

# Management of Tropical Forests for Products and Energy<sup>1</sup>

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**Abstract:** Tropical forests have always been sources for prized timbers, rubber, tannin, and other forest products for use worldwide. However, with the recent concern regarding global change, the importance of effective forest products management and utilization has increased significantly. The USDA Forest Service's Forest Products Laboratory at Madison, Wisconsin, has embarked on a new program on the utilization and identification of and research on tropical tree species. This new work will be centered at the Laboratory and at the Forest Service's Institute of Tropical Forestry in Puerto Rico.

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The USDA Forest Service's Forest Products Laboratory, at Madison, Wisconsin, has started a new program in tropical forestry. This utilization program emphasizes the identification of wood decay fungi in the tropics, improved drying processes for tropical species, and improved sawing of difficult to process tropical species. We are also investigating new panel and molded products capable of being manufactured with tropical species and recycled wood and plastics. We have strengthened our research effort in identification of extractives from tropical species. In an effort to permit construction of affordable houses with local materials, we are studying construction techniques for the tropics.

Other important work that can lead to improved economic opportunities in the tropics includes determination of properties and uses of native species and modification of production processes for mixtures of tropical species, utilization of plantation species such as eucalyptus for products and energy, and protection of wood under severe exposure conditions such as extreme moisture and the Formosan termite.

This paper describes the new work in tropical forestry planned for the Forest Products Laboratory, and in the Forest Service's Institute of Tropical Forestry in Puerto Rico.

## Forest Products for Energy

That the tropical forests are being destroyed at an alarming rate is widely known and accepted. This prompted President Bush and the other world leaders at the recent Economic Summit in Houston, Texas, to call for a global forest convention or agreement to curb deforestation in their July 11, 1990, communique.

The motivation behind tropical forest deforestation is not widely understood. Most studies estimate that less than 20 percent of the deforestation is due to logging for timber. Most of the deforestation occurs because of land clearing operations for conversion to other uses such as grazing or agriculture, commonly slash and burn agriculture which leads to short-term

use followed by desertification. Perhaps some trees are removed and utilized, but most are felled and burned to clear the site.

Although the importance of tropical deforestation is widely recognized, the basic reasons behind it are more subtle. The root causes of deforestation are primarily social ones: abject poverty, population pressure, overwhelmed institutions, and uncontrolled development. As a result of these factors, the tropical forests are under pressure by indigenous peoples who are forced to resort to slash and burn agriculture, by developers who want to convert the forests to other uses such as ranching, and by loggers who remove but a few commercial species per acre and leave the bulk of the trees that are unmarketable to be felled and burned. It is important to the world economy that industry, infrastructure, and domestic markets be established in developing countries so that the wood currently being wasted may be used, and so that the productivity of forest lands be sustained.

Tropical forests can contribute to economic development only if they are used. Furthermore, it is important that these forests be used in an efficient and sustainable way, thus providing an economic incentive for their continued management. This is where the need for utilization research enters in.

Tropical forests have always been sources for prized timbers, rubber, tannin, and other forest products for use worldwide. However, with the recent concern regarding global change, the importance of effective forest products management and utilization has increased significantly. Generally, commodity products are the highest value use of the sustainable resource worldwide, but industrial usage for energy is becoming more important. Traditionally, energy from wood in the form of solid wood or charcoal has been the principal source of cooking fuel in the tropics, but this use was, and still is, extremely inefficient.

The reasons why this material is unused are primarily because of the problems associated with utilization. For many species, the wood and its properties and suitable methods for processing are unknown; consequently it has no value. Improved utilization through research, therefore, can play a key role in enhancing the value of the forest and improve its prospects for sustainable management.

Forest health, productivity, and diminishing fuel wood supplies are becoming issues of international concern in light of the perceived impacts of tropical deforestation on global climate change. To reverse these deforestation trends, forest resources need to be improved, managed, and used. Atmospheric carbon dioxide increase may be as much as 3.0 gigatonnes per year as a result of deforestation. This compares with 6.6 to 7.0 gigatonnes per year from consumption of fossil fuels. Sustainability of forests and increases in forest production instead of wasteful incineration could reduce carbon dioxide emissions to the atmosphere through reducing both fossil fuel use and land conversion. Developed countries such as the United States should assist in sharing expertise and experience in managing forests

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for sustainability and profitable use of production. As developing countries increase living standards and consume more raw materials and manufactured goods, the United States will face greater competition in supplying more goods on the world market. This condition requires more knowledge of demand, pricing, international markets and trade, and natural resource policies.

## Needed Research

Most of the trees are left behind after commercial logging because of the many species found on the typical tropical site. The common practice is to harvest only the highest value material suitable for traditional products. The properties of wood from the remaining trees vary widely and in most cases are not known. Research is needed to determine the properties of these lesser-known species so that ones with similar properties and processing characteristics can be grouped to optimize their processing and use.

Most of the exported tropical timber is in log form or with very low levels of primary processing. This minimizes the favorable employment effect that would occur with additional domestic processing. Domestic processing and use within the originating country is limited because of the low recovery rates that are common in tropical areas; wastage is unacceptably high. Property and processing research are needed to improve recovery and lower degrade. Research can also lead to the processing of woods that are presently unused because of their high density and silica content.

Some tropical species such as rubberwood, coconut, eucalyptus, and teak are currently grown in plantations. These plantation-grown trees either do not have a long history of utilization for wood products, or have altered properties because of their plantation origins. Research is needed to determine the properties and optimize the processing and end use of these plantation species, thus helping to relieve some of the pressure on the natural tropical forests.

Adequate shelter is a critical need in the tropics, particularly after natural disasters. Tropical timbers could play a much more active role in providing this shelter if appropriate structural designs were available and if grades and standards were available to guide the appropriate use of these timbers. Also needed are ways of protecting these structures from biological deterioration, possibly by natural preservatives extracted from naturally durable tropical woods. The tropics furnish a fruitful field for insect and disease pests to operate. If some species of pests are destructive in the temperate zones, they are usually even more so in the tropics. And some species, such as the Formosan termite, are of concern only in the tropics and sub-tropics.

Finally, there is the question of domestic energy from wood and energy used in processing wood products. Fully a third of the world's population relies on wood for domestic fuel, and in some areas, such as Africa, this is a critical need. More efficient and appropriate cook stove designs and charcoaling techniques can help ease the demand if householders and colliers can be convinced of their effectiveness. As more lumber is processed at the points of origin, seasoning before shipment will also assume more importance. Seasoning of wood consumes considerable

energy in lumber processing, and more efficient drying processes and alternative forms of energy are needed.

## Planned Action

The Forest Products Laboratory is proceeding with plans to create a Tropical Woods Research Team at the Laboratory with some of the scientists located at the Forest Service's Institute of Tropical Forestry, in Puerto Rico. The unit is to be given a mission to conduct research on the utilization of tropical woods and the implementation of this research. The mission will extend beyond the utilization problems of the American tropics to include all tropical regions. However, initial emphasis will be given to the Caribbean and lowland landscapes of Latin America, particularly the Amazon basin.

The research team will focus on tropical wood utilization questions and provide vivid evidence of the Forest Service's commitment to the broader issues of tropical forest deforestation and economic development. It will be highly practical and applied and heavily slanted toward training and demonstration, possibly with support from the International Tropical Timber Organization Fellowships and Small Grants Program (*fig. 1*). It will enable us to offer technical assistance, when needed, and will offer the advantage of a fast response, particularly in the case of responding to natural disasters. The team will also enhance opportunities for research monitoring within the Forest Health Monitoring Program/FIDR Initiative. Forest Health Monitoring is a focused Forest Service research effort with broad participation nationwide. The mycology work in the tropics could provide early indication of changing forest health that heretofore have been missed.

## Areas of Emphasis

Research pertinent to tropical forest utilization includes the following areas which are anticipated to receive special attention.

### Mycology

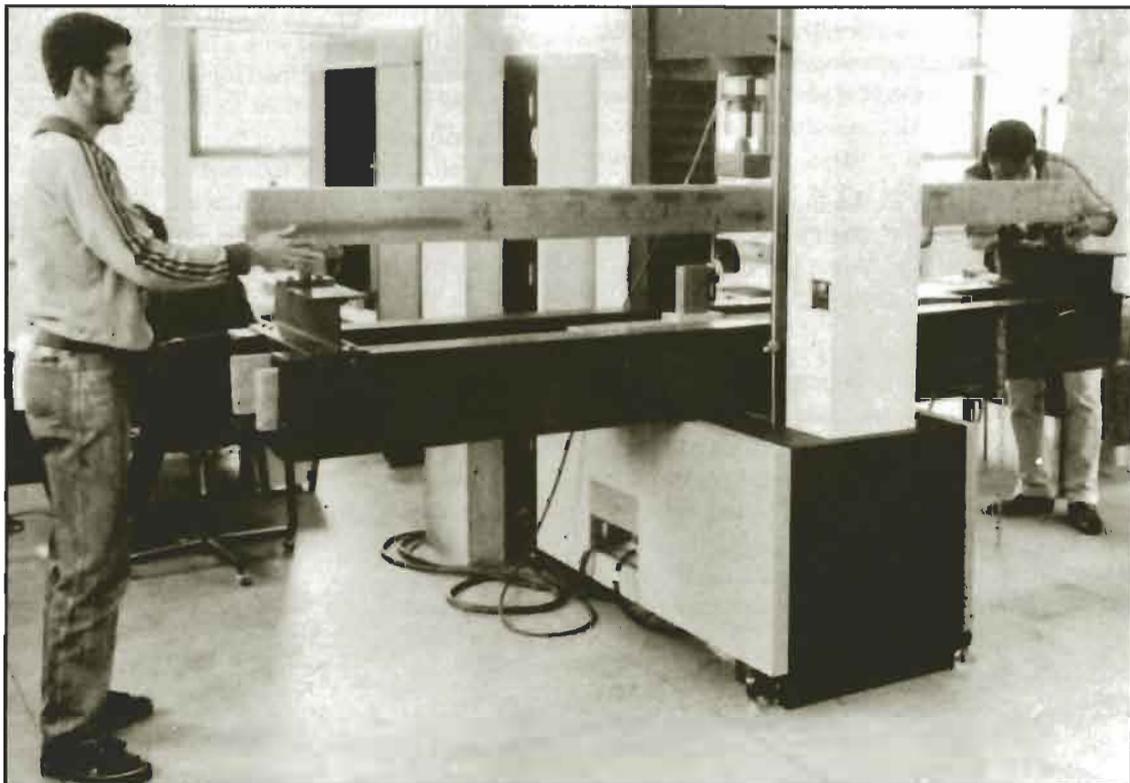
Initial efforts will survey the fungi present on the various sites. For the first time, we will have an organized study of the fungi found in the various tropical ecologies. This will provide background information for the selection and enhancement of fungi for site rehabilitation and for screening for biotechnological purposes. The expanded Center for Forest Mycology Research collection of wood rotting fungi, which will result, will serve as a resource for other scientists and industry who are attempting to employ fungi for biotechnological purposes.

### Processing

Processing research would focus on methods of handling the large number of species that are difficult to process because of such characteristics as high density and the presence of silica (*fig. 2*). Embodied in this work would be research on metallurgy and sawblade design. This would complement our ongoing efforts on sawtooth design and the effect of vibration on surface quality so it would be of interest to the domestic industry as well.



**Figure 1**—Training is critically needed in tropical institutes. At the USDA Forest Service's Forest Products Laboratory, a scientist from China learns how to use a universal testing machine from a Laboratory specialist.



**Figure 2**—Timber is being readied for strength testing at an institute in Brazil. To optimize the processing and intended use of lesser-known tree species, research is needed on their properties.

## **Drying**

Drying research will evaluate the utility of a variety of lumber dry kiln types and will develop proper kiln schedules and procedures. Species groupings will be evaluated as a presorting procedure to cope with the large number of species to be handled.

## **Composites**

In the composites area, research will evaluate the feasibility of mixtures of tropical hardwoods as furnish for a variety of panel products and shaped sections for furniture and other local uses. Board investigations will include the feasibility of using mineral binders for producing a naturally durable panel for use in tropical applications. Also included here are evaluations of chemical modification of the fibers or particles so as to optimize the properties of the finished board or shaped product.

## **Wood Properties**

Research will evaluate the anatomical and mechanical properties of the lesser known species to aid in their utilization. Additional research will evaluate other characteristics such as shrinkage, density, silica content, grain characteristics, appearance, and possible extractives from naturally durable trees that might be synthesized to produce protective compounds such as for sapstain control.

## **Grading**

Alternative visual and automated grading systems will be developed to introduce species-independent grading. Such systems are necessary to handle the large numbers of species that will be handled at the typical small sawmill in the tropics. The development of alternative grading technology that is more suitable for a small sawmill would have domestic application as well.

## **Construction**

Research here will focus on expanding the use of native species for much needed housing through the development of construction guidelines and design. Wood has natural advantages for such uses as in roof systems when we develop the

appropriate truss designs. Also included here are designs and treatments to protect the structure.

Strength values are not critical for housing. But as strength values are determined for the various species or groups of species we can anticipate expanded use of these species in more engineered systems such as light industrial and commercial construction and timber bridges. Greater acceptance of wood in construction could expand the demand for domestic woods as well.

## **Economics**

Overlaying all of this work is the need for economic feasibility analyses of new and emerging products and processes. Economic assistance is also needed to evaluate the domestic supply implications and international trade prospects as more of the lesser known species achieve commercial importance. We foresee a basis for effective trade and use of American wood products and processing equipment in tropical forest development and utilization.

## **Approach**

We will start this new program through problem analysis or an integrated array of problem analyses on tropical wood utilization problems. As the work progresses it will probably involve outside researchers, especially those in the tropics. Tropical research institutions would undoubtedly have much to contribute.

The new unit for work on the problem at the Forest Products Laboratory will require the addition of three staff. Two of the positions will be located at the Institute of Tropical Forestry. They will probably consist of a Forest Mycologist and a Forest Products Technologist with a broad general background. The third position is that of the Tropical Forestry Manager, who will supervise the two positions located in Puerto Rico and provide day-to-day management of the entire team.

In all of this work, the need to respond to severe deforestation of lands throughout the tropics, and reverse serious adverse environmental impacts is the driving force. This is a long overdue step in the right direction.