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P R O C E S S I N G F O R E F F E C T I V E W O O D U S E

by
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INTRODUCTION

What does wood processing have to do with the crucial situation in the tropical forests? Does it make sense to discuss wood processing when further reduction of the forest can have global effects on the climate? We believe that the answer is a definite YES. We will explain our position by defining the need for increasing effectiveness of wood use, for placing value on the wood resource, and for meeting the increasing worldwide need for wood for shelter and commodities.

From before recorded history, the forest has directly or indirectly satisfied many human needs. Humans have lived on the periphery of the forest, where its benefits could be easily derived while the forest itself was not a threat. The forest has been viewed as both friend and foe. In the United States, we have observed both standpoints in the settlement of our land. The first European settlers readily used the vast forest reserves for many of their needs, such as food, shelter, and transportation, and also sent forest materials back to their homelands. But, the forests were also perceived as a barrier to the future development of the land for both agriculture and settlement, and thus extensive forest areas were cleared. Today, the same responses to the forest are taking place in the tropical areas of the world, especially in the largest remaining tropical forests in Latin America. In some regions, the forest is seen as a valuable resource,

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The Forest Products Laboratory is maintained in cooperation with the University of Wisconsin.

providing employment, income, and trade; in others, it is a barrier for growing populations in need of settlement and agricultural space.

As the forests are cleared for settlement, agriculture, reservoirs, and other uses, the world at large is becoming concerned over the loss of forest diversity, commodities derived from the forest, and the forest itself. We can no longer ignore what goes on a hemisphere away; we must attempt to understand and accommodate the needs of people. Because we are people interested in the forests and the products derived from them, we must show to the world the value of the forest from environmental, ecological, and economic perspectives. At the same time, we must process the products of the forest in the most effective way possible. Thus, perpetuation of the forests will depend upon worldwide recognition of their value and effective and responsible processing of wood products.

THE FOREST RESOURCE

We often hear about the importance of preserving undisturbed virgin forests. Yet, forests are really dynamic and everchanging. In the tropics, the forest has historically been disturbed by shifting cultivation and other human activity. In coastal and island areas, which are sometimes unpopulated, storms regularly change the structure and composition of the forest.

The major questions to be asked about the forest are as follows:

(1) Is forest retention really necessary?
(2) If retained, how diverse should the forest be?
(3) Can the forest be used without destroying it?
(4) Can the tropical forest be managed?

(1) Is forest retention really necessary? Tropical forests are vital to the whole world. These forests can have a major influence on the climate and quality of life on earth in the most basic sense. The loss of extensive forest regions in the Middle East, Mediterranean countries, and North Africa testify to the adverse effects of forest removal without replacement. The once mighty forests of the Moroccan Atlas mountains are but a remnant (Encyclopedia Britannica, 1974a), the cedar forests of Lebanon are gone (Moldenke and Moldenke, 1952). What remains--barren land and adverse effects on weather-- is all too visible. The retention of the forests is necessary.

(2) If retained, how diverse should the forest be? Although the forest cover, regardless of type, may keep the climate in balance, what happens to the other components of the forest--the birds, animals, and vegetation? The great diversity of the tropical forests makes them very valuable and yet so difficult to manage. It is this diversity that stands as a barrier to many discussions on the future of the resource. While we cannot resolve the question here, it very likely that a high level of diversity can be retained while using the forest for wood products. However, retention of diversity demands good management and control over the perpetuation of the resource.

(3) Can the forest be used without destroying it? Yes! In the case of moist tropical forests, we can look to the Central American Mayan areas. Great settlements existed here 1,000 years ago. Land was cleared, structures built, civilizations established. The people disappeared and the land was recovered by a diverse forest, complete with a complex of flora and fauna (Standley and Record, 1936; Encyclopedia Britannica, 1974b). However, if land is maintained in unforested condition for very long, soil deterioration may occur and make reforestation difficult or impossible. Much of the tropical forest land in the world is very fragile. Yes, the forests can be used and maintained but not without management.

(4) Can the tropical forest be managed? For many years foresters have studied systems for managing tropical forests. It has not been an easy task. In the past two decades, the experiences of Jari in Brazil have shown both the positive and negative sides of plantation management. The negative aspects are being corrected and management continues (Welker, 1987). In Peru, recent work on clearcutting in narrow strips is showing great promise for natural reproduction and recovery of forest diversity (Hartshorn et al., 1987). The key to this type of management is the judicious and effective use of the wood. Processing wood for effective use places value on the resultant products. Management systems are available, but unless they are applied promptly and properly they are useless.

FUTURE MANAGEMENT OF TROPICAL FORESTS

The Human Element

The human element is without doubt the major factor that controls how tropical forests will be used in the future. Grainger (1987) notes that the combination of population growth and the need for agricultural and economic development to sustain the population is responsible for most current forest depletion. In the foreseeable future, these human demands will not be greatly diminished. It is therefore imperative that the forestry sector make it clear that the forest is valuable for its supply of renewable commodities and potential for jobs and trade. The effects of the forest on world climate must also be considered. With education, it may be possible to slow the reduction of forest area and perhaps reach an equilibrium between forest and nonforest land.

To accomplish this goal, major efforts are needed in marketing: marketing the concept of forest value through processed products and marketing the products themselves.

Processing High-Value Species

The characteristics of high-value species are color and figure, ease and quality of machining, ease of drying and finishing, and stability in use. In most tropical areas, European explorers long ago took on the discovery, extraction and processing of high-value species. Trees such as teak in Asia, mahogany in the Americas, and ebony in Africa were selectively taken from the forest for processing. This practice continues today in many areas. The problem with this approach is the residual damage to the remaining forest stands. The select species are removed as a seed source, surrounding trees are damaged in the cutting operation, and the forest is often severely degraded.

For many years, high-value species were processed in Europe and North America; very little processing took place in the country of origin. Shipments of teak, mahogany, and ebony logs to Europe were quite common at the peak of the colonial empires. These valuable woods were processed into paneling and some of the classical furniture of the period (Record and Mell, 1924; Johnson and Sironen, 1928; Margon, 1954). Later shipments of logs were made to North America, where several major lumber and veneer firms were established to use the fine tropical woods (Callahan, 1985). Today, the processing of high-value species continues primarily in Europe, the Pacific rim, and North America. However, more and more of thewse species are being processed within the country of origin. Value is being added to the product; rather than shipping logs, many countries are now shipping lumber, veneer, and plywood.

Other processing is being done within country with varying success. Furniture and casegoods manufacture is growing in many of the timber-producing countries. In many instances, however, processing techniques need improvement. Especially needed are climate control in the manufacturing plants and moisture control in the products. While the craft and design of high-value items manufactured from high-value species are often good, the lack of moisture content control sometimes leads to failure of the product in the temperate climates to which many products are shipped for sale.

High-value species are also being used in products and applications that do not take economic advantage of the potential value of these species. The use of mahogany in opaque lacquered furniture is an example of mismatching use and wood quality. Substitute woods, with less natural appeal but with adequate stability and structural quality for furniture application, would allow mahogany to be used for other higher valued applications. Some species are attractive and have potential for high value, but lack machinability or finishing quality. These woods may find increased use in the near future because of new technology in processing and finishing, and thus become classified as high-value species.

Even when it is possible to saw secondary species, there may be problems in drying some woods. Tropical forest products laboratories are engaged in research to solve drying problems. Recent advancements in technology (dehumidifiers, vacuum drying, kiln control systems, and combinations of these with older technologies) have opened the door to processing difficult-to-dry woods, such as the oaks (Quercus spp.) of Mexico and Central America. Much research on drying methods is required for the efficient use of these woods. New technology for economically drying these species will make available a new and valuable resource for a wide variety of products. Preliminary research at FPL is focused on combining tropical woods for mixed species drying. Another recent development is the continuous press drier for veneer. The veneer is held flat against rotating oil-heated drums. This method produces the flatness that is achieved by a press drier, using continuous drying instead of batch drying. The resulting product is high-quality, flat veneer with much reduced shrinkage.

Secondary species can be used for housing materials. The housing needs of Latin America are estimated to be near 6 million units per year.[2] Although structural materials are a logical first choice for using secondary species wood, Latin American countries also need panel products for structural application; secondary species could be used for structural plywood, composite panels, and cement panels. Processing techniques are needed for sawing, peeling, chipping, drying, and gluing. Data on the engineering characteristics of lesser known and smaller sized species are also required.

Converting Diversified Natural Forests to Plantations

Some products are best described as commodity products; for example, pulp, paper, structural lumber, structural plywood, and composite panels. In general, these products are best manufactured from low- to medium-density woods that are easily processed, stable, and fairly strong. In the area of pulp and paper, fiber characteristics, pulpability, and bleachability are important. Many species worldwide meet these criteria. For example, eucalyptus, pine, and gmelina have taken their place in plantations for pulp. The major example of such a dedicated plantation in the tropics is Jari in Brazil. There are many other examples of major plantations for lumber, veneer, and pulp throughout both temperate and tropical areas of the world. The conversion of specific tropical areas from diversified natural forest to plantations to meet commodity needs makes sense. Plantations help to maintain the forest cover while simplifying the processing requirements for the products. The cultivation of select species for commodities has progressed quite rapidly in recent decades, and research continues to improve growth

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[2]Personal communication with Dr. Julio Centeno, Instituto Forestal Latinamericano, Merida, Venezuela.

Processing Secondary Species

In highly diversified forests (especially those of the Amazon), tradition has been to selectively log high-value species. This practice has often left a multitude of secondary species with little or no tradition of use. In some instances, little is known about the species. Secondary species are often small by nature, especially in diameter. They also may be high in density or possess other attributes that are less desirable to processors. These species, which must be used if forest management is to continue, must be examined for markets other than those used for more common commercial species.

Many secondary species have less intrinsic value than traditional high-value species. Such species most likely will have to be used within the country of origin, probably as construction materials. For example, Hartshorn et al. (1987) suggest developing markets for poles and other preserved products to use tall, straight, small-diameter secondary species. Structural use of wood in tropical locations will require treatment with preservatives. Processing techniques for refractory species is a primary concern. Technology for processing treated materials will need to be developed to prove the value of secondary species. The U.S. Forest Products Laboratory (FPL) has recently begun testing the preservative treatment of hardwoods, beginning with domestic species. We hope to establish cooperative studies in the tropics to continue this vital work.

The properties and quality of some small secondary species may qualify them for processing into high value products. In the past, there was no technology for economically processing small logs. Today, advanced processing techniques permit full use of small logs. However, the technologically advanced machinery must be transported into the countries where small-diameter species grow because transporting small logs out of country is too expensive. Highly trained people for operating and maintaining the equipment are also required. However, the biggest problem in utilizing the resource of small-diameter trees may be not processing technology but bureaucratic and legal restrictions. Many countries have diameter limits on cutting trees. If the trees are not large enough, they cannot be cut. Even though the trees of small diameter may never get any larger, the diameter-limit laws prohibit their extraction from the forest.

Small-diameter trees are not the only secondary species of concern. Perhaps the greatest problem is trees that are difficult to cut, many of which are large. These are trees of extremely high density, many with silica in the wood. The color and texture of some of these species would classify them as high-value woods, but the trees cannot be readily processed with saws, planers, or veneer knives. New cutting materials must be developed for processing these species. Current research at FPL and the University of Wisconsin is aimed at developing new saw blade materials that are less affected by heat, new tooth and blade coatings with better wear characteristics, and new, more efficient tooth designs. We are also pursuing international cooperation in this research.

for lead institutes and participating institutes in cooperative efforts. It is time for us in IUFRO to begin discussions toward this end. Institutions from the developed nations need to reach out in an effort to initiate the cooperative effort. The process is not going to be simple. In the last two years, FPL has attempted to establish contacts, programs, and funding for such efforts. While progress has been made, much work remains to be done.

We also need to develop better methods for transferring available technology internationally. This may also be facilitated using the suggestions of de Freitas, Kauman, and Youngs (1986) for pairing ("twinning") organizations. A major effort to establish regional extension training stations may also be needed, whereby one country would become the pilot nation and assist in preparing the neighboring countries.

Finally, training is needed for the next generation of scientists and technologists. Many emerging nations need to more fully develop their university capabilities; government forestry agencies need to gain in technical capabilities; and industries need more technically capable people. Again, the concept of twinning is a way to facilitate training.

SUMMARY

As people interested in the forests and the products derived from them, we must show the world the value of the forest from environmental, ecological, and economic perspectives. Only when the world at large realizes the value of the forest to all of us, and processors behave consistently with their responsibility for effective wood use, can we feel confident that the forests will be perpetuated. The four major questions addressed in this paper can be answered in the following way:

(1) Is forest retention really necessary?
Yes!
(2) If retained, how diverse should the forest be?
As diverse as possible. Such diversity requires good management and control.
(3) Can the forest be used without destroying it?
Yes, but not without management!
(4) Can the tropical forest be managed?
Yes, but management must be prompt and consistent.

The human element is without doubt the major factor that controls how tropical forests will be used in the future. It is therefore imperative that the forestry sector begin to make it clear that the forest is valuable for its renewable commodities, its potential for creating jobs and trade, and its effect on world climate.

Processing for effective wood use is necessary for both high-value species and secondary species. The high-value species have been processed for

conditions and wood characteristics. Though plantations reduce the biological diversity in a specific area, they alleviate exploitation of other forests and thus may help to maintain their biological diversity.

Plantation-grown woods are now exerting a major effect on the wood products industry; such woods include the radiata pine of Chile, the Caribbean pine of Venezuela, and the eucalyptus plantations worldwide. Plantations in Europe, North America, New Zealand, Australia, and South Africa continue to be productive. Most major plantations focus on production of pulp and paper, and their technological needs are fairly well established. However, different methods of pulp manufacture will probably have to be considered in the future. The development of industries other than the pulp and paper industry that feed off the plantations is also becoming critical. For example, a major lumber industry has been developed for exploiting the radiata pine resource in Chile; similar developments have occurred with the pine resource in New Zealand and Australia. Plantation pines have long been used for lumber, veneer, and composite panel furnish in Europe and North America. In the tropical regions, the plantation resources need to be used for panel products, such as plywood, particleboard, structural composite panels, and cementboards.

Future Processing Needs

Areas for Research

Perhaps the most urgent need behind more effective use of the world's wood resources is technology transfer of known methods and equipment. Many production facilities in both developed nations and emerging nations lack up-to-date technology or operating levels of maintenance. To extend the timber supply, currently known methodologies need to be transferred to those who are now processing the timber resource. Next in importance are the major processing problems that presently have no good solution. Some research needs are as follows: (1) methods for cutting dense and siliceous woods, circumventing growth stress degrade, drying dense and other difficult-to-dry woods, and speeding the drying operation while reducing degrade; (2) new chemicals for protecting wood from decay and insect attack that are not toxic to humans and methods for treating refractive woods; (3) new wood finishes for interior and exterior use in tropical areas; and (4) new nonpolluting pulping methods.

Efforts for developing new saw blade materials, tooth coatings, and tooth designs for processing dense and siliceous woods are already underway; these efforts need to be expanded and accelerated. Large amounts of wood fiber are lost each day to excessive saw kerf. In addition, much labor and energy are expended needlessly because of inefficient sawing of dense and siliceous woods.

Another major concern is the problems caused by growth stresses in logs and lumber. In the tropics, the effects of growth stresses reach their peak,

and literally hundreds of millions of dollars are lost each year to difficulties caused by growth stresses. The problems vary from dangerous log splitting when trees are felled to warp in lumber. At this IUFRO conference, a group of scientists from all over the world will be discussing research proposals to combat the difficulties in efficient processing caused by growth stresses.

Poor drying prohibits the efficient use of wood. Many woods are difficult to dry without substantial degrade. New processing machinery is now available, but it has not been examined fully for some of the more difficult species. Thus, expanded and accelerated research is needed on difficult-to-dry species and on adapting new processing techniques for these species. Tied closely to the drying of difficult woods is the need to accelerate the drying rate of all wood species. Many new technologies can dry difficult woods but at a sacrifice of time. The combining of technologies that can both dry wood effectively and reduce drying time is required.

In areas where decay and insect attack are problems, the timbers require treatment with preservatives. However, many chemicals that are toxic to both fungi and insects are also highly toxic to humans. The great research need is to find chemicals that can be used effectively with minimal or no danger to humans. Some research has been conducted to determine the chemical constituents in naturally durable woods and to simulate them in the laboratory. These efforts have had limited success. This type of research must be expanded and intensified along with other attempts to find suitable chemicals.

Even if the proper chemicals can be found for treating wood, applying the treatment is another problem. Many species are refractive and resist treatment. Penetration into the wood is limited. The use of many species requires the development of suitable processing technology for effective preservative treatment.

The acute need for housing in tropical areas has generated a need for finishes. Wood lasts longer when finished, but finishes suitable in temperate climates are often not suitable in the tropics. Research is needed on the development of durable interior and exterior finishes for the tropics.

Finally, there is a vital need for developing nonpolluting pulping systems. State-of-the-art technology is currently being used in most pulp and paper mills. However, this technology is not optimal. Water and air pollution needs to be reduced. Major efforts are underway to find methods that are practical and efficient. The development of oxygen and biological pulping needs to be intensified to get these systems on line soon.

International Cooperative Efforts

Cooperation is the key word in getting results in a timely and efficient manner. In Improved Utilization of Timber Resources in South America: A Programme for Action, de Freitas, Kauman, and Youngs (1986) discuss the need

centuries in Europe and North America. Now processing is being done in the countries of origin. More effective processing is needed to assure best use of the woods. For secondary species, many of which have not been used, effective processing technology must be developed or enhanced to make the species more valuable. Improved sawing, machining, drying, preservation, and finishing are needed for many of these species. Processing for effective wood use may also involve plantation management for commodity products. To conserve the diversified natural forest, it makes sense to dedicate some areas to plantation management and product manufacture. This is already being done in many areas of the world and must be continued to meet needs for paper, lumber, and panel products.

Needs yet to be met include extensive technology transfer of already known information on processing and new research. Research is needed on methods for cutting dense and siliceous woods, circumventing growth stress degrade, drying dense and other difficult-to-dry woods, and speeding the drying operation while reducing degrade; new chemicals for preservative treatment of wood that are not toxic to humans; methods for preservative treatment of refractive woods; new wood finishes for interior and exterior use in tropical areas; and new nonpolluting pulping methods.

Consistent with the IUFRO document Improved Utilization of Timber Resources in South America: A Programme for Action, we feel that the development of lead institutes and participating institutes in cooperative efforts is needed to accomplish this research. We also feel that the twinning of research and academic institutions is vital to the training that will continue to be needed throughout the world, to make processing for effective wood use a reality.

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