PROFOR

SUSTAINABLE FOREST MANAGEMENT: AN EVOLVING GOAL

JOHN SPEARS

April 1999

PREFACE

Sustained yield timber management systems, the cornerstone of professional forestry practice for the last three centuries, have come under increasing criticism in recent decades for three main reasons. First, such systems ignored the vast array of non-timber goods and services provided by forests, which sustain the livelihoods of more than 300 million people dependent on forests. Second, sustained yield systems lacked an understanding of the global importance of the ecological services provided by forests, such as the preservation of biodiversity and the storage of atmospheric carbon (a 'greenhouse gas' that in too high a concentration contributes to global warming). Third, these systems kept forestry experts overly focused on a singular strategy: the commercial management of closed forests. *Forestry experts frequently ignored the important role remnant woodlands and agroforestry farming systems play in contributing to the forest product needs of more than 1 billion of the world's poorest people. This is particularly so regarding fuelwood, maintenance of agricultural productivity, and generation of rural incomes.*

This paper is concerned with the continuing evolution of approaches to *sustainable forest management* (SFM). This evolution has brought about radical policy shifts to address earlier shortcomings over the past two decades. This paper discusses the emergence of *New Forestry, agroforestry, plantation forestry*, and *ecosystem management*. It summarises the existing knowledge base and primary techniques and strategies for achieving socially and environmentally acceptable SFM in various forest formations. It describes ongoing initiatives for the improved monitoring of SFM through the introduction of scientifically based criteria and indicators. The growing consumer interest in ensuring that forest products originate from forests that are independently certified as sustainably managed is also discussed. The paper goes on to set out key principles the United Nations Development Programme (UNDP), through its Programme on Forests (PROFOR) suggests be adopted as guidelines for achieving SFM in the coming century.

ACKNOWLEDGEMENTS

This paper draws heavily on studies by the following: David Cassells, Hamish Kimmins, Gill Shepherd, Mary Hobley, Pedro Sanchez, P.K.Nair, Stephen Bass, John Palmer, Timothy Synnott, N.C. Jodha, Narendra Sharma, Clark Binkley, Jeffrey Burley, Don Gilmour, Peter Kanowski, Jeff Sayer, Roger Leakey, Gary Hartshorn, John Wyatt Smith, Sten Nilsson, Michael Arnold, Peter Dewees, Norman Myers, Bruce Cabarle, Nels Johnsosn, Robert Buschbacher, Duncan Poore, Ralph Schmidt, Robert Goodland, Mohammed Salleh Nor, Julian Evans, Ian Bowles, Richard Rioe, Chip Rowe, Collier Dawkins, and Bill Mankin. The paper gives special attention to the recommendations of the Intergovernmental Panel on Forests, and to the report of the World Commission on Forests and Sustainable Development. The UNDP expresses its appreciation to all of the above for the contribution their work in this field has provided.

CONTENTS

FIGURES

ACRONYMS

ATO	African Timber Organisation
CIFOR	Centre for International Forest Research
CMS	CELOS Management System
DBB	Dutch Working Group
EFI	European Forest Institute
EMS	environmental management system
FAO	Food and Agriculture Organisation of the United Nations
FSC	Forest Stewardship Council
GDP	gross domestic product
ICRAF	International Council for Research in Agroforestry
IFPRI	International Food Policy and Research Institute
IIED	International Institute for Environment and Development
INBAR	International Network of Bamboo and Rattan
IPF	Intergovernmental Panel on Forests
ISO	International Organisation for Standardisation
ITTO	International Tropical Timber Organisation
ITW	Initiative Tropenwald
IUCN	World Conservation Union
IUFRO	International Union of Forestry Research Organizations
LEI	Lembaga Ekolable Indonesis
MUS	Malaysian Uniform System
NGO	non-governmental organisation
ODI	Overseas Development Organisation
PROFOR	Programme on Forests, United Nations Development Programme
SFM	sustainable forest management
TFF	Tropical Forest Foundation
UBC	University of British Columbia
UNDP	United Nations Development Programme
US	United States of America
USDA	United States Department of Agriculture
WCFSD	World Commission on Forests and Sustainable Development
WRI	World Resources Institute

Introduction

Sustainability has long been a primary concern for the forestry profession. What individual foresters mean, however, by sustained yield can vary significantly. Cassell (1988) provides a review of the evolution of sustained yield concepts, and how they relate to Old World forests, New World forests, and tropical forests. In its earliest and simplest forms, sustained yield forestry aimed to balance the rate of harvesting with growth. While this approach was effective in many of the European forests, it was not effective for many forests in Russia, North America, Australia, and the tropics. This was because old growth forests in these areas had accumulated substantial volumes of timber, with large trees that had developed over the centuries without having been subjected to industrial-scale utilisation pressures. In these forests, the initial timber management challenge was to oversee the orderly utilisation of the accumulated volume in an extended transition period, which would ultimately lead to balancing timber yield allocation with managed growth.

The fundamental weakness of traditional sustained yield forestry was that it gave undue emphasis to industrial wood production and largely ignored the other non-wood forest values and uses. Additional problems occurred because forest managers lacked a detailed understanding of both the ecological and social processes governing resource sustainability.

While forestry's understanding of ecosystem processes has been inadequate, it is now evolving rapidly. This has created a growing demand for all forest goods and services, and rapid changes are visible in both forest ecosystems and the policy environment that governs their management. New insights from both the ecological and social sciences have undermined the authority of forestry professionals and the antiquated institutional arrangements for forest management in many countries. Concerns about the interests of non-industrial stakeholders, and the rights of peoples dependent on forests, are increasingly tied with concerns about forest biodiversity and the fragility of habitats.

As a result, forest policy issues (which, only a few decades ago, were viewed as purely technical and remote from the concerns of community life) have aroused considerable public interest in both the developed and the developing world. In many countries, the public is increasingly demanding participation in decisions that have long been the purview of professional foresters and government officials. In countries such as the United States (US), these social changes have led forest policy makers, forest managers, and the general public to seek new alternatives for management — to calls for a *New Forestry* (Brooks and Grant, 1992). Globally, these developments have led to heightened concern about the ecological, social, and economic sustainability of forest management systems.

Recent statements on sustainable forest management go well beyond concern with the mere maintenance of timber volumes and site productivity; they focus on the sustainability of forests as ecosystems (Poore, et al, 1989; ITTO, 1991, 1992). Current opinion suggests that for timber production from natural forests to be considered sustainable, it should only be permitted after land planning has allocated forest lands for the protection of biodiversity and fragile environments (such as steep slopes and critical watersheds). Increasingly, it is being acknowledged that to ensure the sustainability of forest ecosystems, the integrity of the natural

forest in terms of their (i) structure; (ii) composition (species composition and biological diversity); and (iii) ecological processes, along with the environmental services they provide, must be maintained (IUCN, 1992).

This paper traces the historical evolution of *sustainable forest management* (SFM) from traditional sustained yield timber management systems to more recently introduced concepts known as *ecosystem management*. This paper indicates the main techniques and strategies characterising different management approaches. It reviews the current status of knowledge on how to sustainably manage the main forest associations of the temperate and tropical regions. It summarises attempts that are being made to scientifically assess the success or failure of forest management operations, by adoption of both criteria and indicators for SFM and various certification processes.

The paper sets out some of the more important principles the UNDP believes should govern decisions on how to achieve sustainable forest management in the 21st century. Special emphasis is given to the controversial issues in sustainably managing moist tropical forests.

Traditional Sustained Yield Forestry

Traditional sustained yield forestry, both in temperate and tropical regions, carried the assumption that forest ecosystems could be sustainably harvested for timber by relying on 'nature' to renew the timber supply. It was believed harvested forests would either regenerate within an appropriate time scale, or they could be successfully regenerated by planting or seeding. The soil was thought to be capable of supporting the existing, or even improved, levels of forest growth. The idea was that ecosystems were sufficiently resilient for all desired values to recover from any negative effects of harvesting prior to the subsequent harvest. It was also assumed that forest composition and overall forest condition could be changed at will to suit the economic climate and market demand.

The basis for these assumptions was the observation that forests regenerated and persisted in the face of periodic, and sometimes severe, natural disturbances. In any particular landscape unit, there may simultaneously exist many different stages and forest conditions, which result from cycles of natural disturbances and successive recoveries. There was a widespread belief, during this early stage of forestry, that forest landscapes could be managed like any other industrial enterprise—that nature could be designed to fit the industrial paradigm. Little or no attention was given to designing forestry with respect for the spatial and temporal variability in the composition, structure, and functioning of forest ecosystems.

The major focus of traditional forestry was silviculture: the growing of tree crops for the harvest of wood products. Tree crops were grown in a way thought to be sustainable for wood products; it was assumed this would automatically provide habitat for wildlife, and would have negligible consequences for fish, streams, and watershed values.

Wherever traditional sustained yield forestry has been practised for long enough, evidence has accumulated that some or many of the above assumptions are incorrect for at least some forest ecosystems. There are ecological constraints on the design of forest management if it is to succeed in sustaining all the values desired by today's societies. Recognition of the inadequacies in the narrowly focused approach of traditional sustained yield forestry is leading to the development of ecologically based forestry. This normally involves ecological site classification, which identifies variations in the ecological character of the forest across a landscape. Ecological site classification includes the design of forest management practices that are consistent with the functional processes, values, and sequences for each type of forest ecosystem.

Despite the above conclusions, some of the world's temperate forests have been harvested for a long time and are still producing sustainable yields of timber. In some regions of Japan, for example, there is evidence that forest harvesting has taken place for more than 1,000 years. Although there are examples of severe site degradation in a few areas that have extremely nutrient-poor or unstable soils, most of the forests appear to be healthy and productive after this long period of management and utilisation. In Scandinavia and Central Europe, forest harvesting has occurred for five or six centuries.

Despite the widely publicised problem of ‘forest decline’ in Europe, recent manifestations of this phenomenon have been attributed mainly to air pollution, overloading of the soil with nitrogen from acid rain, or the toxic effects on tree roots caused directly or indirectly by sulphuric and other acids in acid rain.

The forest problem has been recorded where spruce or pine monocultures have been cultivated. Even before the acid rain phenomenon began, second-rotation spruce decline was reported before acid rain was a major environmental influence. Pure spruce plantations result in more acidic soil conditions than the beech, fir, and spruce forests they replaced, and this is thought to have predisposed these forests to air pollution and acid rain damage.

New Forestry

New Forestry (in the context of temperate North America) was a concept developed by a group of forest ecologists in Oregon and Washington, as a way to manage forest land to conserve a range of *old-growth values* (i.e., the partial retention of some characteristics and environmental services of the pristine forest, after harvesting). This new framework did allow for the extraction of timber and other commodities. It was an attempt to move certain environmental groups away from their preoccupation with forest preservation, which sought to limit the harvest of timber over large areas. New Forestry sought to persuade production-oriented foresters to develop and use systems of silviculture and forest management that maintain the environmental and wildlife values normally associated with unmanaged second-growth or old-growth forest. New Forestry, it was suggested, offered an alternative to the conflict between preservation and intensive timber harvesting. Under this new paradigm, the need for extensive old-growth values would be conserved in the working forest. The trade-off would be a reduced rate for production of timber per hectare of working forest.

The major concepts in New Forestry can be divided into two groups: (i) new approaches to stand-level management and (ii) new patterns of landscape-level management. The issues at play include longer rotations, partial cuts rather than clear-cuts where this is ecologically appropriate, and a variety of clear-cut sizes with a number of mature live trees kept to provide habitat for cavity-nesting birds and mammals (and as a source of food for birds that eat wood-boring insects). Appropriate management practices include: (i) the retention of large decomposing logs as habitat for small mammals, amphibians, and other organisms and (ii) removal of less wood per hectare at harvest time in order to maintain site organic matter resources and carbon storage.

New Forestry has run into resistance from commercial interests. In the Pacific Northwest of the US, it has been suggested that implementation of this system could lower the yield of logs from the forest by as much as 25 percent in some cases, and that much of this loss would be in the more valuable logs of larger diameter (In some shelterwood cuts in Oregon now being considered for ‘green tree retention’, 30 to 35 percent of the volume may be reserved.). Questions have been raised about the potential for the practical application of New Forestry (Gregg, 1991; O’Keefe, 1990).

Sustainable Management of Moist Tropical Forests

Traditional sustained yield timber management in tropical moist forests has proven difficult because of a combination of technical, economic, and social factors. These emanate from (i) the complexity of moist forest ecosystems; (ii) the length of time required for trees to achieve marketable size; (iii) the use of inappropriate harvesting systems; (iv) economic pressures to repeatedly log areas in which regeneration is not yet mature; and (v) encroachment pressures from commercial plantation operations or migratory communities, who survive by the slash-and-burn farming of forest lands.

The fundamental difference between temperate and tropical forests lies in the much greater complexity of the latter, and in the social and population pressures to which they are subjected. About two-thirds of the world's approximately 250,000 species of flowering plants flourish in the humid tropics. Few of these species are common to all three main blocks of tropical moist forest. The immense richness of some tropical moist forests is not uniform to all.

Tropical forest ecosystems with infertile soil, bad drainage, or difficult topography may be much poorer in species. Some tropical forests are adapted to disturbances such as hurricanes, cyclones, or landslides. Salt-tolerant mangroves, for instance, form communities on muddy tropical coasts. The more extreme the seasonality of climate, the more dramatic the reduction in the number of species. There are notable examples of forests dominated by one or a few non-pioneer species. Silviculture and timber management of these species-poor forests may be either relatively easy, if regeneration of the dominant species is abundant (as in some *Mora excelsa* forests in Trinidad), or relatively difficult, when regeneration is absent (as in forests dominated by *Meliaceae* in West Africa or the *Shorea albida* peat-swamp forests in Borneo).

Box 1 summarises some of the experimental approaches that have been tried in tropical moist forests over the last 100 years, generally with mixed results. While technical possibilities for achieving sustained yield timber regeneration are reasonably assured, social and economic pressures to re-enter the forest before a second crop is ready for harvesting have, in many situations, made SFM policies less than popular.

Box 1

Evidence Relating to Sustainable Timber Management in the Moist Tropics

Study	*Evidence and/or Conclusions*
Wyatt-Smith (1987)	The Malaysian Uniform System (MUS) was successful when abundant natural regeneration was present. In the Philippines, selective logging shows excellent regeneration of preferred species. Successful natural regeneration in Trinidad, Puerto Rico, and under the CELOS management system (CSM) in Suriname is promising.
Schmidt (1987)	In Malaysia, MUS resulted in successful regeneration in lowland *dipterocarp* forest. *Liberation thinnings* in selectively logged forests in Sarawak produced new, good quality stands. Selective logging in Philippines leaves a commercial residual stand.
Poore, et al. (1990)	Sustainable management achieved in Queensland. Some small-scale projects in Africa have begun. Sustained management in Malaysia shows promise. Sustained production is carried out in Trinidad and Tobago.
Goodland, et al. (1990)	True detection of sustainability cannot be achieved until at least a third rotation. Sustainability approaches during colonial regimes in Asia, Africa, MUS, and other systems fell prey to forest conversion before sustainability could be proved. Several experiments underway in Latin America may prove sustainable.
ITTO/HIID (1988)	It is probable that forests managed under MUS would be producing a second rotation if land had not been converted to agriculture; strip shelterwood system in Palcazu showing abundant regeneration; polycyclic systems with liberation thinning show promise in Sarawak and Cote d'Ivoire.
Jonsson, Lindgren (1990)	Forests in Costa Rica where *carpaguiatisis* was harvested are showing abundant regeneration. Regulations in Queensland recognise long-term economic and environmental concerns.
Keto, Scott, Olsen (1990)	They argue that the Queensland model, which had been promoted as sustainable, is based on an inadequate database and is thus inappropriate as a model.
Perl, Kiernan, McCaffrey, Bushbacher, and Baumanian (1991)	Thirteen examples in Latin America are given, none of which are demonstrably successful in all the necessary elements of SFM, and all require additional time to mature.

Hartshorn (1990)	In Palcazu, natural regeneration on two demonstration strips has been very good.
Bruering, Poker (1980)	Indicators for sustainable forestry in Congo are positive. SMS Malaysia has achieved sustained yield. In Mexico (Quintana Roo), successful sustainable timber production demonstrated; TSI project in Philippines successful in residual diperocarp forests

Source: Johnson, N. and Cabarle, B. *Surviving the Cut*. WRI, Washington, DC, 1993

A recent and important step towards improving the possibility for SFM in moist tropical forests has been the introduction of low-impact harvesting technologies, such as those being promoted by the Tropical Forest Foundation (TFF). Low-impact logging practices minimise damage to surrounding trees and vegetation, improve regeneration and, in some situations, may be less costly than traditional logging methods employing heavy bulldozers.

In Brazil's Amazon Basin in the states of Para and Mato Grosso, five demonstration models have been established. The one in Para has created a permanent training centre, which teaches the principles and practices of low-impact logging to timber company and government agency supervisors. In Sumatra, plans for such training centres are underway, including the establishment of a major demonstration project. The TFF has received numerous requests from a number of African countries to initiate similar demonstration models and programmes.

As New Forestry has evolved in temperate regions, parallel approaches have developed in the moist tropics. These sister frameworks include an increasing emphasis on SFM for the preservation of non-timber forest products and services essential to the way of life of forest communities. Strategies for tropical forests also address the preservation of biodiversity, the role of carbon sequestration, and the watershed protection services provided by forests.

The trend toward multiple end-use management of tropical moist forests is evident in many tropical countries' national forest management plans. Such plans increasingly acknowledge the wide range of goods and services provided by forests.

Recently, there have been significant advances in the scientific understanding of the ecological and economic value of the global carbon sequestration services provided by moist tropical forests. Studies in countries such as Malaysia, Costa Rica, and Indonesia suggest that the carbon sequestration value of forests may often be more than double the timber values. This has stimulated the introduction of financial mechanisms and joint implementation schemes based on carbon trade. Some developing countries such as Costa Rica, Malaysia, and Guatemala have benefited substantially from joint implementation investments in forest restoration and/or in low impact harvesting practices.

Box 2

Forest Goods and Services Provided by Tropical Moist Forests

Major Products	***Minor Products*** *(Non-Timber Forest Products)*	***Ecological and other Services***
• Timber logs, plywood, veneers, sawn lumber • Poles • Firewood (charcoal) - Shingles - Bamboo - Rattan - Fodder - Thatching Grass	• Extractives (bark, dyes, fibres, gums, incense, latexes, oils, resins, shellac, tanning compounds, waxes) • Parts of plants and animals for magic and medicine, and decoration • Food (bush meat, flowers, fruit, honey, leaves, nuts, seeds, spices)	• Carbon sequestration • Protection of ecosystems and conservation of biodiversity • Perennial flows of clean water • Reduced flooding and sedimentation/bed-loading downstream • Protection for crops and domestic animals against wind damage, excessively high and low temperatures, blown sand, epidemic predators, and parasites • Tourism and recreation

Source: FAO 1992

Conflicting Perspectives on Moist Tropical Forests

Many people view the fragmentation and loss of tropical moist forests as the single greatest threat to the world's biological diversity and a major contributor to global climate change. Ecological concerns are rooted in the growing appreciation of the abundance of species endemic to these forests, and to the understanding that so much is still unknown about the structure and function of these ecosystems. Ethical concerns derive from ecological ones; is it right for one generation to irreversibly draw down the world's stock of biological diversity? Is it right for anyone to destroy the livelihood of indigenous peoples whom occupy these forests, no matter what the short term benefits? In view of such questions, some leading conservation agencies argue that none of the remaining tropical moist forest areas should be exploited for industrial purposes.

The developing countries that actually control tropical moist forests have a quite different perspective. Tropical moist forests represent ecological capital that can be converted into much-needed economic capital—funds that increase their gross domestic product (GDP) and standards of living. Government control over access to forests may be limited by cultural or social practices, or even by sheer ineptitude. When control of forests is vested in a ruling elite, it is virtually impossible to disentangle the governance of a country from the management of its

forests. Developed countries exploited their own forests in a headlong rush to expand national income, extirpating species in the process.

Given the gravity of today's ecological concerns, on the one hand, and national intransigence rooted in entrenched sovereignty and poverty on the other, "*a middle course between complete protection and unbridled exploitation is the only pragmatic course of action* (Sharma, Binkley, and Burley, 1992)."

This approach argues that the capacities of tropical moist forests are multiple, and must be used to: (i) contribute to human needs, (ii) protect biological resources, and (iii) conserve diverse forest ecosystems for environmental services. The biological diversity of tropical moist forests that is so critical to the global ecosystem will survive only within this larger context of sustainable development and conservation.

Under these current circumstances, countries must approach forest exploitation with caution in favour of conservation because the trade-off between conservation and development can rarely be evaluated objectively. There are several reasons:

- Many of the environmental goods and services (also known as *public goods*) provided by tropical moist forests are difficult to value
- Scientific knowledge about tropical forest ecosystems and biodiversity is limited.
- Further work is required to establish workable sustainable management systems for commercial logging
- Forests have option value (i.e., the value of future benefits compared with actual present-use value)
- Loss of forests is associated with irreversibility (i.e., the loss of biodiversity) and uncertainty (i.e., forgone future choice)

Dry Forests

While most Northern countries have focused on the destruction of moist tropical rainforests (and the associated global consequences), less attention has been given to the dry tropical and subtropical forests. Dry forests are at least as problematic and are definitely more extensive. Furthermore, they are disappearing at a faster rate than moist forests. Because such forests and woodlands occur in more densely populated regions than rainforests, their loss is likely to have a more severe impact on people living nearby the forests. The location of dry forests in arid areas may mean their disappearance will increase the threat of desertification. They are usually the major suppliers of urban fuelwood to distant markets. Despite this, more public interest and drama is currently attached to rainforests

The tropical and subtropical dry forests are furthermore important for a variety of reasons. First, like rainforests, they have a protective function—not only directly, by protecting and cooling soil (and, thus, maintaining soil fertility), but also indirectly, by locking up quantities of carbon.

Carbon sequestration provides the world the ‘breathing space’ crucial for the mitigation of global warming.

Second, most tropical dry forests support larger numbers of people and domesticated animals than the rainforests on a hectare for hectare basis—though the sustainable density is still relatively low. Humans have learned to live in symbiosis with these woodlands—by relying upon the milk and the meat of animals living off forests, and on the replenishment by trees of the soil fertility necessary for agriculture. As a result, the disappearance of forests affects people living nearby *at least as* severely as those living in rainforests. Recent trends in dry forest management, as is the case with both temperate and tropical forests, have been influenced by an improved understanding of the social and ecological implications of such forests.

From a technical perspective, it has been recognised that earlier attempts to meet forest product needs by establishing dry-zone plantations are not the answer. The emphasis has now shifted to management practices aimed at sustainably harvesting of the slow-growing but ecologically robust indigenous tree species of open savannahs and desert margins. The requirements of pastoral communities have now been more fully recognised. Management techniques, such as the frequent but light lopping of trees, have been shown to produce, for instance, more digestible fodder. Likewise, harvests of poles and fuelwood from multiple sprouts, on coppiced stumps in dry forests, may have more usable biomass than the large logs produced from timber-oriented management systems.

Some of the most promising experiences in sustainable dryland forest management come from India, where community-driven *joint forest management* schemes have emerged as a highly influential force for restoring India’s degraded forest lands. Throughout the 1980s, and without waiting for supportive policies or judicial decisions, thousands of communities began to protect their degrading forests, primarily in eastern India’s tribal forest tracts. Often with little or no outside help from government, NGOs, or donor programmes, village leaders began to recognise the magnitude of the environmental crisis confronting them — their once densely forested hills were denuded. Communities formed hamlet-based forest protection groups and halted cutting and grazing, often initiating rapid regeneration of the natural forests (see Box 3).

Box 3

Sustainable Dry Forest Management

Around Tangi and the Khurda Forest Division of eastern Orissa in India, in response to growing environmental problems, village leaders from five neighbouring communities began holding meetings in Tangi in 1985 to discuss how to preserve and restore their natural forests. In 1987, the communities agreed to form the Five-Village Forest Protection Committee (Poffenberger, 1990).

Over the past decade, 120 villages have joined the original five in the Kurdha Forest Division alone. Statewide, 4,000 communities currently protect over 250,000 hectares of vigorously regenerating mixed *Shorea robusta* forests. By 1996, between 10,000 and 15,000 communities across India have joined this grassroots forest protection movement with minimal cost to the government. In many areas, flora and fauna that have been disappearing from these habitats have begun to return. In response to the growing political demands of village communities, a national policy breakthrough occurred with the passing by the Indian government of a new National Forest Policy Act in 1988, which explicitly recognised the legal status of Joint Forest Management Contracts.

Agroforestry

As common property resources disappear or degrade, farmers everywhere have sought to retain control over the production of 'outputs of value' from their lands often by protecting, planting, and managing trees of selected species. The International Council for Research in Agroforestry (ICRAF) estimates than 1 billion people depend on their own tree stocks and agroforestry systems for some products and on common property resource sources for others.[1] Recently, the process of adding tree farming to agricultural systems has been accelerated or transformed by the growing commoditisation of fuelwood and other tree products, and the consequent emergence of trees as a cash crop (Spears, 1987).

Agroforestry is practised in almost all ecological regions of the tropics. The most common criteria used to classify agroforestry systems are: (i) structure (composition and arrangement of the forest's components), (ii) functions, (iii) socio-economic scale of management, and (iv) ecological spread. The types of systems used are consequently diverse and complex. However, all systems are characterised by the presence or lack of three basic components—woody perennials (trees), herbaceous plants (crops), and animals.

The main agroforestry systems have been broadly classified as:

[1] For a comprehensive treatment of agroforestry, see "The Prospects for Agroforestry in the Tropics." World Bank Technical Paper, No. 13. P.K.R. Nair. 1990

- Agrosilvicultural (crops and trees)
- Silvopastoral (trees and grazing pasture)
- Agro-silvopastoral (crops, trees, and grazing pasture)

Other specialised agroforestry systems can also be defined. There are systems involving, for example, apiculture with trees, aquaculture involving trees and shrubs, and multi-purpose tree lots.

Agroforestry holds considerable potential as a major land management alternative for conserving soil, and for maintaining soil fertility and productivity in the tropics. This conclusion is based on the evidence that trees and other vegetation can improve the soil beneath them, and thus the yields of associated crops. Observation of the interactions in natural ecosystems have identified a number of points that support this assumption.

- From time immemorial, farmers have known that they will get a good crop by planting in forest clearances.
- Soils that develop under natural woodland and forest are known to be well-structured, with good moisture-holding capacity and high organic matter content. The ability of trees to restore soil fertility is illustrated by experiences in many developing countries. Several case studies indicate that the best way to reclaim degraded land is through afforestation, or a similar type of tree-based land use. For example, the enrichment qualities of trees such as *Faidherbia albida* in West Africa and *Prosopis cineraria* in India have long been recognised.
- The conversion of natural ecosystems to arable farming systems leads to a decline in soil fertility and to a degradation of other soil properties unless appropriate, and often expensive, corrective measures are taken.

These observations have led to a number of research studies on the role trees play in soil productivity and protection, especially in the context of agroforestry development.

To summarise, there is now a substantial volume of well-researched information available on the soil-improving and positive crop yield attributes of trees. There is a wealth of evidence to indicate that agroforestry farming systems (those incorporating trees and shrubs) can make a significant contribution to (i) maintaining and improving the fertility and overall productivity of the soil beneath them, (ii) increasing the productivity of agriculture, (iii) generating rural incomes, and (iv) to sustainable development in general.

Plantation Forestry

The majority of plantation forests have been established almost exclusively as monoculture crops of trees, planted all at once, and with the primary purpose of wood production. They represent the most intensive form of commercial forest management. It is projected that plantations will become an increasingly important source of industrial wood in the coming century.[2]

Around 90 percent of existing plantations have been established for industrial wood production, and most of the remainder are used to produce wood for fuel or for *roundwood* (building poles or fencing stakes). Some forest plantations are harvested for non-wood products, such as essential oils, tannins, or fodder. Those grown as parts of agricultural systems, however, (e.g., rubber or coconut) have not generally been considered forest crops. The harvest rotations of forest plantations vary enormously—from annual or sub-annual for some non-wood products, to around 200 years for traditionally managed, high-value temperate hardwoods. With few exceptions, plantations that harvest on shorter rotations have produced fuel, cellulose fibre, or roundwood. Plantations with a longer rotation—typically harvesting in cycles upwards of twenty-five years—are used principally to produce wood for veneer and other specialised uses.

Large-scale plantation forests are a twentieth-century phenomenon, notwithstanding successful antecedents in both temperate (e.g., oak in Europe) and tropical (e.g., teak in Asia and India) environments. The majority of the world's plantation forests have been established in the past fifty years, and the rate of plantation afforestation has been increasing progressively. Subject to the substantive caveats that definitions vary and the quality of some data is poor, the best current estimates are that the area of plantation forests is approaching 135 million hectares globally (Box 4). The world's plantation forests are thus assuming an increased importance—as a way of using land in general, as sources of forest products, and as a means of delivering forest benefits and services as diverse as recreation, environmental protection and rehabilitation, and carbon sequestration.

Box 4

Plantation Forests

Approximately 75 percent of the world's existing plantation forests are in temperate regions and about 25 percent are in the tropics and subtropics. Some 5 percent are found in Africa, a little more than 10 percent in each of the American continents, some 20 percent in the former United Soviet Socialist Republics, and around 25 percent in the Asian Pacific and Europe. Approximately 10 percent of existing plantations can be classified as 'fast-growing', yielding more than 15 cubic metres per hectare per year. Most of these plantations are in the Southern Hemisphere, with about 40 percent in both South America and the Asian Pacific. The majority of 'fast-growing' plantations are of species such as *Acacia* or *Eucalyptus* that are grown on short rotations for the relatively low-value uses of

[2] Based largely on "Plantation Forests at the Millennium," Peter Kanowski. Report prepared for the WCFSD Scientific Committee. 1997.

fuel, cellulose fibre, or roundwood. Perhaps a third are longer-rotation crops, of either softwood or hardwood species, grown principally for sawn- or veneer-wood. Some species (e.g., *Araucaria, Gmelina, Larix, Paraserianthes, Populus, Pseudotsuga,* or *Tectona*) have significant regional importance. The renewed interest in plantations of indigenous hardwoods has yet to lead to their large-scale establishment. The testing of a wider range of these species, and the development of appropriate propagation technologies, is a prerequisite to their more widespread use.

Source: "Plantation Forestry" Peter Kanowski. Paper prepared for the WCFSD Science Committee 1997

Simple plantation forestry, the relatively intensive management of simplified forest systems for a range of wood products, can return commercial wood yields five to ten times greater than most natural forest systems. Well-managed simple plantation forests will continue as a major component of the productive forest resources in many countries, subject to satisfying sustainability criteria. Prevailing political ideologies also suggest they will increasingly be under private, or quasi-private, ownership and management.

Simple plantation forestry will increasingly be characterised by expectations of competitive financial returns, thus both demanding and permitting a relatively high level of input. Consequently, sites that are inherently more productive than those which are marginal, where the cost of transport to processors are least, and where environmental and social values are not prejudiced, will receive the majority of resources and attention. The focus becomes on simple plantation programmes that are (i) more intensive culturally and less extensive geographically, (ii) located where the land base is stable, secure, and productive, and (iii) where the economies of wood production—in terms both of cost structures within forestry and of relativities with other land uses—are most favourable.

Environmental concerns have been expressed about the sustainability of plantation forests, and about their potentially harmful social and economic impacts (Lohmann and Carrere, 1996). In some circumstances, plantation forestry is unlikely to be feasible or sustainable without assuming a broader role, one more integrated with other land uses. There are well-documented instances of situations where plantations founded on inappropriate sites have contributed to reduced water yield from catchment areas (Calder, 1996). There are also many case studies of situations where large-scale industrial plantations have been established without regard to local community needs and land rights.

Notwithstanding these very legitimate concerns, research carried out over several rotations of plantation crops (such as *Pinus patula* in Swaziland, *Pinus elliotii* in Australia, *Eucalyptus spp*. in Brazil, and teak plantations in Kerala) indicates that yields over time can be steadily increased (Evans, 1992). The technologies for achieving sustained-yield plantation management are well documented, particularly regarding the importance of leaving in place the lop-and-top from harvesting operations in order to maintain sufficient organic matter and soil structure. There are also thousands of small farmers and private woodland owners, both in temperate and tropical regions, whom derive substantial income and benefits, from plantations.

Environmental guidelines have been developed for plantation forestry that suggest forest planners will now have to take into account objectives, species composition, management regimes, and tenure arrangements more complex than those typical to simple plantation forestry (Kanowski, 1997). C*omplex plantation forestry* is characterised by:

- a more intimate association between forests and other land uses;
- more direct involvement of local people in the conception and implementation of plantation forestry, and in the sharing of its benefits and products; and
- a more diverse species composition and plantation structure, yielding an earlier and more continuing flow of a wider range of products and services than result from simple plantation forests.

From a global environmental perspective, plantations provide an attractive strategy for reducing pressure on natural forests. By the year 2050, more than half of the world's industrial wood consumption will be of cellulose fibre for the production of wood-based pulp and paper (Solberg, et al, 1996). Assuming quite conservative yields of 15 cubic metres per hectare a year— in theory, all of that pulpwood could be produced from an area of less than 100 million hectares (equivalent to less than 3 percent of the world's remaining forest area).

While in practice this substitution of natural forest-derived pulpwood for plantation pulpwood supplies is perhaps not fully viable, there is a trend toward increased private sector investment in plantations. This is primarily seen in Southern Hemisphere countries with favourable ecological conditions for forest growth, such as New Zealand, Brazil, Chile, Argentina, Uruguay, Indonesia, South Africa, and the People's Republic of Congo. Similarly, in temperate region countries, the trend of relocating industry to areas with conditions favourable for strong forest growth and cheap wood production [such as the southern states of the United States of America (US) and parts of Vancouver Island in British Columbia, Canada] will certainly continue.

Ecosystem Management

As the debate on SFM has evolved, the most recent and complex development has been the emergence in the US of ecosystem management (Forest Ecosystem Management Assessment Team, 1993; Overbay, 1992; Slocombe, 1993). Initially, there was much confusion and concern over the meaning of this term, but ecosystem management appears to be essentially the same approach as ecologically based forest management, applied at both the stand and the landscape levels.

Ecosystem management involves ecological site classification, which identifies ecologically significant variations in climate, soil, vegetation, and ecosystem function across the landscape. Site-specific management objectives and practices are then developed for the ecologically distinct portions of the landscape—objectives and practices consistent with both the ecology and the individual landscape units as well as with the regional forest management objectives. Ecosystem management is also concerned with i) the rate and landscape pattern of forest harvesting, ii) watershed effects and impacts on fish and streams, and iii) wildlife habitat.

Many of the ideas of New Forestry are incorporated into ecosystem management, but the latter is a broader framework for management than the former. Although there is still much debate about ecosystem management, if it is indeed a synonym for ecologically-based, sustainable forest management for multiple values, the concept should be accepted as the ecological foundation for sustainable forestry.

Ecosystem management has engendered a similar range of avid support and equally vigorous criticism as greeted New Forestry. A major focus of ecosystem management is on maintaining a desired landscape pattern or mosaic of ecosystem conditions. The focus on *forest stands* (local forest ecosystems) and local populations, which characterised much of the public discussion over New Forestry, has changed to concern about *meta-populations* (the regional population of a species, made up of all the local populations). Concern about local extirpation (loss) of a species has given way to concern over the processes by which that depleted local population can be replaced from the meta-population.

With a landscape view comes the appreciation that not all species present in the landscape can or will be represented in every local ecosystem all, or even some, of the time. A landscape is a shifting mosaic of various and changing plant, animal, and microbial communities. This has important implications for the design of biodiversity reserves, the location of which may shift to different places in the landscape over time. Reserves and ‘connectivity’ corridors (links between areas of similar ecosystem condition) are seen as dynamic and shifting conservation strategies in the face of either natural or anthropogenic disturbance in the landscape.

The focus on ecosystems in ecosystem management has restored the recognition of soils as a major determinant of sustainability. This focus had become rather lost in the early days of New Forestry. Ecosystem management also has less preoccupation with climax or later-stage forest conditions (‘old growth’). There is nevertheless recognition for the general need to have a wide range of forest growth stages represented in the landscape, if all desired social values are to be sustained. Because of soil fertility, pathogens, and biodiversity considerations, ecosystems may need to be cycled through a sequence of stages, rather than being statically maintained in any particular stage. This in turn results in the acceptance of stand-replacing ecosystem disturbance as an essential part of the sustainability of many forest ecosystems.

In New Forestry, there was concern about retention of dead branches, coarse woody debris, and individual trees uniformly across harvested areas. In ecosystem management, this concern has shifted to a focus on ‘aggregated retention’—small patches of forest rich in dead branches and coarse woody debris. These are deemed more favourable for wildlife and biodiversity values than the retention of individual live trees or decaying stumps and branches occurring rather uniformly across harvested areas.

Ecosystem management is indeed logical and desirable. New Forestry was designed as an alternative to large wilderness reserves, and Ecosystem management as an alternative to New Forestry. In some cases, environmental groups are urging that all three be applied. In some cases, what were developed as alternatives are being proposed as additions. Under the restrictions posed by the additional effects of these three strategies, economic timber management and harvesting

could become increasingly difficult. The practical application of ecosystem management is still too new to fully gauge whether its objectives can be achieved.

Implications for Future Policy

The implications of increasing complexity in the debate over what constitutes sustainable forest management have been succinctly summarised by Hamish Kimmins.

> *"All the planning and the management techniques will be in vain if there is no commitment to sustaining the many different values provided by our forests. There must be a stewardship ethic among government policy makers, the corporate levels of forest industry, and those who plan and manage forest resources on the ground. This stewardship ethic should cover the environmental, social, and economic values of our forests. These different and sometimes conflicting issues cannot be separated if we are to achieve sustainable use and development of our forests." (Kimmins, 1997)*

Useful, if broad, guidelines for future strategy were suggested in recommendations made to the Intergovernmental Panel on Forests (IPF) (Mankin, et al.).

They define sustainable forest management as a system that:

- maintains the forest, its ecological functions, processes, and overall structure in healthy condition in perpetuity;
- does not degrade soil or water quality;
- does not produce any irreversible consequences or losses to biological diversity—including genes, species, ecosystems, and forest types;
- applies to the entire forest as an integrated, ecological whole rather than to any single component or product of the forest;
- can be either active or passive, and does not require the extraction or harvest of a particular product from the forest;
- can be applied to any size or scale of management area (e.g., individual forest management unit or ecosystem, watershed, landscape, forest type, bio-region, nation, etc.) and for each scale must then be assessed entirely within those particular boundaries; and
- can produce a wide range of environmental, social, and economic benefits to society, depending on the scale of the management area and its capabilities.

As noted earlier, forest land use planners face a difficult task in evaluating trade-offs between the various objectives summarised above. Current institutional processes for achieving compromise between various stakeholder groups are extremely weak. It is an underlying goal of the UNDP Programme on Forests to address this issue and to focus on the development of more equitable public/private partnerships and consensus-building mechanisms.

Key Elements of Future Strategy

In designing SFM strategies, the UNDP urges countries to give special attention to the following issues:

- Acknowledging the dynamic nature of forest change
- Maintaining flexible management strategies based on application of the precautionary principle
- Using scientifically measurable criteria and indicators of forest health and quality
- Recognising the growing interest of the public and forest product consumers have in ensuring that the forest products they purchase are derived from forests that have been certified as sustainably managed
- Capitalising on the potential of spontaneous, local community traditional knowledge and creating an enabling policy framework that is conducive to local participation and forest ownership
- Improving knowledge of the forest ecosystem functions through increased support to scientific research.

Acknowledging the Dynamics of Forest Change

Many environmental groups have suggested that it should be a primary objective of sustainable forest management to maintain ‘current’ (or ‘pre-European’ in the case of North America) levels of biodiversity and species range. This implies that the present condition of the world’s ecosystems is the way nature intended it to be areas—an implication that is scientifically unsupportable. Climates have always changed and will always change. Many species have occupied their present geographical distribution for only the past few centuries or millennia, and are still changing their range in the wake of the last glacial period, or at least of the ‘little ice age’ in the Middle Ages. Many ecosystems owe their present condition to wind, fire, and past timber harvesting or deforestation for agriculture. Their present species diversity and structure reflect the history of human and natural disturbance, and not what the forest would look like after another 500 years of development in the absence of disturbance.

In most forests, biodiversity is not a fixed, ‘God-given’ thing, but a complex and ever-changing ecosystem and landscape characteristic. Maintenance of a given pattern of diversity requires management. In its absence, nature will produce a continually changing mosaic of biodiversity in forested landscapes.

As a guiding principle it would seem reasonable to endeavour to keep all the various components as mankind ‘tinkers’ with forest ecosystems, but this is a landscape-scale and not a stand-level concept. This means maintaining species and species range wherever possible. It does not mean that the ecosystem will fail to function unless every species is present in every ecosystem all the time—something that is ecologically impossible and completely unnatural. A broad landscape view of biodiversity makes more sense than a narrow, local view.

Maintaining Flexibility in Management Strategies: The 'Precautionary Principle'

There are three central ideas about how in practice to manage forests for multiple values: multiple use, best use, and integrated use. Some people advocate managing forests to sustain all values in all forests all the time; something that cannot be achieved unless the spatial scale over which sustainability is evaluated is very large. Others recommend ‘zoning’ or stratification of forests into a mosaic of single-use areas according to the balance of values that each area can provide: timber production areas, wildlife corridors and reserves, stream protection forests, wilderness areas, and so on. Secondary uses and values would exist in these single-use areas only if they did not interfere with the main value; although maintenance of soil conditions, hydrology, and the integrity of streams and rivers would be a requirement in all areas.

Another approach is to identify some areas as single use—such as plantations near mills or discrete wilderness areas—and to achieve a mixture of uses and values in the rest of the forest, the balance of uses varying according to the potential of the ecosystem to sustain the values, and the social demand for them in the forest area in question.

It is probable that no single approach is ideal for all forests. However, given the possibility of grave ecological decline on one hand, and the preoccupation of many developing countries with poverty eradication and raising standards of living on the other, as a middle path to be found between strict conservation and full-blown extraction. Under such an approach, the multiple capacities of forests must be used to contribute to human needs, protect biological resources, and to conserve diverse forest ecosystems for environmental services. The critical biological diversity of forests will survive only within this larger context of sustainable development and conservation. To cite Duncan Poore:

> *“Thus, if one is to be strictly accurate, sustainability can only be defined in relation to a specified set of products and a specified condition. It may, however, be possible to design a system that is an acceptable compromise between a number of objectives.”(Poore, 1993)*

To reduce pressure on existing forests, Sharma, et al, argue that developing countries should work to increase forest resources through afforestation and integration of trees in agricultural land use. Because it is inevitable that developing countries will continue to log tropical forests, they suggest as guidelines that each country should:

- provide adequate compensatory preservation forests designed to maintain biodiversity and safeguard forest dwellers’ access and rights to designated forest areas;
- adopt a comprehensive forestry conservation and development plan that includes a clear definition of the roles and rights of the government, private sector, and local peoples (including forest dwellers);
- establish a policy and institutional framework to ensure conservation and sustainable use of existing forests, and to promote the more active participation of local people and the private sector in the long-term management of forests;

- complete social, economic, and environmental assessments of the productive forests designated for commercial use; and
- adopt a conservationist approach to commercial use of forests, ensuring that logging operations conform to 'best practice' methods [using guidelines such as those of International Tropical Timber Organisation (ITTO)], and take vigorous action to ensure that operational performance is independently assessed using scientifically established criteria and indicators.

Monitoring SFM: The Role of Criteria and Indicators

Recent years have seen a concerted effort to develop clear standards and benchmarks for sustainable forest management. These efforts were initiated by the ITTO in 1992, and were followed by a series of regional initiatives in Europe the same year. The efforts continued in other temperate and boreal countries in 1995. Criteria and indicators of sustainable management are a central feature of regional intergovernmental processes such as the 'Helsinki' and 'Montreal' Accords, the 'Tarapoto Process' in the Amazon region, the Central American Forest Convention, and several other regional agreements.

Criteria and indicators hare been further articulated through a number of national and local initiatives to develop criteria and indicators, in Canada and elsewhere. Despite a profusion of activity, international harmonisation has proved elusive.

The questions about definition of criteria, indicators, and the minimum acceptable standards of logging were extensively debated by the IPF, which recommended, inter alia:

> *"The need for a broad spectrum of qualitative and descriptive indicators covering social, cultural, economic, ecological, institutional, legal and policy elements (including local tenure)."*

Some indication of the increasingly complex range of factors that have to be taken into account by forest policy decision-makers can be gauged from the criteria recently proposed for the Amazon region countries, under the Tarapoto process. They include evaluations of policies and benefits at management unit, national and global levels. Proposed criteria cover:

Environmental Criteria

- Biodiversity (genetic, species, ecological, and landscape)
- Productivity (of the ecosystem)
- Soil conservation (including erosion and natural hazards)
- Water conservation (including water quality and quantity)
- Forest ecosystem health and vitality (ecosystem functioning and processes)
- Contribution to global ecological cycles

Socioeconomic Criteria

- Institutions and infrastructure to provide for sustainable forestry
- Long-term supply of social benefits
- Long-term output of multiple economic benefits
- Recognition of full spectrum of forest functions and uses
- Recognition of, and respect for, indigenous rights, and knowledge of historical and archaeological sites

At the drafting of this report, the process of evaluating the practicality and usefulness of various criteria and indicators is still ongoing in an initiative lead by the Centre for International Forestry Research (CIFOR).[3] It is premature to assess the outcome at this juncture. What can be stated with certainty is that these attempts to improve the scientific measurement of various elements of forest sustainability constitute a significant advance over earlier approaches, which were often limited to periodic assessment of logging operations by frequently weak forest administrations. UNDP, though its country programmes, intends to give high priority to fostering the further development and application of criteria and indicators.

Certification

Many forest product consumers in Europe, the US, and Japan (who between them account for more than 60 percent of world consumption of manufactured forest products) increasingly insist on ensuring that the products they purchase emanate from forests that have been certified as under sustainable management.

Certification is perhaps the most powerful 'soft' policy instrument to be designed and implemented outside government.[4] The key actors have been NGOs and the private sector. Although of recent origin, certification is already making a positive impact on private sector forestry. Several of the private sector companies who made submissions to the Commission confirmed their willingness to adopt certification.

Forest management certification is an established and recognised procedure, by which a third party gives a written assurance that the quality of forest management conforms to specified

[3] CIFOR is an international forestry research organisation based in Indonesia. One of its programmes is to test criteria and indicators for sustainable management of forests. The test is being undertaken by a core group of CIFOR scientists with input from international NGOs, certifiers, and local forest specialists. CIFOR is utilising criteria and indicators generated by certification organisations such as Lembaga Ekolable Indonesis (LEI), Initiative Tropenwald (ITW), Smart Wood Programme (Rainforest Alliance), the Dutch Working Group (DBB Netherlands), and the Green Label of the African Timber Organisation (ATO).

[4] This section drew heavily on the work of Stephen Bass and input from the staff of the International Institute for Environment and Development (IIED).

environmental and social standards. Certification links market demands for sustainably produced forest products with producers who can meet those demands.

At present the Forest Stewardship Council (FSC) and its accredited certifiers offer the only established international system of forest management certification. FSC was established precisely for the purpose of forest certification. It offers a complete package: a forest management standard, an international accreditation programme for certifiers, a trademark that can be used in labelling products from certified forests, and a communication and advocacy programme.

The International Organisation for Standardisation (ISO), through its ISO 14000 series, offers a framework for the certification of environmental management systems (EMSs). This covers similar ground to forest management certification, except that it does not specify forest management performance standards, and does not permit a label to be attached to products. The EMS is certified, rather than the forest. Although not strictly a forest certification programme, the ISO approach offers much potential for assessing the environmental quality of forest management. An ISO Technical Committee Working Group is preparing an information document on the various forest performance standards available, to help enterprises incorporate relevant standards into their EMS.

While both FSC and the ISO 14000 series aim to improve environmental performance, they are very different in structure and operation. The FSC and ISO approaches have two distinct philosophies with respect to forest verification—the former emphasising forest performance standards and the latter, management system standards. Despite this 'divide' between the two approaches, there is considerable overlap in many matters, and even some communication. There are other approaches that cross the division, but are essentially based on a management system approach. One is the Canadian Standards Association approach (designed for forestry), with its orderly integration of prescribed types of performance criteria at the local level.

Many companies whose operations are now certified have been practising adequately sustainable forestry for some time. Certification allows the good producers to be recognised, and rewards their performance by enabling them to maintain, or to reclaim or improve, their market share. In other words, certification at present is more of an instrument for market strategy than it is an instrument for encouraging improved forest management. As certification becomes more widespread—encouraged by Northern buyers' groups committed to trading only in products from certified forests, either:

- so many forest enterprises will be shut out of environmentally discriminating markets that they will improve their forest management to enter such markets; or
- forestry corporations that do not see themselves able to be certified, for reasons of cost or skill deficit, will divert their products to undiscriminating markets.

The UNDP intends to lend strong support to the fostering of certification mechanisms. It will give emphasis to capacity building at the national level, and especially to the establishment of local, independent certifying institutions. One such institution is Indonesia's recently created *Kelompok Kerja Ekolabel,* which includes a broad representation of all major stakeholder

groups, and has adopted very similar standards to those promoted by the Forest Stewardship Council.

Building on Traditional Knowledge

The importance of capitalising on traditional knowledge was given high priority in the report of the IPF. Many of the world's more than 1 billion poorest people are highly dependent on the management of remnant woodlands, on farm trees, and on agroforestry farming—both for subsistence needs (food, fuelwood, fodder, medicinal products) and income generation (Arnold, 1989). There are many well-documented examples of how local communities and small farmers have been sustainably managing forest resources and farm trees, based on traditional knowledge accumulated over long periods of time (Barrow, 1986). Indigenous societies are highly adapted to their area, and have developed a database of time-proven methods for harvesting and regenerating their resource base. The potential of forests to contribute to poverty alleviation justifies special emphasis on local community efforts and on the major role they play in improving the welfare of local people—particularly the rural poor.(King, et al, 1990)

'Spontaneous' community forest management and tree planting (although it is generally a quite deliberate application of indigenous knowledge) by local communities and smaller farmers outside of closed forests, are making a highly significant, but inadequately acknowledged, contribution to reforesting the tropics.

For example, a recent International Food Policy Research Institute (IFPRI) research study in Africa observed:

> *"A picture is also beginning to emerge of how deforested land is subsequently used. As it turns out, reestablishment of ground cover plays a major role in that picture. In parts of Africa, over the decade from 1980-1990, for example, much of the land lost to open forest was not left barren, but rather converted to agriculture, including planting of trees. A 1985 aerial inventory of selected districts in Kenya, conducted for the Beijer Institute revealed close to 20 percent of originally forested agricultural land to be under woody biomass. Evidence of such spontaneous 'reforestation' exists for Asia and Latin America as well."* (IFPRI 2020: Vision Brief, 1996)

In many situations, traditional knowledge-based, spontaneous community forest management and on-farm tree planting far exceed the accomplishments of national forest agencies and at a very much-lowered cost.

> *"Grassroots efforts by land owners and small farmers in parts of Asia are achieving results where millions of dollars of external funding along with the application of new technologies and policy instruments have failed to dent the problem."* (Poffenberger and Stone, Sustainable Development Institute, 1996)

Scientific Research

A major constraint on the formulation of sound policies for forest conservation is the uncertainty about the functioning of how forest ecosystems work: about forest and climate change relationships, about the underlying causes and potential solutions for toxification of forest soils, and about other ecological functions of and in forests.

The debate on many forestry issues has been characterised by superficial interpretations of scientific evidence and misinformation about the impact of alternative forest conservation and management strategies.

There are also uncertainties about how alternative policies, strategies, and institutional arrangements for sustainable forest management are likely to impact on people and on forest resources. Much of the data on the extent of both ecological damage and forest recovery is incomplete. Accordingly, the UNDP will use its influence to urge the scientific community, policy research institutions, and universities to play a proactive role in seeking increased investment in and implementation of scientific and policy research. The foci for such efforts are outlined below.

- Improved understanding of i) the implications for forests, human welfare, and planetary stability of human-induced climate change, loss of biodiversity, industrial pollution, and toxification of forest soils and ii) how to manage entire ecosystems as opposed just managing for timber.
- Research and development of environmentally friendly forest end use, harvesting, and management technologies, with special emphasis on low-impact harvesting methods as well as investment in tree breeding and improvement programmes of key fast-growing agroforestry and industrial species.
- Strengthening of scientific global forest resource assessments and institutional capability for information and data collection.
- Policy research with special reference to improved understanding of how to remove obstacles to local peoples' involvement.
- Policy and institutional options for ensuring responsible forest stewardship by private Industry.
- Improved understanding of the value of ecological benefits of forests and of the effectiveness of different financial mechanisms in payment of such benefits.

Existing international and regional research centres such as CIFOR (Indonesia), EFI (Europe) ICRAF (Nairobi), International Network for Bamboo and Rattan (INBAR), (China), Iwokrama Research Centre (Guyana), and the member research institutions of the International Union of Forestry Research Organisations (IUFRO) will play an increasingly important role in monitoring the rapidly evolving approaches to SFM, and in providing guidance on socially and ecologically acceptable procedures.

Conclusions

Sustainable forest management is not just about maintaining a supply of timber and jobs. It is about maintaining the function of the global ecosystem and global biodiversity. Forest management focused only on environmental issues such as wilderness, biodiversity, and old growth is certain to fail. Sustainable forestry will be a meaningless goal unless it begins with the recognition of local peoples' dependence on forests, their subsistence and economic needs.

The greatest threat to the world's forests is people, and one of the major threats to the world's people is the loss or degradation of the world's forests. People and forests are thus inextricably linked.

This does not imply that there will be no change in any of the world's forests, but that the cycles of ecosystem disturbance and recovery should be such that desired ecosystem conditions and values are sustained at acceptable levels, and that the long-term trends in ecosystem development conform to society's goals.

Thanks to public concern about the environment, the issue of sustainability is now high on the agenda of many of the world's politicians. It is almost unimaginable that there could ever be a return to the old attitudes that focused primarily on sustainable timber production. Although we face a long and uncertain path to the ultimate achievement of sustainable management of the world's forests, public pressure has already moved forest policies a significant distance.

Forestry began as an organised human activity to sustain a variety of desired environmental conditions and a supply of desired products from forested landscapes. In the present century, there has been a broadening in public perception of the importance of different forest formations. For example, while much of the early forest literature concentrated almost exclusively on ‘closed’ forests, today there is growing recognition of the important role agroforestry farming systems play in meeting the forest product needs of more than a billion of the world’s poorest people, as well as contributing in a major way to sustainable agriculture.

There has also been an acceptance of the potential for intensive plantation forestry to relieve pressure on natural forests, particularly in situations where such plantations can be established on agricultural wastelands or in badly degraded forests. Intensive plantation forestry will become increasingly important, both as a source of industrial cellulose and of renewable biomass-based energy.

Within closed forests, ‘sustained yield’ has been the maxim under which most foresters have operated—many successfully, but some unsuccessfully. More recently, the focus on sustained yields of timber has been replaced by ecosystem management, in which a wide variety of values, including timber, are sustained. A growing segment of society is now equally concerned about forest sustainability, though the values they wish to sustain are often different from the traditional focus of forestry. This difference has been the cause of much of the present conflict between forestry and the environmental movement. It is time to resolve the conflict and recognise that both forestry and conservation have the same origin, namely, sustainability of the very wide range of goods and ecological service forests can provide. These goods and services are essential to both human welfare and global stability. The energies and talents of both sides of the debate are urgently needed. The challenge for the coming century is to implement management systems that will sustain all of the goods and services provided by forests. The UNDP intends to use its influence to achieve that goal.

References

Arnold, J.E.M. 1989. "People's Participation in Forest and Tree Resource Management: A Review of Ten Years of Community Forestry." MS prepared for the Policy and Planning Service, Forestry Department, FAO, Rome. (ODI Library.)

Barrow, E.G.C. 1986. "The Value of Traditional Knowledge in Present Day Soil Conservation Practice: The Example of the Pokot and the Turkana." Paper presented to the Third National Workshop on Soil and Water Conservation, Kenya. (ODI Library.)

Brooks, D.J., and Grant, G.E. 1992a. "New Approaches to Forest Management: Part I." Journal of Forestry, 90(2): 21-29

Calder, I.R. 1996. "Water Use by Forests at the Plot and Catchment Levels," *Commonwealth Forestry Review* 75: (19).

Cassells, D.S., Bonell, M., Gilmour, D.A., and Valentine, P.S. 1988. Conservation of Australia's Tropical Rainforests: Local Realities and Global Responsibilities. *Proceedings*, Ecological Society of Australia, 15: 313-26

Evans, J. 1992. *Plantation Forestry in the Tropics*. Oxford Clarendon Press.

Forest Ecosystem Management Assessment Team. 1993. *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment*. USDA Forest Service, US Fish and Wildlife Service, National Marine Fisheries Service, Bureau of Land Management, Environmental Protection Agency, and National Park Service.

Gregg, N.T. 1991. "Will 'New' Forestry Save Old Forests?" *American Forestry* 97: 70, 49-53.

ITTO. 1991. *Guidelines for the Sustainable Management of Natural Tropical Forests*. ITTO Policy Development Series No. 1. International Tropical Timber Organisation: Yokohama, Japan.

ITTO. 1992. *Criteria for the Measurement of Sustainable Tropical Forest Management*. ITTO Policy Development Series, No. 1. International Tropical Timber Organisation: Yokohama, Japan.

IUCN. 1992. "Guidelines for the Ecological Sustainability on Non-Consumptive and Consumptive Uses of Wild Species." Draft Guidelines Presented to IUCN General Assembly, Buenos Aires, Argentina.

Kanowski, P. 1997. Internal Paper prepared for consideration by the World Commission on Forests and Sustainable Development.

Kimmins, H. 1997. *Balancing Act: Environmental Issues in Forests.* UBC Press, Vancouver.

King, G.C., Hobley, M., and Gilmour, D.A. 1990. "Management of Forests for Local Use in the Hills of Nepal: Towards the Development of Participatory Forest Management." *Journal of World Forest Resource Management* 5: 1-13.

Lohmann, L. and Carrere, R. 1996. *Pulping the South: Industrial Tree Planting and the World Paper Economy*. Zed Books, London.

Mankin, W. et.al. Global Forest Policy Project Recommendations to the IPF.

O'Keefe, T. 1990. "Holistic (New) Forestry: Significant Difference or Just Another Gimmick?" *Journal of Forestry*, April: 23-24.

Overbay, J.C. 1992. "Ecosystem Management." In Proceedings of the National Workshop: Taking an Ecological Approach to Management. USDA Forest Service. Washington, D.C. 3-15.

Poffenberger, M. (ed.) 1990. "Forest Management Partnerships: Regenerating India's Forests." Executive summary of the Workshop on Sustainable Forestry, New Delhi, 10-12 September, 1990. Ford Foundation.

Poore, Duncan. 1993. "The Sustainable Management of Tropical Forests: The Issues" In *EarthScan Reader on Tropical Forestry*.

Poore, D., Burgess, P., Palmer, J., Rietbergen, S., and Synnott, T. 1989. *No Timber without Trees: Sustainability in the Tropical Forest*. EarthScan Publications. London.

Sharma, N., Binkley, C., and Burley, J. 1992. "A Global Perspective on Forest Policy," in *Managing the World's Forests.* The World Bank, Washington, DC

Slocombe, D.S. 1993. "Implementing Ecosystem-based Management." *BioScience* 43: 612-22.

Solberg, B., Brooks, D., Pajuoja, H., Peck, T.J., Wardle, P.A. 1996. "Long-Term Trends and Prospects in World Supply and Demand for Wood and Implications for Sustainable Forest Management." European Forest Institute and Norwegian Forest Research Institute.

Spears, J. 1987. Agroforestry: "A Development Bank Perspective" in *Agroforestry: A Decade of Development*. ICRAF.

World Bank. 1990. "The Prospects for Agroforestry in the Tropics." World Bank Technical Paper, No. 13. P.K.R. Nair. 1990

Young, A. 1988. "Agroforestry and its Potential to Contribute to Land Development in the Tropics." *Journal of Biogeography* 15: 19-30.