the concept unworkable.

The definition of sustainable development referred to by most economists is: "development that does not result in reduction of future productive capacity of the economy depending on the stock of natural, human and man-made capitals, and technology". None of these stocks should diminish, but depletion of a particular stock may be compensated by repletion of others. Some limitation is imposed upon the above definition by the possible extent of compensation among stocks relating to irreversible loss of a particular characteristic of the stock, especially of natural and human capitals.

The Brundtland Commission defined sustainable development as "a process in which the exploitation of resources, the direction of investments, the orientation of technological development, and the institutional changes are all in harmony and enhance both current and future potential to meet human needs and aspirations. Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs and does not imply in any way encroachment upon national sovereignty."

Achievement of sustainable development involves cooperation within and across national boundaries. It implies incorporation of environmental concerns and considerations into development planning and policies and does not solely represent a new form of conditionality in financing the development (WCED, 1987).

Inherent in the concept of sustainability is continuity - perpetuating the flow of benefits from the resource stock and maintaining its productive potential. However, a definition based on maintaining or increasing the flow over time is difficult to justify because the rate of removal/utilization of the resources is influenced by the size of the resource stock. An example in relation to natural forests: a natural forest with plenty of over-mature trees will provide a large first harvest, followed by a lower, sustainable harvest.

Sustainability requires certain conditions, including: (1) only sustainable yield is extracted from renewable resources and their long-term productivity is maintained, (2) profits (rents) from depletion of non-renewable resources are invested in human and man-made capitals and technology, and (3) capacity of the environment to receive and assimilate waste is not exceeded or damaged. Sustainability is impossible without management. Hence, management is another requirement for sustainability.

Production capacity of resources is often the criteria used to determine sustainability. The problem here is that, the term *resource* is actually undefined. For example, a tropical forest is an entity that covers so many things; it is an ecosystem that consists of many components, living and non-living. Some have monetary value, some cannot be valued at all. To measure

its production capacity is to define its product. Using criteria of production capacity of a resource in terms of a specific product would justify a uniform development of the resource, such as agriculture estate crops and single species forest plantations. A common criteria of economic scales, however, fails to recognize the value of diversity in nature. Another condition of sustainability, then, is the availability of options for diversity in the decision making process.

Ecologically, sustainability is the continuous functioning of the ecological life-support system. Since an ecosystem has a certain tolerance limit, the measure of sustainability will vary from ecotype to ecotype, within a certain range. In nature conservation, for example, 10 percent or more of an undamaged ecotype is sufficient to protect biodiversity. About 30 percent of the land area under forest cover is considered sufficient to maintain/support the ecological functions of a watershed system. If this criteria is used, many areas in the world are already unsustainable, including parts of Western Europe and North America. Clearly, visual degradation of resource productivity is not always an indication of unsustainability.

Economically, sustainability is the continuous functioning and contribution of natural resources to support growth. The depletion of one resource results in the increase of productivity of the other resources. How much economic growth is needed by any community depends on the community's economic-cum-social value system. Economic measures will have to work within this value system. In the 1930s, depletion of natural forests in Western Europe and Northeastern USA was instrumental in developing high productivity of other resources (human resources, technology, man-made resources). This development was acceptable. Now, we hear that a degradation of tropical forest is not acceptable, even though this degradation of the forest has improved productivity of other resources (cattle ranches, estate crops, industries, real estate, human resources and technology, etc). Here is a paradox. Also, depletion of certain resources in the Third World, even though it enabled development of other resources in developed countries, did not result in continuous and sustained functioning of the ecosystem supporting worldwide development.

Without a clear definition (and criteria) of sustainability, it is impossible to identify the symptoms of unsustainable development. Clearly, the measure of sustainability is directly related to the value system of the community. Objectives of resources development must be determined by the community. Most importantly, the owner of the resource must have a dominant role in determining the objectives of resource development. So far, we have heard only the objectives defined by "international communities" for sustainability of natural resources, especially of tropical forests and genetic resources. We seldom hear about the objectives established by local, regional or national communities for sustainability of natural resources. Conflicting objectives among local, regional, national and international interests for a certain resources are very common. Clearly, every community has its own objective and value for a certain resource and, therefore, every community has its own measure of sustainability.

Economy, Ecology and Social Values

It seems clear that economy has to work within an ecological value system, and both have to work within the social value system defined by the community. For a community living in a desert, a condition without trees is acceptable, although it would like to have trees if possible. For the industrially and economically advanced community of the temperate "North", a condition without natural forest is acceptable, but it would like to keep the tropical forest intact in the "South".

Physically, evidence of unsustainability can be traced to the earth's ecological life-support system in relation to the human race. Increasing CO_2, ozone layer depletion, warming of the earth and toxication of the sea are important topics for discussion and have obtained political support. Regionally, it can be traced to the deterioration of the function of the ecosystem. The

problem is that the ecosystem boundary usually is not a country's boundary. Cooperation among countries worldwide is important.

Evidence of sustainability in the economic sense, such as apparent non-scarcity, results in wastage and consequent environmental degradation. But in an ecosystem there is no waste. Here, again, the concept of scarcity and abundance in economic terms is not a proper yardstick to be applied in ecology. The economy works on options, the art of making a good choice among many. Ecology relates to the entire integrated life-support system where everything is important in its own way.

All common evidences of unsustainability cited by many experts are either related to economic disutility of a resource or physical depletion and degradation of a natural resource. The capability of the ecosystem to recover after a certain time is not considered. It seems that the ability to recycle resources into development is an important consideration in analyzing the evidence of sustainability and unsustainability.

Although visual impression of resource degradation and fall in productivity are not always itself a good measure of unsustainable development, these can indicate the potential risk of slipping into unsustainable development. In many countries, increasing soil erosion and water pollution are considered as indicators of unsustainable development of land and water resources and the watershed ecosystem. Depletion of the land and water resources has so far not been accounted as a cost in systems of national accounts. Due to the assumption of abundance, no priorities on institutional development have ben set at the regional or national levels to deal with the problem of soil and water quality degradation.

The Case of NWFPs

Sustainability of NWFPs will certainly depend on the sustainability of the forests, and the interaction among natural systems, man-made production systems (technology) and social systems. Hence, it has become a more complex issue than just "optimal harvest" or "biodiversity conservation".

At the field level, however, we need to define sustainability in more practical terms. In the context of extractive reserves, the following issues are important: understanding optimal harvest rate and resource stock, effects of property rights on resources, and effects of increasing demand.

Optimal level of harvest and the corresponding stock of resources depend on environmental and economic objectives of the extractors. Many trees can produce a steady flow of exudates daily, and optimal production will depend on the health of the tree and the forest ecosystem. In the dry season, production of exudates is lower than in the rainy season.

Unlike wood products, non-wood products may be harvested from production forest, protected forest and nature reserves. From production forests, all material NWFPs may be harvested. From protected forests, some NWFPs, such as flower, fruits and animals, should be harvested with caution. In nature reserves, only non-consumptive uses, such as recreational activities, may be allowed; also some medicinal herbs may be harvested as cultivars. Any calculation of the total production of NWFPs will have to include all type of forestland uses other than production of wood.

In most countries, the objectives of forest management are related to the category of uses. In general, production forests produce timber, protected forests and nature reserves produce environmental services such as protection of the hydrological system and preservation of genetic resources and biodiversity.

In most cases, the production of environmental services has been the responsibility of national governments. But maintaining and sustaining the services requires investments; and someone must pay for the services. Therefore, the pricing of the services becomes crucial.

The considerable uncertainty over the potential value of genetic resources has been compounded by the emergence of new biotechnologies. Controversy surrounds genetic resource ownership and access. At the root of the current debates is the knowledge that genetic resources found in many developing countries are assets that, if managed properly, could make significant contributions to local and national economies. The potential value of genetic resources for developing countries is demonstrated by Costa Rica, where INBio has signed a contract with a pharmaceutical company in the United States to collect plant species and carry out primary screening for potential pharmaceutical and other uses. As part of this contract, Costa Rica will receive a 5 percent share of the revenues (a potentially enormous sum) of any commercial product that might eventually result.

Ecolabels

Increasing awareness of the world's environmental problems in the consuming countries has created a lot of pressure on most industries to seek more acceptable production and distribution processes. The main focus was originally on the major polluting industries. But, in due course, all the natural resource-based activities, particularly forestry and forest-based industries, have become the subject of increasing attention. Many in the consuming countries consider certification or "eco-labelling" for timber and NWFPs necessary to achieve sustainability of forest management and to assure consumers that they are not contributing to deforestation when buying tropical forest products.

A survey by MORI and WWF on public attitudes towards tropical rain forest revealed that: 33 percent would accept higher prices if it would guarantee that raw materials come from countries protecting the forests; 50 percent find that labelling of wood products very or fairly important; 15 percent would avoid buying or buy less tropical hardwoods for health, environment, moral and other reasons; 35 percent would be prepared to pay an average of 13 percent extra for sustainably produced timber. But the main factor in buying wood products is quality (for 66 percent), price (50 percent) and style of product (48 percent) (MORI and WWF, 1991; Simula, 1993).

In its early stage of development, eco-labelling was used to mark traded goods that conserve the environment, such as biodegradable bottles and electric bulbs. Some consider that eco-labelling of biodegradable forest products as a means to protect the forest resources is an irrelevant issue, and only a trade gimmick to protect the interests of forest industries in developed countries. Issue of eco-labelling has become a political football (Kay, 1993; MORI and WWF, 1991; Barbier, 1993; ITTO, 1992).

Currently, eco-labelling is being directed at forest management practices. Forest products from well managed forests are automatically eco-labelled. Several criteria of forest eco-labelling are being developed by institutions such as ITTO and Forest Stewardship Council (ITTO, 1992; FSC, undated). Considering the potential negative impacts of NWFP harvesting on the forest ecosystem and environment, a regulatory measure like eco-labelling is probably needed.

NEED FOR ENVIRONMENTALLY SOUND MANAGEMENT OF NWFPs

One of the most basic, and rarely questioned, assumptions underlying much of the current interest in extractive resources is that commercial exploitation of NWFPs has little or no ecological impact on the forest ecosystem. As NWFPs are harvested from the trees in the forests, many are of the opinion that NWFP harvesting does not have any impact on the environment as long as the trees are not cut. This assumption seems to have originated from

an inadequate interpretation of two simple observations: (1) local people have been harvesting fruits, nuts and latex from forests for thousands of years, and (2) a forest exploited for NWFPs, unlike a logged-over forest, maintains the appearance of being undisturbed. Of course, without appropriate explanation both could be incorrect and potentially very dangerous. Therefore, two qualifiers should be added to these observations. First, the intensity of subsistence harvesting as traditionally practised by forest people is usually substantially lower than that of commercial extraction. Second, the gradual extinction of a plant species which takes place over time is rarely a visible phenomenon. Collecting fruits and tapping latex are clearly less damaging than felling trees or building roads, but this certainly does not imply that the former activities are entirely benign from an ecological perspective. Every NWFP resource has a site specific, maximum sustainability level of harvest. If this harvest level is exceeded, the plant populations that are being exploited, as well as the faunal community that depend on them, will all be adversely effected.

Uncontrolled hunting and grazing in the forests and rangelands may result in the depletion of the animal population and soil fertility. Forests in South America and Africa are disappearing at a fast rate due to grazing activities (WRI-UNEP-UNDP, 1994). Even recreational activities may have a detrimental effect on the forest ecosystems, reducing the production of NWFPs in the long run.

Impacts of Harvests

The way NWFPs are harvested have contributed to much disturbance of the forests. For example, in many tropical countries it is a common practice to simply cut down forest trees to harvest fruits or barks. This practice is under no circumstances sustainable and it can have dramatic impact on the distribution and abundance of fruit or bark resources within a forest.

Managing forests for wood and non-wood product harvests requires a comprehensive scheme. A single-product harvest, whether wood or non-wood, will produce less compared to a balanced output of both, in terms of financial and ecological benefits. Although financially appealing perhaps, mass production of a single commodity will always have negative impacts on biodiversity and ecological processes. mass production will normally direct the development toward the establishment of plantations which have more negative impacts on the environment. For example, high resin production from pine plantations which use sulphuric acid will gradually destroy the trees and the ecosystem. Excessive hunting of tigers and panthers will create overpopulation of hogs which will destroy many tree seedlings.

Benefits of good management and costs of bad management of NWFPs have been acknowledged by many countries in terms of species loss, biodiversity loss and damage to the ecosystem.

In the Peruvian Amazon, for example, female trees of the dioecious aquaje palm (*Mauritia flexuosa*) are frequently felled by commercial fruit collectors. After very few of these harvest cuts, the forest is left with a preponderance of barren male palm trees; with time, the species disappears completely from the forest (Kahn, 1988; Vasquez and Gentry, 1989). Forests surrounding Iquitos, Peru, have no female palm trees left, and fruit collectors are now forced to travel upstream for up to three days to find unharvested palm stands.

There has been some accidental loss of diversity due to over-exploitation by those possessing more sophisticated technology but less ethology than hunter-gatherers. However the main loss of diversity has been due to deliberate forest ecosystem destruction (Ehrlich, 1985). There is growing concern over possible effects of pollution. Global warming could cause habitat destruction on a massive scale (Cohn, 1989).

Fruits and seeds left in the forest after harvesting will almost certainly be subjected to an unusually high level of consumption by animals of the forest. Commercial collectors, in effect,

are competitors with fruit-eating ground animals, and their activities reduce the total supply of food resources available to ground foraging animals. Decreased fruit densities could mean increased foraging and a corresponding increase in the overall percentage of fruits and seeds destroyed. As a consequence of the decreasing fruit and seed supply on the ground, the animal will migrate trying to find new foraging ground (Sutton *et al.*, 1983). This response could have a serious impact on seedling establishment for those species whose seeds require scarification by animals to germinate (Ng, 1983). Without a dispersal agent, a relatively high proportion of the fruits and seeds produced will fall directly under the crown of the parent tree where they are more easily gathered by collectors, more easily encountered by potential seed predators, and more susceptible to the effects of intraspecific competition (Augspurger, 1983; Clark and Clark, 1984; Howe *et al.* 1985; Schupp, 1988).

In addition to its impact on seedling establishment, population structure and the foraging behaviour of local animal populations, harvesting of fruits, nuts, and oilseeds in commercial quantities can also affect the genetic composition of the tree population being exploited (Peters, 1990). In this case, the important question is not so much how many fruits or seeds are harvested, but rather which ones. Tropical tree populations usually exhibit a high degree of genetic variability (Hamrick and Loveless, 1986; Bawa and Krugman, 1991).

For example, a single population of forest fruit trees will invariably contain individuals that produce fruits of intermediate size and quality, and a few individuals that produce fruits that are commercially inferior in terms of size, (bitter) taste, or (poor) appearance. If this population is subjected to intensive fruit collection, the "inferior" trees will be those whose fruits and seeds remain in the forest to regenerate. Over time, this will result in a population dominated by trees of marginal economic value.

ECONOMIC IMPLICATIONS AND LINKAGES

The world economy in a broad sense is an integral part of the earth's ecosystem, which creates the conditions that make life possible. The industrial revolution, which began around the year 1750, brought the first real change in the interaction between human activities and the ecosystem. "Control" over nature has paradoxically resulted in the actual destabilization of the ecosystem in many areas. Worldwide, the function of the ecosystem to support life is threatened by the human quest to improve material life.

The seriousness of biodiversity degradation was acknowledged in the United Nations Conference on Environmental Development, held in Rio de Janeiro, Brazil in 1992. But the expected actions to mitigate the causes have not been forthcoming. Many developed countries have blamed the economic recession for the inaction or inadequacy of measures for conservation of ecosystem and biological diversity.

Yet this ignores the fact that from an economic point of view, the ecosystem plays several important roles: as a production factor in production (especially in agriculture and fisheries), as a supplier of consumer services (e.g. health, nutrition, recreation, and aesthetic and spiritual needs), and as a source in technological progress. The last is perhaps the least known, but biological diversity, in particular, supports agricultural and pharmaceutical research with a vast gene bank in the form of potential fruits, crops and medicines.

In performing these economic functions, the ecosystem contributes to the human quest for prosperity, unbounded by national borders. For example, Brazil nuts (*Bertholletia excelsa*) have been exported mostly to European and Northern American countries. Sustainable harvesting of the nut depends, therefore, not only on the behaviour of the indigenous population of Brazil, but also of the world market. For sustainable harvesting, it is important that the product is not underpriced in the developed market countries and that consumer demand remains consistent.

Valuation of Goods and Services

Today, the production of non-timber goods and services has become an issue because the demand for these goods and services has increased, and is competing with timber for the use of lands. But timber has a more readily determined dollar value, while most of the other goods bring goodwill and often ample, but unquantified, satisfaction. Again, while timber and some recreational facilities are market priced, water, wildlife, and other recreational activities such as hunting and fishing are provided free or at a low token price. The outputs associated with preservation of endangered species or scenic beauty present difficult valuation problems. Opportunity costs can be estimated on different assumptions, but this still begs the question of what the spotted owl or scenic view is worth. The U.S. Forest Service in 1981-1982 estimated a total opportunity cost for spotted owls based on the value of timber left unutilized in the National Forests for their protection to be somewhere in the neighbourhood of US$ 3.6 billion dollars, or about US$ 500,000 per breeding pair.

The most politically appealing and economically attractive argument in favour of maintaining biodiversity is that it provides enormous direct economic benefits in the form of food, medicines, and industrial raw materials, and has the potential for generating many more (Ehrlich and Wilson, 1991; McNeely, 1988). Many countries earn substantial foreign exchanges from natural ecosystems with touristic values. Such direct economic values of biodiversity are, conceptually at least, rather easy to quantify and value, even though relevant scientific and economic data are lacking in all but a handful of examples (Braatz, 1992).

Besides direct contributions in terms of goods and services, the value of forests includes indirect contributions of soil conservation, carbon sink storage capacity, recreation and amenities, watershed stability, and the protection of biodiversity.

Ecoventures

Ecotourism represents an NWFPs with high potential economic value. Such tourism can generate support for conservation by:

- providing attractive financial return, it can justify setting aside large areas of forestlands for conservation;
- gate fees/entry fees that can generate substantial funds to support parks and reserves management;
- tourist expenditures in and around the parks (on lodging, transportation, goods, guides, and souvenirs) can be an important source of income for communities near protected areas and forests, compensating them for the loss of access to traditional resources and giving them incentive to conserve the protected areas.

The total benefits accrued from ecotourism have proven to be very significant sources of income for countries like Kenya, Nepal, Thailand, and Costa Rica (Braatz, 1992).

Economic benefits of ecotourism in some of Thailand's protected areas far exceeds the government's direct management expenditures. Tourist spending at Khao Yai National Park amounted to between US$ 3.8 to US$ 7.7 million per year during 1982-88. But this apparent economic benefit has been slow to persuade the government to establish adequate park management to ensure protection and sustainability (Dixon and Sherman, 1990).

Another potential ecoventure is the harnessing of the recreational value of forestlands. Recreation in the forest is generally free to the general public, although some fee may be imposed on game hunting, fishing and camping.

Buffer Zones

To meet local communities' traditional needs for NWFPs from the forest while preserving the forest, forest agencies have established buffer zones around forest areas. If properly managed, NWFPs can be harvested sustainably from the protected forestland by the local community and the forest can be saved from destruction.

In general, communities harvest NWFPs in small-scale operations using appropriate technology. Many communities possess substantial indigenous knowledge about the sites and the seasons for harvesting these products. The prospect of local benefits from primary processing of NWFPs provides an incentive for communities to manage the forest sustainably.

Local Environments and Market Niches

Many commercially important NWFPs can only grow in very particular kinds of natural habitat, within a narrow range of ecological conditions and micro climate. This often means that they cannot be systematically cultivated despite known demand in distant and local markets. For example, black mushrooms or morels are gathered almost exclusively in wooded areas of north-central Pakistan and traded internationally. There are many more examples of NWFPs produced locally by small-scale operations and simple technology that reach the world market (e.g. gum arabica, natural silk, honey, truffles, snails, berries, and traditional medicines).

INSTITUTIONAL CONSIDERATIONS IN SUSTAINABLE FOREST MANAGEMENT

Although the issues of forest resource depletion and degradation have been widely recognized by policy-makers in both developed and developing countries, improvements in instruments to address these problems are still in their infancy. Practical instruments for policy implementation (e.g. government regulations, market mechanism, an accepted social value system) have not developed sufficiently to mitigate resource degradation or resource depletion.

Policy and Institutions

In addition to the failure of market instruments mentioned earlier, poverty is another cause of unsustainable development. A poor community concentrates on meeting basic needs, and cannot afford to consider the future of the environment.

In many developing countries, natural resources have been used as the base for increased investment, especially in remote areas. Subsidies and fiscal incentives ? common tools for increasing investment ? create an impression of abundance and disincentives for managing the resources on a sustainable basis. The rationale behind such subsidies is that the short-term competitive advantage is more important than the long-term environment.

To translate sustainable development principles into practice requires knowledge of both the ecosystem and the economic and social behaviour of the parties involved. Interaction among ecology, economics and sociology would lead to harmonious development.

Even though sustainable development has often been interpreted as a dynamic interaction among the production system, natural system and social system, planners have tended to focus on the production system as an easy and practical way of planning economic development in the initial stages. The natural and social systems are assumed to be able to adjust to a changing production systems. This does not always happen. Most production systems are linked to the improvement of social welfare; they are linked to the natural system only to the extent that natural resources supply inputs to the production system.

Basic strategies in improving sustainable development, regionally, should:

- develop public awareness and community organisation to address environmental issues;
- improve capability in spatial planning with environmental objectives;
- develop human resources and improve capability in the area of environmental planning and management;
- improve knowledge and information on the regional ecosystems;
- develop institutions to integrate the production, natural, and social systems into development practices;
- establish appropriate procedures in national and regional accounting systems to take environmental costs into account.

Research Needs

Much research needs to be done to improve our understanding of the behaviour of ecosystems and social systems, material balance in production systems, and dynamic interaction of production-nature-social systems. Sustainable development in a global sense is an aggregation of development action at local and regional levels. Research is needed to measure the impacts and roles of regional actions in sustainable development, as a step toward assessing the global situation.

Productivity and biodiversity conservation are both part of sustainable management of tropical rain forests. Therefore, the ecological and economic aspects of these parameters should be incorporated as tools for management (Fantini *et al.*, 1992).

Because NWFPs are part of the forest ecosystem, each with a specific role in its functions, considerations relating to sustainable forest management are also applicable to non-wood forest resource management.

Because the viability of a management system under a sustained yield regime should foresee the multiple use of forests for both wood and non-wood products, the sustainable management of forest should be based upon two fundamentals: the cyclical character of exploitation and the specific nature of the exploitation of individual species.

As always, evaluation of the available stock of non-wood forest resources through an inventory is the starting point for a plan to adequately exploit the forest (see the paper by Reis). Projecting growth and yield of NWFPs may proceed using a correlation with biomass production over time. Certainly the correlation will differ with different ecotypes and

situations. Understanding ecological cycles is also important for balancing the harvest of NWFPs to maintain sustainability and harmony in forest composition and growth.

In many cases, increases in the sustainable supply of NWFPs will require more intensive management of the resource through domestication. Domestication of a species may weaken the species over time. Thus such production programmes should establish nature reserves with wild varieties of the domesticated species as a resource for genetic improvement.

Traditional knowledge about NWFPs on their production, utilisation, and maintenance should be understood, adapted, and incorporated into forest management schemes.

Conservation Strategy

The World Conservation Strategy outlines ways in which conservation objectives should be integrated into broader land-use plans in order to obtain more benefits and sustained yields from the world's natural renewable resources (IUCN, 1980; MacKinnon and MacKinnon, 1986). Since NWFPs are renewable natural resources, both the Conservation Strategy and Sustained Yield of NWFPs are linked together by relevant environmental considerations. Healthy forests with a high level of biodiversity are the objectives of Conservation Strategy. Similarly, the objective of non-wood forest resource management is to obtain sustainably high production, dependent on and consistent with the management of a healthy forest.

At the regional and local levels, sustainable development follows this sequence:

- Step 1. allocate space considering the capability of the ecosystem to function sustainably in producing specific products such as NWFPs;
- Step 2. improve the efficiency of the production system, including increased use of recycling technology;
- Step 3. employ "waste" treatment and reduction and "disutility" management of the forest resources, i.e rehabilitate degraded ecosystem through application of appropriate technology friendly to the environment.

In other words, site selection is the first step in sustainable management, and environmental considerations have to be the guiding principles in site selection. This is followed by selection of technology that increases efficiency and reduces the use of resource inputs. Considerations of environment as well as social suitability/acceptability are important in this regard. And the last step relates to disutility management to improve the capacity of the resource-base to withstand damage caused by developmental activities such as harvesting.

Spatial Planning

In the case of Indonesia, the great diversity of natural systems is linked directly to a high diversity of social systems. This diversity provides a large number of options for development. A primary consideration in selecting options for sustainable development, as part of spatial planning, is to preserve the existence of the natural system. Many countries have set aside some of their forestlands as protection and nature reserves. Indonesia has set aside 10 percent (19.5 million ha) of its terrestrial area for nature conservation; of this, 16.2 million ha have already been gazetted (Anon., 1991b).

The broader system of protected areas covers conservation areas (nature reserves, wildlife sanctuary, protection forests) and protected areas (such as aquifer recharge areas, coral reefs, mangroves, deep-peat forests, swamps, vulnerable natural forests and coastal zones, river banks and lake shores). Conservation areas are closed to any development activities except for those in support of their management, while protected areas are open to specifically approved development activities that will not cause damage to the function of the ecosystem.

Once a development area is demarcated, spatial planning requires that it be sub-divided into categories such as permanent agricultural lands, forests, urban settlements and industrial zones. The categorization is usually based on policy considerations and criteria.

Balancing Efficiency with Improved Resource Accounting

Reducing negative developmental impacts on the environment requires minimizing consumption and/or improving production through more efficient technology. Production efficiency is often motivated by the prospect of minimizing costs. Many operations reduce costs by externalizing many environmental costs. The result is degradation of the natural ecosystem. This improves a firm's profits but increases losses to the community and the ecosystem.

Introduction of "rent" for the use of natural resources such as forests, land and water is an effective means to counteract attempts to externalize natural resource costs. Rent on natural resources should be imposed consistently. At present, NWFP resources are drastically undervalued. Rent on land and water is still very low and does not yet represent the resource's real value in terms of benefits provided. Poverty alleviation is one of the factors that must be considered in fixing rent for lands and water.

Efficiency through Waste Reduction

Recycling technologies can improve efficiency of production systems (thus minimizing necessary resource extraction) and minimize wastes discharged into the environment. Pollution control regulations can foster use of recycling technologies. Waste treatment/utilization and waste management may still be needed to process the wastes before they can be discharged into the environment.

The Importance of Regional Development

Most national governments put the production system as its first priority in development, to produce materials and services and increase government revenue. In many developing countries, local governments are less equipped to manage sustainable development than the national government. They have very little knowledge about the environmental impacts of development, and lack information on sustainable development.

There is much research to be done to improve knowledge and understanding of the ecosystem and social system behaviour, material balance in production systems, behaviour and dynamic interaction of production-nature-social systems, and the impact and role of local and regional actions in sustainable development. Action for sustainable development takes place at the local and regional levels, and that is where attention to sustainability should be focused.

SUMMARY AND CONCLUSIONS

Sustainable forest management should include NWFPs in relation to the dynamic process of development and holistic ecosystem approach. Institutional systems, including policy and

market instruments, should be developed to mitigate unsustainability. Wherever the non-market economy supports traditional communities, it should receive policy consideration.

A basic problem in the sustainable development and utilization of NWFPs is that every region and country considers environmental costs as externalities. The benefits and costs of environmentally sound forestry and NWFP development need to be incorporated into accounting systems at the local, regional and national levels. Proper pricing of NWFPs in the market is important in this regard.

Commercial exploitation of non-wood forest resources, if not properly carried out, will have potential negative impacts on the sustainability of the forest and on the social and economic well-being of the local community. Sustainable management of forest resources to improve the ecological, economic and social quality of the forest will eventually improve the potential productivity of NWFPs.

In conclusion, the major issues which the participants may like to discuss would include, among others:

- advantages and disadvantages of alternative approaches to NWFP management;
- considerations in prospecting and developing of NWFP resources;
- environmental criteria and approaches to domestication;
- *in situ* and *ex situ* conservation of genetic resources for NWFPs;
- screening and patenting of life forms in the forest;
- links to national conservation policies and strategies and international conventions (e.g. CITES);
- management of transition of NWFP from subsistence to market economy;
- implication of emerging green consumerism as an opportunity as well as a danger to sustainable utilization of NWFPs;
- economic and environmental viability of eco-ventures;
- methods of quantifying environmental costs and benefits of NWFP utilization;
- specific aspects to be considered in environmental guidelines for NWFP utilization.

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