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Natural Forest Management and the Future of Tropical Forests

by

Nels Johnson, Bruce Cabarle and Dexter Mead

World Resources Institute
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PREFACE

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NJ, BC and DM

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I. Introduction

One of the principal challenges facing governments and donor agencies today is identifying the most productive investments in maintaining tropical forest resources. The sustainable production of timber from natural forest areas (often referred to as "natural forest management") is thought by some to be an important part of a strategy to maintain tropical moist forests. These proponents argue that forests managed for sustained timber production will also yield a number of environmental and nature conservation benefits. To others, natural forest management is often seen as a euphemism for deforestation. To many, however, an important question remains: Under what conditions is the sustainable production of timber from natural tropical forests possible? No issue is more controversial or central to the future of tropical moist forests.

The search for sustainability has grown in urgency as evidence of the vital importance of tropical forests to global climate patterns, local agricultural production, biological diversity and indigenous cultures mounts, while the forests steadily shrink. Thus far, the search for ways to sustainably manage large areas of natural tropical forest for timber production has met with very limited success. Although there is disagreement about why sustainability in tropical forest management has not been more widely practiced, the more important debate is about whether the gap between principle and practice in natural forest management can be closed – and if so, how.

Achieving a better consensus on this issue is particularly timely and urgent. Sustainability plays a central role in current discussions about the Tropical Forestry Action Plan, the International Tropical Timber Organization (ITTO), the G-7 interest in a global forest

convention, the 1992 U.N. Conference on Environment and Development, the World Bank's and InterAmerican Development Bank's new policies on forest sector lending, and is emerging as a issue in a number of other initiatives, such as the General Agreement on Tariffs and Trade (GATT). International support for these efforts will increasingly depend on how well the "sustainability issue" is addressed.

This paper focuses on issues surrounding the sustainable production of timber from tropical moist forest. There are several reasons for this focus. First, commercial logging is often cited as a leading direct cause of topical moist forest loss. And even where it is a minor contributor to overall forest destruction, logging frequently plays a pioneering role.[1] Second, tropical hardwood production from plantations and secondary forest areas remains very low,[2] meaning that for some time, unless demand is reduced and their other values are increased, natural forests will remain as the principal source of tropical hardwoods. Third, despite increases in research and forestry development assistance,[3] especially during the past decade, there is a consensus that only a minute fraction of the world's tropical moist forests is sustainably managed for the production of timber (Poore et al, 1989). Finally, while there is often little difference in objectives (i.e., maintaining tropical forest resources), those debating international responses to the deforestation crisis find few issues more controversial than the role of timber management in tropical moist forests.

This paper first examines the context for natural forest management in the humid tropics. It looks at the causes of deforestation, focusing on problems with present-day logging practices, and reviews the non-timber values of tropical moist forest. Next, the paper examines the concept of natural forest management: What is meant by "sustainable natural forest management" and why is it not more widely practiced? It closes by proposing

new approaches toward the sustainable use of tropical moist forests. These include comprehensive policy reform, redefining sustainable forest management, and moving to alternatives to the conventional timber concession system.

II. The Context for Natural Forest Management in the Age of Deforestation

With the advent of agriculture approximately 5,000 to 6,000 years ago, humans dramatically changed the ecological roles they had played for the previous 200,000 years of their existence. Almost overnight, they became powerful agents of ecological change, much of which has involved forests. During the relatively short history of agricultural society (and even briefer history of industrialization), the world's relatively undisturbed natural forests declined from an estimated 6.2 billion hectares to approximately 1.5 billion hectares (Worldwatch, 1991). Until recently, temperate forests suffered most, losing about a third of their area, and tropical moist forests – largely inaccessible – suffered least, declining only about 4 to 6 percent during this period. During the past fifty years, this relationship has reversed. Now, as much as half of the original tropical moist forest has disappeared, and about half of the remainder is degraded to some extent (FAO, 1988).

Although evidence suggests that some tropical moist forest areas supported large human populations in the past,[4] such areas have traditionally been some of the most inaccessible and least favored environments for human development. Since World War II, however, populations of landless poor in tropical countries have grown dramatically. Likewise, the attractions of small-scale mining, cash cropping and other economic activities have lured many others into the forest in search of a quick profit (Rietbergen, 1991). Consumer demands have grown just as dramatically in temperate countries for crops, wood

and other natural resources from the tropics. All have combined to cause dramatic deforestation rates in the tropics, often unprecedented in the experience of temperate countries.

In an increasing number of countries once extensively covered with tropical moist forest, there is now virtually no primary forest left (e.g. Bangladesh, El Salvador, Benin, Togo, Sierra Leone, Haiti, Peninsular Malaysia, and Sri Lanka). In others, including China, Viet Nam, Laos, Nigeria, Ghana, Cote d'Ivoire, Myanmar, and the Philippines, tropical moist forest has become so depleted that it will essentially disappear before the end of this decade (Goodland et al, 1990). Although data and estimates of remaining forest area are sketchy, the use of satellite imagery from a number of countries indicate that tropical deforestation rates worldwide increased during the past decade. Closed tropical forest loss is now estimated to range between 16 and 20 million hectares annually, at least 50% higher than estimated in 1980 by the UN Food and Agriculture Organization (WRI, 1990).

Because data on deforestation rates and the amount of remaining forest area is incomplete, it is difficult to make reliable predictions on how fast tropical moist forest areas will disappear. Nonetheless, if present trends continue, significant -- probably catastrophic -- declines in tropical forest extent and quality will take place in 30 years, especially in the more accessible lowland forests. In 1987, the World Commission on Environment and Development concluded that, given current deforestation rates and the expected growth in world population and economic activity, little virgin tropical moist forest would survive beyond the turn of the century outside of forest preserves, except in portions of the Congo Basin, western Amazonia, the Guianan tract of forest in northern South America, and New Guinea. Even these forest areas are not expected to last more than a few decades longer since their

export commodity value is likely to increase and pressures to cut or settle them are rising.

The causes of deforestation are many and complex. It is becoming increasingly clear that tropical deforestation is much less a matter of silviculture than public policy, economic pressures and social reality. The principally cited factors driving tropical forest destruction include the over-exploitation of forest resources to meet growing domestic demand for land and wood; commercial logging; weak institutional capacity of the government agencies mandated with forest stewardship; expansion of the agricultural frontier to accommodate landless poor; encroachment due to "boom-bust" initiatives in the agro-industrial, mining, irrigation, energy and transportation sectors (often supported by international development assistance); and the undermining of environmentally suitable, local community systems of resource management (WRI 1990-91; Goodland, 1990; Winterbottom, 1990; Schmidt, 1987; also see Appendix 1 for the underlying issues, direct causes and proposed responses to the deforestation crisis).

Deforestation and logging

Commercial logging may be a more significant factor in the loss of tropical moist forest than most data on tropical deforestation would indicate. A principal reason is that the most frequently cited estimates (e.g. Lanly, 1982; FAO, 1988) refer only to the complete removal of tree cover. Such estimates do not include the 4.4 million hectares of tropical forest that are logged annually without being totally cleared (Lanly, 1982), some of it severely damaged as a result. There is also difficulty in distinguishing the regional differences in causal factors behind forest loss (see WWF, 1989). Shifting cultivation is often very destructive in densely populated areas, such as the inner islands of Indonesia, but is usually much less significant

in sparsely populated areas where timber harvesting is concentrated such as Kalimantan or Irian Jaya. Moreover, clearing by shifting cultivation in these areas generally takes place in secondary forest (for review see Wilson, 1989). Such difficulties with data interpretation should lead to considerable caution in accepting claims that commercial logging is a minor contributor to the loss of natural tropical forest areas.

Logging practices today are typically resource "mining" operations leading to the irreversible depletion or eventual eradication of tropical forest. Frequently, commercial logging precedes the direct conversion of forest lands to other uses such as pasture or agriculture. The opening of logging trails often paves the road for these conversion practices. According to one source, 70 percent of annual clearance of closed tropical forest is in areas recently opened by logging operations (Lanly, 1982). The same source estimates that logged-over closed tropical forest areas are eight times more likely to be completely cleared than are undisturbed forest areas.

Even in the absence of conversion pressures, selective cutting practices, which are typical of most forestry operations in the tropics, can sow havoc in the forest. In many cases, logging operations utilize but a small fraction of the available timber, and damaging much of what remains. For example, in Northwest Ecuador, a typical logging operation may only harvest 17 cubic meters (m^3) from a total standing volume of 130 m^3 per hectare (Cabarle et al, 1989). While such operations may be intended to harvest only 10 to 20 percent of the standing trees, the damage usually affects much more than the trees that are actually cut. If carelessly applied, selective cutting results in the destruction or fatal injury of residual trees, especially intermediate size trees vital for the next harvest, and saplings important to subsequent harvests. Nutrient loss, severe soil erosion, soil compaction, and diminished

water retention cause ecological disturbances that impede or eliminate the remnant forest's ability to regenerate. In the Malaysian state of Sabah, between 45 and 75 percent of the unharvested trees were damaged or killed during logging operations (Bushbacher, 1990). In Brazil's eastern Amazonia, with only two percent of forest trees cut, over 50 percent of the remainder were destroyed or seriously damaged (Uhl and Kauffman, 1990).

Canopies opened by logging cause leaf litter and woody debris to dry-out and substantially increase their flammability. Fires escaped from nearby agricultural burning may spread into logged-over forest areas, and fires may actually burn into primary forest. Conflagrations of this nature have burned millions of hectares during the past decade, including 3.5 million hectares in East Kalimantan in 1982-1983, causing an estimated $5.5 billion loss in timber value alone. It is thought that logging in some parts of the Amazon has created the potential for fires of similar magnitude in Brazil (Uhl and Kauffmann, 1990).

Questionable practices in the timber industry

Why are commercial timber concessions so often linked with destructive logging operations and the mismanagement of forest resources? Some attribute this to the lack of effective policing and other regulatory controls over logging operations, unstable business climates, and market failures to provide incentives for sustainable practices. However, recent research has uncovered more fundamental -- and often ignored or censored -- problems which indicate that the tremendous political and economic forces which govern the timber concession process reward rampant graft, corruption and the abuse of executive privilege (WRI, 1991; Feedback, 1990; Barnett, 1989; Jackson, 1986).

In 1987-89, a Commission of Inquiry charged by the Prime Minister with investigating the timber industry of Papua New Guinea likened it to "rampage and pillage" and concluded that:

> "... the timber industry, by its very nature, is conducive to acts of a criminal nature and acts contrary to law and proper government administration." (Barnett, 1989)

The Commission found prevalent use of "front" companies to mask foreign control of large forest tracts, bribery, transfer pricing, undervaluation of export logs, misdeclaration of species, minimum profit shares accruing to forest land owners, and inadequate monitoring by forestry departments, tax collection agencies and the ombudsman office. Of the 20 major timber companies investigated by the Commission, all but one engaged in fraud and transfer pricing on a regular basis (Barnett, 1989).

Such problems with timber concessions are not unique to Papua New Guinea. For years, import records in Japan have shown considerably more hardwood volume coming from the Philippines than export records in that country indicate (Repetto and Gillis, 1988). In some years, the discrepancies have been in excess of 120%. Recent reviews by the World Bank and the World Resources Institute have identified other limitations with timber concessions in West and Central Africa, Southeast Asia, Brazil, China and the United States (Grut et al, 1990; Repetto and Gillis, 1988). Among the key constraints identified were below-cost timber sales, the undervaluation of the forest resources, low collection rates, windfall profits, inadequate monitoring and policing, inefficient processing (encouraged by log export bans), enormous wastage, short sighted concession lengths, conflicts with agricultural and other national development policies, as well as graft and corruption.

Logging bans and timber boycotts

How much tropical forest is impacted by commercial logging? Between 1981 and 1985, some 4.4 million hectares of undisturbed closed tropical forest were logged annually, mainly in Southeast Asia and South America (Lanly, 1982). It was estimated that approximately half of the productive closed forests in tropical Asia had been logged by 1985. Nearly 25 percent of Africa's forest lands have been logged-over. Latin America -- where only 10 percent of the exploitable forest has been logged -- may eventually become the world's major source of tropical hardwoods as sources diminish elsewhere (WRI/IIED, 1988). An international task force convened in 1985 concluded that only 10 of the world's 33 net tropical timber exporting countries will be able to export timber products by the year 2000 (see Box 1). In the case of Sarawak, Malaysia, current logging rates are expected to liquidate all productive forest within 11 years (ITTO, 1990). In the Philippines, once one of the world's leading exporters of tropical timber, the last of the productive dipterocarp forests will likely disappear during this decade (Johnson, 1989).

In the South, the rapid depletion of forest resources has provoked extreme measures from national governments. The Philippines banned logging in 64 of the country's 78 provinces. Thailand went a step further in 1989, banning all logging after exhausting 57 percent of its tropical moist forest and nearly 80 percent of its tropical dry forests (WRI, 1990; Roselle and Katelman, 1989). Local communities dependent on forest resources have also taken up arms to defend forests and their livelihoods against timber concenssionaires bent on depleting the forest of its valuable timber (see SAM, 1989). These concessionaires often have strong backing from national governments, despite the adverse impacts they can create for local communities (see Repetto, 1988).

In the North, proponents of rainforest conservation link tropical deforestation to the timber industry, and many now call for a moratorium on tropical timber imports to their countries. Among the driving forces identified as propelling rapid depletion of the world's tropical moist forests are the North's development assistance practices, ill-conceived international business ventures, consumer appetites for tropical timber and export crops, and international market forces. Signs are evident that governments in many Northern countries are heeding the conservationists' alarm: some 200 city councils in Germany have banned the use of tropical timbers and 51 percent of Dutch municipalities have followed suit. In the United States,[5] the State of Arizona shunned the use of tropical timbers in public construction projects (Anderson, 1989; Hamilton, 1990). Although such bans seem so far to have had little effect on the international tropical timber trade, they could have considerable impact. For instance, about 100 species of tropical timbers circulate in the US market, representing about 2 percent of all wood products sold and as much as US $2 billion in sales annually (Rainforest Alliance, 1989).

Some, however, believe that such measures could, in fact, have the opposite effect. They believe that the "mining" of tropical forests is but a manifestation of larger land-use decisions and market forces at play. Timber boycotts that effectively decrease the already undervalued forest resources will only make it more vulnerable to conversion to perceived higher valued uses, such as agriculture. Furthermore, they argue that boycotts may indeed harm fledgling forest conservation efforts where attempts at sustainable forest management are an integral part of a larger overall conservation strategy. In these cases, boycotts would effectively undermine forest conservation projects that use market forces on their behalf. Others counter that such arguments are valid only in cases where the forest will inevitably be lost to other uses (e.g. in areas with road access, swelling population densities and

landlessness). Creating higher value for timber products, however, is likely to increase pressures to provide logging access in previously inaccessible areas and thus risk creating the "use it or lose it" situation where newly accessible forests are overwhelmed by landless migrants or fragmented by other activities (Rietbergen, 1991).

Because of the inherent problems with an outright ban on tropical timber, there is a growing movement toward "green" labelling of "good" timber. Although such programs may differ in scope, they all aim to identify sources of sustainably produced tropical timber and reward the producers in the marketplace. Ideas for incentives range from establishing reliable markets for sustainable timber to restricting imports of non-sustainable timber. Today several small private organizations are evaluating sources on a case by case basis, using their own criteria to certify wood as sustainable, and relying on heightened consumer awareness to assist marketing.[6]

Many people agree, however, that in order for labelling to be effective, an international system of criteria, monitoring and control needs to be established. An independent entity would have to be established along with internationally accepted standards of sustainability. Skeptics argue that monitoring timber sources would require a tremendous amount of money and manpower, and point to the already widespread illegal invoicing practices. A movement against unsustainable logging practices would, therefore, give many producers more incentive to cheat. Country-based evaluations might be more easily administered, yet more difficult politically to instate. Advocates of labelling say that, despite the obstacles, it is essential that criteria for sustainable forest management are established and promoted through international trade agreements, such as ITTO and GATT, in order to reduce deforestation.

BOX 1: THE TROPICAL TIMBER TRADE

What percentage of tropical hardwood production is for exports, and where do they go?

In 1984, exports of hardwood products made up only 4 percent of the total hardwood extracted in developing countries. However, for the five largest tropical hardwood exporters, exports accounted for an average 19 percent of all hardwood extracted and over 60 percent of their industrial roundwood production (Nectoux and Kuroda, 1989). Slightly over 50 percent of all tropical log exports go to Japan, 31 percent to Asian countries including Korea, Taiwan, Singapore, and China while 14 percent goes to Europe. For sawnwood exports, 35 percent goes to Europe, 8 percent goes to Japan, 8 percent to Asia, and 7 percent to North America. For plywood, 23 percent goes to North America, 20 percent to Europe, 16 percent to Asia, and 18 percent to the Middle East (Nectoux and Dudley, 1987).

Where do hardwood exports come from and how has this changed over time?

The leading tropical hardwood exporting nations include in order, Malaysia, Indonesia, Cote d'Ivoire, Papua New Guinea, Philippines, and Gabon (FAO, 1988). While hardwood exports[1] from developing countries doubled between 1967 and 1977, over the past 12 years exports have been below levels reached in the late 1970's. During the past 20 years, the percentage of hardwood exports from developing countries has shrunk from 70 percent in 1967 to 54 percent in 1988 (see Figures 1 and 2). Africa, which has some of the higest deforestation rates in the world, has lost the biggest share (11%).

What percentage of world forest product trade value comes from developing countries?

In 1988, forest product exports were valued at US$85 billion worldwide. Of this just US$14.2, or about 17 percent, came from all of Africa, Asia, and Latin America (FAO, 1990). Furthermore, because this figure includes processing countries such as Japan, Singapore, and Taiwan, as well as major softwood exporters such as Brazil and Chile, this percentage is even less for hardwood extracting countries. Developing countries, however, do dominate the world hardwood timber trade contributing 63 percent of its US$8.6 billion in 1984 (Nectoux and Dudley, 1987). The value of tropical hardwood trade is now estimated to be about $7 billion. Recent FAO data (FAO, 1990) indicates that world hardwood exports totaled $15.4 billion in 1988 with $8.3 billion (54%) generated by developing countries.

What share of foreign earnings in developing countries come from forest products?

In some developing countries, the export value of forest products is a significant percentage of total export earnings. However, in most of these countries, the export value of forest products as a share of total export value has fallen since 1980. In the case of Cote d'Ivoire, the percentage fell 10 percent between 1980 and 1985, a period when the country lost an average 5.9 percent of its closed forest annually (IIED/WRI, 1986).

The future ...

Concerns about forest depletion have led many countries to restric log and sawnwood exports.[2] By encouraging value-added processing, these countries hope to maintain their export earnings while cutting down fewer trees. Unfortunately, the development of local processing capacity can outstrip the country's ability to supply it with wood, and a producing country can then become a net importer of logs – as has happened in the Philippines. Already 23 countries, many of which were hardwood exporters, now import forest products in excess of $200 million annually.

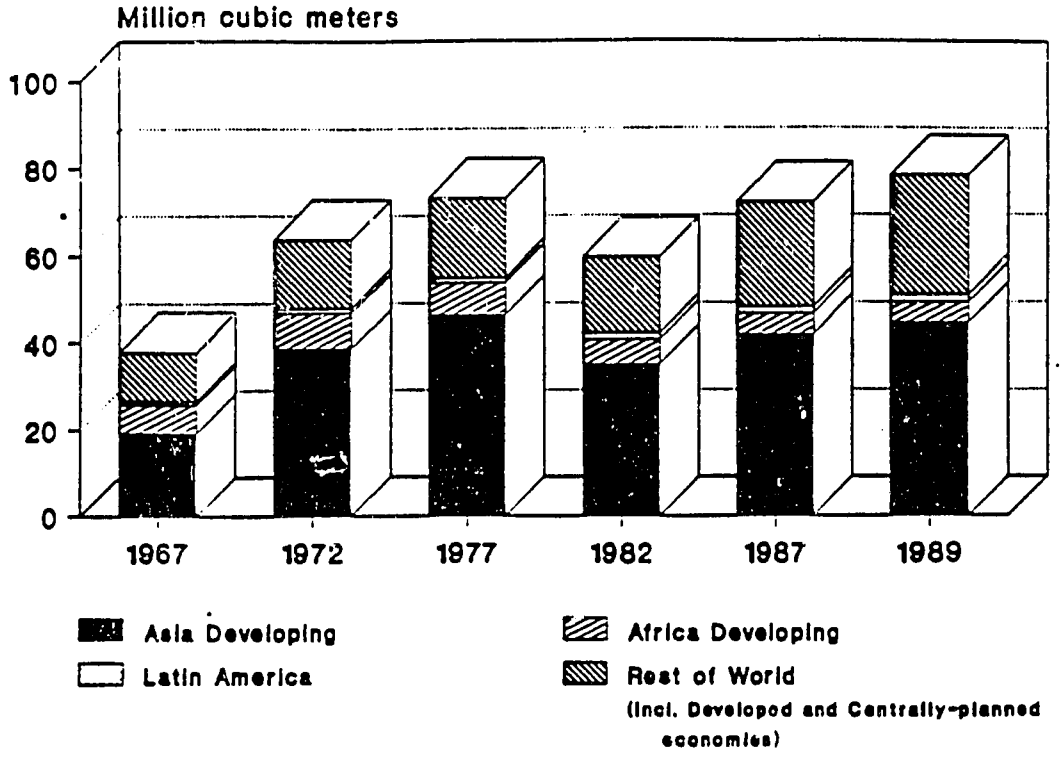
[1] Hardwood exports are defined here as exports of non-coniferous sawlogs, sawnwood and wood-based panels.

[2] Brazil, Indonesia, Peninsular Malaysia, and the Philippines have banned log exports and have restrictions on sawnwood exports. Many West African countries also have log export restrictions.

figure 1

Hardwood Exports

(non-coniferous sawlogs & sawnwood, and wood-based panels)

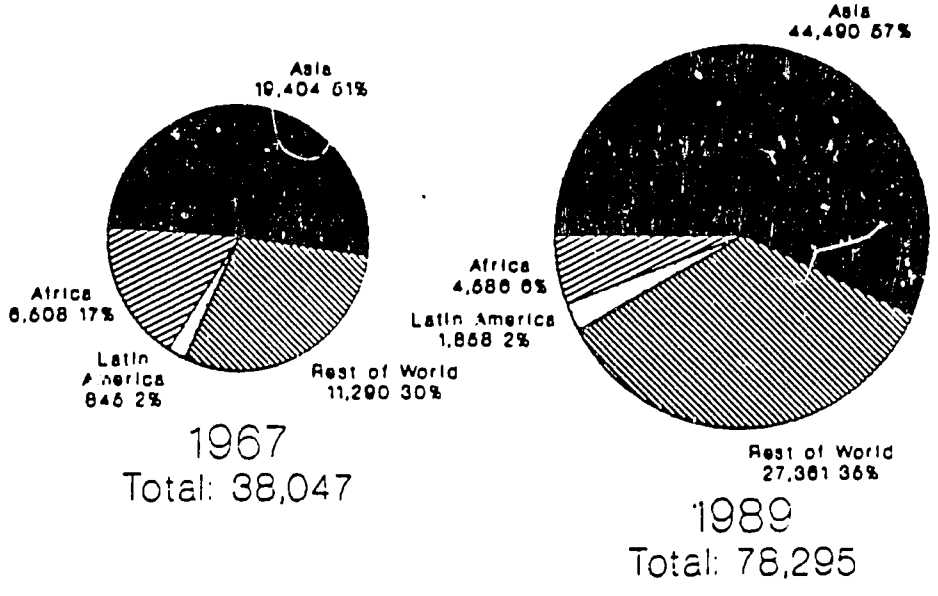


Source: FAO State of Food & Agriculture and Forest Products Yearbooks

figure 2

Hardwood Exports

Million cubic meters



Source: FAO (see Figure 1)

More than just timber

Increased attention to the effects of international timber trade practices on tropical forest resources, and the search for ways to catalyze a transition to less destructive ways of supplying tropical hardwood demands, have grown dramatically during the last five years. Much of this attention is a reflection of the growing international awareness of the non-timber values of tropical moist forest areas.

Although tropical moist forests cover only 7 percent of the earth's land surface, they contain at least half – and possibly as much as 90 percent – of the world's species (Reid and Miller, 1989). With such exceptional species richness, rainforest ecosystems lie at the heart of the world's biological diversity. Critical contributions to modern health, agriculture and industry come from just a few of the millions of species from tropical forest habitats. For example, the cross-counter value of plant-derived pharmaceutical products amounts to some US $20 billion a year[7] (Myers, 1984). Forest losses now occurring in the tropics may extinguish between 5 to 15 percent of the world's species during the next thirty years (Reid and Miller, 1989).

The loss of tropical moist forest affects people as well. Upwards of five hundred million people are believed to live in or be directly dependent on tropical forest resources. As many as two hundred million indigenous peoples have resided in and around tropical moist forest for generations. Many possess local knowledge bases well-suited to sustainably managing natural resources in the absence of rapid, externally driven social change (Lynch, 1990). These people most directly feel the consequences of tropical deforestation. Despite

their large numbers, the presence, rights and potentials of indigenous and migrant forest residents are often ignored by governments and donors in the planning and management of many forest areas. In some cases, this has provoked extreme measures by forest dwellers to defend their territorial rights in Brazil's Amazon Basin and the Sarawak forests of Malaysia.[8]

Although they are often overlooked, non-timber forest products and other wild products gathered from forest lands are also of great economic importance in many tropical countries. A few of these products – rattan, for example, – are traded internationally, but most have large domestic markets or are traded with neighboring countries. Examples include gums, game, essential oils, honey, rope, medicines, fruit and meat. Exports of these commodities have grown steadily during the past decade, and most countries have just begun to tap markets, foreign and domestic, for these products. In Indonesia, the share of non-wood forest products has grown from less than 3 percent of total forest export value in 1973 to more than 15 percent by the mid-1980's (Repetto and Gillis, 1988). In India, it is estimated that one-half of all forest revenues come from the sale of non-timber forest products, and more than 70 percent of all forest export value comes from these commodities.

Tropical moist forests also provide invaluable ecosystem services to society as a whole, including the retention of soil and nutrients, perennial water supplies, and the moderation of runoff during peak flows in the wet season. The rapidly changing scale and nature of human impacts on tropical moist forest threatens ecological services. Too often the value of these services is not realized until after they have been greatly diminished or forfeited by deforestation. Around the world, tropical deforestation is directly linked to severe flooding, sedimentation, water shortages, decreased hydroelectric production, landslides, and the

diminishment of productivity in coastal ecosystems including mangrove forests and coral reefs (see World Bank, 1989 for examples in the Philippines).

Finally, the loss of tropical moist forests may have impacts on climate that are felt by people thousands of miles from the tropics. Tropical deforestation is estimated to contribute 20 percent of all carbon dioxide emissions from human sources -- a distant second to the burning of fossil fuels (WRI, 1990). To the extent that increased levels of atmospheric carbon may contribute to global warming, tropical deforestation plays a significant role. Tropical deforestation also has significant effects on local and regional climate, and is associated with declines in rainfall, increased surface temperatures, and the alteration of local hydrology (Salati and Vose, 1983). The loss of remaining large areas of tropical moist forest (e.g., in Amazonia, or the Congo Basin) could have significant impacts on global climate patterns.

Nevertheless, a variety of forest management options are available that will, hopefully, allow tropical moist forests to persist well into the 21st Century and beyond. These include:

- the effective designation and management of national parks and protected areas;
- turning over the control of "public forest" to local institutions and communities through the creation of extractive reserves and other socially appropriate legal designations;
- the application of agroforestry, reforestation, and forest plantations in deforested areas;
- and the sustainable management of tropical moist forest for timber and other products.

Undoubtedly, the continued existence of tropical moist forest will require applying such options to a greater degree than is today the case. The question is, what is the appropriate

balance between these different kinds and intensities of forest land use? What follows is an examination of one of these management approaches – natural forest management.

III. Natural Forest Management

Foresters generally define "natural forest management" as the controlled and regulated harvesting of timber species in natural forests, combined with the use of various silvicultural and protective measures to sustain or increase the commercial value of subsequent forest stands (Schmidt, 1987). Typically, this involves selective cutting, but clear-felling in narrow strips is also done (see Hartshorn, 1990). Natural regeneration is essential to natural forest management. In the case of timber production, sustainability demands that harvests, averaged over time, must not exceed the forest's regeneration rate. In addition, no irreversible loss of soil, soil fertility, or genetic potential of the harvested species should occur. Some, however, strongly imply that natural forest management means management for multiple use (see for example, Poore et al, 1989), even if much of the focus is on timber.[9]

But where did the concept of sustainable management of tropical moist forest come from? Professional foresters from colonial powers have been tinkering with timber production in tropical forests for as long as 130 years (Poore et al, 1989); and several variations of natural forest management have apparently approached sustainable production levels. Based on this experience, the common assumption behind forest development projects has been that, yes, sustainable natural forest management in the tropics is possible. The forestry literature is replete with case studies and technical articles on how to practice selection, shelterwood, and strip cutting methods that promote natural regeneration in tropical moist

forests and, by extension, sustainable forestry.

Nevertheless, even the most experienced tropical foresters admit that good examples are hard to find (see for example, Budowski, 1988; Wyatt-Smith, 1987; Wadsworth, 1983). Indeed, recent estimates show that only a minute fraction of the world's tropical forests are actually being managed sustainably for timber production (Poore et al, 1989). When compared to earlier efforts – such as teak forest management in Burma until the 1950's or the Malaysian Uniform System in the 1960's and early 1970's – the evidence indicates that the amount of sustainably managed tropical forest is actually declining. Today, the gap between principle and practice in natural forest management has never been wider over the vast majority of tropical forest lands.

Many believe that timber management has its place in conserving the world's remaining tropical forests. However, they advocate that the emphasis on timber production focus on tree plantations, rehabilitating degraded forests, and the management of secondary forests (i.e. forests which have regenerated after major disturbances). These sources of tropical timber would deflect demand from natural forests and protect the immense non-timber values that can be found only in relatively undisturbed tropical forests. Goodland, et al (1990) urge that this transition take place as rapidly as possible with support from development agencies. The urgency attached to such a transition stems in large part from a skepticism that truly sustainable natural forest management can be widely practiced any time soon, if ever.

Many tropical foresters, however, are reluctant to concede that the wider practice of sustainable natural forest management is not possible. They believe that the sustainable management of productive tropical forests is both technically feasible and economically viable

(Schmidt, 1987; Hutchinson, 1989). To some, the transition most needed is one toward the sustainable management of forests for high-value timber production. Without such a transition, they believe that little will remain of productive tropical moist forest outside of national parks and protected areas (Poore et al, 1989). Implicit in this view is a skepticism that the transition to plantations and secondary forest management can replace the reliance on tropical moist forest for timber any time soon (see Box 2 for discussion on alternative sources of tropical hardwoods). As stated by Schmidt (1987):

> "Plantations yield great benefits but cannot replace the functions of current natural forest areas. Thus plantation and natural forest management are not competitive but complementary."

BOX 2: ALTERNATIVE TROPICAL HARDWOOD SUPPLIES

The development of plantations, secondary forest management, and the rehabilitation of degraded forest areas are often promoted as alternatives to logging in largely intact or primary tropical forest areas. Undoubtedly, the development of such alternatives will be part of the solution to slowing and reversing the loss of primary tropical moist forest. The transition to providing significant tropical hardwood supplies from these alternatives will take considerable research, political commitment, investment and time. Such transitions, however, will be productive investments if the non-timber values of primary tropical forest (e.g., biodiversity, climate regulation, watershed protection, non-timber forest products, and cultural diversity) are adequately recognized. Investments in developing these alternatives should, however, recognize the importance of local participation in, and benefits from, these efforts. Also important to the development of plantations and the restoration of degraded forest lands is the role of biotic diversity. Inadequate consideration of these issues has contributed to the limited success of tropical hardwood plantations and reforestation in degraded forest lands.

Although there are as many as 18 million hectares worldwide in tropical forest plantations, the vast majority have been developed for the production of softwoods and eucalyptus (FAO, 1988). As a result, plantations have had little effect in reducing pressure on natural tropical moist forests which are valued as sources of hardwoods. The plantation models which dominate most investments are characterized by large-scale monoculture plantations of industrial wood. These are often intensive operations to produce pulpwood and sawn-wood for distant markets, and fuelwood and poles for local markets. This has frequently meant that large tracts of land have been condemned to biotic impoverishment and provide little benefit to local residents. In tropical moist forest areas (e.g., in peninsular Malaysia), plantation development has often meant the conversion of natural forests to cash crop plantations of oil palm, rubber and other commodities for international markets.

Tropical hardwood plantations in deforested or degraded forest areas could reduce pressures on natural tropical moist forest. Unfortunately, tropical hardwood species are notoriously difficult to grow under the current plantation paradigms of large-scale, monocultural (or perhaps two or three species) plantings of fast-growing, highly productive trees. There are several notable exceptions including teak (Tectonia grandis), laurel (Cordia alliodora), and some dipterocarps (Shorea spp). Tropical hardwood plantations are limited because *most* hardwood species have very narrow environmental requirements that have evolved in highly competitive, polyspecific niches found only in natural forests. Most hardwood trees are late successional species which depend on complex ecological and environmental relationships which cannot be replicated in large open environments with a very simplified ecological structure – leaving them open to insect infestations, deprived of vital soil microbial relationships, and inadequate moisture supplies. With the exception of a limited number of hardwood species, the traditional plantation model is likely to provide limited alternative supplies of tropical hardwoods.

A more promising alternative may be to invest in the management of secondary forests – those forests which have regenerated after logging or outright clearing. Secondary forests account for approximately 36% of all productive closed tropical forest (FAO, 1988). While primary closed tropical forest shrinks at an annual rate of more than 32,000 km2, the area occupied by secondary forest expands at more than half that rate (Wadsworth, 1987). Nevertheless, secondary forests are virtually ignored by forest management efforts in the tropics. According to Wadsworth (1987) the overlooked secondary forests have forestry management advantages over both primary forest and plantations. These forests are more accessible, and are closer to markets and local work forces than primary forests. Compared to plantations, secondary forests contain species adapted to their environment, are more effective at conserving soil, water, and biological diversity, and are more apt to complement rather than compete with agriculture, since they do not need to be situated on the best sites (Wadsworth, 1987). Finally, secondary forest management involves less initial cost and risk than plantations.

continued

BOX 2 - CONTINUED

Rehabilitation of deforested and severely degraded forest lands presents another alternative to timber harvesting in primary forests. In tropical Asia alone, more than 54 million hectares of previously logged forest may be suitable candidates for rehabilitation (WRI, 1988). In Brazil's Amazon Basin, more than ten million hectares of humid tropical forest have been converted to pasture, most of it abandoned within five to ten years (WRI, 1990). Rehabilitation may require little more than protecting degraded forest areas from agricultural clearing, grazing, fire and log poaching. In other situations, active steps may catalyze natural forest succession processes. In the Philippines, restoration efforts in cogon grasslands (Imperata spp.) once forested have shown that severely degraded forests can be largely restored in both productivity and diversity with relatively simple and inexpensive techniques (Jensen and Pfeifer, 1989). Similar efforts in Brazil have also demonstrated the potential for restoring forest productivity in abandoned pastures under certain conditions (Uhl et al, 1990).

The potential for any of these alternatives to replace primary forests as a source of tropical hardwoods is not well researched. As increased attention is directed toward these alternatives, however, it is important that role of local peoples be carefully assessed. Degraded forest lands, secondary forests, and areas targeted for plantation development are frequently called home by many people. If they are not seen as part of the solution in the development of these alternatives, they may very well be a decisive factor in the failure of such efforts.

The search for sustainability

Two common viewpoints among these divergent camps are that natural forest management for sustainable timber production is technically feasible, and that it may have been practiced in very limited areas. According to many foresters (and some conservationists), the obstacles to natural forest management deserve greater attention by development assistance agencies. Many conservationists (and some foresters) argue that these obstacles are too ingrained and beyond the influence of development assistance. What follows is an examination of what those obstacles are, some of the potential solutions, and the tough policy decisions they pose to governments and development assistance agencies if tropical moist forests are to remain a part of our future. Many of these observations stem from forest management case studies presented at a recent WRI colloquium on sustainability in natural forest management and an examination of a representative selection of the forestry literature (see Appendices 2 and 3).[10]

Sustainability

The forestry literature often defines sustainability as the production of a continuous yield of marketable timber. This typically involves reliance on natural regeneration, execution of silvicultural practices to favor the desired species, and protection of the productive capacity of the forest. In some cases, the definition of sustainability is broadened to include general forest products. Explicit reference is rarely made to environmental services, biological diversity unrelated to timber production, or the forest's ability to meet local needs other than employment or wood products. However, in Quintana Roo's "ejidos" forest management project, chicle (latex) production is an integral management objective in addition to timber production.[11] In Peru, one of the major objectives of the Palcazu natural forest management project is to maintain the Yanesha cultural traditions and livelihoods.

Poore et al (1989) indicates that timber sustainability in forest management is quite likely to conflict with other forest values such as biological diversity and some ecosystem services. As they point out:

> "Indeed it is questionable whether one universal definition of "sustainable management" is useful, because it will lend itself to different interpretations by different interests. To avoid misunderstanding it is essential to be very clear which kind of "sustainability" we are talking about in each instance."

Jonsson and Lindgren (1990) are explicit in this regard stating that natural forests, with all their diversity, cannot be completely protected within the framework of commercial forestry -- a view also expressed by a number of speakers at the WRI colloquium.

Evidence of Sustainability

The forestry literature comes closest to offering evidence of sustainability by citing "abundant" or "successful" natural regeneration after the first harvest, and in a few instances after a second harvest. Similar evidence was presented by all the forest managers at the WRI Colloquium on Sustainability in Natural Forest Management. Several noted that, other than evidence of natural regeneration after silvicultural treatments, it is not yet possible to judge sustainability. Some cases, however, provide impressive evidence for regeneration -- in particular Palcazu, where stripcuts showed abundant regeneration of a wide diversity of species. Goodland et al (1990) state that, while this may allow foresters to predict how productive a second rotation of trees might be, true evidence of sustainability can not be seen until after the third cut, at a minimum. Some of the forestry literature recognizes this limitation. For example, Poore et al (1989) states that:

> "It is not yet possible to demonstrate conclusively that any natural tropical forest anywhere has been successfully managed for the sustained production of timber."

Poore et al (1989) and others, however, suggest that such "proof" is nearly impossible to meet and not useful in the search for management techniques that would improve on the current "mining" of tropical forest resources. Sustainability defined in terms of the continuous yield of timber alone is problematic. The first cut in a primary forest will always offer the highest yield due to perhaps hundreds of years of biomass accumulation (Rietbergen, 1991). Susequent cutting rotations will allow less biomass accumulation and less timber yield making strict adherence to absolute sustainability difficult, if not impossible, to meet. As such, timber yields may be an unfair litmus test for sustainable management for natural tropical forests.

The more important issue is its effectiveness as a strategy for conserving tropical forests.[12] Supporters of forest management in Queensland suggest that the system was better than outright forest clearance regardless of whether strict sustainability was achieved, as it provided some income and maintained important ecological functions.

In nearly all of the overview literature on natural forest management, those cases advanced as coming closest to "successful" sustainable management have been interrupted by land conversion, over-exploitation, or institutional and economic instability before conclusive evidence was available. Agricultural clearing and timber poaching have intervened in natural forest management practices at the Carton de Colombia concession before clear evidence of sustainability had been gathered. Sustainable forest practices were cut short in Malaysia by large scale conversion of forest to oil palm and rubber plantations. In the case of the Yapo forest in Cote d'Ivoire, agricultural encroachment threatens to interfere with efforts to document sustainability. In some cases, forestry authors attribute sustainability solely to the existence of a management plan based on the principles of sustained yield. In most of these cases, however, departures from the management plan have occurred before it has been possible to gather data on the effectiveness of their methodology.

Benefits

Beyond sustainable timber production (and in some cases, non-forest products), few authors explicitly address the equitable distribution of other social and economic benefits of natural forest management. Where other benefits have been cited, they come mainly from studies of community-based forestry projects, and include items such as local employment, equitable economic gain and the recognition of land and resource rights for indigenous

communities (Kiernan et al, 1990; Hartshorn, 1990; Bruenig and Poker, 1989). In both community forest management cases presented at the WRI colloquium (WRI, 1991), Quintana Roo in Mexico and Palcazu in Peru, the equitable distribution of social and economic benefits to comunity members is an important management objective. In these projects, secure land or resources tenure is one of the main benefits, in addition to increased community income from a variety of forest products. Yanesha forestry cooperative members view the strengthening of their community's cultural, economic and resource interests as one of the project's major benefits.

Constraints

The forestry literature is almost ubiquitous in suggesting that the main constraints to sustainable natural forest management are economic, social, and institutional issues rather than technical or silvicultural problems. There are, however, examples of sustainability failing on technical grounds due to the complexity of tropical moist forests and the variations among them. Systems developed in one area have failed in other areas because of different ecological and silvicultural conditions which were not considered when the methodology was transferred. For example, the Malaysian Uniform System seemed to be successful on fertile lowland flat soil, but did not work well when applied to steep hillside areas (Wyatt-Smith, 1987). The Malaysian Selective Management System is now used in steep hillside areas, but has transferability problems as well. According to information presented at the WRI colloquium, silvicultural systems are too often applied on a blanket basis due to the lack of adequate data, or the failure to interpret available data. The ability to adapt management plans to new information or changing conditions remains one of the major uncertainties to sustainable management in the Quintana Roo project. Most authors agree that flexibility in

forest management is critical to achieving success. It is very difficult to apply one system developed for one area to another without careful consideration of the ecological and social characteristics of the new area.

Economic constraints are most frequently cited as obstacles to sustainable natural forest management. Pressures to over-exploit natural forests result from a complicated web of economic interactions. Undervaluation of forest resources is often cited as an underlying problem which leads to the wasteful use of forest resources and the lack of both public and private investment to maintain them. Market interventions[13] to restrict exports and stimulate domestic industries can artificially depress domestic timber prices and send the wrong economic signals, thus accelerating the depletion of forest stocks. Such conditions can create unstable markets for tropical timber and frequently lead to over-exploitation as forest managers depart from the relatively low production of sound natural forest management practices in order to maintain profitability. In Malaysia, experience with both the Malaysian Uniform and Selective Management Systems indicates that external economic forces frequently prompt local managers to accept shorter cutting cycles than those called for by the appropriate silvicultural system.

In addition, markets do not recognize the difference between timber that is produced sustainably or non-sustainably. Non-sustainably produced timber is more cheaply produced,[14] vastly more prevalent, and helps to set prices that are marginal or too low for the recovery of investment in sustainable production practices. Also implicated are limited markets for lesser known timber species, which means that logging operations typically ignore harvest damage to trees with limited or no market value.[15] When this happens, the resulting ecological disturbances prevent or severely limit natural regeneration, including that of

valuable timber species. The limited market for lesser known timber species limits the economic viability of the Yanesha Forestry Cooperative project in Peru, and may present problems for the Quintana Roo ejidos project as well. It is thought that wider marketability for more species would make promising natural forest management efforts such as Palcazu much more attractive financial investments -- and eliminate or lessen the need for start-up subsidies. However, the development of lesser known species also runs the risk of stimulating the same short term, rent seeking behavior that characterizes timber mining operations for valuable tropical hardwoods (Rietbergen, 1991).

Closely linked, and to some extent inseparable from economic constraints, are institutional constraints. Several of these constraints serve to undermine long-term forest security and investment. First, there is the lack of strong national land-use policies which protect forest areas from conversion and incompatible development. In some countries, national development policies actually promote the conversion of tropical moist forest to other uses. Although many countries with tropical moist forest have national forest policies, most of these are concerned only with timber production, and few are implemented effectively -- if at all. Even where forest laws are strongly concerned with local communities and non-timber forest products, such as in some African countries, they are often not enforced (Rietbergen, 1991). Moreover, very rarely are the forest policies integrated into an overall national land-use policy (Wyatt-Smith, 1987). Due to the lack of designated permanent forest estates and the indiscriminate conversion of forest lands, there is little long-term security for timber concessionaires, a prerequisite for successful sustainable management.[16] Promising natural forest management practices in Colombia's Carton de Colombia concession have been curtailed by overwhelming encroachment pressures which have undermined concession security.

Furthermore, even if the area is designated as a permanent forest estate -- and it is effectively enforced -- concessionaires still have little incentive to invest in sustainability because logging concessions are almost universally shorter than forest rotation periods[17] (Smithsonian Institution, 1988). The common practice of awarding logging concessions on a political basis also works against sustainability (ITTO/HIID, 1988), as concessionaires push toward making a quick profit before the government changes hands and they consequently lose their logging privileges. The end result in all these cases is that forests will be exploited for short-term gain with no regard for sustainability, leaving behind a badly damaged or destroyed resource. On the other hand, there is evidence to suggest that long-term concessions alone are insufficient -- long term concessions in colonial West Africa did not lead to sustainable management (Repetto and Gillis, 1988).

Another impediment to long-term investment is the low stumpage fees charged to concessionaires. Most governments undervalue their forest resources by not accounting for their replacement costs, non-timber products and environmental services (ITTO/HIID, 1989). The little forest revenue the government does collect is not enough to recoup management costs (Smithsonian, 1988). Additionally, such low rents charged to the concessionaire provide little incentive to invest in efficiency or sustainable harvesting practices (Repetto and Gillis, 1988).

There are also institutional constraints concerning the actual implementation of management plans. The complexity of tropical moist forests demands flexible management plans, based on extensive research, careful control, and thorough monitoring and evaluation. Even if a sound management plan is developed, limited financial and well-trained human resources can hinder its implementation. It is very difficult to adequately train and supervise

personnel to carry out the complicated instructions required to manage tropical moist forest. As Wyatt-Smith (1987) points out:

> "Individual workers are to a great extent on their own and have to assess and take action on each situation as it presents itself."

Lack of training and control inevitably leads to poor execution of the management plan, including reharvesting too soon, inadequate selection of the trees to be harvested, undue logging damage, and over-cutting. The lack of appropriately trained foresters and loggers is cited by some familiar with the Yapo Forest management project as a key constraint to the wider practice of more sustainable timber management in Cote d'Ivoire. In Quintana Roo, those involved with the ejidos natural forest management project believe that a lack of technical personnel and training opportunities are potential constraints to achieving sustainable forest management. Although the strip shelterwood silvicultural system used in the Palcazu project is quite technical, its initial success has demonstrated that it is possible for local peoples to manage a system at all levels. The Yanesha communities involved in the Palcazu project were integrated into all phases of the project, from designing the management plan to harvesting, processing, and ultimately marketing. So far the project appears to be achieving its ecological, economic, and social goals -- and by implication, sustainability.

Another widespread institutional constraint is the inadequate representation of indigenous peoples in forming forest policy (ITTO/HIID, 1988). The implementation of such policies frequently endangers the livelihood, rights and culture of the people living in and around the forest.[18] If left out of the plan, they can also work against it by illegally clearing or occupying newly cut-over areas. Kiernan et al (1990) argue that:

"Resolving local political disputes and carefully distributing the benefits arising from forest management often override the importance of purely technical considerations."

Indeed, social pressures for forest conversion and occupation of cut-over sites are another key constraint to sustainable forestry. High population growth coupled with inequitable distribution of productive agricultural lands in many tropical countries means that there are more people who need food and jobs on the lands least able to sustain them. Pressures which push people into the forest are complicated by other factors (mineral extraction, commodity agriculture, etc.) which pull the not-so-poor into forests. In some areas, particularly in parts of Africa, this may be the larger problem (Rietbergen, 1991). As population pressures increase on dwindling forest resources, sustained forest yield will become ever-more difficult. Lands identified as suitable for sustainable management in Africa and Malaysia have already been converted to agriculture (Goodland et al, 1990). In South America, there is the recurring problem of landless farmers spontaneously moving into forest lands which have been opened up by logging roads (Schmidt, 1987). In addition, squatters and shifting cultivators – spurred by larger economic and social forces frequently beyond their control – often illegally harvest the forest to make money and/or feed their families. Elements of social pressure can be alleviated within the forest sector through better control over forest lands, involving locals in forest planning, and assuring that the benefits are fairly distributed; however, the basis of this problem must be solved outside the forest sector.

Prospects

Despite the extensive constraints to successful sustainable natural forest management, most foresters conclude that it is possible (see Wyatt-Smith, 1987; Schmidt, 1987; Poore et

al, 1989; and ITTO/HIID, 1988). These prospects are usually qualified with the need for strict planning and control, as well as major policy and institutional changes. Those more skeptical of the prospects for widespread sustainable natural forest management (Goodland et al, 1990; and Keto et al, 1990) do not dismiss its possibility, but believe the obstacles to -- and previous experience with -- natural forest management provide little basis for optimism.

Recommendations for the wider practice of sustainable natural forest management are extensive and diverse. Several forestry literature authors give technical recommendations despite their statements that the major problems are non-technical. Generally, they call for the formulation and dissemination of guidelines on cost-effective and environmentally sound logging practices along with training programs developed to help practitioners follow the guidelines (see Jonsson and Lindgren, 1990). Supported by silvicultural data collection and analysis, these guidelines should then be fashioned into site-specific working plans[19]. These plans need to be closely monitored and controlled, and updated when necessary. One still needs to be cautious with this approach; recent experience in Australia has shown that even the application of strict and careful guidelines can lead to controversy over sustainable natural forest management.

While nearly all tropical forest observers agree that the major constraints to natural forest management are economic, social and institutional problems, recommendations targeted at these issues are often general in nature. Wyatt-Smith (1987) and others suggest that natural forest management projects designed to promote the welfare and participation of local peoples are most likely to overcome the many problems historically associated with natural forest management. Two keys to enabling forest communities to practice sustainable natural forest management are the securing of native land rights and developing market acceptance

for a wider variety of timber species. These elements seem to have played a major role in the initial successes of the Yanesha Forestry Cooperative and Quintana Roo ejidos.

Others stress the need for political commitment at the highest levels leading to stronger legislation and land-use planning, complemented with more effective technical training (Schmidt, 1987; Poore et al, 1988; Aidara, 1991). This commitment must be long term, providing land tenure for communities and concession security for commercial interests. Many believe that specific measures need be taken to create market recognition of sustainably produced timber, and therefore increase the price for such products. At the same time, governments should capture more rent from stumpage fees. This money can then be reinvested in forest research, management, and supervision.

Finally, there are those who recommend that natural forest management in primary forest areas should be replaced by a transition to plantation and secondary forest management (see Goodland et al, 1990; Keto et al, 1990). Secondary forests near population centers often provide critical environmental services to large numbers of people, yet they may be more vulnerable to complete destruction than remote primary forests (Rietbergen, 1991). Until such a transition takes place on a large scale, it is recommended that any timber management in natural forest areas take place in the least environmentally sensitive areas, and using the most selective and least-damaging extraction technologies available.

IV. TRANSITIONS TO SUSTAINABILITY

Despite increased recognition in recent years of the need for sustainable practices in tropical forest management, tropical forests continue to disappear at the rate of millions of

hectares per year. Unsustainable forest uses are but a manifestation of larger socio-economic ills driving deforestation in many tropical countries today. One result is that logging operations in many countries are unrelated to sound forestry practices -- and totally out of control. Evidence presented during a recent WRI colloquium on sustainability in the management of natural tropical forests outlined wide-scale abuses throughout the forest industry, the tendency to treat forests as "windfalls" to be quickly converted into cash, and exaggerated government claims to ownership of public forest estates in the face of declining budgets and incapable institutions. Given this status quo, it appears that conventional concession systems and sustainable forest use are mutually exclusive in most cases. Radically new approaches are needed to manage human interactions with the world's diminishing tropical forests.

New paradigms for the sustainable use of tropical moist forest areas will need to address a number of key issues. Incentives that reward poor land-use stewardship, and the wasteful use of forest resources must be eliminated. Comprehensive and effective land-use planning must be in place. The concept of sustainable forest management must be redefined in terms of maintaining vital ecological functions, and alternatives to the conventional timber concession system -- based on this new definition -- must be instated. In many areas, community-based management systems may be the most effective way to sustain tropical forests.

To move toward these new approaches to using natural forest resources, governments and donor agencies must concentrate on building the capacity to design and implement sustainable forest practices at national and local levels. This will require a retrospective analysis by governments and donors, and a shift in their traditional approaches to forestry

projects, and development in general. Moreover, the sustainable use of tropical moist forests will require a tremendous amount of change and committment, both North and South.

1. Comprehensive policy reform and land-use planning

A critical first step in the transition to sustainability is the elimination of credits, subsidies, trade barriers and other incentives that reward poor land stewardship. Natural forest management alone cannot save tropical moist forest areas and the many values associated with them. The successful implementation of sustainable forest management depends upon the necessary "preconditions" -- secure land tenure, sound agricultural development, capable institutions, etc. This will require a full fledged shift in national economies from resource "mining" to development models which do not deplete natural resource stocks. Internal and external market forces driving the polical economy of tropical deforestation -- credits, subsidies, trade barriers and other incentives -- should be subjected to scrutiny, and reforms put in place to create the preconditions for sustainable land use.

Through reforming forest policies, governments can serve two primary goals: to encourage the sustainable use of their natural resources and to improve their financial returns. Deficient charges on concession holders have increased pressures from companies and individuals seeking concessions ("rent-seeking syndrome"), a tendency for high-grading, enormous windfall profits, and lost government revenue. These charges should be increased and restructured to adequately value forest resources (see #3 below). Furthermore, the value of non-timber forest resources (and sustainable practices for their harvest) should not be ignored by governments and donor agencies. As their value becomes better understood, governments will be less willing to forego the income they can generate.

Land use planning in and surrounding forest areas – and its effective implementation - - are essential if critical biodiversity, ecological services, and long standing human cultural relationships are to be maintained. Emphasis should be placed on improving sustainable agricultural practices, developing alternative ways to meet fuelwood demand, and avoiding the construction of roads and other infrastructure which may directly or indirectly lead to forest destruction. Land use planning within the forest should avoid placing industrial timber operations in biological diversity "hotspots," on steep slopes, or in areas claimed by local peoples.

2. *Redefining sustainable forest management*

Humans are often preoccupied with the "management" of forests (or biodiversity or rangelands, etc.) for valued resources and services, rather than with the management of their own uses and interactions with the resource. This emphasis leads to the manipulation of complex natural systems we only partially understand. Too often, there is a belief that the "problem" is with the forest that does not produce enough of what we want rather than viewing the problem as our own unrealistic and inefficient demands for what the natural forest can provide. No doubt some of the complexities of finding sustainable ways to interact with forest resources are compounded by this human arrogance toward natural systems. Successful natural forest management will depend on defining the types and intensities of human interactions with forest resources that can be accomodated by the self-regulating ecological processes that maintain natural forests. This suggests that the identification and understanding of what these processes are will be vital to defining sustainable human uses of forest resources.

Natural forests maintain themselves through efficient self-regulatory ecological processes – nutrient cycling, conservation of water, biotic interactions for pollination and seed dispersal, and successional processes following disturbances are but a few. Natural forests are the most efficient providers of a range of goods and services that humans value, from certain types of wood, non-timber forest products and biodiversity to water, soil retention and climate regulation. They can produce many of these things much more efficiently than we can – if we could find alternative ways to produce them at all. The key to the sustainability of natural forests is to find ways to manage our demands for forest resources within the forest's ability to produce them.

Although other uses (i.e., harvesting non-timber forest products) can lead to forest degradation, timber harvesting carries greater potential for interfering with the forest's ability to maintain itself. Recently, several attempts have been made to develop new frameworks to monitor sustainability in connection with forest management activities, including timber harvesting (see for example, Box 3). In 1990, ITTO supported the development of draft guidelines for the sustainable management of natural tropical forests. These efforts represent modest advances in identifying some of the elements and steps needed to sustainably use natural forests.

Sustainable natural tropical forest management should be defined as managing human uses of natural forest areas at levels compatible with the maintenance of ecological processes upon which the forest's perpetuation depends – and ensuring that such uses respect the needs of people whose livelihoods depend on the forest. While our knowledge of the

ecological processes that maintain tropical forests is limited in most places, the protection of the following processes are a start:

- protect natural regeneration of important successional and dominant tree species through the broad retention of biotic diversity with special attention to pollinators and seed dispersers, as well as maintenance of suitable micro-climates for regeneration;
- protect nutrient cycles through retention of available mineral nutrients, organic soil materials and micro-organisms;
- protect the forest from catastrophic disturbances to which it is not adapted -- in most cases this will include fire, in other situations it may include large canopy openings and large edges that result in blow-downs, altered microclimate, etc.;
- and protect contiguous natural forest areas from conversion and/or maintain habitat corridors with nearest large similar forest habitat.

This definition differs with conventional definitions of sustainable natural forest management in several important ways. First, it does not equate sustainability with continuous timber yield, which is only one variable of forest sustainability. Under the definition proposed here, timber yields might vary considerably from one measurement to the next -- so long as those ecological functions are sustained upon which timber yields, amongst many other things, depend. Moreover, monitoring the health of ecological processes that underlie forest productivity are likely to be better predictors of future timber yield than periodic measures of current timber yield. This definition implicitly includes a wide variety of human uses from timber and non-timber forest products to a range of ecological services. Finally, this definition shifts the emphasis from managing natural forests with active human intervention to better demand management for the products we can obtain only from natural tropical forests. This philosophical shift could have very practical implications for the way we view and interact with natural forests -- but is certainly insufficient in itself.

3. *Redefining the timber concession*

Concessions should not be defined as contracts limited to the extraction of timber, but as a trust between government and the private sector to manage a forest area for a variety of goods and services, including timber. Concessionaires should be responsible for maintaining vital ecological services including water regimes, soil quality and retention, wildlife, and ensure that non-timber forest products are maintained. Levels of timber harvest should be determined by monitoring these ecological indicators, rather than simply calculating the allowable cut of timber. This is an area that will require investments by governments and donors, and more importantly, a commitment to exploring concession alternatives.

The royalty system that provides concessionaires with huge windfall profits while wastefully using forest resources needs to be restructured. Many economists advocate bidding systems to replace prevalent current practices of concession allocation which are too often politically influenced -- although such reforms could raise serious equity questions for communities and local companies unable to compete with highly capitalized bidders. Such a system will require better forest inventories so participants can estimate the value of forest tracts. Other ways to promote less wasteful utilization of the forest is to employ higher area license fees and *ad valorem* royalties rather than undifferentiated royalties. Care must be taken that such systems do not reward inefficient ultilization by producers, and that adequate funds return for reinvestment in forest management.

The official issuance of the concession should be contingent upon the submission of a forest management plan, developed by the chosen concessionaire, in accordance with national guidelines based on international principles (e.g. see ITTO guidelines for sustainable

management of natural forests). Given the difficulty with achieving absolute sustainability, national guidelines should be based upon the "best practices," such as those discussed in Jonsson and Lindgren (1990) and Poore et al (1989). These standards could, with modifications, also apply to the community-based options discussed below (see #4).
It is important that new research be directed to the development of better silvicultural practices which protect diverse natural regeneration in tropical moist forests.

Guideline compliance should be periodically reviewed over the life of the concession, and provide the basis for concession continuance or cancellation. However, such rules and regulations will mean little in the continued absence of institutional capacity at the local level for monitoring and enforcement of the guidelines. Initial investments in forest sector projects should start with a focus on establishing these guidelines and capacities. This is a critical area for donor support.

4. A place for community-based management systems

The clearest alternatives to the conventional timber concession system are community-based forest management systems. Most of the promising new initiatives (and many of the longstanding traditional systems) in natural forest management are community-based and controlled. The advantages of community control can include better policing and monitoring of local forest resources, and more equitable distribution of benefits. Local communities, especially those which are forest-dependent, may be more committed to the principles of sustainability and more resilient in the face of fluctuating markets, political change and social pressures.

Nevertheless, there can be serious problems; communities are often ill-equipped politically, financially, and technically to manage large forest areas. Land claims of forest peoples are often unrecognized by governments and outsiders. Donor institutions are often ill-equipped to support the long term investment (but often smaller overall investment) in developing local capacity. Investors and development agencies often favor highly technical and capital intensive forest operations, which are frequently beyond the capacity (or interest) of local communities.

In areas where there are forest-dependent peoples, there should be an emphasis on transfering the control of forest resources to local communities. These efforts will be more successful where local institutions have a tradition of working together, and/or managing common property resources. Early efforts should focus on strengthening existing community institutions, and developing coordinating mechanisms for project planning, implementation, monitoring, and evaluation. If community management is to be effective, land claims by forest peoples must be recognized. The responsibilities of different groups which have a stake in the outcome of forest management must be clearly defined. Donor support should serve to catalyze government and community cooperation in developing a policy framework that is effective at resolving conflicts between competing interests.

5. Developing alternatives to primary forests for tropical hardwood supplies

Plantations, forest rehabilitation, and the management of secondary forests all hold promise for providing sources of tropical hardwoods that can substitute for some of the supply (eventually, perhaps most of the supply) that now comes from primary forest. Each of these alternatives has its own distinctive advantages and limitations (see Box 2).

Successful plantation development has been limited to a handful of tropical hardwood species, and many valued hardwoods are unlikely ever to be good candidates for plantations. Forest restoration is in its infancy as a discipline; it will take a long period before hardwoods are ready for harvest. Secondary forest management holds the greatest short-term potential for supplying hardwoods. In many countries with little or no primary forest left, these are the only domestic hardwood sources available. With primary forests shrinking elsewhere, these alternatives deserve much greater scrutiny by governments and donors -- both to protect remaining primary forests, and to develop stable, sustainable forest sectors.

6. Looking inward: the donor agencies

Donor agencies committed to the goal of sustainable conservation and development of tropical moist forests should re-assess their own staffing, program procedures and funding priorities in line with this goal. This may require the suspension of funding for non-forest sector projects or programs that promote poor land use practices and/or deforestation. The role of donor country policies regarding debt, trade and other bilaterial affairs should be critically reviewed -- and reformed where necessary -- for their impact on forest resources. This will require a shift from the conventional project approach often employed by donor agencies to a landscape approach aimed at building a policy framework for better land stewardship. Development assistance should be "package deals," focused in and around a specific forest area. These packages need to include support for secure land tenure, sustainable agricultural practices, better market terms for local products, non-agricultural rural enterprises, and rehabilitation of degraded lands.

7. *A North-South Pact on the future of tropical forests*

Controversies over the prospects for the wider practice of sustainable natural forest management are likely to persist into the near future. In the meantime, the forests will continue to disappear at unprecedented rates. Natural forest management, if successful, may play a greater role in slowing runaway deforestation. The gloomy history of natural forest managment in tropical moist forest, however, suggests that this option be approached with considerable caution. The necessary preconditions to effectively implement sustainable timber management in tropical moist forest do not exist in most places today. Creating those preconditions will take a tremendous amount of institutional change, policy reform, and, less importantly, increased investment. This effort needs to take place in all sectors which impact tropical moist forest (forest, agriculture, energy and transportation).

The Tropical Forest Action Plan (TFAP) has been the major international effort to link develop assistance with actions to slow deforestation. There is wide agreement, however, that the TFAP has been too narrowly focused on forestry sector projects, poorly implemented, and has not accomplished many of its original objectives. Future international efforts will have to simultaneously develop policies in tropical countries that will dramatically slow deforestation, while industrial countries reform trade policies (including timber), development assistance, and their handling of developing country debt issues.

Proposals for new international initiatives to slow deforestation have been offered in in a number of fora during the past year -- such as the preparatory meetings for the UN Conference on Environment Development, and in ongoing discussions about the future or replacement of TFAP. The recommendations of the Environmental and Energy Study Institute

Task Force on "Partnership for Sustainable Development" (EESI, 1991) provide a vision of what a North-South pact on the future of the world's tropical forests should look like:

"The central mechanisms for controlling tropical deforestation would be national forest stabilization plans drawn up by tropical forest countries themselves and a new consortium of industrial countries and multilateral agencies committed to providing major support through a process of country-by-country discussions. A national plan would specify what actions the country would take both inside and outside the forest sector to halt the loss of primary forests and address the underlying forces leading to deforestation."

".....Depending on the needs of the particular country, the negotiated package of financial and other support could include phased debt reduction as the plan is implemented; increased support for developing country exports; new concessional financing; incentives for private investment; access to needed technologies; and support for raising agricultural productivity, carrying out land reform and promoting agroforestry."

"Each national plan would specify targets for the preservation and sustainable management of forests covering a period of ten years or longer, leading to the goals of 'no net loss' of forest cover and minimization of primary forest loss.....These national plans would differ from those drawn up in connection with TFAP. They would be based on broad public participation, including that of NGOs. They would feature realistic targets for halting deforestation and would focus on all key national and international policies bearing on forest loss. The understandings arrived at between tropical countries and the donor consortium would provide an impressive range of economic and other support for the duration of the agreement, and not just financing of forest sector projects. In each case, continuation of support would depend on successful implementation of the plan."

Finally, sustainability is a critical issue in the use of forests everywhere, not just in the tropics. Therefore, all countries should support the principle that all the world's forests -- tropical, temperate and boreal -- be sustainably managed. The credibility of the United States, Canada, and others who support such efforts will depend on the treatment of their own forest resources -- resources that are also too often used unsustainably.

BOX 3: ELEMENTS OF SUSTAINABILITY

Although the term "sustainability" is widely used among those who are concerned with TMF, there still exists great ambiguity in its meaning. In large part, this is due to the very complexity of natural forest management. Recent efforts to define sustainability have divided it into a number of factors which may each be assessed separately, although it is recognized that the performance of some factors may be closely linked to the performance of others. Following are two different lists of "elements of sustainability."

PCEFP[1]

Forest management plan shall describe how it will satisfy these elements. Plan deemed to be unsustainable until proven otherwise.

Forest practices must:

1. Maintain and/or restore aesthetics, vitality, structure, and functioning of natural processes
2. Maintain and/or restore water quality and quantity (including habitat)
3. Maintain and/or restore soil fertility, productivity & stability
4. Maintain and/or restore balance and diversity of native species
5. Encourage natural regeneration of native species
6. Not use artificial fertilizers or pesticides
7. Provide local employment and community stability (especially respect workers' rights)
8. Protect archeological, cultural and historic sites
9. Be appropriate in size, scale, time frame, technology and monitoring
10. Not log in ancient forests until further research on ramifications is completed.

TARGET 1995[2]

Each element should be assessed to determine how sustainably managed a particular area of forest is.

1. Protected areas (are they extensive & effectively protected?)
2. Tree species (how difficult are they to manage?)
3. Soil & water conservation
4. Concession management/training (what is the capacity?)
5. Replanting & regeneration (what provisions are there?)
6. Forest management/conservation plans (are they detailed and coherent?)
7. General policy framework (what are concession policies, restrictions, export controls, taxes, etc?)
8. Economic circumstances (do they lead to wasteful use?)
9. Biological diversity (is area of particular importance?)
10. Indigenous/local people (do what extent are their needs met?)

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[1] Pacific Certified Ecological Forest Products. 1991. Criteria for PCEFP Wood. Draft.

[2] Hewett, J, S. Rietbergen and D. Baldock. 1991. Target 1995: Problems and Perspectives Relating to the Import of Sustainably Produced Tropical Timber Into the Netherlands. Institute for European Environmental Policy, London.

ENDNOTES

1. see Winterbottom, 1990; Repetto, 1988; Westoby, 1987; and Lanly, 1982.

2. Out of a total tropical hardwood production of 144 million m^3/year (1978-82 average), only 18 million m^3/year came from plantations. The other 126 million m^3/year came from natural forests (Lanly, 1982).

3. While official development assistance in forestry has doubled from 1980 at $ 500 million to over $ 1 billion a year in 1985, forestry research allocations remained constant in real terms at about 5 per cent of total Forestry Sector ODA (see "A Global Research Strategy for Tropical Forestry," a report of the international Task Force on Forestry Research. 1988).

4. For example, recent research shows that the Yucatan Peninsula and the Northwest Amazon Basin supported larger populations in pre-Hispanic times than today's present day societies (see research from Gomez Pampa).

5. Similar public bans are being considered by the cities of San Francisco and Baltimore. A bill prohibiting the state purchase of tropical timber was drafted in March 1990 by the Massachusetts Congress.

6. Very few sustainable sources have yet been identified. The Ecological Trading Company (1989) and The Rainforest Alliance's "Smart Wood" program (1991) each only list two certified sources.

7. Very little, if any, of this value is returned to the TMF areas for conservation or management purposes. The lack of willingness on part of the pharmaceutical industry to pay for TMF conservation and grant intellectual property rights and just compensation to local inhabitants who pcssess knowlegde of medicinal plants, is a growing North-South debate (Reid, 1991; Rietbergen, 1991) Nonetheless, it is interesting to note that the worldwide tropical hardwood trade itself only generates about US $7 billion a year of business.

8. Perhaps the most notable forest peoples' movement is that of Chicho Mendes Filho and the Brazilian rubber tappers (see Amnesty International, "Amnesty International Brazil Briefing," background paper, Washington, DC, September 1989). In March 1987, thousands of Penan, Kayan and other indigenous communities set up over 25 road blocks in Sarawak, Malaysia to stop violations of their customary rights and forest livelihoods from commercial logging operations (see Sahabat Alam Malaysia/World Rainforest Movement, "The Battle for Sarawak's Forest," Malaysia:Jutaprint, 1989). Under the auspices of the World Rainforest Movement, forest dependent peoples worldwide are joining together in a unified response to the tropical forest crisis through "A Forest Peoples Charter" (see "Towards a Forests Peoples Charter," Interim Report on Progress by Marcus Colchester, World Rainforest Movement, England, 6 September 1990).

9. At a recent conference, WRI Colloquium on Sustainability in Natural Tropical Forest Management (held in Washington, D.C. March 21-22, 1991), several experienced tropical foresters argued that natural forest management, largely defined in terms of timber production, is much too restrictive. A much broader definition should be used,

and applied in practice.

10. Many of these observations stem from forest management case studies presented at a recent WRI colloquium and a brief examination of the forestry literature. The six cases studies include Carton de Colombia (Colombia), Quintana Roo Ejidos (Mexico), Palcazu (Peru), Malaysian Uniform System, Queensland (Australia), and Yapo Forest (Cote d'Ivoire). The literature includes a dozen publications on natural forest management in the tropics: Bruenig and Poker, 1989; Goodland et al, 1990; Hartshorn, 1990; ITTO/HIID, 1988; Jonsson and Lindgren, 1990; Keto et al, 1990; Kiernan et al, 1990; Poore et al, 1989; Schmidt, 1987; Smithsonian, 1988; Wyatt-Smith, 1987, and; Vanclay, 1991. Please turn to Appendix 2 for more information on the literature sources, and see WRI (1991) for more information on colloquium.

11. Individuals can earn more than $3,000 during the rainy season through chicle tapping.

12. Mark Dillenbeck (IUCN/US), 1991. personal communication.

13. A few examples of such measures include tax incentives, credit subsidies, tariffs, quantitative restrictions on exports or imports, embargoes or outright boycotts, licensing or other customs and administrative requirements, pricing regulations and specialized treatment (such as "favored nation" status). These issues are treated extensively in Repetto (1988).

14. This is true in the short run. However, several studies have showen that destructive logging practices are, indeed, less profitable, given the costs of equipment maintenance and repairs, rapeated skid trail construction and entrances into the same stand, due to careless planning and haphazard implementation (see Jonsson and Lindgren, 1990).

15. HIID (1988) provides an in-depth treatment of this issue.

16. Even where designated forests estates do exist, government claims to vast areas of forest lands often outstrip its institutional capacity to manage such areas (see Barber, 1991 for further treatment of this issue).

17. Many argue that its unlikely that lengthening of concession periods will motivate better forest management practices. The long term nature of private investments in forest production will still prove very risky due to the extreme political and economic uncertainty in many tropical countries (Dillenbeck (IUCN/US), 1991. personal communication).

18. See SAM (1989), WRM (1990) and Cort (1991) for further treatment of these issues.

19. Case studies presented on Quintana Roo and Malaysia have demonstrated some of the problems which arise when lack of data leads to the application of an inappropriate silvicultural system.

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Appendix 1. Major Underlying Causes of Deforestation and Proposed Responses (from Winterbottom, 1990)

UNDERLYING ISSUES AND CAUSES	DIRECT CAUSES OF DEFORESTATION	PROPOSED RESPONSES
Poor policies and incentives. Debt burden; macro-economic and trade inequities. Consumer demand in developed countries. Need for foreign exchange.	Subsidies, tax breaks, fiscal policies and legislation which promote deforestation. Destructive commercial logging. Lack of forest management, poor regeneration and low rates of reforestation.	Policy and institutional reform. Elimination of inefficient and destructive subsidies, tax breaks, etc. Incentives and support for improved forest management and improved forest utilization. Increased forestry research. High-yield plantations.
Climate change and drought	Overexploitation of forests, woodlands, and farm trees for fuelwood, poles, other forest products. Neglect of traditional biomass fuels in energy sector assistance. Few incentives and weak extension for private tree-planting.	Satisfaction of fuelwood demand by: Incentives for tree-planting by local communities and private sector; Agroforestry plantings and fuelwood plantations; Fuelwood conservation and increased access to fuelwood substitutes.
Shortages and inefficient use of fuelwood. Lack of alternatives to fuelwood. Shortages and lack of alternative sources of fodder.	Failure to sustain/encourage trees in farming systems. Overgrazing, repeated burning. Degradation of currently cropped land. Shortened fallows and increased consumption of forest land by shifting cultivators. Encroachment by landless farmers.	Agrarian reform and more secure land tenure. Accelerated investment in sustainable agriculture, especially in areas adjacent to natural forests. Greater use of multi-purpose tree species. Redirect agricultural settlement to degraded (deforested) areas.
Rapid population growth. Increased demand for cropland. Inequitable land ownership patterns. Failure of agrarian reform. Insecure land tenure. Lack of support for sustainable agriculture. Poorly planned agricultural resettlement. Increased access along logging roads.	Lack of community participation in development planning and project design. Erosion of traditional community controls over land use and communal resource management strategies. Displacement and disruption of indigenous forest dwellers.	More community participation. More support for forest conservation. Incorporate development concerns into conservation programs (buffer zone development around protected areas).
Poorly planned, large scale development projects (e.g. transportation infrastructure, energy, mining, commercial agriculture, etc.). Land use conflicts. Export commodity/production focus of development projects. Short term profit-taking, corruption.	Ineffective protection and management of national parks, forest reserves, public forest lands. Low valuation of biological diversity. Faulty analysis of full costs and benefits of land conversion. Inattention to sustainability issues in economic development and natural resource use.	Institution strengthening: Increased capacity for research, training and extension; Better data and monitoring of forest resources; Improved land use planning and intersectoral coordination.
Low level of development assistance in forestry, especially for forest protection. Weak institutional capacity. Poor inter-sectoral coordination. Lack of awareness of economic and environmental costs of deforestation and misuse of forest lands among political decision-makers.	Inadequate information base and monitoring of forest land use and forest resources. Inattention to forestry institutions. Low priority to forestry in development plans. Lack of investment in forestry.	Increased awareness among decision-makers and greater political commitment to address deforestation issues. Improved coordination and effectiveness of development assistance. Accelerated investment in targeted areas.

Appendix 2. Summary of recent forestry literature on sustainability of natural forest management

ISSUES	John Wyatt-Smith (1987)	Ralph Schmidt (1987)	Poore, Burgess, Palmer, Rietbergen, Synnott (1989)	Goodland, Ashby, Post, Dyson (1990)
Definition of Sustain-ability	To exploit forest in a way that provides a regular yield of forest produce without destroying or radically altering the composition and structure of the forest as a whole.	Controlled harvesting combined with silvicultural practices to sustain or increase value of subsequent stands, all relying on natural regeneration.	Must not do anything to irreversibly reduce the potential of the forest to produce marketable timber	Use of natural forest which indefinitely maintains the forest substantially unimpaired both in environmental services & in biological quality
Evidence supporting "sustain-ability"	Malaysian Uniform System (MUS) was successful when abundant natural regeneration was present. In Philippines, selective logging shows excellent regeneration of preferred species. Successful natural regeneration in Trinidad, Puerto Rico, CELOS system in Surinam looks promising.	In Malaysia, MUS resulted in successful regeneration in lowland dipterocarp forests; liberation thinnings in selectively logged forests in Sarawak produces a new good quality stand quickly; selective logging in Philippines leaves a commercial residual stand.	Sustainable management system in Queensland some small scale projects in Africa have begun; sustained management in Malaysia shows promise; sustained production is carried out in Trinidad & Tobago (strictly, however, sustainability cannot be proven until after the 3rd rotation).	True detection of sustainability cannot be achieved until third rotation (at minimum); sustainability "approached" during colonial regimes in Asia & Africa - MUS & other systems fell prey to forest conversion before sustainability could be proved; several experiments underway in Latin America may prove sustainable.
Major Achievements (economic, ecological, institutional, social)	Some successful timber management programs have been developed, especially in Malaysia (MUS) and Philippines.	Some success with systems in lowland dipterocarp forests, e.g. Sarawak and the Philippines.	Sustainable production of tropical timber is negligible (approximately 800,000 ha.).	Above mentioned systems in Asia & Africa yielded about 2.5 to 5 m3/ha/year. Burma teak rotation sustainably managed until 1962 when overexploitation began.
Major Constraints (economic, ecological, institu-tional, social)	Overexploitation & logging damage; shortage of trained staff & funding (e.g. Africa); desirable species must be present with abundant natural regeneration (MUS); variation among tropical moist forest (TMF) has led to failures when a system is transferred to another area	Landless poor occupy many cut over sites; liberation thinning requires adequate stock of pole-size trees & much manpower; security problems (e.g. Colombia); short-term thinking by policy makers; low proportion of commercially valuable species; silviculture must be flexible	Land use policy, financial policy, logging control, forest legislation, & economic circumstances (e.g. Africa); illegal clearing of forests & overexploitation (e.g. Asia)	Forests overexploited (e.g. Burma); forest conversion; population pressures; institutional instability; sustainable forests are expensive to maintain & produce low rate of return
Conclusions about prospects for sustain-ability	Tropical forests can be managed sustainably, but plans must be suited for particular local conditions.	Asian experience shows that sustainable tropical forest management is technically feasible.	Management of natural forest for sustainable production of timber is technically possible in many forest types, but current practice is negligible.	"Sustainability of tropical hardwood production has not been achieved, would not be profitable were it to be enforced, & is unlikely to be achieved in future unless major improvements are implemented properly."
Recommendations for wider practice of sustainable management	Management plans must be flexible: need to take local conditions into account, as well as medium & long-term effects; need to promote welfare & participation of local people	Systems must be flexible because of complexity & variability of TMF. Need long-term stability; need commitment by national leadership; need effective technical training; need effective legislation & land use planning	Need government resolve & long-term security; need to promote & help facilitate controlled conditions for sustainable management (establish overall land use plans; set standards for allowable cut, cutting cycles, harvesting techniques, etc.)	Improve sustainability through government commitment & system of incentives; use careful selective extractions; deflect logging to secondary forests & plantations.

ISSUES	Summary: ITTO/MIID (1988)	Janssen, Lingren (1990)	Keto, Scott, Olsen (1990)	Kiernan, Buschbacher, Perl, Batmanian (1990)
Definition of Sustainability	Multiple use management of forests for sustained yield of timber is emphasized	Utilize the forests economically in a way which yields a high production of valuable products in the long perspective, retains fauna, and protects the global & local environment.	Sustainable cut is equivalent to the volume of incremental growth between harvests (Queensland); definition should include maintaining level of biodiversity	To manage natural TMF in order to provide economic benefits without destroying the forests long-term productive capacity
Evidence supporting "sustainability"	Probable that forests managed under MUS would be producing second-rotation if land had not been converted to agriculture; strip shelterwood system in Pelczu showing abundant regeneration; polycyclic systems with liberation thinning show promise in Sarawak & Cote d'Ivoire	Land in Costa Rica where cerpegulmesis was harvested is showing abundant regeneration; regulations in Queensland recognize long-term economic and environmental considerations	(Queensland model, which had been promoted as sustainable, is based on a depauperate database & thus inappropriate as a model)	13 examples in Latin America are given, none of which are demonstrably successful in all the necessary elements of sustainable forest management - all need more time to mature
Major Achievements (economic, ecological, institutional, social)	Forest management systems have shown success (at least technically) in a number of countries (see above)	Good planning & careful logging has led to sustainable use in Costa Rica & Queensland		Make forests a permanent, rather than short-term resource; economic gain for local communities; provide land rights to native peoples
Major Constraints (economic, ecological, institutional, social)	Main constraints are economic, social & institutional rather than technical (conversion of forests, pressure to accelerate felling cycles, unwillingness to invest in long-term, undervaluation of forest resources); size & complexity of TMF	Pressure to have shorter cutting cycle than recommended; natural forests cannot be completely protected within framework of commercial forestry	Timber industry was heavily subsidized by Government (Queensland); logging on a 40 year cycle will lead to structural changes & a reduction in species diversity; sustainable definition usually ignores biodiversity	Social pressures; lack of technical or financial resources; low stumpage value for timber; government policies that impede national forest management.
Conclusions about prospects for sustainability	Sustained management is technically feasible and examples do exist, however, most forests now receive little or no silvicultural treatment & inadequate protection.	Sustainable management can be achieved in most areas through proper planning, execution & control; inherent ecological mechanisms must not be irreversibly disturbed	No valid reason for using the Queensland model as the basis for sustainable timber production	Natural forest management is technically feasible (can extract timber & non-timber products in ways that maintain forest structure & ensure regeneration)
Recommendations for wider practice of sustainable management	Must have silvicultural data & analysis, and socio-economic & institutional data & analysis to develop management plans; successful transfer of methods from one region to another are poorly understood	Cost effective & environmentally sound logging practices must be compiled into practical guidelines & disseminated to all parties working with TMF	Industrial forestry should be restricted to less environmentally sensitive areas; large scale timber supplies can come only from plantations	Need for reform in overall policy management; long-term, consistent technical & financial support; and ability to resolve local political disputes & distribute benefits to local people

ISSUES	Hartshorn (1990)	Summary: Smithsonian Tropical Forestry Workshop (1988)	Breunig, Poker (1989)
Definition of Sustainability	Sustained yield of timber (based on natural regeneration)	Harvesting should not diminish the benefits of future generations; requires protection of soil, water, wildlife & timber resources in perpetuity	Wise use of tropical rainforests for long-term economic and ecological benefits
Evidence supporting "sustainability"	In Palcazu, natural regeneration on two demonstration strips has been very good (approx. 1,500 individuals over 50 cm representing 132 species were found after 15 months)		Indicators for sustainable forestry in Congo are positive; SMS system, Malaysia has achieved sustained yield; Quintana Roo: successful sustainable timber production; TSI project in Philippines successful in residual dipterocarp forests.
Major Achievements (economic, ecological, institutional, social)	Forests will give a sustained yield of forest products; provides employment for native communities; protects cultural integrity of native peoples		Several successful examples exist (see above); income of inhabitants has increased; environment is stable
Major Constraints (economic, ecological, institutional, social)	Numerous past efforts to manage TMF have failed due to the high costs of extracting only the finest wood, the lack of understanding of TMF, & harmful government policies; need marketable building-phase species which grow quickly in forest gaps (for this system)	Tropical forests & products are undervalued; logging operations are inefficient; governments do not have sound long-term forest policy; re-cutting too quickly; timber concessions are too short	Political conditions; laws; traditional lack of attention to non-timber products; lack of technical training for local personnel; lack of incentives to manage forests
Conclusions about prospects for sustainability	Palcazu project has potential for sustainable development of the valley	Tropical forests must be accorded proper economic value if they are to be preserved; Sustainable utilization systems can be viable so long as they mimic natural forest dynamics & work within limitations of ecosystem	Rainforests can be managed successfully.
Recommendations for wider practice of sustainable management	Success of Palcazu project would show the opportunity exists for sustainable management of tropical forests; recent market acceptance of a large number of species has helped open the door for better management of TMF	International Hardwood Products Association (IHPA) members should promote guidelines & criteria for defining sustainable management; governments need secure long-term policy; sale of forest products should reflect replacement & environmental costs; proceeds should be reinvested in forest management	Need adequate political support, involvement of local people, & project-integrated training programs

APPENDIX 3

CASE STUDY BRIEFS FROM COLLOQUIUM ON SUSTAINABILITY IN NATURAL TROPICAL FOREST MANAGEMENT
WASHINGTON, D.C., MARCH 21-22, 1991

TITLE: *CARTON DE COLOMBIA*

LOCATION: Pacific coast of Columbia, north of the port of Buenaventura, 100 km northwest of Cali (3° N, 77° W)

IMPLEMENTING AGENCY: Cartón de Columbia, operated by Smurfit/Latin America, a subsidiary of Container Corporation

FUNDING AGENCY: Private sources

OBJECTIVES: Produce 80,000 m^3 of mixed hardwoods per year for pulp on a sustained yield 30-year cycle.

BIOPHYSICAL CHARACTERISTICS OF THE SITE:
(Forest type; climate; soils; elevation; wildlife; natural forest regeneration)

- tropical rain forest
- very wet; average rainfall of 7500 mm/year
- average temperature is 27 degrees C.
- terrain is low hills (50-100 m)
- 61,000 ha: 60% non-forestry (reserved for natives & permanent forest), remaining 24,000 ha is production forest
- wide mix of tree species (250 per .1 ha) dominated by Dialyanthera gracilipes and Campnosperma panamensis
- soils are clay, entsols; acidic & infertile

FOREST MANAGEMENT SYSTEM:
(Silvicultural management; species harvested; rotation period; thinnings; extraction method; planting; monitoring; special conditions)

- project initiated in 1974; concession ends in 2004
- selective harvesting of 150 species as pulpwood
- cutting cycle is 30 years
- cut 800 ha annually (out of 24,000 ha); 80,000 m^3 pulpwood harvested annually
- harvesting accomplished using aerial cables, thus minimizing damage to residual trees
- company has been researching potential of eucalyptus and pine plantations in Andes; expects to complete move toward plantations by the time concession ends in 2004

MARKETING:

- commercial wood volume is 125 m^3/ha: 100 m^3/ha as pulpwood & 25 m^3/ha as sawlog
- pulpwood is used to make kraft paper at a mill near Cali
- local sawmills buy logs from settlers
- in 1946 Columbia imported 100% of its paper; by 1988 it was nearly self-sufficient in paper (except for newsprint)

EVIDENCE FOR SUSTAINABILITY:

- o studies have indicated that sustainable production can result from natural regeneration

STRENGTHS/ACHIEVEMENTS:

- o limited damage to residual stand through the use of aerial cable logging
- o excellent natural regeneration and evidence of sustained yield on protected sites
- o provides income/employment to locals

KEY PROBLEMS:

- o social pressures have pushed local people into recently harvested areas, thus interrupting regeneration
- o people seeking income from forest has led to over-population in the area and over-harvesting of wood
- o cost of wood to company is high because of careful logging procedures used in extraction; to become more competitive, the company is moving toward plantations
- o move toward plantations may upset local economy and result in high local unemployment

POLICY IMPLICATIONS:

- o technical aspects of management plan seem to be sound, although expensive.
- o population pressure on the production forest had limited the success of this site.
- o results from short fiber plantations in the Andes show that a higher yield of pulpwood can be produced at a lower cost than natural forest management
- o considering move to plantations, can this be seen as truly successful TFM?
- o careful logging procedures could be used as model, but what about their high cost?
- o few countries have high pulpwood demand (Spears)

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CASE STUDY BRIEF

TITLE: *QUINTANA ROO EJIDOS*

LOCATION: Near the town of Felipe Carrillo Puerto in Mexican state of Quintana Roo on the Yucatan Peninsula (approx. 19° N, 88° W)

IMPLEMENTING AGENCY: Organization of 16 communal groups or "ejidos" (National forest service provides a dozen technical advisors)

FUNDING AGENCY: Mexican government, GTZ (Germany), Mexican Bank, World Wildlife Fund

OBJECTIVES:
1. Maintain natural forest with natural regeneration
2. Market new species
3. Increase proportion of mahogany and cedar through enrichment planting

BIOPHYSICAL CHARACTERISTICS OF THE SITE:
(Forest type; climate; soils; elevation; wildlife; natural forest regeneration)

- sub-tropical moist forest with dry season
- average rainfall between 1000-1500 mm/yr
- ejidos pool 360,000 ha of land; 155,000 ha for forest production
- 70+ trees inventoried
- large amounts of mahogany and cedar, although reduced by 25 years of previous logging
- dry, shallow, limestone soils

FOREST MANAGEMENT SYSTEM:
(Silvicultural management; species harvested; rotation period; thinnings; extraction method; planting; monitoring; special conditions)

- project initiated in 1983
- selective harvesting with diameter limit
- 25-year cutting cycle
- ejidos take continuous forest inventories, develop plans, harvest, and market product
- harvesting takes place during dry season
- enrichment planting used to increase proportion of mahogany and cedar

MARKETING:

- new contracts with log buyers provide higher prices (mahogany at $150 m^3) and purchase of a wider variety of species (including white soft woods)
- some value added processing (sawmill & carpentry shop)
- proceeds from log sales are being put into the purchase of more processing equipment so ejidos may eventually sell finished products
- workers are paid for inventory, marking, felling, skidding and hauling as well as sharing in profit for sale of timber
- in rainy season locals can earn up to $3,000/year chicle tapping

EVIDENCE FOR SUSTAINABILITY:

- good natural regeneration, but cannot conclude sustainability after only 8 years

STRENGTHS/ACHIEVEMENTS:

- low population density
- secure land tenure (ejidos have rights to benefits of production, but do not own land)
- forest is ecologically adapted to disturbance
- multiple yields from forest and strong markets for the products (timber and non-timber)
- increased income and employment for locals
- high level of community organization and participation

KEY PROBLEMS:

- lack of adequate information and capacity to produce it
- political and economic incentives to get timber out fast (high short-term benefits)
- communities have limited access to information, limited legal role and political power
- campesinos traditionally do not trust government
- silvicultural system is flawed: 1) selective harvesting with diameter limit assumes multi-aged stands, when, in fact, stands are single or two-aged and mahogany seedlings are not found in understory; 2) harvesting 1-2 trees per ha does not create openings large enough for establishment of new mahoganies; 3) limits on annual volume extraction based on guesses about growth rate, assumptions of ingrowth an inventories with large volumes of ancient trees
- problematic implementation of silvicultural system: 1) calendar of timber harvesting impedes mahogany seed dispersal (felled in January, releases seeds in March); 2) proposed plan of cutting 1/25th of area on 25 year cycle not followed; 3) collection of inventory data skewed

POLICY IMPLICATIONS:

- project demonstrates the real value a sustained natural forest could have to local communities (over 3000 families now benefit in Quintana Roo)
- as profits are directed back into production and value added processing equipment during this first stage, the income of the ejidos should rise in the future
- forest resources must be beneficial locals and locals must be integrated into the management of these resources
- outside technical and political support imperative
- much still needs to be done to improve education, research, technical training and silvicultural methods.

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CASE STUDY BRIEF

TITLE: ***YANESHA FORESTRY COOPERATIVE (PALCAZU)***

LOCATION: Lower Palcazú Valley, eastern base of Peruvian Andes, from 9° 50' to 10° 45' S latitude

IMPLEMENTING AGENCY: Yanesha Forestry Cooperative (local), Pichis-Pelcazu Special Project (PEPP)

FUNDING AGENCY: USAID (Tropical Science Center (TSC) contracted to design management system)

OBJECTIVES:
1) Employment for members of native communities
2) Manage natural forests for sustained yield of forest products.
3) Preserve cultural integrity of Amuesha (Yanesha) Indians.

BIOPHYSICAL CHARACTERISTICS OF THE SITE:
(Forest type; climate; soils; elevation; wildlife; natural forest regeneration)

- tropical premontane rain forest life zone
- average rainfall 6700 mm/yr
- 75% retains coverage of primary forest
- tall (45-55 m), species rich (175-200 per ha >10 cm dbh), no dominant species or genus
- 300-500 m elevation, rolling hills, several rivers
- red clay soils, acidic (pH 3.6-4.5), aluminum abundant, nutrient poor (calcium, phosphorus, potassium)
- forest renewal through gap-phase dynamics

FOREST MANAGEMENT SYSTEM:
(Silvicultural management; species harvested; rotation period; thinnings; extraction method; planting; monitoring; special conditions)

- system began in 1985
- strip shelterwood system: timber exploitation limited to long (200-500 m), narrow (30-40 m) clear cuts bordered on each side by intact natural forest
- new strips will be located at least 100m from recently cut strips
- primary forest excluded from harvesting: steep slopes, swamp, 5-10 m wide buffer along streams, and patches of inaccessible forest.
- 30-40 year rotation between harvests of a specific site
- annual rates of logging set at 1/30th of total productive forest area to give constant sustained yield
- rely on abundant natural regeneration from seed and stump sprouts and high growth rates
- extensive monitoring of tree establishment, survival and growth
- Silviculture: in second year sprouts are reduced to 1 or 2 per stump; as canopy closes, climbers are cut; once trees have formed a closed canopy, the competitive equilibrium can be adjusted to favor desireables or eliminate undesireables
- most of biomass is removed and utilized except for small branches to provide nutrients for regeneration
- draft animals used for extraction to minimize damage

MARKETING:

- o primary products are sawnwood and preserved roundwood; scrap wood is converted to charcoal
- o total harvested wood from first demonstration strip equivalent to 350 m^3/ha (150 m^3/ha in saw logs, 90 m^3/ha for poles & posts, the rest is branchwood sold as specialty items or converted to charcoal)
- o wood processed locally in the valley (portable sawmill, preserving equipment, and charcoal kiln)
- o at least some wood exported
- o economic calculations indicate that limited local processing center will produce net returns of $3500 per ha of forest harvested (expansion of processing center should increase returns to $27,500 per ha)

EVIDENCE FOR SUSTAINABILITY:

- o abundant natural regeneration: inventories of two demonstration strips (20 x 75 m at 30 months and 50 x 100 m at 24 months) showed 203 species & 1,983 individuals on the former and 285 species & 6,624 individuals on the latter. Tree species (> 1 m tall) on the first demonstration strip are more than double the number of original tree species.

STRENGTHS/ACHIEVEMENTS:

- o native land claims have been legally recognized
- o provides employment/income to natives
- o protects natives' social and cultural integrity from effects of colonization
- o natives involved at all levels
- o national park, buffer zones, and production forest areas created

KEY PROBLEMS:

- o for this silvicultural system to succeed, species must be capable of rapid establishment in gaps, grow quickly -- and produce marketable wood
- o management is highly technical
- o project is more profitable than cattle, but less than coffee (thus land-use plan must be effectively implemented)
- o some difficulty developing local markets
- o if the project had to repay debt, it would take up to 15 years to pay back (project given $2 million start-up grant)

POLICY IMPLICATIONS:

- o an important first step was taken when USAID made the following condition preceding the loan agreement: that lands claimed by the natives be officially recognized and legally titled by the government of Peru
- o natives have been involved in management at all levels, from harvesting to processing to marketing
- o if project is successful, it will demonstrate the potential for sustainable management of tropical forests and the ensuing benefit to local communities.
- o plan assumed -- it seems correctly -- that people who lived on the land (natives as opposed to settlers) were interested in long-term sustainability

continued

- o project also assumes that the government could not control land use -- it would be dictated by the rural poor
- o native communities often prove to be more stable and value forests more than national governments -- it would be wise to invest in them (but could an organization like the World Bank manage this sort of project?)

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