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Report No. 9965

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PAPER

THE  
FOREST SECTOR

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# *The Forest Sector*

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*The World Bank  
Washington, D.C.*

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and Development / THE WORLD BANK  
1818 H Street, N.W.  
Washington, D.C. 20433 U.S.A.

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Manufactured in the United States of America  
First printing September 1991

*Cover design by Walton Rosenquist and Beni Chibber-Rao*

Library of Congress Cataloging-in-Publication Data

The Forest sector.

p. cm. — (A World Bank policy paper)

Includes bibliographical references.

ISBN 0-8213-1917-5

1. Forests and forestry—Developing countries. 2. Forest policy—  
Developing countries. 3. World Bank. 4. Forests and forestry—  
Economic aspects—Developing countries. 5. Deforestation—Control—  
Developing countries. 6. Forest products industry—Developing  
countries. I. International Bank for Reconstruction and  
Development. II. Series.

SD247.5.F67 1991

333.75'09172'4—dc20

91-33650

CIP

ISSN 1014-8124

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## *Foreword*

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Forests are the most extensive terrestrial ecosystem, and nearly 500 million people depend on forests for their livelihood. Since the World Bank issued its forestry sector policy paper in 1978, there has been growing concern about the accelerated rate of destruction of the remaining primary forests in various parts of the world. Currently estimates are that 17 million to 20 million hectares of forests are being lost every year, mainly in developing countries. Losses to tropical forests are now estimated at about 1 percent a year—clearly not a sustainable level of use. The need for protection and conservation of natural forests led to a substantial review of the Bank's policies and to the formulation of a new forest policy which is contained in the pages that follow.

This policy paper identifies two key challenges: to slow the alarmingly rapid rates of deforestation, especially (although not exclusively) in the tropical moist forests, and to ensure adequate planting of new trees to meet the rapidly growing demand for fuelwood in developing countries. The Bank intends to move vigorously to promote the conservation of natural forests and the sustainable development of managed forestry resources. Our objectives include support for international efforts and legal instruments to promote forest conservation; assistance to governments in policy reform and institutional strengthening; creation of additional forest resources; and support for initiatives that preserve intact forest areas.

Our forest policy review evoked widespread interest within and outside the Bank. We have learned a great deal from the experience of our borrowing governments. In addition, we invited the views of academics, researchers, concerned individuals, and representatives of non-governmental organizations. These consultations have led to substantial changes in the Bank's policy and approach toward meeting environmen-

tal and developmental concerns. The Bank is only one of many players in the world with respect to the environment. Big challenges lie ahead in moving collectively toward meeting the objectives outlined in *The Forest Sector*. I trust that this paper will contribute to a better understanding of the issues and to the building of a consensus for concerted global action.

Barber B. Conable  
President  
The World Bank  
August 1991

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## *Acknowledgements*

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This report was prepared by Gershon Feder, Mikael Grut, Peter Hazell, Michael Jacobson, William Magrath, Raymond Rowe, Narendra Sharma, and Andrew Steer. Significant contributions were also made by Shawki Barghouti, Michael Cernea, John Dixon, Richard Meyers, and John Spears. The work was carried out under the direction of Michel Petit and the general guidance of V. Rajagopalan. The paper benefited enormously from consultations with others in and outside the Bank who are simply too numerous to list.

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## *Abbreviations*

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CGIAR	Consultative Group on International Agricultural Research
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
ICRAF	International Council for Research in Agroforestry
IIASA	International Institute for Applied Systems Analysis
ITTO	International Tropical Timber Organization
NGO	Nongovernmental organization
OED	Operations Evaluation Department, World Bank
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme

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## *Executive Summary*

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Since 1978, when the World Bank published its policy paper on forestry, the world's understanding of and concern about the forest sector of the developing world has increased substantially. It has become clear that forests and woodlands play an even more important economic and ecological role than had earlier been recognized. In particular, the importance of tropical moist forests in protecting biological diversity has become more fully appreciated, as has their role in the carbon cycle and in global climatic change.

### **The Nature of the Challenge**

A critical feature of forestry activities that distinguishes them from most other primary activities is that private costs and benefits usually differ markedly from national and global costs and benefits. The existence of these externalities implies that the free interplay of market forces will not bring about socially desired outcomes. Some of these externalities are costs borne by the countries in which the forests are located—for example, soil erosion, desertification, degradation of watersheds, and threats to the cultural survival of indigenous people who traditionally live in or near the forests. Others, however, are costs that affect the international community (for example, loss of biological diversity and induced changes in the global climate). Because the people who cut or plant trees typically have no incentive for considering the environmental and social consequences of their actions, externalities inexorably lead to excessive deforestation and insufficient planting of new trees.

Of the various challenges that arise from this divergence between private and social interests, two stand out as deserving special attention. The first is to prevent excessive rates of deforestation, especially in the

tropical moist forests. The second is to ensure adequate planting of new trees and the management of existing tree resources to meet the rapidly growing demand for the products and services that forests and trees can provide for the rural poor in developing countries.

### **Deforestation and Forest Degradation**

Forests in developing countries have declined by nearly half in this century, and the rate of deforestation is still increasing. Recent studies using remote-sensing data and extensive ground surveys have found that between 17 million and 20 million hectares of forest—mainly tropical moist forest—are being lost each year. In addition to the deforestation going on in the tropics, forest degradation, principally as a result of acid precipitation, is affecting large areas of temperate forests, especially in Eastern Europe.

The loss of tropical moist forest is especially worrying because these forests have a much greater influence on the global climate than do the other main types of forest—tropical dry forests and temperate forests—and because they are a major repository of biological diversity. Moreover, they are the most fragile forests in that their soils are easily degraded once deforested, and experience to date indicates that even if reforestation or selective felling is attempted, the original ecosystems cannot be fully renewed or sustained.

Deforestation, including the cutting of woodlands and scattered trees, occurs because somebody finds it profitable. The individuals, communities, and corporations responsible for deforestation, and their primary motives for cutting trees, vary widely across regions and forest types. Although fuelwood gathering accounts for the largest share (80 percent) of wood use in developing countries worldwide, its impact is concentrated in the tropical dry forests and in nonforest wooded areas. The tropical moist forests are being lost primarily to agricultural settlement (about 60 percent of the area cleared each year), with the balance split roughly between logging and other purposes such as roads, urbanization, and fuelwood. Deforestation seldom involves only one type of decisionmaker, and the actions of one can lead to subsequent interventions by others.

Incentives to cut trees have grown in recent years for four reasons:

- The pressure of population on the natural resource base has grown sharply in many countries.
- Income opportunities in settled agricultural regions have deteriorated in some countries, leading to increased migration and encroachment on forested land.

- Access to the forest frontier has increased dramatically in some areas because of infrastructural development, especially road building.
- In a number of countries subsidies for alternative land uses and logging have been deliberately introduced to encourage frontier settlement.

Deforestation can contribute to short-term economic growth and to the alleviation of poverty, but often it does so at the expense of other environmental and social goals. Some of the costs are incurred within the country and some are borne by the international community. If these costs were more fully reflected in the incentives facing those who cut trees, there would be significantly less deforestation today. Adding to the incentive to cut trees are weak property rights in many forest and wooded areas; high private discount rates (the rate at which individuals discount future costs and benefits), especially among poor people who encroach on the forests; inappropriate government policies that make conversion of forestland artificially profitable; and timber concession arrangements that unnecessarily encourage the “mining” of trees.

### **The Growing Demand for Forests and Trees for Basic Needs**

The second major challenge is to meet the rapidly growing demand for firewood, fodder, and building poles and for the environmental services of forests and trees. Most of the world’s future need for wood for industrial purposes can continue to be met by trees grown on a sustainable basis in the temperate forests.

Understanding of the contributions that open woodlands, forest fallows, shrubs, and farm trees make to sustainable agriculture and to economic growth in rural areas greatly improved during the 1980s. Much has been learned about the potential, for example, of leguminous tree species that fix nitrogen and so improve soil fertility. Planting trees on farms and establishing shelterbelts can significantly increase crop and livestock yields, in addition to protecting soil and water resources.

Forest-derived edible plants, fruits, insects, and wildlife contribute significantly to the nutritional requirements of rural populations. The sale of poles and other forest products is a significant source of cash income for many rural households. Indirectly, such income contributes to improved food security. In many developing countries small-scale wood-using industries in rural areas are among the second or third most important activities in terms of employment potential and added value.

In some of the most heavily populated countries the availability of fuelwood is a matter for concern; demand is growing rapidly, and

supplies are increasingly obtained by mining the available stock of natural trees. Fuelwood gathering contributes to land degradation, especially in agricultural regions with limited wooded areas, and to loss of forest near densely populated areas. These effects are most severe in tropical dry forests and in nonforest areas. Growing awareness of the importance of trees in rural areas was an important factor in the World Bank's 1978 decision to give greater support to people-oriented forestry.

Many of the same social and economic forces that induce excessive deforestation also reduce the incentive to plant trees, either for fuelwood or for timber. As with any crop, a farmer's willingness to plant trees will depend on the crop's profitability. Planting is discouraged when the price of wood is depressed by open access to natural forests and by poorly defined property rights to forests. There also has been relatively little progress in developing higher-yielding, faster-growing trees for farm rather than plantation conditions, and the high discount rates of poor farmers make it particularly unattractive for them to tie up scarce capital for the relatively long payoff period involved in growing trees. The establishment of large-scale industrial plantations is similarly restricted by low profitability.

### **Strategies for Forest Development**

The challenges faced by the world community in addressing forestry issues are enormous, and progress in arresting the current trends requires concerted efforts by governments and many international organizations, of which the Bank is only one. Government policies and programs need to be directed toward changing the incentive and institutional structures that are leading to excessive deforestation and that discourage rural people from planting trees and practicing good forest management. In addition, global externalities, particularly those related to the preservation of tropical moist forests, need to be internalized into local actions through international cooperation and assistance.

#### *Protecting the forests*

A fourfold strategy is required to check deforestation.

POLICIES TO ALLEVIATE POVERTY. Policies to protect the forests or to slow deforestation seem doomed when pitted against a growing tide of poor people who need land to survive. General economic development, including increased diversification of the national economy, reductions in inequality and poverty, and slower population growth, are necessary

for a long-term solution to the forestry problem. But in the interim, priority must be given to increasing agricultural productivity in poor, densely populated areas, especially those adjacent to forested areas and those from which most forest encroachers originate, and to expanding nonfarm employment opportunities in these target areas. In the long run, even if economic development takes place, specific policies will still be needed to deal with problems of externalities.

**FOREST ZONING AND REGULATION.** Part of the forest will have to be protected through specific legislative and regulatory measures, especially in tropical moist forests. Decisions on zoning and regulation should be based on an understanding of what is expected of the land and a realistic assessment of what is technically feasible in light of local capacities and incentive structures. Given the likely limitations on resources and the desirability of increasing the size and number of protected areas, countries must develop workable priority criteria for setting aside specific forest areas that will be protected from any intrusion and for managing areas designated for different uses. This involves undertaking appropriate surveys of natural resources in the forested areas and determining which areas are of special value for their ecological diversity, which are essential for protecting indigenous forest dwellers, and which protect sites that are environmentally fragile, such as hillsides and watersheds. Available resources for protective purposes can then be focused on these priority areas.

Commercial logging can be contained through a strict policy that limits the extent of timber concessions and allows them only in areas that can be put under sustained timber management systems. Given the practical difficulties of achieving sustained management in tropical forests and the related environmental costs, governments should be cautious in allowing such activities and should give priority to the preservation of intact tropical forests. In all types of forests, high priority should also be given to reforesting degraded areas, and new timber concessions could be tied to the successful replanting of degraded lands. Because these areas may have become the source of livelihood for some communities, the interests of these people need to be considered when reforestation is undertaken.

**CORRECTING PRIVATE INCENTIVES.** Enforcement of zoning and other regulations is likely to be ineffective unless private incentives are also changed. In many instances government policies systematically underprice forest concessions. This, together with governmental reluctance to offer long-term concessions, increases the incentive for quick "mining"

of trees. Timber concession systems can be modified in several ways. Stumpage fees or area concession rents can be increased to reflect the real value of the trees. Felling leases or licenses and logging rights can be allocated by competitive bidding (through auction or tender) that is open to the private sector, nongovernmental organizations (NGOs), and local communities and is adjusted as necessary to take account of externalities. And concessions can be made long term and, with appropriate controls, transferable.

Incentives for agricultural settlers have sometimes been distorted by policies that actually encourage deforestation (for example, subsidies for livestock ranching in the Amazon and the tying of land titling to land clearance). All such distortions should be removed. Customary land rights of forest dwellers need to be formalized and respected, to protect both forest dwellers and resources against excessive agricultural encroachment or exploitation by outside interests.

**PUBLIC INVESTMENTS.** Access to forests needs to be carefully controlled. Many infrastructural projects, such as roads and reservoirs, inadvertently open up forestlands to settlers. Public investments need to be preceded by much more careful environmental assessments and, where possible, should be directed toward preservation. Substantial expenditures are required to strengthen forestry institutions so that they can better protect designated forest areas; to develop improved systems of silviculture, forest management, and policymaking; to conduct forest research and development; and to carry out afforestation and replanting, especially on degraded land.

#### *Policies to meet basic needs for forest products and services*

The achievement of a more sustainable balance between supply and demand requires actions to reduce the demand for fuelwood and other local wood uses and to increase supply by encouraging the planting and husbandry of trees.

**REDUCING DEMAND.** As wood becomes scarcer, more widespread and more efficient markets are likely to develop, and price increases will become more important in reducing the growth in demand. Because of environmental externalities and inadequate property rights, however, market prices will generally not reflect the full social value of wood. Hence, direct interventions to encourage conservation and the use of more efficient technologies are necessary. These should include research and training to improve the fuel efficiency of household stoves, brick

and charcoal kilns, and other wood-burning equipment. In addition, more efficient markets for alternative fuels such as kerosene need to be developed. Investment subsidies may also be appropriate in the initial stages to encourage individuals to purchase the necessary equipment for converting from wood-burning technologies, particularly when new and innovative technologies (such as solar stoves) are involved.

**INCREASING SUPPLY.** Most wood users in developing countries live in rural areas, and the best way of satisfying their demand for wood and for the services that trees provide is to mobilize their own resources for tree planting and for better management of existing trees. Supply of rural wood through large-scale commercial operations is not likely to be viable on the scale required, nor is continuation of widespread wood gathering in forests sustainable or environmentally acceptable. It is increasingly recognized that wood production issues should be dealt with at the farm level. Forestry departments need to be reoriented in light of this recognition, and the special capabilities of nongovernmental organizations concerned with the alleviation of poverty and with environmental conservation should be mobilized to help users organize themselves for tree planting. Achieving the level of planting and management required will be possible only if economic incentives and the abilities of farmers are enhanced. Promoting awareness of the role of trees in retaining soil fertility and averting degradation will also help reduce tree cutting and foster better management. This will require extension and training services, a ready supply of tree seedlings and other inputs, and, in some cases, improvements in rights to land and trees.

Past attempts to increase tree planting for fuelwood and other rural uses were based on community woodlots established on lands managed under common-property tenure regimes. They often failed because local communities were inadequately organized for collective action and were unable to reward adequately those who provided labor. Future efforts need to be focused on smaller and more tightly defined groups of local actors, including the poor, who have a common interest in planting and raising trees. Recent programs based on family farm forestry and group farm forestry have shown promise.

### *Strengthening forestry institutions*

Governments are increasingly recognizing that the scale of demands for conflict resolution and mediation now placed on forestry agencies was never adequately anticipated. Governments must recognize and act on

the critical need to reorganize forestry institutions and introduce greater accountability and higher performance standards into the public sector. Creative use of private sector contractors and consultants as auditors and monitors and more rigorous intersectoral oversight by agriculture, environment, planning, finance, and other relevant ministries are effective devices for improving the performance of government forestry agencies. Commitment at the highest levels of government is necessary for introducing these reforms.

### *The role of the international community*

The international community must support developing countries in achieving their own national goals for the management of forest resources and must help find ways of better incorporating the value of global externalities from forests into incentive structures for local action. International legal instruments, being discussed currently in various forums, demonstrate the wide interest in these objectives for international action. The adoption of such instruments could facilitate the transfer of resources to promote the conservation of tropical forests. There are three main areas in which the international community can play an important role.

**TECHNICAL ASSISTANCE, RESEARCH, AND INSTITUTION BUILDING.** Developing countries need assistance in (a) undertaking the detailed resource inventories that are essential for establishing priority forest protection areas and demarcating areas for sustainable commercial forestry or agriculture, (b) developing appropriate criteria for forest use plans, (c) providing training and specialized skills for forest management, and (d) strengthening local institutions in their forest planning, protection, and management functions. International mechanisms for providing this assistance need to be strengthened by, among other steps, revising the Tropical Forestry Action Plan and reorienting the Consultative Group on International Agricultural Research (CGIAR) toward greater emphasis on sustainable forestry.

**FINANCING.** Special mechanisms may be needed to finance policy reform and investment. From a financing perspective, measures to correct policy and market failures fall into three categories:

- Measures that require only small incremental resource requirements and that will pay for themselves in reduced fiscal burdens (an example is the elimination of perverse policies)

- Measures that involve rectifying domestic externalities and property rights and that can be financed domestically or on non-concessional terms from external sources
- Measures intended to secure benefits that will accrue partly or entirely outside the country; for these, international financial transfers and concessionary terms may be appropriate. (Examples are measures to preserve biological diversity and the carbon-sequestering function of forests).

The availability of financial support from international agencies such as the World Bank can reinforce the benefits of such policy adjustments. Concessional financing for supporting initiatives that have global benefits (for example, debt-for-nature swaps) can also be helpful. Such funds, however, should be in addition to existing levels of official development assistance. The recently established Global Environment Facility represents a useful mechanism for testing innovative financing approaches, and the experience gained in its operation may lead to follow-up initiatives.

**INTERNATIONAL TRADE REFORMS.** Only a very small share of the wood that is cut from primary forests each year enters international trade, but the share is much larger for high-value and rare species. Experience with other products suggests that consumers will modify their behavior substantially if they are given information on the ecological sustainability of the production process. For this reason, the international community should encourage organizations such as the International Tropical Timber Organization (ITTO) to develop programs of green labeling to permit preferential market treatment for wood grown under sustainable conditions. In addition to lowering the overall demand for wood produced by unsustainable practices, such a scheme would remove the disincentive for adopting improved management practices that might otherwise diminish competitiveness.

A more contentious issue is that of trade taxes on tropical timber. Such measures may be desirable to the extent that (a) taxes (whether import or export) could be targeted to those species that are culled exclusively from primary forests, (b) taxes would apply equally to processed wood and to logs, and (c) revenues raised would be returned to developing countries to be used for forest protection activities. If these conditions are not fulfilled, however, trade taxes are likely to create additional distortions by discouraging new planting and plantation agriculture and by protecting inefficient domestic wood-processing industries, thus placing an unfair burden on countries heavily dependent on timber

exports. More research is needed on these issues before such taxes should be supported.

### **The Role of the World Bank**

Since its inception, the Bank has financed ninety-four projects in the forest sector, with total commitments of nearly \$2.5 billion. Lending has grown rapidly since the publication in 1978 of the policy paper on forestry, and there has been greater emphasis on social forestry and, lately, on environmental issues. Bank lending for other projects, particularly tree crops, agricultural settlements, and infrastructure, has sometimes had an undesirable impact on forest resources.

According to the recent review of this experience by the Operations Evaluations Department (OED) of the World Bank, the Bank needs to strengthen its forest sector work and to link it more strongly to other country economic and sector work, to improve the technical performance of projects, and to design social forestry projects with a better understanding of local social dynamics and the motivations of different social actors in tree planting and management. Moreover, because the scope of forestry problems faced by developing countries has changed dramatically and understanding of their causes and implications has improved, a reformulation of the Bank's forest policy is required.

### *Principles of future involvement*

The World Bank's involvement in the forest sector will be designed as a component of a multisectoral approach, in line with the lessons learned from the OED review. To relieve the fundamental pressures on the forest over the longer term, the Bank, through its normal mechanisms, will continue to support population policies, agricultural intensification, the alleviation of poverty, and the creation of employment opportunities in other sectors. The Bank will give closer attention to infrastructural and other land-using projects and will minimize their potentially negative effects. In its efforts directly related to the forest sector—aid coordination, country dialogue, sector work, and lending—the Bank will focus on the following areas.

**INTERNATIONAL COOPERATION.** The Bank supports the adoption of international legal instruments conducive to sustainable forest development and conservation. The Bank will encourage international initiatives for the transfer of concessional resources to assist projects that protect globally important biological diversity. It will continue to explore the

feasibility of using global transfers to protect forests for their carbon sequestration.

**POLICY REFORM AND INSTITUTION STRENGTHENING.** The Bank will assist governments to identify and rectify market and policy failures that encourage deforestation and inhibit sustainable land use. The Bank will assist governments in completing resource inventories and establishing systems for continuous resource assessment. Efforts will be made to improve the technical performance of government forestry institutions. Pilot projects designed to gain insights into the merits of alternative approaches will be undertaken.

**RESOURCE EXPANSION AND INTENSIFICATION.** The Bank will increase its efforts to finance the creation of additional forest resources and the expansion and intensification of management of areas suitable for sustainable production of forest products. In addition, the Bank will promote a continued reorientation of forestry toward participation by rural people in tree planting and conservation of indigenous woodlands. In the past, social forestry projects have had mixed results, primarily because they relied on community groups that were not adequately motivated and organized to carry out collective actions. Greater emphasis will be given to farm family and farm group forestry, including women's groups. Where the scope for plantations outside areas of intact forests is sound from a social, environmental, and economic perspective, the Bank will assist in the establishment of plantations to reduce pressure on the existing forest resource base and to ease the transition to sustained-yield forest management. The primary target areas for new plantings will be potentially productive degraded forests, wastelands, forest fallows, shrublands, and abandoned farmlands. The interests of communities that depend on such areas will have to be considered in setting target areas.

**PRESERVATION OF INTACT FOREST AREAS.** The Bank will support initiatives to expand forest areas designated as parks and reserves and to institute effective management and enforcement in new and existing areas. In tropical moist forests the Bank will adopt, and will encourage governments to adopt, a precautionary policy toward utilization. This policy is motivated by the uncertainties regarding full valuation of environmental services, the inadequacy of knowledge concerning sustainable management systems, and the irreversibilities associated with the loss of tropical moist forests. Specifically, the Bank Group will not under any circumstances finance commercial logging in primary tropical moist

forests. Financing of infrastructural projects (such as roads, dams, and mines) that may lead to loss of tropical moist forests will be subject to rigorous environmental assessment as mandated by the Bank for projects that raise diverse and significant environmental and resettlement issues. A careful assessment of the social issues involved will also be required. The Bank will continue to place more emphasis on support to programs that involve institutional development, forest protection measures, and income-generating projects not dependent on forest resources and that have as their primary objective the preservation of tropical moist forests. In implementing this strategy, the Bank will pay special attention to the twenty countries (accounting for 85 percent of tropical moist forests) whose forests are seriously threatened by encroachment and destruction. In these countries special efforts will be made to support economic development in poor, densely populated areas around the forests or in the origin areas of forest encroachers. The Bank will also support the amelioration of forest damage caused by acid rain through projects for rehabilitation, reforestation, and abatement of industrial pollution.

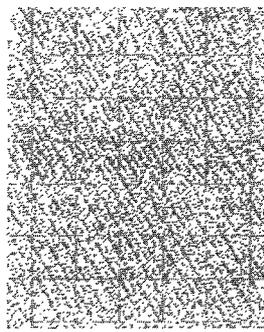
### *Conditions for Bank involvement*

In all countries, and for all types of forests, lending operations in the forestry sector will distinguish between projects that are clearly environmentally protective (such as reforestation to protect watersheds) or which are oriented toward small farmers (for example, farm and social forestry) and all other forestry operations (for example, commercial plantations). The first two types will be considered on the basis of their own social, economic, and environmental merits. Other lending operations in the forest sector will be conditional on governmental commitment to sustainable and conservation-oriented forestry. Such a commitment entails:

- Adopting policies and an institutional framework to ensure conservation and sustainable use of existing forests and to promote more active participation of local people and the private sector (with proper incentives) in the long-term management of natural forests
- Adopting a comprehensive and environmentally sound forestry conservation and development plan that contains a clear definition of the roles and rights of the government, the private sector, and local people (including forest dwellers)
- Undertaking social, economic, and environmental assessments of the forests being considered for commercial utilization

- Setting aside adequate compensatory preservation forests to maintain biodiversity and safeguard the interests of forest dwellers, specifically their rights of access to designated forest areas
- Establishing the institutional capacity to implement and enforce the above commitments.

If these conditions are present, projects will be judged on their individual merits. If they are not present, Bank support in the forest sector will be restricted to operations that directly help countries to achieve them. Such operations will be appropriately limited in scope, sequenced, and specifically targeted at helping countries meet the stated conditions.



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## *Introduction*

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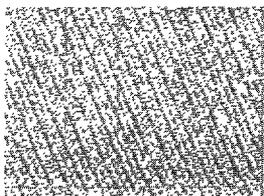
Since the publication in 1978 of the Bank's policy paper *Forestry*, there has been a profound increase in the world's understanding of and concern about the forest sector of the developing world. All the problems and opportunities that drove the current policy are still important today. Fuelwood scarcities continue to impose terrible burdens on women and children, opportunities for the environmentally sound industrial utilization of a valuable form of capital are still being missed, and, above all, deforestation continues and has even accelerated in many countries. As our understanding has deepened over the intervening years, it has become clear that forests and woodlands play an even more important economic and ecological role than had been recognized earlier. The importance of nonwood forest products in providing employment, incomes, and sustenance to forest dwellers and the rural poor is now more fully appreciated, as is the importance of tropical forests in protecting biological diversity. The role that forest ecosystems play in the world's carbon cycle and climatic conditions was scarcely recognized in 1978.

The growing awareness of the value of forests makes it all the more urgent to address the continuing high rates of deforestation. Negative ecological and social consequences can accompany deforestation in any type of forest, but loss of the tropical moist forests is uniquely costly because of their extraordinary richness of biological diversity, their apparent significance in regional and global climatic patterns, and the vulnerability of their soils under other forms of land use. Although scientific knowledge in this area is imprecise, it is clear that tropical moist forests are qualitatively different from other forest types because of the magnitude and the irreversibility—in terms of natural habitats and ecological systems—of the losses accompanying deforestation. For these

reasons the problems of the tropical moist forests are given a priority, although by no means an exclusive, emphasis in this paper.

Parallel with improved understanding of the ecological aspects of forests has been deepened understanding of human behavior with regard to trees—and of why this behavior is often not in accord with national and global interests. A wide range of analyses and policy research over the past decade has shed light on the determinants of the effective demand for land and wood (the cause of deforestation), the importance of tenure arrangements, and the links between government policies and the forest sector. The use of government policies to influence behavior in the sector will be a principal theme of this paper.

The paper is organized as follows. Chapter 1 describes the two most important challenges in the sector—excessive deforestation and inadequate afforestation and reforestation—and highlights the extent and the causes of the problems. Drawing on the analysis of the causes of excessive deforestation and inadequate planting, chapter 2 discusses policies and programs directed toward overcoming those underlying causes. Finally, chapter 3 discusses the role of the World Bank in supporting governments' efforts to implement these policies and programs.



# 1

## *Challenges for the Forest Sector*

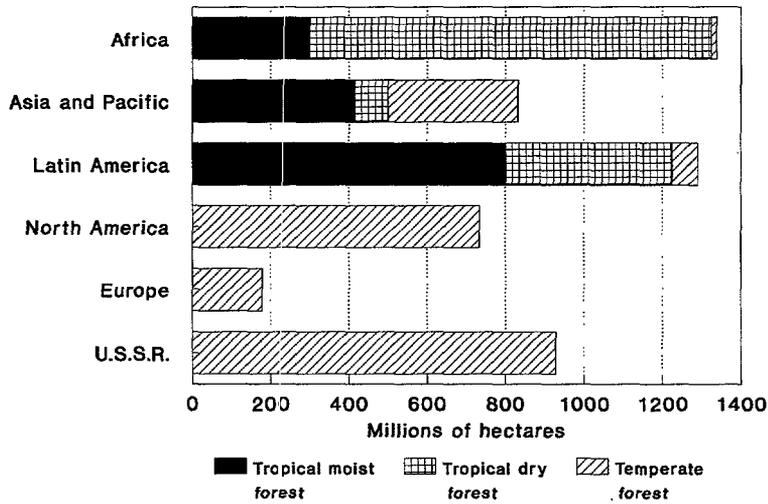
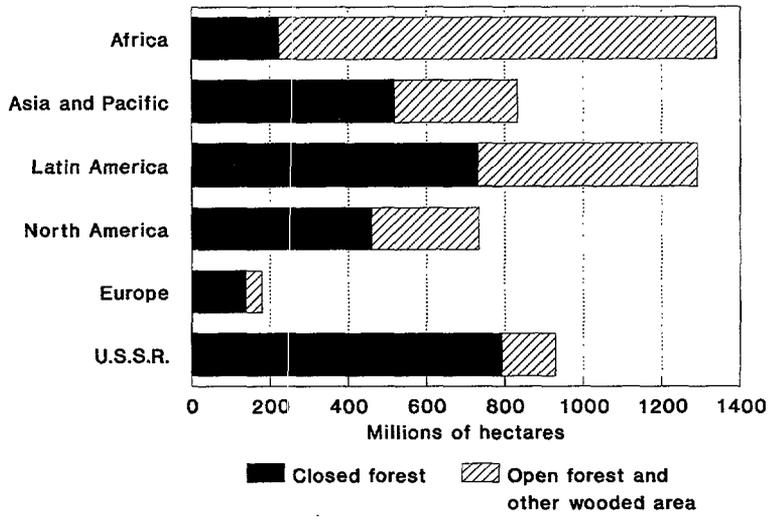
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Forests, which cover more than one-fourth of the world's land area, are the most widespread terrestrial ecosystem. They are also an important feature of the environment and economy of the developing world. Nearly 500 million people, most of them poor, live in or near forests and depend on them for food, fuel, fodder, timber, and income. Worldwide consumption of wood totals nearly 3.4 billion cubic meters a year, of which about 50 percent is consumed as fuelwood and building poles in developing countries. Figure 1 summarizes the area, density, and types of forest in different regions of the world. A more detailed description of the importance of forests and trees in natural and social systems is found in appendix A.

A critical feature of forestry activities that distinguishes them from most other primary activities is that private costs and benefits usually diverge markedly from national and global costs and benefits. The existence of these externalities implies that the free interplay of market forces will not bring about socially desired outcomes. These failures have become more acute, and world opinion has become increasingly aware of them in the past decade. They also lead to varied and sometimes conflicting challenges for the sector. Of these challenges, two stand out.

- To prevent excessive rates of deforestation by expanding efforts toward the conservation, protection, and management of the world's remaining forests and woodlands, especially tropical moist forests
- To ensure adequate planting of new trees to meet the rapidly growing demand for fuelwood, fodder, building poles, and other products and to ensure that adequate tree cover remains in rural areas for protection of soil and water resources.

Figure 1. Typology of World Forests



The second challenge is especially severe in densely populated areas, mostly outside the tropical moist forest zone. This chapter briefly reviews the extent of these challenges and the causes of the problems.

### **The Extent of the Problem**

Standing forests can be thought of as providing five principal sets of services:

- A habitat that affords a livelihood and way of life for forest dwellers
- A habitat for a diversity of plant and animal species
- Protection and nutrition of soils, associated watershed services, and prevention of desertification
- Regulation of local and global climatic patterns through evapotranspiration and carbon sequestration
- Production of wood for future use.

Cutting down trees may or may not bring about the loss of these services. If the land is converted to an alternative use, such as pasture, food crops, or urban development, most of these forest services will be lost. If trees are replanted after cutting, or if cutting is highly selective, some or most of these services may remain, depending on the resilience of the forest type.

### ***Forest typologies***

Different forest types provide different combinations of the five services and have different potentials for tolerating and supporting human intervention and utilization. Although there is enormous variation in forest types, for analytical purposes four types can be distinguished: tropical dry forests, tropical moist forests, temperate forests, and degraded forestlands (which overlap the other types). There is considerable variation within all four types, and all are capable of sustainably providing flows of some combination of goods and services. For example, all serve as carbon sinks, and all perform highly site- and time-dependent hydrologic functions. The outputs of a particular forest depend greatly on management and silvicultural intensity, on natural events such as rainfall, and on the level and type of human interference.

*Tropical moist forests* account for 1.5 billion hectares and are the densest terrestrial ecosystems, containing the greatest biomass of any forest type. Nearly two-thirds of tropical moist forests are in Latin America, mainly in Amazonia. The remainder are split between Africa and Asia (figure 1). Approximately 1 billion hectares of tropical moist forest are consid-

ered to be intact or primary forest in which human activity has had little impact on the ecosystem. In the remaining 500 million hectares human interference, including logging and agriculture, has resulted in damage that ranges from slight to severe.

Tropical moist forests provide all five of the services listed above, but they are especially valued as repositories of biodiversity. Although tropical moist forests cover only 7 percent of the earth's land area, they contain about one-half of the 1.9 million named species in the entire world biota, as well as innumerable species as yet unnamed. They fill a relatively small but significant niche as a source of industrial wood. Although only about 15 percent of total world consumption of industrial wood originates in tropical moist forests, the special characteristics of tropical woods make them especially valuable. The capability of land under tropical moist forests to support alternative land uses is highly variable but is generally poor. Experience indicates that even when reforestation or selective felling of trees is attempted, most of the services of these forests are lost.

*Tropical dry forests*, 75 percent of which are in Africa, total 1.5 billion hectares, about half of the total tropical forest area. They are mostly open woodlands and forest fallows and contain far less biomass per unit area than tropical moist forests. Their principal economic uses are for livestock grazing and fuelwood collection by rural people. Their biodiversity is small in comparison with that of tropical moist forests, but many unique species are adapted to the harsher conditions of the ecological zones where tropical dry forests are found.

*Temperate forests*, three-quarters of which are in developed countries, are the world's primary source of industrial wood. In total, they cover about 1.6 billion hectares, or one-third of the world's forest area. In the developing world, temperate forests cover large areas of China, southern Latin America, and the Mediterranean region. The biodiversity of temperate forests is considerably less than that of tropical forests. Temperate forests are well suited to industrial utilization; the relatively small number of species present in a typical temperate forest makes it an easily managed source of raw material. Much of today's agricultural land in developed countries was once under temperate forest.

*Degraded forestlands*, along with open woodlands, forest fallows, and on-farm trees, account for most of the tropical forest area. Overexploitation (which in the case of tropical forests could result from even light intervention) can cause severe forest degradation, including soil erosion, weed infestation that eventually ends in conversion to grassland, increased susceptibility to fire and insect attack, and, in some areas, desertification. Of 3 billion hectares under tropical forests and woody

vegetation, 2 billion hectares (two-thirds of the total), including essentially all of the tropical dry forest and approximately 550 million hectares of secondary and fallow tropical moist forest, fall into this category. These areas are utilized extensively by millions of small farmers and local communities which are highly dependent on patches of woodland, forest fallow vegetation, natural shrubs, and planted on-farm trees for their fuelwood, fruit, fodder, building poles, and other basic needs. Depending on the inherent quality of the site, market conditions, and technology, degraded lands may be suitable for restoration as forest plantations or for conversion to other uses.

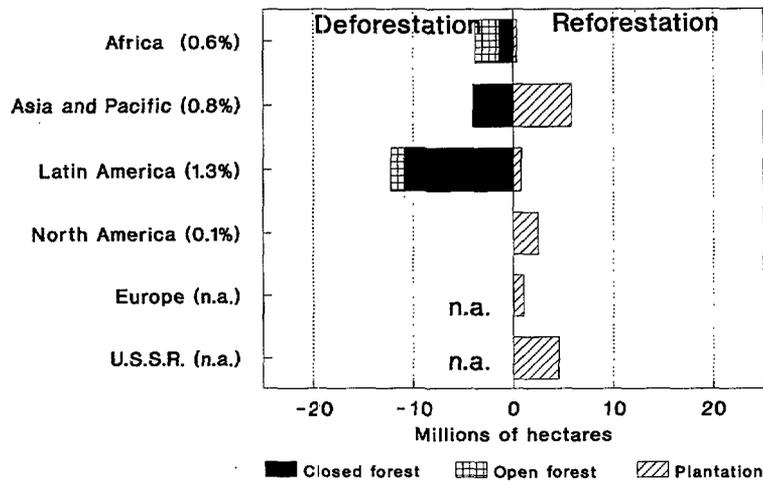
### *Deforestation and degradation*

Developed and developing countries differ sharply in the status of their forests. Following an earlier era of significant deforestation, the forest area of many developed countries has stabilized and in some cases has even increased during this century (figure 2). In contrast, forests in developing countries have declined by nearly half in this century, and the rate of loss is still increasing. Estimates from the early 1980s concluded that 11.4 million hectares of tropical forest (moist and dry) were being cleared annually for other uses. The largest annual losses were occurring in Latin America (5.6 million hectares). The corresponding figures for Africa and Asia were 3.7 million and 2.0 million hectares, respectively. More recent studies using remote sensing data and extensive ground surveys have found that the rate of deforestation is currently about 17 million to 20 million hectares a year.

Just as deforestation accompanied the economic development of many of today's developed countries, so deforestation cannot be slowed significantly in the developing countries without some sacrifice of short-term economic growth. Deforestation allows alternative use of forested land for agriculture, urbanization, and infrastructural investments such as roads and dams, as well as for timber. Such short-term economic gains may involve serious costs in terms of environmental and social goals, particularly where alternative uses of forest land are not sustainable. This tradeoff between narrow economic pursuits and preservation of intact forests lies at the heart of the challenge of preserving the world's forests. To complicate matters further, part of the environmental costs are borne by the global community at large and not just by the countries that own the forests.

Although much of the current environmental concern relates to the humid tropics, temperate forests, particularly in Eastern Europe, have also been subjected to environmental stress caused by a combination of

**Figure 2. Deforestation and Reforestation: Annual Average Rates in the 1980s**



n.a. Not applicable.

Note: Numbers in parentheses as a percentage of total forest area.

Sources: World Resources Institute 1990; Food and Agriculture Organization 1985 and 1988.

acid rain and past silvicultural practices—for example, the planting of close-spacing conifer monocultures on inappropriate sites. In the arid tropics desertification has been widely attributed to deforestation of tropical dry forests. In fact, the causes of dryland deterioration are quite complex, involving a combination of increasing human and livestock pressures and erosion of traditional systems of woodland and range management, often exacerbated by drought. Nevertheless, the badly degraded woodlands of the savannas do play a key role in soil conservation and in providing essential grazing fodder, fuelwood, and many other basic needs.

Tropical moist forests present special problems with regard to deforestation. First, if tropical moist forests are converted to other land uses, the costs in loss of biodiversity and other forest services may be extremely high and irreversible. Second, loss of tropical moist forests may have a serious effect on regional and global climatic patterns. Tropical moist forests play a special role in influencing the distribution of moisture in the atmosphere and hence affect regional, and possibly global,

rainfall patterns. Because of their high per unit density of biomass, tropical moist forests account for 55 percent of the world's organic carbon, and their clearance by burning contributes significantly to atmospheric loadings of carbon dioxide, accelerating the buildup of greenhouse gases. This source of pollution, however, is still much smaller than the 5 billion to 6 billion metric tons a year attributable to the consumption of fossil fuel.

#### *The growing demand for forests and trees for basic needs*

The second major challenge is to meet the growing demand for fuelwood, fodder, and building poles and for the environmental services that forests and scattered trees provide to poor rural populations. Global consumption of wood is split almost evenly between industrial use (sawnwood, panels, and pulp and paper) and use as a source of energy (mostly domestic firewood in developing countries). Nearly 80 percent of industrial wood is harvested sustainably from temperate forests, and approximately 15 percent is essentially mined from the tropical moist forest. The demand for industrial wood in both developed and developing countries will continue to increase. Since, however, supplies from temperate forests are reasonably elastic and there is considerable scope for substituting temperate for tropical wood, no serious supply problems for industrial wood are foreseen.

Understanding of the contributions that open woodlands, forest fallows, shrubs, and farm trees make to sustainable agriculture and to economic growth in rural areas greatly improved during the 1980s. Much has been learned about the potential, for example, of leguminous tree species that fix nitrogen and so improve soil fertility. Planting trees on farms and establishing shelterbelts can significantly increase crop and livestock yields, in addition to protecting soil and water resources. Forest-derived edible plants, fruits, insects, and wildlife contribute significantly to the requirements of rural populations and to wildlife nutrition. The sale of poles and other forest products is a significant source of cash income for many rural households, and such income contributes indirectly to improved food security. In many developing countries small-scale wood-using industries in rural areas are among the second or third most important activities in terms of employment potential and added value.

In some of the most heavily populated countries there is concern regarding the availability of fuelwood; demand is growing rapidly, while supplies are increasingly obtained by depleting the available natural stock of trees. Nearly 3 billion people depend on wood as their

main or only source of household energy, and it is especially important to rural households and to the poor. As tree stocks diminish, women and children spend increasing amounts of time gathering firewood from more distant sources and have less time to spend in other vital activities. Fuelwood gathering contributes to land degradation, especially in agricultural regions with limited wooded areas. It also contributes to deforestation in forests adjacent to densely populated areas, mostly tropical dry forests. Growing awareness of the importance of trees in rural areas was an important factor in the World Bank's 1978 decision to give greater support to people-oriented forestry.

### **The Causes of Deforestation and Degradation**

Policies and programs in the forest sector need to be targeted to the underlying causes of the problems to be addressed. A strategy for countering excessive deforestation must be based on the answers to three questions: Why do individuals, companies, and communities cut down trees? Why and how do the private interests that drive deforestation differ from national interests? Why and how do national interests differ from global interests? This section discusses these questions.

#### *Private incentives for deforestation*

Deforestation, including the cutting of forests and scattered trees, occurs because somebody finds it profitable. The types of agents (individuals, communities, and corporations) responsible for deforestation and forest degradation vary widely across regions and forest types, as do their primary motives for cutting trees. Although fuelwood gathering accounts for the largest share of wood use in developing countries, it is concentrated in densely populated areas, tropical dry forests, and non-forest wooded areas. Tropical moist forests are being lost primarily to agricultural settlement (about 60 percent of the area cleared each year), with the balance split roughly between logging and other uses (roads, urbanization, fuelwood, and so on). In reality, however, as described in box 1, deforestation seldom involves only one actor or decisionmaker.

In much of the Amazon region, the main actors causing deforestation have been livestock ranchers, whose primary objective has been to convert the forest to pasture. In many of the tropical moist forests of East Asia, logging companies are the primary tree cutters, and often their interests are short term and do not extend to replanting harvested areas. In many land-scarce countries (for example, in Central America, parts of Central and East Africa, and South Asia) small-scale agricultural

**Box 1. The Dynamics of Deforestation**

The conversion of forest to other land uses or to wasteland takes a variety of forms and seldom involves only one actor or decisionmaker. Common forms of deforestation include deliberate clearance and conversion, degradation and subsequent clearance following logging, and gradual conversion as a result of the shortening of fallow cycles in shifting cultivation.

*Direct conversion*

Mechanical or manual techniques are sometimes used to remove completely the existing forest vegetation and to prepare the site for a subsequent use. Both public and private efforts to identify and utilize forestland for alternative uses have historically been significant contributors to this form of deforestation.

The success of conversion in establishing a new and sustainable land use varies widely. Much of the world's most productive agricultural land was once under forest cover, and more suitable land doubtless remains for future conversion. Serious mistakes have been made, however, in attempting to convert forestland to other uses. Forest soils, despite their ability to support vibrant forest ecosystems, are often extremely poor in nutrients and when cleared may be subject to excessive erosion and other forms of soil degradation. The reasons for the conversion of forests to inappropriate uses include policies that excessively subsidize alternative uses, efforts by project planners to meet project targets, and ignorance of the true potential of the land.

A special case of deliberate conversion is the replacement of natural forests with plantations of forest trees. This, typically, is part of planned development of timber-based industries that rely on a steady stream of particular combinations of raw material. (Pulp and paper operations, for example, require a particular balance of long- and short-fiber feedstocks.)

*Logging*

Logging of natural forest, by itself, seldom brings about total deforestation and conversion to other uses. In tropical forests only a relatively small proportion of the standing volume consists of merchantable trees worth the costs of felling and extraction. This is especially true for veneer and sawlog operations but also holds for lower-value products such as pulp logs. Only when forests are close to towns and cities is conversion of logging residue to charcoal economically viable. Recommended systems of tropical forest logging also involve limits on the removal of small-diameter trees as a means of ensuring regrowth for subsequent harvest. In practice, these limits are often ignored, and smaller trees are felled.

Clear felling is not usually practiced in moist tropical forest logging. Even so, the residual stand suffers significant damage. Construction of logging roads and trails, clearance for yarding, and other operations entail considerable additional felling and soil disturbance. These intrusions and the influx of laborers and other people lead to subsequent damage to the forest, as partially disturbed sites can be converted much more easily to agriculture than can natural forest.

Further damage results when loggers, unable to control access, accelerate their reentry to previously logged sites. Girth diameter limits are respected even less in these circumstances, and the site is made even more vulnerable to intrusion by agriculturalists. The potential for further damage by fire is increased by changes in moisture regimes and by ranchers' attempts to combat the invasion of low-quality grasses by burning pastures.

#### *Shortened fallow cycles*

Shifting agriculture is now clearly understood to be a sustainable system of food production, provided that the land base is large enough to allow regeneration of soil fertility. As population pressures increase and fallow periods become shorter, however, the ability of forest cover to reestablish itself is endangered. Increased farming pressure on the forest creates the same conditions as logging, and eventually the integrity and viability of the forest ecosystem are lost.

In the absence of strong systems of control, demand for fuelwood and other forest products by rural people and for charcoal by urban dwellers can also lead to deforestation. This problem is especially severe in tropical dry forests.

settlers are the prime cause of change, often encroaching illegally onto government-owned forestland. Fuelwood gatherers are another important group of actors; their impact is especially severe in the tropical dry forests of Africa and South Asia.

Incentives to cut trees have increased in recent years for four basic reasons. These are interrelated and sometimes mutually reinforcing, although not all of them are operative everywhere.

- The *pressure of population on the natural resource base* has grown sharply in many countries. This has been one of the main causes of the deforestation of the open-access tropical dry forests of Africa and Asia, as fuelwood gatherers have found it increasingly difficult to satisfy their energy needs.

- *Income opportunities in settled agricultural regions* have deteriorated in some countries—often as a result of increased population pressures on the land but also because of adverse or unstable general economic conditions, perverse policies, and inequitable distribution of land. This deterioration partly explains, for example, why large numbers of small-scale farmers are willing to risk what little resources they have to settle in the Amazonian tropical moist forest.
- *Access to the forest frontier* has increased dramatically in some areas. Mining, oil exploration, and infrastructural development (especially roads and railways) have dramatically, if often unintentionally, increased access to the forests. The control of pests and disease (such as tsetse flies and malaria) has also opened up forest areas.
- *Subsidies for alternative land uses and logging* have been deliberately used to encourage frontier settlement in a number of countries, although the tendency now is for their elimination as the costs of deforestation have become apparent. Examples of such subsidies are official settlement schemes involving land grants and associated services (as in Indonesia, Malaysia, and Sri Lanka) and credits for livestock ranching (as in Brazil). In some situations logging companies have been subsidized by the provision of access roads and other infrastructure and by very low stumpage fees.

#### *Why private interests differ from national interests*

If deforestation and tree planting are left to the market, will countries arrive at socially optimal levels of forests and woodlands? Will the right types of land be cleared? Will that land be put to its best use? There are several reasons why these questions must generally be answered in the negative in developing countries and why the problem is worsening over time. The problems cut across forest types and sometimes appear in combination, heightening the need for multisectoral analysis and integrated policy reform.

First, important *externalities* lead to a divergence between private incentives to cut or plant trees and the real economic costs and benefits of these actions for the nation. These externalities arise because some forest products, particularly forests' environmental protective functions and role in sustaining indigenous peoples, are not valued in the marketplace. For example, individuals who cut trees do not consider the economic costs that others may incur as a result of land degradation, soil erosion, or siltation of rivers and dams. Again, forest loss can threaten the cultural survival of indigenous groups who have traditionally resided in or near forests, yet these people have little influence on the

activities of intruders. Because the values of externalities are not incorporated in private decisions, inevitably too many trees are cut.

Second, individuals who have access to forests and forestlands often have insufficient *property rights* to take a long-term interest in the land or the trees. Inadequate property rights are found in areas encroached on by illegal squatters, in common-property and open-access areas, and when timber concessions to logging companies have too short a duration.

Third, *government policies*, which should be directed at moving private behavior into conformity with social interest, sometimes do the opposite. Policies such as those that subsidize tree cutting, underprice concessions to logging companies, or link land-titling procedures to land clearing effectively drive a wedge between private behavior and the common good. Macroeconomic policies can affect the perceived benefit of keeping trees on land. The consequences of these policies are, however, complex, and their net impact needs to be evaluated case by case.

Fourth, the *private discount rate*—the rate at which future costs and benefits are discounted—may be too high. There are two elements here. Poor people, who, through encroachment, are responsible for a significant share of the annual loss of forests, have higher discount rates than society as a whole because of the urgency of their current needs. And today's population, on average, may undervalue the longer-term benefits of investments in forests, which would only accrue to future generations.

Over time, increasing population and development pressures can exacerbate some of the factors that lead to a divergence between private and social interests. For example, as land becomes scarce, property rights on communally held land are more likely to break down, and the traditional rights of indigenous people are more likely to be challenged. And increasing land scarcity often pushes encroachment and settlement into more marginal, environmentally fragile areas.

### *The divergence between national and global goals*

In most developing countries more trees are being cut than is desirable for national economic welfare. One of the priorities for domestic policy must be to correct these imbalances. But even if this can be achieved, the global net loss of trees, particularly in the tropical moist forests, will still be excessive from a global perspective.

At least two of the five main forest services discussed earlier—preservation of biodiversity and regulation of global climatic patterns through evapotranspiration and carbon sequestration—are of value to the world

as a whole and not just to the countries in which the forests are located. Global interests thus call for a greater preservation of forests, especially tropical moist forests, than do national interests. Incorporating global interests into decisionmaking may be expensive for individual countries if they have to forgo alternative uses that in some instances would bring higher living standards to their own citizens. Of the total area covered by tropical moist forests, 85 percent is in twenty developing countries, most of which have serious poverty problems.

The global externalities from maintaining intact tropical moist forests cannot be measured with accuracy but are probably substantial. They are also undoubtedly increasing as the remaining global stock of tropical

### **Box 2. Sequestering Carbon in the Amazon**

There has been considerable discussion about the role of forests in removing, or sequestering, carbon dioxide from the atmosphere. It is widely recognized that mature forests, particularly tropical moist forests, with their large amount of biomass per hectare, contain a great deal of carbon that is released when these areas are cleared or burned.

In the Amazon region of Brazil, land clearing and burning to create agricultural land and develop pastures have received worldwide attention. Since land uses after conversion produce less biomass per hectare, the net result is an addition to the global atmosphere of up to 125 tons of carbon per hectare. The release of carbon from these actions is considerable; estimates for the peak year of Brazilian deforestation (1987) have ranged as high as 80,000 square kilometers. Recent evaluations indicate that the deforestation rate in the Amazon is now about 20,000 square kilometers a year (Schneider 1991).

Over the 1978–89 period an average 21,000 square kilometers of native Amazon forest was cleared each year. This is equivalent to potential releases of up to 260 million tons of carbon a year as a result of forest destruction (Fearnside, Tardin, and Meira Filho 1990). In comparison, during this same period in Brazil, combustion of fossil fuels—primarily oil, gas, and coal—accounted for less than one-fifth this amount, or an average of 50 million tons of carbon a year (Boden and others 1990).

The total potential contribution to global carbon dioxide emissions of forest burning worldwide is about 1.6 billion tons a year—about 30 percent of the approximately 5.5 billion tons from all fossil fuels burned during a year. Of the grand total of 7.1 billion tons of carbon released, therefore, deforestation accounted for about one-quarter of the total, and the Amazon contributed about 15 percent of the forest-related share, or 4 percent overall (Schneider 1991). Although there is considerable uncertainty about the

moist forests declines. Tentative estimates (summarized in box 2) indicate that the potential value of carbon sequestration in the Amazon is high. Many observers believe that the value of biodiversity protection is even higher. Great uncertainty will surround all estimates of global externalities until the complex ecology of tropical moist forests is better understood. In the meantime, on precautionary grounds alone, the international community needs to actively support the preservation of tropical moist forests.

Forest destruction and degradation, especially in the temperate forests of Eastern Europe, can also be the result of global externalities arising in other sectors. For example, acid precipitation caused by emissions of

forest numbers, other estimates are similar. According to Houghton (in Myers 1989), total global carbon emissions from burning amount to 1.4 billion tons a year, and in the Amazon an average 50,000 square kilometers are burned each year, with each hectare containing 90 tons of carbon.

An economic analysis can be carried out to see whether forest preservation is a cost-effective way of reducing carbon emissions and the associated costs of global climatic change. The costs of damage from climatic change can be compared with the costs of reducing carbon emissions. Nordhaus (1990) estimates the annual cost to the world economy of carbon emissions at \$3 to \$13 per ton of carbon emitted. Therefore, if an average hectare of Amazonian forest contains 125 tons of carbon, the sequestered value of carbon in an undisturbed hectare may be in the range of \$375–\$1,625. These amounts are considerably larger than current land prices of \$20–\$300 per hectare in the Amazonian state of Rondonia in Brazil. It has also been estimated that modest reductions in carbon emissions in the energy sector of developed countries would cost about \$10 a ton. Again, the carbon sequestered in new or preserved forest cover is an economically attractive alternative for reducing total carbon emissions.

Thus, opportunities exist for trades between developed countries and owners of Amazonian and other forest resources. Whether forest cover is used to reduce total carbon in the atmosphere or to offset emissions elsewhere, it appears economically efficient for outsiders to pay owners of Amazonian land not to deforest their land and to preserve the natural forest cover. In addition, there are other important environmental benefits from undisturbed forests, such as preservation of biodiversity and wildlife habitat, watershed and sedimentation benefits, and potential recreational uses. Whether such international transfers can actually be made and enforced depends on a complex and difficult set of issues, including land rights, institutional and economic factors, and national sovereignty, all of which require further analysis.

by-products from use of fossil fuels in some countries has been associated with forest decline in other countries.

### *The causes of poor management and inadequate new planting*

Many of the same social and economic forces that induce excessive deforestation also reduce the incentive to plant trees, either for fuelwood or for timber. From the point of view of tree planting, it is useful to consider trees primarily as an agricultural crop.

As with any crop, a farmer's willingness to plant trees will depend on the value of the crop, the available technology, and the speed with which his or her initial investment is recovered. There are disincentives for planting on all three counts. First, the price of wood tends to be depressed by open access to natural forests and by poorly defined property rights to forestland. Second, there has been relatively little progress in developing higher-yielding, faster-growing trees for farm rather than plantation conditions. Third, the high discount rates of poor farmers make it particularly unattractive for them to tie up scarce capital for the relatively long payoff period involved. Faced with a choice between using scarce family labor for planting and protecting trees or for gathering wood from a receding forest, poor farm families will exploit the commons until the forest is severely degraded. Evidence now accumulating in Kenya, Nepal, and other countries shows that farmers do respond to scarcity of wood by planting trees but that this response is muted and delayed by open access to the forest. Moreover, even when wood prices do increase, they do not adequately reflect externality benefits that can arise from planting trees, such as protection of watersheds, improvement of soil fertility, and the arrest of desertification.

The establishment of large-scale industrial plantations is similarly restricted by the prospects for profitability. Supplies of underpriced timber as a result of cheap access to natural forests will discourage private investment in industrial production of timber in the same way that farmers are discouraged from growing their own firewood and poles.

Farmers' interest in tree planting is also often stifled by public policies and regulations that effectively limit their rights to trees. Limitations on rights to harvest privately owned trees are common in developing countries. Although the original motivation for such restrictions was sound environmental concern, their application to small-scale wood-growing activities retards incentives for replanting. Similarly, restrictions on log transport, often originally instituted because of forestry agencies' inability to control access to the forest effectively, are the

equivalent of a tax on private forest investment even when such investment is carried out in an environmentally sound manner.

Extensive public sector involvement in certain aspects of the forestry sector of developing countries has also discouraged replanting by the private sector. Government ownership of forestland has been widely interpreted as requiring public sector production. Public corporations have frequently had the responsibility for plantation establishment and management but have not been subject to the discipline of private sector competition. At the same time, underinvestment by the public sector in the development of forest technology, including improvement of the genetic base, and the unresponsiveness of government systems for supplying seeds and seedlings have further lowered the relative profitability of forestry.

# 2

## *Strategies for Forest Development*

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The foregoing discussion suggests that the causes of deforestation and of forest degradation are numerous and complex. It is therefore not realistic to expect a significant change in current trends unless governments and international organizations, of which the Bank is only one, make a concerted effort to tackle the challenges. Government policies and programs need to be directed toward changing the incentive and institutional structures that (a) lead to deforestation that is excessive in relation to national interests and is often accompanied by land degradation and (b) restrict the ability and incentives of rural people to pursue tree planting and to implement appropriate management practices. In addition, global externalities, particularly those related to the preservation of tropical moist forests, need to be internalized into local actions through international cooperation and assistance.

Policies must be tailored to the types of forests and actors involved. Preservation of tropical moist forests primarily concerns approximately twenty developing countries. Tropical moist forests, because of the richness of their ecological systems and because they cannot be restored once deforestation has occurred, require a more conservationist approach than maintenance of other types of forest.

Appropriate policies for protecting forests of all kinds will be different if lumber companies rather than settlers are the chief cause of intrusion. Similarly, policies for increasing rural wood supplies will be different when dealing with individuals farming private land rather than groups farming communal or open-access land.

The discussion in this chapter begins with an examination of policies that lead to better management of the forests, including policies for protecting forests of special social and ecological value. This is followed by a discussion of how to achieve a more sustainable balance of demand

and supply for fuelwood and other forest products. Progress on both requires that local forestry institutions be strengthened and that the international community provide additional assistance and cooperation. These two issues are taken up in the last two sections of the chapter.

### **Protecting the Forests**

National policymakers need to move on several fronts to meet the challenge of excessive deforestation and environmental degradation. A fourfold strategy is required. First, and most important over the longer term, policies to alleviate poverty are required to relieve direct and indirect pressures on forests. Second, carefully planned zoning measures and regulations need to be put in place. Third, private incentives for conservation of forests need to be improved. And finally, decisions about public expenditure must take into account the potential impact—negative or positive—of these expenditures on forest preservation.

#### ***Policies to alleviate poverty***

Policies to protect the forests or to slow deforestation seem doomed when pitted against a growing tide of poor who need land to survive. General economic development, including increased diversification of the national economy, reductions in inequality and poverty, and slower population growth, are necessary for a long-term solution to the forest problem and must receive increased priority. The World Bank policy paper *Assistance Strategies to Reduce Poverty* spells out appropriate strategies. For forest conservation, priority should be given to increasing agricultural productivity in poor, densely populated areas, especially those adjacent to forested areas or those where most immigrants into forests originate, and to expanding nonfarm employment opportunities in these target areas.

Increased public investments in agricultural research and extension, rural education, and population policies are required, together with government commitment to further these objectives by meeting recurrent costs. Such emphasis is not always consistent with narrowly defined economic efficiency. (For example, agricultural investments in the most favored agroclimatic regions usually have a higher growth payoff, but these are not always the areas in which the poor are concentrated.) Because of the environmental externalities arising from excessive deforestation, however, greater emphasis on poor areas can still be consistent with the national interest and must be adopted.

### *Forest zoning and regulation*

Part of the forest will have to be protected through specific legislative and regulatory measures. Decisions on zoning and regulation should be based on an understanding of what is expected of the land (box 3) and on a realistic assessment of what is technically feasible in light of local incentive structures and capacity for implementation. In view of the likely limitations on resources and the desirability of increasing the size and number of protected areas, countries must develop workable priority criteria for setting aside specific forest areas that will be protected from any intrusion and for managing areas designated for different uses. This involves undertaking appropriate natural resource surveys in forested areas and determining which areas are of special value for their ecological diversity, which are essential for protecting indigenous forest dwellers, and which protect sites that are environmentally fragile, such as hillsides and watersheds. Available resources for protective purposes can then be focused on these priority areas.

Pressure from interest groups to open new areas to logging can be expected. Since, however, much of the forest is public land, commercial logging can be contained through a strict policy that limits the extent of timber concessions and allows them only in areas that can be put under sustained timber management systems. Given the practical difficulties of achieving sustained management in tropical forests and the related environmental costs, governments should be cautious in allowing such activities there and should give priority to the preservation of intact tropical forests. In temperate forests and, to a lesser extent, in tropical dry forests, experience with sustained management is more encouraging. In all types of forests high priority should also be given to reforesting degraded areas, and new timber concessions could be tied to the successful replanting of degraded lands. Because these areas may have become the source of livelihood for some communities, the interests of these people need to be considered when reforestation is undertaken.

The protection of forests can be enhanced by strengthening the rights and abilities of indigenous communities to control the forest. But part of the remaining forest will continue to be settled in the short term, and indeed, some forestlands, particularly in temperate and dry tropical areas, have alternative uses that can be economically desirable even if all environmental and social costs are considered. Access to and use of these lands need to be regulated to ensure that adequate areas remain under tree cover in environmentally fragile sites and that the land is used sustainably.

### **Box 3. What Is Expected of Systems for Sustainable Use of Forestland**

At least three definitions of sustainability have been applied to the use of forest areas of all types: (a) the continuous flow of timber products or other specific goods or services, some of which may be essential for sustaining the livelihood of indigenous forest dwellers; (b) the continued existence of the current ecosystem; and (c) the long-term viability of alternative uses that might replace the original ecosystem. The extent to which any particular land area can satisfy any or all of the criteria suggested by these approaches is highly site specific and depends on soil quality, topography, markets, and the availability of skills and technology.

If sustainability is broadly defined as ecosystem continuity, only the lightest nonextractive use of forests is acceptable, particularly in tropical moist forests. For example, collection of minor forest products might be allowed, but only on a scale that would not influence the pattern or pace of regeneration. Timber extraction or conversion would be unacceptable. Given the scale of demands for land and forest products, only a small portion of the world's forests will remain in its purely natural state.

If sustainability is defined as the continued provision of specific products or services, the scope is much greater. Box 4 discusses approaches to timber production in some types of forests that are widely considered sustainable if practice adheres to theoretical prescriptions. Other forest services—in particular, protection of water resources—can also be sustained in the face of significant alterations in the forest ecosystem. It must be recognized that in practice only relatively small tropical forest areas have been successfully managed as forest according to any—even very loose—sustainability criteria.

The sustainability of various alternative uses of forestland similarly varies widely. Some of the world's most productive and robust agricultural land was once forested. Conversely, some planned agricultural settlement projects in forested areas have been serious failures. Site selection, technology, and the institutional setting are key determinants of the success of efforts to convert forests to other uses.

Given the experience, especially, of government-sponsored efforts to utilize forestlands, it is prudent to be highly skeptical about proposals to develop forests. In view of the diminishing area of forestlands, especially tropical moist forests, highly demanding environmental and policy analyses should precede any significant new development or utilization efforts. These analyses should include assessments of soils, hydrology, the institutional and incentive framework, and the value of conservation for all concerned, particularly indigenous forest dwellers.

Moreover, since biodiversity and other forest values cannot be preserved in protected forest areas alone, forest utilization practices need to be instituted outside protected areas that will maximize the simultaneous production of multiple forest products and services. Appendix B and box 4 discuss the technological and policy obstacles to achieving sustainable multiple-use management of different types of forest resources.

### *Correcting private incentives*

Zoning and regulation by themselves will not be sufficient to correct the market failures that lead to excessive deforestation. The basic incentives that lead individuals to overexploit the resource must be changed, or the

#### **Box 4. Experience with Sustained Tropical Timber Management**

It is estimated that less than 1 percent of the world's tropical forest is managed in a way that will lead to sustainable timber production—much less preservation of biodiversity and other forest values. But poor performance in managing tropical moist forests sustainably is not a result of technical shortcomings. Sustainable production of timber is technically possible in most areas of tropical forest that have suitable soils, provided that the economic, sociological, and political environment is satisfactory. Four conditions must be met: a permanent forest estate with guaranteed security; adequate control of harvesting, silviculture, and other forestry operations; reasonable profitability; and adequate information on the resource base and markets. The absence of these conditions is often precisely the consequence of the policy and market failures described in chapter 1.

The Myanmar teak forests have been managed under a sustainable system since the 1840s. The accumulated annual increment was removed on thirty-year felling cycles using nondamaging extraction methods (elephants and water transport). The abundance of teak in these forests made them easier to manage sustainably than is the case in the more heterogeneous tropical rain forests.

In 1910, in what is now Malaysia, a series of silvicultural treatments known as departmental improvement fellings was started in the tropical forest. This was modified into a system of regeneration improvement fellings. Later, the forestry department developed the Malaysian Uniform System (MUS), which was used until the late 1960s.

A number of management systems have been tried in other countries. These include the monocyclic, shelterwood, and polycyclic systems. Under *monocyclic systems*, such as the MUS, all merchantable trees down to a specific diameter are removed in a single operation, and the remaining large noncommercial stems are then cut. Treatments promote the growth of desired species, and a second crop reaches maturity after seventy years. This method had shown promise in Malaysia's lowland dipterocarp forests, but most of these forests were converted to oil palm and rubber plantations in the 1960s. The system was unsuitable for mountain dipterocarp forests and was replaced by the Selective Management System (SMS), described below.

Under *tropical shelterwood systems* (TSSs), tested in Nigeria and Ghana in the 1940s and 1950s, the canopy is opened several years before harvest to provide adequate regeneration. The system was unsuccessful because of the low regeneration rates of the prime economic species, vine infestation, and high labor costs. A recent development of this system is being practiced with rather more success in Peruvian Amazonia (Palacazu Valley); it is known as the "strip shelterbelt system."

*Polycyclic systems*, such as the modified selection system of West Africa and the SMS of Malaysia, are designed to ensure the regeneration of the commercial species that will become the final timber crop after twenty to thirty years. These systems are showing more promise. They rely on efficient monitoring of stand development, with thinning where necessary to favor the growth of promising individual timber trees. Since 1970 peninsular Malaysia's forests have been managed on the SMS. Although the SMS has not yet been in operation for three harvests, preliminary indications, based on the measurements of upper-canopy trees, are that sustainable management has good prospects for success. These systems are considered moderately successful in Malaysia, but there is little evidence to suggest that current systems are working satisfactorily elsewhere—apparently because of the way in which the system is being implemented rather than the system itself.

In practice, it is reasonable to expect that industrial forest management is compatible with three of the widely desired functions of forest ecosystems: timber production, carbon fixation, and protection of water resources. The compatibility of industrial management with biodiversity and the welfare of forest dwellers (see box 5) is considerably more contentious. The selective preference of commercial systems for high-value or rapidly growing species will influence the architecture and composition of the forest. This, in turn, will affect the availability of niches for certain species, subjecting them to stress and diminishing biodiversity. Commercial forest utilization, however, does not entirely eliminate biodiversity, and systems can be designed and implemented so as to be less disruptive to the ecosystem.

administrative and enforcement powers of government will be overwhelmed.

**LOGGERS.** Since most logging occurs on public lands, timber concession arrangements directly condition resource management and utilization. The evidence suggests that in many instances government policies or corruption lead to overly lenient granting of concessions in areas which should not be logged. Frequently, there is also a systematic underpricing of concessions, which reduces the logging companies' extraction costs and makes logging more profitable. At the same time, governmental reluctance to offer long-term concessions that would encourage loggers to replant or engage in sustained harvesting and management practices raises the incentive for quick "mining" of the trees.

To correct these distortions in areas in which logging can be justified from both a social and an ecological perspective (for example, in some temperate or secondary forests and in mature plantations), timber concessions should be modified to reflect the real value of the trees and should be adjusted over time for inflation. Timber concessions—felling leases or licenses, and logging rights—should be sold through competitive bidding (auction or tender) that is open to the private sector, NGOs, and local communities and is adjusted as necessary to take account of externalities. Concessions should be long term and, with appropriate controls, transferable. Properly constructed timber concession terms would not only provide more appropriate incentives to loggers but would also generate additional public revenues. These revenues could then be used to supplement available funds for financing reforestation, forest protection activities, and other government functions. Restructuring concession terms in this way will require considerable upgrading of forestry institutions and strong political commitment.

**FARMERS, RANCHERS, AND FOREST DWELLERS.** Incentives for agricultural settlers are sometimes distorted by agricultural policies. For example, in Brazil the returns from livestock ranching in the Amazon were, until recently, grossly inflated by subsidies and tax policies that encouraged ranching. Moreover, the land titles issued to settlers were conditional on clearing the forest. Obviously, these kinds of distortion should be removed whenever they arise.

Lack of adequate economic incentives is also a result of absent or weak property rights to forestland and trees. Many indigenous groups that have traditionally resided in or near forest areas have customary rights to land and trees, sometimes shared with certain nonresident groups that are entitled to gather forest products or to graze their cattle. These

traditional rights, however, are often ignored or transgressed by various forest encroachers. Customary land rights need to be formalized and respected to protect both forest people and resources against excessive agricultural encroachment or exploitation by outside commercial interests. Governments should provide local communities with security of property or usufruct rights, thus ensuring stable incentives for cooperation in sustainable management schemes, and must recognize these social groups as key actors in the preservation of forests (box 5).

Economic incentives for more appropriate use of the forests also need to be enhanced by policies that specifically favor the trees. For example, the development of ecotourism and of markets for nontimber forest products such as medicines, berries, and fodder could increase the value of the forest in relation to nonforest use of the land.

### ***Public investments***

Public investments can have enormous direct and indirect effects on forests. Many infrastructural projects—roads, railways, power lines, dams, and so on—inadvertently open up forestlands to settlers, as do some mining operations and oil explorations. Unfortunately, some public health programs have the same effect; examples are malaria control and control of tsetse flies, which makes possible more widespread ranching operations. Publicly sponsored settlement schemes have also been a significant cause of forest conversion. Public investments need to be preceded by careful environmental assessments, which might include a cost-benefit analysis that assigns a value to all important environmental effects. Experience in applying available economic valuation methodologies to environmental problems in developing countries is scarce. Considerable progress has been made over the past fifteen years in refining techniques for the shadow pricing of environmental services, but continued research and development to find practical approaches is necessary. Moreover, emphasis needs to be given to developing capabilities for multidisciplinary policy analysis if environmental problems are to be adequately addressed.

Public investment can also contribute significantly to

- Strengthening forestry institutions to improve their ability to protect designated forest areas, to issue and enforce more responsible timber concessionary arrangements with logging companies, and to enforce desired regulations in settlement areas
- Developing improved systems of silviculture, forest management, and policymaking. Forest research and development in public

**Box 5. Forest-Dwelling Populations**

Indigenous and forest-dwelling populations are important social actors in forest-related programs. The people found in forest areas can be grouped into three broad categories: people who have lived in the area for generations (indigenous), people who have recently moved into the area (settlers), and nonresident groups who enter periodically to extract selected resources. The first two actually reside in the forest, but the last group often plays a significant role in the deterioration or shrinkage of the forest. Development strategies designed to relieve local pressures on forests must involve all three groups differentially and should be tailored to reflect the needs and capabilities of these three types of populations.

The production systems of communities that have occupied a forest for generations are often based on shifting cultivation with long fallow periods and present little or no threat to forest areas as long as population size and density remain low. External pressures on indigenous people are reducing their resource base, however, and are making previously viable production systems more precarious. Improvement of indigenous people's ability to protect forest areas and to intensify their production systems is often needed. Appropriate programs should also encourage culturally acceptable development. Forest comanagement, the establishment of extractive reserves, and marketing of forest products are ways of ensuring benefits to indigenous communities.

Projects intended to conserve or utilize forests may have significant adverse social impacts on human communities whose livelihoods and cultures depend on forest areas. The most severe social effect is the involuntary displacement of forest dwellers, which has sometimes occurred because of conflicts between new settlers and forest-dwelling groups. The World Bank's policy is that involuntary resettlement should be avoided whenever possible, since it carries with it high risks of impoverishment of indigenous populations. Involuntary resettlement of forest dwellers is also rarely practical: suitable land is difficult to find, and usually other settlers quickly move into the cleared areas. According to the Bank's policy and operational guidelines, projects should thoroughly explore all alternatives to involuntary resettlement. Alternative approaches should incorporate forest-dwelling people as direct participants and beneficiaries in the design, implementation, and operation of forest projects.

Populations living outside but near forest areas usually have customary rights to gather fuel, fodder, and nontimber forest products. The pressure on forests from agriculturalists and landless people living outside the forest can be more intense than that caused by forest dwellers. To cope with such pressures, agricultural diversification and intensification programs in areas close to forests should emphasize food production and income generation, thus mitigating the threat of encroachment on the forest.

agencies needs to be expanded and professionalized. Improved technology transfer mechanisms and incentives for the rapid application of new systems are also needed.

- Carrying out afforestation and replanting, especially of degraded lands.

### **Meeting the Growing Need for Forest Products and Services**

The global demand for industrial wood can increasingly be met by timber from sustainable forestry systems in temperate forests. The supply of other forest products and services in the developing countries is more of a problem. Planting and management have frequently been inadequate, the gap between wood stocks and needs is rapidly widening, and harvested land is suffering environmental degradation. The basic goal of policy should be to change attitudes and incentives so that wood is perceived as another agricultural crop—as a commodity to be raised by farmers and plantation owners, using high-yielding technologies for profit, and not as a free resource to be mined from the forest. To achieve a more sustainable balance between supply and demand requires action on both sides of the market equation—to reduce the demand for fuelwood and poles and to increase the supply through policies that encourage the planting and husbandry of trees.

#### ***Reducing demand***

In urban areas people accept having to pay for wood, charcoal, and poles and have created markets for these products. Wood markets are much less developed in rural areas, where people still find it more economical to gather than to buy wood. As wood becomes scarcer, more widespread and more efficient markets are likely to develop, and price increases will play a greater role in constraining the growth in demand. But because of environmental externalities and inadequate property rights, market prices will generally not reflect the full social value of wood. For this reason, direct interventions to encourage conservation and the use of more efficient technologies are necessary.

These interventions include research and training to improve the fuel efficiency of household stoves, brick and charcoal kilns, and other wood-burning equipment. In addition, incentives need to be increased for the substitution of alternative fuels and for energy conservation. In many rural areas supplies of alternative fuels, such as kerosene, are restricted and costly, and more efficient marketing systems need to be developed. Investment subsidies may also be appropriate in the initial stages to encourage individuals to purchase the necessary equipment for

converting from wood-burning technologies, particularly when new and innovative technologies (such as solar stoves) are involved.

### *Increasing supply*

Most wood users in developing countries live in rural areas. The best way of satisfying their demand for wood and for the services that trees provide is by mobilizing their own labor and land, for tree planting and for better management of nonforest trees. Supply of rural wood through large-scale commercial operations is not likely to be viable except in very special circumstances. Nor is continuation of widespread wood gathering in forests and other wooded areas sustainable or environmentally acceptable. It is increasingly recognized that wood production issues should be dealt with at the farm level and that significant areas are being reforested and brought under management through the efforts of farmers responding to growing scarcities. Promoting awareness of the role of trees in retaining soil fertility and averting degradation will also help reduce demand for products that require cutting trees. Forestry departments need to be reoriented in light of this recognition, and the special capabilities of nongovernmental organizations concerned with the alleviation of poverty and with environmental conservation should be mobilized to help users organize themselves for tree planting.

Expansion of planting and improvement of management will only be possible if economic incentives and the abilities of farmers are enhanced. This will require extension and training services, a ready supply of tree seedlings and other inputs, and, in some cases, improvements in rights to land and trees. Incentives for encouraging participation by smallholders and the private sector in forest management and reforestation have been tested in Brazil, Haiti, India, and elsewhere. Such incentives range from subsidized distribution of seedlings to fiscal incentive and credit programs. Much has been learned about how to increase significantly the productivity of natural woodlands and forests by well-proven silvicultural practices such as early burning, lopping, and pollarding. Low-cost reforestation technologies such as direct seeding of trees by smallholders are being increasingly adopted by farmers in the tropics.

In the late 1970s and early 1980s planners and foresters assumed that large amounts of fuelwood could be produced on community woodlots established on lands managed under common-property tenure regimes. The evidence about community woodlots increasingly indicates that they frequently did not achieve their stated objectives. Failure was mostly attributable to communities' lack of incentives and of adequate organizational arrangements for carrying out collective actions. Com-

munity woodlot schemes often had no clear labor-sharing responsibilities, no tree tenure security for those who provided labor, no self-management systems for woodlot participants, and no transparent arrangements for distributing benefits.

Future social forestry programs should therefore focus their participatory approaches on more carefully elaborated social and institutional arrangements. The poor, especially women, should be included, and the groups that are organized should be of a size compatible with incentives for planting and maintenance.

Two approaches are more likely to be successful than the previous emphasis on community woodlots: (a) *family-centered* strategies and (b) *group-centered* strategies (based on groups larger than the family household). Public investments in social forestry should be made through both and have the potential of attracting large complementary investments by the actors themselves, through labor, land, and inputs. Local participatory forestry approaches must recognize and integrate the characteristics of social actors, land tenure systems, tree tenure systems, and technology.

**FAMILY FARM FORESTRY.** Recent experiences offer a broad spectrum of tested approaches and models that can be utilized. Family forestry programs in Haiti, India, Nepal, Nigeria, and other countries have shown that good results can be obtained by programs adapted to suit the labor and land opportunities available to the individual farm (box 6).

**GROUP FARM FORESTRY.** Group-centered strategies have also generated successful models. The principle underlying these approaches is to link specific groups of people who have surplus labor resources with well-defined plots of land that are unused or underused and can be brought under tree cover. Programs directed to women can be particularly effective (box 7). Several examples illustrate promising approaches. In a scheme successfully implemented in India, denuded land was leased over a sufficiently long period to established groups of small farmers or landless laborers who planted trees as a cash crop and were given ownership of the trees. In other countries (Japan and Pakistan) forest cooperatives or associations have been established either for the ownership and management of privately held patches of forest or for joint marketing of forest products. Another innovation establishes a contractual relationship between the forestry department and former forest encroachers whereby, in exchange for steady employment in reforestation activities and access to some secondary forest products, the former

**Box 6. Successful Family Farm Forestry in Haiti**

Family farms hold great potential for incorporating tree planting into their production systems when security of tree tenure is guaranteed. This was demonstrated in Haiti by an agroforestry outreach project. Guided by knowledge of Haitian tenure systems and farmers' behavior, the agroforestry project was designed around the family farm. (The average smallholding in Haiti is 1.5 hectares.) Under this project the family was expected to plant 500 trees of fast-growing fuelwood- and pole-producing species in intercropping and border plantings. Lightweight micro-seedlings were provided free to the farmers, together with technical assistance. Most important, the project guaranteed that the farmers themselves, not the government or the project, would be the sole owners of the trees and that they would have unlimited decisionmaking rights to harvest, use, or sell the wood whenever they wished. Nongovernmental organizations were involved in carrying this message to the farmers.

The results were outstanding. The target was 3 million trees planted on 6,000 family farms. As it turned out, 75,000 families joined the effort voluntarily and planted 20 million seedlings. The key ingredient of success was providing the family farm with a balanced combination of economic incentives, secure ownership of the trees, and technical assistance while giving the farmer full autonomy in decisionmaking.

encroachers participate with the forestry department in forest conservation and protection against further encroachment.

**Strengthening Forestry Institutions**

Implementing the strategies discussed above—with regard to both forest protection and new planting—will require stronger and reoriented forestry institutions. Like the public institutions in other sectors of many developing countries, forestry institutions are in great need of strengthening. Prevention and amelioration of environmental damage and the integration into forest management of measures to correct for externalities and market failures should be among the principal tasks of forestry institutions. Instead, the forestry institutions now in place in many developing countries frequently focus on the extraction of revenue from the land. Forestry agencies have often been pressured by political demands for concessions to special interest groups and are expected to provide low-cost supplies of raw material to industry, rural employment opportunities to the landless poor, and a multitude of other goods and

### **Box 7. Women in Forestry**

Because of the traditional gender division of labor, women have specific needs and interests in forestry that have often been ignored in planning forestry projects. In most rural areas women and children collect the household's fuelwood for cooking and heating, as well as a variety of food products, medicinal plants, raw materials, and marketable nonwood products. Women are repositories of knowledge that men may not have about forest products, plant attributes, and traditional methods of tree management.

Bank-assisted social forestry projects must recognize that in parts of Asia, Africa, and Latin America women have often proved more interested than men in raising trees for fuelwood, fodder, and salable nonwood products. Although there has been some attention to women in Bank-funded projects, a much more concerted effort is needed in the future. Forestry programs that do not consciously plan for women's needs can miss significant opportunities to increase returns on forestry investments and can worsen the situation of women and their families.

If forestry projects are to successfully involve and benefit women, there is a need for more refined gender-based planning during the preparation phase. For example, women's tenure rights to land and newly planted trees must be strengthened, and women's groups should be assisted to undertake their own plantation or rehabilitation activities. Direct involvement of women in management schemes can reduce the destruction of forests caused by fuel and fodder gathering. To increase incentives to women, their incomes must be substantially raised by assisting them to gain access to wider markets for forest products and by enabling them to undertake value-adding processing of primary forest products.

Women's participation should be an integral part of project objectives and strategies, and progress on this front must be an integral part of supervision and evaluation. Within projects, there is a need for better technical forestry training for women. When Bank projects create awareness of how diminished collection time can increase women's productivity, the local propensity for producing fuelwood and cash-remunerative tree products increases.

services. The integration of these multiple, and sometimes contradictory, functions into coherent programs is difficult, and many forestry agencies need more political support and strengthening to prevent their drifting away from their essential roles and missions. Accounting systems and procedures need to be made appropriate for managing important economic and environmental assets, producing and marketing output,

planning and carrying out investments, and introducing technical innovations.

In many countries conflicting and irrational legislation and regulations that affect forestry directly and indirectly have proliferated. Laws and policies relating to rights of local people, forest dwellers, and commercial entities frequently overlap, are contradictory, or are completely absent. Legal obstacles to NGO activities are also common.

Governments are increasingly recognizing the scale of demands for conflict resolution and mediation now placed on forestry agencies. Governments must act on the critical need to restructure forestry institutions, improve training and equipment, and introduce greater accountability and higher performance standards into the public sector. Creative uses of private sector contractors and consultants as auditors and monitors and more rigorous intersectoral oversight by agriculture, environment, planning, finance, and other relevant ministries are effective devices for improving the performance of government forestry agencies. Commitment at the highest levels of government is necessary for introducing these reforms. Past forest policies in many developing countries have been hampered by lack of adequate participatory approaches to timber management. Because two-thirds of the tropical forested area lies outside the domain of government forestry departments, the key to sustained-yield management of open access woodlands and on-farm trees lies in mobilizing the involvement of local communities and small farmers. Traditional village associations, NGOs, and farmers need to be supported by effective rural forestry extension services. Experience suggests that this is best achieved by building forestry into the mandate of existing agricultural extension agencies, with foresters serving as trainers in tree management and planting technologies.

### **The Role of the International Community**

The policies and programs described in this chapter will need the active support of the international community, both in assisting developing countries to achieve their own national goals in managing their forest resources and in providing ways of better incorporating the value of the global externalities from forests into incentive structures for local action. International legal instruments, being discussed currently in various forums, demonstrate the wide interest in these objectives for international action. The adoption of such instruments could also facilitate the transfer of resources to promote the conservation of tropical forests. There are three main areas in which the international community can

play an important role: technical assistance, research, and institution building; financing; and international trade reforms.

*Technical assistance, research, and institution building*

Developing countries need assistance in undertaking detailed resource inventories of their forests. Such assessments are essential for establishing priority areas for forest protection, demarcating areas in which commercial forestry or agricultural activities could be sustained on a viable basis, and establishing management procedures throughout forested areas (for example, pest control, protection of specific tree species, and protection of watersheds and hillsides). Assistance is required in developing appropriate criteria for forest use plans, providing training and specialized skills for forest management, and strengthening local institutions so that they can better meet the challenges of their forest planning, protection, and management functions.

Since the early 1980s the world community has recognized the diverse needs inherent in global forestry, and various international and national groups have taken significant steps to address these needs. The Tropical Forestry Action Plan, initiated in 1985, was expected to make a major contribution to arresting tropical deforestation, but the results have fallen well short of expectations. The current effort to revise the plan should be continued. This process focuses on reformulating the goals and objectives of the plan and developing institutional arrangements to ensure that the revised plan is effective and is fully consistent with the general thrust of this policy paper. For example, there is an emerging consensus that future institutional arrangements for the Tropical Forestry Action Plan must facilitate (a) the integration of the plan's national-level efforts with other national planning and decisionmaking exercises, (b) the use of a multisectoral and multidisciplinary approach, (c) the participation of local people whose livelihoods depend on the forest, and (d) the adoption of sound policies to safeguard the sustainability of forest resources. Furthermore, a clear need has been expressed for an international forum that can provide a broad strategic orientation for efforts by developing countries and donors to address the challenges entailed in the conservation and wise use of tropical forests. An international consultative group on tropical forests will probably be formed to provide advice on strategic policy issues, national and international, of importance to the fate of tropical forests; to help identify overall priorities for the development of programs to conserve and manage tropical forests; to provide a forum through which interested parties can raise their concerns about adherence to the goals and objectives of the Tropical

Forestry Action Plan; to serve as a clearinghouse for identification of critical problems being encountered in the principal tropical forest countries; to undertake periodic review of the impact of the Tropical Forestry Action Plan; to promote dissemination of information on research results, country experience, and "best practice"; and to help identify funding needs and sources.

Another important step is the inclusion of forestry, agroforestry, and related environmental issues under the mandate of the Consultative Group on International Agricultural Research (CGIAR). An extensive review has been undertaken of the potential for incorporating forestry more directly into the CGIAR system. Two new institutions being brought into the system—the International Council for Research in Agroforestry (ICRAF), which will primarily address agroforestry issues, and a new entity to be created soon—will share a strategic research agenda on forestry. In addition, of eighteen CGIAR centers, ten are including in their research programs work on the technical or policy aspects of tree production. Other activities include the establishment of the Special Program for Developing Countries within the International Union for Forestry Research Organizations and the increased support for augmenting national forestry and agroforestry research capacity in developing countries themselves.

There is a particularly urgent need for a strong global research effort to deal with deforestation and the associated problems of loss of soil and forest productivity, increased carbon emissions from the burning of forests, watershed degradation, and loss of biodiversity. This thrust must extend beyond forestry to include research on appropriate policies for containing deforestation and on sustainable agriculture in the tropics. At the same time, it must include a significant increase in the more traditional research on tree selection and improvement, as well as on management of natural forests.

### *Financing*

If forest policy is to correct the market distortions and failures highlighted in this paper, special mechanisms may be needed to finance the required resources. From the financing perspective, measures to correct the policy and market failures discussed in chapter 1 fall into three categories: those, such as the elimination of perverse policies, that involve only small incremental resources and that will pay for themselves in reduced fiscal burdens and other costs to the economy or even by generating additional tax revenues; those, such as protection of locally important watersheds, that involve domestic externalities and inade-

quate property rights and that can be financed domestically or on nonconcessional terms from external sources; and those, such as preservation of globally important biological diversity or carbon sequestration, in which the benefits accrue partly or entirely outside the country and for which international transfers and concessionary terms may be appropriate.

Management of externalities that are completely contained within one country is eminently suited to public action. If physical measures, such as protection of critical watersheds or reforestation of coastal mangroves, can be linked to flood or siltation control or to increased fishery productivity, and if systems of recurrent cost recovery and resource protection can be installed, public investment is appropriate. The externalities should be treated as additional benefits in the economic analysis of such projects. Not all domestic externalities in the forestry sector will justify public investment. (For example, the downstream benefits of watershed management may be small in relation to costs.) This, however, is an empirical question that needs to be examined case by case, using established methods of environmental and economic analysis.

As discussed earlier, protection of large areas of natural forest entails global externalities. These benefits can be viewed as services rendered by one country to the global community. International transfers and concessional financing are thus appropriate for supporting such projects.

Debt-for-nature swaps provide a good example of financial arrangements in this category. The recently established Global Environment Facility is a useful mechanism for testing innovative financing approaches, and the experience gained in its operation may lead to follow-up initiatives.

Creation of a large-scale system of international transfers is impeded by difficulties in valuing appropriate levels of transfers, reluctance on the part of developed countries to provide resources, and difficulties in monitoring performance. Development assistance agencies should focus on the removal of perverse policies and the management of domestic externalities. This will simultaneously serve the interests both of developing countries and of the world community. To the extent that policy reforms and projects respond to the desires of the international community to manage global externalities, they should be financed by flows of funds that are additional to existing levels of official development assistance.

### *International trade reforms*

Only a very small share of the wood that is cut from primary forests each year enters international trade, but the share is much larger for high-

value and rare species. Experience with other products suggests that consumers will modify their behavior substantially if they are given information on the ecological sustainability of the production process. For this reason, the international community should encourage organizations such as the International Tropical Timber Organization (ITTO) to develop programs of green labeling to permit preferential market treatment for wood grown under sustainable conditions. In addition to lowering the overall demand for wood produced by unsustainable practices, such a scheme would remove the disincentive for adopting improved management practices that might otherwise diminish competitiveness.

A more contentious issue is that of trade taxes on tropical timber. Such measures may be desirable to the extent that (a) taxes (whether import or export) could be targeted to those species that are culled exclusively from primary forests, (b) taxes would apply equally to processed wood and to logs, and (c) revenues raised would be returned to developing countries to be used for forest protection activities. If these conditions are not fulfilled, trade taxes are likely to create additional distortions by discouraging new plantings and plantation agriculture and by protecting inefficient domestic wood-processing industries, thus placing an unfair burden on countries that are heavily dependent on timber exports. More research is needed on these issues before such taxes should be supported.

# 3

## *The Role of the World Bank*

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The World Bank's role in the forestry sector will be directed toward supporting member governments and international initiatives in formulating and implementing the policies and programs described in the previous chapter. This chapter briefly reviews the evolution of Bank activities in the sector and describes the principles of future involvement.

### **The Evolution of Bank Involvement**

Bank lending to the forest sector has mirrored the Bank's overall approach to the development process. Early lending for forest-based industries and extraction of raw material came at a time when the development process was seen largely as a problem of capital accumulation and the utilization of idle resources. As the Bank turned its attention to a broader social agenda—the alleviation of poverty, rural development, and women in development—these concerns were incorporated into Bank support to forestry. Bank lending to the forestry sector grew rapidly following the issuance of the 1978 policy paper on forestry. Before fiscal 1978 total commitments had been only \$199 million for seventeen projects. Since then an additional \$2.3 billion has been committed for seventy-seven free-standing forestry projects. Another significant aspect of the Bank's work in forestry has been the forestry components of agriculture and rural development projects, some of which have experimented with soil and moisture conservation and other technologies aimed at stabilizing marginal agriculture that would otherwise infringe on forested areas. Bank lending for other agricultural subsectors, particularly tree crops and agricultural settlement, has some-

times had undesirable effects on the forest resource, as have projects in other sectors such as infrastructure.

According to the recent report by the Operations Evaluation Department (OED) of the World Bank on the Bank's experience in the forest sector from 1949 to 1990, the Bank needs to strengthen its forest sector work and to link it more strongly to other country economic and sector work; to improve the technical performance of projects; and to design social forestry projects with a better understanding of local sociocultural structures and the motivations of different social actors in tree planting and management. In particular, the OED report highlights the following (see also appendix D).

- Forestry projects need to be more carefully prepared and processed, and longer time frames should be considered for some types of forestry projects.
- Broader involvement of people in planting trees on and off farms is necessary and feasible, under innovative social forms.
- If cooperation and coordination among many line agencies are required in the planning and implementation of a project, an effective mechanism for coordination is crucial.
- Monitoring and evaluation need to be improved considerably to facilitate supervision and final evaluation.
- Land tenure and potential land use conflicts should be thoroughly investigated during project formulation.
- Market analysis and market programs should be an integral part of project preparation.
- Pricing policies should adequately reflect the environmental benefits obtained from forests.
- The development of buffer zones around remaining natural forests should be a national priority.

The report also emphasizes the role of institutions, in particular, property rights and organizational arrangements; the improvement of complementary services (such as research and extension and marketing); recognition of intersectoral and macroeconomic linkages that affect the sector; the need to center operations around land use; and the need to increase the capability inside and outside the Bank for assessing natural resources and to strengthen the role of local communities in managing forest resources. Finally, experience suggests that in the 1990s greater emphasis than in the past should be given to "program" operations as against discrete project operations. But the success of sector loans will depend on a consistent sector policy, a comprehensive forest management component, favorable macroeconomic policies, a large

infusion of resources for human capital development, and a clear recognition of the interplay among the forest, people, and culture. These findings, as noted by the OED, are consistent with efforts under way in several recent Bank projects. Operations that are successfully employing approaches along these lines are described in box 8.

As noted in the preceding chapters, the scope of forestry problems faced by developing countries has changed dramatically, and the understanding of their causes and implications has improved. The changed circumstances and the lessons learned from reviews of experience with earlier approaches require a reformulation of the Bank's forest policy. This policy paper takes these factors into account while recognizing that the Bank is only one of the many national and international entities which need to join forces to meet the new challenges.

#### **Box 8. Innovative Features in Recent Bank Forestry Loans**

In attempting to address the growing challenges of the forestry sector, the Bank continues, through its lending program, to encourage governments to innovate and experiment. Some recent examples are:

- The involvement of about 4,000 forest-user groups in forest management in Nepal
- The establishment of an environmental planning and managing unit in Sri Lanka that will develop and enforce environmental guidelines in all national forest use programs
- Support for an initiative by the World Wildlife Fund and the U.S. Agency for International Development to protect a specific forest area for wildlife management in the Central African Republic
- The strengthening of property rights in buffer zones around two forest areas in Guinea
- Support for women's groups in tree planting and woodlot management in Zimbabwe; participation of local communities in a wildlife management scheme
- Development of environmentally sound guidelines for managing plantations in China; the guidelines will be applied to the government's entire national planting program and not just to the Bank-supported part
- Involvement of private sector expertise to improve the enforcement of timber concession terms in Indonesia
- The introduction of competitive bidding for timber concessions in Ghana.

## **Principles of Bank Involvement**

Bank involvement in the forestry sector will be designed as a component of a multisectoral approach whereby operations in other sectors, such as energy and industry, are required to consider the implications for forest development and conservation. Attention to forest issues needs to be incorporated into the general policy dialogue and the country assistance strategy. To relieve the fundamental pressures on the forest over the longer term, the Bank, through its normal mechanisms, will continue to support population policies, agricultural intensification, the alleviation of poverty, and the creation of employment opportunities in other sectors. The Bank will give closer attention to infrastructural and other land-using projects and will work to minimize their potentially negative effects on forests. In its efforts directly related to the forest sector—aid coordination, country dialogue, sector work, and lending—the Bank will promote international cooperation, policy and institutional reform, resource expansion, and forest preservation.

### *International cooperation*

A number of initiatives for the conservation and wise use of tropical forests are in various stages of discussion and formulation. These include a forests convention, a biodiversity convention, and a global biodiversity strategy and action program. These efforts are an outcome of the growing worldwide consensus on the global importance of forests. Should an international instrument on the conservation and development of forests emerge, it would clearly influence the role of the Bank in the forest sector. The Bank's forest program will need to evolve in ways that are complementary to and mutually supportive of parallel initiatives that currently exist or may emerge over time. The Bank will maintain and improve its regular consultations on forest issues with the regional development banks, as well as with the Food and Agriculture Organization of the United Nations (FAO), the United Nations Environment Programme (UNEP), IITD, and NGOs. The World Bank has been active in the efforts to revise the Tropical Forestry Action Plan, as described in chapter 2. It will continue to take the initiative in collaborating with other interested parties in reformulating national and international processes under the Tropical Forestry Action Plan to make them a more effective means of addressing the problems of the use and conservation of tropical forests.

Through involvement in activities such as the Global Environment Facility (GEF), the Bank will encourage the transfer of concessional

resources from developed countries to those developing countries that are taking effective measures to safeguard world biodiversity, particularly in tropical moist forests, because these countries contribute to the global welfare by forfeiting the development benefits that they could derive from the exploitation of their forests. In addition to its support for specific projects, the GEF is designed to be a means of testing new policy and program approaches to preservation. To accomplish this, it is harnessing the experience of the United Nations Development Programme (UNDP), the UNEP, and the Bank. This combination is uniquely suited to developing broad intellectual leadership in addressing environmental issues. As experience is gained through GEF support for forest conservation, the types of activities and the nature of financing requirements will be assessed.

Through the CGIAR, the Bank will assist in the expansion of forestry research and the integration of forestry and other natural resource management concerns into the work of the International Agricultural Research Centers. The Bank will also collaborate with scientific organizations such as the International Institute for Applied Systems Analysis (IIASA) to develop improved scientific understanding of the causes of forest decline associated with acid precipitation.

#### *Policy reform and institution strengthening*

To enable the Bank to assist governments in identifying and rectifying market and policy failures that encourage deforestation and inhibit sustainable land use, the Bank's economic and sector work should address forestry issues within a multisectoral context. This is also in line with the OED's recommendations. Of importance here are reforms of concession policies, forest revenue systems, fiscal, tax, and agricultural policies, infrastructural and land use planning procedures, land tenure systems, and enforcement mechanisms aimed at creating a proper institutional and incentive structure. The Bank will assist governments in completing resource inventories and establishing systems for continuous resource assessment. Special emphasis will be given to expanding public participation in resource planning and management and to mobilizing private sector investment resources and skills. The Bank will support improvement in the performance of government agencies that deal directly or indirectly with forestry through improved training of staff, improved compensation, better equipment, and creative use of private sector contractors and consultants. Governments will be encouraged to increase intersectoral oversight of forestry and other land management agencies to monitor achievement of forestry goals. Alternative

applications of the multisectoral approach will be the subject of experimentation through pilot projects or programs in a few countries. The Bank will encourage more effective collaboration among traditional forestry services, agricultural extension agencies, and NGOs. All this implies that forest policy in rural areas will need to be inextricably linked to the planning and implementation of agricultural, household energy, population, and other related sectoral activities.

### *Resource expansion and intensification*

The Bank will increase its efforts to finance the creation of additional forest resources and the expansion and intensification of management of areas suitable for sustainable production of forest products. The Bank will promote a continued reorientation of forestry toward participation by rural people in tree planting and conservation of indigenous woodlands. In the past, social forestry projects have had mixed results, and the lessons learned indicate that the Bank's investments in woodlots and agroforestry need to be built on the identification and mobilization of specific social units capable of implementing forestry investments. Farm family and farm group forestry approaches have been effective in a number of countries. The keys to expanding the mobilization of such groups are a balance of economic incentives, security of tree tenure, motivation, and technical assistance. Special efforts will be directed toward agroforestry technologies that can help improve soil fertility, conserve soil moisture, and increase crop and livestock yields. Cash crop tree farming in rural areas will be encouraged in situations where it can be clearly demonstrated that this will not have adverse effects on local people's access to essential fuelwood and fodder supplies. More emphasis will be given to market intelligence and marketing systems for cash crop tree farming and to assisting small-scale wood-using enterprises in rural areas. Where the scope for plantations outside areas of intact forests is sound from a social, environmental, and economic perspective, the Bank will assist their establishment as a means of reducing pressure on the existing forest resource base. The primary target areas for new planting will be potentially productive degraded forests, wastelands, forest fallows, shrublands, and abandoned farmlands. The interests of communities that depend on such areas will have to be considered in setting target areas. The Bank will also finance pilot experimental forest management operations aimed at expanding knowledge regarding sustainable utilization of degraded forest areas.

### *Preservation of intact forest areas*

The Bank will support initiatives to expand forest areas allocated as parks and reserves and to institute effective management and enforcement in new and existing areas. In particular, the Bank will assist governments in protecting high-priority areas as identified by the International Union for the Conservation of Nature and by local conservation experts through the provision of support for the preparation and implementation of conservation plans. The Bank will stress new approaches to management of protected areas that incorporate local people into protection, benefit sharing, and planning and will highlight the need to consider the needs and welfare of forest-dwelling people. Experimental programs to test alternative approaches to the participation of local people and to the promotion of nonwood products of natural forests to benefit such people will also be financed.

In tropical moist forests, the Bank will adopt, and will encourage governments to adopt, a precautionary policy toward utilization. This policy is motivated by uncertainties regarding the full valuation of environmental services, the inadequacy of knowledge concerning sustainable management systems, and the irreversibilities associated with loss of tropical moist forests. Specifically, the Bank Group will not under any circumstances finance commercial logging in primary tropical moist forests. Financing of infrastructural projects (such as roads, dams, and mines) that may lead to loss of tropical moist forests and other primary forests will be subject to rigorous environmental assessment as mandated by the Bank's operational guidelines for projects that raise diverse and significant environmental issues. A careful assessment of the social issues involved will also be required. The Bank will continue to place more emphasis on support to programs that involve institutional development, forest protection measures, and nonforest income-generating projects, the primary objective of which will be the preservation of tropical moist forests. In implementing this strategy, the Bank will pay special attention in its forestry lending to the twenty countries (accounting for 85 percent of tropical moist forests) in which forests are seriously threatened by encroachment and destruction (see table 2 in appendix C). In these countries special efforts will be made to support economic development in poor, densely populated areas around the forests or in the origin areas of forest encroachers. The Bank's efforts in forest conservation will also be directed toward ameliorating environmental damage in temperate and boreal forests. Investments will be directed toward

rehabilitation and reforestation of degraded forest lands, coupled with support for programs to abate industrial pollution and conserve energy.

### *Conditions for Bank involvement*

In all countries, and for all types of forests, lending operations in the forestry sector will distinguish between projects that are clearly environmentally protective (for example, reforestation to protect watersheds) or which are oriented toward small farmers (for example, farm and social forestry) and all other forestry operations, such as commercial plantations. The first two types will be considered on the basis of their own social, economic, and environmental merits. Other lending operations in the forest sector will be conditional on government commitment to sustainable and conservation-oriented forestry. Such a commitment entails:

- Adopting policies and an institutional framework to ensure conservation and sustainable use of existing forests and to promote more active participation of local people and the private sector (with proper incentives) in the long-term management of natural forests
- Adopting a comprehensive and environmentally sound forestry conservation and development plan that contains a clear definition of the roles and rights of the government, the private sector, and local people (including forest dwellers)
- Undertaking social, economic, and environmental assessments of the forests being considered for commercial utilization
- Setting aside adequate compensatory preservation forests to maintain biodiversity and safeguard the interests of forest dwellers, specifically their rights of access to designated forest areas
- Establishing institutional capacity to implement and enforce the above commitments.

If these conditions are present, projects will be judged on their individual merits. If they are not present, Bank support in the forest sector will be restricted to operations that directly help countries achieve them. Such operations will be appropriately limited in scope, sequenced, and specifically targeted at helping countries meet the stated conditions.



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## *Appendix A. The Dynamics of Forests and Trees in Natural and Social Systems*

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### **Forest Types**

Forests account for 3.6 billion hectares, or about 28 percent of the world's land area. Of this area, about 2.9 billion hectares are closed forests (land covered mostly by trees, with stand density greater than 20 percent), and 700 million hectares are open forests (mixed forest-grassland systems, with trees covering at least 10 percent of the ground). In addition, there are 1.7 billion hectares of other wooded land, including forest fallows and shrubland. Thus, the total area of "woody vegetation" is 5.3 billion hectares, or 40 percent of the world's land area. There are three main forest types: tropical forests, temperate forests, and man-made plantations.

### ***Tropical forests***

Tropical forests consist of tropical moist forests and tropical dry forests. Together with woodlands they account for about 3.1 billion hectares. Tropical moist forests (1.5 billion hectares) can be further divided into tropical rain forests and tropical deciduous forests. Tropical rain forests, which account for two-thirds of the tropical moist forests, are rich in biodiversity and contain valuable tropical hardwood. The tropical deciduous forests, which lie along the fringes of the tropical rain forests, are less complex than the tropical rain forests and have more distinct wet and dry periods. Tropical moist forests can be classified according to management criteria as primary forest (900 million hectares), secondary forest (300 million hectares), and forest fallow (300 million hectares). Tropical dry forests (1.6 billion hectares) range from tall deciduous stands to more open grassland and shrubland.

### *Temperate forests*

Temperate forests, including woodlands, now cover about 2.2 billion hectares. Of this, about 1.6 billion hectares are classified as closed forests. Temperate forests account for 85 percent of the world's coniferous forests and the bulk of the world's industrial wood production. There are two main groups of temperate forest: boreal forests and mixed forests. The boreal forests stretch across Canada, northern Europe, and the U.S.S.R. and include large areas of almost pure single-species stands.

### *Plantations*

Plantations are primarily for industrial use, although in recent years they have been established for nonindustrial purposes, such as conservation, household energy needs, and agroforestry. Plantations usually grow faster than natural forests and are established to produce desired single species, mainly exotic, selected for wood quality, growth rate, stem form, disease resistance, and manageability. There are now about 100 million hectares of temperate plantations and 35 million hectares of tropical and subtropical plantations. Together they account for less than 3 percent of the total forest area.

### **Distribution**

The world's forests are highly concentrated among a relatively small number of countries. This concentration is even more apparent with respect to specific types. North America and the U.S.S.R. account for most of the world's coniferous forest. Together, Canada, Brazil, and the U.S.S.R. account for nearly one-half of the world's closed forest area. Brazil has three times as much tropical moist forest as Zaire or Indonesia. Twenty countries contain 85 percent of the world's tropical moist forest. Africa has about 700 million hectares of forest (24 percent of its land area), most of which are savanna, open forest, or shrubland. Forests in Latin America cover about 940 million hectares, of which more than 50 percent are in Brazil. Asia and the Pacific have about 550 million hectares of forest. Tropical Asia has 350 million hectares of forest and about one-fourth of the world's tropical moist forest.

The share of forests in total land area varies widely. The U.S.S.R. is the world's most forested country (42 percent of the land area). Europe's forests (about 140 million hectares) cover 35 percent of its total land area. The Nordic countries have the highest proportion of land covered with

forests (50 percent); next highest are Eastern Europe (28 percent) and Western Europe (23 percent). North America's forests total about 460 million hectares; Canada has slightly more than 250 million hectares.

### **Utilization of Forests**

Although forests occur in all the main geographic regions, their use varies widely. The developed countries have more than 90 percent of the world's temperate forests, and more than 80 percent of their wood extraction is for industrial timber. Forests and other wooded areas in developed countries cover 2 billion hectares, or about 40 percent of their total land area. After experiencing rapid deforestation, developed countries have stabilized and in some cases increased their forest areas. These countries have encouraged multiple-use management of forests, and private investment has brought about substantial reforestation since World War II. Forest recreation and other nonconsumptive uses of the forest tend to become more important as income rises, as does the role of public opinion in setting the agenda for both public and private forestland management.

Developing countries account for 2.1 billion hectares of the world's forests and 1.2 billion hectares of other woodland. In contrast to developed countries, these countries are still experiencing loss of forests. The rate of natural regeneration and forestation in the tropics has lagged behind the rate of deforestation. Under colonial rule, external factors in the form of increased demand for primary commodities, including tropical hardwood, contributed to rapid deforestation. The rate of deforestation has continued to increase because of rapid population growth, agricultural expansion, and accelerated economic development.

During the three-year period 1986–88 the value of total annual exports of logs and wood products in the world market was about \$68 billion. Of this total, the developing countries' share amounted to \$10 billion. During this period these countries also spent \$13 billion annually on imports, mainly wood-based panels, pulp, and paper. World trade in wood products is dominated by the developed countries, which accounted for more than 80 percent of the total annual volume of industrial wood exports during the period.

Tropical hardwood products from natural forests account for just over 15 percent of world timber trade. In volume, this represents nearly 70 percent of industrial wood exports from developing countries. The principal tropical countries, with exports valued at between \$2 billion and \$3 billion annually, are Indonesia, Malaysia, and Brazil. Malaysia and Indonesia export about 85 percent and 50 percent, respectively, of

their total industrial wood production. Indonesia is the world's largest exporter of plywood derived from tropical hardwood. Brazil exports about 7 million cubic meters, or about 10 percent of its annual industrial wood production. Local processing of wood is expanding rapidly in response to the cost advantages of domestic manufacturing, savings in transport cost as a result of weight reduction, and conscious industrial policy in exporting countries. Trade barriers, including tariffs that escalate with the degree of processing, are significant obstacles to the growth of wood products industries in developing countries.

Many nonwood products are consumed mainly within a country but are also traded internationally. Markets for nonwood products are still expanding and will be a potential source of foreign exchange earnings for developing countries. Sudan earns about \$60 million annually from exports of gum, and Madagascar earns the same amount from exports of vanilla. In 1986 Indonesia earned \$134 million from exports of rattan, resin, essential oils, kapok, and chinchona bark (quinine).

### **Forests and Trees in Natural Systems**

Forests and trees are important environmental resources. They provide valuable environmental services and play a key role in the maintenance of local, regional, and global natural systems.

Forests and trees protect watersheds. They retard soil loss and erosion, particularly in areas of high rainfall, and supply water to streams and rivers. They improve air quality and help to maintain regional climates, especially patterns of rainfall. Forests maintain the dynamic conditions necessary for their own continued existence and support other ecosystems within the natural system. Trees outside forest areas also provide environmental services. For example, shelterbelts—narrow plantings of trees across farmlands—protect the soil from the drying effect of wind.

A large proportion of the earth's biodiversity (species, genetic, and ecosystem), which may have significant environmental and economic value, is found in forests. Tropical moist forests probably account for more than half of the earth's plant and animal species. The diverse species within a forest play a significant role within the ecosystem. No single species can create its own food from inorganic materials and completely decompose all its own wastes. Nor can any species maintain all the necessary characteristics of its habitat. The maintenance of forest ecosystems requires that the chemical elements necessary for life be recycled and that usable energy be continually available.

Species exist in an intricate web of interdependence. Many trees, for instance, depend on a number of species of fungi to derive nutrients from

the soil. Free-living soil bacteria fix nitrogen from the air, making it available to trees. Small animals in the soil, such as earthworms and termites, modify the physical characteristics of the soil, improving tree growth. Trees depend on birds, bats, and bees and other insects for pollination of flowers and on many kinds of vertebrates for the distribution of seeds. High biodiversity means greater ecosystem complexities because there are more, and more highly specialized, interdependencies than in low-diversity systems.

Forests act as carbon sinks and so are vital to the global carbon cycle. Forests and their soils contain about three times as much carbon as is currently held in the atmosphere. Trees absorb carbon dioxide from the atmosphere through photosynthesis and emit oxygen. Whereas deforestation and the subsequent decomposition of forest organic matter add carbon dioxide to the atmosphere, reforestation absorbs carbon dioxide from the atmosphere.

### **The Role of Forests and Trees in Economic Development**

People have depended on forests and trees for their economic livelihood and quality of life for many centuries. This dependence is just as real today as it was in the past. Forests, as an economic resource, provide food, fuel, fiber, timber, and various nonwood products. They provide many goods used by forest dwellers and local communities that are never sold in markets. Trees and forestlands have aesthetic value and offer recreational opportunities for both rural and urban people. Forests are also a source of new land when agricultural and urban expansion is necessary. For all these purposes, forests offer an important resource base for both modern and rural economies.

#### ***Wood products***

At the end of the 1980s the forest sector in developing countries alone made a direct economic contribution of approximately \$35 billion to gross domestic product (GDP). For example, the wood industry in Malaysia accounted for 5 percent of GDP. Value added in the forest sector as a share of GDP was more than 5 percent in Liberia and Côte d'Ivoire and 4 percent in Cameroon and Tanzania.

The forest products industry contributes significantly to employment. Presently, in the United States 765,000 people are directly employed in the wood industry, and another 693,000 are employed in paper and allied products. In Malaysia 151,000 people are employed in the wood products industry. In Gabon, Cameroon, and Nigeria the forest sector

employs 28 percent, 7 percent, and 4 percent, respectively, of the labor force. These jobs, in turn, stimulate local economies and generate additional secondary employment.

The forest products industry's contribution to government revenues generally amounts to only a fraction of timber's potential rent but is still sizable. The forest sectors of Indonesia, Malaysia (Sabah), and the Philippines made annual payments to their domestic governments of \$400 million, \$425 million, and \$50 million a year, respectively. In Sabah forest income accounted for 70 percent of total government revenue. In addition, trade in forest products provides hard currency for the exporting nations, including developing countries.

Forests and scattered trees provide a critical supply of energy for rural people in many parts of the world. An estimated 3 billion people rely on fuelwood for energy. Most roundwood production in developing countries is for fuelwood.

### *Nonwood products*

Although individual nonwood products (nuts, fruits, gums, fibers, fodder, latex, bushmeat, spices, construction materials, ornamental plants, and medicine) are less economically significant than timber, as a group they sometimes contribute more to domestic and international economies on a per hectare basis than does timber. Brazil, Guatemala, Indonesia, Malaysia, Sudan, and Thailand have significant exports of nonwood products. Although most nonwood products are consumed locally, international markets for some products, such as rattan, latex, spices, gum, and ornamental plants, already exist, and new markets for fruits and medicine are developing.

Forests contribute an enormous amount of recreational services to many countries. For example, recreation is probably the single most important commodity supplied on U.S. public land. Recreation (including hiking, hunting, and fishing) is highly valued throughout Europe and in other industrial countries. Tropical forests, although less studied, also generate significant amounts of recreation. With the growing international interest in nature tourism, countries may be able to use intact natural forests to generate a new source of foreign currency.

Forests and trees contribute to agriculture, and forestlands provide important inputs for grazing. Trees offer critical protection from soil erosion on hillsides and near streams, stabilizing large land areas. Shelterbelts of trees protect lands from desertification, thus allowing continued farming. The tree canopy provides needed shade for agroforestry crops, and some trees fix nitrogen that fertilizes soils and enhances crop

productivity. Finally, trees grown in orchards and plantations provide an important food supply in all nations.

### *Forests as a repository of land*

Although forest conversion is currently proceeding at a rapid pace in tropical forests and woodlands, historically it was also important in the temperate forests of today's developed countries. Over the centuries one-third of the world's temperate forests has been converted to alternative land uses. In contrast, less than one-fifth of tropical forests has been converted to date. For countries with rapid population growth and limited food supplies, nonacidic forestlands are important sites in which agriculture can expand.

### **The Interaction of Social and Natural Systems**

The social system plays a significant role in modifying natural systems. In the case of forestry, social factors are important in shaping demographic pressure on forest resources, property rights governing access to forest resources, and values and attitudes toward forest use. Economic forces influence which forest outputs are marketed and which are used for subsistence needs, how important the forest sector is to the national economy, and how income from forest activities is distributed. Political factors affect the degree of intervention in the pricing and extraction of forest products, which interest groups receive favorable treatment, and which forest outputs will be provided as public goods. The way in which these social, economic, and political factors interact with one another and with natural systems determines whether there is sustainable use of forest resources or destructive deforestation.

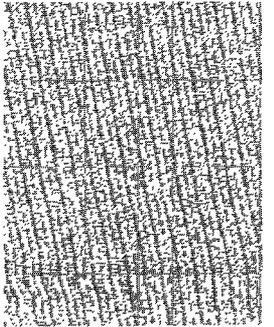
When well-defined private property rights for forest resources exist, the private sector has an incentive for careful management of products that have commercial value. When, however, governments view exploitation of forests as a means of generating revenue rapidly, they may structure concession and other policies to encourage a short-term orientation toward the use of forest resources.

Many forest resources are the common property of specific groups of users. The poor are often heavily dependent on common-property resources for fodder, fuel, and a variety of marketable minor forest products. Historically, allocation mechanisms have evolved for preventing overexploitation of common-property forest resources, but these systems have broken down in many areas as a result of encroachment, privatization, and government appropriation.

Forest management and use are also influenced by the perceived importance of forests in the national economy. In terms of both income and employment, forestry is less important than the other principal rural activity, agriculture. The forest sector often contributes less than 10 percent of measured national income. As a result, governments often assign a low priority to the forest sector and underinvest in forestry research and forest management agencies.

Both governments and the private sector tend to overlook the environmental benefits derived from intact forests and the environmental costs of improper forest harvest and management activities. Because these environmental aspects are not valued in the market, they are easily ignored. A society may place a high value on the environmental services provided by forests, but forests may be undervalued by the market, the private sector, or governments if the services do not generate a monetary return.

One of the most important political factors affecting forest use is the influence of special interest groups on the political process. "Rent-seeking" behavior can take a variety of forms, including lobbying, contributions, media campaigns, and bribes. In Brazil, for example, agricultural special interest groups were, until recently, successful in obtaining changes in tax and agricultural policy that increased the incomes of those who cleared forestland for cattle ranching. In Indonesia and many other countries special interests have sought more favorable concession policies. Recently, environmental special interest groups have been attempting to influence forest policy in an effort to protect intact forests and the rights of forest dwellers. Any attempt to reform policies that affect forests must take into account the political feasibility of reforms and their impact on special interest groups.



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## *Appendix B. Technical Notes*

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### **Examples of Sustained Management of Tropical Timber**

Management of forests and forestland is both an art and a science. Although most parts of the world have long traditions of forestry—many of them derived from American and European professional and scientific experience—there remain significant areas of uncertainty and research needs. This appendix briefly summarizes the state of knowledge on a number of key technical issues in forest management.

Tropical forests are highly complex systems that have not proved easily amenable to management. A few countries have embarked on promising approaches to timber management. Foremost among them is Malaysia, which in 1910 started a series of silvicultural treatments known as departmental improvement fellings. This was later modified into a system of regeneration improvement fellings. Then, on the basis of observations of the heavy fellings during World War II, the Malaysian forestry department developed the Malaysian Uniform System (MUS), which was used until the late 1960s. Since 1970 peninsular Malaysia's forests have been managed on the Selective Management System (SMS). Although the SMS has not yet been in operation for three harvests (because felling takes place only every twenty-five to thirty years), measurements of upper-canopy trees suggest that sustainable management has good prospects for success.

The Myanmar teak forests have been managed under a sustainable system since the 1840s. The accumulated annual increment was removed on thirty-year felling cycles using nondamaging extraction methods (elephants and water transport). The abundance of teak in these forests made them easier to manage sustainably than the more heterogeneous

tropical rain forests. It is not clear to what extent sustainable management is being practiced today.

A number of management systems have been tried in different countries. These include the monocyclic, shelterwood, and polycyclic systems. *Monocyclic systems* such as the MUS provide for the removal of all merchantable trees down to a specific diameter at breast height in a single operation, followed by a poison-girdling of the remaining large noncommercial stems. Silvicultural treatments are continued at intervals to promote the growth of desirable species, and a second crop reaches maturity after seventy years. This had some promise in Malaysia's lowland dipterocarp forests, but because most of these forests were converted to oil palm and rubber plantations, the system was discontinued in the 1960s. The MUS was unsuitable for mountain dipterocarp forests and was replaced by the Selective Management System. The SMS is generally used in Africa, more intensively (up to two trees per hectare every twenty years) in accessible areas such as West Africa and less intensively (one tree per 2 hectares every forty years) in remote areas such as the Zaire basin.

*Tropical shelterwood systems* (TSSs), in which the canopy is opened several years before harvest to provide adequate regeneration, were tried in Nigeria and Ghana in the 1940s and 1950s. These systems were unsuccessful because of low regeneration rates for the prime economic species, vine infestation, and the high labor costs associated with the numerous intensive interventions. A recent development of this system is being practiced with rather more success in Peruvian Amazonia (Palacazu Valley), where it is known as the "strip shelterbelt system."

*Polycyclic systems*, such as the modified selection system of West Africa and the SMS of Malaysia, are designed to ensure the regeneration of commercial species that will become the final timber crop after twenty to thirty years. These systems are showing more promise. They rely on efficient monitoring of stand development, with thinning, where necessary, to favor the growth of promising individual timber trees. Although these systems are considered moderately successful in Malaysia, the available evidence does not suggest that current systems are working satisfactorily elsewhere—apparently because of the *way* in which they are being implemented rather than because of the systems themselves.

Management based on polycyclic systems is being carried out on an operational scale in Australia (Queensland), Ghana, India (including the Andaman Islands), Indonesia, Malaysia, Myanmar, Nigeria, the Philippines, Trinidad, and Uganda. In other countries there are examples of management on a pilot demonstration or research scale. The better-known examples are in Brazil (Ibama, Cpatu, and Tapajos), western

Cameroon, Central African Republic, Colombia (Cali), Côte d'Ivoire, French Guiana, Mexico (Quintana Roo), Papua New Guinea, Peru (Palcazu and A. von Humboldt), Venezuela (Ticoporo and Barinas), and Zaire. Possibly one of the best examples of a potentially successful polycyclic system of sustained yield management is in Trinidad; the system was introduced in 1927, and according to recent observations the forests look better today than they did thirty years ago.

There are four main reasons why most management systems have failed. First, inability to limit damage to the ecosystem leads to inadequate regeneration. This occurs because of the desire to maximize initial offtake to offset the very large capital investments often required and because forestry department operating rules are often ignored. Second, the international market has generally dictated concentration on only a few species whose regeneration may be difficult or expensive (and that are less economic to market than a variety of species). Third, controls over productive forest have rarely been rigorous. Logging lease agreements have discouraged investment in future stands, and harvested areas are too often encroached on by rural populations or used as a source of poles or fuelwood or for illegal timber felling. Only where controls are rigorously enforced can a harvesting system hope to be sustainable. Finally, incentive policies favor exploitation of forests for short-term benefits and profit maximization.

Since the 1960s the approach adopted by most donor agencies concerned with forestry has been (a) to establish monocultures of industrial plantations, usually of exotic tree species, to meet industrial wood needs and (b) to support social forestry, farm forestry, and agroforestry initiatives. Little effort has been directed toward the natural forests of the tropics because their ecological complexity makes them difficult to manage. Thus, for some thirty years scant emphasis has been placed on further development of management systems.

### **Plantation Establishment**

Plantations make up about 100 million hectares of temperate plantations and about 35 million hectares of tropical and subtropical plantations. As measured by wood increment per unit area, well-managed plantations are many times more productive than most natural forest systems, and the plantation forests of many countries (for example, Australia, Chile, Kenya, New Zealand, and South Africa) are now an important component of their productive forest resources. Managed natural forests in the tropics can be expected to yield between 2 cubic meters and 8 cubic meters per hectare annually, whereas man-made plantations in the

tropics can yield between 10 cubic meters and 60 cubic meters per hectare annually depending on site, species, and intensity of management. The financial returns from plantation forests can compare favorably with those from alternative land uses.

### *Compensatory and tropical hardwood plantations*

Expectations that the expansion of *softwood* or *eucalyptus* plantations would substantially reduce the pressure on tropical moist forests have generally not been fulfilled. These plantations usually produce quite different products (industrial sawnwood and pulpwood), and thus the opportunities for substituting plantation-grown material for high-quality hardwood from natural forests are few. In semiarid and arid regions, providing plantations for fuelwood and building poles can reduce pressure on natural woodland, but it is in these regions that the greatest number of failures has occurred, primarily for social reasons and because of lack of technical expertise. Temperate forests, which formerly yielded sawlogs for the local market, have been replaced by plantations in some countries (for example, in Chile, New Zealand, and South Africa and in the highlands of Kenya).

Tropical *hardwood* plantations can reduce pressure on tropical moist forests. Unfortunately, with a few notable exceptions (such as teak), valuable tropical hardwood species are difficult to grow in plantations. The reasons lie in the ecology of the trees: most species have evolved in highly competitive, polyspecific environments, and many are elements of late successional stages. Such species are usually ecologically unsuited to being grown in pure stands or, when young, in open environments. Attempts to do so usually result in chlorosis and decline or in fatal insect attacks. This supports the notion that production from natural forests should concentrate on valuable decorative, joinery, and veneer species rather than on species for industrial cellulose, poles, and the like, which can probably be grown more effectively in plantations. There is, however, merit in undertaking more research on a limited number of valuable tropical hardwood species that appear to have some prospect of success under plantation conditions, such as *Cordia alliodora*, *Shorea* spp. and *Eucalyptus* spp. (for example, *E. pilularis*). Very large areas of well-managed hardwood plantations are common in temperate countries of Western Europe and the northeastern United States. Some European countries have made deliberate policy decisions in recent years to concentrate on the production of high-quality, decorative native hardwoods on suitable sites, in anticipation of a continual decline in and eventual cessation of supplies from the tropics.

Current research suggests that plantation forest systems can be managed to meet criteria of sustainability, and experience with particular species and ecosystems suggests that objectives other than production, notably conservation, can be satisfied if improved land use planning precedes plantation design and management.

Plantation forestry has become synonymous with large-scale, monocultural, intensive tree growing for the production of industrial wood (poles, fuelwood, pulpwood, sawnwood, and so on) This model is typified by the coniferous plantations in both the Southern and Northern hemispheres and by temperate and tropical eucalyptus plantations. Optimal management strategies for such plantations are, in general, well developed and sophisticated. Historically, most development agencies have promoted this form of plantation forestry. With hindsight, it is apparent that the traditional model of plantation forestry is most appropriate in industrial countries where land resources are not scarce. An alternative approach is required for many developing countries. Given the circumstances of rural societies and the land scarcity prevalent in much of the nonindustrial world, the integration of other crops with plantation forestry is likely to be the best means of successful plantation production in the future.

The primary distinguishing feature of trees as wood production crops is their relatively long production period, which is seldom less than four years, commonly ten or more years, traditionally at least twenty-five years in the tropics, and usually at least twice that in temperate regions. The return on investment for well-managed, fast-growing tree crops is usually of the order of 10 to 15 percent and probably about 5 percent for slower-growing temperate or tropical species. In many countries the successful involvement of the private sector in plantation forestry suggests that factors other than the economic characteristics of trees themselves are the primary determinants of the level and source of investment.

Plantation forestry is characterized by high levels of initial investment in relation to those necessary for natural forest management. For example, in Côte d'Ivoire plantation-grown timber reportedly costs \$7.40 a cubic meter, as against \$5.60 a cubic meter for timber derived from managed natural forest. These analyses typically ignore or underestimate the nonmarket benefits associated with natural forest management. A valid comparison of plantation and natural forest options demands more sophisticated and comprehensive economic analyses than have been applied in the past. The balance between reliance on and investment in plantations and natural forests will depend on particular circumstances; the level and nature of demands on the forest resource—

and the capacity of plantations and natural forests to meet those demands—will determine the appropriate balance. In general, it is likely that both forms of forest will have an important role.

### ***Plantation technology***

There is a pressing need to develop and disseminate sound plantation technology and tree improvement practices to increase adaptability and productivity. The selection of appropriate species and strains is critical for successful plantation forestry. The largest, cheapest, and fastest gains in most forest tree improvement programs can be made by using the proper species and seed sources within species.

The principal technical requirements for successful plantation forestry are (a) the availability of genetic resources of potentially useful species; (b) the selection of the best-adapted species and strains, their continuing genetic improvement, and the raising of planting stock under favorable nursery conditions; (c) informed scientific observation by competent staff; and (d) adequately paid, well-motivated, qualified staff, available on a long-term basis to manage plantations. The staff should receive support, when necessary, from specialists in relevant disciplines such as anthropology, entomology, genetics, land use planning, and soil science. Concerning the third point, scientific observation, the least that should be done is to monitor growth, nutrition, and health. When necessary this should lead to timely silvicultural interventions so that plantations can achieve their potential. Since these activities involve expense, adequate finance should be available on a continuing basis.

### **Agroforestry Interventions**

Agroforestry holds considerable promise as a sustainable approach to agriculture and land management. But successful agroforestry systems are extremely site specific, and at present it is difficult to prescribe general solutions. There are, however, a number of important approaches that will need to be taken to support further agroforestry interventions in natural resource development projects. These include:

- Greater efforts to incorporate agroforestry components into farming systems-oriented agricultural projects as well as into forestry projects. This has special relevance for those areas between settled agricultural zones and the intact forest—that is, for degraded or converted forests in danger of not being able to support sustainable agriculture or ranching.

- Acceptance that farmers generally prefer multipurpose species to single-purpose species, mixed-cropping systems to single-commodity systems (for example, woodlots), and passive (labor-saving) agroforestry techniques to active (labor-consuming) techniques
- Greater use of “nonconventional” agroforestry in the reclamation of degraded land: seriously eroded areas (using grasses, shrubs, and trees); saline areas (using salt-tolerant multipurpose woodlots); imperata grass-infested areas; and acidic grasslands and degraded African savannas (using silvipastoral systems)
- Acceptance that the success of agroforestry components will depend greatly on a full appreciation of local social and cultural values, customs, and traditions. These include rights to tree and forest products; gender-based distinctions in the allocation of land, labor, and capital; and the complex issues of land and tree tenure. All need to be considered in project planning and design.
- Greater efforts to quantify the short- and long-term benefits of agroforestry under field conditions rather than at research stations
- Greater efforts to support agroforestry research at the field level through national agricultural research programs
- Recognition that NGOs and community groups have an important role in the design and implementation of agroforestry projects, particularly where small-scale, innovative, people-oriented projects are concerned.

### **A New Approach to Management of Preservation Forests**

The old approach to management of preserves tended to treat intact forests as monuments that would persist indefinitely with external care—cleaning up the grounds, neatening the landscape—as though trees were not living things. This approach 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. No area is managed for the next generation of mature forests.

The new approach to management of preserves recognizes that forest ecosystems are dynamic and will change naturally over time. 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 the main representative stages present to provide the habitats associated with these stages.

Professional ecosystem managers, trained in the conservation of biodiversity, must be on staff. Other experts from several disciplines, including hydrology, soils, erosion, geology, and restoration, must be available.

Baseline measurements and continuous ecological monitoring are essential and must be integrated into the management plan. Usually, a small set of factors must be measured and monitored to determine the status of the forest ecosystem. The challenge is to devise a program of measurement that can be sustained over a long period. Although this may be best done through national government agencies (with the exact administrative nature depending on the country), national measurement programs could benefit from an international program in ecological monitoring.

Research to improve understanding of ecosystem dynamics and interactions among species is essential and must be integrated into the management plan. The preserve must be planned and managed from a landscape perspective so that various parts of the preserve are put to their best uses. As an example, in Taiwan (China) the La La Shan Nature Preserve, covering approximately 8,000 hectares, was set up for three uses: conservation of habitats for specific endangered species; research and monitoring of natural, intact ecosystems; and creation of large-area ecosystem conservation areas with no habitat modification either for conservation of endangered species or for research. This approach could serve as a model for other preserves. When possible, indigenous people should be involved in the conservation, management, and protection of these areas so that their needs are incorporated and they benefit from the preserve.

## Appendix C. Tables

**Table 1. World Bank-Financed Forestry Projects, by Country, 1949-90**

<i>Project name</i>	<i>Borrower</i>	<i>Approval year</i>	<i>Amount (millions of dollars)</i>	<i>Type</i>
Forestry	Yugoslavia	1949	2.70	I
Forestry	Finland	1949	2.30	I
Chemical Pulp and Newsprint Mills*	Chile	1953	20.00	I
Karnaphuli Paper Mill*	Bangladesh	1955	4.20	I
Forestry	Zambia	1968	5.30	I
Forestry	Kenya	1969	2.60	I
Jengka Forestry	Malaysia	1970	8.50	I
Forestry	Finland	1972	20.00	I
Forestry I	Madagascar	1974	13.60	I
Forestry	Myanmar	1974	24.00	I
Antalya Forest Utilization*	Turkey	1974	40.00	I
Forestry II	Kenya	1975	20.00	I
Forestry Technical Assistance	India	1975	4.00	I
Forestry I	Tanzania	1976	7.00	I
Industrial Forestry I	Zambia	1977	16.80	I
Smallholder Tree Farming and Forestry*	Philippines	1977	6.68	S
Hazara Forestry Preinvestment	Pakistan	1977	1.70	I
Forestry	Guyana	1978	10.00	I
Integrated Forestry	Liberia	1978	6.00	I
Forestry Technical Assistance	Niger	1978	4.50	S
Forestry Development	Turkey	1978	86.00	I
Forestry	Côte d'Ivoire	1979	18.00	I
Forestry I	Nigeria	1979	31.00	I

(Table continues on the following page.)

**Table 1 (continued)**

<i>Project name</i>	<i>Borrower</i>	<i>Approval year</i>	<i>Amount (millions of dollars)</i>	<i>Type</i>
Forestry I	Jamaica	1979	12.00	I
Forestry	Burundi	1979	4.30	S
Forestry II	Myanmar	1979	35.00	I
Forestry Development	Greece	1979	25.00	I
Uttar Pradesh Forestry Development	India	1979	23.00	S
Gujarat Community Forestry	India	1979	37.00	S
Afforestation I	Mali	1979	4.50	S
Forestry	Portugal	1980	50.00	I
Integrated Forestry and Livestock	Rwanda	1980	21.00	S
National Rural Development Project				
Wood Energy II*	Malawi	1980	13.80	S
Mangrove Forests	Bangladesh	1980	11.00	S
Forestry	Burkina Faso	1980	14.50	S
Forestry I	Nepal	1980	17.00	S
Watershed Management I*	Philippines	1980	38.00	E
Kandi Watershed and Area Development*	India	1980	30.00	E
Mangoro Forestry II	Madagascar	1981	20.00	I
Wood Industries I	Myanmar	1981	32.00	I
Forestry	Senegal	1981	9.30	S
West Bengal Social Forestry	India	1981	29.00	S
Forestry	Cameroon	1982	17.00	I
Forestry II	Niger	1982	10.10	S
Forestry III	Kenya	1982	37.50	S
Sao Hill Forestry Phase II	Tanzania	1982	12.00	I
Forestry	Morocco	1982	27.50	I
Haryana and Jammu and Kashmir Social Forestry	India	1982	33.00	S
Forestry	Haiti	1982	4.00	S
Forestry II	Nepal	1983	18.00	S
Rural Afforestation	Zimbabwe	1983	7.30	S
Quesso Wood Processing*	Congo	1983	12.00	I
Forestry I	Sri Lanka	1983	9.00	I
Karnataka Social Forestry	India	1983	27.00	S
Himalayan Watershed Management*	India	1983	46.20	E
Rainfed Areas Watershed Development*	India	1983	31.00	E
Forestry	Benin	1984	5.40	I
Forestry I	Bhutan	1984	5.50	S
Forestry II	Zambia	1984	22.40	I
Wood Industries II	Myanmar	1984	25.00	I

<i>Project name</i>	<i>Borrower</i>	<i>Approval year</i>	<i>Amount (millions of dollars)</i>	<i>Type</i>
Kerala Social Forestry	India	1984	31.80	S
Forestry II	Burundi	1985	12.80	S
Forestry II	Côte d'Ivoire	1985	31.30	I
Sabah Forestry	Malaysia	1985	6.50	I
Forestry	China	1985	47.30	I
Forestry II	Bangladesh	1985	28.00	S
National Social Forestry	India	1985	165.00	S
Forestry—Bosnia	Yugoslavia	1985	35.00	I
Agricultural Forestry	Guyana	1985	8.80	I
Forestry II	Nigeria	1986	71.00	S
Wood Energy II	Malawi	1986	16.70	S
Forestry	Ethiopia	1986	45.00	S
Forestry II	Mali	1986	6.30	S
National Forestry Research and Development	Malaysia	1987	9.00	I
Forestry	Tunisia	1987	20.00	S
Minas Gerais Forestry	Brazil	1987	48.50	S
Forestry/Firewood	Uganda	1987	13.00	S
Forestry II	Rwanda	1987	14.10	S
Forestry Institutions and Conservation	Indonesia	1988	34.00	E
Forest Management and Conservation	Madagascar	1988	7.00	I
Forestry Resource Management	Ghana	1988	39.40	I
Forestry II	Bhutan	1988	1.06	S
Da Xing An Ling Forestry	China	1988	56.90	I
Forestry Development	Mexico	1989	45.50	S
Hill Community Forestry	Nepal	1989	30.50	S
Forestry Sector Development	Sri Lanka	1989	19.90	S
Forestry and Fisheries Management	Guinea	1989	8.00	E
Forestry II	Morocco	1990	49.00	E
Forestry II	Côte d'Ivoire	1990	80.00	E
Forest Resource Management and Development	Zimbabwe	1990	14.50	E
Natural Resource Management	Central African Rep.	1990	19.00	E
National Afforestation I	China	1990	300.00	I
Forestry Development	Kenya	1990	19.90	S
Forestry Institutions and Conservation II	Indonesia	1990	20.00	E
<b>Total</b>			<b>2,485.94</b>	

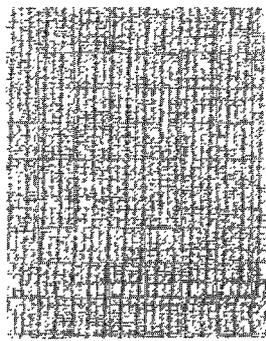
\* = Agricultural sector operations examined as part of this study.  
Type of forestry: I = industrial, E = environmental, S = social.

**Table 2. Countries with Threatened Tropical Moist Forests**  
(thousands of hectares)

<i>Country</i>	<i>Closed forest area</i>	<i>Annual deforestation rate</i>
<i>Latin America and the Caribbean</i>		
Bolivia	44,010	87
Brazil	375,480	8,000 <sup>a</sup>
Colombia	46,400	820
Ecuador	14,250	340
Mexico	46,250	595
Peru		69,680
Venezuela	31,870	125
<i>Sub-Saharan Africa</i>		
Cameroon	16,500	100
Central African Republic	3,590	5
Congo	21,340	22
Côte d'Ivoire	4,458	290
Gabon	20,500	15
Madagascar	10,300	150
Zaire	105,750	182
<i>Asia and the Pacific</i>		
India	36,540	1,500
Indonesia	113,895	900
Malaysia	20,996	255
Myanmar	31,941	677
Papua New Guinea	34,230	22
Philippines	9,510	143
<b>Total (twenty countries)</b>	<b>1,057,490</b>	<b>14,498</b>

a. More recent estimates suggest that the rate of deforestation may have declined to 2,000,000 hectares a year.

Source: World Resources Institute 1990.



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## *Appendix D. The OED Report on Forestry: Lessons Learned*

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The OED's assessment of Bank lending and policy in the forestry sector from 1949 to 1990, "Forestry Development: A Review of Bank Experience," reviewed forestry projects and their components, analyzed development implementation issues, and evaluated sector work. The report sought to put into perspective the economic and social significance of forest development, to provide feedback to guide future policy, procedures, and practice, and to complement recent analyses of Bank involvement in pertinent sectors such as agriculture and rural development, energy, and land management. The report made recommendations for eventual changes in forest sector policies and new proposals for Bank forestry lending. Several of these recommendations are discussed below.

### **General Issues**

Some of the broader issues covered included acknowledging the careful planning, preparation, and processing that forestry projects require, as well as the longer time frames some projects entail. If cooperation and coordination among many line agencies in the planning and implementation of a project are needed, an effective mechanism for coordination is crucial. Monitoring and evaluation are often weak and do not facilitate supervision and final evaluation. Land tenure and potential land use conflicts should be thoroughly investigated during project formulation. In addition, market analysis and market programs should be an integral part of project preparation.

Issues at the national level involve the inadequacy of individual projects for addressing broad sectoral concerns or structural imbalances in the economy. The high ratio of recurrent cost to capital cost is a major problem in sustaining forestry projects at the country level, particularly

in view of the pressures to reduce public expenditures. Governments alone do not have the capacity to tackle single-handedly problems of wood deficits and forest depletion. In addition, the report noted that countries should develop buffer zones around remaining forest areas and that pricing policies should adequately reflect the environmental benefits obtained from forests.

Some of these lessons have important implications for policy formulation. Many supervision reports have emphasized that most forestry projects face serious financial problems. Although it is recognized that project performance depends on how macroeconomic policies affect both land use and management of existing forests, no comprehensive study of intersectoral linkages has been made. Moreover, there is no evidence that forest sector concerns are systematically incorporated into macroeconomic policy formulation and reform.

The OED report highlighted the importance of:

- Strengthening the role of institutions, with particular emphasis on property rights
- Developing organizational arrangements
- Improving complementary services (for example, research and extension and marketing)
- Recognizing intersectoral and macroeconomic linkages that affect the sector
- Centering operations around land use
- Increasing the capability inside and outside the Bank for assessing natural resources
- Finding new lending instruments, with special emphasis on financing.

Experience suggests that operations in the 1990s should place higher priority on the program than on the discrete project type. The success of sector loans will depend on a sector policy, a comprehensive forest management component, favorable macroeconomic policies, a major infusion of resources for human capital development, and a clear recognition of the interplay among the forest, people, and culture.

The OED study also recommended that (a) every project in the sector be conditioned to conform to a country forest sector policy; (b) a forest sector assessment unit be established to improve Bank knowledge about natural systems affected by other sectoral interventions; and (c) new lending instruments be created for projects that are not immediately or directly productive, such as forest management operations.

### **Lessons Learned from Specific Project Components**

The OED report selected five components of free-standing forestry projects for special analysis: plantations, nurseries, farm and community

forestry, natural forest management, and watershed rehabilitation or protection. The following sections summarize the OED's findings regarding each component.

### *Plantations*

Before large-scale planting begins, the technological soundness of the chosen species mix should be ensured. Often this means allowing the trial to run long enough to determine changes in growth rates as the stand ages and to monitor possible disease or pest infestation problems that may not emerge until later in the growth cycle. The trees chosen should represent a multicriteria mix that takes into account, for example, speed of growth, fire or pest resistance, quality of wood for industrial uses, fodder potential, income generation, and contribution to the preservation of genetic diversity. Indigenous tree varieties should be given high priority. Marketing analyses, soil surveys, species research, and plantation trials should be conducted during project formulation so that an appropriate species mix is chosen for large-scale planting. Trial plantations should be small and preferably near existing plantation programs to maximize access to expertise and minimize infrastructure costs. Investigating land use and land tenure as part of project preparation is particularly important in plantation projects.

Sufficient attention should be given to maintaining plantations, particularly during the first few years, even if planting targets suffer. The increased growth rate that results from weeding apparently compensates for the additional costs. A fire prevention or fire-fighting capability that includes providing equipment and designing a fire protection and control program needs to be established early. (Adequate weeding is also important for fire prevention.) Close monitoring of these programs should be a priority in fire-prone areas to ensure that forestry protection measures are enforced correctly and promptly.

Lower-cost alternatives to clear-felling secondary forests to establish plantations should be explored (examples are reseeded logged-out forests, managing natural forests to allow regeneration of more valuable timber, and providing private sector incentives for reforestation). There is a need for greater attention to and research on thinning, processing, and marketing secondary tree species and on secondary products (such as fuelwood and charcoal) that could increase benefits. A careful analysis of the marketing and trade possibilities of potential products should be part of project formulation.

Finally, solutions to shortages of energy (fuelwood) and wood products and to environmental degradation often lie beyond the sector and may require a multisectoral approach that includes modifying basic policies and increasing private sector participation.

### *Nurseries*

A large-scale, nationwide nursery program should not be carried out until a pilot program has been instituted to resolve design flaws, particularly where retail nurseries are a new concept and the forestry department has no prior experience with them. The location of nurseries should be based on a thorough supply-and-demand analysis that identifies wood-deficit areas and accessibility of sites, among other factors.

A good approach is to establish nurseries on a temporary basis until farmer response is sufficient to justify upgrading to permanent status. To reduce the transport costs of rural consumers, it is preferable to have numerous small nurseries rather than a few large ones. Diversified nursery production with more species and types of trees will increase demand. Production costs will be decreased by shifting from purely potted stock to more than half bareroot stock. Sound communication with rural communities through good information and extension (which is also facilitated by having a large number of smaller nurseries) is an effective marketing strategy and allows nurseries to respond rapidly to changes in species preference.

Seedlings should be sold rather than given away. Although farmers are quite willing to pay for seedlings, they are more selective than had been anticipated. A rural nursery program is an appropriate way of making rural populations self-sufficient in fuelwood by offering seedlings at affordable prices. High costs of production may be addressed through greater use of labor and increases in production volume. Nurseries should not be set up without establishing extension to advise farmers on planting and tending techniques, planting distance, planting seasons, protective activities, and so on. Also, nurseries require a supportive policy environment; they cannot be economically viable unless incentives are provided for planting trees. Attention should be given to control and protection of natural forests, to adequate producer prices for wood products, and to a strong revenue collection system.

### *Farm and community forestry*

Studies indicate that rural forestry development should be based on the complete participation of the rural population (family tree plantations) rather than on community plantations and that the "top down" approach should be avoided. An approach that encourages smallholders to grow trees by providing them with seedlings, extension services, market guarantees for their product, and credit remains viable and is worthy of public sector support. A rigorous approach should be used,

however, in evaluating the long-term viability and commitment of private companies that might provide markets for smallholder produce.

Project activities should achieve socioeconomic as well as physical objectives. Special financing arrangements for smallholder or subsistence farmers might be needed. Even for family farms, labor and transport costs should be studied and, if appropriate, provision for these expenses should be made in the subloans. The technical packages promoted in farm forestry should be thoroughly researched. There is a crucial need for more attractive and adaptable technical packages and a more participatory and multisectoral approach to rural forestry. The technical packages should be appropriate to the relevant conditions (such as soil and management).

Extension is an important part of farm forestry. Where private extension is weak, alternative government extension services should be arranged. Farm forestry programs should not be attempted without a supportive policy environment. Supplying farmers with subsidized seedlings is not sufficient. As with nurseries, the control and protection of natural forests, adequate producer prices for wood products, and a strong revenue collection system must be examined. More effort needs to be put into project design and supervision to monitor the survival and use of distributed seedlings. Techniques for using trees in cultivated areas should be considered as tools for intensifying production systems. This intensification can be achieved only in conjunction with a management plan for village lands, conceived and carried out with the participation of the local population. Such land use plans should be comprehensive, with particular emphasis on all the social and legal problems posed by the utilization of trees in production systems. Moreover, future rural forestry investments should include a comprehensive approach to integrate forestry, agriculture, and pastoralism.

### *Management of natural forests*

Experience has not been sufficiently satisfactory to warrant the indiscriminate replication of this type of component. In view of the urgent need to manage existing forest resources, it will be essential to obtain a clear commitment from the government to ensure proper implementation. Experience shows that in carrying out management-related tasks, in defining and implementing the necessary instruments (including institutional reforms), and in assessing the optimal pace during implementation, the government has the absolute and relative comparative advantage.

More training may be needed at the national and local levels. Good management work plans require comprehensive resource assessment

studies, including ground survey work. Efforts must continue on improved management of fire and on techniques for the recovery, care, and exploitation of natural forests. Concerns should go beyond the production of wood to encompass pasture management and conservation of flora and fauna.

There is a need for greater understanding of natural forests to make possible sound forest management. This may not significantly increase production, given the magnitude of the need, but it will significantly affect environmental protection.

#### ***Watershed rehabilitation or protection***

If a watershed area is being put to multiple uses that may affect revegetation, components for controlling or managing these uses should be implemented prior to revegetation attempts. It should be assumed, unless there is significant contradictory evidence, that the most ecologically appropriate, technically sound, and economically viable approach to flood attenuation is through watershed rehabilitation rather than through dam storage of water. According to a project completion report, watershed stabilization through rehabilitation that reduces the siltation rates of reservoirs to economically acceptable levels moderates the torrential, sediment-bearing nature of floods so substantially that little room is left for justifying additional flood attenuation through dam construction. In watershed areas with existing land use, substantial emphasis should be placed on extension, information, and public relations efforts toward local farmers to elicit their cooperation. Maintenance activities should be adequately planned and should be implemented in several watershed projects; costs, in both money and time, should be realistically estimated.

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## Glossary

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**Afforestation.** The planting of trees in unforested areas.

**Agroforestry.** Land use system in which woody perennials are used on the same land as agricultural crops or livestock in some form of spatial arrangement or temporal sequence.

**Carbon fixation; carbon sequestration.** The conversion by plants, through photosynthesis, of atmospheric carbon dioxide into organic compounds.

**Closed forest.** Forest in which the stand density is greater than 20 percent of the area and tree crowns approach general contact with one another.

**Commercial logging.** Extraction of timber in large quantities for industrial or export markets.

**Common property.** Tenure system whereby resources are collectively owned and managed and nonowners are excluded from access to the resources.

**Conifers; coniferous species.** Softwood species, as distinguished from broadleaved (hardwood) species; mostly evergreens.

**Conservation.** Rational and prudent management of natural resources to achieve the greatest benefit while maintaining the potential of the resource to meet future needs.

**Conversion forest.** Forest assigned for conversion to agriculture or other nonforest use.

**Deforestation.** The clearing of forests and the conversion of land to nonforest uses.

**Degradation.** Biological, chemical, and physical processes that result in loss of the productive potential of natural resources in areas that remain classified as forests. Degradation may be permanent, although some forests may recover naturally or with human assistance.

**Depletion.** Reduction in forest area or volume as a result of deforestation.

**Desertification.** Degradation of the land that ultimately leads to desert-like conditions.

**Designated forest.** Forest legally set aside for preservation or production.

**Ecotourism.** Nature tourism.

**Environmental services.** Beneficial functions performed by natural forest ecosystems, including the maintenance of biodiversity, protection of soil and water resources, moderation of climate, influence on rainfall, sequestering of carbon dioxide, provision of habitat for wildlife, and maintenance of the earth's natural balance.

**Exotic species.** Species introduced from another ecological zone; usually opposite of indigenous.

**Externality.** A cost (or a benefit) of an economic activity by one party that is unintentionally imposed on (or received by) another party without compensation (or payment) and that leads to inefficiencies in competitive markets.

**Farm forestry.** People-oriented forestry that is carried out on private farmlands. Related but not synonymous terms are agroforestry, community forestry, and social forestry.

**Forest fallow; bush fallow.** Area dominated by woody vegetation after having been cleared and used for shifting cultivation.

**Hardwood.** Wood of broadleaved trees, as distinct from softwood (produced by conifers).

**Industrial plantation.** Stands of trees raised for the production of industrial forest products (for example, sawlogs, veneer logs, pulpwood, poles and pitprops, and wattle bark).

**Industrial forestry.** Industrial plantations and forest industry.

**Lopping.** Pruning or pollarding as a means of harvesting small-diameter branches, typically for firewood or leaf fodder.

**Market failure.** A deviation from the conditions required for the efficient allocation of resources by a purely competitive market.

**Nonwood products.** Tangible minor forest products, such as fruit, nuts, and bushmeat.

**Open access.** The absence of ownership claims over resources, permitting and leading to uncontrolled and excessive attempts at appropriation and use.

**Open forest.** Forest in which the tree canopy layer is discontinuous but covers at least 10 percent of the area and in which the grass layer is continuous.

**Other wooded area; woodland.** Area that has some forest characteristics but does not meet the definition of *forest* given above. Includes areas occupied by windbreaks, groups of trees, fallow land, and shrubland.

**Poles.** Small-diameter wood used in unprocessed form for construction, fenceposts, and other purposes.

**Pollarding.** Cutting the branches of a tree to promote the growth of a dense head of foliage.

**Preservation forest.** Forest designated for total protection of representative forest ecosystems in which all forms of extraction are prohibited.

**Primary forest.** Relatively intact forest that has been essentially unmodified by human activity for the past sixty to eighty years.

**Production forest.** Forest designated for sustainable production of forest products.

**Protection forest.** Forest designated for stabilization of mountain slopes, upland watersheds, fragile lands, reservoirs, and catchment areas. Controlled sustainable extraction of nonwood products could be allowed.

**Reforestation.** The replacement of trees in cut-over forest areas.

**Secondary forest.** Forest that is subject to a light cycle of shifting cultivation or to various intensities of logging but that still contains indigenous trees and shrubs.

**Selective felling; selective cutting.** Harvesting of only a small proportion of the standing crop; the opposite of clearfelling.

**Shelterwood system.** A silvicultural system in which an existing stand of trees is removed in two or more fellings to encourage regeneration in the shelter of the remaining trees.

**Shifting cultivation.** Farming system in which land is periodically cleared, farmed, and then returned to fallow; synonymous with slash-and-burn or swidden agriculture.

**Shrubland; brushland; scrubland.** An area more than 20 percent of which is covered by shrubs or stunted trees and that is not primarily used for agricultural or other nonforest purposes, such as grazing of domestic animals.

**Social forestry.** Farm forestry and community forestry.

**Softwood.** Wood from conifers, as distinguished from hardwood (from broadleaved trees).

**Stumpage; royalty.** Fee or price of standing trees before logging.

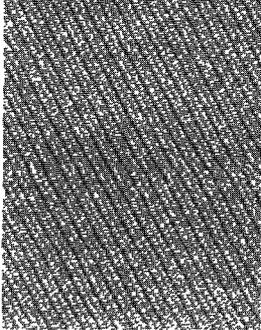
**Sustainable development.** Development that meets present needs without compromising the ability of future generations to meet their own needs.

**Sustainable management.** Utilization of forests without undermining their use by present and future generations. Different systems of management are required for each category of forest, depending on the intended output.

**Sustained yield.** Production of forest products with an approximate annual balance between net growth and harvest.

**Tropical dry forest.** Open forest with continuous grass cover; distinguished from other tropical forests by distinct seasonality and low rainfall. Includes woody savannas and shrubland.

**Tropical moist forest.** Forest situated in areas receiving not less than 100 millimeters of rain in any month for two out of three years, with a mean annual temperature of 24°C or higher; mostly low-lying, generally closed. Subdivided into tropical rain forest and tropical moist deciduous forest.



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ISBN 0-8213-1917-5