Biodiversity Conservation in Production Forests

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Executive Summary

The basic contention of this paper is that conserving biodiversity in forests producing timber is not substantively different from biodiversity conservation in a nature reserve. Conserving biodiversity requires a social choice about which components of biodiversity are to be maintained in a given site and the subsequent implementation of an appropriate mix of incentives and regulatory measures to achieve these objectives. Attempts to pursue biodiversity objectives in both protected areas and in production forests have often failed because the attribution of costs and benefits was unfair and regulations proved unenforceable. In many cases initiatives were based on assumptions about global values of biodiversity and failed to recognise local values of alternative land-use options.

Most people would agree that biodiversity is most likely to be maintained if local benefits are maximized and local costs are minimised. This can be achieved by the carefully negotiated allocation of forest land to different purposes and by optimising the balance between all the goods and services derived from forests. This paper will argue that various sorts of multiple-use forests are likely to be the best option for biodiversity conservation in many situations where poor people live in proximity to forests rich in biodiversity. It is inevitable that timber extraction will be a major element of this multiple-use in many forest areas. We will further argue that there are no fundamental technical obstacles to meeting many biodiversity objectives in forests managed for timber. Such technical obstacles as do exist will need to be addressed through research and adaptive management at each locality. The diversity of forests and the people who depend upon them is so great that it is neither desirable nor possible to develop broadly generalised prescriptions for management. The GEF must deploy its resources to favour the emergence of institutional arrangements which can reconcile local and global values in an equitable and durable fashion. The extent of the trade-offs in reconciling global and local values is such that even with optimal management arrangements some form of compensation or subsidy to forest-dependent stakeholders will often be unavoidable.

Conserving forests on the landscape:

There is a strong emerging consensus that it is imperative to conservation that efforts extend beyond protected areas (Cabarle 1998). For one thing, the track record for "protection" systems, particularly in the poorer tropical countries, has been poor. For another, even the most ambitious exponents of biodiversity protection only advocate the allocation of around 10% of forests to parks and reserves and obviously the fate of much biodiversity will depend upon what happens to the residual 90% of the forest estate. Many species will only be conserved within a matrix of protected and managed forests. Land uses can be conceived as falling along a continuum among (1) intensive commodity production areas, (2) areas with little or no resource use by people, or (3) areas in which modest resource use occurs while ecological values are protected (Seymour and Hunter 1992, Hunter and Calhoun 1996). All three types of land use have validity and finding the proper balance among these uses is the key to improve resource and biodiversity conservation (Hunter and Calhoun 1996). It is important to contribute to the development and implementation of processes to

facilitate making choices at a regional and local level to balance the land-use mosaic to optimise economic, social and environmental utility.

There is one clear priority issue in forest conservation - that native forest cover is maintained on the landscape. Conservation agendas will require that different parts of the regional/national forestry estate be managed with different goals and priorities. The process of negotiating a diversified forest estate will also define where direct financial revenues may be sought, and where a subsidy may have to be directed.how much land to allocate to different uses and how to regulate the use of that land. If society decided to shift the balance of land-use allocations, it could do so through zoning and other forms of regulations, tax incentives and disincentives, and other forms of direct and indirect subsidies Simply tightening environmental regulations on multiple-use lands while relaxing regulations on intensively managed lands would shift the costs of doing business to encourage more production on a smaller area.

Enhancing Biodiversity Conservation in Production Forests

The greatest threat to forest biodiversity is the conversion of natural forests into other land uses. The fact that a very large proportion of the world's forests are used for the production of timber, and that and this situation is likely to persist (ITTO 1993), can represent an opportunity for conservation. Production forests provide habitats for many, often the majority, of the plant and animal species found in more pristine forests. However, the management of a forest for production generally involves the modification of the natural ecosystem to provide access for removal of products and in some cases, to increase the yield of commercial species. The net result, at least in the short-term, is often a change in diversity, but the intensity of these changes and the time frame over which they are detectable can be greatly influenced by the techniques used in the planning and execution of harvesting. Significant gains in conserving biodiversity can be made by improving harvesting and silvicultural practices (Hunter 1990; Johns 1997; Cabarle 1998) and managing all activities in the concession areas (Robinson et al. 1999). These include measures designed to address both direct and indirect impacts of timber harvesting, principal among them:

a) Setting aside sensitive areas for conservation, avoiding logging and skidding on steep slopes, and leaving appropriate buffers along water courses, both to protect aquatic systems and to provide riparian corridors for movement of fauna;
b) Implementing careful planning and engineering of roads and layout of skidtrails to minimize erosion, sedimentation, ponding, and the total area subject to soil disturbance;
c) Closing roads after logging to reduce likelihood of subsequent access and conversion;
d) Using appropriate logging technology;
e) Using directional felling and vine cutting (where required) to reduce damage to residual trees, both to protect trees and to reduce the risk of post-logging;
f) Avoiding felling trees which will be left in the woods because of defect ;
g) Leaving snags for cavity nesters; leaving keystone food sources, and providing favorable conditions for regeneration of tree species harvested;

h) distributing harvest areas across the managed forest in configurations designed to create mosaics of different-aged patches or patches recently-harvested, and those not-harvested for a long time, to permit long-term survival of both forest interior and disturbance-adapted species;
i) Feeding logging camps from sources other than hunting.

Since most tropical forests are considered to be unmanaged (Poore et al. 1989) or poorly managed, there is much room to improve forest management, and thus the potential for sustainability (which increases the likelihood that forests will be able to hold their ground on the landscape) and biodiversity conservation. However, measures designed to enhance biodiversity values may increase costs or reduce yields. This brings up the important issue of who pays for the opportunity costs of foregoing or reducing an immediate economic return in order to meet biodiversity conservation objectives?

Stakeholder issues

Fairly allocating among forest stakeholders of the costs and benefits associated with tradeoffs related to biodiversity conservation may represent the biggest challenge to improving management. Stakeholders in forests and their products and services range from local inhabitants of forests, loggers and concessionaires (whose interests in forests may be conflicting), to downstream fishermen, more distant national governments, and global stakeholders in biodiversity, living in far away countries. Who should bear the costs associated with the loss of biodiversity, or the loss of production? "Markets" that would provide a mechanism for paying for many of the benefits of biodiversity conservation are lacking. Could the GEF provide for global mechanisms to overcome these constraints?

In a given forest, different stakeholders give different values to different components of biodiversity. How can tradeoffs be negotiated between those who are near the forest and those who are distant? Between those who are powerful and those who are not? Between those who are linked together within a national political system and those who are linked across borders through a global market system? The ecosystem management approach developed by the US Forest Service is a strategy based on integrating ecosystem science and socioeconomic concerns with a process that involves stakeholders in defining objectives (Underwood 1998). It is dependent on a basic institutional, organizational and legal framework already being established. In many poorer countries this framework does not exist and will have to be gradually developed over time. "Adaptive co-management" is an attempt to facilitate stakeholder negotiation among forest-dwelling communities in developing countries and the government agencies and timber industries who oversee or utilize the timber in the forests where they live. Additional development of these mechanisms is necessary to provide for the representation of the stakeholder community to local, regional, national, and global perspectives.

Institutional issues

The main reason for losing biodiversity in the tropics is not a lack of technical knowledge about forest management but rather the absence of the institutional and political framework under which social choices can be negotiated and biodiversity-friendly management practices can be implemented. The opportunities and constraints for improved forest management are greatly affected both by the laws and policies that relate to the uses and pressures upon forested lands and by the capacity and abilities of the institutions established to secure their implementation. A fundamental obstacle often lies in the relationships between various agencies, commercial interests and local people. In order to sustainably manage forests, there has to be in place a basic enabling framework of institutions, policies, and laws that allow governements and their insitutions to succeed. These include (adapted from ITTO 1998 and Verolme and Moussa 1999):

Insitutional arrangements

a) Ensuring an appropriate number and adequacy of institutions to support sustainable forest management.
b) Training of professional and technical personnel at all levels to perform and support management, implementation, research and extension;
c) Existence and application of appropriate technology to practice sustainable forest management and the efficient processing and utilization of forest produce.
d) Capacity and mechanisms for planning sustainable forest management and for periodic monitoring, evaluation and feed-back on progress.
e) Degree of public participation in forest management, such as in planning, decision making, data collection, monitoring and assessment.
f) Adequacy and timeliness of information to increase public awareness about forest policies, legislation and sustainable forest management practices.

Policy and Legal Framework

a) national objectives for forest including production, conservation and protection;
b) the establishment and security of the permanent forest estate;
c) establishment of land tenure and property rights relating to forests;
d) the control of forest management, harvesting, and encroachment;
e) the passage of laws which recognize the participation of local communities and a wide-range of other stakeholders and the role of traditional knowledge;
a) effective enforcement of legal measures to prevent corruption
b) effective implementation of national forest policies through an appropriate legal framework

Economic Framework

a) Eliminate inappropriate subsidies and credits;
b) Develop economic instruments and other incentives to encourage sustainable forest management.
c) Reassess international loans and export credits
d) Support community-based economies and networks for the management of natural resources

Considerable effort needs to be focused on: 1) the development of appropriate policies and adequate legal frameworks, 2) the building of insitutional capacity to implement those policies, 3) the use of incentives and trade policies to favor private and government level compliance, and 4) participatory mechanisms to determine the values of both goods and services.

The establishment and development of proper national institutions is a basic requirement for action towards sustainable forest resources development (UNCSD 1996). Unfortunately, developing countries oftentimes have difficulty sustaining the acquired expertise and human capacity and establishing and building the needed institutional framework, for many reasons including inadequate funding and frequent turnover of staff. The successful integration of training programs, networking, technology transfer and information dissemination is needed to build significant capacity for sustainable forest management.

Over the longer term, countries will need to develop the ability to learn and institutionalize new roles and new performance standards with respect to sustainable forest management. Capacity-building in this context will likely entail more far-reaching organizational, social and even political reforms. Of critical importance will be two-factors: first, the enhancement of the role of groups outside government such as non-governmental organizations and the private sector; and second, the shift to a more cross-sectoral approach to the design and implementation of sustainable forestry practices. whatever the specific objectives of commitments or projects, capacity building is above all a long-term process that must emphasize the domestic development of local structures.

Use and development of information

Sustainaing biodiversity in production forests requires adaptive management incorporating scientific information about the effects of management on different components of biodiversity. This requires both the dissemination of information and the capacity for research. To maximize the effective use of scarce resources in developing countries, efforts should be made to (1) improve the availability of basic reference materials, (2) improve access to current information (3) establish technological information systems and (4) supply adequate equipment and the means for its use and maintenance.

Ongoing conservation of biological diversity also requires integrated basic and applied ecological, social, and economic research to provide:

? A basis for sustaining ecosystem productivity and biodiversity
? More adaptive and flexible management systems.
? A broader basis to support the development of a public “will” to lead to a higher likelihood of adoption of ecologically-based management.
? Mechanisms to ensure a wide range of stakeholder participation.
? An improved information base for decision making.
? Techniques for incorporating spatial analysis to link objectives at differing scales into planning and decision-making.
? Methods to predict responses of ecosystems to management activities.

? Methods for integrated planning and management across site, landscape, regional, and perhaps even continental levels.
? Methods to examine the relationships and interdependencies of management actions on one spatial/temporal/biological scale upon actions at other scales, e.g. externalities.
? Participatory techniques to assess the relative values of different components of biodiversity and assess the trade-offs between the costs of conservation, including the opportunity costs incurred by restricting use and the "willingness to pay" of the proponents and beneficiaries of conservation.

Conclusions

By "opting out" of projects associated with forest harvesting, the GEF, World Bank and other lending agencies are unable to apply pressure that might significantly improve logging practices. Financial support is important to could contribute to the development and implementation of institutional arrangements to favor biodiversity-friendly management, leveraging the capital of the timber producing private sector and national governments which obtain rents from timber production. Among those areas of investment which the GEF might consider are :

a) contribute to the development and adoption of institutional arrangements which internalize the externalities associated with environmentally-destructive logging practices, and create incentives for biodiversity-friendly practices on the part of loggers (encourage any and all alternatives to short term logging concessions!);
b) provide financial incentives (tax breaks, subsidies, what?) to overcome the perverse incentives resulting from discount rates and inflation;
c) contributing to improved funding of government forest management agencies in tropical countries and overcoming perverse incentives for corruption;
d) develop and fund mechanisms to translate the global benefits of biodiversity conservation into compensation for those who pay the opportunity costs of foregoing financial benefits associated with biodiversity-destructive resource extraction practices in tropical forests; (support independent certification and green premiums?);
e) develop mechanisms to compensate for losses in profits associated with reductions in yield
f) contribute to actions to reduce demand and make timber use more efficient;
g) encourage the production of wood from sources with higher production potential and lower biodiversity value than -tropical forests (ie biodiversity-poor forests; plantations on degraded lands);

Biodiversity Conservation in Production Forests[1]

Why this paper?

The Global Environment Facility (GEF) and The World Bank are interested in biodiversity conservation within the context of forest management with the overall objective of better directing their assistance in the forestry sector. This also meshes with the efforts of The Convention on Biological Diversity which has adopted an ecological approach to management as part of its program of work for conserving biodiversity (CBD 1998: UNEP/CBD/COP/4/Inf.9[1]; UNEP/CBD/COP/4/27).

---Key Points---

- Destruction or conversion of habitat is the most significant cause of biodiversity loss
- Biodiversity loss in the tropics is not due primarily to a shortage of technical knowledge but rather to a lack of institutional and political frameworks under which biodiversity –friendly management practices can be implemented.
- The study of impacts on biodiversity in logged forests must include an understanding of the response of biota both inside and outside the logged-over boundary.
- Components of biodiversity are valued differently by different people.
- There are diverging ethical perspectives on biodiversity loss, on who should take action and who should pay.
- The lack of readily available methods to attach real values to biodiversity remains a serious obstacle to developing options for conservation.
- Most people would not pay for the conservation of a species of no demonstrated value; i.e. "willingness to pay" does not exist in real life.
- Clearly defined and locally meaningful biodiversity objectives are essential for negotiations between different forest stakeholders.

The basic contention of this paper is that conserving biodiversity in forests producing timber is not substantively different from biodiversity conservation in a nature reserve or any other area of land for which specific biodiversity objectives have been established. The term biodiversity represents a very general concept of values related to genes, species and assemblages of species. Conserving biodiversity requires a social choice about which components of biodiversity are to be maintained in a given site and the subsequent implementation of an appropriate mix of incentives and regulatory measures to achieve these objectives. Attempts to pursue biodiversity objectives in both protected areas and in production forests have often failed because the attribution of costs and benefits was unfair and regulations proved unenforceable. In many cases initiatives were based upon unproven assumptions about global values of biodiversity and failed to recognise local values of alternative land-use options.

Most people would agree that biodiversity is most likely to be maintained if local benefits are maximized and local costs are minimised. This can be achieved by the carefully negotiated allocation of forest land to different purposes and by optimising the balance between all the goods and services derived from forests. This paper will argue that various sorts of multiple-use

forests are likely to be the best option for biodiversity conservation in many situations where poor people live in proximity to forests rich in biodiversity. It is inevitable that timber extraction will be a major element of this multiple-use in many forest areas. We will further argue that there are no fundamental technical obstacles to meeting many biodiversity objectives in forests managed for timber. Such technical obstacles as do exist will need to be addressed through research and adaptive management at each locality. The diversity of forests and the people who depend upon them is so great that it is neither desirable nor possible to develop broadly generalised prescriptions for management. The GEF must deploy its resources to favour the emergence of institutional arrangements which can reconcile local and global values in an equitable and durable fashion. The extent of the trade-offs in reconciling global and local values is such that even with optimal management arrangements some form of compensation or subsidy to forest-dependent stakeholders will often be unavoidable.

1 Underlying Issues

--Key Points—

from the Convention on Biological Diversity (COP4) (UNEP/CBD/COP/4/27, 1998)

- "at the third meeting of the Conference of the Parties the ecosystem approach has been addressed as a guiding principle, although the terminology used has varied, including: "ecosystem approach", "ecosystem process-oriented approach", "ecosystem management approach" and "ecosystem-based approach".
- "Decides to endorse the work programme for forest biological diversity".
- The work programme includes: "Holistic and inter-sectoral ecosystem approaches that integrate the conservation and sustainable use of biological diversity, taking account of social and cultural and economic considerations".
- "Decides to provide the following additional guidance to the Global Environment Facility in the provision of financial resources, in conformity … the Global Environment Facility should … provide adequate and timely financial support to Parties for projects and capacity-building activities for implementing the programme of work of forest biological diversity at the national, regional and subregional levels".

Since the United Nations Conference on Environment and Development in Rio de Janeiro in June 1992, attempts at sustainable forest resource utilisation and management have increasingly taken into consideration the conservation of biodiversity (May and Pastuk 1995). It is crucial that they do so as most of the world's forests are not protected but fall between the extremes of intensively harvested plantation and managed conservation forests (Noble and Dirzo 1997). Unfortunately, there is strong evidence that most current forest management practices are not favourable to biodiversity because after initial harvest, the forests are converted to non-forest uses (Noble and Dirzo 1997). Technical knowledge exists to achieve biodiversity objectives in managed forests, but it is rarely being translated into reality.

1.1 What is the problem?

One of today's most pressing environmental issues is the conservation of biodiversity. Many factors threaten the world's biological heritage (Szaro 1995). The challenge is for nations, government agencies, organizations, and individuals to protect and enhance biodiversity while continuing to meet people's needs for natural resources. This

challenge exists from local to global scales. If not met, future generations will live in a biologically impoverished world and perhaps one that is less capable of producing desired resources as well.

Why should people care about protecting biodiversity? Why should they support the effort required to sustain and enhance genetic resources, recover endangered species, restore riparian areas, maintain ancient forests, or conserve trees, insects, and marshes? The answers span ethics, aesthetics, economics, and quality of life (Szaro and Shapiro 1990).

The diversity of life benefits us in infinite ways:

- Our building materials, fibers and food both wild (many fish) and domesticated, have all been derived from diverse and healthy ecosystems.
- More than half of all our medicines today can be traced to wild organisms.
- Diverse communities of plants, animals, and microorganisms provide indispensable ecological services: they recycle wastes, maintain the chemical composition of the atmosphere, and play a major role in determining the world's climate.
- Countless people enjoy the special pleasures of hiking in lush forests, visiting scenic mountains and seashores, and pursuing recreational activities that are dependent on biodiversity, such as hunting and fishing.

Some of these services and products provided by forest ecosystems and forest biodiversity components have direct use value and directly translate into substantial financial benefits:

- A study in Australia (State of Victoria) calculated the financial benefit of water supplied to Melbourne from forested water catchments at $250 million per year (DEST, 1993).
- The tropical non-coniferous forest product exports were valued at $11 billion/year (Barbier *et al.*, 1994).
- The viewing value of elephants in Kenya is estimated at $25 million/year (Brown & Henry, 1993)

Others such as watershed protection, control of flooding, soil fertility maintenance, and carbon storage by forests are more difficult to estimates as they represent indirect use values. Estimates of such indirect use values are:

- Support by mangroves of agriculture, fishing and cottage industries in Indonesia is valued at $ 536 million (Ruitenbeek, 1992)
- Carbon storage by forests in Brazil is valued at $1300/ha/year (Pearce, 1990)
- Control of flooding and soil fertility maintenance by forests is valued at $31/ha/year (Ruitenbeek, 1989)

In addition, many people believe that we have an ethical obligation to protect the diversity of living things with which we share our planet, whether or not they are known to be useful to us, simply because humans bear a responsibility for the stewardship of all life on Earth. Yet, the full values of biodiversity far exceed our current knowledge. Despite decades of scientific effort, we know only a small fraction of the species on this planet; every day species are lost before we have a

chance to learn anything about them. We will never know which potential foods, medicines, and commercial products have disappeared forever with each extinction. An astonishing wealth of wild plants, animals, and microorganisms have served humans since we first walked on Earth. Future generations are entitled to expect, and will need, an environment as biologically rich as the one inherited by today's generations.

1.2 What are the causes?

Over the past few decades, the rate of global biotic impoverishment has increased dramatically. Exponential growth in human populations and even faster growth in consumption of the world's natural resources, have led to high rates of loss of species and habitats. Current rates of species loss greatly exceed those of the past 65 million years (Wilson 1988). If the trend continues, by 2050 we may see the loss of up to one quarter of the world's species (Reid and Miller, World Resources Institute, Unpublished manuscript) and potentially dramatic changes in the climate and hydrology of entire regions such as Amazonia (Salati and Vose 1983). The biotic resources we stand to lose are of immediate future value to humanity and essential for the maintenance of productive ecosystems.

Many of our most serious problems are centered in the tropics, where biodiversity is highest and species and whole ecosystems are being lost most rapidly (Raven 1987). In developing countries, the issues are most intense, because hundreds of millions of people struggle simply to survive (Repetto 1988). The destruction of forests in developing countries amounts to more than 11 million hectares annually (7.5 million ha closed forest and 3.8 million ha open forest) (Repetto 1988). Between 1950 and 1983, forest and woodland areas dropped 38 percent in Central America and 24 percent in Africa (Repetto 1988). In spite of increasing general concern regarding deforestation, natural forest area continues to decrease in many countries. For example in the Latin American and Caribbean Region, deforestation, at a yearly rate of 0.5%, mainly in tropical and subtropical forests, has continued due to causes that have been present for many years: conversion of forest land to agriculture and livestock production; spontaneous settlement; fuelwood extraction; industrial over- exploitation; forest fires; the construction of infrastructure and governmental development and settlement policies (FAO 1999d). The incidence and extent of forest fires increased in 1998, especially in Central America and the Caribbean and in the Amazon Region of Brazil, as a result of the draught caused by the El Niño climatic phenomenon..

But what are the true underlying causes of the destruction of forests? Four factors are of special importance: (1) the explosive growth of human populations, (2) widespread and extreme poverty, (3) biodiversity is consistently undervalued (4) failure to adequately use and recognize stakeholder input and knowledge, and (5) government policies that encourage the wasteful uses of forest resources (Raven 1987, Repetto 1988). The last factor includes inappropriate trade policies (including resultant market pressures), the lack of a political will to enforce sustainable management policies, and the lack of appropriate institutional and legal frameworks.

1.3 Can we develop solutions?

Expanses of pristine forest that support an enormous diversity of wildlife and plants and a richness of human cultures are being rapidly converted into vast wastelands that support a few tough, fire-resistant weeds and perhaps some cattle, while people scrounge for food and fuelwood from the newly-degraded soils and sparse shrubbery (Gradwohl and Greenberg 1988). We cannot conserve biodiversity simply by preserving areas and trying to prevent all changes, whether naturally occurring or human-caused. Nor can we conserve biodiversity by trying to maximize diversity on any particular site.

How can land managers and policy makers react to the oftentimes painful dilemmas they face on an almost daily basis when making decisions that can have potentially devastating impacts on ecosystem stability? The discipline of Conservation Biology has been described as a "crisis discipline, where limited information is applied in an uncertain environment to make urgent decisions with sometimes irrevocable consequences" (Maquire 1991). This really speaks to the heart of all land managers. They find themselves trying to find the balance between maintaining and sustaining forest systems while still providing the forest products needed by people. Trade-offs aree inevitable and necessitate formulating and using alternative land management strategies to provide an acceptable mix of commodity production, amenity use, protection of environmental and ecological values, and biodiversity. Conserving biodiversity now is likely to alter immediate access to resources currently in demand in exchange for increasing the likelihood that long-term productivity, availability, and access are assured.

But is this dilemma something new? Are we the first to wrestle with these kinds of decisions? With massive simplification of landscapes? Plato in approximately 2350 B.C. describes an area in ancient Greece that was stripped of its soil following clearing and grazing (Formann 1987). In fact, since the development of agriculture, there have been extensive modifications to the natural vegetation cover of every continent except Antarctica (Saunders et al. 1991). Yet, never before have there been so many humans on earth taking advantage of its resources.

It is hardly surprising then, that global awareness and concerns for conserving biodiversity are continually increasing. When we have concerns for biodiversity we are saying we have a concern for all life and its relationships (Szaro 1992a). As arguably the most intelligent species on earth we have a responsibility to try as much as possible for the continuance of all forms of life. But how can we go about this? One step is to try to determine the amount, variety, and distribution of species, ecosystems, and landscapes. This will require more comprehensive inventories which must be followed by monitoring efforts to determine the impacts of management activities. Another step is to develop and implement strategies for the preservation, maintenance, and restoration of forest ecosystems. These efforts should also incorporate strategies for the sustainable use of forest resources including more efficient utilization, recycling programs, and forest plantations in order to meet human needs.

The responsibility for biodiversity belongs to all people and institutions, both public and private (Salwasser 1990). The repeated association of biodiversity with preservationist approaches

leads to the perception that biodiversity requires wilderness and preserves and can not be sustained where human activities are prevalent. This view has disastrous consequences. It is clear that the major accomplishments on behalf of biodiversity must occur in conjunction with human activities.

To maintain biodiversity, we must ensure that a sufficient amount of each ecosystem is conserved and managed through a variety of actions that address different and related concerns. And because these actions must occur on lands under a variety of ownerships, goals, and uses, considerations for biodiversity must be blended into a myriad of management approaches (Salwasser 1990). We must strive to understand the functions and processes of natural ecosystems, and make the wise, tough decisions that are necessary to maintain and enhance the productivity of those systems for all purposes and uses. This means that biodiversity, and an understanding of ecosystems, should be the underlying basis for the management of all lands.

1.4 What are the priorities?

A clear priority in forest biodiversity conservation is the establishment of a permanent forest estate that includes extensive areas of native forest. The delineation and long-term viability of a permanent forest estate is fundamental (Burgess et al. 1989). At the same time, we need to recognise that the vast majority of forest areas cannot be "protected" against all human use. The largest pay-offs for investments in biodiversity conservation will be achieved by better reconciliation of biodiversity objectives with improved forest management systems for logging and other extractive uses of forests (Grieser-Johns 1997).

Many questions have been raised about the role and impacts of logging (and other uses) on the conservation of forest biodiversity (Bowles et al. 1998, Chazdon 1998, Gascon et al. 1998, Rice et al. 1997, 1999, Reid and Rice 1997). These include:

- ? Is total protection the best or only way to ensure the conservation of forest biodiversity?
- ? Is the ***log-once-and-leave-it*** strategy viable?
- ? Can forest management practices be adapted to achieve biodiversity conservation?
- ? How can one favour a mosaic of differing but complementary forest uses, including logging, across larger landscapes?

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Soulé and Sanjayan (1998) argue that comprehensive conservation of all the world's species requires that 50% of the Earth's surface be included in protected areas. Whatever the uncertainty associated with such estimates, protection at this scale is likely to be impossible. There is currently neither the will nor the ability to protect all taxa from extinction. The medical community uses triage as a means to optimise the allocation of its resources in situations where not everyone can be saved (some taxa will be lost whatever, and some will certainly survive – we must identify and focus attention on the remaining category where intervention can make a difference). Such an approach must be applied to the current situation in the world's forests. What this means however is the development of systems under which realistic assessments are made about the potential outcome of "treatment". Does it really make sense to spend millions of dollars "saving" a single charismatic species or are our resources better spent on saving as many species as possible? Our actions must

be attuned to the reality that many species will ultimately become extinct no matter what heroic efforts are made.

This leads to some essential and inescapable questions: How do we set our priorities? Who sets them? Who pays for attaining them? What are they? Then finally - when we have agreed and clearly articulated priorities - what actions will be most effective in achieving these goals?

The "best" choices will depend on the realistic options available. These real-world scenarios are ill served by absolute stances, e.g. against logging per-se. Real choices are about how much land to allocate to different uses and how to regulate the use of that land. In most cases societies will not accept the opportunity costs of protecting all forests. In poor countries the evidence suggests that the use of logging systems that are more sensitive to biodiversity conservation will be a preferred conservation option. Especially, as there is abundant empirical evidence that forests under all intensities of management can contribute to biodiversity objectives in a landscape mosaic. Recent work by Parrota et al (????) has shown this to be true even for industrial tree plantations.

Broadly generalisable approaches to achieving biodiversity objectives in logged forests may have little relevance. Both the objectives of biodiversity conservation and the technologies and trade-offs needed to achieve them will need to be developed in response to local social and biophysical conditions. A process will be required to work at a regional and local level to balance the land-use mosaic to optimise economic, social and environmental utility. Conservation agendas will require that different parts of the regional/national forestry estate be managed with different goals and priorities. The process of negotiating a diversified forest estate will also define where direct financial revenues may be sought, and where a subsidy may have to be directed. However, the application of broad and well informed guidelines and principles may be useful as a check-list in formulating management practices without blind-spots (e.g. see Mangel et al. 1996 for one useful synthesis of management issues).

The difficult technical issue is to optimise the balance between protected and managed areas across total landscapes (Szaro and Johnston 1996). In order to do so, we must take an approach that integrates multiple scales. It is important to realise that principles that apply at smaller scales of time and space do not necessarily apply to longer time periods and larger spatial scales (Crow 1989). Long-term maintenance of species and their genetic variation will require co-ordinated efforts across entire landscapes (Miller 1996). In most cases biodiversity should be dealt with at the scale of habitats or ecosystems rather than species (Hunter et al. 1988). If context is ignored in conservation decisions and landscape patterns change radically, the content of habitat patches will be altered by edge effects and other external influences (Noss 1996). In general the scale and scope of conservation has been too restricted and steps must be taken to incorporate the benefits of biodiversity and the use of biological resources into local, regional, national and international economies (Miller 1996, WRI/IUCN/UNEP 1992).

2 The Relationship Between Forests, People, and Biodiversity

2.1 Humans as an Integral Part of the System

---Key Points---

- Many tropical forests are anthropogenic landscapes even though we do not always perceive them as such (Posey and Balée 1989)
- In some cases local people are *responsible* for the generation and maintenance of forest cover through complex systems of traditional management (Fairhead and Leach 1996)
- Forest immigrants frequently undervalue forest biodiversity, e.g. Brazil, Indonesia.
- Local people often endure costs (as well as benefits) from local forests: these include crop damage, predatory animals, and diseases.

Humans must be considered as parts of almost all ecosystems, so sustainability must be applied to human economies, societies, and to development as well as to ecosystems. It is important to recognise the holistic view needed to sustain natural and human systems. This "view" expands the previous focus on "protected areas" which inherently views all human action as "disruptive" to "nature's balance" to one that views human activities as part of the overall system and integral to the solution and not simply the "problem".

There has in some cases been too little attention to the role of indigenous peoples, and their roles in creating the forested landscapes we see today (Posey and Balee 1989, Fairhead and Leach 1996). In some cases the assumption of people as an inherent threat to forests has lead to disastrously inappropriate policies (Fairhead and Leach 1996).

Archaeological evidence points to the interaction between humans and tropical forests that extends far into the past when population densities were actually higher than they are today (Gomez-Pompa & Kaus 1990, Parsons 1975). In Mexico, studies clearly document the existence of ancient civilizations with high population densities integrated within tropical forest ecosystems. Examples are both the Olmec and Maya civilizations of southeastern Mexico that existed in that region for a combined period of at least 3000 years (Turner 1976). Population densities in the rural Mayan area today are only about 5 people per Km^2 compared to the peak of 400-500 people per Km^2 during the height of the Olmec and Maya civilizations (Turner 1976). Extensive areas of tropical forests in Mexico that have been cut over the last 50 years were not untouched primeval forest but the result of regeneration since the last cycle of abandonment (Gomez-Pompa & Kaus 1990).

Recent tropical deforestation is associated with a pervasive cycle of initial timber extraction followed by shifting cultivation, land acquisition, and subsequent conversion to pasture (Partridge 1984) which leads to loss of forest resources, reduction of biodiversity, and impoverishment of rural people (Gomez-Pompa & Kaus 1990). The effect of past civilizations on the structure and composition of today's forests is more than just an intriguing questions but is important in determining those practices used by those civilizations to maintain the tropical biodiversity left by previous generations. In fact, one of the primary causes of tropical deforestation in Mexico is due to the neglect of traditional people's vast experience with resource management. The persistence of forest resources and ecosystems following widespread human intervention indicates that a knowledge of

management techniques practiced by ancient civilizations, such as the Olmec and Maya, could help in reverting current processes of landscape degradation in the tropics (Gomez-Pompa & Kaus 1990).

However idealising the ecological 'good will' of local communities can also be naïve. We need to foster a more realistic and pragmatic view of the needs and wishes of forest dependent peoples. In many cultures pushing back the forest frontier is still synonymous with progress and development (as in early US days). People do not want to remain hunter-gatherers (many forest communities do not even want to live in forests).

2.2 Forests as a Source of a Multiplicity of Benefits

One of the most perplexing problem arising from the multiplicity of benefits from forest ecosystems is how to place a value on them. It is relatively easy to determine market values for things (i.e. timber, mushrooms, etc.) that are trade in the global marketplace. It is quite another matter when trying to place values on ecological services. Gowdy (1997) points out "Although market exchange values of environmental services may be used to justify biodiversity protection measures, it must be stressed that exchange value constitutes a small portion of total biodiversity value. The total value of existing biodiversity is largely unknown but indications are it is essential to human existence." Yet, although there is a need for a valuation of these benefits, there is already sufficient evidence that the value of the goods and services from forests is enormous. Even with this evidence, there is a critical lack of recognition of the real value and the integral role of forests in maintaining life support systems (Verolme and Moussa 1999). The value of forests, including socio-cultural and ecosystem services, are not currently fully reflected because their valuation is not rooted in ecosystem sustainability. This leads to deforestation due to the unrealized opportunity cost of maintaining/losing forest resources. What is missing are the "markets" for many of these benefits and the appropriation of the benefits. These are often addressed in the extreme local versus global context while the conflict is often over local benefits.

2.3 Differences Between Types of Forests

Much of the concern on deforestation has been focused on the tropical forests because of their high species richness. Yet, the area of the world's forests, including natural forests and forest plantations, was estimated to be 3,454 million hectares in 1995 with an almost equal split between tropical/subtropical forests and temperate/boreal forests (FAO 1999c). These statistics argue for a balanced approach that considers all forests.

Many differences exist among boreal, temperate, and tropical forests, from species richness to their adaptability to changing climatic and disturbance regimes. Within these broad regions additional differences exist related to geographic, climatic, and species distribution patterns. Given these differences it is hardly surprising that proposed solutions for managing them also have to be different. Further consideration has also to be given to the role of primary versus modified forests.

Changes in silvicultural systems are occurring in all types of forests but those systems differ both among regions and among countries. In the temperate zone, revised silvicultural guidelines are being developed by many countries as an outcome of the recent initiatives related to identification and use of criteria and indicators (FAO 1999c). The Pan-European Operational Guidelines for Sustainable Forest Management, addresses regeneration, choice of management system, tending and harvesting, the use of pesticides and herbicides, and protection of key types, sensitive areas, and sites of historical, cultural, or spiritual significance.

Similarly, in North American Temperate and Boreal Forests, there has been a dramatic shift in forest management thinking to the concept of "ecosystem management" and its implementation through adaptive management (Johnson et al. 1999). Codes of best management practices or forest management practices have been developed for virtually all regions of Canada and the United Stated.

In the tropics, there are clear indicators of gradual change towards silvicultural practices that better reflect the principles of sustainable forest management even in secondary forests that have developed on fallow agricultural lands (FAO 1999c).

2.4 Protection vs. Management

---Key Points---

- Many areas of natural forest will remain outside the limits of economic feasibility for commercial logging for the foreseeable future.
- No single strategy, policy, or operational response can possibly fit all situations.
- Lack of funding by the GEF, World Bank and other lending agencies would mean that these institutions are unable to apply pressure that might significantly improve timber harvesting practices (Dykstra 1999).

The recent debate over logging and tropical forest conservation emphasises the controversy over the role and benefits of forest management for biodiversity (Bowles et al 1998, Chazdon 1998, Gascon et al. 1998, Cabarle 1998, Hartshorn 1998). Bowles et al. (1998) argue that to "protect what remains of tropical forests, the most appropriate investment may be in new protected areas, more investments in existing parks and reserves, and creative mechanisms like corridors to link protected areas." However, the track record for "protection" systems particularly in the poorer tropical countries has been poor. There is a strong emerging consensus that if forest conservation is to succeed, it is imperative that conservation efforts extend beyond protected areas (Cabarle 1998). Even the most ambitious exponents of biodiversity protection only advocate the allocation of around 10% of forests to parks and reserves and obviously the fate of much biodiversity will depend upon what happens to the residual 90% of the forest estate. Most forests will never be incorporated into protected area systems and the vast majority will be subject to some management intervention (Gascon et al 1998). An important issue in this mix is who pays for the opportunity costs of foregoing or reducing an immediate economic return in order to meet biodiversity conservation objectives? Are costs to be born locally by inhabitants of forests, at a distance by those who benefit from the existence or use of biodiversity, or could they be met by global mechanisms such as the GEF. ***The solutions to these problems are complex but they will be more readily solved if land is allocated and managed in such a***

way as to maximise the financial benefits derived from biodiversity and minimise the opportunity costs incurred through reduced forest product harvesting.

There has been an increasing appreciation that rather than the millions of years of tranquil evolution imagined by many commentators that many of the world's forests have had a distinctly dynamic and violent history. With this realisation has come a greater appreciation of the robustness of many tropical forest systems (e.g. Whitmore & Burslem 1998). Many forests are much more robust than is supposed, though some (e.g. white sand forests of Surinam (Oldeman, de Graaf et. al. ?????) are almost incapable of recovery after major disturbance.

Ideally, systems can be developed and used which will both increase revenues and be environmentally acceptable. Significant gains in conserving biodiversity can be made by improving silvicultural practices (Cabarle 1998) and managing all activities in the concession areas (Robinson et al. 1999).

This does not mean that protected forests are unimportant, but that they are unlikely to be large enough. Many species will only be conserved within a matrix of protected and managed forests. Preserved "islands" of biodiversity will always be located within such matrices (Callicott et al. 1998). This has major implications for the sustainability of both protected and managed forests and has long been recognised as an integral requirement of sustainable management (e.g. Dawkins 1958). According to Naeem (1998), local extinctions are inevitable and frequent. However, immigration of species from adjacent areas can ensure that such losses are transient. Thus the maintenance of ecosystem function and structure (sometimes equated with ecosystem health) in inhabited and exploited areas may depend upon of the distribution of biodiversity and protected sites in the wider landscape. A blending of both protected and managed forests is needed and neither approach should proceed in isolation (Callicott et al. 1998).

Definitions

Much of the confusion surrounding the debate on biodiversity conservation derives from the loose or inconsistent use of terms. For the purposes of this paper we are adopting as far as possible the definitions of terms which have been adopted by, or are widely accepted in, official documents of the COP of the CBD. In particular, and for practical purposes, we are using the following working definitions

Protected area and **Protection:** We use these terms in the sense of IUCN's, WCPA Protected Area categories I to III. That is areas that are managed exclusively for the maintenance of indigenous biodiversity with human use being limited to non-extractive recreation and amenity.

Conservation: We use this term as a loose synonym for sustainable or wise-use. Conservation of biodiversity can include use providing adequate provision is made for future benefit flows and options.

Management: Means any purposeful intervention to achieve a desired outcome. Chasing poachers and improved silviculture are both forms of management.

Managed Forests: Forests where such interventions alter the balance of goods and services derived from the forest.

Production Forests: Forests maintained for the primary

There are important ecological dependencies that are not restricted to forests. For example Frankie *et al.* (1990) have shown that the key pollinators in some forests of Costa Rica depend upon non-forest patches, generally outside the reserved forest areas. One-quarter to one third of the migrant bird species of the world are forest dependent during one or more phases of their life cycle and forest loss appears to pose the main threat to these species (Rappole 1996). Other examples include the importance of mangrove as spawning grounds for local fisheries.

Forests managed for timber and/or non-timber products provide habitats

for many, often the majority, of the plant and animal species found in more pristine forests. The number of species persisting is dependent on a variety of factors, predominantly on the degree of intervention and modification of the original ecosystem (ITTO 1993). However, in general, the management of a forest for timber production and many other purposes requires the modification of the natural ecosystem to provide access, to remove forest products and in some cases, to increase the yield of commercial species. Inevitably, some of the original forest species will then be locally lost. The net result, at least in the short-term, is often a change in diversity. Often, generalist species are favoured at the expense of old-growth specialists. But the intensity of these changes and the time frame over which they are detectable can be greatly influenced by the techniques used in the planning and execution of harvesting.

There is a deep-rooted division even within conservation. Callicott et al. (1998) consider the jargon surrounding biodiversity conservation and distinguish two views (normative concepts): with very different philosophies about the purpose and rationale of conservation. *Compositionalism* excludes people from the system and values nature for its existence value, *functionalism* values products and services and takes a fundamentally anthropogenic stance. Not surprisingly these two schools respectively reject and embrace extractive management.

Converting natural forests into other land uses has far more drastic impacts on biodiversity than management for timber production. A very large proportion of the world's forests are used for the production of timber and this situation is likely to persist (ITTO 1993). We do not need to prove again and again that productive forest systems can have considerable biological value - this is clearly known (e.g. Thiollay 1995). The future of much of the world's forest biodiversity depends upon the way in which these forests are managed.

2.5 Forecasting Impacts of Management Practices on Biodiversity

2.5.1 Impacts of Silvicultural Practices on Biodiversity

The earth's forested estate has shrunk by about a third since the rise of agriculture-based civilisations and continues to be converted at dramatic rates (Noble and Dirzo 1997). Most clearing arises from pressures that are external to the forested ecosystem. For example, in places like Para, Brazil, the frontier expands with the logging roads, and logging expands to other species (see Uhl et al. 1997). Fire and cattle ranching follow, in a process of degradation and conversion. There has been a history of undervaluing forest resources and setting royalties, purchase costs, or "stumpage" payments too low to cover the cost of management let alone the cost of externalities (Noble and Dirzo 1997). The example in Brazil is a classic example of this - log prices are so low that landowners are apparently not interested in management. Low prices encourage the liquidation of forests and their conversion to agricultural systems that yield quicker but oftentimes-unsustainable returns (Noble and Dirzo 1997).

Whether forests are considered as protected areas or under some degree of harvest, there is a wide range of potential management practices to choose from. Choices depend upon the goals and objectives of management and the composition, function, and ecosystem processes of the forest themselves. Additionally, they are affected by a wide range of geographic and physical features that limit accessibility or the feasibility of any given silvicultural system. The choice of silvicultural systems is also partially determined by human resources, forest policies, and institutions (Dawkins and Philip 1998). It has been shown in Europe and North America that selection silviculture and harvesting require more intensive supervision than more simple uniform systems (Dawkins and Philip 1998). The impact of any particular system is determined by the extent of forest extraction and also by the way the system is implemented.

Silvicultural systems range from the traditional clear-cutting, shelterwoods, strip-cutting, and even-aged management to those being promoted as being more conducive to the conservation of biodiversity such as the uneven-aged selective logging systems. All silvicultural systems leading to ***logging, in all types of forests, ultimately will have some potentially negative impacts on forest biodiversity. The key point however is NOT whether they will impact biodiversity but the degree to which they do so, the proportion of the landscape affected use, and the time span of the effects***. Well-designed systems, no matter the intensity of harvesting, can contribute to the conservation of biodiversity within an overall landscape mosaic. Certainly, any forest is superior to no forest in this equation. Systems can be chosen within the overall landscape context that can contribute to the desired goals and objectives for conservation. In some cases, logging or clearing might even prove to absolutely crucial to meeting certain biodiversity objectives. For example, in the Rocky Mountains of the United States, aspen forests are declining because of extensive fire suppression and the reduction of forest clearing in the region. Systems that evolved under the influence of some sort of disturbance regime will require management practices that mimic natural disturbance patterns.

Can we manage tropical forests to sustain them? Some believe that our technical knowledge is grossly inadequate while others maintain that an adequate technical base exists for sustainably managing tropical forests. In reality, the answer probably lies in another direction. Most of the literature concerning forestry in the tropics deals with the consequences of technological practices. Little reference is made to the challenge of promoting social acceptance and support for implementing those practices (Wadsworth 1997). ***The main reason for losing biodiversity in the tropics is not a lack of technical knowledge about forest management but rather the absence of the institutional and political framework under which biodiversity-friendly management practices can be implemented***.

Is there a better way?

In the Asia-Pacific region, there are now in place a number of technical guidelines for improved systems and approaches to timber harvesting in Production Forests. These documents come in the form of Codes of Practice or reduced impact harvesting guidelines (RIL) such as the Code of Practice for Forest Harvesting in Asia-Pacific, designed to provide details on the principles and the operational practices to be adopted in harvesting of timber from production forests. Similar codes and RIL guidelines are now part of policy in many countries including Vanuatu, PNG, Solomon islands (to be reviewed), Fiji, Samoa (draft), Indonesia, Lao PDR, Sabah, and Peninsular Malaysia.

These Codes for improved management of the remaining Production Forests, address not only methods of timber production, but also conservation of biodiversity, and maintenance of soil and water quality. However, If these codes or RIL guidelines are not accompanied by other necessary reforms, these efforts will be unlikely to change practice

Given that an abundance of tropical biodiversity dwells in production forests outside the limits of totally protected areas it is critical that they be sustainably managed. In many countries, the large size and varied habitats of these working forests offer opportunities to complement the existing system of reserves (Fimbel et al., in press). Assessing the optimum potential benefits of tropical forests may appear futile in view of the social difficulties inherent in halting uncontrolled felling of state-owned forests for shifting cultivation and other forms of agriculture (Wadsworth 1997). Because no land area can produce all the desired benefits, the role of individual forests must be determined by compromises. Each possible use yields different benefits accruing over different periods, and many forest benefits continue to be difficult to quantify economically (Wadsworth 1997).

2.5.2 Forest Logging and Biodiversity

Most studies of the impact of logging have been gross scale 'comparisons of estimates' based on assessment of specific taxonomic groups. Most, even the best known studies, are severely compromised by poor experimental designs. Bawa and Seidler (1998) summarise that 'post-harvest surveys of a spectrum of tropical forests indicate a range of logging effects from local extirpation to substantial increases in local densities of some species'. They point out three difficulties in interpreting past studies:

1) Differences amongst the conditions and circumstances associated with the harvesting (ecological, scale, practical),
2) Associated effects (e.g. hunting, roads, fire, legal enforcement), and
3) Data are often too short term to be interpreted.

They do however conclude that while quantitative information is scarce, all harvesting appears to have simplifying and homogenising effects on tropical forest diversity (Bawa and Seidler 1998).

There is certainly a wide range of views as to the implications of such studies. Struhsaker (1997), considers the long-term impacts of forest harvesting to be totally incompatible with conservation and challenges the notion of 'sustainable'. On the other-hand Grieser-Johns (1997) in a major review of the effects of timber harvesting on rain forest wildlife, strongly argues that wildlife conservation can and should be enhanced through a managed forest estate that pays enough attention to the needs of the wildlife it contains.

Hawthorne (1993, 1996) in reviewing Ghana's forest flora concluded that no plant species would become locally extinct as a consequence of harvesting, providing the measures outlined in Hawthorne and Abu Juam (1995) were adopted and fires controlled, but that monitoring would nonetheless be essential. Crome et al. (19++) note that most studies of logging effects offer little guidance to managers who are unable to interpret the changing abundances of long lists of species in terms of clear management actions.

Few studies have looked at ecological relationships influenced by harvesting. For example, the ecological role of large, old and hollow trees in tropical forests has been poorly evaluated, though the balance of evidence would suggest it could be considerable (Newton 1994). Many

forest species depend more or less exclusively on large moribund stems, e.g. epiphytes (Hietz-Seifert *et al*. 1996), hornbills (Datta 1998, Whitney and Smith 1998, Whitney *et al*. 1998), woodpeckers (McNally and Schneider 1996), and hyraxes and other hollow tree nesters (Zahner 1993). This includes important pollinators like bees (Kerr *et al*. 1994, McNally and Schneider 1996) and seed dispersers (Whitney and Smith 1998, Whitney *et al*. 1998). The loss of such stems can thus have significant long-term influences (Gordon *et al*. 1990). Although such processes are not well documented, they are believed to have contributed significantly to changes in forest biodiversity in various parts of the world.

The loss of aquatic biodiversity as a result of logging is understudied, but the impacts of such loss is of concern to local communities, so improved practice with respect to hydrology and aquatic systems is likely to be of broad benefit. Greiser-Johns (1997) reports that after logging the predominant amphibians specialized in anoxic water. He also notes that a dramatic increase in mosquitoes after after logging is a common phenomenon – and health risk. Silt deposition caused major declines in bottom-feeding river fish (Samat 1993). Such silt-loads can have major impacts far down stream – even in some cases degrading coastal habitats such as coral reefs, mangroves and offshore fisheries (e.g. Hodgson and Dixon 1988).

Logging impacts are patchy and uneven due to the irregular distribution of the harvested trees and the localized effects of extraction sites, log bays, loggers' camps, etc. These spatial patterns add considerably to the complexity of assessing harvesting effects (what scale is appropriate?), and are further compounded by the specific details and uniqueness of every site and operation (Cannon et al. 1994, Plumptre 1996).

Loss of tree cover often allows the recruitment of naturalized exotics (that is species that are not native to the area). While the ability of exotics to colonize intact continental rainforest is disputed (Whitmore 1991, Cronk and Fuller 1994), the presence of exotics will, at the very least, reduce options for maintaining biological integrity after harvesting (Sheil 1994, Rejmanek et al. 1996).

We should not pretend that timber harvesting can ever be synonymous with total conservation of biological diversity. There is, at the site level, a very real potential conflict between longer-term silvicultural objectives ('high disturbance') and conservation goals to maintain old-growth ('low disturbance'). This is clear in Uganda where most valuable timber species grow best in open or disturbed environments (e.g. *Maesopsis*), and most will not regenerate without significant opening of the forest canopy (e.g. Meliaceae, such as *Entandrophragma* spp.). Thus the long-term aims of local forestry in Uganda have been to deplete the low-yielding 'old-growth' formations in favour of the 'earlier successional' timber forests (Dawkins 1958, Dawkins and Philip 1998, Sheil and Van Heist unpublished).

A limited view of 'improved silviculture' is not adequate to address conservation concerns. Increased accessibility of forest areas, growing and immigrant populations and increasing demands for wildlife and non-timber products are very much a part of challenges that need to be met (Robinson et al. 1999).

2.5.3 Do Species Lists Reflect Values?

Species are not of equal value and the length of a species list does not reflect the value of a site for conservation. Conservation needs to ensure the long-term protection of useful, vulnerable and threatened taxa. There may be trade-offs between usefulness and rarity. A poor forest dwelling person in a tropical country would not necessarily agree with a museum taxonomist on the list of species to be targeted for conservation.

Disturbance in old-growth forest can promote increased species richness in the local area - but the added species are generally common species, while old growth forest-dependent species are becoming ever rarer. Many environmental changes, even those associated with environmental degradation, can lead to a transient rise in species densities (Sheil *in press*). These increases also occur in already diverse forests (Cannon *et al*. 1998,Sheil *et al*. 1999). Some species may not be tolerant of forest harvesting, (e.g. Lian et al. 1996) hence the need for setting aside Nature Reserves, or devising specific protection measures

---Key Points---

- Clear operational objectives are needed. Good management requires the pursuit of clear objectives that are simultaneously realistic, clearly articulated, acceptable, well informed and clearly prioritised. Such a 'local management policy' will explicitly guide the choice of verifiers and the purpose for which they are assessed.
- The main priorities in tropical forestry are often obvious; e.g. forest cover must be maintained with limited management capacity. Verifiers should address such priorities and not detract from them.
- We cannot sustain everything 'as it was' in a harvested forest - we require indicators of *good management,* not of pristine nature.
- Management tasks and targets can be defined in C&I terms. Good verifiers should reflect and guide the attainment of reasonable management priorities.
- Foresters and protected-area managers already use many useful and cost effective indicators. There should be greater consideration of methods already used by managers and of other potentially useful sources of management information.
- Indicator data are not used in isolation - they are simply one means of assessment to be interpreted in the light of informed common sense and negotiation. Interpretation of verifier data will depend on value judgements, preconceptions and assumptions - not upon scientific principles alone. Even when data is unequivocal there may still be disagreement on the management implications. We need to consider the use and value of data as much as the process of data collection

2.6 The Use of Criteria and Indicators to Determine Sustainable Management

Several international and regional initiatives on criteria and indicators for sustainable forest management have emerged, stemming from the UN Conference on Environment and Development held in Rio de Janeiro in June 1992. These emphasize the maintenance of biodiversity as vital to ensure a sustainable system. Criteria and Indicator initiatives involve more than 100 countries and include the Pan-European Helsinki Process, the Montreal Process for temperate and boreal forests, the Tarapoto Proposal for the Amazon, and regional initiatives for Dry-Zone Africa, the Near East, Central America and the

African Timber Organisation. In February 1997, the UN Commission on Sustainable Development's Intergovernmental Panel on Forests endorsed the concept of criteria and indicators for sustainable forest management and called on all countries to become involved in implementing them (ITTO 1998).

Local, national and international negotiations on criteria are essential to clarify the biodiversity outcomes desired by diverse sectors of human society. Indicators will be needed to assess our progress in attaining these outcomes. But just how useful or effective is the concept of criteria and indicators? The search for a consensus on sustainable forest management (SFM) Criteria and Indicators may have delayed action to improve forest practices that clearly fall below professionally acceptable standards (Dykstra 1999). Much can be done to improve forest management without worrying about whether or not all criteria for SFM are being achieved. An adaptive approach to SFM can allow for changes in management practices while dynamically moving towards the goal of SFM without waiting for a "perfect" set of criteria and indicators (Dykstra 1999). ***Criteria and Indicators processes need to be linked more pragmatically to realities on the ground. If they are based upon a uniform top-down vision of universally applicable forest management prescriptions they are likely to hinder rather than assist the emergence of viable local management outcomes.***

2.7 The Role for Restoration in Biodiversity Conservation

While research and management are urgently needed to slow continuing losses of biodiversity, the remediation of past losses can help offset unavoidable future losses (Szaro 1995). Restoration of ecosystems and biological communities is one important means of maintaining biodiversity, or at least of slowing its net loss. Biodiversity is threatened not only be a reduction of habitat area and of connections between habitats, but also a degradation of quality of the remaining habitats. Restoration activities respond to these problems by restoring eliminated habitat types (e.g., native prairies and wetlands) and enhancing the condition of remaining habitat fragments. By restoring both the extent and quality of important habitats, restoration programs provide refuges for species and genetic resources that might otherwise be lost. Moreover, surrounding landscapes are habitats that disperse into these disturbed areas, and so restoration programs can also affect the recovery and renewed diversity of their biota.

Restoration is not a substitute for preservation or good management and is both time-consuming and expensive. In tropical forests, the incredible diversity and complexity of the ecosystem make restoration of the original vegetation and ecosystems particularly difficult (Gradwohl and Greenberg 1988). But even though it addresses the symptom of deforestation rather than the causes, restoration ecology is worth serious consideration. It can speed regeneration in managed systems, make non-productive land productive again, relieve pressure on natural forest resources, and protect closed-canopy forest. It is a strategy most appropriate in areas of severe erosion and soil compaction, where quick action is desperately needed (Gradwohl and Greenberg 1988).

Many techniques are used to restore ecosystems, depending on the ecosystem and impact type being addressed. These include vegetation planting to control erosion, fertilization of existing

vegetation to encourage growth, removal of contaminated soils, fencing to exclude cattle, reintroduction of extirpated species, restoration of hydrologic connections to wetlands, and others. Not all these restorations strategies are compatible with the goal of maintaining biodiversity. For example, eroding lands can be rapidly restored by introducing some types of aggressively spreading plants, but the same plants can spread beyond the site and imperil the diversity of flora in adjacent areas. Thus, restoration actions can be either a savior or a nemesis for regional biodiversity, depending on their design, application methods, and existing conditions of the landscape.

Just as there are many restoration techniques, there are a very large number of species that exist in habitats that are candidates for restoration. Each has particular environmental requirements, minimum viable population size, and expected recovery rate and pattern--knowledge which is essential to evaluating restoration potential. Although responses of some species to specific restoration techniques is known, the theoretical basis is weak for grouping species so that results can be extrapolated to other combinations of techniques and species. Ecosystem restoration does not always require intervention. Left to natural processes, many ecosystems will return to something like their pre-disturbance condition if populations of original species still exist nearby (Reid and Miller 1989). For example, a temperate climate and productive soils promote natural re-establishment of forests in most regions of the United States. However, restoration technologies can speed the recovery of communities and ecosystems after disturbance and can enhance *in-situ* conservation (Reid and Miller 1989).

2.8 The Role of Plantations for Relieving Pressure on Primary and Minimally Managed Forests

---Key Point---

? Forest plantations constitute the fastest-growing source of industrial roundwood outside of natural forests but it will be at least a generation before they take the lead from natural forests as the primary global source of timber and fibre (Citation ????).

The potential role of forest plantations in supplying future demands for timber products will be determined by the balance struck in policy decisions responding to increasing demand for forest products and public pressure for an environmentally sensitive manner of land management. Intensively managed forest plantations may help alleviate pressure on other more sensitive forest ecosystems by meeting demands on a smaller proportion of the overall land-base and thereby allowing more "natural" areas to be set aside and left alone.

Although not a panacea, plantation forestry is anticipated to become increasingly important as a means to meet global demand for wood products (FAO 1997). Production trends indicate a global shift in reliance for wood supply from native forests to plantations, with plantation forestry having expanded rapidly in recent years (Brown et al. 1992, Turnbull and Byron 1997). This is particularly true in tropical regions where plantation lands increased from 10 million ha in 1980 to 44 million in 1990, and presently account for approximately 80-100 million ha (1995) (Evans 1992, FAO 1997). Plantations provide higher rates of production per unit area than native forests, can produce similar products, and relieve pressure to exploit natural forest reserves (Evans 1992, Spellerberg 1996).

Based on the success of forest plantations, increasing attention is being paid to possible negative ecological consequences of plantation programs. Forest management techniques in general, and forest plantations in particular have been criticized for emphasizing single species monoculture in place of the mixed species aggregations that are more characteristic of native forests. Yet, many species planted, particularly in temperate forests, are native and plantations contain a considerable variety of genetic material, minimizing susceptibility to insects and diseases. Biological and structural simplification, although enhancing production efficiency, are a source of concern when widespread. There is increasing recognition of the impacts of plantation management on non-timber components of forests (especially wildlife). These concerns are legitimate, but the possible negative consequences of plantation management can be minimized when plantations are on component in a landscape-level approach to conserving biodiversity. It is also critical to differentiate between plantation management objectives and their historical development. For instance, the impact of large-scale, monoculture plantations on biodiversity is markedly different for those established on degraded or deforested land as compared to plantations that replace natural forest.

2.9 Land Allocation: Zonation as a Concept for Determining Land Use Patterns

Decisions about how to use land are a fundamental component of natural resource management (Hunter and Calhoun 1996). Should this valley be dammed to create a reservoir? Should this forest be set aside as a park? Often these decisions are made one at time--should this valley be dammed?--, but a broader temporal and spatial perspective is required to evaluate cumulative impact and regional context. One such broad-scale issue is the overall allocation of land to different uses. How much land do we need for agriculture, timber production, recreation, or wildlife?

As with many decisions made in a political arena, the answers often become extremely polarized (Hunter and Calhoun 1996). Environmentalists advocate setting aside as much land as possible by arguing that too much land has already been converted to human use, and that we should curb our resource consumption and, thus, the demand for more land. Resource developers advocate minimal restrictions on land use by arguing that a growing human population and demands for a higher standard of living, especially among the impoverished people of the developing world, necessitate that more land be allocated to meet human needs. Government employees and policy makers often end up refereeing these arguments and negotiating compromises. The compromises usually involve dividing the "pie" among competing demands; in some cases, they involve promoting intermediate forms of land use in which several compatible uses are accommodated on the same tract.

The intensity of land use varies in a continuum from no human manipulations to management that is so intensive that natural ecosystems are replaced by artificial or cultivated ecosystems (Hunter and Calhoun 1996). This continuum can be conceptualised as a model in which lands are viewed as: (1) intensive commodity production areas, (2) areas with little or no resource use by people, or (3) areas in which modest resource use occurs while ecological values are protected (Seymour and Hunter 1992, Hunter and Calhoun 1996).

The advantage of the model of a triad is that the concept of a continuum is too easily reduced to its two poles, and that polarised constructs lead to divisive discussions. All three types of land use have validity and finding the proper balance among these uses is the key to improve resource and biodiversity conservation (Hunter and Calhoun 1996). The contrasts between forests in a pristine state and those that are being intensively manipulated for wood production make forests an excellent example of the polarisation that often marks arguments about land use (see Poulsen (1999) for a discussion of the use of this model in agro-ecosystems).

Examining the allocation of current land-uses among this triad of categories of use can reveal imbalances that, if rectified, could improve land use from both an ecological and economic perspective. The two extremes can be viewed as the "intensive use" and "no use" components of the triad model. The "extensive" or "intermediate use" part of the triad is also well represented in forestry; it is the multiple-use doctrine that was the mainstay of foresters for many years and which, with modern refinements, was resurrected initially as New Forestry and finally came to be known as ecosystem management (Franklin 1989).

"Should we harvest forests so as to meet our needs from the smallest possible area, or should we harvest less intensively over a larger area?" That question was examined by Noble (1995) who with the use of a model based on simple relations between disturbance and biodiversity loss concluded that it is best to restrict harvesting to the smallest possible area. Many people view intensive forestry, with its monocultures grown on short rotations and clearcuts, as an environmental calamity, but there is a positive side: by obtaining maximum production on minimal areas, more land can be available for other purposes that are incompatible with timber production or other extractive uses (Seymour and Hunter 1992).

The tradeoffs suggested by a triad approach to land allocation would not work very well in a laissez-faire economy (Hunter and Calhoun 1996). Without government intervention, each tract of land would be exploited as intensively as possible, given economic constraints like the cost of doing business and the current market for the products being generated. Of course, governments always regulate the economy in general and the cost of doing business in particular. If society decided to shift the balance of land-use allocations, it could do so through zoning and other forms of regulations, tax incentives and disincentives, and other forms of direct and indirect subsidies. For example, if a government determined that lack of investment capital was the major hurdle to intensifying management on a smaller land base (this will often be the case), then it could offer low-interest rate loans. On the other side of the coin, areas under low-intensity use could be purchased by the government from willing sellers and made into reserves. Funds to support these expenditures could be generated by higher stumpage and grazing fees on public land and higher property taxes on corporate land. Simply tightening environmental regulations on multiple-use lands while relaxing regulations on intensively managed lands would shift the costs of doing business to encourage more production on a smaller area.

An implicit assumption of these potential tradeoffs between extensive management and intensive management is that the level of commodity production would remain about the same; it would just be obtained from a different land area. In stating that intensive management has a role in

wise land use, we must explicitly exclude management regimes that are so intensive that they are not sustainable. Practices that significantly compromise soil fertility are the best examples; they are well known to agriculturists and are becoming of concern in forestry circles too (Maser 1988).

3 Ecosystem Management as a Concept for Making Progress

Definition

Ecosystem management is management driven by explicit goals (developed by a wide range of stakeholders), executed by policies, protocols, and practices, and made adaptable by monitoring and research based on our best understanding of the ecological interactions and processes necessary to sustain ecosystem composition, structure and function (Christensen et al. 1996).

The Forest Principles adopted at UNCED (Rio de Janeiro, 1992) constituted a commitment to sustainably manage all types of forests: "Forest resources and forest lands should be sustainably managed to meet the social, economic, ecological, cultural and spiritual needs of present and future generations." The concept of ***ecosystem management*** arose as a reaction to the predominantly top-down, command-and-control approaches to natural resource management (Grumbine 1994). Ecosystem management can be thought of as an operational framework under which forests can be sustainably managed (Sexton and Szaro 1999).

The term ecosystem management has been used to imply an interdisciplinary, environmental approach to maintaining natural diversity and productivity of the landscape while sustaining human culture (IEMTF 1995; Brussard et al. 1998; Lackey 1998). The ecosystem approach emphasizes place- or region-based objectives, with scopes and approaches defined appropriately for each given situation. To achieve this, consideration is directed toward whole ecosystems although special attention may be needed for single species or single uses of natural resources. Because natural ecosystems typically cross traditional village territories, administrative and jurisdictional boundaries, managing them requires interactions among different stakeholders and institutions (Cortner and Moote 1994). The approach therefore is a strategy based on integrating ecosystem science and socioeconomic concerns with a process that involves stakeholders in defining objectives (Underwood 1998). Institutional coordination and change (Cortner et al. 1998), stakeholder participation, and collaborative decision making are key components of the process.

Key Points---

- There is abundant evidence that it is possible to modify forest management practices in order to enhance the biodiversity values of the residual stand or to contribute to biodiversity conservation at the broader landscape level.
- Only limited generalizations can be made about the types of modification to management that are required in order to achieve general biodiversity objectives. It is much easier to develop management models if the biodiversity objectives are clearly defined in terms of taxa, assemblages, populations, communities, etc. Management techniques will often need to be developed independently for all localities.
- The ecosystem approach emphasizes place- or region-based objectives, with scopes and approaches defined appropriately for each given situation.
- Ecosystem management is not a linear or standardized means to identify the one right way to manage resources. It attempts to involve stakeholders in defining sustainable alternatives for the interactions of people and the environments in which they live.

Ecosystem management is not a linear, highly standardized, or certain means to identify the one right way to manage resources (Szaro et al. 1998). It attempts to involve stakeholders

in defining sustainable alternatives for the interactions of people and the environments in which they live. It is not necessarily an easy process to implement. It is dependent on a basic institutional, organizational and legal framework already being established. In many poorer countries this framework will not exist and will have to be gradually developed over time. Many conservation problems exist because traditional institutions have been disrupted.

Conflict resolution can provide a means to find ways to balance conflicting views and objectives among stakeholders. There are also important scale issues within the stakeholder community as they reflect local, regional or global perspectives. This approach does aid in the development of better options and sustainable solutions by incorporating human needs and values, with our best understanding of the environment, while recognizing that science alone has not and will not produce a single "right" answer for resource use and management objectives. Instead, decisions will be a complex blending of social, economic, political (Freemuth and McGreggor Cawley 1998), and scientific information and interests.

3.1 Obstacles to modifying forest utilization patterns to enhance biodiversity values

The success or failure of forest resource management is greatly affected both by the laws and policies that relate to the uses and pressures upon forested lands and by the capacity and abilities of the institutions established to secure their implementation. A fundamental obstacle often lies in the relationships between various agencies, commercial interests and local people. Values, perceptions, and participation are important. Obstacles to the implementation of ecosystem management include:

3.1.1 Obstacles relating to having the necessary institutions, structures, and capacities for implementation

- lack of security of permanent forest estate
- Inappropriate power relationships, failure to apply ***subsidiarity*** resource control.
- lack of incentives to users (i.e. logging operators, non-timber forest gatherers, hunters) to improve their practices
- lack of a political will
- lack of capacity to apply laws and regulations
- lack of appropriately trained, socially sensitive staff
- lack of implementing structures and institutions especially at the local level

3.1.2 Obstacles arising once the basic institutional and management capacities are in place

- inappropriate planning and management processes
- conflicts in goals within and between government agencies, commercial interests, and local resource users
- inappropriately defined management units
- short-term asset-stripping by entrepreneurs

- ? lack of clarity in management goals and priorities
- ? poor use of existing information
- ? lack of management guidance on local biodiversity goals and priorities (Need to have clear regional biodiversity planning and priority setting (what where why?) – needs surveys - could cite recent Uganda work by Peter Howard et al. or Ghana work by Hawthorne Swaine et al. (Costa Rica example?)).
- ? Inabilities to assess and judge major threats to biodiversity and develop and or implement appropriate management responses.

3.2 The Importance of Scale and Spatial Resolution

---Key Points---

- ? Understanding scale is critical to accurately assessing the impact of land management practices on biodiversity.
- ? The scale of a conservation endeavour affects the strategy involved, the determination of realistic goals, and the probability of success.
- ? Long-term maintenance of species and their genetic variation, will require co-operative efforts across entire landscapes.

Ecosystem management is an approach that is scale-dependent. Many significant biological responses and cumulative effects become more evident at greater scales than at smaller ones. Consequently, framing problems and solutions at the appropriate scale is critical to evaluating management options. Planners and managers are increasingly aware that adequate assessment of any options requires consideration of their effects at all levels.

The scale and scope of conservation has been too restricted. Spatial scale be it local, regional, or global, greatly influences our perceptions of biodiversity. Understanding the importance of scale is critical to accurately assessing the impact of land management practices on biodiversity. The scale of a conservation endeavor affects the strategy involved, the determination of realistic goals, and the probability of success. For example, a strategy to maximize species diversity at the local level does not necessarily add to regional diversity. In fact, oftentimes in our haste to "enhance" habitats for wildlife we have favored edge-preferring species at the expense of area-sensitive ones and consequently may have even decreased regional diversity. It is important to realize that principles that apply at smaller scales of time and space do not necessarily apply to longer time periods and larger spatial scales. Long-term maintenance of species and their genetic variation, will require cooperative efforts across entire landscapes. This maintenance is consistent with the growing scientific sentiment that biodiversity should be dealt with at the scale of habitats or ecosystems.

Perhaps one of the most significant elements of the evolving ecosystem management approach is that it deals with information and analyses at multiple scales (Sexton et al. 1998). Historically, characterization and analyses tended to focus intensely at individual projects and programs based on the area and scale they directly affected. However it is important to understand resources and landscapes at several scales simultaneously during assessment and analysis. Collecting and analyzing information at several scales provides a relational context at multiple levels and supports an improved understanding of linkages and relationships within and between scales. This supports a better understanding of connections between features, patterns and processes and helps characterize potential effects and outcomes. Because of the constraints surrounding the selection of

appropriate scales and the need to scale up as well as down for management, it is useful to consider biodiversity assessment along gradients of land use intensity and the natural environment.

3.3 Stakeholder Involvement and Contributions

Successful implementation of the ecosystem approach depends on involving all stakeholders in planning, decision-making, and implementation (IEMTF 1995). There are three keys to effective stakeholder participation: 1) providing access to information on planning and technical documents, 2) developing educational programs on environmental concerns, and 3) engaging the public in dialogue at various stages of projects, both before and after implementation (IEMTF 1995). It is essential to use a highly participatory process, from beginning to end, before deciding on a course of action by involving all those interested in formulating alternatives, evaluating those alternatives and describing the process used to select one. The focus should be on end results--desired future ecological and social conditions and the land-use classes and management actions that will best attain them.

This is not an easy process as public input can be varied and conflicting. For example, those who live in local communities directly affected by management or policy decisions may have different perspectives from those at national, regional or global levels (IEMTF 1995). Stakeholders or participants in ecosystem management initiatives may assume a variety of roles and responsibilities, including initiator, participant, advisor, technical or scientific resources, funder, implementor, and decision maker (KNPDEM 1996). The nature and extent of each participant's involvement will depend on his or her interests and ability to participate. Roles and responsibilities can and do change over time.

Collaboration among organizations and individuals comprising an ecosystem management initiative is usually critical to its success. Effective collaboration allows all parties' concerns to be aired and potentially resolved in a less charged atmosphere. Moreover, stakeholders can make substantial contributions. The value of locally generated knowledge (including traditional knowledge handed down from one generation to the next) can provide incredible insight into the role of past practices and their potential use in future efforts. Local people oftentimes understand the consequences of their actions and how to arrive at desired outcomes much better than teams of "experts."

3.4 Establishing Goals and Objectives

Managers need clear and rational objectives in terms that they can understand. Much discussion of biodiversity management has floundered on ill-defined objectives. While loose wording can often be the best political solution to stating a consensus amongst a wide range of diverse interest groups it is not a satisfactory way to define and assess management goals. How can we say whether a given management practice is good or bad for biodiversity if we fail to define 'good and bad' in operational terms? Goals for ecosystem management need to reinforce its core characteristics and needs. For example, ecosystem-based management goals should, as agreed by the stakeholders:

- involve people and actors (participatory),
- be explainable and operational in a consistent way to different people and groups (understandable),
- reflect the wide range of interests, goals and objectives that exist (integrative),
- imply and reflect agreed values and limits (normative),
- reflect agreed upon ethical principles and rules (principled),
- work with, not artificially reduce, complexity (complex),
- recognize and accept the inevitability of change (dynamic),
- synthesize the full range of relevant information and knowledge (multi-disciplinary),
- be based on local needs, conditions and priorities (applicable and suitable)
- evolve as demands, conditions and knowledge change (adaptive).
- operate on scientific principles (logical)
- methods by different people should achieve similar results in similar circumstances (repeatable)
- techniques should be readily communicable (transferability)
- methods and options should be socially and economically acceptable (cost efficient)

3.5 Implementation Through Adaptive Management

---Key Points---

- Our ability to predict the impact on most components of biodiversity of specific management interventions is limited and ***adaptive management*** is required.
- Adaptive ecosystem management depends on an evolving understanding of relationships in both biological and social systems.
- Localized community or household management and devolved decision-making are key components of using adaptive management.
- While the concept of adaptive management is relatively straightforward, applying it to complex management situations requires answers to several critical questions. What new information should compel an adjustment to the management strategy? Who decides when and how to make adjustments? What are the definitions and thresholds?

In an ideal world we would have enough information and be able to predict with sufficient certainty that we could just plan our management activities and be assured of the desired outcome. Unfortunately, this is not the case and ***adaptive management*** is essential because our understanding of ecosystems is not, and may never be, complete. There are inherent uncertainties within and among ecological, economic, and social systems. Surprises in the behavior of ecosystems are inevitable and management systems must be designed to adjust to the unexpected rather than act on the basis of a spurious belief in certainties (Gadgil 1999, Gunderson 1999). Adaptive management addresses uncertainty by structuring initiatives as experiments in which results are used to continually correct course (The Keystone National Policy Dialogue on Ecosystem Management 1996).

A formal process of adaptive management can be used to maximize the benefits of any option for land and natural resource management and to achieve long-term objectives through

implementation of ecosystem management (Lessard 1998). The process itself is straightforward and simple: new information is identified, evaluated, and a determination is made whether to adjust strategy or goals. It is a continuing process of action-based planning, monitoring, learning and adjusting with the objective of improving the implementation and achieving the desired goals and outcomes. In this process goals and objectives are clearly stated, an initial hypothesis of ecosystem behaviour is described, and monitoring is conducted to provide feedback for redirection of management "experiments" or practices. While the concept of adaptive management is relatively straightforward, applying it to complex management strategies requires answers to several critical questions. What new information should compel an adjustment to the management strategy? What threshold should trigger this adjustment? Who decides when and how to make adjustments? What are the definitions and thresholds of acceptable results? Are thresholds is feasible to detect given the oftentimes latent effects of impacts? Adaptive ecosystem management depends on a continually evolving understanding of cause-and-effect relationships in both biological and social systems. Planning for and adapting to surprise will provide an actionary rather than a reactionary basis for more informed decisions.

3.6 Information and Feedback Needs and Opportunities

Feedback between managers and scientists and between the public and scientists is a fundamental component of the adaptive management strategy, and periodic assessment is its operational foundation (Szaro et al. 1995). In adaptive management, models and monitoring are applied within the framework of an assessment protocol, which helps focus monitoring efforts and define how models will be applied at various stages in management. Ecological indicators are used to evaluate and, when fed into appropriate models, help select among management alternatives. A baseline condition is determined for the same indicators, using monitoring before management strategies are implemented. Then the same indicators, which continue to be monitored after the new management strategies are in place, are used to assess the effect of a management action. To be effective, ecological, economic, and social indicators must be practical, sensitive, and capable of being both monitored and modeled.

Adaptive management encourages active participation by all stakeholders in the planning, implementation, monitoring, and redirection of ecosystem management initiatives (Keystone National Policy Dialogue 1996). It depends on negative and positive feedback in the reiterative evaluation of both the continued desirability of management goals and progress toward their achievement (Everett et al. 1993). Social and economic values and expectations are routinely considered along with ecological objectives in continually correcting the course of management. Results from the monitoring of ecological, economic, and social variables are used to track management outcomes.

This reiterative approach causes management execution and adaptation systems to make progress towards goals, even if the goals change with time (Baskerville 1985). It promotes and information-rich environment and a rationale for routinely monitoring and evaluating social, political, and biological environments. Feedback loops for an adaptive management process already partially exist within many societies. These can be in the form of project scoping activities, participation in project design, analysis, and review, special public forums, and in worst case scenarios – litigation

and legislation (Everett et al. 1993).

Unfortunately, an adaptive approach to decision-making has not been implemented as broadly and frequently as possible, in part because (adapted from Bartuska et al 1995):

- The information feedback loops on which the process depends may not exist;
- Existing feedback loops can be easily obstructed;
- Existing feedback loops may not provide useful information;
- Institutions/agencies/organizations may not be willing to reevaluate decisions with the available information or necessary frequency; and
- No (or very limited) budgets are provided for the monitoring required.
- Feedback loops are too long.

Adaptive ecosystem management also depends on an evolving understanding of cause-and-effect relationships in both biological and social arenas. In the social arena, communities interested in the issues must be identified, and their values and expectations understood (Daniels et al. 1993, Montgomery 1993). Although social and biological components of ecosystems are often ill defined, managers and policy-makers must at least explicitly state hypothesis and proceed via a reiterative process toward developing management models. If a management model operates outside a range of socioeconomic acceptability, the model must be reconsidered, or if the model is constrained by biological realities, society must be informed of the unfeasibility of the goal (Everett et al. 1993).

3.7 Integrating Science into the Decision-making Process

It is almost a truism that any important policy decision is better with stronger information behind it (Szaro et al. 1995). Three main factors have inhibited the integration of science into the decision-making process: (1) decision-makers have not always been aware of how or when research might be useful to them; (2) in the past, decision-makers have been reluctant to ask researchers for help because it meant acknowledging uncertainty, or worse, relinquishing some power by reducing the range for their discretion; and (3) basic research is not always designed to answer management and policy questions. Science makes two significant contributions to the decision-making process. First, it allows decisions to be based on past experience and knowledge. Second, ignorance can be confronted because it has been explicitly recognized. Because of this, policy must be cautious and flexible (maybe even reversible). Programs that result from the policy could be designed specifically to capture the knowledge that is needed. Policies relating to such a difficult concept as biodiversity must have an iterative adaptive management strategy that permits feedback and modifications. Incorporating evaluation mechanisms that allow policies, programs, and performance to be assessed encourages agency officials to be prudent and responsive. Using scientific information tends to push decision-makers towards moderation and towards policies and programs that are more likely to work.

4 Institutional Requirements for Sustainability and Conservation

4.1 Creating an Enabling framework

Many efforts targeted at improving biodiversity conservation in forests oftentimes overlook the basic infrastructure for implementation. In order to sustainably manage forests, there has to be in place a basic enabling framework of institutions, policies, and laws that allow governements and their insitutions to succeed. These include (adapted from ITTO 1998 and Verolme and Moussa 1999):

4.1.1 Insitutional arrangements

g) Ensuring an appropriate number and adequacy of institutions to support sustainable forest management.
h) Training of professional and technical personnel at all levels to perform and support management, implementation, research and extension;
i) Existence and application of appropriate technology to practice sustainable forest management and the efficient processing and utilization of forest produce.
j) Capacity and mechanisms for planning sustainable forest management and for periodic monitoring, evaluation and feed-back on progress.
k) Degree of public participation in forest management, such as in planning, decision making, data collection, monitoring and assessment.
l) Adequacy and timeliness of information to increase public awareness about forest policies, legislation and sustainable forest management practices.

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4.1.2 Policy and Legal Framework

f) national objectives for forest including production, conservation and protection;
g) the establishment and security of the permanent forest estate;
h) establishment of land tenure and property rights relating to forests;
i) the control of forest management, harvesting, and encroachment;
j) the passage of laws which recognize the participation of local communities and a wide-range of other stakeholders and the role of traditional knowledge;
c) effective enforcement of legal measures to prevent corruption
d) effective implementation of national forest policies through an appropriate legal framework

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4.1.3 Economic Framework

e) Eliminate inappropriate subsidies and credits;
f) Develop economic instruments and other incentives to encourage sustainable forest management.
g) Reassess international loans and export credits

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h) Support community-based economies and networks for the management of natural resources

4.2 Capacity building

--Key Points From Agenda 21--

Agenda 21 defines ***capacity development*** as the process and means through which national Governments and local communities develop the necessary skills and expertise to manage their environment and natural resources in a sustainable manner within their daily activities. To promote it, chapter 37 emphasizes the following main themes:

- A cross-sectoral, multi-disciplinary approach to planning and implementation;
- Improved capabilities in both the public and private sectors;
- Optimum use of national (as opposed to expatriate) human and organizational resources;
- Reorientation and coordination of external support for sustainable development;
- Better integration of environment protection, economic development and social equity in the development of capacities at the local, regional, national and international levels (UNCSD 1997).

The term *capacity building* refers to enabling the indigenous people of developing countries to carry out development processes successfully by empowering them through strengthened domestic institutions, provision of domestic markets, and improvement of local government efforts to sustain infrastructures, social institutions, and commercial institutions (James 1998). Capacity building also involves the need to recognize indigenous interest groups, encourage local efforts, provide incentives for privatization, and coordinate local, regional, and international strategies to enhance productivity and wise use of natural and human resources. Most important, capacity building encourages a "bottom-up" or grassroots effort for sustainable development. Capacity building should address all areas of social, economic and health, and environmental processes through a holistic approach (James 1998).

The establishment and development of proper national institutions is a basic requirement for action towards sustainable forest resources development (UNCSD 1996). Unfortunately, developing countries oftentimes have difficulty sustaining the acquired expertise and human capacity and in establishing and building the needed institutional framework, for many reasons, including inadequate funding and frequent turnover of staff to deal with these concerns. The successful integration of training programs, networking, technology transfer and information dissemination is needed to build significant capacity for sustainable forest management.

Over the longer term, countries will need to develop the ability to learn and institutionalize new roles and new performance standards with respect to sustainable forest management. Capacity-building in this context will likely entail more far-reaching organizational, social and even political reforms. Of critical importance will be two-factors: first, the enhancement of the role of groups outside government such as non-governmental organizations and the private sector; and second, the shift to a more cross-sectoral approach to the design and implementation of sustainable forestry practices. It should be expected that this shift will prove to be one of the most difficult to achieve given the embedded patterns of behavior in Governments, donors, professional groups and other participants (Szaro et al. 1998).

4.2.1 Human resources

If capacity building is to be sustainable it must involve local expertise and experience (Szaro et al. 1998). It is not enough to reinforce decision-making and research structures, capacity building efforts must also contribute, where possible, to the weaving of the networks of relations between institutions that can allow for the effective involvement and exploitation of local expertise. The primary task for each country is the identification of local expertise. There is no need to replace existing expertise or to start from scratch. The real innovation needed is in the approach of the project implementers - particularly in adapting the methods of capacity building to the particularities of local capacity. Giving precedence, for example, to the transmission of skills and know-how through apprenticeship: "on-the-job" training, technological support, informal communications, and so on. However, care must be taken on how these resources are developed. This is particularly true as overseas training has become increasingly expensive and is in some cases less relevant to domestic needs. At least a partial solution to these problems can be obtained if relevant development activities and training opportunities in those countries are improved and expanded (Thulstrup1993).

The effectiveness of capacity building depends on a step-by-step approach beginning with existing capacity and activities. The goal is to make capacity building a unified process within which particular activities can be organized and delivered in a logical order. The sequence of capacity building methods should then be scheduled in accordance with the national commitments: inventories; adaptation; vulnerability and mitigation studies; national communications; national development plans and strategies, and so on. It must not be forgotten that whatever the specific objectives of commitments or projects, capacity building is above all a long-term process that must emphasize the domestic development of local structures. Capacity building projects, if they are to succeed and contribute in a lasting way, must reject the linear and discontinuous thinking that can characterize the project before it is placed in the context of actual implementation. The challenge is to replace the board-room project with a dynamic vision of a project in process, which adapts to existing structures and strengthens them rather than undermining them. The welfare of both the project itself and the project recipient depends on such an approach (Cissé et al. 1998).

4.2.2 Information dissemination

Dissemination of information is becoming an increasingly critical factor in a world where more and more groups make themselves heard in national and international debates on issues related to forestry (UNCSD 1996). In both developed and developing countries, changes in information needs relate mostly to the multi-functional role of forests in general and their environmental functions in particular. The environmental information also has global implications (UNCSD 1996).

Barriers to effective sharing of ideas and information are certainly a shared problem. At the local and national levels, effective communication and sharing of information across sectoral barriers remain a daunting challenge. But these problems are only part of the broader global capacity building challenge of promoting, legitimizing and institutionalizing effective sharing of ideas and information across many types of barriers, including sectoral but also national, cultural, linguistic, socio-economic, etc. Effective means to create unique opportunities for people to interact with each other

in new ways - often to interact with one another for the first time - are critical for maximizing the effective use of scarce resources. These initiatives should focus on: (1) improving the availability of basic reference materials; (2) improving access to current information; (3) establishing technological information systems; and (4) supplying adequate equipment and the means for its use and maintenance.

4.2.3 Public education

Governments need to ensure that the public has the opportunity to learn about the sustainable management programs. Educational programs should place environmental issues in their broader political, social, economic, and biological contexts, promoting public sensitivity to environmental problems and efforts to address them. Developing public education packages is essential for gaining public support for maintaining biodiversity. Such packages of education materials fulfill well-documented needs (Mullins and Watson 1996). For example, a report on biodiversity from the Office of Technology Assessment (1987) noted:

> "*Conveying the importance of biological diversity requires formulating the issue in terms that are technically correct yet understandable and convincing to the general public. To undertake the initiative will require not only biologists but also social scientists and educators working together*."

No single formula exists for the content of a public education program. Each organization must clearly understand its mission and role in biodiversity protection, identify clientele and client needs, and match its mission to its client needs. Out of this market-oriented process will evolve the appropriate content and technologies for developing the public education program.

Clearly at issue in the messages are the immediate "hot topics" relating to biodiversity, such as tropical deforestation, as well as the long-term issues relating to maintenance of ecological, economic, educational, ethical, and esthetic values associated with biodiversity. These issues are bound up in missions of resource management organizations, scientific studies, legalities, agendas of special interest groups, and the positions taken by various governing bodies.

The complex nature of this evolving web lends itself well to the use of all forms of ecological communications (Mullins and Watson 1996). Various general public and agency constituency groups, as well as the staff of the resource management organizations, often have an unclear understanding of the issues. Public education is one technique to help all parties better understand what they know, or think they know, about a critical resource issue such as biodiversity.

4.3 Targeted research

---Key Points---

- ? In order to support ecosystem management, it is necessary to understand how ecosystems work and have knowledge of ecological structure, process, natural variability, vulnerability to stress, and potential for recovery, at multiple scales in space and in time.
- ? Adaptive management systems, which permit action while concurrently increasing our scientific understanding, are necessary because of our current limited understanding of large ecosystems.
- ? Though scientific input is essential to address most conservation problems it is usually not sufficient. Scientists should not be forced to set policy goals and values but should be encouraged to develop policy/management alternatives and elucidate their potential outcomes. Scientific consensus should not be forced when it do not exist

The need for scientific information as a foundation for resource management decisions continues. Science should be expected to contribute technical answers and insights and suggest reasonable solutions that recognise uncertainty so that responsible resource policies and management solutions can be developed and implemented. Science should develop options and scenarios that will help decision-makers to make "informed choices" on the ramifications and consequences of any choice, and reduce the critical uncertainties relating to the costs and benefits associated with any avenue of intervention. Much of the debate on sustainability and biodiversity has in the past become uncoupled from objective rigour, developing a blind momentum devoid of good science. While there is real urgency to get things started there needs to be systems in place that allow learning and adaptation (see Redford and Sanderson 1992).

Changing societal expectations and increased public involvement have challenged traditional management policies and practices. Often these public expectations are in conflict. Policy decisions must apply the best science to meet the needs of society. To facilitate this, the interface between social, economic, physical-biological, and ecological models must be improved. The ability to quantify social demands for both consumptive and non-consumptive goods must be perfected. These demands must then be weighed against the need to maintain ecosystems and their attributes. There is a pressing need to assemble and format new and existing research results into packages that are usable by managers and decision-makers. We require innovative ecosystem management approaches and technologies that will accommodate these demands while maintaining healthy ecosystem functioning.

A comprehensive program of integrated basic and applied ecological, social, and economic research should be developed to provide:

- ? A basis for sustaining ecosystem productivity and biodiversity
- ? More adaptive and flexible management systems.
- ? A broader basis to support the development of a public "will" to lead to a higher likelihood of adoption of ecologically-based management.
- ? Mechanisms to ensure a wide range of stakeholder participation.
- ? An improved information base for decision making.
- ? Techniques for incorporating spatial analysis to link objectives at differing scales into planning and decision-making.

- ? Methods to predict responses of ecosystems to management activities.
- ? Methods for integrated planning and management across site, landscape, regional, and perhaps even continental levels.
- ? Methods to examine the relationships and interdependencies of management actions on one spatial/temporal/biological scale upon actions at other scales, e.g. externalities.
- ? Participatory techniques to assess the relative values of different components of biodiversity and assess the trade-offs between the costs of conservation, including the opportunity costs incurred by restricting use and the "willingness to pay" of the proponents and beneficiaries of conservation
- ? Providing the information and education that lead to greater appreciation of biodiversity. (Willingness to pay is often strongly associated with personal knowledge).

5 Where Do We Go From Here?

The Role of Institutions and Policies

Where land tenure is secure and/or government regulation is effective, there are significant opportunities to manage forests in ways that can contribute in important ways to biodiversity conservation. Where these are absent, as is the case in many tropical forests, the right kind of export orientation, when combined with certification, can help leverage improved management. However, in other cases (such as mahogany logging in Brazil), the rapid expansion of the frontier, through road building financed by logging or through development projects can facilitate "rapid trashing of primary forest", which is not followed by intensification of management, but by conversion to non-forest uses. This is true in many parts of the world where conversions are not only to non-forest uses such as agriculture but also to biomass plantations of fast growing trees or to other agro-industries based on tree-crop plantations such as palm oil and rubber.

Previous efforts to develop guidelines for conserving biodiversity in forests managed for timber focused primarily on the goals and objectives for such conservation (Blockhus et al. 1992, ITTO 1993, 1998). Relatively little attention was placed on the process through which such goals and objectives would be implemented. Certainly, the goals and objectives are a critical step in the process but only one of the many steps needed to ensure successful conservation.

The task of improving production, reducing overall impacts, and sustainably managing forests so exceeds the funding to be expected that misdirected efforts are tragic (Wadsworth 1997). Considerable effort needs to be focused on: 1) the development of appropriate policies and adequate legal frameworks, 2) the building of insitutional capacity to implement those policies, 3) the use of incentives and trade policies to favor private and government level compliance, and 4) participatory mechanisms to determine the values of both goods and services.

The current development paradigm, which is based exclusively on consumerism and growth, leads to a high demand for natural resources, including timber, and the resultant massive deforestation and forest degradation evident in many parts of the world today. (Verolme and Moussa 1999). It depreciates indigenous and traditional knowledge and usurps communities' rights to manage their own resources. It has also led to government policies that create subsidies and

other perverse incentives that is further exacerbated by the lack of commitment from politicians, bureaucrats and law enforcement agencies with regards to conservation. Even worse is that in many areas corrupt political and government systems favor arbitrary decisions on forest management that contributes to deforestation.

Project interventions to support biodiversity in managed forests should ideally be simple, locally adaptive and easy to administer. This requires a high level of accountability and competence at the local level, the very attributes which are most often absent in the situations that the GEF is dealing with. Thus while minimising bureaucracy and hierarchical decision processes it is necessary to (adapted from Wadsworth 1997):

- ? Ensure clear objectives that are simultaneously realistic, clearly articulated, acceptable, well informed and clearly prioritised.
- ? Ensure sufficient linkages among the national institutions responsible for leadership, whether their function is stewardship, information dissemination, or research.
- ? Place decision-making responsibility in the hands of local groups, be they small communities or isolated rural people.
- ? Recognise the need for local expertise at the professional, managerial, and technical levels and invest in the professional development of local capacity.
- ? Develop links among research, demonstration, extension, training, and education. Without such links, programs generally fall far short of their potential.
- ? Do not begin programs on a scale that will overtax the local system, calling for more scarce resources (especially human-resources) than exist
- ? Maintain open communication with key stakeholders.
- ? Make sure that rewards to management personnel are attractive and closely linked with responsibilities and accomplishments on the job.
- ? Ensure working conditions that are sufficiently favourable and stable to develop career involvement and commitment in employees.
- ? Ensure an ongoing in-service professional development programs, to improve technical skills and understanding.

The technical aspects, which promote bio diversity conservation in production forests, need to be complemented by direct incentives in many developing countries for both communities and corporations to "invest in tomorrow":

- ? Appropriate policy and regulatory framework that supports long term corporate and community based management investments required in forestry.
- ? Long-term allocation of areas for harvesting to companies, cooperatives or communities by auction, etc.
- ? Trading and transferring of concessions i.e. confer some financial value to the areas that are being managed by the corporation or community.
- ? Extension of concessions or area of management based on performance and compliance with reduced impact logging (RIL) guidelines.
- ? Performance bonds that are invested and returned once monitoring and evaluation have shown results are satisfactory.

? Independent assessment procedures based on clearly stated local conservation priorities

Once these bases are in place (although some of the above can certainly be accomplished concurrently with project implementation) then it is feasible to think of an ecological approach to management and the use of adaptive strategies.

5.1 How Can Biodiversity Conservation be Enhanced in Managed Forests?

A significant potential exists to modify forest management, harvesting and silvicultural practices to enhance biodiversity values. (see Hunter 1990, Fimbel et al. 1999). These include measures designed to address both direct and indirect impacts of timber harvesting, principal among them:

j) Implementing careful planning and engineering of roads and layout of skidtrails to minimize erosion, sedimentation, ponding, and the total area subject to soil disturbance;
k) Closing roads after logging to reduce likelihood of subsequent access and conversion (ie arrangements WWF and loggers in PNG?);
l) Using appropriate logging technology (i.e. animal traction or skidders with blades up rather than bulldozers with blades down);
m) Using directional felling and vine cutting (where required) to reduce damage to residual trees, both to protect the biodiversity of trees and to reduce the risk of post-logging fire (see Nepstad et al. 1999);
n) Avoiding felling trees which will be left in the woods because of defect (i.e. TFF RIL demonstration results in Brazil);
o) Setting aside sensitive areas for conservation, avoiding logging and skidding on steep slopes, and leaving appropriate buffers along water courses, both to protect aquatic systems and to provide riparian corridors for movement of fauna;
p) leaving snags for cavity nesters; leaving keystone food sources (i.e. figs, see Terborgh 199?), leaving a minimum number of individuals of all tree species on each cutting area (ie Programme for Belize harvesting guidelines), and providing favorable conditions for regeneration of tree species harvested;
q) distributing harvest areas across the managed forest in configurations designed to create mosaics of different-aged patches or patches recently-harvested, and those not-harvested for a long time, etc., to permit long-term survival of both forest interior and disturbance-adapted species;
r) Feeding logging camps from sources other than hunting (i.e. prohibition in Bolivia).

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5.2 What Are the Obstacles to Changing Forest Utilization Patterns?

Tremendous obstacles make it unlikely, under current conditions, that forest utilization patterns, particularly in the tropics, can be modified to enhance biodiversity values. Among the most important impediments:

a) most forest management (forest harvesting) decisions are made according to a single criterion: maximizing short-term profit. This is particularly true in settings where forests are administered by granting short-term concessions for timber harvesting. This kind of logging can be expected to result in maximum environmental damage and maximum biodiversity loss (both within the forest and in associated systems, such as rivers, which are likely to be severely affected by consequent erosion), with minimal recuperation potential;
b) high discount rates associated with inflation and uncertainty in many tropical countries accentuate the pressure for resource mining (ie Rice et al. 1997);
c) management agencies in tropical countries tend to be underfunded and lack capacity to regulate forest practices. Corruption further undermines this option;
d) the opportunity costs associated with foregoing financial returns from timber harvesting accrue to a different group of stakeholders, usually local interests who would obtain the benefits of harvesting timber or other resources from the forest, than the benefits of conserving biodiversity, which accrue at least in part to stakeholders in biodiversity who are global and distant from the forest. There is currently no mechanism for transferring compensation from those who accrue these benefits to those who pay the opportunity costs;
e) many, if not most practices to enhance biodiversity values in forests lead to a reduction in timber yields (cite PNW New Forestry article; RIL Sabah results, etc.), yet the current environment is one in which timber demands are increasing on a per capita basis as the area of primary forest with the potential for high-volume harvests is diminishing;
f) biodiversity-enhancing practices are not widely known by foresters even in the temperate zone, and are not taught in forestry curricula nor included in forestry texts in tropical countries;
g) additional practices need to be developed on a site-by-site basis, to reflect the disturbance dynamics of the forest in question and the habitat needs of local species with particular needs (for example, the needs of monkeys to move from tree to tree without coming to the ground), meaning that processes and human resources for designing and adapting biodiversity-relevant alternatives need to exist within forest management systems;

5.3 Who Needs to Do It?

Conserving forest biodiversity will require partnerships and coordination at all levels from the local to global. Too often in the past efforts have have misguided and duplicative because of a lack of adequate coordination. Just as determining appropriate actions for biodiversity are scale dependent so are actions by the variety of players involved. Nations have the ultimate responsibility for managing their own resources in a sustainable way but the problems are so servere that many will require global and/or bi-lateral assistance to set up the institutions, policies, and legal frameworks that will allow them to make progress.

Clear ground rules to implement national forestry programmes could help reconcile differing priorities of developing countries and external agencies (Simula 1996). These rules could be developed within the overall socio-economic and environmental justification of public finance to reduce the need for conditionalities. Coordination should be aimed at increasing resources and improving cost-effectiveness within a framework which provides accountability, decentralized

implementation, transparency, stream-lined delivery systems, and integration of financing with national priorities and plans (Simula 1996). International coordination is voluntary between individual countries and independent agencies but it should be compulsory between intergovernmental organizations within the UN system through adequate formal arrangements. Voluntary coordination would also benefit from mutually agreed guidelines.

5.4 How can it be financed?

Substantial financial resources are needed for the sustainable forest management of all types of forests, but new and additional resources are not seen as forthcoming as expected, despite commitments from both international and domestic public sources (IFF2 1998a). The financing situation in developing countries with low forest cover is especially serious. Private capital flows to forest activities are increasing, mostly from international sources but also from within some of the developing countries. However, such capital flows, aimed at more traditional extractive operations, may not contribute significantly to sustainable forest management. The private sector also faces problems in gaining access to the start-up capital and in overcoming fear of risks and uncertainties involved in newer operations. Private-sector capital flows are unevenly targeted, aimed generally at countries with extensive forest cover. There is a need for policy reforms providing tax, financial and other incentives conducive to sustainable forest management while eliminating subsidies that are detrimental to it.

It is widely recognized that public funds to promote sustainable forestry practices have been lacking and existing funds have not been very effective in reducing deforestation or in achieving sustainability objectives (Crossly et al. 1996). Sometimes the biggest problems are much less exciting than cutting edge science lead us to suppose. Inamdar et al. (1999) point out that throughout the tropics conservation bodies are short of cash and capacity to manage - banal but true - this is a major non-technical problem for conservation and one that has to be faced.

Where can countries get the money to invest in sustainable forestry since most of the standing forest generates no cash income (Repetto and Sizer 1996)? The real answer is obvious according to Repetto and Sizer (1996). Governments could gather substantial resources if they collected the rents due to them as proprietors and landowners from the concessionaires and commercial interests who exploit the public forests. However, Simpson and Sedjo (1996) argue that economic analyses do not support the notion that the inclusion of conservation activities to the mix can generally be self-financing, or well supported through subsidizing commercial activities. They claim that while there will be substantial obstacles there is a strong case to be made for some sort of direct payment for conservation schemes.

Sustainable forestry, or at least the environmental services that the practice ensures, have often been framed as public goods which should be subsidized or "paid for: entirely by public and concessional funds. This has created the misperception that sustainable forestry is not a viable industry sector, and has significantly forestalled private capital investment (Crossley et al. 1996).

5.4.1 The private sector and economic instruments

The ways and means to mobilize locally available financial resources, including those from the private sector, should be explored. Strengthening public-private partnerships is one way to mobilize such resources (UNCSD 1997). Inevitably, the focus of much capacity building in the future must come from the private sector. While an ever greater portion of global production (and consumption) is taking place in developing countries, available investment capital remains concentrated in the private sectors of industrialized countries. The ability of these firms to collaborate with governments and communities in pursuit of both eco-efficiency and eco-sufficiency may be the most important sustainability issue of the next few decades (UNDP 1998).

Foreign capital flows in forestry in developing countries represent both a potential opportunity to attract private investment in forestry, particularly in light of declining external public funding, and a possible threat to long-term forestry if business as usual continues (IFF2 1998b). Much of current private capital flows is directed to conventional extractive operations and export trade with an objective to capture as much rent as possible (Chandrasekharan 1997). However, because of the comparatively long-term nature of investment, the forest resources sector particularly when the focus shifts from traditional extraction regimes, in most developing countries, does not attract sufficient private investment (Chandrasekharan 1996). On the other hand, harvesting, processing and marketing of forest products tend to be attractive to the private sector given its higher and quicker payback. Governments, led by those in industrialized countries, need to re-orient these firms through judicious use of economic instruments. These instruments, economic carrots to encourage shifts to sustainable practices and economic sticks to discourage unsustainable ones, should be the key tools in many future sustainable development strategies. That they are used far less often than they are proposed is a function of wavering political will (UNDP 1998).

5.4.2 The role of philanthropic foundations

Philanthropic foundations have a key role to play because they can focus their funding much more closely towards specific needs. Effective sustainable management programs don't always need huge amounts of funds, but they do need a clear focus. But do foundations address perceived needs or simply their own agendas? A frustration for developing countries is to be sucked into programs who push their own agendas which are of little relevance to their country's needs (Lebel 1996). The recipients of foundation support must work hard at defining and marketing their real needs. This means consulting with stakeholders and developing a broad base of support for projects which are truly relevant. Otherwise recipient countries will be steam-rolled by international organizations with their own agendas and interests. The promise of dollars can make people too complacent and agreeable (Lebel 1996).

5.4.3 The role of local investments

Small investments in forestry are often local investments – sponsored by or for local people using local resources (Chandrasekharan 1996). Small entrepreneurs, mainly at the rural lvel, contribute considerably to the mobilization of investment. The main sources of funds are personal savings, gifts, loans and subsidies. Several factors affect the extent and efficiency of local private investment – access to land, regulations related to tree/forest crops, organized credit facilities, price guarantees for products, institutional support, extension services and adequate incentives

(Chandrasekharan 1996). Recent experience in forestry development shows that if the resources of the local populations are mobilized effectively, a great deal of productive, effective, and appropriate forestry investment can take place at relatively low cost (Chandrasekharan 1996). Government forest departments can enter into a variety of forest management agreements with local producers that can ultimately benefit both the local users and local forest biodiversity.

5.4.4 The role of national level public investments

Domestic public financing is clearly very important for sustainable for management and biodiversity conservation because of the many direct benefits at the national level (UNDP 1996). The responsibility for in-country coordination should be with the government. Effective coordination requires strong political leadership, planning bodies with adequate capacity and finance, a qualified and responsive planning capacity, and a consensus building process where all stakeholders should participate and be provided with the necessary information (UNDP 1996).

However, for various reasons, many countries are unable to raise public funds for the forest sector (IFF2 1998b). Problems are further compounded by low levels of general economic growth, lower priority of the forest sector in national policy (thus smaller budget allocation), and the attitude to treat forests as a source of quick revenues or even as an obstacle to economic development. Strategies to increase domestic public funds for forestry should address increasing public revenues from forests and allocate funds appropriately to promote sustainable forest management and biodiversity conservation. Methods to increase forest revenues should include proper pricing of goods and services produced from public forests so that market prices reflect true scarcity values of forest resources.

5.4.5 The role of global level public investments

Traditionally, international funding from bilateral and multilateral sources in the form of official development assistance (ODA) has remained the primary sources of assistance to the forestry sector in developing countries (IFF2 1998b). ODA generally includes grants, concessional loans and technical assistance through bilateral or multilateral mediums.

International coordination of development financing should focus on eliminating duplication, competition, and support country-driven programs (UNDP 1996). It should focus on providing a better flow of synthesized information on program progress, policy development, best practices, and lending strategies. This would help to avoid repetition of past failures and allow fast transfer of knowledge on successful pilot projects and evaluation of lessons learned.

5.5 What can we learn from past experiences?

We should not lose sight that we have much to learn from past practices – positive as well as negative. Many practices in the past have contributed to our overall understanding of forest ecosystems and their functions. Forest managers and local peoples have accumulated a wealth of knowledge about such systems and how to manage them for specific goals and objectives. Obviously many of those goals and objectives have shifted in the past decade and the practices

dedicated towards extraction and fiber production are now often viewed negatively. However, these practices and the knowledge gained from them can make substantial contributions to biodiversity conservation when applied with these revised goals in mind. Projects applying best practice within an adaptive management framework make use of both past experience and new knowledge gained as they are implemented.

5.6 *What is the comparative advantage and role of the GEF?*

GEF actions designed to reduce or overcome these impediments could enhance the role of tropical timber-producing forests in in biodiversity conservation. These might include:

h) contribute to the development and adoption of institutional arrangements which internalize the externalities associated with environmentally-destructive logging practices, and create incentives for biodiversity-friendly practices on the part of loggers (encourage any and all alternatives to short term logging concessions!);

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i) provide financial incentives (tax breaks, subsidies, what?) to overcome the perverse incentives resulting from discount rates and inflation;

j) contributing to improved funding of government forest management agencies in tropical countries and overcoming perverse incentives for corruption;

k) develop and fund mechanisms to translate the global benefits of biodiversity conservation into compensation for those who pay the opportunity costs of foregoing financial benefits associated with biodiversity-destructive resource extraction practices in tropical forests; (support independent certification and green premiums?);

l) develop mechanisms to compensate for losses in profits associated with reductions in yield (see a, b),- contribute to actions to reduce demand and make timber use more efficient; encourage the production of wood from sources with higher production potential and lower biodiversity value than -tropical forests (ie biodiversity-poor forests; plantations on degraded lands);

m) contribute to the dissemination of information on biodiversity-enhancing forest management practices to teachers of forestry, foresters, and students in tropical forest countries, through training and educational media;

n) train foresters to consider biodiversity and then give them the responsibility to design management systems; make it possible for ecologists/conservation biologists to have input to forest management plans; contribute to teaming environmental NGO's with forestry agencies to provide input on biodiversity conservation.

5.7 *Specific proposals*

a) Master classes in Ecosystem Management: Facilitated meetings of managers of GEF projects in ecosystem approaches.

b) Master classes in Ecosystem Management: Consulting services, management advice and support for institutional changes for natural resource institutions responsible for the management of biodiversity and forests.

c) Development of practical management tools for adaptive management.
d) Pilot projects: Experimental approaches to Ecosystem Management in forests of global biodiversity value that are likely to be managed for timber.

6 Conclusions

---Key Points---

? First priority should be to maintain forest cover and establish a permanent forest estate.

? Reasons for losses are not due to the lack of the technical knowledge needed for forest management, particularly in developing countries where institutions are weak.

? Biodiversity is consistently undervalued by most stakeholders and external landowners

? No standard precriptions can be developed but principles can guide strategies that allow for local involvement but also adequately address scale issues (i.e. landscape and regional perspectives).

? Ecosystems are constantly changing with uncertain and unpredictable futures whose management will necessitate the use of practices that are flexible, adaptive, and experimental. The rate of change will increase if climate change occurs.

Opportunities and constraints for biodiversity conservation in forests from which timber is extracted vary from place to place. Ultimately successful approaches to biodiversity conservation will be ones that make sense to, and are supported by, the people most immediately concerned -–in most cases this will be people who depend upon the forest in some way for their livelihoods. Finally the most important points to improving conservation for biodiversity in forests are:

? There is one clear priority issue in forest conservation - that native forest cover is maintained.

? Resource use must be managed considering all uses and threats (e.g. Robinson et al 1999)

? The main reasons for losing biodiversity in the tropics are not because of a shortage of technical knowledge about forest management but rather the absence of the institutions and political framework under which sustainable management practices can be implemented.

? Many problems in the forest sector reflect the lack of political will (and consequently lack of human and financial resources) to implement and enforce laws and regulations.

? A centralized bureaucratic apparatus will possess only a limited appreciation of the forces at work and therefore find it very difficult to devise ways of guiding and regulating the behavior of a variety of stakeholders in appropriate ways).

? No blanket management prescriptions should be given - the principles should be to work within regional and local policy frameworks recognizing the need to balance the regional land-use mosaic as a whole. Conservation agendas will require that different parts of the regional/national forestry estate be managed with different goals and priorities.

? Much can be done to improve forest management without worrying about whether or not all criteria for Sustainable Forest Management (SFM) are being achieved. An adaptive approach to SFM can allow for changes in management practices while dynamically moving towards the goal of SFM without waiting for a "perfect" set of criteria and indicators.

? By "opting out" of projects associated with forest harvesting the GEF, World Bank and other lending agencies are unable to apply pressure that might significantly improve logging practices.

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