CHAPTER - II

Forest Management Issues
The influence of man on the nature has become increasingly dominant. Environment has started to be overwhelmed by man, where man interacts with the natural environment through a complex system of relationships embracing the entire planet in which causes and effects are often separated by dimensions of space and time, and these transcend conventional, geographical, national and institutional boundaries.

Scientific methods have the power to produce knowledge and knowledge changes peoples' beliefs. At the same time scientific achievements have changed the image of the universe and the earth, especially the role of man in creation, radically, very different from the earlier times. This scientific revolution has coerced the people to become more concerned about the 'quality of life'.

In current times various strategies are being adopted by the countries of the world to manage and utilise the resources optimally and at the same time not causing undue degradation of the environment.

Environmental management is the most talked about subject all over the world. The only difference is that in the developing world it is a matter of survival, whereas, for the developed countries it is a matter of quality of life.

2.1 Significance of Forests

Forests give many valuable functions ranging from their fundamental role as a range of diverse ecosystems harbouring a large proportion of terrestrial species, to the provision of valuable foods, building materials and other products of great importance to man. Forests are varied and their uses
are diverse depending upon where they are situated; however the principal roles of forests can be expressed as follows:

- Major contributor to global biodiversity (e.g. tropical forests contain the highest level of biodiversity of any terrestrial ecosystem)
- Major contributor to nutrient cycling through uptake (soil and atmospheric) and decomposition
- Important factor in soil protection (direct and indirect influences)
- Source of fuel wood, particularly in developing economic regions
- Source of raw material for forest industry (logs, pulpwood)
- Source of other forest products (e.g. foods, medicinal plants, tourism)

Forests give a renewable source of raw materials for the forest industry, which in return supplies essential goods to modern society such as building materials and paper products. The value of global forest products produced in 1996 was estimated to be USD 415 billion. The pulp and paper industry contributed USD 265 billion.\(^{19}\)

In spite of the economic value of processed forest products, fuel wood accounts for over 50% of the volume of wood removed from forests. Fuel wood usage is highest in developing economies where access to other energy sources for heating and cooking is limited. Demand for fuel wood will continue to increase in line with global population placing increased pressure on forests as a source of fuel wood.

2.2 Forest Management

Forestry is the science of managing forests to give multiple benefits to society while maintaining the inherent nature of forest ecosystems. The broad nature of forest types and conditions, from tropical forests to the northern boreal forests, necessitates a vast knowledge of forest ecosystem dynamics as well as highly developed management systems to ensure these objectives can be fulfilled. The development of society dictates where and how forests are utilised, and hence how forests are managed. The challenges facing forestry as we move into the 21st century will be to continue managing the balance between society's needs and the forests integrity in a sustainable manner.

Two principal problems confront forestry as we move into the 21st Century. How do we meet the increasing demand for forest products? And how do we meet increasing environmental and social development demands?

Solving these problems will require a global commitment to sustainable forest management initiatives and preparedness by the international community to permit trade in forest products between regions with resource surpluses and those with resource deficits.

2.3 Forest Product Demand

The global forest products industry is dynamic and growing. Global demand for forest products will continue to increase in volume terms by 1-2% per annum for mechanical wood products and nearly 3% per annum for paper products until 2010. These demand increases will be generated by simple increases in population, literacy rates and improved standards of living, especially in developing countries.
Wood Fibre Demand Development by Region 1994 and 2010

Figure 2.1

Industrial Round wood and Fuel wood Harvest 1994

Figure 2.2
The demand for industrial forest products differs considerably by region as shown in the following figure. Demand is highest in industrialised regions such as North America, Scandinavia and Western Europe, even though growth in demand is slow in relative terms. In contrast, the greatest demand growth is occurring in regions with developing economies, particularly Latin America, Asia and Russia.\textsuperscript{20}

Supply of industrial forest products will meet demand, even though there will be regional deficits necessitating continued international trade and industry rationalisation. In regions with increasing scarcity of industrial wood, and related price increases, the development of more efficient processing technologies and higher utilisation rates of less favoured species have resulted in more efficient wood resource utilisation, absorbing some of the demand increase.

Fuel wood accounted for 54\% of wood usage in 1994, with most demand coming from developing countries (Figure-2). A quarter of the total energy requirement in developing countries, and over half in Africa, is obtained by burning wood, compared to 1\% in industrialised countries. In 1994, 2.0-2.2 billion people were affected by a shortage of fuel wood and this is expected to increase to 2.8 billion by 2000. The increase in fuel wood demand from 1.74 billion m\(^3\)/a in 1994 to over 2.0 billion m\(^3\)/a in 2010 will put continued pressure on forest resources, particularly in developing countries, compounding the effects of other land use pressures.

\textsuperscript{20} J. Virta, L. Carbonnier et.al, 'Forestry towards 21st Century - Challenges and Opportunities' \textit{Common Seven Papers} (Melbourne, 1998), pp.2-4
2.4 Environmental Protection and Sustainable Development

Sustainable development encompasses many interdependent and interrelated factors defining how a country progresses towards its desired goals. Economic sustainability is a common goal influencing strategies to achieve development in industry, agriculture and other sectors. The sustainability of forestry is strongly influenced by the demands of these other sectors.

Agricultural development has got a major role in the current distribution of forestland. In developed countries, the conversion of forestland to agriculture and other non-forest land uses has largely been completed, resulting in the total forest area remaining stable or even increasing in some regions. However, in forest rich, developing countries there is a continuing trend towards forest conversion to other land uses to enable economic and social development. The FAO estimated that an additional 85 million hectares of forest would need to be cleared for agriculture between 1995 and 2010.21

The Charter of the United Nations grants every nation the sovereign right to exploit its own resources abiding to its own environmental policies, provided that activities within its control do not cause damage to the environment of other nations. This gives nations with the right to utilise, manage and develop their forests in accordance with their development needs, including the conversion of forests to other land uses within their overall socio-economic development plan and based on rational land-use policies. Continued development of agricultural systems, as part of sustainable

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development initiatives to remove poverty will place substantial pressure on existing forest areas in these regions.\textsuperscript{22}

Increasing pressure is being placed on the utilisation of forest resources as the impact of social development on the nature of the global forest resource becomes more widely appreciated. The United Nations Conference on Environment and Development held in Rio de Janeiro in 1992 focused attention on issues of global environmental significance, identifying the need for the adoption of national level strategies to ensure sustainable development. The outcomes of the conference directly applicable to forests were that countries should:

- Promote integrated planning and management through development of supportive policies and instruments, strengthen planning and management systems, raise awareness and public participation, and strengthen information systems and international co-operation
- Sustain the multiple roles and functions of all types of forests
- Enhance the protection, sustainable management and conservation of all forests, and the greening of degraded areas through forest rehabilitation, afforestation, reforestation, and other means
- Promote efficient utilisation and assessment to recover the full value of goods and services provided by forests
- Promote sustainable commercial trade and processing of forest products

\textsuperscript{22} UN, \textit{Global Outlook 2000: An Economic, Social and Environmental Perspective} (New York, 1990)
• Integrate the conservation of biological diversity and sustainable use of biological resources of forests into national development strategies and plans

After the Rio Conference, many international forums have been conducted to explore the issues associated with the sustainable development of different forest types. This has led to the development of the principles of sustainable forest management (SFM), which give guidelines for individual countries to develop appropriate management strategies for their local conditions.  

Due to the large variation in forest types and management objectives around the world, consensus has yet to be reached on a single definition for sustainable forest management. However, broadly it can be defined as the management of the commercial and non-commercial values of forests to improve the welfare of society (both material and non-material), whilst maintaining the values of forests as a resource for commercial use and for conservation, for current and future generations.

The key rules and criteria for assessment of sustainable forest management are:

• To maintain the full suite of forest values for present and future generations
• To maintain and enhance long-term multiple socio-economic benefits to meet the needs of societies
• To protect and maintain biodiversity

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- To maintain the productive capacity and sustainability of forest ecosystems
- To maintain forest ecosystem health and vitality
- To protect soil and water resources
- To maintain forest contribution to the global carbon cycles
- To maintain natural and cultural heritage values

Besides the issues and principles applying directly to forest management, it is essential to consider the impact of other land uses on current and future forest use. For example, the provision of adequate food and other agricultural products will put continued pressure on forested land, as will the need for housing, industrial and infra-structural development. Disputed land tenure and customary land rights issues pose further obstacles to forest management, particularly where traditional land owners are not adequately consulted prior to commencement of forestry activities. These issues act as constraints to the development and implementation of truly sustainable forest management systems, and must be considered at the highest level to ensure the successful integration of forest management planning into overall land use planning and development at the local level.24

Considerable debate currently surrounds the means by which sustainable forest management can be assessed to ensure submission with the defined principles. Requirements from product markets are a driving force in this debate. Some parties favour a system of certification in which the quality of forest management is assessed against predefined criteria covering environmental, social and economic factors. It is essential that such certification systems are repeated at appropriate intervals to ensure continued acceptance. Certification has only been conducted for a small number of

24 J. Virta, L. Carbonnier, et.al, op.cit, no.20, p.6
forests globally and the quality of assessment has been questioned in some instances due to the failure to address pertinent issues.

Once a forest has been certified, all products derived from that forest could be labelled as being produced from sustainably managed forests. This would permit forest owners and subsequent users of this raw material to market their products as being derived from sustainably managed forests, providing a promotional tool in some highly discerning markets. A major obstacle to the successful implementation of a labelling scheme is establishing exactly which products originate from sustainably managed forests. The 'chain-of-labelling' from forest to processing facility to final market is difficult to establish particularly where raw material is derived from both certified and uncertified forests.

2.5 Plantations

Fast-growing plantations give a growing opportunity for the forest industry to augment wood supplies from natural forest with low cost, uniform supplies. Plantations are typically grown on short-rotations ranging from 6-8 years for tropical hardwood pulpwood plantations to 25-35 years for temperate softwood saw log plantations. This permits much greater returns than from slow-growing natural forests, where it typically takes between 80 and 120 years for the forest to mature before harvesting.25

Fast-growing plantations are managed intensively with the principal aim of maximising the production of quality wood products. The principles of management are similar to that of modern agriculture, with the plantation

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being treated as a crop and subjected to regular tending operations such as weeding and fertilising. The area of fast-growing plantations is expanding rapidly through the afforestation of cleared agricultural land as well as the reforestation of degraded natural forest, principally in tropical Asia as in the Nordic region too.

2.6 Global Carbon Cycle

One of the great advantages of forestry is the vast range of benefits that can be provided through sustainable management of this renewable resource. Forests play an important role in the global carbon cycle through the storage of large quantities of carbon in vegetation and soil, and exchange of carbon with the atmosphere through photosynthesis, respiration and disturbance.

Forests contain more than 55% of the global carbon stored in vegetation and more than 45% stored in soil. Most of the carbon pool in forest vegetation (62%) is found in tropical forests, whereas most carbon in forest soils (54%) is located in boreal forests, where more than four times the amount of carbon is found in soil than in vegetation. Consequently, changes in the amount of forest cover in the tropics have a greater potential to influence the global carbon cycle than equivalent changes in the boreal zone. While forests play an important role in the global carbon cycle, they are nevertheless considered to be a small net contributor to atmospheric carbon dioxide levels, due mainly to the release of carbon through the conversion of tropical forests to other land uses.26

26 FAO, op.cit, n.21, p.100
The type of management applied can manipulate the magnitude of the role of forests in the carbon cycle. For example, young rapidly growing forests absorb large quantities of atmospheric carbon dioxide compared to over-mature forests which are relatively balanced in their absorption and release of carbon. Thus influencing the climate change.

2.7 Forest Ecosystems

Forests cover about 25 percent of the world's land surface, excluding Greenland and Antarctica. Global forest cover has been reduced by at least 20 percent since pre-agricultural times, and possibly by as much as 50 percent.

Forest area has increased slightly since 1980 in industrial countries, but has declined by almost 10 percent in developing countries. Tropical deforestation probably exceeds 130,000 km² per year.

Less than 40 percent of forests globally are relatively undisturbed by human action. The great majority of forests in the industrial countries, except Canada and Russia, are reported to be in "semi-natural" condition or converted to plantations. Many developing countries today rely on timber for export earnings. At the same time, millions of people in tropical countries still depend on forests to meet their every need.

The greatest threats to forest extent and condition today are conversion to other forms of land use and fragmentation by agriculture, logging, and road construction. Logging and mining roads open up intact forest to pioneer settlement and to increases in hunting, poaching, fires, and exposure of flora and fauna to pest outbreaks and invasive species.
Traditional and Ecosystem Forest Management Approach: A Contrast

<table>
<thead>
<tr>
<th>Objective</th>
<th>Traditional Forest Management</th>
<th>Ecosystem Forest Management</th>
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<tr>
<td>• Maximizes commodity production</td>
<td>• Maintains the forest ecosystem as an interconnected whole, while allowing for sustainable commodity production</td>
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<td>• Maximizes net present value</td>
<td>• Maintains future options</td>
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<td>• Aims to maintain harvest or use of forest products at levels less than or equal to their growth or renewal</td>
<td>• Aims to sustain ecosystem productivity over time, with short-term consideration of factors such as forest aesthetics and the social acceptability of harvest practices</td>
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| Scale                      | • Works at the stand level within political or ownership boundaries                                | • Works at the ecosystem and landscape level                                              |

| Role of Science            | • Views forest management as an applied science                                                  | • Views forest management as combining science and social factors                         |

| Role of Management         | • Focuses on outputs (goods and services demanded by people), such as timber, recreation, wildlife, and forage | • Focuses on inputs and processes, such as soil, biological diversity, and ecological processes, since these give rise to goods and services |
|                           | • Strives for management that fits industrial production                                          | • Strives for management that mimics natural processes and productivity                  |
|                           | • Considers timber is the most important forest output (timber primacy)                           | • Considers all species—plant and animal and considers services (protecting watersheds, recreation, etc.) are on an equal footing with goods (timber) |
|                           | • Strives to avoid impending timber famine                                                       | • Strives to avoid biodiversity loss and soil degradation                                 |
|                           | • Views forests as a crop production system                                                       | • Views forests as a natural system                                                      |
|                           | • Values economic efficiency                                                                     | • Values cost-effectiveness and social acceptability                                       |

Table 2.1
Figure 2.3

Area of Forest Ecosystems

- North America
- South America
- Europe & Russia
- Asia (excl. Middle East)
- Sub-Saharan Africa
- Central America & Caribbean
- Oceania
- Middle East & N. Africa

Millions of km²

Figure 2.4

Population of Forest Ecosystems

- North America
- South America
- Europe & Russia
- Asia (excl. Middle East)
- Sub-Saharan Africa
- Central America & Caribbean
- Oceania
- Middle East & N. Africa

Millions of people
The Table 2.1 describes the differences between traditional forest management and an ecosystem approach to forest management. Forest management techniques have evolved over the temporal and spatial scale and their changing patterns are evident from the Table 2.1.\textsuperscript{27}

2.8 Role of Forests

2.8.1 Fibre Production

Fibre production has risen nearly 50 percent since 1960 to 1.5 billion cubic meters annually. In most industrial countries, net annual tree growth exceeds harvest rates; in many other regions, however, more trees are removed from production forests than are replaced by natural growth. Fibre scarcities are not expected in the foreseeable future. Plantations currently supply more than 20 percent of industrial wood fibre, and this contribution is expected to increase. Harvesting from natural forests will also continue, leading to younger and more uniform forests.

2.8.2 Water Quality and Quantity

Forest cover helps to maintain clean water supplies by filtering freshwater and reducing soil erosion and sedimentation. Deforestation undermines these processes. Nearly 30 percent of the world's major watersheds have lost more than three-quarters of their original forest cover. Tropical montane forests, which are important to watershed protection, are being lost faster than any other major forest type. Forests are especially vulnerable to air pollution, which acidifies vegetation, soils, and water runoff. Some countries are protecting or replanting trees on degraded hill slopes to safeguard their water supplies.

2.8.3 Biodiversity

Forests, which harbour about two-thirds of the known terrestrial species, have the highest species diversity and endemism of any ecosystem, as well as the highest number of threatened species. Many forest-dwelling large mammals, half the large primates, and nearly 9 percent of all known tree species are at some risk of extinction. Significant pressures on forest species include conversion of forest habitat to other land uses, habitat fragmentation, logging, and competition from invasive species. If current rates of tropical deforestation continue, the number of all forest species could be reduced by 4-8 percent.

2.8.4 Carbon Storage

Forest vegetation and soils hold almost 40 percent of all carbon stored in terrestrial ecosystems. Forest regrowth in the Northern Hemisphere absorbs carbon dioxide from the atmosphere, currently creating a "net sink" whereby absorption rates exceed respiration rates. In the tropics, however, forest clearance and degradation are together a net source of carbon emissions. Expected growth in plantation area will absorb more carbon, but likely continuation of current deforestation rates will mean that the world's forests remain a net source of carbon dioxide emissions and a contributor to global climate change.

2.8.5 Wood Fuel Production

Wood fuels account for about 15 percent of the primary energy supply in developing countries and provide up to 80 percent of total energy in some countries. Use is concentrated among the poor. Wood fuel collection is responsible for much local deforestation in parts of Asia, Africa, and Latin America, although two-thirds of all wood fuel may come from roadsides, community woodlots, and wood industry residues, rather than forest sources.
Wood fuel consumption is not expected to decline in coming decades, despite economic growth, but poor data make it difficult to determine the global supply and demand.²⁸

2.9 Commercial Logging

Commercial timber exploitation (as distinguished from subsistence extraction by forest-dwellers) generally is in the form of clear-cutting, selective cutting, enhancement or improvement forestry, or plantations. Plantations simply replace the original forest or other previous vegetation, typically with a single species planted at regular intervals to form a grid. Enhancement or improvement forestry seeks to increase the growth rate or numbers of the desired (i.e., economically valuable) tree species by plantings and by cutting or poisoning the “weed” (i.e., uneconomic) species. In either case the effect is to change the original forest into a form of plantation, which is substantially different from the natural forest.

The effect of clear-cutting depends on the site, the size and pattern of the clear-cuts; the amount of cut material left on the ground, and the subsequent treatment of the area. Except for very small cuts surrounded by intact forest, the effect of clear-cutting is devastating to an original tropical forest, at least for many decades. If clear-cutting is practised simultaneously over a large area, genetic diversity may be diminished, especially when no seed-bearing mature trees are left, or when the habitats of the mature trees are damaged to the extent that mature seed bearing trees cannot survive. Species diversity declines rapidly in the clear-cut area, although there may be a temporary increase in the local diversity in remaining forest patches as organism struggle for the remaining habitats. Clear-cutting is carried out in

²⁸ ibid, p.230
tropical regions to clear the land for agriculture. For example, in the Amazon Basin, trees are cut, girdled, or burned; then the cleared land is cultivated. In other areas, where specific species are of special interest, selecting logging is more common.29

Selective cutting (including “high-grading” or “creaming”) seeks to remove only a limited number of target trees, such as all those of a given species or those of a particular age of that species. Typically the target species represents a small percentage of the total number of trees present, so that even limited lumbering may effectively remove the species from that part of the forest. Where the target species is a key component of the forest ecosystem, even this limited removal may alter the forest in significant ways. In addition, inevitably a substantial percentage (often estimated at more than 50 percent) of the remaining trees and other vegetation will be removed or damaged by the selective cutting and removal of the target timber, and the species composition of the remaining forest will be changed. As a result although selective cutting is the least disturbing form of forest exploitation, it still substantially alters the natural forest system. In reality no commercial logging of tropical moist forests has proved to be sustainable from the standpoint of the forest ecosystem, and any such logging must be recognised as using a potentially renewable source as a non-renewable one - in other words, as mining, not sustaining, the basic forest ecosystem. In fact, the question can be asked whether any extraction has resulted in sustainability of the original level of abundance and productivity, or in the original biological diversity.

The methods of cutting and removing logs have a significant effect on biodiversity, and in recent decades considerable experience has been obtained in techniques that are less damaging to forests than older mechanical methods. The most damages are bulldozers, tractors, and skidders; the least damaging are aerial cables, balloons, and helicopters in combination with hand felling. International assistance to logging projects should take into account whether the least-damaging methods are to be used. If extraction of timber is allowed, a code of “Best Practices”, including the least-damaging methods of cutting and removal of timber, should be effectively developed.

2.10 Sustainability of the Ecosystem

In terms of time-horizons for economic planning and human lifetimes, forests regenerate slowly to their original or pre-disturbance forms after being severely disturbed and changed. White pine in North American can live more than 400 years, and forests dominated by this species can take that long or longer to reach the biomass and composition of the original forests. The tropical forest of Angkor, Cambodia, which began to regenerate after that city was abandoned in the 15th century, is still structurally different today from nearby original forests. Because the trees that dominate many forests can live so long, it would not be surprising for a forest dominated by such under a constant climate. A computer model of forest growth, shown to be realistic and accurate, projects that a forest of the northern temperate zone of North America requires more than four centuries to reach a maturity from a clearcut.30

Regeneration of original forests is more complicated by climate change. Forests modify the climate near the ground. Not only is it cooler and more moist under the shade of a forest canopy during the daytime, it is also warmer during the night and during the cold seasons. An established forest can persist under climate change, while the same forest may no longer be able to regenerate. Over the centuries the climate can change considerably, so that a forest that developed to maturity in one location in a previous climate may not regenerate, if cut, in current climate. Some existing forests thought earlier to be the kind that will regenerate and assumed to be sustainable, may be remnants of past climate conditions. For example, some teak forests in Zimbabwe, which regenerate marginally when affected by frost, may persist in the current climate because mature trees protect young ones from frost. Logging mature trees exposes younger ones to frosts, which may kill them. The failure of white pine forests of North America to regenerate may be the result of a similar response by trees to climate change. Such possibilities emphasise the need to establish prior to logging whether the type of forest to be managed can regenerate under current conditions of soils, climate, and vegetation i.e., whether sustainability is a possibility at all.

Forest varies in their susceptibility to logging; tropical rain forests are known to be especially fragile. One reason is that two-thirds of these forests grow on poor and fragile tropical yellow and red soils, which are poor in nutrients and, when cleared and exposed directly to sunlight and rain, from a hardened surface from which regeneration of vegetation proceeds poorly. In these forests, most of the chemical elements necessary for life are contained in living vegetation and dead organic matter, which decomposes when the forest is cleared by logging; their constituent chemical elements are decayed rapidly. Trees in these forests typically have shallow root systems, an adaptation to the need to capture nutrients quickly from the shallow soil. Such trees maybe
more vulnerable when surrounding trees are cleared away. The remaining trees are more vulnerable than deep-rooting trees to windstorm damage and sun scalding of their roots. Another reason tropical rainforests regenerate poorly after logging is that many of the seeds of rain forest trees germinate almost immediately and are not stored for long periods in the soil; thus they are not available after logging. Some tropical rain forests do regenerate rapidly from some kinds of natural disturbances, as do, for example, some dipterocarp forests of the Asia-Pacific region.31

Recently, sustainability has come into limelight within the World Bank both in connection with Tropical Forestry Action Plan (TFAP) and with the Environmental Assessment (EA) process, especially in the case of some of the Forest/Environment and Natural Resource Management projects that have a component involving sustainable exploitation of tropical forests.

A major hindrance for the lack of agreement over the concept of sustainability is the definition of the world sustainability itself. There are two main elements in the definition of sustainability in use at present: one refers to the yield of timber. Sustainability of the ecosystem refers to maintaining the integrity of the natural forest in terms of its structure, composition (i.e., species composition and biological diversity), and ecological processes, along with the environmental services it provides. Sustainability of timber yield refers to maintaining a yield of timber from the forest area.

The concept and practice of sustainable forestry in the context of economically viable, relatively large-scale harvest of timber were developed in the Nordic countries. Subsequently, sustainability of timber harvest has

31 N P Sharma, op.cit, note 29, pp.60-61
frequently been a stated objective of industrial forest exploitation throughout the world. In some cases in the northern temperate zone such exploitation may have proved sustainable in timber terms, but it is difficult to find cases where sustainability has been maintained in ecological terms and in terms of biological diversity. Timber sustainability in the northern temperate zone may be more likely than in the tropics, because temperate tree species have evolved in a frequently disturbed and variable environment, and because there are a small number of tree species and a relatively simple structure and composition of the forest ecosystems involved. Most northern forests have been actively managed (through selective cutting, planting, etc.) for many decades or centuries; hence they are substantially different from their pre-management ecological status and may appear ecologically sustainable when they are not. Where old-growth “virgin” temperate-zone forests are involved (e.g., in the north-western United States), opposition to commercial timber exploitation is growing specifically on the ground that it is not compatible with sustaining the ecosystem.

Ecological conditions in the moist tropic-especially in terms of diversity of trees and associated plants, complex physical structure, soil, and hydrological characteristic - are dramatically different from those in the northern zones. The reasons why tropical forests have so much more diversity than northern forests are not entirely very clear, but whatever the reasons, the differences are enormous. As a result, industrial forest exploitation is not compatible with maintenance of the ecological integrity of most - more probably, of any-tropical moist forests.

2.10.1 Timber Yield's Sustainability

Sustaining a yield of timber from a forest area implies maintenance of a forest but not necessarily the original forest. Foresters speak of a “rotation
period”, which is the time between harvests. Three harvests are usually considered to be the minimum required to determine sustainability in any agricultural system, whether the harvest is of an annual vegetable or a tree. The first harvest establishes a baseline; the subsequent ones indicate whether harvests are steady, rising, or falling. These terms can also be used to distinguish between a sustainable original harvest and a sustainable disturbance harvest. In a sustainable original harvest, third harvest would equal the first harvest. In a sustainable disturbance third harvest would equal the second harvest. Because a typical rotation period in a temperate forest (where there is more experience in the attempt to achieve sustainability than in a tropical forest) is 20 years or more, a minimum of 60 or more years would be required to determine whether a harvest appeared sustainable. Data on sustainability in temperate-zone forests are not easily available in open scientific literature. If data exist, they may be in the records of timber companies and forestry agencies.

Sustainability of timber yield, even when it is the stated goal of forestry is rarely achieved. Sustainability of the original forest is especially rare; where forests are grown as sustainable crops, it is a sustainable disturbance harvest, as explained earlier, that is sometimes achieved. The foresters are said to have believed that they would never run out of white pine, because the resource appeared huge, and that by the time the last hectare was cut the first would have re-grown. In fact, many of the hectares never regenerated but have become “stump barrens”, open fields of grasses, lichens, and shrubs, where no white pine or any other large trees grow. Where regeneration of pines has taken place, the original mature size of the trees is never found. These forests developed over long periods, subject only to natural rates of disturbance by fire and windstorms, and not to clearings of large areas or intense fires produced by the large amounts of fuel, in the form of the parts of the trees
considered waste, left on the ground by the loggers. In some of these areas, red pine plantations were established in the 1930s, with great expectations for future sustainable harvest. But as these trees have approached maturity, disease outbreaks in the homogenous, single-species stands have caused serious problems. Thus even in northern temperate-zone forests where sustainability is believed to be achievable there are many counterexamples and contradictions.

Sustainability of early successional species is more likely than sustainability of late successional species. In the northern temperate zone, pines and aspen are common early successional species, and these species are more likely than others to be maintained in plantations that are harvested regularly. In the moist tropics, some of the most commercially viable species are characteristic of light-gaps in the forests, that is, of areas of early or midsuccession. These include the entandrophragmas of Africa, some Dipterocarps of Southeast Asia, and mahoganies in Central and South America.

Sustainability of timber is much less likely in the tropics, especially in the moist tropics, than in the northern temperate zones. Plantations offer the best and probably the only proven way to assure such sustainability. Consequently, plantations offer the only real option for meeting the future demands for timber (and, in most cases, for fuel wood also) from tropical areas. The degree to which tropical forests, especially moist forests, are sustainable for timber production is a research question that must be studied objectively in the future.

If wood production were to be sustainable from natural tropical forests as opposed to plantations or “enhanced” forests the yield would have to be
very low, but the need for the timber enterprise to be financially beneficial may make a low yield uneconomic. True sustainability from natural tropical forests has yet to be demonstrated. As the 1988 International Tropical Timber Organisation report stated, “It is not yet possible to demonstrate conclusively that any natural tropical forest anywhere has been successfully managed for the sustainable production of timber. The reason for this is simple. The question cannot be answered with full rigor until a managed forest is in at least its third rotation”.\textsuperscript{32} In practice, the opportunity for a third rotation almost never occurs because the earlier exploitation altered the forest system too much, because the forest management policy or practice changed, or because the forest was cleared for cultivation and settlement. Consequently, most natural tropical forests that have been subject to timber exploitation have ceased to exist, at least as natural forests. The exception may be very low-level extraction by indigenous people.

Therefore if a forest appeared sustainable after three harvests, in the sense that the yield of the third harvest was equal to or greater than that of the second harvest, the forest might not be sustainable indefinitely. The reason is that some secondary effects of the harvest - such as decreases in the fertility of the soil decreases in the organic content of the soil, and compaction of the soil - may not be evident after three harvests. The response to logging is better known for temperate forests. Although these forests are usually believed to be more resilient to logging, they undergo severe changes after clear-cutting. For example, it has been estimated that the nitrogen available to trees declines by more than half following a clear-cut in a temperate-zone hardwood forest, and that the available nitrogen may remain below half of the original value for 90

years or more. As a result, timber production is greater for long rotation periods than for short periods. Such damage occurs even if only the main boles of the trees, which are low in nitrogen content, are removed. Any practice followed that removes leaves, twigs, and roots, where a tree stores most of its nitrogen, leads to greater and longer-lasting damage. The activities of felling, cutting, and removing timber from a forest inevitably result in some compaction of the soil, which is minimised by the most careful techniques, such as the use of balloons, helicopters, and aerial cables to remove the timber. But these methods may be impractical in inaccessible tropical locations, or the forests may not be economically profitable when the costs of these methods are included in the economic analysis.

Irrespective of the form of management, any yield from tropical moist forests that are sustainable represents a vanishing small part of the total existing forestry efforts. The 1988 report by the International Tropical Timber Organisation concluded that sustainability was achieved in only 0.125 percent of total area of tropical moist forests managed in theory for sustainability of timber production, and even these management results are in controversy.

2.11 Sustainability of Other Aspects

In most of the developing countries it is perceived that the value of the tropical forests in terms of their potential to earn foreign exchange through logging. Most of these governments allow the destruction of this national resource because they have pressing needs for revenue, and they accept the land claims that the forestry is sustainable. The many other values of the

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tropical forests are less visible and often may be obtained only indirectly. But many other values are sustainable under proper forest management.

Biodiversity of tropical forests has great actual as well as potential economic and other values of mankind. Science has barely touched the surface of knowledge about these forests, and the potential benefits to humanity from research into this kind of complex ecosystem and its component species are incalculable. Non-timber forest products, which already produce substantial economic returns in many areas, promise substantial increases further.

Forest ecosystems also provide life support, and, through wildlife and other non-timber forest products, economic livelihood for vulnerable ethnic minorities and other local people both inside and around the margins of the forests. Forests also contribute to regional and even global life support systems by providing a series of ecological services, ranging from watershed protection to amelioration of climate.

Finally, tourism based on forests as exemplified in Nordic countries offers the possibility of earning valuable foreign income for government and for private entrepreneurs without damaging destroying the basic forest resource. Properly managed, tourism also can provide substantial economic benefits to people living in or around forests, assisting in their economic development and providing incentives to protect the resource. Most non-timber values depend on maintenance of an intact forest ecosystem. It suggests that any form of forest management that does not also sustain the ecosystem will not provide most of these benefits.
2.12 Measures for Biodiversity Conservation

There are three general categories of measures for conserving biological diversity of forests: protection of natural or near-natural ecosystems, restoration and rehabilitation of degraded lands, and ex situ protection of individual species. By far the most important of these is protection of ecosystems, which is probably the only way to assure maximum protection for the full range of biological diversity involved. Under some conditions, measures to restore and rehabilitate degraded lands may conserve biological diversity. The measure range for planting one or a few selected species of indigenous trees to mounting complex efforts to replace a range of the pre-existing species of plants and animals. Because abused and degraded lands occupy an ever-increasing area of the earth's surface, these steps are becoming increasingly important, both to restore productivity of lands for direct human use and to conserve some biological diversity. The third category of measures ex situ protection of species, for example, in zoos, botanical gardens, aquaria, and seed banks - may be the last resort for some species when survival in their natural habitats is no longer possible, but its greatest value is probably in the context of temporary protection with the objective of eventual reintroduction in the wild.

2.12.1 Protected Areas

Various types of protection for forest areas are the principal measures that have been used or proposed for conserving biological diversity in forests. Forms of legally protected status range from national parks and integral nature reserves, where resource exploitation and most human activity other than tourism are excluded, to forest reserves that are maintained primarily to maintain forest resources for future harvesting. At present, there are 4,500 legally protected biological conservation areas around the world covering 4.9
million km²-about 3.2 percent of the earth's land area - and including all types of ecosystems. Tropical Africa has 860,000 km² of totally protected areas, the Central and South American tropics together have a total of 768,000 km², and Indonesia and Malaysia have 357,000 km² (Reid and Miller 1989). In all, less than 5 percent of tropical forests lie in protected parks and reserve.34

Low as these figures are however, it is estimated that only 300,000 km²-some 15 percent - of these tropical parks and reserve are actually strictly protected. The rest are used with or without government consent for exploitation of resources including timber, fuel wood, forage for cattle, soils and water for cultivation, and wildlife for hunting. Furthermore, very few of the existing protected areas are self-sufficient ecological units. Most indigenous birds and mammals require a larger or more varied habitat than the protected area itself provides, and these animals spend part of the year away from the protected area as well. In addition, the smaller the area protected, the greater is the "edge effect" (i.e., the often profound changes in the original ecosystem caused by influences at its edges) and the less likely the area will be to survive intact, regardless of the degree of protection.

Evidently few protected area are large enough to maintain their integrity in the face of changes in land use around their perimeter. Existing protected areas do not cover some important types of forests. For example, it has been shown that 88 percent of Thailand's forest bird species occur in the 7.8 percent or its land that is in national parks and wildlife sanctuaries (IUCN/UNE1986b) - but that is not to say that the 7.8 percent is sufficient to assure the continued survival of all these species. Therefore, although an important start has been made, much more needs to be done before the

conservation of biological diversity, particularly in the tropics, can be considered to be adequate.

The International Union for the Conservation of Nature (IUCN) has established a set of eight categories of protected areas. Categories I through II (scientific reserves, national parks, and natural monuments) are "strictly protected areas", where the objective is to maintain biological diversity and natural formations. In categories IV through VIII (managed nature reserves, protected landscapes, resource reserves, anthropological reserves, and multiple-use areas including game ranches, recreation areas, and extractive reserves), the objective is controlled exploitation of resources, plus limited but significant commitments to maintaining biological diversity.\footnote{M. D. F. Udvardy, \textit{A Classification of Bio-Geographical Provinces of the World}, IUCN (Switzerland, 1986), p.60}

Many nations with a strong commitment to protected areas have apportioned 10 percent or more their land area to the strictly protected areas (IUCN categories I, II, and III). Given the considerations analysed in this chapter, it is simply prudent for a reasonable percentage of the land to be allocated to these uses. The World Bank Wild lands policy has suggested 10 percent of the land as a reasonable starting point for strictly protected areas, but higher figures also have been proposed e.g., former World Bank President Robert Mcnamara proposed maintaining 25 percent of African countries' land area as wilderness areas.\footnote{J. T. Mathews, ed., \textit{Preserving the Global Environment} (NewYork, 1991), pp.63-69} It is therefore utmost necessary for the two aspects should accompany consideration of any figures:

- Conditions vary greatly from one country to another, and no single figure will be adequate for all countries. In countries with high
biological diversity and diverse habitats, a relatively high figure may be needed to secure reasonable conservation coverage, whereas a lower figure may be appropriate in countries with very low, localised biological diversity, or countries where less than 10 percent of the land remains in natural or near-natural ecosystems.

- Strictly protected areas should not be islands in a sea of wholly altered or degraded lands. In such cases much of the biological diversity will eventually be lost. A rule of thumb is that if 90 percent of a habitat is lost, ultimately about half of the original biological diversity will be lost. Consequently, protected areas should be a central concern in the development of a set of land-use areas as described earlier, which would include a range of uses, from complete protection to some use of biological resources. The first measure in managing land for forest biological diversity is to establish a policy for the conservation of intact forests. It is also important to protect certain areas of secondary or somewhat degraded forest where inventories show that these areas also contain essential components of biological diversity. For example, certain forest areas that are considered to be “hot spots” of biological diversity may still contain important elements of such diversity even though they have been somewhat modified or altered.

Legal protection alone cannot assure the survival of forest areas. Protection measures must be combined with measures to provide solid benefits to local peoples and governments. Furthermore, rapid conversion of the world's remaining forests is due in large part to the rapid increases in human population and extension of temporary or low-intensity subsistence agriculture. As a result, measures to conserve biological diversity ultimately must involve a combination of approaches that stabilise or reduce the human
population pressure itself, and reduce pressures on forest areas by providing more intensive production of food and fuel elsewhere.

2.12.2 On-Site Factors

Because a number of factors tend to decrease biological diversity, a decline in one kind of biological diversity leads to a decline in others. Loss of genetic diversity leads to a decline in species diversity. Reduction in total population size of a species can threaten that species with a loss in genetic diversity or with extinction. Rapid environmental disturbances, such as a series of storms, or a single cold spell or cold season, can decrease total species diversity. Large-scale disturbances, such as drought over a region affects species diversity.

Reduction in size and diversity of habitats are notorious causes of recent extinction, especially when habitats are disrupted by human activities. Introduction of technologies that disrupt the soil in ways that are not found under natural conditions disrupts habitats, kills organisms, and decreases biological diversity. Introduction of artificial chemicals, such as biocides, can decrease biological diversity through several mechanisms. First, pesticides are toxic to many species. Second, loss of vegetation from herbicides can increase erosion, increase the variability of water runoff, and decrease habitat diversity. Loss of pollinators from use of insecticides reduces biodiversity.

Introduction of exotic species, which are not native to a location, tends to decrease genetic and species diversity. A new predator will find unwary prey that becomes easy victim. For example, the extinction of birds on islands has been attributed to the introduction of dogs, cats, rats, and goats, as has occurred on the Galápagos. A tree species that is introduced may survive in
competition with native trees, which are then lost as habitat to native insects, birds, and mammals.

It is often believed that hunting and direct killing of individual animals is the only cause of animal extinction. In the past these were major causes, but today disruption of habitat or loss and introduction of exotic species, along with direct destruction of an animal population by hunting or by eradication because the animal is believed to be a pest, are the principal ways that human activities lead to a rapid increase in the rate of extinction.

An optimal population is the smallest number of individual members of a species that can be expected to persist for a specified time. This size is determined by many factors, including genetic diversity, rates of birth and mortality, mobility, environmental variability, likelihood of large and destructive habitat disturbances, as well as the likelihood of human intervention. A minimum viable habitat is a habitat factually; they are a set of habitats that is large enough to sustain a minimum viable population and have all the habitat characteristics required for that species. Although these two concepts may seem simple, there are few cases for which the size of either a minimum viable population or a minimum viable habitat is known. Research to determine minimum viable populations and habitats is essential if conservation areas are to be of appropriate size. Until research establishes these minimum sizes, management must take a conservative approach and err on the side of establishing conservation management areas that are larger rather than smaller; even then, there is no absolute surety of success.

2.12.3 Off-Site Factors

In addition to direct, on-site effects, there are other, indirect off-site effects that decrease biological diversity.
2.12.3.1 Pollution and Biological Diversity

The potential for pollution to decrease biological diversity was first called to the public attention by Rachel Carson in her 1962 book, Silent Spring, in which she explained the effects of DDT on birds. In general, pollution by toxic substances simplifies forests reducing the number of species; severe pollution can destroy forests and all their diversity. A classic example is the area near Sudbury, Ontario, surrounding a large industrial belt. Heavy metals and other pollutants released by industries have killed trees. Some areas have now complete absence of vegetation. Once the vegetation cover was lost, the soil eroded away, leaving only exposed bedrock in some places. Forests can never regenerate on exposed bedrock. Although direct destruction of habitat appears to be the main cause of decline in species diversity at present, the effect of pollution on biological diversity can be expected to increase in the future, especially as developing nations increase their industrial capacity and as their standards of living rise.

Until recently, little information has been available about the effects of pollution on forests in central Europe and the Soviet Union, but air and water pollutants have severely damaged forests in the European part of the former Soviet Union and in central European countries. For example, Czechoslovakian forests and the Kola Peninsula are among the most heavily affected by acid rain of any forests in the world. Programs to assist biological diversity in the forests of these regions must include reduction of air pollution and restoration of damaged forests. Intense pollution effects are not yet a major problem for tropical moist forests, but as industrial development progresses in tropical nations, such pollution is likely to increase.
2.12.3.2 Global Warming and Biological Diversity

If global warming occurs as projected by computer models of climate, it will significantly disrupt the distribution of species and reduce biological diversity. It will also cause important changes in patterns of climatic phenomena such as hurricanes, which disturb community structure in tropical forests. Effects of global warming are projected to be most severe at middle and high latitudes and least severe in the tropics. Nonetheless, projected changes in climate are severe and, in comparison with the time scale of biological evolution and the natural migration of forest trees, rapid. It is estimated that climate will change approximately 40 times faster than the rate at which trees migrated north-ward in the temperate zones at the end of the last ice age. One result of it will be that current parks and reserves may no longer have climate appropriate for the species they were established to protect. This is a special problem for forest ecosystems, because of the longevity of forest trees and the length of time required for the establishment of forests. Any program to conserve biological diversity in the future must begin now to plan how to revise the boundaries and sizes of parks and reserves, so that effects of rapid climate change can be compensated for in the future.37

2.13 Management of Intact Forests

Under the old approach to preserve management, most intact forests were treated as monuments that would persist indefinitely with only a little maintenance. This approach often failed in the past and will fail in the future. For example, in the United States small stands of original forests set aside in preserves are beginning to decline. Visitors trample the soil and reduce

regeneration. Few areas are managed for the next generation of mature forests.

Under the new approach to preserve management, forest ecosystems are recognised as dynamic. Not only must the intact mature forest be maintained, but the preserve must be large enough so that forest succession takes place within it, with major representative stages present to provide habitats associated with these stages as envisaged by the Nordic countries.

Forest management staffs must include professional ecosystem management trained in the conservation of biological diversity. Experts on hydrology, soils, erosion, geology, and restoration also must be available.

Baseline measurements and ecological monitoring must be integrated into management plans. Usually, a small set of factors need be measured and monitored to determine the status of the forest ecosystem, but a program of measurement must be sustained over a long time. The administrative nature of these programs may vary from country to country, but national measurement programs could benefit from an international program in ecological monitoring.

Research to improve understanding of ecosystem dynamics and interactions among species must be integrated into management plans. A preserve must be planned and managed from a landscape perspective, so that various parts of the preserve are put to their best uses.

A preserve must be established and managed with the involvement of indigenous people, so that their needs are accounted for and so that they
benefit from the preserve. Where possible, indigenous people should be involved in the conservation, management, and protection of the preserves.

2.14 Forest Goods and Services

Society as a whole now seeks an enormous range of goods and services from forests (Table 2.2). This range is far greater than the market can currently deal with. Different actors, at different levels from the household to the international community place greater or lesser value on specific goods and services. Some needs may be direct and urgent e.g. for rural people's livelihoods. Others may be more indirect e.g. ensured water supplies for agricultural development.

<table>
<thead>
<tr>
<th>Goods and Services from forest</th>
<th>Local benefits</th>
<th>National benefits</th>
<th>Global benefits</th>
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<tbody>
<tr>
<td>1. Wood products</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Non-wood products</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>3. Maintenance of hydrological cycle</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>4. Soil and water quality conservation</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>5. Wind and noise control</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>6. Landscape amenity</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>7. Recreation and tourism</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>8. Cultural and religious services</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>9. Microclimate regulation</td>
<td>X</td>
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<tr>
<td>10. Climate moderation</td>
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<td>X</td>
<td>X</td>
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<tr>
<td>11. Maintenance of biological diversity</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>12. Scientific research and education</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Table 2.2

Stakeholders have different access to the means for expressing their specific needs. Many have access to the market, which can be a relatively efficient means of producing and distributing some goods and service e.g.

38 O. Segura et al, *Forestry and Land Use Series*, No.11, IIED (1996), pp.2-8
timber and recreation. For other goods and services, such as biodiversity, there are often neither efficient markets nor other effective mechanisms for ensuring their needs are fully met.

In recent years, various forest goods and services have become increasingly scarce in many regions. A number of supply-side strategies have evolved for dealing with these scarcities:

- Developing a permanent forest estate (through protection and afforestation)
- Obtaining forest goods and services from non-forest land (such as farm trees)
- Regulation of forestry management practices to increase/improve non-wood outputs and protect the residual stand
- Technological innovation to increase the efficiency of fibre use, e.g. "engineered" wood panels such as OSB and MDF
- Importing forest goods and services
- Producing substitutes for forest goods and services (such as non-wood fibres, concrete, metal and plastics)

Such strategies have evolved in part through government planning, but also largely through the spontaneous action of stakeholders - often spurred on by market pressures.

The private sector has become an increasingly dominant actor in all of these strategies, notably for producing wood fibre. It is driving the expansion of the forest products industry into new regions, aided by technological developments, which allow the use of a greater range of species and sizes in wood products. Policies have come to reflect both the important of fibre and the perceived significance of the private sector in producing it.
In contrast, policy and civil society movements are now also making non-timber forest products, biodiversity conservation and cultural benefits a priority. This is clear from (inter) governmental policy initiatives and from civil society campaigns. The private sector is less routinely involved in producing these goods and services - to the contrary, its production of wood has often reduced other stakeholders’ abilities to produce and/or consume these non-fibre benefits. Policy processes have begun to recognise the private sector as a key stakeholder, but have yet to create the right signals to encourage the private sector to provide a broader range of goods and services.\footnote{S. Bass, R. R. Hearns, 'Private Sector Forestry: A Review of Instruments for Ensuring Sustainability', \textit{Forestry and Land Use Series}, No.12, IIED, Forestry and Land Use Programme (1997), pp.2-8}

\subsection*{2.15 Sustainable Forest Management (SFM)}

At the forest level, the ways in which supplies of the various forest goods and services can be integrated, and the security of such supplies maintained over time, has come to be called 'sustainable forest management' (SFM). In recent years, there has been a spate of initiatives to define, or to prescribe SFM.

The earliest, unilateral initiatives to define SFM e.g. by industry associations, or by environmental NGOs alone, became mistrusted by other stakeholders. Hence the current interest in defining SFM through multiple stakeholder processes. These processes attempt to forge patterns of forest management to meet the multiple needs of different actors (not only those which can be expressed in the market place), and to redress the inequalities between those who bear the costs of forest exploitation, and those who reap the benefits. These range from the global/intergovernmental (notably the UN Forest Principles and ITTO Criteria), to the regional (e.g. the Helsinki Criteria...
for Europe and the Tarapoto Agreement for the Amazon) and national (e.g. the UK's Sustainable Forestry initiative and national standards), to those defined by civil society groups (e.g. the Forest Stewardship Council's Principles and Criteria of forest stewardship).

Such initiatives have come about in response to escalating clashes of interest and opinion about how best to overcome the increasing scarcities of particular forest benefits. The various stakeholders involved have, of course, had their own agendas, overt or otherwise. For example, governments have wished to protect their sovereignty over forests from possible supranational control. Public interest groups have tried to elevate concerns for biodiversity. And many corporations have tried to protect their markets and their access to land and raw materials, and to avoid increased costs.

IIEED (1996) analysed 17 initiatives to define SFM and found they all had the following in common:

- Sustaining yields of all forest goods and services;
- Conserving biodiversity; and
- Ensuring positive social and economic impacts on different groups

All these initiatives acknowledge that the basic principle of SFM needs to be interpreted locally. Forest ecosystems, and the human systems with which they interact, are neither identical nor predictable in their responses to different uses or management interventions. Hence most initiatives stress the need for local interpretation (by more than one stakeholder), and for careful experimentation, monitoring and adaptation dependent upon the impacts achieved, whilst employing precautionary principles that acknowledge the many uncertainties involved. There is usually an acknowledgement that management of the forest for specific goods and services will affect the
availability of other goods and services; but not always recognition that in many cases we do not know the optimum production mix. This mix will be a moving target, defined not only by changing preferences of the various groups, but also by new technology.

The practical application of SFM will, therefore, require openness to non-market demands, and mechanisms to integrate them with commercial forest uses. It will demand improved knowledge of local ecosystem responses. It will also entail greater attention to the traditional knowledge that has evolved through observation of forest ecosystems over many years. It will certainly not be about universal solutions on clear-cut size, chemical applications, etc.

2.15.1 Role of Private Sector in SFM

How can the private sector continue to manage forests to produce wood and other market good, whilst improving its delivery of non-market goods and services? And in what ways can the private sector be encouraged to do the above through the market, or through other mechanisms and instruments put in place by government and civil society?

Offering a preliminary overview of private sector performance and tactics, a review of the various mechanisms and instruments, and suggesting promising avenues for research and action that will, in future, ensure that the private sector continues to deliver more than mere fibre, and does so on the basis of greater sensitivity to other stakeholders, and a broader knowledge base, as well as commercial interests.

IIED's approach here builds on its observations, made over 25 years, that progress in the private sectors achieved by leaders either becoming aware
of some of the business/environment win-win possibilities that lead to spontaneous improvements, or being pushed by other actors as long as the other actors can fashion the right carrots and sticks to cajole the mainstream private sector towards best practice. Research should therefore focus on the root causes, which constrain more widespread adoption of best practice.

2.15.1.1 Private Sector Involvement in Forestry

We must acknowledge that there is a broad spectrum of private sector actors. All of them may be distinguished from government and civil society in their imperative to make a private profit, where individuals in isolation own capital resources and other property, jointly or in association. This is in contrast to government economic activity (public enterprise) or to individual/community livelihood activities, which aim at subsistence.

A particular private sector actor might be characterised by reference to a number of dimensions, for example:

- Size of operations
- Longevity
- Degree of vertical integration
- Degree of horizontal integration
- Form of ownership (source of capital and debt)
- Numbers of countries in which the company operates
- Scope of action (multiple or single products/sectors)
- Motivations other than profit
- Attitude toward risk

Each of these dimensions may or may not be significant in influencing a company's impact on forests and forest stakeholders. There will be other
factors, too, which future research should determine. The point here is that there are multiple dimensions to the term 'private sector'.

2.15.1.2 Significance of Large Corporation

As there are very different types of private sector enterprise described by the above dimensions, it is difficult to generalise about the role of the private sector in forests. Here we concentrate on large forestry corporations. This is because of the relative significance today of large (often foreign-owned) forest corporations in forest ownership/management, forest product yields, investment, influences on policy and markets, technological development, and impacts on environments and societies.

A current phenomenon is the globalisation of SE Asian companies. This is taking place in response to huge demand growth for forest products in SE Asia. In fact, this is the region with fastest demand growth and it is one where demands for wood are not accompanied by demands for better social and environmental performance (unlike in Western Europe). Furthermore, SE Asian companies are meeting this demand by working in countries with few effective social and environmental controls.

This does not mean, however, that other private sector actors are not significant. Indeed, in many countries, such as the USA, Finland, Sweden, and some Pacific Island states, the private forest small holder is highly significant. In others, small private sector logging companies and individual chain sawyers may be dominant, as in Guyana. Non-forestry companies can also play a significant role in forests: corporations involved in agriculture, civil engineering, mining and oil, impact on the forest. (Oil companies, in particular, are becoming aware of their potentially adverse impacts on forests.
and some have undertaken great efforts to minimise and mitigate such impacts).

Nonetheless, we focus on the larger private sector actors in the forestry sector, and specially national or multinational forest corporations, for the following reasons:

- The concentration of market power in large firms
- Their comparative advantage in access to credit, in technological innovation, in developing commercial plantations, and in cost of production
- Because of the scope of mergers and buyouts

The largest companies produce an increasing proportion of the world's traded wood. The ten largest forestry companies produce 38 percent of the global yearly turnover of all forest products.40 The International Paper Company alone has annual sales of $20 billion, exceeding the GDP of 75 countries.

Within a given country, a few forestry companies may be predominant in land ownership, and in influence on policy and practice. In Chile, for example, ten years of government subsidies resulted in "just three Chilean corporations (holding) 70 per cent of the planting grants, plantation areas and timber exports".41 The level of profits and export earnings, of contributions on government tax revenue, of land-holdings, and of employment, tend to mean that large companies play a dominant role in the setting of policies and decisions affecting forests. In today's climate of increasing scarcity of many

40 M. Scott, 'Extended Accounts for National Income Product', Journal of Economic Literature, vol.28, No.3 (1990), pp.7-10
41 S. Bass, op.cit, note 39, pp.12-15
forest benefits, such dominance is being questioned where corporations appear reluctant to produce more than fibre on the lands under their control.

The worst conflicts concerning to rests today tend to involve large companies and (often indigenous) peoples' groups e.g. in Canada, Sarawak, Papua New Guinea (PNG) and Brazil. Sometimes, this may be because they are prominent 'targets', rather than because they are the worst offenders - although numerous accusations of very poor practice are made against large companies (e.g. EIA 1996). In many cases, the statutory role of governments in resolving conflicts has not been exercised, perhaps due to excessive private sector influence on the government.

2.15.1.2.1 Comparative Advantage

The larger companies tend to be the lowest-cost producers. They have greater resources, technology and skills. The influence of these producers creates a price ceiling, which others have to match if they are to retain a market share. This can be a disincentive for other producers to improve their forestry and compete in cost terms.

In the last remaining large areas of natural forest e.g. Russia, Canada, the Congo Basin, the Amazon and the Guyana, it is only really the private sector, which was access to adequate capital to create the infrastructure required to open up these areas to logging or forest management. Many observers are worried about the impacts of such investment on the areas of old-growth forest.

Indeed, few of the planned investments by such companies appear to be accompanied by adequate controls on the part of (weak, cash-starved) governments. However, eventually these large areas will not be as
commercially attractive as plantations, due to their increasing economic inaccessibility.42

Large companies are best placed to use the market to their advantage. That is, they can create or modify demands through the power of advertising and competition. Sometimes, this appears to be helping forests. Many forestry companies are creating alliances with large retailers, such as the WWF-organised timber buyers in Western Europe, which promote certified timber to the public.

At other times, it appears to generate demand for 'wasteful consumption' of forest products, which can take off where large companies deliver forest products at very low prices, but do not include the social and environmental externalities in their pricing.

The trend in many countries is towards more private ownership, or at least private management of state lands. Much of the privately held land is under the control of large corporations. It is estimated that forty corporations control over 115 million hectare of the world's forests, through ownership and leases/licences; and that most of the 5.9 million ha of tropical forest, which were logged annually during the late 1980s, were harvested by the private sector.43

Corporations have been the main actors investing in commercial plantations, especially in the subtropics. These plantations will become increasingly significant for traded wood volumes, with global demand for

42 World Resources, op.cit, note19, p.60
43 ibid, p.80
industrial wood expected to grow by nearly 20 per cent in the next fifteen year. Large companies particularly favour plantations or highly intensively managed forests with plantation like characteristics as they present practical, logistical and tenure advantages. They are low cost, low risk, high yield and with a uniform and predictable product, which can be used for a wide range of finished goods thanks to recent technological developments.44

Corporations, which have access to the genetic resources, today own most of the highest yielding forests in the world technology and other inputs needed to achieve such yields. However, it is notable that most of these are intensively managed forests and plantations which are devoted almost entirely to single/few species for wood, and no other outputs have as high a priority as wood in management objectives.

Many of the larger companies have acted quickly in the last few years to improve their environmental performance, partly due to pressure from environmentally aware consumers and NGOs, but also in response to the growing raft of environmental legislation. Furthermore, companies have realised that they can reduce costs further by developing and employing technologies, such as low-impact logging, integrated pest management, and nutrient monitoring, that protect the resource base and require fewer external inputs with their attendant environmental impacts.

However there are diseconomies of scale. Large companies are vulnerable to changes in demand in certain sectors. For example, the European forest industry is highly susceptible to down-turns in the construction industry; and the global pulp industry suffers boom-bust cycles.

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44 S. Bass, op.cit, n.39, pp.29-30
resulting in part from the huge size of every new pulp mill, which substantially increases the quantities of pulp available when it comes on stream, which consequent price reduction.

2.15.1.3 Mergers and Buyouts

Mergers and buy-outs are continuing, and are international in scope. For example, International Paper of the US has bought control of Career Holt Harvey, New Zealand's biggest timber producer. Both International Paper and New Zealand's Fletcher Challenge have established operations in Asia and Latin America. Enso-Gutzeit from Finland has teamed up with two Indonesian companies to invest $100 million in new plantations in Borneo. With "southern" forestry companies getting forestry companies getting bigger, this has forced mergers within European companies, largely driven by economies of scale: two Finnish companies merged in 1996 to become Europe's largest forestry firm, UPM-Kymmene.

Similar mergers have been taking place within the USA firms active in the north-west are now buying companies in the south, where there are accessible forests and fewer environmental pressures. The potential gains of such mergers include lower costs, increased possibilities for research and development, and technological transfer.

Mergers certainly help companies to control prices and wages, concentrate production in large "efficient" mills, and minimise risk. They also become more difficult to contest by local groups who may be seeking a veto on forestry operations.
2.16 Conclusion

To summarize it can be said that the environmental geography, which studies the symbiotic relationship between the environment and human beings, who live in it, simultaneously emphasizes that how humans utilise it and organise over space.

Therefore geographers strive to identify and analyse the form and nature of ecological system in which humans interact within the environment. Since geographers deal with the spatial systems in which human interact through social, economic and political activities, the aspect of forest management from the political geography point of view becomes very relevant in today's world.

We analysed how sustainability is affected by various factors of forest management and how private sector's role is increasingly becoming significant in maintaining the equilibrium. Here the role of governmental agencies through legislations, regulations and incentives to maintain sustainable development becomes very significant.