Chapter 14

Options for Congress

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HIGHLIGHTS

- Forestry projects sponsored by the U.S. Agency for International Development (AID), the United Nations, the World Bank, and other agencies are poorly coordinated.
- Many opportunities exist to modify development assistance practices so they produce economic benefits while sustaining renewable resources.
- Resource development planning can help maintain tropical forest resources and simultaneously make economic development more profitable, but the techniques to do so are underused.
- Research on tropical forest resources needs to be more interdisciplinary and linked more closely to the needs of technology users.
- Developed nations benefit from the tropical forests' biological diversity, so they could pay a share of the costs of preserving natural forests.
- Demand for U.S. expertise in tropical forest resources is increasing, but U.S. organizations are not well organized or supported to use the limited existing expertise efficiently or to build more expertise.
- Forest resources in the U.S. tropical territories generally are degraded, underdeveloped, and inadequately managed.

INTRODUCTION

Tropical forests in U.S. territories and in other nations are important to the United States. Forests support economic progress in tropical countries, progress which is important for humanitarian reasons and for political stability. They supply fuel, food, fodder, and materials and will be increasingly important as population doubles over the next 30 years. Tropical forests also provide many materials used by U.S. industry and consumers. Moreover, they contain a great diversity of biological resources. This is important to U.S. agriculture and medicine and will become more important as nonrenewable resources are depleted. In addition, forests have significant beneficial effects on the conservation of soil and water resources and maintenance of environmental quality.

Although data on the condition of tropical forest resources are poor, information on their extent and location is improving. Recent studies indicate that tropical forests are being degraded rapidly by unmanaged exploitation and that substantial areas are being deforested for unsustainable land uses.

Rates of deforestation and forest degradation, and the severity of the consequences, vary greatly from region to region. From a near-term economic and social perspective, the loss of trees is most damaging in dry areas, where deforestation is both a cause and an effect of desertification, and in mountainous watersheds, where deforestation upsets the hydrologic cycle and accelerates soil erosion. Resource degradation and deforestation in the humid tropics are resulting in permanent loss of biological resources.

Many organizations, some funded entirely or partly by the US. Government, are grappling with tropical forest resource problems. Funding and levels of effort have risen substantially during the past 5 years, and progress has been made in developing and transferring tech-

nologies that can help sustain tropical forests, both in natural and modified condition. Yet, the rate of technology improvement does not seem sufficient to overcome the processes of forest resource degradation.

Further increases in U.S. and international funding to develop and disseminate technologies will be necessary. But incremental changes in current techniques alone will not suffice to sustain tropical forests. The underlying causes of deforestation and resource degradation are institutional, social, and economic. Consequently, many needed reforms can only come from the governments and people of the tropical nations. Here, too, the United States can be effective by helping tropical country governments focus on root problems.

The ultimate objective of forest resource development is to support people. Future generations are expected to need forest products and services as much as those of the past, so production of forest goods and services must increase as fast as population growth. Today, increasing yields of forest products are accomplished in most tropical regions by sacrificing the renewability of resources.

Investment in technologies discussed in previous chapters of this report might make it possible to achieve the necessary production while sustaining the inherent renewability, at least for a time. However, if population growth is not controlled, development and conservation objectives eventually will not be attainable. Technologies directly related to population growth are outside the scope of this assessment but have been addressed in another OTA assessment, ***World Population and Fertility Planning Technologies.***[1]

U.S. technology has helped stimulate institutional reforms. For example, U.S.-trained analysts in tropical countries working with U.S.-provided Landsat imagery have documented deforestation rates (e.g., 2,7 percent per year in Thailand) that have motivated national governments to institute new laws giving forest conservation a higher priority. U.S. diplomacy—e.g., supporting and influencing the United Nations' Environment Program and UNESCO's Man and the Biosphere program—has been effective in raising international awareness of tropical forest problems.

Forests in U.S. Caribbean and western Pacific island territories have hardly benefited from the increased international awareness of the importance of sustainable forest resource development. Those forests continue to receive little, if any, management, and data on erosion indicate that their potential productivity is being reduced.

Tropical forest resources represent a great opportunity for sustained development. However, because of complex institutional and technical constraints, too little such development is occurring. Congress can encourage sustainable development of forest resources in the U.S. territories by giving these areas higher priority in domestic natural resource programs. It also could direct domestic agencies to adapt programs to the special situations that prevail on tropical islands. For other nations congressional action can help resolve some institutional constraints by enhancing tropical governments' abilities to plan and coordinate resource development projects.

Some technical constraints can be addressed directly through congressional actions. U.S. organizations and individuals have the capability to assist in developing forest use systems that provide goods and services for the basic needs of tropical people while conserving forest productivity. U.S. agencies already applying some of this expertise include the Agency for International Development, Forest Service, National Academy of Sciences, National Park Service, Fish and Wildlife Service, and Soil Conservation Service.

Congress also could act to improve U.S. efforts in technology development. Some actions, such as the establishment of U.S. centers of excellence in tropical forestry or increased U.S. participation in multilateral agencies, would require increased funding in the near term. In the long term, however, these actions should

[1] World *Population and Fertility Planning Technologies: The Next 20 Years* (Washington, D. C.: U.S. Congress, Office of Technology Assessment, OTA-HR-157, February 1982).

improve the tropical nations' own abilities to use and sustain forest resources and, thus, should reduce the need for U.S. Government involvement. Other opportunities such as improved coordination of fundamental research, applied research, and technology implementation do not necessarily require additional funding but could require redefinition of priorities.

This chapter identifies several major issues where Congress could take significant action to improve conservation and sustainable development of tropical forest resources. For each issue, options for specific actions and their advantages and disadvantages are discussed.

U.S. TROPICAL FORESTS

Issue

Most forest resources in U.S. tropical territories are not now being overexploited, but neither are they being managed or developed. The territories lack strong institutions concerned about the productivity and sustainability of forest resources. Thus, when the demand for land or jobs increases, the productive potential of the forests is likely to be sacrificed.

Most forests in the U.S. tropical territories are substantially degraded from their original condition. However, because of U.S. Federal income supports and the relatively low population pressure on some islands, little incentive exists to exploit them further. There is also little incentive to develop and conserve the forest.

Whether the forests are stable in their degraded condition, improving, or continuing to degrade is unclear. Probably all these processes are occurring in different places. Available data on soil erosion rates and anecdotal evidence suggest that the potential productivity of the islands forests is being lost gradually.

Continued existence of large acreages of relatively unproductive forest land may promote the idea that forests should be removed to make way for development. Forests need to be managed as an integral part of overall island resource development, especially to protect watersheds and coastal marine environments.

Over the long term, as populations grow and Federal supports decline, the productivity of the forests will become more important and yet more difficult to sustain. Whether that productivity will be realized depends on how soon forestry becomes integrated into the economic development of rural areas. Getting the necessary support for forestry depends on building an informed group of people who perceive that they will gain from forest conservation.

The U.S. Forest Service's Institute of Tropical Forestry (Puerto Rico) and Institute of Pacific Islands Forestry (Hawaii) will continue to have the major roles in researching and demonstrating forestry technologies until territorial natural resource agencies become sufficient. Low levels of onsite research and demonstration will inhibit growth of a constituency that wants and uses appropriate forest management technologies. Meanwhile, without such technologies, rising populations and expectations are likely to result in eventual degradation of the forest resources,

Unfortunately, many experts consider the U.S. tropical forests to be a relatively insignificant part of the overall tropical forest conservation problem. Further, the institutions that might be expected to provide professional resource development expertise in the U.S. tropical territories lack the necessary support to do so.

Natural resource agencies in U.S. tropical territories are small or exist in name only. They require increased funding, professional personnel, and technical assistance to be effective. In addition, Federal resource conservation and production programs for privately owned for-

ests are, in general, not compatible with the characteristics of the U.S. tropical territories. These program funds might be more effective if they supported private forestry programs designed and administered by territorial forest agencies.

Option 1:

> Congress could increase funding for U.S. Forest Service research and technology development and could direct the Forest Service to increase coordination of its activities with other resource agencies in the U.S. tropical territories.

The Forest Service institutes in Puerto Rico and Hawaii have small budgets and have been cut back recently. These organizations have too few staff to support the scale of activity necessary to sustain U.S. tropical forest resources. Increased budgets and greater participation by U.S. tropical forest experts are needed.

This option might be coupled with option 22, which is to establish U.S. centers of excellence to focus U.S. research, teaching, and resource development expertise related to forest resources. Such centers could demonstrate a variety of sustainable management technologies at sites in the U.S. tropical territories. They also would help develop the territories' human resources by supporting education and training activities.

More integration of U.S. Forest Service activities with the objectives and programs of territorial agencies responsible for resources other than forests (e.g., water and coastal marine resources) could help ensure that technologies are appropriate to the social and ecological needs of individual islands. Also, cooperative activities could provide a way to help the local agencies prepare to eventually assume total responsibility.

This option would require increased funding for the U.S. Forest Service institutes and could require some reordering of research priorities to increase emphasis on such topics as watershed management and agroforestry. Unless new moneys were appropriated, the funds might have to be transferred from other U.S. Forest Service programs. Competition for such funds probably would be great.

Option 2:

> Congress could support natural resource agencies in U.S. territories by increasing funding for the cooperative State and private forestry programs of the U.S. Forest Service institutes in Puerto Rico and Hawaii. Congress could also create a program of grants to territorial governments to encourage investment in privately owned forests.

Stronger local capacity to manage forest resources would contribute to the territories' self-sufficiency. In the long run, it might reduce the need for development assistance from the United States. Forestry could provide rural employment and increase sustainable production of food, wood, and other products that could be used instead of subsidized imports. A stronger local research capability could help ensure applicability of technologies to local conditions and could reduce dependence on research performed by the U.S. Forest Service.

The Federal Government subsidizes private forestry with cost sharing and direct payments to forest owners. Replacing these subsidies with a program of grants administered by the territorial governments would provide the flexibility needed to respond to each island territory's unique cultural, economic, and ecological characteristics. Furthermore, it would encourage the development of a constituency concerned with sustaining the forest resources. Such a program could be used to keep the benefits available if the Federal forestry cost-sharing programs in other areas were replaced with income tax incentives as has been proposed.

This option would require increased funds for the Forest Service institutes both for dispersal to local natural resource agencies and for increased administrative and professional personnel. State and private forestry funds (for grants, loans, subsidized inputs, and extension services) have been declining and would need to be increased. This could either be new money or money reallocated from other U.S. Forest

Service programs, but these programs have been cut substantially in recent years. In the short term, the local natural resource agencies might not have the human and logistical resources necessary to implement a greatly expanded program.

This option also would require new negotiations with the emerging Pacific territory governments to determine the guidelines for forestry program assistance. No resource programs are included under the Compact of Free association. The roles of local, U. S., and international resource agencies in the U.S. Pacific territories need to be defined to coordinate actions.

DEVELOPMENT ASSISTANCE

Issue (Projects)

Development assistance is making progress **to sustain tropical forests, but the gains are insufficient to offset resource degradation. Many opportunities exist to continue and accelerate the progress. But congressional vigilance is necessary to ensure that forestry projects receive an appropriate share of U.S. development assistance funds and that other types of projects complement the forestry efforts.**

The Foreign Assistance Act directs development assistance organizations in which the United States participates to give higher priority to the problems of loss and degradation of tropical forests. AID, the world Bank, the U.N. Food and Agriculture Organization (FAO), and some other multilateral organizations have increased funding for forest-related projects. Furthermore, AID has developed new forestry and environmental strategies and policies. Additional opportunities for development assistance projects to sustain tropical forest resources include greater support for:

- Participation by local people in identifying resource development problems and opportunities.
- Agriculture and rural development programs that increase productivity for people who live near forests. This would entail allocating a larger share of agricultural development assistance to relatively remote areas.
- Agroforestry and innovative crops and techniques that can sustain permanent agriculture on relatively poor soils.
- Locating new agricultural settlements where the natural and human resources are capable of sustaining farming practices used. In some cases, this would mean refusing support for settlement projects planned for closed forest areas and redirecting settlements to sparsely populated areas that are not forested.
- Reforestation and management of natural forests to sustain environmental services and produce fuelwood, construction wood, polewood, and nonwood products.
- Development and dissemination of locally acceptable technologies to make woodfuel use more efficient.
- Long-range planning for infrastructure development projects (e.g., hydroelectric dams), so that wood from clearing operations is used effectively, displaced farmers are resettled permanently, and watersheds are protected by forest cover.
- Institution-building to enable tropical governments to exercise improved control over timber concession operators.
- Technical improvement and increased application of technologies for sustainable regeneration in logged forests, including mangrove forests.
- Plantations of fast-growing industrial tree species to help take pressure off the remaining natural forests.
- Financing wood product development projects that encourage domestic processing as opposed to log exports.
- Innovative institutional approaches to forestry and agroforestry designed to ensure participation of local communities and to

increase diffusion of appropriate technologies beyond the boundaries of subsidized demonstration projects.
- Livestock raising projects that do not result in deforestation or forest degradation.

Option 3:

Committees of Congress could **continue periodic oversight hearings requiring testimony from AID and U.S. representatives to multilateral development assistance organizations on the extent to which development assistance practices are being modified to accomplish the objectives set forth in section 118 of the Foreign Assistance Act.**

Development assistance projects can be planned to produce improvements in income and income distribution and to simultaneously provide long-term conservation benefits. Such projects are being pursued to some extent by the various agencies. AID has one of the best records in this regard. However, the total effort is still small compared with other, more conventional approaches to agricultural and industrial development. Continued pressure from Congress, especially on the multilateral organizations, might lead to greater investments in resource-conserving projects. This in turn could result in more cost-effective and sustainable economic development and, eventually, in a reduced need for U.S. Government involvement.

Placing a higher priority on resource-conserving forest development might have some disadvantages. First, higher priority for these approaches means lower priority for some others. For example, investment in agricultural development in remote areas at the forest fringe may not produce short-term yield increases as great as the same amount of investment in already-developed farms on more fertile lands.

Projects designed to increase revenues available for forest management by making forestry more profitable or more sustainable have some other drawbacks. For example, promoting manufacture of wood products within tropical countries might reduce opportunities for employment and profits in industrial countries that now import logs and do the manufacturing.

Issue (Coordination)

Development assistance organizations generally do not coordinate their projects effectively at the country or regional level. To improve effectiveness, projects could be organized as steps in a comprehensive strategy designed to develop sustainable forest management systems. Individual development assistance organizations have neither developed nor coordinated such strategies.

The scope of tropical forest resource problems is great relative to available capital and human resources. No single project or single organization's program is likely to sustain a substantial portion of the tropical forest resources in perpetuity. The U.S. Congress has determined that improved coordination among the various international organizations is necessary to make forestry projects more cost effective. Section 118 of the Foreign Assistance Act specifically requires the President to seek opportunities to coordinate public and private development activities and investments that affect forests in tropical countries. It also instructs U.S. representatives to multilateral organizations to promote such coordination. AID recognizes this need in its Policy Determination documents on environment and natural resources and on forestry.

AID and other development assistance organizations do keep track to some extent of what other agencies and host government departments are doing and try to develop projects accordingly. AID has participated in some important joint efforts with other international organizations. Also, the International Union for the Conservation of Nature and Natural Resources, the united Nations Environment Programme, and the world Wildlife Fund have jointly prepared a world Conservation Strategy which calls for coordinated global efforts for the conservation of natural resources. These organizations plan to coordinate their endeavors to implement the strategy.

Several regional technical centers have informal coordination roles within their area of expertise. At the country level, the United Nations Development Programme country representatives sometimes are able to assist with coordination. Still, little progress has been made in getting international organizations to work together to develop national or regional forest resource plans that would assign specific tasks to each agency.

AID and other development assistance organizations are not likely to follow a long-term plan devised by any one organization because each organization works toward its own particular objectives, Each organization's country mission has specific pressures from its central office—whether it is in Washington, Rome, or elsewhere. Many bureaucrats are under pressure to spend an exact level of funds during each fiscal year. That requires flexibility that would be constrained considerably if they had to follow a strict plan devised under the leadership of another organization.

International development assistance organizations are, however, subject to the decisions and direction of tropical nations' governments. In theory, these host governments are responsible for coordinating development assistance efforts. In practice, host governments get help from each international organization in identifying projects for that organization and there are few attempts to make the different agencies' efforts complementary.

Why do host governments not coordinate the international organizations' activities more effectively? One problem is that tropical governments need to maximize assistance funds they receive each year, even though that means accepting some projects that are poorly integrated into the nation's long-term development plans. Also, different government agencies, and individuals within agencies, have different goals. Diplomatic pressure to accept particular projects can be another problem. Finally, the development assistance organizations have little incentive to encourage tropical nations to show strong leadership.

However, if the U.S. Congress believes that close coordination of international development assistance is necessary and that achieving such coordination is worth relinquishing some degree of U.S. control over what projects are funded, Congress could mandate increased U.S. efforts to enable the tropical nations to do long-term development planning and to coordinate international assistance more effectively,

Option 4:

> Congress could direct the Department of State **to** report **on** whether **various tropical nations are able and politically ready to develop** long-term **action plans for sustained development of renewable natural resources. AID and the multilateral organizations could use these assessments as a basis for assisting tropical nations in planning and coordination.**

The purpose of these assessments would be to indicate where institution-building and environmental education should be given a high priority; it would **not** be to reduce funding for nations where the political will to conserve and develop natural resource productivity is weak. Redirecting the type of aid offered could result in more cost-effective use of limited funds.

The first steps in assessing institutional capabilities for sustainable development of forest resources are being taken in AID's Environmental Profile reports. However, those reports now focus on environmental opportunities and problems primarily from a biophysical perspective and, to a lesser extent, an economic perspective. The reports suggested by this option would place more emphasis on assessing political will, values, and institutional capability. For example, does the government have effective control over logging concessionaries? Does it maintain land tenure arrangements that cause people to clear forest land that will not sustain agriculture?

The Department of State has the expertise to conduct political and economic analyses. The assessment process could be undertaken in

stages, beginning with syntheses of information available in Washington, moving later to work done under the auspices of U.S. embassies.

This option has some disadvantages. Since U.S. embassies would need to make critical judgments about political willingness and capabilities, any negative statements might offend host government officials. Thus, the Department of State might be reluctant to comply rigorously. If the reports were given security classification to minimize this effect, they would be of limited use in planning development assistance activities.

Option 5:

Congress could direct the Department of State and U.S. representatives **to multilateral development assistance organizations to promote international ad hoc committees formed to assist tropical nations in planning long-term forest development.**

These ad hoc committees could include experts from the United States, other developed countries, and the developing countries. They would identify problems, plan a forest resource development strategy, and coordinate various assistance projects. The committees could be modeled after the Coordination for Development in Africa program (CDA).

Many benefits can be anticipated from assisting tropical nations to take increased responsibility for planning and coordination. First, if such efforts were effective, the **cost** effectiveness of U.S. and other nations' development assistance efforts could be improved. Effective coordination increases the probability of meeting both the necessary and sufficient conditions for sustaining tropical forest resources. Second, and perhaps most important in the long run, improved planning and coordination might encourage some tropical governments to identify and resolve the institutional constraints, such as land tenure, that inhibit development of forests and other potentially renewable resources.

Increasing tropical nations' responsibilities for planning and coordinating assistance projects may be difficult and could have some negative effects. For instance, tropical governments might have to reject some inappropriate forestry projects and the funds that go with them. This would be a hard decision politically, but such decisions are sometimes made, at least by some of the wealthier tropical nations. A greater obstacle would arise where governments do not have the necessary expertise for resource development planning. Thus, in addition to the ad hoc committees for nation-level planning, it may be necessary to provide increased support for development of local planning capabilities.

RESOURCE DEVELOPMENT PLANNING

Issue

Although resource development planning is essential for sustainable production of forest products and environmental services, the available planning technologies are seldom applied to their full potential.

Tropical governments, development assistance organizations, and private firms often make forest development decisions without sufficient planning. Unplanned forest resource use is commonly a side-effect of narrowly planned development of some other resource or other area of the forest. For example, roads are built into forest land where logging and agriculture are inappropriate. The spontaneous development that follows usually is not sustainable or economic in the long run.

There are several reasons why planning is neglected. First, government and development assistance agency decisionmakers maybe un-

aware or unconvinced of the cost effectiveness of such planning. Second, decisionmakers may doubt that planners can provide timely results focused on relevant information and presented in understandable form. Third, many tropical countries have too little planning expertise. Fourth, domination of resource-use decisions by special interest groups can preclude comprehensive planning.

The effectiveness of planning in tropical areas is hampered by shortages of data on biophysical, social, and economic factors and by a lack of knowledge of how such factors interact. Many tropical nations need assistance to build their own capacity to produce data bases and to use them for planning. For example, improved information on biological diversity of various sites is needed to make decisions about where to locate protected areas.

Biophysical site capability and land classification are the most commonly applied components of resource development planning. These techniques are usually not well integrated with analysis of social, economic, or institutional factors. As a result, many development projects fail even though they may be suitable for the biophysical characteristics of the chosen sites.

AID is required to consider environmental impacts and has a policy requiring a "social soundness analysis" as part of project design. However, agency staff vary in their degree of cooperation with these requirements; some extend such an analysis beyond its useful bounds while others produce pro forma responses.

Option 6:

Congress could maintain the availability of low-cost Landsat images to governments in the Tropics.

Landsat images have proven useful in many tropical nations for measuring forest cover and identifying broad categories of forest types and conditions. In some instances, images taken at different times have been compared to identify rates and locations of deforestation problems. AID has had successful programs to train tropical government analysts to use Landsat imagery for resource development planning. The Landsat images have been available at low cost, but proposals to sell the U.S. satellites to private firms have been considered. Private ownership of Landsat could lead to increases in imagery prices that might discourage the use of this important tool for planning.

Resource planning can be greatly improved in many tropical nations with maps based on broad classifications of land capability. Using Landsat images, such classifications can be made rapidly and inexpensively for large areas. This is important because timeliness and expense are two of the major constraints on the use of planning analyses. Landsat is useful even where computer analysis is not available because the images can be interpreted visually. Small computers that can analyze the data in digital form are becoming more widespread in tropical nations and as a result, Landsat interpretation is becoming an even more accurate tool.

Constraints on the use of Landsat include cloud cover that consistently obscures views of some tropical areas. Many tropical governments do not yet have enough skilled personnel or facilities to use the imagery. Resource planning agencies, in some nations, cannot get images of certain forest areas because they are classified for security reasons. The major disadvantage to this option is that the U.S. Government would have to continue paying the costs of the Landsat satellites.

Option 7:

Congress could encourage AID to provide resource development planning assistance by improving the use of macrolevel land classification and the analyses of social and institutional factors in AID's "Follow-on Country Environmental Profiles." Congress could direct the U.S. representatives to international development assistance organizations to promote similar policies.

AID's Environmental Profile process is proving to be an effective mechanism for environmental education as host government agencies are becoming involved in production of the second phase of profile reports. Still, this does not guarantee that decisionmakers will consider

the environmental profiles useful for development planning. Thus, it is important to proceed slowly with these activities until local interest and participation are assured. Followup is necessary so that the environmental concerns are incorporated in AID's country development strategies and in the host country's development planning.

Much technical information on natural resources in tropical forest areas already exists in the United States. It is scattered in such places as the archives of the Soil Conservation Service, the map collections of the Library of Congress, the Central Intelligence Agency, and the electronic data bases at USDA's Economic Botany Laboratory. This information can be used to produce first approximations of land-capability or life-zone maps. These could then be checked for accuracy in the subject nations, as were the first drafts of the Environmental Profiles.

Providing more pragmatic information on natural and human resource capabilities may make the reports more useful. Performing these assessments cooperatively with the host nations provides opportunities for U.S. and tropical nation personnel to gain new expertise. Cooperative production of the information also enhances the likelihood of its use outside of AID.

A number of objections to this option can be anticipated. It calls for the production of more reports not tied to specific development projects, so some tropical nations may perceive that it is an activity that only benefits AID. Preparation of such reports maybe perceived by many AID and host country officials as a distraction of available time and funds.

The fact that much data on tropical forest resources gather dust in U.S. archives may indicate that many such efforts do not produce useful reports. Also, AID has sponsored biophysical land capability assessments in the past, and, when necessary, they might do so again without special prompting from the Congress. In countries where planning expertise is scarce, promotion of these techniques may be premature.

Option 8:

> Congress could direct the U.S. directors of multilateral development banks **to** promote **environmental assessments at an early stage of project planning. Congress could follow up on this request by holding periodic hearings to determine whether the banks are using environmental assessment procedures effectively.**

A variety of development assistance projects affects tropical forest resources directly and indirectly. The negative effects can best be identified and mitigated at the project level because they tend to be highly site-specific. Thus, environmental quality and natural resource considerations should be integrated into the design and continuing evaluations of development projects.

For example, irrigation projects should in some cases include funding for protection of forested watersheds. The negative impacts of projects that convert tropical forest to other uses can sometimes be offset by funds to establish protected areas elsewhere. More thorough and analytical environmental review processes could increase the long-term net benefits of development projects. They also might help convince tropical governments of the importance of these factors.

The U.S. experience with environmental impact statements demonstrates the need to focus on tradeoffs that arise in decisionmaking. The U.S. process has at times been time-consuming and expensive, but it has been an effective tool for avoiding negative environmental effects. The multilateral development banks are beginning to use such procedures. The World Bank, for instance, has established an Office of Environmental Affairs. However, the environmental reviews occur late in the planning process, so the information they produce is less useful than it could be.

For the banks, it may be more desirable to integrate environmental quality and natural resource considerations into the early stages of planning than to require separate environmental impact statements. Follow-up monitoring of environmental effects during and after proj-

ect implementation also deserves higher priority. However, such analyses could be pro forma and superficial if the banks and the host governments do not perceive them to be an important tool.

RESEARCH AND MARKET DEVELOPMENT

Issue (Research)

Fundamental research, applied research, and technology implementation related to tropical forests are not well coordinated. Moreover, interactions among factors that constrain forest resource development are poorly understood. Consequently, resource development projects often fail, and promising technologies too seldom spread beyond the demonstration areas. Expanded interdisciplinary research efforts in tropical forest resources are needed and these need to be more closely related to technology implementation.

Profitable technologies that can supply local people's needs and simultaneously sustain forest productivity do not exist for many types of tropical forests, Incremental improvements of existing technologies seem unlikely to accomplish these goals. Rather, new approaches in both techniques and institutions also must be invented. These must be based on improved understanding of the biological, economic, and social factors affecting forest resources. Thus, new fundamental research is needed. But forest resource degradation is occurring too rapidly for fundamental research to be conducted in the traditional, somewhat aloof fashion. Fundamental research could play a larger role in conservation and development if scientists would increase their efforts to understand the needs of applied researchers and technology users.

Interdisciplinary research on tropical forest resources has seldom been based on an adequate understanding of the needs of technology implementors. Research results often are presented in unusable formats and published in academic journals that technology implementors have little time and incentive to locate. Consequently, much applied research is not used for technology development. When it is used, there is often a time lag between completion of the research and its use.

Solutions to this problem include building more research and training components into the implementation stages of development projects and improving communication among researchers and between researchers and technology implementors. Reorganizing research efforts to improve this communication should be relatively inexpensive.

Option 9:

Congress could conduct hearings to determine 1) whether research agencies (such as the National Academy of Sciences, the National Science Foundation, and the U.S. Forest Service laboratories and institutes) are giving sufficient priority to interdisciplinary tropical forestry studies that link research and development, and 2) whether the results are being disseminated adequately. Congress could reward those agencies and programs that follow such priorities.

Hearings are a relatively inexpensive way to express congressional recognition of a need, gather information, and provide impetus to government agencies and the private sector to redirect and expand their efforts. Hearings can give recognition to individuals and programs that have taken desired actions. If hearings reveal that agencies are doing interdisciplinary research that is used to sustain tropical forest resources, Congress may choose to increase funding for those agencies.

Hearings alone, however, do not carry legislative weight. They usually require followup to affect agency behavior. Since they may reflect the interest of only a few Members of Congress, organizations may not be induced to

change their priorities simply as the result of the hearing process.

Option 10:

> Congress could appropriate funds specifically for UNESCO's Man and the Biosphere program.

The International Man and the Biosphere (MAB) program receives money from the general funds of UNESCO. Current levels of funding are low and much reduced from previous years. Concurrently, the Department of State support for U.S. liaison activities with the MAB program is being cut back.

MAB provides a framework for international cooperation in problem-oriented research on natural resource development. Part of its budget is earmarked for activities concerning the Tropics. Continued U.S. support for MAB would strengthen the ability of tropical nations to conduct significant research and could facilitate communication of research results to developers and users of resource-sustaining forest management technologies. In addition, it would help maintain U.S. scientists' links to this research network.

This option would require some additional funding from Congress. Moreover, increased support may not lead to improved coordination in tropical forestry research or to reorientation of research so that it addresses the real needs of technology implementors.

Option 11:

> Congress could determine the feasibility of establishing agroforestry and forestry research programs at existing Consultative Group on International Agricultural Research (CGIAR) institutions.

CGIAR is a network of regional and international organizations that have experience in conducting agricultural research in developing countries and in linking research to technology implementation. The mandates of the CGIAR institutions do not include forestry and have been interpreted to exclude agroforestry as well. By developing and promoting agroforestry and forestry systems, CGIAR research could help alleviate pressures to convert remaining tropical forests to other uses.

The addition of forestry or agroforestry programs to these institutions could facilitate interdisciplinary research cooperation and the development of production systems in which agriculture and forestry are integrated. Capital outlay would be minimal because the network and institutional infrastructure already exist.

Adding such programs would involve internal adjustments and priority shifts within and between existing institutions, so the CGIAR institutions might resist an attempt to incorporate forestry or agroforestry unless substantial additional funding were provided. Even with additional funds the changes might be disruptive for CGIAR institutions, many of which are oriented not to farming systems but rather to production of particular agricultural commodities.

Option 12:

> Congress could amend existing legislation that allocates funds for tropical agriculture activities to include tropical forestry and agroforestry explicitly. To do so would improve the likelihood that forestry, agroforestry, and conventional crop production would be viewed as complementary activities.

Some forestry activities take place under agricultural programs. For example, Public Law 480 funds have been used occasionally to support reforestation, and a few forestry schools have been awarded Title XII grants where "agriculture" has been interpreted broadly. However, without specific reference to tropical forestry and agroforestry, important opportunities to apply techniques that can sustain resource productivity may be lost.

Congress could amend Public Law 480, the Food for Peace Act of 1966 (specifically sec. 406(a) 2 and 4) so that "agriculture" explicitly includes forestry and agroforestry, Similarly, Congress could broaden Title XII of the Foreign Assistance Act (specifically sec. 211(d)),

which awards grants to help solve critical food problems of the developing world, to increase involvement by U.S. forestry schools and other appropriate government agencies. These expanded mandates could be supported by diverting money from other development activities or by allocating new moneys through existing institutions.

Broadening existing agricultural funding mechanisms to include forestry and agroforestry avoids overhead expenses that would occur if new programs were created. It also would help promote a much needed interdisciplinary approach to deal with problems of tropical land use.

The major argument against amending existing legislation would be that such an action might hinder the achievement of other goals by diluting limited funds and personnel. Many experts believe that substantially more funds will be necessary to advance agroforestry and forestry significantly. Another problem is that even with explicit direction from Congress, the institutions committed to agriculture may continue to give forestry and agroforestry only a small share of their resources.

Option 13:

> Congress could establish a trust fund for the Forestry Department of FAO to support improved communication among researchers and technology implementors.

FAO has the world's largest accumulation of professional tropical forestry expertise. The organization has strong connections to tropical governments, tropical forestry experts, and both multilateral and bilateral development assistance agencies. FAO'S activities include creating a world forest resource information system and promoting social forestry. It publishes a forestry journal, ***Unasylva,*** and series of technical forestry papers. FAO has been instrumental in focusing world attention on the need to integrate forestry into community development.

The U.S. contribution to FAO goes into a general fund; FAO then allocates portions to its various programs. Forestry receives only a small share and the United States has a relatively minor role in FAO'S Forestry Department. A trust fund is a way to ensure that the forestry program receives additional money and to enhance opportunities for use of U.S. expertise on tropical forests.

A trust fund also would permit the United States to negotiate some particular priorities for funding. For example, the United States could establish a trust fund specifically to support interdisciplinary research components in FAO forestry development projects and to enhance the communication of research results and technical information. Such a trust fund might support management training programs or the preparation, publication, and dissemination of forestry information in appropriate languages for technical schools and practitioners.

However, FAO may not be the best place to invest U.S. funds intended to support technologies to sustain tropical forest resources. This would require additional funds beyond the current statutory limits on the U.S. contribution to FAO. The United States has not had a strong voice at FAO planning sessions for regular forestry activities. Finally, political benefits to the United States from funds spent through a multilateral agency may be less than political benefits from a U.S. bilateral agency.

Option 14:

> Congress could amend the Foreign Assistance Act (sec. 301, U.S. Voluntary Contributions to U.N. Organizations) to include funding for the United Nations University (UNU).

UNU functions through and strengthens networks of existing universities and research institutions around the world. It provides a variety of courses, instructors, and research facilities. It is an international community of scholars engaged in interdisciplinary research, post-graduate training, and dissemination of knowledge to international organizations, governments, scholars, policy makers, and the public. The U.S. Government has never provided financial support to UNU. The main advantage of such a contribution would be promotion of interdisciplinary research.

The main objections to this option are that it requires increased Federal spending and that funds might be used more efficiently by the U.S. National Science Foundation or by AID's technology transfer programs.

issue (Product and Market Development)

Sustaining forests in many tropical areas will depend on developing markets for local forest products. Many products that are gathered on a subsistence basis do not attract investment for sustainable development because they appear to be 'free. Furthermore, government agencies are often unaware of the forest's potential **to support rural development.**

Tropical forest ecosystems house complex associations of vegetation, wildlife, and other potential resources, some of which could be developed as commodities profitable to harvest on a managed basis. Information gathered on noncommercial tree species and nonwood forest products is abundant. But it seldom includes more than taxonomic identification and a brief discussion of existing product uses by tropical people. Developing markets for unused or underused forest products could motivate local people and development agencies to invest time and capital in managing forest resources. Thus, in some areas, product and market development could be a way to maintain biological diversity and simultaneously provide profitable rural development.

Option 15:

a) Congress could mandate and fund the U.S. Forest Products Laboratory to develop new products and market information for tropical forest resources and to increase its efforts to transfer the technologies.

b) Congress could direct AID to expand its support for dissemination of information on underused tropical forest resources and to pursue market development for those products that are sustainable with the kinds of management likely to occur.

Using a wider range of tree species and sizes should make intensive management of smaller forest areas feasible and profitable. This would allow larger harvests from smaller areas, protecting biological diversity in unharvested areas while providing materials for export or local development. Use of many tree species and sizes can supply growing domestic markets and at the same time continue to produce wood for export markets. Logging from smaller areas would also make enforcement of strict regulations regarding road engineering, site protection, and restoration of the forest more feasible.

The U.S. Forest Products Laboratory is conducting some research on tropical wood product use, and several of its projects for temperate zone forestry are producing technologies that can be used in the Tropics. A more specific congressional mandate and additional funding would ensure continuation and expansion of such activities and could enhance technology transfer to tropical areas.

Additional knowledge of the role of forest products in subsistence economies and improved development of markets for nonwood forest products could cause decisionmakers to value forests more highly. More support could be developed for local forestry investments and conservation efforts, Development of production systems and markets for nonwood tropical forest resources could provide employment and income-generating activities for rural people while reducing incentives to convert forest to unsustainable land uses.

AID has considerable experience with production system and market development for agricultural products and this could be applied to tropical forest products, Furthermore, AID could increase its support for the BOSTID project that synthesizes, publishes, and distributes information on underexploited tropical resources. This relatively inexpensive project already has been very effective in stimulating investment in such resource development.

Several constraints hold back development of new forest products. Even if research were increased, it is not clear that the potential new products would attract investment. One problem is that inexpensive and reliable screening techniques for evaluating potential forest prod-

ucts have not been developed. Another problem is that market research for new products often must depend on unverified assumptions about what the product price will be and on unreliable consumer preference surveys. Also, in many tropical countries capital earns high rates of return and entrepreneurial talent is highly rewarded in enterprises less risky than new product development. Furthermore, information on traditional uses of minor forest products is difficult to collect.

Successful product and market development should lead to higher profits from forest resource harvesting. If governments do not make simultaneous investments in forest management and in regulation and control of those who harvest the resources, however, market development could lead to more rapid depletion of the resources.

BIOLOGICAL DIVERSITY

Issue

Benefits from preserving biological diversity of tropical forests accrue to society as a whole, including future generations, yet the costs are borne by the present generation in tropical countries.

Tropical forests are great reservoirs of biological diversity. They contain some 2 million species of plants and animals. But diverse forest ecosystems generally do not produce high yields per hectare per year of highly valued products. So development usually entails replacing diverse systems with simpler ones.

Natural forests can be modified to make them economically productive while maintaining significant biological diversity. However, for many types of forests this will not occur until more profitable management technologies are developed. For now, the full original species composition of tropical forests probably can be preserved only in areas that remain inaccessible or in areas set aside for research, education, and recreation.

Maintenance of some natural forest ecosystems can be justified because they are on steeply sloping watershed catchments. Cloud forests are an example. For now, however, investments in protection and maintenance of other biologically diverse natural forests will have to be motivated by recognition of the potential these areas and the genetic resources they contain hold for future generations.

Option 16:

Congress could conduct hearings on its recent amendment to the Foreign Assistance Act which directs AID, in concert with other appropriate agencies, to develop a comprehensive U.S. strategy to maintain biological diversity. Congress also could encourage U.S. representatives to multilateral organizations to promote similar strategies.

Over the past 5 years, AID, the World Bank, and some other assistance organizations have developed strategies for investing in forest resources (mainly to produce wood) and for ameliorating the negative environmental effects of development projects. The process of developing and implementing these strategies has helped educate decisionmakers about environmental consequences of economic development projects and about new approaches to forestry. The strategies have begun to foster more sustainable development projects.

The strategy to support biological diversity can be expected to have a similar effect. If conservation of biological diversity were made an explicit goal for development projects, development agencies would act to keep open future options for development of renewable resources. This eventually could lead to new ways of using and sustaining these resources to meet basic human needs or to produce biological products for export. Maintaining biological diversity can complement sustainable economic development because it fosters en-

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vironmental stability and renewable resource productivity.

Some AID officials may be reluctant to comply rigorously with the intent of the amendment. It may be perceived as another restriction that hinders AID and other development assistance organizations. Actions will not necessarily stem from the strategy unless there is strong commitment and support within the agencies.

Option 17:

Congress could support the creation of an international fund to subsidize the establishment and maintenance of protected areas in the Tropics.

Although there are many designated protected areas in the Tropics, most receive little protection and many are being deforested or degraded. Often this is because poor nations can not afford the costs of adequate protection. Various ways to finance protected areas have been suggested. One proposal is to solicit contributions from developed countries or to tax some internationally traded commodities to create an international fund. The fund would provide grants to tropical nation governments to establish and manage protected areas. Another suggestion is for the assistance agencies to finance an international fund that would support a wide variety of development projects outside the forests. These would be designed to reduce the motivation for exploiting the protected areas. The fund would support such projects as compensation for the direct and indirect costs of protected areas. (Indirect costs include the foreign exchange and income foregone as a result of restrictions on harvesting forest products.)

Creating a major fund for tropical forest protected areas would increase opportunities to preserve these habitats and their vast biological diversity. The fund would make additional moneys available for parks where and when most needed. Some money is available for protected area establishment from scattered sources, but it is not sufficient and is rarely available to manage existing protected areas.

This option is likely to be expensive. The tropical forests to be protected are often in remote areas. The logistics of both policing the protected areas and creating suitable economic development opportunities for people outside the protected areas would be difficult. Furthermore, the suggested funding mechanisms may face serious objections. International funds for work on environmental problems, such as desertification, have not had much success in soliciting contributions from developed nation governments. Taxes on forest products would raise consumer prices in importing countries and reduce revenues to tropical countries. Diverting funds from existing development assistance activities could have adverse effects on those activities.

U.S. EXPERTISE

Issue

U.S. expertise on tropical forest resources is widely scattered and is not being developed or used effectively.

Tropical governments and international organizations are beginning to increase investments in tropical forest resources. As a result, demands for U.S. technical and financial support are increasing. The United States has few well-qualified, experienced experts on tropical forest resources and has limited funds to allocate to this field of growing importance. Nonetheless, U.S. expertise is recognized in fields that include reforestation, watershed management, forest industries, resource inventory and mapping, resource development planning, information processing, botany, zoology, and environmental education. Furthermore, the United States has a wide variety of public and private organizations that could contribute to an expanded international program on trop-

ical forests. Much more could be done to create opportunities for U.S. expertise to help sustain tropical forests.

U.S. science and technology alone cannot be sufficient to sustain tropical forests because of the scale of the problem and because most of the tropical forests are the sovereign resources of foreign nations. In the long term, science and technology expertise must come from within the tropical countries. However, U.S. expertise is needed now both to assist directly with technology development and implementation and to build indigenous scientific and technical capabilities in tropical nations.

Option 18:

> Congress could modify the organic legislation for those U.S. agencies* whose actions affect forest resources in tropical nations and U.S. tropical territories. The amendments would state in substance that the agencies, in their regular activities: **1) will not contribute to or fund conversion or degradation of tropical forests unless such activities are preceded by detailed resource development plans indicating that the conversion will result in sustainable land use, and 2) will act to maintain and enhance trop ical forest resources and act to slow or stop deforestation end degradation.**

Ensuring that the Federal agencies do not contribute to the unsustainable use of tropical forest resources would be a significant first step. Federal agencies also could do a great deal to help develop and use resource-sustaining technologies. Such a mandate from Congress would signal the importance of maintaining tropical forests and the species they contain while developing them to benefit those who rely on their products and services for livelihood.

The U.S. National Park Service, Fish and Wildlife Service, and Forest Service have international offices, but their responsibilities are not well-defined in the organic legislation. For example, the National Park Service's organic legislation could be amended to direct that agency to share its expertise in protected area establishment, management, and related training with tropical countries. The Forest Service's institutes in Puerto Rico and Hawaii could be directed to provide research and training in response to tropical nation needs. In addition, various agencies might provide more opportunities for foreign resource managers to receive training.

One disadvantage of this option is that expanded mandates might conflict with existing interests and abilities in some agencies. Thus, the changes might not receive support from agencies that perceive them as hindering their abilities to function effectively, especially if significant staff time is taken from other responsibilities. In addition, more funds and staff might be needed, depending on how the mandate is implemented.

Option 19:

> Congress could request the General Accounting Office to determine how Federal agencies are using existing legislation enabling Federal employees with appropriate expertise to work in international assistance agencies, American embassies, and international nongovernmental organizations. Where appropriate, Congress could hold hearings, up date or amend existing legislation, and direct the Office of Personnel Management to encourage the use of those laws.

Mechanisms exist that enable U.S. Government personnel to work on such problems as tropical deforestation. To determine if this is occurring, GAO could review the agencies' use of the Federal Employees International Service Act, the Intergovernmental Personnel Act, and appropriate Executive Orders in the Federal Personnel Manual (e.g., Executive Order No. 11552 of Aug. 24, 1970, enables details and

*Government organizations concerned with tropical forests include the Department of State, Agency for International Development, Council on Environmental Quality, Department of Agriculture, U.S. Forest Service, Industry and Trade Administration, National Oceanic and Atmospheric Administration, Bureau of Land Management, Fish and Wildlife Service, National Park Service, International Development Cooperation Agency, National Aeronautics and Space Administration, National Science Foundation, Peace Corps, Smithsonian Institution, Department of Defense, Corps of Engineers, International Executive Service Corps, Overseas Private Investment Corporation, Export-Import Bank, and Trade and Development Program.

transfers of Federal employees to international organizations).

Updating or simply calling attention to these mechanisms for overseas work may encourage Federal employees to work on tropical forestry issues. This would help build a cadre of experienced U.S. tropical forest resource experts to support future U.S. tropical forestry initiatives.

Legislation alone may not be enough to increase substantially the participation of U.S. forest resource experts overseas. To date, involvement of U.S. resource managers abroad has been limited by absence of long-term career opportunities. In fact, agencies may discourage staff participation in international programs. Federal agencies, already short on staff, are reluctant to let personnel go abroad. Thus, employees who do work overseas commonly are in the early stages of their careers or are nearing retirement. It maybe necessary for Federal agencies to re-examine their reward structures and ensure re-entry to responsible positions upon participants' return to the United States.

Option 20:

Congress could encourage the U.S. private sector to develop and implement technologies that sustain tropical forest resources.

Congress could encourage the Overseas Private Investment Corporation (OPIC) and the Trade and Development Programs under the International Development Cooperation Agency (IDCA) to give special help to U.S. firms that have technologies appropriate for maintaining and enhancing tropical forest resources. OPIC and IDCA could help such firms establish or expand operations in tropical nations. In addition, Congress could amend the Foreign Assistance Act to direct AID mission directors to give such firms a preferred status in procurement of technologies, products, or services. This incentive in conjunction with OPIC assistance might expedite transfer of resource-sustaining U.S. technology to tropical nations.

Another law that might be modified is the Small Business Innovation Research Act, which at present does not require AID's compliance. In addition, the International Executive Service Corps could devote more effort to recruiting volunteer retired executives with expertise in managing natural resources. Further opportunities to influence the private sector could be identified from congressional hearings.

A wealth of information, technology, and expertise that could be used to help tropical nations resides within the private sector. U.S. firms could stimulate investment in forest resource conservation and development, and, as a consequence, the United States could benefit from more reliable sources of goods and from new investment opportunities. The private sector can be more efficient than government in technology research, development, and implementation.

Reinvestment of profits into projects in developing countries, especially joint ventures, is one important mechanism for technology transfer. Another is private sector exchange programs, including on-the-job instruction in the United States, consulting, onsite workshops and training programs, support of local scientific and educational institutions, serving as guest instructors at foreign universities or management institutes, and sponsoring attendance of developing country personnel at international symposia and conferences.

Increased involvement of the U.S. private sector could cause some problems, however. U.S. private businesses might displace or stifle growth of some indigenous private businesses in the forestry sector. Markets might collapse or infrastructure might not be maintained when U.S. firms leave a tropical area. In addition, most resource-sustaining ventures involve long-term commitments of capital which many private businesses may be unwilling to risk in potentially unstable developing countries, even with OPIC insurance. Finally, U.S. businesses are not required to perform environmental im-

pact assessments overseas and may cause unintended damage to tropical forest resources.

Option 21:

Congress could authorize U.S. participation in the United Nations Associate Experts Program.

Under the U.N. Associate Experts program, developed countries send technical personnel to developing countries to work on U.N. agency projects, including forestry and rural development projects. The developed country pays the salary of its own experts. The United States does not participate in this program, although most OECD countries do. U.S. participation might be administered through existing offices of the Peace Corps or the Forest Service.

U.S. participation in the Associate Experts program could have advantages for both the U.S. and the tropical nations. U.S. participants would be able to transfer technical and managerial skills needed for resolving practical forestry problems in the Tropics. This program also would increase the visibility of the U.S. role in tropical forestry and facilitate scientific and cultural interchange between Americans and decisionmakers in tropical countries.

The United States has few opportunities to develop tropical forestry expertise beyond the level acquired by Peace Corps volunteers. This is one reason why few Americans work on forestry projects administered by FAO and other multilateral development organizations. Participation in the Associate Experts program would give U.S. experts the needed opportunities to acquire tropical experience. Thus, it should lead to a greater role for U.S. citizens in international agencies and increased marketability of U.S. consulting services abroad.

Since this would be a new program for the United States, new funding would be required. Only a small number of qualified U.S. experts may be available for participation in this program. To some extent, the Associate Experts program may overlap with bilateral programs of U.S. AID and other agencies.

Option 22:

Congress could designate U.S. centers of excellence to focus U.S. expertise on tropical forest resources and provide opportunities for research, education, and technology transfer.

Effective use and further development of United States tropical forestry expertise are constrained by a lack of institutions in which tropical forests are an issue of prime importance. The U.S. experts with knowledge and experience needed for sustainable development of tropical forest resources are scattered among public, private, and academic institutions. The experts have too few opportunities to practice or improve their expertise or to provide fieldwork for students. Development assistance agencies, private firms, and organizations working with forest resources in tropical countries have difficulty locating expert scientists. Much of the work by U.S. experts is terminated before it succeeds because institutional continuity is lacking.

Centers of excellence could address many of these faults. They could organize education curricula and research programs that integrate social, physical, and biological perspectives. They could establish strong links between fundamental and applied researchers and communication between researchers and technology implementors. They could act as brokers of information and expertise by directing tropical governments, tropical universities and students, and assistance agencies by directing them to appropriate U.S. experts. Also, they could help U.S. experts and students locate private firms, tropical universities, or government agencies interested in collaborative work, and by identifying sources of funding for these kinds of exchanges.

Centers of excellence in tropical forestry could be established to correspond to each geographic region of the tropical world (tropical America, Asia, and Africa), or centers could be organized according to ecological categories (dry open forest, moist closed forest, mountain forest). Possible locations for such centers in-

elude the U.S. Forest Service's Institute of Tropical Forestry in Puerto Rico (perhaps in conjunction with the USDA Mayaguez Institute of Tropical Agriculture and the University of Puerto Rico), the U.S. Forest Service's Institute of Pacific Islands Forestry (in conjunction with the University of Hawaii and the East/West Center), or the Klieberg Institute at Texas A&I University (in conjunction with other departments of that university).

Locating centers for tropical forestry excellence in U.S. tropical or semiarid environments would have important advantages. Research, demonstration, and education field work could be conducted on technologies appropriate for the biophysical conditions that prevail in tropical regions. The centers could be expected to get more support from local organizations than if they were located at U.S. sites where their work had no local applicability. Centers in the United States would be accessible to the U.S. experts and students who are scattered among many organizations. This accessibility would be most important for the expertise brokering function.

There are several arguments against this option. First is the problem of funding. Developing the institutes in Puerto Rico and Hawaii as centers of excellence in tropical forestry would require significant changes in the Forest Service budget. Another problem is that many of the ecological, institutional, social, and economic conditions typical of the tropical nations do not occur on the U.S. tropical islands or semiarid sites. Institutes located in tropical nations would be more accessible to indigenous tropical scientists and students and so might be more effective in supporting the tropical nation's own institutions. Another problem is that centers of excellence, whether located in the U.S. or tropical nations, might focus too narrowly on technical issues and biophysical sciences, thus neglecting institutional and social issues that are fundamental constraints on forest development and conservation in tropical countries.