TOWARDS SUSTAINABLE FOREST MANAGEMENT

AN EXAMINATION OF THE TECHNICAL, ECONOMIC AND INSTITUTIONAL FEASIBILITY OF IMPROVING MANAGEMENT OF THE GLOBAL FOREST ESTATE

Food and Agriculture Organization of the United Nations

Working Paper: FAO/FPIRS/01 prepared for the World Bank Forest Policy Implementation Review and Strategy

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July 1999

FOREWORD

There is a considerable amount of knowledge available about the techniques to achieve various dimensions of sustainable forest management. Thus, although there is some uncertainty about the precise effects of forest management over the long-term, it is generally believed that enough is known to manage forests on a more sustainable basis. However, it is also estimated that a significant proportion of the world's forests is not managed in a way that could be described as sustainable. The questions facing forestry policymakers around the world therefore, are: why is this the case and what actions would encourage the wider implementation of sustainable forest management practices?

It is against this background, that this working paper has been prepared as part of an FAO input to the World Bank Forest Policy Implementation Review and Strategy. The paper assesses the technical, economic and institutional feasibility of sustainable forest management and the conditions under which governments, FAO, the World Bank and other international agencies can effectively support its implementation. It describes the experiences with attempts to improve forest management across a broad range of forest types and locations, with management objectives ranging from purely timber production towards broader multipurpose forest management. It also examines the constraints that account for why sustainable forest management practices are not implemented across much of the world's forest estate and the possible ways in which development finance could support the implementation of some of the more important aspects of sustainable forest management.

The paper is in four main sections. The first section examines what is meant by sustainable forest management, how this varies between different people and how it has varied over time. The next section then describes the technical requirements for improving forest management in areas such as silviculture, harvesting and forest planning. This draws on experiences from a number of countries around the world. The third section examines economic and institutional aspects of the implementation of sustainable forest management. It examines the economic feasibility of sustainable forest management in different forest ecosystems, the trade-off between sustainable and unsustainable forestry practices and the market failures that can affect the way in which forests are managed. The economic challenges to wider implementation of sustainable forest management practices are sometimes exacerbated by policy and institutional failures and these are also examined here. The final section of the paper presents some recommendations for FAO and the World Bank to consider as they develop strategies to encourage improved management of the global forest estate.

This paper has been prepared from a number of inputs. The section on technical aspects of sustainable forest management draws heavily from two background papers produced by CIRAD Foret (Dupuy *et al*, 1998) and Stig Hagner (Hagner, 1998). The last section summarizes the conclusions reached at a joint FAO and World Bank consultation held to discuss some of the challenges raised in this paper (Technical Consultation on Management of the Forest Estate: Issues and Opportunities for International Action by the World Bank and FAO, 28-29th April 1999, FAO, Rome).

Arnoldo Contreras was the author of the other sections of this paper and overall editor and co-ordinator of this piece of work. FAO would like to express its gratitude to all the contributors to this paper and to thank everyone that has provided comments on earlier drafts of this work.

FAO will continue to explore, with member countries, the ways in which sustainable forest management can be implemented with greater success and to assist with implementation through its technical and normative work programmes. In this respect, we would welcome comments on all aspects of this study from readers.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF BOXES

LIST OF FIGURES

1 INTRODUCTION

For decades, sustainable forest management has remained an elusive goal in many regions of the world, but particularly so in tropical areas. This document focuses on the questions:

- why is sustainable forest management not happening on a large scale in the world;
- what does the experience in trying to apply sustainable management concepts tell us; and
- what are the most important obstacles to the implementation of more sustainable forest management strategies?

The paper also discusses development strategies for overcoming these obstacles and for promoting the wider application of more sustainable forest management techniques.

First, the paper discusses the concept of sustainable forest management, which, as it is well known, is open to a variety of interpretations. Then, the paper focuses on a restrictive interpretation of the sustainable forest management concept: the sustainable production of wood. This does not mean that other goods and services of forests are irrelevant, but that experience on their management is even more limited than in the case of sustainable wood production systems. Therefore, it is much more difficult to derive general conclusions for this broader but more imprecise concept of sustainable forest management.

Next, the paper examines the obstacles that influence the technical, financial and institutional feasibility of more sustainable forest management practices. In general, enough technical and silvicultural knowledge is available to implement the restrictive concept of sustainable forest management (i.e. the production of a sustainable flow of wood products) in most ecological conditions. This is generally true in most tropical moist and dry regions and in temperate forests and plantations. In the case of tropical forests, this assertion may meet with some scepticism, because no sustainable forest management systems have ever been implemented for a sufficiently protracted period to provide indisputable evidence that long-term sustainability of wood production is possible. However, these failures to implement sustainable forest management over long periods of time have mostly been due to economic or institutional obstacles, rather than imperfect technical knowledge.

If the sustainable forest management concept is expanded to cover the whole range of multipurpose forest goods and services and to embrace the social and environmental aspects of sustainability (ecosystem management), then the above assertion is a great deal weaker. Experience of this type of much more complex sustainable forest management is practically non-existent and, therefore, the degree of uncertainty about its feasibility is much higher.

Examined in isolation, some sustainable forest management practices may show positive financial results in the long run and a few practices may also be profitable in the short-run. However, these results, even if good, are generally not good enough. Frequently, other forest management options or other land development options are more profitable from the point of view of the private operator. These options include the depletion of the natural forest capital stock and the complete removal of forest cover, to convert lands to activities such as cattle ranching or agriculture.

To a great extent, the economic factors acting against the achievement of sustainable forest management arise because there are no markets for many of the benefits derived from

sustainable forest management. Even in cases where markets exist for outputs these are often plagued by a number of distortions. In such cases, forest managers are unable to capture the benefits of any efforts to implement more sustainable forest management methods and are, therefore, reluctant to undertake such efforts. In addition to this, in many cases the motivations of forest managers are steered in the wrong direction by mistaken, albeit frequently well intentioned, government policies.

The institutional requirements to implement more sustainable forest management practices, especially in tropical countries (where institutions are often weak), pose formidable obstacles to the wider implementation of this concept. These obstacles include: defective land ownership arrangements; the open access nature of many public forestlands; illegal operations; and corruption.

Given the above factors, encouraging sustainable forest management is a particularly challenging undertaking in many tropical, temperate and boreal countries. This is not a surprising conclusion as there is much evidence to show that most tropical forests and many other forests in temperate and boreal regions are not currently managed in a sustainable manner.

Finally, the paper discusses some principles for promoting more sustainable forest management practices. Given that ecological, economic and institutional conditions vary widely between different parts of the world, it is clearly impossible to derive a formula of universal validity. Consequently, this discussion centres on the conditions that are likely to prevail in different forest ecosystems and the possible policy reforms that could be implemented in each.

2 WHAT IS SUSTAINABLE FOREST MANAGEMENT?

Sustainable forest management, particularly in its widest sense, is an ambiguous concept. The lack of conceptual precision relates to various dimensions:

- the question of what needs to be sustained (i.e. what should be the objectives of sustainable forest management?);
- the values attached by different stakeholders to the various sustainable forest management objectives;
- the uncertainties associated with interventions in complex forest ecosystems; and
- the time frame and spatial boundaries that should be adopted when examining the sustainability of different forest management options.

2.1 What should be sustained?

The first question that normally induces contrasting answers is: what should be sustained? In the past, most forest management systems tended to focus on one objective of overwhelming importance, such as the maintenance of a certain flow of timber, protection of a fragile watershed or provision of an attractive forest environment for outdoor recreation. However, this approach did not recognize that forests are capable of producing a multitude of goods and services, frequently at the same time and from the same piece of forestland.

Indeed, forests are the source of a diverse array of products in addition to roundwood. They can also produce a wide array of environmental services and offer opportunities for social and economic development. For example, non-wood forest products and forest services directly contribute to the livelihoods of some 300 million forest dependent peoples around the world. These products and services acquired great importance in the last few decades.

Thus, the focus on single, or almost single, purpose management gave way to a much more complex objective of managing forest for multiple outputs. *Box 1* presents an example of the number of worthwhile objectives of sustainable forest management. Unfortunately, this more complex objective introduced a great deal of confusion about the concept of sustainable forest management.

2.2 How can different objectives be balanced against one another?

If all of these (and other) objectives could be attained simultaneously, there would be no great problem in implementing sustainable forest management. However, of course, this is simply not possible because, in most situations, some of these objectives conflict. Managing forests in a way to maximize simultaneously all these objectives is impossible.

Box 1: An example of an attempt to define the objectives of sustainable forest management

Participants at a conference on sustainable forest management (held at the University of California in March 1997) discussed the specific objectives of forest sustainability, starting with those from Agenda 21. These objectives included:

- to preserve biodiversity;
- to maintain economic productivity;
- to take advantage of present economic opportunities;
- to maintain future options;
- to respect inter-generational equity; and
- to respond to social and cultural needs.

Participants then added more objectives to those given above, including:

- to satisfy the values of indigenous peoples and local communities;
- to take into account aesthetics;
- to provide recreation opportunities;
- to avoid of off-site consequences and the export of environmental problems;
- to satisfy existence values; and
- to provide flexibility.

Some participants suggested that the list should be broadened even further to include human and non-human issues, environmental rights, ethical restraints on behaviour, fair land tenure practices and the creation of political structures for environmentally sensitive development.

This leads to the second challenge for the achievement of sustainable forest management: that some (often difficult) choices must be made and trade-offs must be considered. To quote Duncan Poore:

> *"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"*.

The questions facing forestry policy makers are:

- How can this compromise be achieved?
- What criteria can be used to judge the different options and compromises?
- How can forestry policymakers decide how far to go in pursuing one objective that implies a sacrifice of some of the others?

The answer to these questions is complex because the trade-offs involved can only be analysed within the framework of a commonly accepted value system. Values determine the "weight" or importance of each one of the objectives in sustainable forest management. However, values held by people vary enormously and are seldom expressed in terms that would provide clear operational guidance (see *Box 2*). In other words, it is hard to agree on objectives and their relative importance and thus, to be able to decide whether a forest is sustainably managed or not.

Box 2: Same forest - different values!

The same forest is valued by different persons and by the same person, as any and many of the following:

- a source of foreign exchange
- a place to hunt wild animals for food
- a site for recreation and education
- a space for a large forest plantation
- an agent for the protection of watersheds
- a place for settlement of poor people
- a place for grazing
- a place to find unknown species
- a source of raw materials for industry
- a source of medicines
- a place of worship
- a source of fuelwood
- a place of unique natural beauty
- a sink for carbon sequestration

2.3 Uncertainty and intergenerational issues

It takes a long time to produce timber and some of the other products and services that forests can supply. The long production period introduces further complications and presents more opportunities to have different interpretations of the concept of sustainable forest management.

Basically these complications fall into two categories:

- The first complication is that there is greater uncertainty about the likely results of any particular forest management system. This is because forests and, in particular, tropical forests, are enormously complex ecosystems. Thus, in addition to the two problems already noted, technical specialists may also fail to agree about what will be the eventual outcome of any particular silvicultural intervention. This problem is compounded further by the fact that it often takes a long period of time to obtain reliable results from field-tests of such interventions and, therefore, identify the best course of action.
- The second complication arising from the long production process, is that values change over time and, accordingly, so should the objectives of sustainable forest management. The implication of this is that the forestry policymaker has no sure way to predict how these values may change in the future. Furthermore, they often do not have technical or management tools that can accommodate such uncertainty in the decision-making process.

A final complication is that, in theory, the values of future generations should be integrated into today's decisions about what is or is not sustainable forest management. However, there is no practical way of doing this. In these circumstances, different stakeholders pass various subjective judgements about how forests should be managed for the benefit of future generations and there is no clear way to determine which of these judgements is the "best".

2.4 The spatial and temporal dimensions of sustainable forest management

A fourth complication associated with sustainable forest management is that it is not clear what the forest management planning horizon should be. This is partly because forests need to be managed for long periods of time in order to produce a full array of goods and services. For example, should the forest manger be aiming to manage forests in a sustainable way over the next 50, 100 or 150 years, or in perpetuity?

In the case of countries and regions with substantial areas of mature natural forests, sustainable forest management, may be impossible if there is any timber harvesting. In these cases, the forest policymakers' challenge is usually not to achieve a sustained yield of timber of a similar quality to that taken in the first cut. Rather, it is to either manage a smooth transition to a sustainable harvest of new growth timber (after a large and valuable first harvest of old-growth trees) or to leave these areas untouched.

To complicate matters further, the sustainable forest management concept is also imprecise in relation to spatial dimensions. For example, should sustainable forest management apply at the single stand level, at the landscape level or at the regional or national level?

2.5 Synthesis: the current level of understanding about sustainable forest management

To summarize, there is a multitude of possible combinations of all the various objectives commonly associated with sustainable forest management. Different values are given to each objective over various periods of time and physical spaces. Furthermore, these values vary between different members of the wide ranging group of stakeholders that have an interest in forests. They are also likely to change and evolve over time as well as with respect to different spatial scales.

This complexity partly explains the different and sometimes sharply contrasting opinions held about what exactly sustainable forest management really means in practical terms. In the real world it is necessary to know clearly what needs to be sustained, how the different objectives can be balanced, and what period of time and geographical space is being examined. However, unfortunately, there are no definitive answers to these questions.

In view of the above, it would be a futile exercise to attempt to define exactly what is sustainable forest management, because it would be almost impossible to reach a compromise that satisfied all parties. It is likely therefore, that sustainable forest management will remain an imprecise concept. Given this, some analysts have suggested that forestry policy should promote forest management decisions that will contribute incrementally to more sustainable forest management or that will avoid unsustainable forest management. This “continuous improvement process” can be viewed as a set of “goal posts”, that are based on the best (but still imperfect) information and can be used to practically guide forest management decisions (Byron and Costantini, 1998). This view is appealing to those, such as forestry policy makers, that are more concerned with the practical application of sustainable forest management and less with the theoretical details.

Keeping in mind the conceptual limitations described above, the following sections of this paper will look at the feasibility of implementing a rather loose interpretation of sustainable

forest management. This interpretation mostly considers sustainable wood production, which continues to be the management objective of utmost importance in most cases and the only management system about which much evidence exists. However, in a few cases when information exists, the text also deals with other dimensions of forest sustainability. The analysis examines sustainability at the landscape level in various types of forests and over elastic periods of time covering between 50 and 100 years. This is an admittedly imperfect interpretation of sustainable forest management but in view of the limitations of information, it presents a practical basis for analysis.

3 THE TECHNICAL FEASIBILITY OF SUSTAINABLE FOREST MANAGEMENT

This section summarises knowledge about the technical feasibility of sustainable forest management in natural and planted forests in the tropical, boreal and temperate regions of the world.[1]

3.1 Tropical forests

Natural tropical forests cover some 1,700 million hectares, of which around 900 million hectares are in Central and South America, 500 million hectares are in Africa and about 300 million hectares are in Asia and Oceania. Tropical forests comprise the most biologically diverse ecosystems on earth, containing more than half and possibly as much as 90 percent of the earth's known living species (World Resources Institute, 1989). No tropical forest has been managed for long periods of time and nobody knows for sure whether even the best management practices are truly sustainable. However, experience suggests that there is enough technical knowledge to considerably improve the current management of this type of forest, or at least to avoid the most blatantly unsustainable practices.

3.1.1 Sustainable forest management in moist tropical forests

Moist tropical forests produce a significant number of global externalities. However, of all the forest types in the world, moist tropical forests probably also present the greatest technical challenges to implementing sustainable forest management. Many experiments to examine sustainable forest management have taken place. Unfortunately, most were marred by non-technical obstacles and events that occurred before conclusive empirical evidence of the technical feasibility of sustainable forest management could emerge.

Most of the obstacles were related to a number of economic, institutional and social factors, including:

- the length of time required for tropical trees to achieve commercial size;
- the use of inappropriate harvesting systems;
- economic pressures to repeatedly log areas in which regenerated trees have not yet matured; and
- encroachment pressures from migratory communities that survive by practising slash and burn agriculture.

In areas with scarce population, there are large reserves of forests that are not threatened. Protected areas in these places have a low opportunity cost and forest plantations are generally not an economically viable option. Furthermore, indigenous peoples frequently utilize forests in a sustainable way. In many cases, there is no need for drastic interventions to ensure sustainable forest management. Circumstances may change rapidly if roads open-up remote

[1] Large parts of this section have been drawn from the two background papers commissioned by FAO for this study (Dupuy *et al*, 1998; and Hagner, 1998).

areas, if mineral or oil deposits are found under the forests, or if high value species become more accessible.

But in areas of high population density, the proliferation of unsustainable practices is a major problem. In such areas, the total area of moist tropical forests is shrinking and some forest types are extinct. Frequently, the forest has been converted to a mixture of primary and secondary forest. Logging in accessible areas of these moist tropical forests is intense and deforestation and forest degradation prevails. Furthermore, the pressure to convert forestland to farmland to meet expanding agricultural requirements is often intense.

Setting aside forests for protection or for sustained production of wood in areas of high population density is also difficult because the generally high opportunity costs and political costs of such actions. It is also quite likely that wood scarcity may have to become acute before more sustainable forms of forest management become attractive. When this occurs, it is more likely that the establishment of forest plantations and more intensive management of secondary forests will become economically feasible. A brief record of experiences in each one of the tropical regions is given below.

3.1.2 Experiences with sustainable forest management in moist tropical forests in Asia

The tropical forests of Asia contain a large proportion of large-sized trees compared with forests in Africa and South America. These forests are often dominated by species from the *Dipterocarpaceae* family, a large number of which are commercially valuable (e.g. *Meranti, Keruing* and *Kapur*). The richness of commercial species in much of this forest allows volumes of up to 70 cubic meters per hectare (and sometimes more) to be obtained at the first-cutting.

In the last few decades, several experiments to examine the sustainability of wood production took place in Asia. One outstanding example is the experiment with the Malaysian Uniform System. The Malaysian Uniform System, developed during fifty years of research, involves felling all commercial species of a diameter at breast height of more than 45 cm, on a cutting cycle of 50-60 years. Each cutting is then followed by silvicultural operations to eliminate all non-commercial species of more than 15 cm diameter at breast height, to reduce competition.

Initially, the Malaysian Uniform System resulted in successful regeneration of lowland *dipterocarp* forests in Malaysia. Unfortunately however, the forests were converted to agricultural uses, before the long-term sustainability of timber yield from this system could be confirmed. Also, the precarious security conditions in many forest areas prevented the timely application of some treatments specified in the Malaysian Uniform System. However, most analysts generally agree that, had the experiments continued, most of the lowland *dipterocarp* forests of Peninsular Malaysia would now be sustainably producing second-rotation timber.

The rapid conversion of the lowland forests to agriculture resulted in a movement of forest harvesting into the more complex and fragile hill *dipterocarp* forests of Malaysia. Forest managers are now attempting to apply the Malaysian Uniform System here, but the system is untested in these types of forest and little research is available to suggest how successful it will be.

As an alternative to the Malaysian Uniform System, its successor, the Selective Management System, is being applied in some parts of Peninsular Malaysia and Sabah, mainly in forests with an abundance of commercial species. Under this system, large trees are felled every 25-30 years, without any silvicultural operations after logging. The production of the next crop relies exclusively on the survival of commercial trees of a medium diameter at breast height (between 30 and 50 cm, depending on the species). The system aims to save these stems for later harvests, by limiting damage to the forest during harvesting.

The system has the advantage that it gives forest managers the flexibility to choose the minimum diameter of stems they wish to exploit. However, it is less reliable than the Malaysian Uniform System and marks a drastic departure from the uniform, monocyclic felling system to a much more complex polycyclic system. Also, the more frequent harvesting may cause substantial damage to the remaining forest and the system requires a strong capacity to monitor and control harvesting. Empirical evidence of the sustainability of this system is also lacking, because large areas managed under this system have yet to be harvested for a second time.

The most recent experiment to look at sustainable forest management in Malaysia is the Model Forest Management Zone, recently established in Sarawak. This experiment aims to demonstrate sustainable management approaches, utilizing knowledge gained from past experiences and modern planning, silvicultural and harvesting techniques that minimize logging damage. It is also too early to assess the success of this experiment.

Other forest management systems tried in Asia include the TPI (*Tebang Pilih Indonesia* or Indonesian Selective Cutting System) and its successor, the TPTI (*Tebang Pilih Tanam Indonesia* or Indonesian Selective Cutting and Planting System). These systems involve cutting trees above a certain diameter (depending on forest type) on a monocyclic felling system. Also, in the latter case, regeneration relies on silvicultural operations, on leaving a minimum number of commercial trees after felling or, if this were not possible, on planting a certain number of desirable species.

Experience with these systems suggests that they were complex to organize and monitor. They also require sophisticated technical capacity that often is not available. Because of these obstacles, as in the case of the other experiments reported here, experience with these systems is insufficient to prove their feasibility although their failure was not caused by lack of technical knowledge.

3.1.3 Experiences with sustainable forest management in moist tropical forests in Africa

The moist tropical forests of Africa contain a large diversity of species, few of which are commercially valuable. The main commercial species are the so-called “red woods” and forest managers often only harvest these trees, taking between 10 and 40 cubic meters per hectare.

Compared with Asia, the idea of managing forests in a sustainable way is a more recent concept in Africa. Therefore, experience is limited.

The Malaysian Selective Management System was initially tried in Ghana, but the experiment failed because the cutting-cycle used (15 years) was too short and because the forest contained

few valuable species. The implementation of this system gradually led to progressive stand impoverishment.

The Tropical Shelterwood System was tried in the moist tropical forests of Nigeria. This system relies on gradually removing the forest cover over a period of 20 years to promote the regeneration and growth of desirable seedlings. However, the complexity of implementing the system on a large scale proved to be too difficult and it was eventually abandoned.

Several other experimental sustainable forest management systems launched in a number of countries, including: Central African Republic; Congo, Cameroon; Côte d'Ivoire; Burkina Faso; and Zimbabwe, relied on a variety of silvicultural treatments to ensure regeneration. Many failed because of non-technical reasons, including: political upheaval; a lack of economic resources to finance operations; and pressure on governments to abandon such methods and exploit forests for more immediate benefits.

3.1.4 Experiences with sustainable forest management in moist tropical forests in South and Central America

Moist tropical forests in South and Central America have a lower species diversity and smaller tree diameters than the moist tropical forests of Africa and Asia. The density of stems is higher, but the lower volume of commercial species in these forests generally results in harvests of only 5 to 30 cubic metres per hectare.

There have been few attempts to implement sustainable forest management techniques in the region and documentation of the few attempts that have been made is poor. Some attempts have been made by private enterprises, but the results of these attempts have not been made public. It appears that none of these experiments have been conducted over long periods of time.

In Trinidad and Tobago, the Periodic Block System was designed but it does not appear to have been fully implemented. Results were never published and much of the data was lost. Similarly, in Surinam, the CELOS Management System was developed on the basis of several years of forest research, but the system was not implemented on a large scale. It was abandoned because of political conflict and insecurity in the area. Other examples of experiments with sustainable forest management systems exist in Mexico (Quintana Roo and Sierra Madre projects), Peru (Palazcu Valley), Brazil (Tapajos, Minas Gerais Cerrado and Caatinga, Mata Atlantica, IMAZON Paragominas and others), Costa Rica (Portico, BOSCOSA and FORESTA projects) Bolivia (Chimanes, MACA-IDB Project) and French Guyana, but these have all suffered from similar problems of implementation or are too recent to derive definitive conclusions (Kirmse, Constantino and Guess, 1993). Therefore, the overall experience with the application of sustainable forest management systems in this region is very limited, too recent or poorly documented.

3.1.5 Experiences with sustainable forest management in dry tropical forests

Dry tropical forests are a mosaic of ecosystems, comprising: dry dense forests; open forests; small woodlands; and forested and shrub savannah. There are some 240 million hectares of

dry and very dry forests in the world, nearly two thirds of them in Africa. These arid and semiarid ecosystems (dry forests and other arid land) support the livelihood of some 1 billion people and half of the world's domestic cattle.

Dry tropical and subtropical forests generally receive less international attention than the moist tropical forests. However, dry forests are at least as problematic and are disappearing fast. For example, seventy percent of the world's dry tropical areas are threatened by desertification. Also, because such forests and woodlands tend to occur in more densely populated regions than moist tropical forests, their degradation is likely to have a more severe impact on the poorest members of society. If these forests are not sustainably managed, their disappearance is likely to increase desertification and fuelwood scarcity, leading to increased human suffering.

Although their vegetative density is relatively low, most dry tropical forests support larger numbers of people and domesticated animals per hectare than moist tropical forests. Dry tropical forests are not usually managed for timber production, but for the production of many other goods and services, which they provide to local populations. Therefore, the forest harvesting and processing industry is much less of a dominant force in the management of these forests than in the moist tropical forests.

However, despite the above comments, wood production is still an important output of these forests. For example, one important local use of dry tropical forests is the harvesting of poles and fuelwood from multiple sprouts on coppice stumps. This management system may produce more usable biomass than the traditional timber management systems that are used to produce large logs for the wood processing industry. Other complex management techniques are also used to produce a variety of non-wood forest products, such as frequent light lopping of trees to produce digestible fodder.

While the value of dry tropical forests for commercial timber production is low, dry tropical forests are an essential component of the many complex and interdependent agricultural-forestry-livestock production systems that support large numbers of rural communities. People have learned to live in these harsh ecosystems by living in symbiosis with these woodlands, by relying upon the milk and meat which their tree-browsing animals produce and the replenishment of fertility that the trees bring to the soil.

The scope for implementing sustainable forest management in dry tropical forests is somewhat limited by natural and human factors. Two major natural challenges are soil erosion and the decline in fertility after tree harvesting, which both drastically reduce the scope for sustainable wood production. These forests are also susceptible to bush fires.

Given the intensive use of these forests by many rural people, human considerations are significant in any analysis of how they could be sustainably managed. Indeed, the management of dry tropical forests is so dependent upon the active participation of local communities, that any examination of sustainable forest management in these forests must go beyond purely technical considerations to examine these complex community interactions. Often, however, forest services and donor agencies are unable to develop strategies to cope with many of the dimensions involved in managing these forests, at times concentrating only on silvicultural aspects of forest management. Still some issues related to land and resource tenure are national or constitutional in definition and beyond the purview of forestry authorities.

Comprehensive research into the sustainable management of dry tropical forests is scarce, particularly in America. In Africa, research has concentrated on experiments to examine different participatory approaches to forest management. Also, it has tended to concentrate on the analysis of wood production from different tree species, rather than on the sustainability of the ecosystem as a whole. As a consequence, current understanding of these ecosystems remains inadequate.

Past efforts to meet expanding wood demands in dry tropical forests employed a number of different forest management systems. Initially, forest plantations received great attention. However, these were not managed sustainably. Many were established without the support of local people. Forest management practices then shifted towards the sustainable harvesting of the slow growing, but ecologically robust, indigenous tree species of open savannahs and desert margins. More recent forest management strategies started to recognize the importance of the requirements of pastoral communities living in these areas as components of sustainable forest management.

Some of the most promising examples of sustainable forest management in dry tropical forests come from India, where community-driven Joint Forest Management schemes emerged in the last couple of decades as an influential force in restoring India’s degraded forest lands (see *Box 3*).

Throughout the 1980's, thousands of communities, primarily in eastern India’s tribal forestlands, began protecting their degraded forests, often with little or no help from government, NGOs, or donor programmes. In most cases, this process was started by village leaders, when they began to recognize the environmental crisis confronting them as their once densely forested hills were deforested and denuded. Communities then formed hamlet-based forest protection groups and halted cutting and grazing, which often led to the rapid regeneration of the forest.

Box 3: Joint forest management in India - an example of sustainable forest management in dry tropical forests

In response to growing environmental problems around Tangi and the Khurda Forest Division of eastern Orissa, 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 and, by 1996, they had been joined by another 120 villages in the area. These results were replicated elsewhere. For example, at the state level, 4,000 communities started to protect over 250,000 hectares of vigorously regenerating mixed *Shorea robusta* forests over this period and between 10,000 and 15,000 communities across the whole of India joined the grassroots forest protection movement, with minimal cost to the government.

The results of this grassroots action were immediate and, in many areas, flora and fauna that had been disappearing began to return. In response to the growing political demands of this movement, a national policy breakthrough occurred in 1988, when the Government passed the new National Forest Policy Act. This Act explicitly recognized the legal status of the Joint Forest Management Contracts that were established with these communities.

Key factors that have successfully contributed to the joint management of public forestlands in India include:

- that forest management decisions are taken and implemented by the user group(s), rather than by the village or panchayat as a whole;
- that the user group(s) have been given security of tenure, with the state playing an active role in defining and protecting their boundaries against outside use and encroachment;
- that use regulations have evolved, are enforced locally and have been turned into rules that are understandable and easily adjusted to meet new challenges;
- that the benefits of community management are allocated in a way that reflects both the interests of the people dependent on the resource as well as the elite and the powerful; and
- that the management of the forests has focused on the production of low value products that are locally important.

Source: Arnold and Stewart (1991).

3.1.6 Experiences with sustainable forest management in degraded tropical forests

In addition to the tropical forests described above, there are some two billion hectares of degraded tropical forests in the world. Often, these are remnant forests, left after overharvesting of wood and non-wood forest products. The soils in these areas are usually susceptible to erosion and have low fertility. These forest areas are also often susceptible to forest fires. However, some species of trees thrive in these degraded ecosystems and often, due to the poor soils, such sites have few alternative uses (other than to be used as forests).

Large-scale reforestation of degraded tropical forests started during the first half of the century and an impressive body of technical knowledge has been built-up over the years about how to re-establish high-quality forest cover in these areas. For example, reforestation techniques are well developed for a wide variety of tree species and large expanses of degraded forestland have already been replanted, especially in Asia and Latin America. Most of these plantations have been planted with fast growing species for the production of industrial roundwood. However, concerns about the vulnerability of monocultures to pests and fire, recently led to the greater use of species mixtures in forest plantations.

Experience shows that one of the conditions for sustainable forest management in forest plantations, is that appropriate species are selected for planting on each individual site.

Another condition is that forest plantations have to be well managed throughout the whole rotation. If the species chosen are not correct, or if forest plantations are not properly managed, then the establishment of forest plantations may lead to undesirable outcomes such as greater soil erosion and, eventually, greater pollution and sedimentation of watercourses. This may also eventually reduce the sustainable wood harvest from such areas.

3.2 Boreal forests

The boreal forests form a broad belt between latitudes 50º and 70º, across North America, Europe and Asia. At its northern edge, the boreal forest belt stops at the treeless tundra, and its southern fringe merges into the temperate forest region. Boreal forests account for about a third of all forests in the world and contain half of the world's remaining tracts of natural, relatively undisturbed forest (World Resources Institute, 1997). They are also the world's largest store of terrestrial carbon. Seventy percent of the world’s boreal forests are located in the Russian Federation.

With few exceptions, present-day boreal forests grow on land formerly covered by ice. Except in mountainous areas or along riverbeds, the glacial soils are largely resistant to erosion. Due to frequent fires, the boreal forest usually consists of a patchwork of tree communities that have regenerated over time after these fires. Frost-hardy conifer species (e.g. spruce, pine, larch and fir) dominate these forests, of which the spruces are the most common. Broadleaf tree species, mainly poplar and birch, also occur in mixed stands with these conifers or occasionally in single species stands.

The Nordic countries have a longer history than anywhere else of sustainable wood production from the boreal forest. In these countries, most of the old-growth forests were replaced long ago by forests managed following sustainable yield principles and many of these forests are now being cut for the second or third time. Management practices are sophisticated and, during the last 40 years, resulted in a 23 percent increase in the growing stock volume and a 36 percent increase in wood increment or yield. These changes are expected to continue for the foreseeable future. For example, forecasts for Sweden’s boreal forest suggest that it will be possible to increase the sustainable level of timber harvesting by a further 55 percent over the near-term.

The Nordic countries, the Russian Federation, China and Canada harvest significant quantities of wood valued for sawing and pulping. Canada and the Russian Federation also still have large tracts of virgin boreal forest. In the few areas where boreal forests were converted to other land types, this was mainly been due to logging activities rather than to the deliberate conversion of forestland to agriculture.

In the boreal forests of the Russian Federation and Canada, roughly 75 percent of the total annual removal of industrial roundwood comes from clearfelling in cutting blocks of 25 to 100 hectares or more. Currently, the removals are from forests being harvested on a large-scale for the first time. In the Nordic countries, the forest industry operates in a similar way, but the forests are mostly of second or third generation stands. In comparison, the commercial utilization of the Alaskan boreal forest is relatively limited.

The main reason for the widespread use of clearfelling in the boreal forest, is that this is generally the cheapest way of harvesting the forest. However, all of the commercially important species found there, with the exception of White spruce (*Picea glauca*), grow best in even-aged stands (Bull *et al*, 1995). Harvesting operations are predominantly mechanized in the boreal forest and even in forests belonging to small private forest owners (mainly found in the Nordic countries and Eastern Canada) harvesting methods do not differ much from those of the large forest owners. In such cases, large forest harvesting and processing companies usually buy the rights to harvest from small private forest owners and carry-out their own harvesting operations on the land.

3.2.1 Experiences with sustainable forest management in boreal forest regions

Management methods used after clearfelling boreal forests are fairly similar everywhere. Natural regeneration is either spontaneous or is encouraged by leaving seed-trees or by using a shelterwood silvicultural system. In some areas, shade-tolerant fir trees regenerate spontaneously in sufficient numbers without significant intervention.

Natural regeneration usually produces stands with a “natural” appearance, containing species that are well adapted to local conditions. On the other hand, the fact that the stand composition is very similar to the adjacent forest, can be a disadvantage in certain situations. Also, Another disadvantage of natural regeneration, is that forest growth and yield is generally lower than could be achieved if the site were more actively managed. For example, the use of genetically improved tree species could drastically increase timber yields and soil treatment (such as controlled burning) would make it easier for seedlings to establish.

Stands are generally thinned (usually at least twice) in the boreal forests in the Nordic countries. However, thinning is less common elsewhere, either because second-generation forests have yet to reach the thinning stage, or because the markets for small diameter roundwood are more limited. The application of fertilizer to improve tree growth is also common in the Nordic countries, but less common elsewhere. In many areas, seedlings and young stands are often treated with chemicals to increase their resistance to insects and diseases.

The management procedures described above usually result in sustainable wood production, but they are not free from risks. For example, because of the adverse climatic conditions in most boreal forests, timber harvesting along the timberline or in areas at the margin of forest growth, may lead to the complete elimination of these forests if regeneration does not occur.

Moreover, there are other concerns about the wider sustainability of harvesting in such areas. For example, soils are frozen in most of these areas during the winter and may even be frozen permanently in some areas. If harvesting operations take place during these periods (as often happens in northern Russia and eastern and central Canada), damage is minimal but harvesting using heavy machinery when the soils are not frozen, damages soils irreversibly. Furthermore, the boreal wetlands are also extremely fragile ecosystems and the practice of draining them in order to increase forest growth (which used to be fairly common practice) has almost ceased in the Nordic countries and the Russian Federation.

During the last couple of decades, forest managers modified the forest management systems used in the boreal forests, to accommodate concerns about the environment. For example, in some ecologically valuable areas, some stands are left untouched and ecologically valuable trees (e.g. very old, hollow and dead trees) are now left in clearfelled areas to provide niches for species. Also, forest managers moved away from more intensive management of clearfelled areas, back towards more benign management systems, such as re-establishment by natural regeneration. In many cases, the forest industry promotes these more environmentally friendly approaches (See *Box 4*).

Box 4: Examples of sustainable forest management initiatives currently being promoted by private industry in the Nordic countries

In 1987, a large Swedish forest owning corporation (SCA) published a "Declaration on Nature Conservation" for its forest operations. This was one of the first commitments made by a large forest owner to introduce a modern environmental vision as part of its commercial forestry strategy. The SCA document states that its forestry operations should be conducted in such a way as to:

- avoid permanent adverse effects on soil, surface water and ground water;
- preserve a rich variety of plant and animal life;
- protect all plant and animal species occurring in the part of the country where we operate (although we are aware that this objective cannot always be achieved, this is not an acceptable excuse for failing to pay attention to or take action that has a reasonable chance of succeeding);
- preserve the plants and animals now living in the area in the first instance, with reintroduction of vanished species to take second place; and
- give first priority to species that are unique, with second priority to other species that are locally rare but plentiful elsewhere.

The operational consequences of this commitment, including the reservation of production forest areas, leaving trees that could have been harvested and other measures, resulted in a 10 percent reduction in timber harvest at a cost of about US$ 10 million per year.

While these initiatives may be commendable, the long-term consequences of applying less intensive forest management methods in boreal forests are uncertain, both in terms of their impacts on the volumes and quality of wood produced and their environmental benefits.

3.3 Temperate forests

The temperate forest zone comprises two bands circling the world in the northern and southern hemispheres, extending from around 30 degrees latitude to around 50 degrees latitude. This definition is only approximate, because local climatic and terrestrial features affect the boundaries of these zones. The climate in the temperate forest zone is characterized by cold winters, when snow may occur and summers that are mild and moist.

The temperate forest zone contains a great variety of ecosystems. It includes humid rainforests such as the rainforests along the West Coast of the United Sates of America and Canada, where conifers (*gymnospermae*) dominate, and the rainforests of the wet southernmost parts of South America (where the broadleaved *Notofagus* species dominates). The natural forests of Eastern Canada and the North-eastern United Sates of America (including the Appalachian

Mountains) closely resemble the forests of Central and South-eastern Europe, with an abundance of broadleaved species, such as: oak (*Quercus spp*); ash (*Fraxinus spp*); beech (*Fagus spp*); elm (*Ulmus spp*); and maple (*Acer spp*), and conifers, such as: pine (*Pinus spp*); spruce (*Picea spp*); fir (*Abies spp*); and larch (*Larix spp*). Southern Europe, the southern states of the United Sates of America, China, Japan, Chile and New Zealand, also possess other types of temperate forest ecosystems.

The main tree species found in temperate forests are: pine; oak; beech; and eucalypti (*eucalyptus spp*). Pines tend to dominate in areas of frequent forest fires, such as the southern states of the United States of America. Here, the regeneration process is similar to that of the boreal forest. In areas where fire is less common, oak tends to dominate at first, being later replaced by shade tolerant beech and maple species. However, even where broadleaf species dominate the natural forest, shade tolerant conifers are also generally present.

In many parts of the temperate forest zone, the natural forest contains a large number of trees with an uneven age structure. Natural regeneration occurs in an environment with many seedlings, saplings and mature trees, all coexisting on the same patch of land. However, management of temperate forests of North America and Europe has tended to convert these forests to more even aged stands, with a more simplified composition and structure.

Harvesting in the temperate forest zone produces an amount of industrial roundwood that is somewhat greater than the amount produced in the boreal forest zone. However, these forests are also an important source of other goods and services, including: mushrooms; fruits; and berries and recreational activities such as hunting, walking and fishing.

3.3.1 Experiences with sustainable forest management in temperate forest regions

European countries have the longest experience with temperate forest management. For example, some countries have been managing their forests as even-aged stands for commercial timber production for many decades or even centuries. Many European countries have strict forest legislation, that regulates forest management according to “classical” sustained yield principles and also usually mandates a certain amount of forest management for environmental protection and nature conservation purposes. Many government agencies in Europe also advise private forest owners and often control some of their activities. In contrast, in most other temperate regions, private forest owners have much more freedom to choose how they want to manage their forests.

Western European countries have tried many very different approaches to forest management. For example, France used to manage vast areas of deciduous forests on fairly short rotations for the production of fuelwood (the so-called “low forest” regime), although many of these forests are now being converted back to high forest. The United Kingdom, Ireland, the Netherlands and Denmark established large plantation areas, based mainly on exotic species such as: Sitka spruce (*Picea stichensis*); Norway spruce (*Picea abies*); Lodgepole pine (*Pinus contorta*); and Douglas fir (*Pseudotsuga merziesii*). Spain and Portugal also planted vast areas with Radiata pine (*Pinus radiata*) and Eucalypti.

Forest management methods employed in central Europe are more similar between countries. Clearfelling is usually restricted to a few hectares for various reasons, including: the high

aesthetic value given to continuous forest cover; biological conservation; and the risk of erosion or avalanches on steep slopes. Instead, many forest areas are often managed on an almost continuous thinning regime. Many central European foresters also prefer to use manual harvesting methods or light harvesting equipment in order to prevent soil damage, but this is often difficult in the case of tall, heavy trees, which often grow in these forests.

One traditional system of forest management, which has a long history in central Europe, is the so-called "*Plenterwald*" system. This selection forestry system is designed to create, conserve and utilize mixed, often hardwood dominated, forest stands of uneven age, by harvesting single trees as they mature. It also involves harvesting some smaller trees with the mature trees, in order to keep the composition and structure of the forest in a similar state. The system works well biologically in forests containing shade tolerant tree species. It becomes more difficult to use, or even impossible, for forests containing light demanding species such as pines and larches.

The *Plenterwald* forestry system has attracted attention as seemingly being environmentally-friendly and, therefore, biologically superior to the even-aged forestry system. This is true for some hardwood dominated ecosystems, but is not true in locations where light demanding tree species are growing. It is also regarded as aesthetically more acceptable, which is probably true. In central Europe, particularly in the case of state-owned forests, there is a trend towards the wider application of the *Plenterwald* forestry system because of these benefits.

In contrast to Europe, harvesting in most of the rest of the temperate forest zone is highly mechanized. The operations are similar to those commonly found in boreal forests and are driven by concerns of profitability and cost-efficiency. Clearfelling is not unusual, but in sensitive areas selective cutting is more common, both in softwood and hardwood forests.

On the West Coast of the United Sates of America and Canada, some forest ecologists have suggested that selection forestry systems may be an ecologically acceptable method for harvesting the humid rainforests found there. To the surprise of many, this advice was accepted by MacMillan Bloedel in 1998, when it announced that it was phasing-out clear-cutting, the standard forest industry practice in British Columbia, to manage its concessions using a selective cutting system.

3.4 Forest plantations

Forest plantations are mainly established for the production of roundwood, but are also occasionally planted for environmental purposes, such as soil protection. In terms of roundwood production, they have several economic advantages over wood from the natural forest and are expected to become an increasingly important source of industrial roundwood supply in the coming century. (See, for example: Brown (1999), for a more comprehensive discussion of the future prospects for forest plantations). About 10 percent of the world's existing plantations can be classified as "fast growing" (i.e. yielding more, often much more, than 15 cubic meters per hectare per year).

The technical aspects of planting and managing forest plantations for sustainable wood production, are well developed. Particularly in the temperate forest zone, some forest plantations have been producing sustainable yields of wood for many decades or even much

longer. For example, in some regions of Japan, there is evidence that forests have been harvested for more than 1,000 years. There is also evidence that forest harvesting has occurred over five or six centuries in some areas of Scandinavia and Central Europe. There is enough technical knowledge to produce sustainable yields of timber in most of the other regions of the world.

To be sustainable, forest plantation development must consider environmental and social impacts. For example, there is evidence of site degradation in a few areas where forest plantations have been established on nutrient-poor sites and unstable soils. Plantations may also reduce the water available for other uses and this can be a problem in areas where water is scarce (e.g. South Africa). However, enough technical knowledge is generally available now, to avoid most of these negative environmental impacts.

When implemented at a broad scale by a single owner, establishment of forest plantations can displace rural populations and result in frictions. Migration of labour into the region can result in a change in social values and behaviour that hurt local people. Where changes lead to social problems, the sustainability of forest plantation is jeopardized. With the present state of knowledge, most of these potential limitations can be quite easily avoided.

Forest plantations can also have an indirect positive impact on the way the natural forests are managed. The most positive impact they are likely to have, is that they provide an alternative source of fibre, which can be used to relieve the pressure to use the world's remaining natural forest as a source of wood supply. For example, by the year 2050, more than half of the world’s total demand for wood and wood products is likely to consist of demand for paper and paper products. Much of this demand could be satisfied with wood originating in fast growing forest plantations. Therefore, this trend will provide even greater scope for forest plantations to reduce the pressure on the natural forest. Although, it seems unlikely that plantation grown wood will completely replace wood from the natural forest in the manufacture of pulp, the trend towards increased investment in industrial forest plantations is evident in many countries, such as: New Zealand; Chile; Brazil; Argentina; Uruguay; Indonesia; and South Africa.

A very useful summary of the sustainability (in its narrow sense) of forest plantations established around the world is given in Evans (1999) and this is reproduced in *Box 5*.

Box 5: Some general conclusions about the sustainability of forest plantations established around the world

- Measurements of yield in successive rotations of trees suggest that, so far, there is no significant or widespread evidence that plantation forestry is unsustainable in the narrow sense. Where yield decline has been reported, poor silvicultural practices and operations appear to be largely responsible.
- Evidence in several countries suggests that current rates of tree growth including in forest plantations, exceed those of 50 or 100 years ago.
- Plantations and plantation forestry operations do affect the sites on which they occur. Under certain conditions nutrient export may threaten sustainability, but care with harvesting operations, conservation of organic matter and management of the weed environment are usually more important for maintaining site quality. Plantation forestry appears to be entirely sustainable under conditions of good husbandry, but not where wasteful and damaging practices are permitted.
- Plantations are at risk from damaging pests and diseases. New threats will inevitably arise and some plantations may become more susceptible owing to climate-change factors, but the history of plantation forests suggests that these risks are containable with vigilance and the underpinning of sound biological research.
- There are several interventions in plantation silviculture, which point to increasing productivity in the future, providing management is holistic and good standards are maintained Genetic improvement, in particular, offers the prospect of substantial and long-term gains over several rotations.
- Environmental changes will undoubtedly have an impact on plantation forests. Some changes may yield improvement, others damage. Most plantation species are resilient and broadly based genetically and are unlikely to suffer seriously from the kinds of climate change scenarios currently predicted. It will be prudent to maintain genetic diversity and minimize stress to planted trees.

Source: Evans (1999) p57.

3.5 Synthesis: a summary of the experience with sustainable forest management in all types of forest

A summary of the conclusions drawn from experience with sustainable forest management systems in all moist tropical forests is given in *Table 1*. Details about the technical features of each of these systems in Asia, Africa, and South and Central America can be found in Annex 4 of Dupuy *et al* (1998).

Table 1: Summary of conclusions about sustainable forest management for timber production in moist tropical forests

Study	Evidence
Wyatt-Smith (1987)	The Malaysian Uniform System 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 system in Surinam is promising.
Schmidt (1987)	In Malaysia, the Malaysian Uniform System resulted in successful regeneration in lowland dipterocarp forest. Liberation thinnings in selectively logged forests in Sarawak produces new good quality stands quickly and selective logging in the Philippines leaves a commercially valuable residual stand.
Poore *et al* (1989)	Sustainable management in some small scale projects in Africa has begun. Sustainable management in Malaysia shows promise and sustainable production is carried out in Trinidad and Tobago.
Goodland *et al* (1990)	Sustainability cannot truly be detected until at least the third cutting-cycle has been completed. Forests managed using sustainable management techniques during colonial regimes in Asia and Africa, the Malaysian Uniform System and other management systems have largely been converted before sustainability could be proved. However, several experiments currently under way in Latin America may turn out to be sustainable.
ITTO/HIID (1988)	It is likely that forests managed under the Malaysian Uniform System would be producing second rotation timber if the land had not been converted to agriculture. The strip shelterwood system used in Palcazú shows abundant regeneration and polycyclic systems with liberation thinning show promise in Sarawak and Côte d'Ivoire.
Jonsson and Lindgren (1990)	A forest in Costa Rica, where *Carapa guianensis* was harvested, is showing abundant regeneration.
Keto *et al* (1990)	Current forestry regulations in Queensland recognize long-term economic and environmental concerns. However, this study argues that the Queensland model for sustainable forest management is disputable, because it is based on inadequate evidence.
Perl *et al* (1991)	This study gives thirteen examples of forest management systems in Latin America. None of them are demonstrably successful in every aspect of sustainable forest management and they all require additional time to mature before conclusions can be drawn.
Hartshorn (1990) and Southgate (1998)	In Palcazú, natural regeneration on two demonstration strips has been very good and this suggests that the management methods used in the forest were biologically sound.
Bruenig and Poker (1991)	Positive indications about the feasibility of sustainable forest management have been obtained in Congo. The Selective Management System in Malaysia and the management system used in Quintana Roo have also demonstrated the feasibility of sustainable timber production. Selective logging in dipterocarp forests in the Philippines has successfully left a commercially viable residual stand..

Source: Johnson and Cabarle (1993) and Southgate (1998).

The systems examined all aimed at the sustainable production of wood, with little or no consideration of the many other objectives often associated with sustainable forest management. Most specialists agree that, in these cases, the forest management systems were technically sound, despite the fact that the empirical evidence of sustainable wood production remains incomplete and is mostly limited to evidence of successful regeneration.

The Asian experience shows that forest management of moist tropical forests for sustainable wood production is technically feasible in this region. In Latin America, various researchers believe that sustainable wood production is technically feasible, at least in some ecosystems. For example, Barros and Uhl (1995) contend that sustainable wood production is feasible in the Brazilian Amazon, especially in the floodplains where the diversity of timber species is lower, the volume per hectare of commercial species is relatively high, growth rates are also high and logging does relatively less damage to the remaining vegetation and to the soil. Southgate (1998) reports that the forest management system used in the Palcazú project in Peru is probably biologically sound on the basis of the evidence of abundant regeneration after harvesting. However, the project itself could not be sustained because of security concerns and the poor economic results, which were due to a relative abundance of alternative wood supplies in the area.

In summary, the evidence from Asia suggests that sustainable wood production in moist tropical forests in this region is technically feasible, but that most experiments did not last long enough to eliminate all doubts. In Africa, failure was mainly a result of ineffective public administration. In Latin America, the main problems (with experiments to examine sustainable forest management systems) were the lack of security and insufficient commitment to implement sustainable forest management, on a larger scale.

The evidence generally points to the fact that the forests are either evolving as the researchers expected them to, or that any technical failures could easily be corrected with existing knowledge. The balance of the technical evidence is quite positive and numerous studies and projects provide a solid base for technically sound forest management for sustainable wood production in most of the world's moist tropical forests.

In dry tropical forests the overall experience matches the experience gained in moist tropical forests and suggests that sustainable forest management of dry tropical forests does appear to be technically possible. However, sustainable forest management in this type of forest will only be achieved when forest managers secure the participation of rural people, by integrating their activities with the rural economy and with other activities that sustain the livelihoods of local people. Also, as in the case of other experiences in the tropical region, it is generally too early to judge whether or not the approaches, which currently appear to be successful, will be sustainable in the long-run.

Experience in the boreal forest region is limited to the few attempts to advance from purely timber orientated forest management systems to more ecosystem-orientated sustainable forest management systems. These attempts are all fairly recent and are surrounded by long-term uncertainties. However, despite these caveats, enough technical knowledge is currently available to practice sustainable wood production in the boreal forest, or at the very least, to identify and avoid the most unsustainable practices.

Similar conclusions can be drawn from experience in the temperate forest zone. It is somewhat difficult to generalize from the experience gained in the temperate forest zone because of the many different types of forest ecosystem within this zone. However, in most cases, there is generally enough technical knowledge and experience to manage most of these forests for sustainable wood production and to avoid the most excessive examples of unsustainable practices.

Finally, there is adequate technical knowledge to establish forest plantations that produce a sustainable flow of wood, but there is less certainty about the sustainability of current forest plantation practices in a broader sense. There is also insufficient evidence to report on how successful reforestation projects in degraded tropical forests have been or will be in the future.

4 THE FINANCIAL AND INSTITUTIONAL FEASIBILITY OF SUSTAINABLE FOREST MANAGEMENT

The previous section of this report suggests that there is enough technical knowledge to design sustainable wood production systems that work in most ecological situations. It also suggests that there is adequate knowledge to identify and avoid most forest practices that are unsustainable in the wider sense. Thus, it is likely that the preponderance of unsustainable forestry practices in many of the world's forests is due to factors other than a lack of technical knowledge.

Among the possible factors leading to unsustainable forestry practices, the financial implications of different forest management systems are of paramount importance. In other words, it is reasonable to expect that, without regulation, private investors, forest landowners, farmers and timber concessionaires would only manage their forests in a sustainable way if it were financially advantageous.

Evidence gathered from several examples around the world indicates that sustainable wood production can produce acceptable financial results. However, the evidence also shows that, at least over the relatively short periods of time considered by most private investors, unsustainable practices are even more profitable. Thus, it appears that in most circumstances, private investors will have little financial incentive to adopt sustainable forest management methods. Consequently, strategies to promote sustainable forest management must make such an approach more financially attractive than its unsustainable alternatives (i.e. “cut and run” options). Also, because timber is generally the product of highest commercial value in most forests, it seems likely that improving forest management for timber production must be a key element of these strategies.

As will be discussed later, the financial profitability of forest management is often reduced by distorted and imperfect markets as well as by policy failure or ineffective administration. If these market imperfections and policy errors were corrected, the relative profitability of more sustainable wood production systems would certainly rise, increasing the likelihood that they would be accepted by the private sector. It is also worth noting however, that many commentators argue that forests are far too important to be managed according to private financial and commercial considerations. They argue that forests have “intrinsic” values and that morally, and quite independently from financial implications, it is simply wrong to destroy them.

A substantial volume of literature exists on the debate about these anthropocentric and ecocentric values (see, for example; Hayward, 1994; and Rolston, 1994). However, it is evident that financial considerations intensely affect private decisions. The ecocentric view requires forest managers to reject financial considerations and pursue sustainable practices regardless of the financial consequences to them personally, but the effectiveness of moral persuasion is open to question and doubt. While there have been some successes in persuading private operators to follow a moral route rather than a financial one, the prospect of this happening on a global scale is negligible.

This section of the report is organized as follows. The first part of this section looks at the empirical evidence about the financial profitability of sustainable wood production. It then examines the scope for increasing the financial profitability of sustainable forest management.

All of the studies quoted here take market forces as given. In other words, they accept the existence of market distortions and the generally faulty policy environment in the forest economy of many countries. The second part, therefore, discusses the problem of market failures and possible solutions to this problem. The last part of this section discusses the institutional challenges to the implementation of sustainable forest management. This includes sections on the government policies and institutional forces that influence private investment decisions and generally tend to act against the introduction of sustainable forest management techniques.

4.1 What are the commercial returns to sustainable forest management?

As noted in the previous section, much of the experience with attempting to introduce sustainable forest management techniques is relatively recent. Nearly all the studies of the profitability of sustainable forest management have focused on short-term results (i.e. the financial impacts of changing harvesting techniques and the investment in subsequent silvicultural operations) and most have ignored market and policy failures.

Most studies of sustainable forest management also only concentrated on management at the forest stand level, often using controlled experiments or simulation models. Some studies focused on the capacity of the forest to sustain a certain level of commercial timber production. Others attempted to examine how forests can be managed for sustainable yield but, at the same time, satisfy certain additional constraints to protect biodiversity and respect social values. None of them examined the feasibility of implementing broader sustainable management concepts, such as those that include a comprehensive set of actions to ensure economic, social and environmental sustainability (Williams *et al*, 1997).

Table 2 displays the results of various studies of the financial impacts of sustainable forest management systems across a range of different regions and ecological conditions. The majority of the results indicate that the short-term financial profitability of sustainable forest management can not compete with the profitability of resource depletion, even in cases where the former is high. These studies suggest that it is generally most profitable to harvest the most valuable timber species in unsustainable ways, then invest the proceeds from these activities in other highly profitable activities (Barbier, 1995). This finding is confirmed by the evidence of the preponderance of such “cut and run” strategies found in many countries around the world.

Table 2: A summary of the results of various studies of the financial profitability of sustainable forest management in tropical forests

Study	Results
Reid and Howard (1994)	Unsustainable logging in Guatemala is substantially (21-55 percent) more profitable than logging operations that integrated some sustainability considerations.
Hardner and Rice (1997)	Sustainable forest management practices in Pará (Brazil) are clearly financially inferior than unsustainable practices.
Bruenig (1990)	Timber liquidation generates the highest profits in Sabah, Malaysia.
Kollert *et al* (1995)	Estimates of the financial returns from eight sustainable forest management options tested in Malaysia, indicate that they all generate positive results, but that these are also lower than could be obtained in the short-term through unsustainable practices.
Howard and Valerio (1996)	Financial returns from sustainable forest management are competitive compared with those of cattle ranching and crop production in three regions of Costa Rica. However, defying this conclusion, evidence shows that unsustainable forest practices continue. The authors attribute this to the comparatively undesirable patterns of cash flows generated by sustainable forest management practices, to the lack of land ownership security and to sheer ignorance about the financial benefits of sustainable forest management.
Mendoza and Ayemou (1992)	The analysis of several forest management options in Côte d'Ivoire reveal that sustainable harvesting reduces profitability considerably compared with a strategy of resource depletion.
Howard *et al* (1996)	A simulation model of the Chimanes forest in Bolivia shows that sustainable practices will reduce profitability by 35-67 percent.
FAO (1997)	A case-study in the Brazilian Amazon shows that reduced impact logging and other more sustainable harvesting techniques increase costs, but only slightly. It also suggests that future benefits may compensate for these costs in the long-run.
Kishor and Constantino (1993)	Analysis of four competitive alternative uses of forest land in Costa Rica show that the "cut and run" forest depletion option is the most profitable one and far more profitable than the sustainable forest management option.
Johns *et al* (1996)	Study of Paragominas Region (Brazil) shows that reduced impact logging (involving directional felling, climber cutting, improved planning and less waste) is profitable. These measures increased the net present value of the timber harvest by 34 percent.

4.1.1 What are the factors that reduce the comparative profitability of sustainable forest management as a forest management option?

To fully understand how sustainable forest management might be promoted in the future, it is useful to answer the following questions:

- why is sustainable forest management financially unattractive compared to "cut and run" or "cut and convert" forest management options;
- is sustainable forest management intrinsically unprofitable or could this be due to the prevalence of incorrect signals determining pricing and output decisions, in distorted and very imperfect markets; and
- to what extent are these distortions compounded by or ameliorated by government action and policies?

Answers to these questions should help to show how policies to support sustainable forest management, might be designed and implemented in the future.

The simple answer to the first question posed above, is that sustainable forest management, compared with "cut and run" forest management options, tends to have fewer benefits in the short-term but larger benefits in the long-term. Given the strong time-preference for the present amongst most private individuals,[2] the future benefits of sustainable forest management have little weight in today's commercial decisions. Therefore, "cut and run" forest management options tend to appear more profitable, in most cases, than the alternative of sustainable forest management.

A major factor behind this financial disadvantage of sustainable forest management, is the slow growth rate achieved in many of the world's natural forests. For example, sustainable forest management systems in the tropics can produce physical growth in commercial timber volumes of around 0.5 to 2 cubic meters of per hectare per year (Reid and Rice, 1997). This is equivalent to a compound growth rate of only around 0.5 to 4 percent per year. This rate of growth is, in most cases, not sufficient to outweigh the benefits that could be achieved from liquidating all the commercially valuable timber in a stand, converting the land to some other land use, or some other unsustainable option.

Furthermore, the long-term penalty of unsustainable harvesting practices is often reduced because forests that have been heavily logged, even those where the harvesting has been really damaging, often recuperate with a surprising vitality. For example, Southgate (1998), describing four studies in the Brazilian Amazon, indicates that:

> *"Even though felling and skidding resulted in substantial damage to trees left in the forest, including commercial species, timber was regenerating rapidly."*

Similarly, Uhl *et al* (1991), in a study of tropical forests in Tailandia (Brazil), found that natural regeneration produced 4,300 seedlings and saplings per hectare harvested. This was despite the fact that, for every tree harvested, 27 trees of 10 cm diameter at breast height or more were also damaged, More generally, it is fairly common for forests that have been unsustainably harvested, to accumulate biomass rapidly, particularly in the first two or three decades after harvesting (Smith *et al*, 1998).

4.1.2 Options to increase the financial benefits of sustainable forest management

As explained above, the relatively slow growth of most natural forests, is one of the main factors contributing to the relatively unattractive financial returns that can be obtained from sustainable forest management. However, there is some hope that the rates of growth in commercial timber volume and, more importantly, potential timber revenue from sustainable forest management, can be increased in the future. The factors that might lead to such increases, including the following:

- improvements in silviculture, that boost the future growth of commercial timber volumes;

[2] With, for example, real discount rates as high as 20 percent per year determining investment decisions in many countries.

- possible increases in the future prices of select grades of commercial timber, particularly for tropical woods, as these resources become more scarce;
- changes towards the utilization of species that are not, at present, considered commercially valuable, but may become valuable as markets develop;
- increases in the commercial volumes that can be harvested from a given area of forest, because of advances in industrial processing technology that allow small diameters of roundwood and mixed species to be used to manufacture solid wood and fibre products; and
- increases in the commercial volumes that can be harvested from a given area of forest, due to the use of improved harvesting technology that reduces harvesting waste.

In other words, the benefits of sustainable forest management may increase due to better silviculture, prices and harvesting and processing technologies that are likely to appear in the future.

Silvicultural improvements. Assuming that improved silvicultural methods could boost commercial timber yields in the natural forest by as much as 50 percent, the growth rate of commercial timber could be increased to 0.75 - 6.00 percent per year. This is probably the most optimistic assumption that could be made about future improvements in yield in the natural forest, because there are many biological barriers to significantly increasing forest growth rates. However, it does indicate that sustainable timber yields could increase to a level where sustainable forest management is likely to be a more financially attractive forest management option.

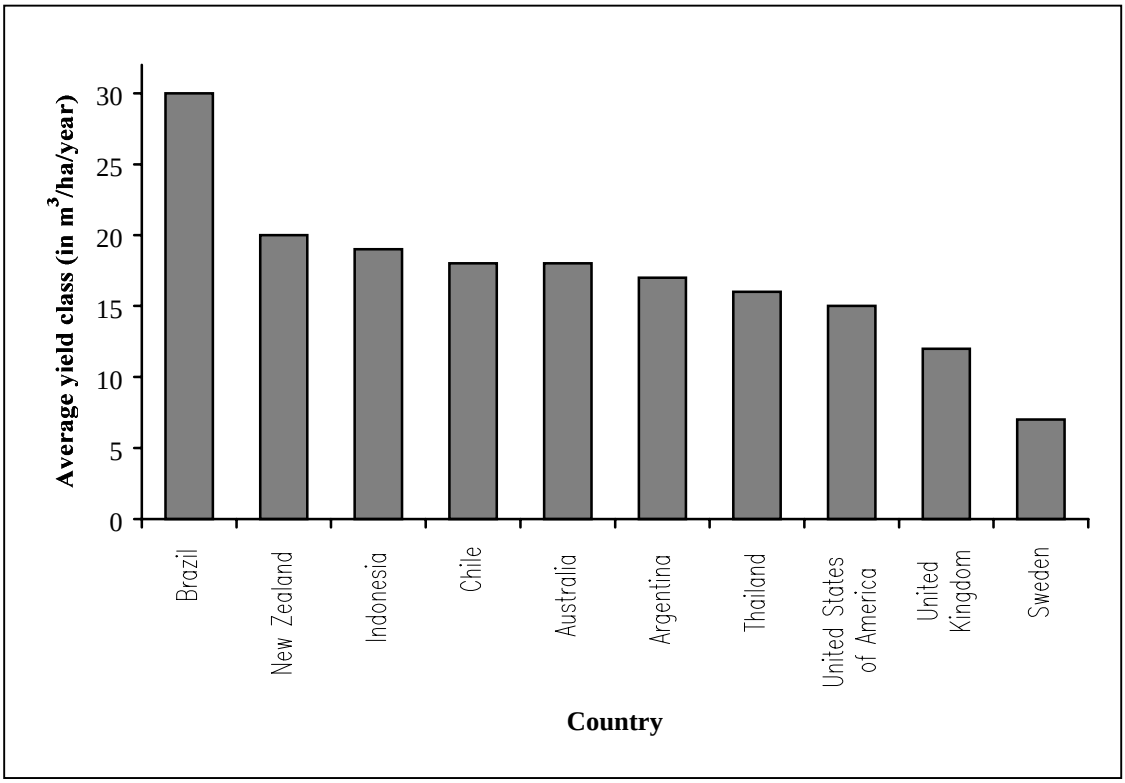
Price developments. With respect to the outlook for industrial roundwood prices, there is some evidence to suggest that the prices of certain types of industrial roundwood from the natural forest may increase somewhat in the future. For example, the overall demand for wood and wood products is projected to increase at just under 2 percent per year in the immediate future (Whiteman *et al*, 1999). But, on the supply side, there is evidence that suggests that supplies of wood from the natural forest are becoming either more limited, more difficult to obtain, or of a generally lower quality. This combination of increased demand and limited supply implies that there might be upward pressure on the price of industrial roundwood in some areas and for certain grades of high quality grades such as tropical and other "old growth" sawlogs and veneer logs.

However, for the majority of forest products, most market forces are working in the opposite direction to that described above. The most important of these forces is probably product substitution where, due to the problems with supply outlined above, many users of forest products are now using lower quality products[3] in applications where previously they would have used higher-quality wood from the natural forest (LEEC, 1993; Johnson and Sarre, 1995). Most of this low quality wood is coming from managed second-growth temperate forests and forest plantations. In particular, the supply of wood from forest plantations will compete strongly with wood from natural forests in the future due to improvements in

[3] Including wood-composite products and an array of non-wood substitute products.

technology that will continue to increase the productivity of forest plantations to levels far in excess of those achieved in the natural forest (see, for example, *Figure 1*).[4]

Figure 1: Approximate average growth rates (maximum mean annual increment) in forest plantations in various countries around the world



Another factor that is likely to limit the scope for price increases for roundwood from tropical natural forests is the dominance of roundwood from temperate and boreal countries in World markets. Roundwood from temperate and boreal forest resources areas already dominates world production and trade, the stock of these resources is, on the whole, rising and the roundwood produced from these resources is very competitively priced. Furthermore, advances in processing technology continue to de-link the nature of final products from that of raw materials, making it possible to use a wider variety of these available resources plus alternative materials such as non-wood and recycled fibres.

In conclusion, the prospect for a long-term price increase in roundwood produced from natural tropical forests is only moderate, with an increase of, at most, only around 1 percent per year being the best that could reasonably be expected.[5] The exception to this may be the case of speciality species that enjoy niche markets and already command high prices. However, these niche markets are not large and are unlikely to grow by any significant amount in the future.

[4] For example, average plantation growth rates of nearly 20 cubic meters per hectare per year are already quite common and are greatly exceeded in new planting and in existing plantations in some countries such as Brazil (see *Figure 1*).

[5] Bull (1998); Reid and Rice (1997); and Varangis (1992).

Technological advances. Technical advances may improve the financial profitability of sustainable forest management in a number of ways, by increasing the variety of trees that can be commercially utilized and reducing production costs. For example, the profitability of sustainable forest management would rise if a larger number of species could be used to produce wood products. Past efforts to introduce less well known species to the market have met with limited success (most notably, rubberwood in Southeast Asia), but it is reasonable to expect that improved milling technologies may make a substantial difference in the future. Furthermore, regardless of species, roundwood of smaller dimensions can now be processed into useful products with modern milling techniques. Improved milling techniques, which increase the variety and sizes of roundwood that can be processed, have substantial potential to increase potential production volumes, perhaps by as much as 50 percent (Spelter, 1998). However, it should be noted that these developments would not necessarily favour sustainable forest management options because, to a great extent, these technologies are "neutral" in the sense that they could also be applied as effectively to unsustainable alternatives.

Improved harvesting techniques would also have a positive effect on profitability as they could lower production costs, reduce harvesting waste and increase future roundwood yields by causing less damage to the remaining forest stand. Harvesting studies supported by FAO show that the physical magnitude of the impact of improved harvesting techniques can be quite substantial, perhaps again in the order of 50-60 percent increases in roundwood recovery rates (Dykstra, 1992; Dykstra and Heinrich, 1997). This could translate into important increases in profitability. For example, in a study of improved harvesting and logging technologies in Paragominas in the Brazilian Eastern Amazon, Johns *et al* (1996) concluded that these improved technologies could result in an increase in the Net Present Value of commercial logging by as much as 34 percent.

4.1.3 Overall costs and benefits from implementing sustainable forest management

As the above discussion has shown, there are various reasons to believe that at least some of the above factors will work in favour of increasing the future commercial profitability of sustainable forest management methods. However, there are also some additional costs of achieving these benefits.

Sustainable forest management practices require activities such as topographical mapping, forest inventories, boundary delimitation and demarcation, resolution of land disputes and arrangements for land titling and the preparation of forest management plans. Some area will have to be set aside from commercial timber production, further reducing profitability (IPF, 1996). In most cases, sustainable forest management methods will also require monitoring and policing to prevent illegal occupation of lands. Furthermore, these methods imply that more intense and careful silvicultural treatments will be required, including protection against pests and fire and more careful harvesting technologies. While these additional costs of sustainable forest management obviously vary widely between countries and regions, they roughly appear to exceed the costs of unsustainable practices by at least 5 percent and possibly up to 25 percent (Sandbrook and Bass, 1997).

The net difference between these costs and benefits can only be determined in specific cases. However, by roughly adding together the average costs and benefits of the various factors working in favour of sustainable forest management, it can be concluded that the net increase

in the commercial value of sustainably managed forests could perhaps be in the order of 10-12 percent. This is not a discouraging result, but may be insufficient in view of the fact that some of the forces that improve the profitability of sustainable forest management practices (e.g. some of the technological innovations) also increase the commercial profitability of non-sustainable options. Furthermore, because the benefits of sustainable forest management materialize far into the future, investors run a substantial risk of never receiving them.

This latter point is a particular concern, because the institutional and political situation in many tropical countries is unstable and the rules of the game can change drastically from one week to next. The legal framework supporting investments in land-based production activities is not always very clear and in many cases totally absent. Even long-term legal contracts, such as those on timber concessions, are sometimes subject to the vagaries of the political situation and may, therefore, mean little in practice. The likelihood that an operator will not be able to hold on to the fruits of any long-term investment in sustainable forest management is a major barrier to implementation of such practices that should not be underestimated by policymakers.

4.2 The problem of market failure

In the circumstances described above, it would be pertinent to ask whether forest products markets are producing signals that will lead private operators to apply more sustainable forest management practices or whether present methods will continue to prevail. Assuming that market imperfections and policy errors that frequently compound these imperfections will continue to operate unimpeded in the future, it is likely that the market will not producing the right signals to encourage the application of more sustainable forest management practices.

There are at least three reasons why markets are imperfect and give the wrong signals to investors interested in implementing sustainable forest management methods. First, they are ineffective in valuing some of the benefits of sustainable forest management. Second, government interventions sometimes compound the errors of the market and further alter the market signals and other decision parameters in favour of unsustainable activities in the forest. Finally, public institutions in tropical countries also sometimes fail to function properly and are generally inefficient administrators of the vast public forest estate. This often leads to the treatment of the forest an open resource with essentially no value and, consequently, unsustainable forest practices. The problem of valuation will be dealt with below, before the rest of this section discusses the other two aspects in more detail.

4.2.1 Valuation and the distribution of costs and benefits

A fundamental reason for resistance to adopt sustainable forest management practices is that markets are not equipped to award the benefits from such practices to the investor that has to shoulder the costs. This is due to several imperfections of the market, including the absence of prices for some of the goods and services of forests, as well as monopsonistic and monopolistic forces. Also, markets do not register the values for such goods and services that might be obtained by future generations and they introduce differences between the private and social rates of discount.

It is a well-known fact that many of the services provided by forests (as well as some of the costs of poor management of the resources) have no market price and, therefore, are not usually considered in the private sector decision-making process. For example, a forest manager operating in the upper part of a watershed does not get paid for the services that the forest might provide to others located downstream. These services may be valuable, although, frequently, the estimated value of such services has been exaggerated in the past (Hamilton and King, 1983; Chomitz and Kumari, 1996). They may include soil protection against erosion and protection of irrigation and hydropower dams against sedimentation. Similarly, the forest manager does not receive compensation for capturing carbon, maintaining scenic beauty or for preserving biodiversity resources, all of which may be of value to national societies or the global community as a whole. In such situations, the forest manager does not obtain financial payment that reflects the total value of all of the services provided the forest under management and, consequently, will have less of an incentive to manage the forest in a sustainable way.

In situations where such non-market values may arise, the question that the forestry policymaker faces are: how important are the "external" effects of managing forests in a sustainable way; and if somehow it was possible to "internalise" them into the decisions of the private operator, would they be important enough to encourage sustainable forest management?

4.2.2 Estimates of the value of non-market benefits from forests

Various analysts have attempted to estimate the magnitude of the value of non-market benefits produced by forests. For example, in their project appraisals, many international financing institutions routinely estimate the economic magnitude of external benefits and costs of forest management and adjusting their estimates of project impacts to take into account the presence of imperfect and non-existent markets. These appraisals also routinely show that the balance of benefits over costs of forestry projects, when they include these "external" non-priced impacts, are more favourable than the results calculated purely on a simple comparison of commercial benefits and costs.

For example, a number of environmental economists have attempted to produce a consolidated picture of the value of non-market goods and services of forest resources and the results of one such analysis are displayed in *Table 3*. As a comparison, the table also includes the market value of roundwood produced from these forests. The results in this table must be interpreted with caution because the methodologies employed by the different analysts are not likely to be the same. However, notwithstanding this problem, the following two interesting conclusions emerge:

- some of these non-market values are indeed important, in some cases being nearly equal to the market value of roundwood produced from the forest; and
- the only sizeable global non-market benefit is carbon storage (see also *Box* 6).

Table 3: Some examples of the comparison between local and global market and non-market values of forest benefits

Product or type of benefit	Mexico	Costa Rica	Indonesia	Malaysia	Peninsular Malaysia
Roundwood (market value)	-	1,240	1,000-2,000	4,075	1,024
NWFPs (market and non-market values)	775	-	38-125	325-1,238	96-487
Carbon storage (non-market value)	650-3,400	3046	1827-3654	1,015-2,709	2,449
Pharmaceutical (non-market value)	1-90	2	-	-	1-103
Ecotourism/recreation (market and non-market values)	8	209	-	-	13-35
Watershed protection (non-market values)	<1	-	-	-	-
Non-use value (non-market value)	15	-	-	-	-
Option value (non-market value)	80	-	-	-	-

Note: All figures are in US$/ha; non-wood forest products (NWFPs) refers to resins, nuts, mushrooms, wildlife and other forest products (some of which have market values); option values relate to the non-market value of preserving forests for future use; and existence values are those attached to forests by people even if they will not use them. This table is adapted from Pearce (1995).

Indeed, apart from the special local cases associated with tourism and recreation, carbon storage is the only benefit, at the global scale, that could favour sustainable forest management options if it were to be included in the appraisal of forest management options.

The table also shows that, contrary to popular belief, the values of some services of forests that are thought to be rather large, in fact are not. One notable example is the potential of forests to contain substances that can be developed into medicines. This value is normally thought to be high, but research shows that this is not the case. The main reason for this low valuation is that the probability of discovering a valuable medicinal plant is low (per hectare) and the fact that only a small number of hectares are required to capture a significant share of the biodiversity in tropical forests.

A similar argument applies to the values ascribed to tourism and recreation. Forests have tremendous tourism potential, but this is not distributed over large areas; rather it is concentrated in a few highly valued localities. Thus, although on a global basis tourism values are low, they may be very high in a few localities and effectively contribute, if captured, to make sustainable forest management practices financially more attractive in those localities.

4.2.3 Attempts to redistribute benefits

There have been two major attempts to date to redistribute the benefits from sustainable forest management towards forest managers: carbon trading initiatives and forest product certification initiatives.

Carbon trading. Because of the relatively high values associated with the carbon sequestration services of forests, the UN Framework Convention on Climate Change attempts to create a market for this non-market service, by allowing carbon dioxide emitters to pay for carbon sequestration services in developing countries to offset their emissions. This idea looks promising, but it is too early to assess the impact such schemes might have and whether they will become important at a global scale.

The challenges facing the implementation of these schemes are formidable and include the need to put in place an efficient system of financial transfers, to make sure that payments from carbon emitters reach forest operators on the ground. However, these challenges are not insurmountable and various initiatives are now under way to test different mechanisms for creating carbon markets and demonstrate the value of such schemes.

Box 6: The value of carbon storage

Based on various studies, Fankhauser and Pearce (1994) estimate that the value of a tonne of carbon stored avoids damages that may be equivalent to some US$ 20. A hectare of forest that remains under forest cover avoids emissions varying between 100 and 200 tonnes of carbon, depending of the features of the original forest and the transition to other uses if it were deforested. For example, a transition from closed forest (which contains some 280 tonnes of carbon per hectare) to pasture (63 tonnes per hectare) would result in a net release of more carbon (around 220 tonnes per hectare) than the transition from the same forest to shifting agriculture (around 200 tonnes per hectare after conversion). Alternatively, a transition from open forest (that contains some 115 tonnes of carbon per hectare) to permanent agriculture (63 tonnes per hectare) would release around 50 tonnes of carbon per hectare.

Taking into account these different variations and assuming averages of 100 - 200 tons of carbon stored in forests per hectare, the average value of this forest service is probably around US$ 2,000 to US$ 4,000 per hectare. This figure is comparable to the values for carbon sequestration described in *Table 3*. Several researchers believe that the unit value of US$ 20 per ton of carbon stored may be too high.[6] Still, even if these estimates were reduced substantially, by half for example, the value of carbon sequestration is considerable and certainly higher than other non-market values of forests[7].

Clearly, the desire to adopt unsustainable forest practices would decrease substantially if those that adopted them had to pay (according to the polluter pays principle) US$ 2,000 to US$ 4,000 per hectare. Or, on a more positive vein, if the global community could pay forest owners these amounts for keeping their lands under forest cover, the incentive to implement sustainable forest management would increase tremendously[8].

Forest product certification. Another possible mechanism to redistribute the benefits of sustainable forest management is to put in place international mechanisms for consumers (particularly in the rich economies) to voluntarily pay for some of the global environmental non-market services of forests in the form of a premium for products that originate in certified sustainable, well managed, forests. An alternative to this is to grant such products preferential market access.

6 For example, a value for carbon storage of US$ 2,000 per hectare would be equal, if summed across the total global forest estate, to US$ 1,000 per capita.

7 Of course, a value of only US$ 10 per tonne of carbon is open to question. Some analysts believe that this value may be as low as US$ 5 per tonne. Still, this does not alter the fact that carbon sequestration is one of the most important global non-market benefits of forests.

8 Gregersen, and others have questioned the soundness of paying forest owners for merely protecting their forests and doing nothing with an old growth forest that has no net carbon sequestration value (see, for example, Gregersen *et al*, 1998).

The practical problems of implementing reliable certification systems are also formidable. Who would have the authority to certify? What would be the criteria to certify forests? What is the magnitude of consumers' willingness to pay for certified products? How can schemes be effectively monitored? If these schemes are government induced and compulsory, several difficulties with respect to existing fair trade rules would have to be overcome.

There is a very intensive debate on all of these issues currently taking place in different fora around the world. Certification is an attempt to favour the profitability of sustainable forest management while, at the same time, reducing the profitability and market access for wood originating in forests under liquidation. So far, the expectation that prices for products originating in certified sustainably managed forests would command a significantly higher price has yet to materialize (World Resources Institute, 1994).

4.3 Institutional challenges to the implementation of sustainable forest management

In addition to the financial challenges to the introduction of sustainable forest management there are, as noted above, a number of institutional challenges that must be overcome. The two principle challenges are faulty government policies that encourage unsustainable forest practices and weaknesses in the institutions themselves in many countries.

4.3.1 Faulty government policies

There is a large body of literature showing how some government policy interventions may not only create obstacles to sustainable forestry but also promote the liquidation of forest resources. These policy interventions are not necessarily always purposely biased against sustainable forest management practices but often this is their unintended result. As expressed by Repetto (1993):

> *"Governments, many of which are committed in principle to conservation and wise resource use, are aggravating the loss of the forests under their stewardship through mistaken policies. Such policies, by and large, were adopted for worthy objectives: industrial or agricultural growth, regional development, job creation, or poverty alleviation. But such objectives typically have not been realised or have been attained only at excessive cost."*

Examples of policy interventions that may pose obstacles to the implementation of sustainable forest management are summarized in *Table 4* and explained in greater detail below.

Transportation infrastructure policies. Policies that promote the construction of roads near or through forest resources frequently are blamed for the proliferation of unsustainable forest practices. Various economic models of deforestation applied in a number of country or regional situations show a close association between greater access to forests and the

expansion of unsustainable management. Scrutiny of some 150 models of deforestation by the Center for International Forestry Research (Kaimowitz and Angelsen, 1998) suggests that:

> *"forest fragments are more accessible than forest compacts and forests in coastal countries and islands are more accessible than in continental countries. Roads seem to have a stronger impact in regions dominated by commercial agriculture and areas with better soils, than in marginal lands inhabited mostly by small farmers that practice slash and burn cultivation."*

Table 4: Examples of policy measures that may lead to unsustainable forest management practices

Type of action	Examples of specific projects or policies
Direct Government investment in the forest sector or in related sectors	Road construction Hydropower investments
Government command and control regulations	Conservation area protection Obligation to replant harvested areas Prohibition to harvest without a permit Obligation to prepare forest management plans as a condition for intervening in forest areas Log export bans
Fiscal, price or monetary policies	Subsidies affecting forest raw materials or other inputs Subsidies affecting competitive uses of lands, such as cattle ranching Plantation subsidies Price controls Subsidies affecting forest harvesting or manufacturing Forest products taxes Subsidized credit Foreign exchange policies affecting competitive uses of lands
Provision of services	Delimitation, demarcation and land titling Actions to promote exports Settlement of frontier areas

Government-sponsored road construction and the onset of deforestation and the start of unsustainable forest practices are frequently easily observable circumstances in various tropical countries. For example, in the Brazilian state of Pará, deforestation following road construction increased from 0.6 percent to 17.3 percent of the state's area between 1972 and 1985.

It is obviously unrealistic to propose a stop to road construction.[9] Furthermore, changes in road policies are unlikely to promote better forest management alone. What reforms to road policies can do is to reduce the incentives to pursue unsustainable forest management practices (i.e. conversion of forest land to other uses). For example, roads can be diverted to areas of potentially high agricultural productivity. Also, there is usually the option of intensifying road construction rather than extending the network to areas previously inaccessible. These reforms and others do not necessarily imply a reduction in road building investments or considerable economic costs. Often, simple and relatively low cost changes in

[9] Although, for example, Colombia is resisting efforts to build the linking stretch of the Trans-American Highway, for fear of opening-up remote forest areas.

the nature of road systems, their type or location would be likely to produce a noticeable impact (Kaimowitz, 1997).

Subsidy policies. Governments frequently grant subsidies either directly to forest sector operators or to entrepreneurs in other sectors related to forests. Not infrequently, these subsidies unintentionally generate powerful incentives to pursue unsustainable forestry practices. To quote Repetto (1993) again:

> *"These subsidies can become so large that they encourage activities that are intrinsically uneconomic, or push alternative land uses beyond the limits of economic rationality. The effect of all such (subsidy) measures is to shift the margin of relative profitability between forest and the competing land use, encouraging more forest conversion than would otherwise take place."*

Such subsidies often affect forests because they frequently make unsustainable activities more profitable than the sustainable alternatives. In particular, the management of forests is strongly influenced by two types of subsidies: those that apply directly to the forest sector and those that apply to other economic activities that interact with forests.

The most common subsidy in the forest sector is that implicit in the generally low forest charges paid by timber concessionaires in many countries. Large areas of public forests in the tropics have been granted to private forest managers as forest concessions[10] and some companies are also aggressively seeking new forest concessions in the few remaining countries with large areas of relatively untouched forest resources. For example, about 30 percent of Guyana's forests were reported to be under timber concessions in 1997 (Wilkinson, 1998), more than half of the closed forests of Indonesia were, until recently, divided into almost 600 forest concessions and practically all of Ghana's forest reserves are under the control of some 200 concessionaires (Gray, 1997). Forest charges paid by forest concessionaires often bear little relationship to the market value of the resource or the economic rents[11] generated by forest harvesting (see examples in *Table 5*).

Why is the implicit subsidy in "underpricing" wood important in terms of its "perverse" effects on forest management? The subsidy encourages the wasteful use of roundwood, because roundwood is so inexpensive that forest concessionaires can afford to harvest larger areas and, thus, cut more roundwood, than is absolutely necessary. Also, "super profits" derived from low prices charged for roundwood translate into a tremendous insecurity about how long forest concessionaires will be able to hold to their concessions. Under these circumstances, there is no particular incentive to invest in long-term management of forest resources. Rather, the incentive is to log as quickly as possible.

[10] Forest concessions are permits issued by governments for exclusive rights to access forest resources for the production of wood or other forest products, usually with the additional requirement that the forest area is managed in a certain way.

[11] Economic rent, in the context of forest management, is the surplus revenue from the sale of roundwood harvested in the forest after taking into account all the costs of harvesting and forest management, including an allowance for a normal return on the capital invested in the forest operation. Governments can capture part of all of the economic rent by levying a variety of forest charges. Any economic rent that is not captured by the government, is obtained by producers and consumers in the form of excess profits and cheap wood products.

Furthermore, concessionaires have little inclination to prevent illegal occupation of the forest land in their concessions, even if those migrants practice slash and burn agriculture. They also have no motive to manage the forest resources in a sustainable way, because logging rights in concessions are not usually transferable and forest concessionaires can not, therefore, capitalize on their investments by selling them to other investors.

The final detrimental effect of the underpricing of wood is that it reduces forestry department budgets that could be used to promote more sustainable forest management practices. The more general dangers of inappropriate forest concession policies are described in *Box* 7, using the situation in Indonesia as a case-study.

The elimination of this type of subsidy would increase the costs of depletion options and may lead to increases in the value of forest resources. In the short-term, increases in forest charges may lead to more unsustainable practices but higher charges should also induce long-term investment in better forest management, if some security of tenure could be provided.

Table 5: Examples of low rent capture in forest concession agreements

Country and source	***Period of Analysis***	***Estimated proportion of economic rent captured by the government (%)***
NICARAGUA (Gray and Hagerby, 1997)	1997	6-30
VENEZUELA (Centeno, 1995)	1995-1997	2-3
INDONESIA (Reid Collins, 1993)	1993	25-35
INDONESIA (Myers and Kent, 1997)	1997	25
MALAYSIA:		
PENINSULAR MALAYSIA (Vincent *et al*, 1993)	1989	9-49
SABAH (Vincent, 1991)	1966-89	53-64
SARAWAK (Vincent, 1991)	1966-89	35-69
GHANA (Gronow, 1996)	1993-1995	7-13
CAMEROON (Grut *et al*, 1991)	1987	2-4
CAMEROON (World Bank, 1997)	1994-1996	22
CAMBODIA (Global Witness, 1997)	1996-1997	9

Note: differences within countries may be due to different estimation procedures and/or to variable factors such as economic accessibility or market prices for wood products. Percentages are estimated on the basis of government revenues for various charges such as timber charges, area fees, export taxes etc., but generally excludes income (personal or corporate) taxes, divided by stumpage prices.

Box 7: Why do some forest concessionaires in Indonesia exploit the forest in unsustainable ways?

- ***The method of concession allocation gives too much land to concessionaires.*** *Low forest concession fees induce concessionaires to acquire vast forest areas. In addition the timber royalty fees in Indonesia are based largely on the volume of timber extracted rather than on the area of concession. This reinforces the tendency to obtain large areas. Forest concessionaires have little incentive to prevent encroachment by smallholders, or are unable to stop such encroachment and this sometimes results in deforestation.*
- ***Policies encourage rent-seeking behaviour and provide few incentives for long-term management.*** *High profits resulting from low concession fees open the way for corruption and the terms of forest concession contracts are sometimes not observed. Moreover, forest concessionaires rush to exploit the forest in a careless manner because the favourable conditions that generate high profits may not last. Indonesia also has low forest fees and high export taxes, which depress the domestic price of timber and, thus, limit the desire to invest in sustainable forest management. Considerations other than the likely quality of forest management affect the decision to grant concessions and, thus, provide little incentive for good performance.*
- ***There is insufficient support for provincial-level protection of forests.*** *In Indonesia, provincial governments receive a very small share of the already low timber concession fees. Provincial governments with extensive forests may prefer to replace them with other forms of land use that generate more revenue.*

Source: Sunderlin and Resosudarmo (1996).

Governments also frequently grant direct or indirect subsidies to other sectors that may have a great influence on the way forests are managed. Thus, for example, governments often use subsidies to favour the agricultural sector. Increased profitability in agriculture may increase the demand for land and, if land is scarce, increase the pressure to convert forest land.

The effect of agricultural subsidies depends on whether such policies lead to agricultural intensification or extensification. It also depends on factors such as the technologies adopted, the economic conditions facing farmers and the nature of subsidies. Because of this, not all subsidies necessarily lead to increased pressure on forest land. Subsidized irrigation is more likely to lead to agricultural intensification because it is generally not convenient to irrigate remote areas at the forest frontier. Subsidized fuel and transportation infrastructure has the opposite effect, because these subsidies make it more profitable to use remote forest land. Subsidies that encourage livestock development are also likely to increase the pressure to convert forest land to this use, although the impact of such subsidies may have been exaggerated in the past (Kaimowitz et al, 1998; Kaimowitz, 1996).

In some instances however, even subsidies that lead to the intensification of agriculture may indirectly increase the pressure to use forests in unsustainable ways. For example, generous government incentives led to increases of land prices in South Brazil during the 1970s and 1980s. These incentive policies encouraged land ownership concentration, agricultural intensification and the adoption of capital-intensive methods of production. All of this resulted in increased unemployment. Some of the workers displaced by mechanization and the concentration of land ownership migrated to forested frontier areas in the Amazon and this led to growing pressure to use forest resources in ways that led to depletion (Southgate, 1992).

Structural adjustment policies. In their efforts to promote economic growth, many countries have implemented structural adjustment policies (SAPs). These policies frequently lead to reductions in public expenditure and forestry staff, the promotion of privatization, the liberalization of foreign exchange flows and the international movement of capital, the

removal of other restrictive trade policies and, in general, a reduction of the role of the state (World Bank, 1990).

The impact of these policies on attempts to implement sustainable forest management is currently uncertain. Some forces triggered or fostered by the implementation of SAPs may lead to forest conversion, while others may create more favourable conditions for sustainable forest management.

For example, trade and foreign exchange liberalization policies normally improve the terms of trade for agriculture in tropical countries and this may reduce the incentive to invest in forest management and increase the pressure to convert forest land to agricultural uses. Detailed studies of the effects of SAPs in: Bolivia; Cameroon; and Indonesia, suggest that devaluation has had a variable effect, placing the most intense pressure on forest resources when competing uses for forest land are export-orientated activities.

In the last few years, liberalization policies as well as the globalization of the world economy, raised the concern that unscrupulous and powerful transitional corporations, with a poor record of environmental or social management, may take advantage of weak and cash-strapped forested countries and expand their unsustainable and resource degrading operations to these countries. Thus, in 1995, the World Resources Institute (Sizer and Rice, 1995) warned that forest concessions offered to Asian logging corporations in Suriname could lead to the country:

> *"Losing its forests, and getting shattered biodiversity, ruined fisheries, eroded soil, displaced populations and perhaps ethnic strife in return."*

Furthermore, Martin[12] (1996) indicated that:

> *"A disturbing new trend has emerged in Africa with an influx of Asian-based logging companies…In Cameroon a Malaysian timber firm is alleged to be involved in the illegal export of more than 30,000 cubic meters of logs a month - bypassing official export controls by sending the wood out from a specially constructed harbour."*

In the past, unsustainable harvesting by European companies destroyed the forests of Côte d'Ivoire and Nigeria and it appears that Congo and Cameroon are rapidly following suit.

As mentioned above, SAPs often require reductions in government spending and sometimes forest management programmes suffer when governments are forced to dismiss staff and reduce monitoring and law enforcement. Although the link between more staff, higher public spending and more sustainable forest management is unclear, in many cases it is plausible that the reduction of staff and financial resources resulting from the application of SAPs has not helped the implementation of sustainable forest management

The studies mentioned above highlight the complexity of the various relationships involved in SAPs. The impacts of SAPs on the implementation of sustainable forest management are, to a

[12] Director-general of the World Wide Fund for Nature.

great extent, country-specific and driven by a number of economic forces working in different, sometimes opposite, directions.

Log export policies. Many governments impose log export bans or prohibitive log export taxes. These are often imposed to support the development of domestic processing industries, but are sometimes also promoted in the hope that they will create incentives to improve forest management or at least to reduce some of the pressures that result in unsustainable practices. Such policies are often partly introduced because of uncertainty about the impact of market forces and other government policies on the management of the resource.

The question of whether export bans and taxes do, in fact, reduce the pressure to convert forest land to other uses or favour sustainable forest management, is the subject of much debate. Again, the results of these policies depend on a number of complex factors. Under certain circumstances, they can work against sustainable forest management, as in the case of Indonesia, where a log export ban led to the installation of excessive industrial capacity, the wasteful use of roundwood and, more generally, to an economically inefficient situation (Repetto and Gillis, 1988; Whiteman and Scotland, 1999).

Export restrictions immediately decrease the total demand for forest products and, consequently, the pressure to harvest forests in unsustainable ways. However, the long-term impacts are less clear. Reduced demand translates into lower prices for those forest products that cannot be exported (typically roundwood), which now have to be sold in the domestic market. If the domestic market is very small, this price contraction can be significant. In these circumstances, the profitability of implementing sustainable forest management practices would decrease and the relative profitability of converting forest land to other uses, such as agriculture or cattle ranching, would increase. This pressure is likely to be even more intense if agricultural lands are in short supply.

The reduction in roundwood prices also reduces the incentive for the forest industry to use roundwood more efficiently. This, in turn, expands the amount of forest land required to produce a certain level of output. Moreover, forest harvesting tends to become more careless and destructive because avoiding damage the forest (which has become less valuable) may not justify the costs of improved logging technologies. Finally, lower roundwood prices also diminish the incentive to invest in forest plantations.

All of these forces may work against sustainable forest management or in its favour, but the importance of all these forces can not be easily generalized. Only specific studies of individual countries can throw some light on the possible effects of log export bans or other policies to restrict trade.

Land titling policies. In the past, a general policy failure that lead to extensive deforestation, was the requirement to demonstrate use of an area of public land and the presence of improvements, to obtain legal property rights or some sort of title over that lands. In many cases, a good way to demonstrate occupation and “improvement” of forest land was to remove the forest cover.

In many cases deforested land is also less likely to be expropriated for other purposes, while land with forest cover is more likely to be declared a protected area or be expropriated for other purposes by the government. For example, the simple declaration that the government

intended to expand the system of protected areas may have contributed to the rapid expansion of unsustainable forest practices in Costa Rica (World Bank, 1996).

Thus, land titling policies are likely to produce mixed results (see *Box 8*). Firstly, they are generally aimed at discouraging forest conversion, but they do not introduce any particular incentive to implement sustainable forest management. Secondly, in some cases, they may increase deforestation if landless farmers invade the areas where large titling efforts are under way. In general, governments usually find it difficult and expensive to implement these programmes.

Box 8: Examples of positive and negative impacts of increased land tenure security

Increased land tenure security may lead to:

- farmers' greater access to credit
- clearer and easier transfer of land ownership
- increased protection against squatters
- longer term investments such as tree growing
- more capital intensive and less extensive land utilization schemes and therefore decreased pressure on frontier lands
- better control by the government of agricultural and forest operations
- increased government revenue

But conversely, it may also lead to:

- excessive farmers' indebtedness and loss of land ownership
- increased land prices and displacement of small farmers
- increased pressure on the agricultural frontier
- deforestation, if tree cutting can prove land occupation and therefore priority for land titling
- concentration of land ownership.
- large government expenditures on land titling and demarcation
- increased costs affecting small farmers now subject to taxes
- increased resistance and mistrust of government interventions among local population

4.3.2 Institutional weaknesses

For the successful and widespread implementation of sustainable forest management, the demands that will be placed on forestry institutions will be many and varied. Public forests covering millions of hectares, will have to be inventoried and management plans will have to be designed, implemented and monitored over these vast areas. The amount of data that will be required throughout this process is huge and will have to include information about aspects such as: terrain; site conditions; accessibility; growing stock volume; species composition; silvicultural requirements; land tenure situation and issues; market demands and prices; and the complex variety of data required for adequate land-use planning (Wyatt-Smith, 1987).

In industrialized countries, the institutional demands of forest management are met by agencies that generally have adequate funds and sufficient capable professional staff to carry-out their duties. The most notable institutional problems in these countries have been related to the inflexibility of forestry institutions to change with evolving demands of society. This is

symbolized by the spotted owl controversy as well as the current debates about “salvage logging” in the Pacific Northwest region of the United States of America. In other cases, institutional inability to cope with the demands of sustainable forest practices have more to do with the disruptive effects of political change, such as in the case of the boreal forests of Russia. In general however, most institutional demands are appropriately met in many of the industrialized countries.

In developing countries the situation is quite different. Here, generally weak governments must face these same intense institutional demands to manage large expanses of forest. However, the catalogue of institutional weaknesses currently prevalent in many developing countries is long and includes, for example:

- inadequate research facilities;
- insufficient number of trained officials;
- weak intersectoral institutional links;
- planning deficiencies; and
- insufficient funding.

As a result, governments in these countries often do not or can not effectively manage their forest resources (i.e. state forests) and, instead, tend to contract-out these operations to private concessionaires. This arrangement is supposed to be planned and controlled by the state but, in fact, these arrangements are often corrupted, resulting in ineffective monitoring or, sometimes, a total lack of control.

Forests that are not claimed or held by the state are generally in an even worse position. Use of these forests is often totally unregulated by the government and they are typically used as open-access resources by companies, local communities, shifting cultivators, or other groups.

A final institutional problem is that areas of forest land that are claimed by community or indigenous groups (under traditional or customary laws and rights) are often also claimed by the government as public property. This leads to further complications for the implementation of sustainable forest management (see *Box 9*).

Box 9: ***Indigenous peoples and forest management***

Social scientists and ecologists have been instrumental in illuminating the potential role of indigenous forest dwellers in counteracting tropical deforestation. When still intact, indigenous forms of land use and natural resource management maintain forest habitants. Indigenous peoples have a sophisticated knowledge of biodiversity and depend upon it for their social and cultural survival. Their farming systems have been documented to be ecologically sustainable and potentially able to support much larger populations than indicated by previous research. Finally, recent research and practice suggest that under conditions of modernization (i.e., incorporation into regional and international markets), these systems can be modified to produce surpluses that contribute to local and national economic development.

So far, those that have advocated the participation of indigenous peoples in prevention of deforestation have emphasized these ecological and economic advantages. Much less attention has focused upon the juridical and socio-political requirements for securing an adequate territorial base for indigenous peoples. Without such territorial security, it will be difficult (if not impossible) for indigenous peoples to have a more active and significant role in tropical forest management.

Source: Davis and Wali (1993)

All of these institutional weaknesses create powerful disincentives to the implementation of sustainable forest management and some of the major disincentives are discussed in more detail below.

Control of property rights. One of the most important factors that works against the implementation of sustainable forest management in developing countries is the confusion and conflict over the rights of ownership rights to public forest land and land that has traditionally belonged to communities and indigenous groups.

The lack of effective exercise of ownership rights of public forests means that these resources are, from the point of view of the private operator and for all practical purposes, very accessible and abundant. For private operators, utilizing public forest lands under concession contracts or other type of arrangements, the question is why introduce sustainable forest management practices with all their complications and very uncertain financial benefits, when it is possible to utilize the next piece of forest land for a quick "cut and run" operation, which is also financially much more attractive? Resources, when abundant, are not used with care.

For others, the illegal occupation of uncontrolled public forest land may open an opportunity for subsistence in the short-term but not an incentive to conserve and manage forests because the fruits of such a long-term undertaking will likely not be received by them. On the contrary, as has been shown above, frequently the act of forest clearing may be a powerful instrument in securing the transfer of property from the government to the agent that clears the forest.

If governments have been less than effective in establishing controls over public forestlands, they have also been slow in recognizing the forest rights of local communities and indigenous peoples. In many cases these communities have a long tradition of managing forests in sustainable ways but the desire to continue to do so vanishes when governments do not recognize their ancestral rights to these resources and, instead, authorize the utilization of lands for other purposes and by other agents.

Illegal and corrupt activities. Many governments are often unable or unwilling to control illegal operations. This lack of control can be either voluntary, often due to corruption,[13] or is determined by the limitations of government's administrative capacity to carry-out the functions assigned to them. One way or the other, illegal and extremely wasteful utilization of forest resources is rampant in most forested countries. By their very nature, the true extent of illegal operations in the forest sector cannot be known with precision, but what little evidence is available suggests that they are important and that they constitute an important factor in the conversion of forests.

For example, in the 1980s, the Philippines lost about US$ 1.6 billion per year (equal to a large share of the country's gross domestic product), to illegal logging. The World Wide Fund for Nature estimates that virtually all timber exported from India, Laos, Cambodia, Thailand and the Philippines is illegal and that a third of the exports from Malaysia may also be illegal (WWF, 1996).

In 1993, Malaysian log exports to Japan were under-declared by as much as 40 percent (Sizer, 1997). As much as one third of the volume harvested in Ghana may be illegal and aid observers indicate that money poured into the country as part of a SAP led to illegal forestry practices on a massive scale (FoE International, 1997). Up to 95 percent of all logging in Indonesia is not wholly legal (Dudley *et al,* 1995).

In 1998, Global Witness released a report describing the scale of corrupt forestry activities in Cambodia and stated that, in 1997, a minimum of US$ 184 million worth of timber was felled in Cambodia, with much of the money from these activities going to corrupt government officials (Global Witness, 1998). Furthermore, illegal logging could mean the complete disappearance of Cambodia's forests in only five years.

All of these studies strongly suggest a close link between illegal and corrupt activities on the one hand and the proliferation of unsustainable forestry practices on the other (see, for example: Global Witness, 1998). Furthermore, many illegal operations are the consequence of corruption. A list of illegal and corrupt acts that contribute to deforestation is contained in *Box 10.*

[13] Corruption can be defined as: "the sale by government officials of government property for personal gain" (Shleifer, and Vishney, 1993) or "behavior on the part of officials in the public sector, whether politicians or civil servants, in which they improperly and unlawfully enrich themselves, or those close to them, by the misuse of public power entrusted to them" (Transparency International, 1996).

Box 10: A catalogue of illegal and corrupt acts that promote deforestation and forest degradation

Illegal logging:

- logging timber species protected by national and international law such as the Convention on International Trade in Endangered Species of Fauna and Flora (CITES);
- contracting with local entrepreneurs to buy logs from protected areas outside the concession;
- logging outside concession boundaries;
- contracting with local forest owners to harvest on their land but then cutting trees from neighbouring public lands instead;
- logging in protected areas;
- logging in prohibited areas such as steep slopes, riverbanks and water catchments;
- removing oversized or undersized trees;
- extracting more timber than authorized;
- logging in breach of other contractual obligations; and
- obtaining timber concessions illegally.

Timber smuggling:

- exporting tree species banned under international law;
- exporting illegal logs in contravention of national bans; and
- obtaining declarations of lower volumes exported.
-

Undergrading, undermeasuring and undervaluing timber and misclassifying species:

- avoiding royalties and duties by declaring lower value and volume of timber extracted from timber concessions; and
- declaring exports of lower-priced species.

Source: Environmental Investigation Agency (1996).

Illegal and corrupt operations are likely to have an important effect on forests because they increase investment risks and thus reduce the willingness of investors to implement sustainable forest management practices. Corruption weakens the administrative apparatus of the state, as decisions begin to be biased against activities that do not attract bribes. Also, because the government is deprived from income that could otherwise go to improving public administrative procedures and supporting sustainable forest management activities, corruption generates incentives for organizing "cut and run" logging operations.

Policy reforms to combat corruption rely on increasing public scrutiny of government decisions that would make illegal operations and corruption easier to find and trace. Procedures that could be used more intensely to reduce the scope for corruption in the forestry sector include: public bidding for contracts; regular rotation of personnel in charge of contracts; frequent and unannounced checks and inspections; and the establishment of independent inspectors. By reducing corruption, such measures would improve the chances that forests will be managed in more sustainable ways.

The resistance to reform. As mentioned earlier, public institutions are often resistant to reform. Policies tend to perpetuate themselves even in cases where there is evidence of their negative or "perverse" effects on the stated desire to implement sustainable forest management methods.

Government institutions, particularly in less democratic regimes, tend to reflect the interests of powerful stakeholder that have a vested interest in maintaining the *status quo*. These groups include: loggers; concessionaires; agricultural entrepreneurs; ranchers; etc. In contrast, other groups that depend on the forest for their livelihoods (such as forest dwellers and indigenous populations) and that may have a greater interest in managing forests in more sustainable ways, often have a great deal less power.

Poorly paid forestry staff tend to associate their values and align their actions much more closely to the first group than the second. Therefore, the introduction of reforms to promote sustainable forest management, such as increasing timber prices in public concessions or reducing subsidies to agriculture, may face stiff political resistance not only from private vested interests, but also from inside the forest administration itself. This explains why some international organizations, such as FAO, that have organized efforts to improve the management of forests for many years, have met with limited success.

There is, ultimately, no easy solution to this problem other than to continue to press for reform, by highlighting the benefits that such reforms can bring to all stakeholders.

5 APPROACHES TO INTERNATIONAL AID

Based on the above analysis and more general discussions[14] about some of the issues raised here, a set of general and specific strategies to promote more sustainable forest management through the use of international aid, have be derived. These are briefly outlined below.

5.1 General principles and strategies

1. It may be unrealistic to expect to reach agreement on what sustainable forest management really means, particularly when the concept includes a wide variety of the goods and services that forests produce. Even the immensely simpler concept of sustainable wood production is open to various interpretations. Therefore, it is probably more pragmatic to focus on the process of improving forest management, particularly by reducing or eliminating clearly unsustainable practices and by promoting an incremental progress towards more sustainable forest practices.

2. Sustainable forest management for wood production is feasible in many ecological, economic and political situations. However, the number and complexity of factors that affect the feasibility of implementing sustainable forest management is such that it is not possible to design clear and certain paths towards improved forest management. There are no obvious recipes of universal validity to promote more sustainable practices in different political, economic and social environments. The forces that influence the management of forests, including: technological processes; environmental and economic conditions; political and social factors; are all likely to be present in most situations. Nevertheless, they are likely to be mixed in many different ways, requiring a combination of measures specifically crafted to respond to local conditions in order to foster improved forest management in any particular case.

3. The promotion of sustainable forest practices requires sound institutions, policies and political support for reform. Institutional strength is perhaps the most essential ingredient required to implement improved forest management through clear rules of the game, effective control over forest resources and the elimination of negative policies and corrupt activities. In countries where these condition are not present, a productive role of international aid is probably that of introducing new ideas, promoting public awareness about the consequences of continuing business as usual and developing institutions. However, because these reforms depend heavily on political factors, it is not easy for international aid institutions to influence them. Mobilization of political forces supporting reform in these cases may take a long time. But abundant experience indicates that the alternative of throwing money at the problem simply does not work when policies and institutions are not adequate. Experiences also shows that lasting policy reforms can not be “bought” by international institutions or effectively imposed through conditionalities (Spears, 1994). On the other hand, in countries where sound policies and institutions exist

[14] The suggestions presented here are based on the results of a two day meeting organized by FAO: "Technical Consultation on the Management of the Forest Estate: Issues and Opportunities for International Action by the World Bank and FAO" and held in Rome, Italy (28-29th April 1999).

or where governments are willing to introduce reforms, financial resources can produce an impact.

4. It should be noted that the promotion of improved forest management does not always require large amounts of money. In fact, frequently the opposite may be true: some of the actions to foster better forest management, such as the elimination of subsidies, may save government's money or increase their revenues. Thus, the role of development finance is likely to be less important in terms of providing additional money than in terms of improving governance.

5. Many, perhaps most, of the actions to promote improved forest management will have to aim at sectors other than the forest sector. Also, many of these actions may not be politically palatable. Ensuring more sustainable development may require changes in sectors such as: transportation; mining; and oil exploration. Policy reforms need to be based on a careful assessment of how developments in these sectors will affect different stakeholders because benefits and costs are likely to be distributed unevenly. The initial role of international aid should be that of analysing and disseminating the consequences of inaction, education of the general public and strengthening institutions. Financing may be needed to compensate those that lose as consequence of policy reforms.

6. Frequently it is not necessary to design new models or policy approaches to improve forest management. A more productive approach is likely to be to target policy and institutional failures that are known to exacerbate the proliferation of unsustainable practices.

7. In general, and most fundamentally in forest rich countries, it is imperative to reduce the uncontrolled invasion of public forest resources. Access may be needed, particularly for the rural poor, but under more controlled circumstances. Development finance should support the attainment of a firmer grip on public property rights, land demarcation, land titling and land ownership enforcement. No investments in improved forest management will be sufficiently attractive until the option of unsustainably harvesting valuable wood acquired at nominal prices in public forests is effectively brought to an end.

8. Enhanced forest management plans, policies and projects are only as good as the knowledge upon which they are based. International institutions should support applied research that will provide essential insights about the economic, political, social and technological forces that shape the incentives to improve forest management.

5.2 Specific principles and strategies

Specific principles to promote more sustainable practices have been derived for broadly defined forest types and these are described below.

5.2.1 Tropical forests in areas of high population density

1) Promote zoning and identify lands that will be dedicated for timber production and for protection purposes. Protect areas of high environmental value.

2) Develop concession policies in a participatory and transparent manner that emphasise more sustainable management principles, provide for stiff penalties for non compliance and reduce opportunities for corruption. Promote third-party independent assessments.

3) Eliminate subsidies in the forest and other sectors that induce unsustainable forest practices. In particular, eliminate policies that link unsustainable methods and deforestation with the acquisition of land ownership.

4) Promote the adoption of impact assessment of development activities in sectors that are likely to have a considerable impact on forest resources such as transportation, agriculture and cattle ranching.

5) Recognize and support traditional and community management schemes. Support the rights of indigenous peoples.

6) Develop policies that induce off-farm employment.

7) Promote incentives to farmers that adopt more intensive and sustainable technologies and that reduce the need to expand the agricultural frontier.

8) Design policies that will reduce the difference between the financial and economic returns of more sustainable forest management.

9) Design mechanisms to organize producer groups to develop markets for wood and non-wood forest products.

10) Strengthen forest management institutions.

11) Raise awareness in the general public and in decision-making levels of government of the consequences of inaction, of the costs of continuing unsustainable practices.

5.2.2 Tropical forests in areas of low population density

1) Promote participatory zoning involving forest dependent communities and indigenous groups.

2) Develop policies to protect indigenous forest dwelling communities land, forest access and forest harvesting rights.

3) Support the development of markets for non-wood products, including ecotourism.

4) Establish large protected areas in high biodiversity and low opportunity cost regions and taking into account indigenous peoples' traditional rights.

5) Develop mechanisms to capture the global values of forests and to use the proceeds for better forest management and protection.

6) Dedicate large efforts to improve the policy framework and strengthen the administrative apparatus of the state and its capacity for enforcement. Promote open and transparent decision-making and third party independent verification and monitoring. Support governments' contracting services to private companies, communities and other institutions.

7) Rationalize and co-ordinate policies in other sectors, e.g. mining; oil and gas; agriculture; hydropower development; and transportation, which affect the management of forest resources.

8) Develop alliances of international institutions and NGOs that are interested in promoting a better policy and institutional framework for improved forest management.

9) Introduce methods to analyse the impact on forests of macroeconomic and sectoral policies.

10) Support efforts to rationalize concession policies based on participatory and open processes, preferably involving third party independent assessments of the value of the resource, transparent allocation methods and clear and easily verifiable rules of the game. Establish clear penalty procedures for non-compliance including blacklisting of unscrupulous companies.

11) Promote the adoption of codes of conduct among private corporations.

5.2.3 Countries with low forest cover

1) Reform policies based on a through analysis of household perceptions of the value of forest and tree resources and of strategies for their sustainable management.

2) Support community-based forest management, joint management schemes and the proliferation of trees outside forests.

3) Support the development of small-scale enterprises that would depend on tree resources, thus providing incentives for sustainable management.

4) Strengthen government institutions for the protection of state owned forest and biodiversity resources.

5) Identify and protect the remaining old-growth resources.

6) Promote incentives to forest plantation developments, particularly wood lots, trees outside of forests and other areas developed for biodiversity resources.

7) Eliminate policies that prevent the equitable sharing of benefits by local communities.

5.2.4 Temperate and boreal forests

1) Promote integrated land use management and zoning.

2) Integrate forestry as part of rural development.

3) In previously centrally planned economies, carefully plan transition from subsidized economies and state planning to market economies.

4) In Russia and Eastern Europe, develop strong regulatory frameworks, independent monitoring and audit procedures; support institutional development; ensure the protection of fragile ecosystems; and establish much stronger timber concession systems and stronger law enforcement.

5) In China, encourage the integration of watershed and forest management, promote small-scale farmers and plantations.

6) Establish large biodiversity reserves in areas where opportunity cost is low.

7) Promote innovative financial mechanisms based on the global externalities of forests.

5.2.5 Dry forests and woodlands

1) Promote integrated land use management based on a sound analysis of local populations' perceptions about the value of trees and their role as part of local production systems. Integrate forestry as part of rural development.

2) Promote joint management and forest management by the community. Empower communities.

3) Foster the diversification of tree crops.

4) Promote activities for the more intense utilization of dry forests for wildlife and ecotourism.

5) Encourage small pilot and demonstration projects that would test and demonstrate advantages of low risk improved forest management in the context of rural life, for example though the introduction of genetically improved trees.

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