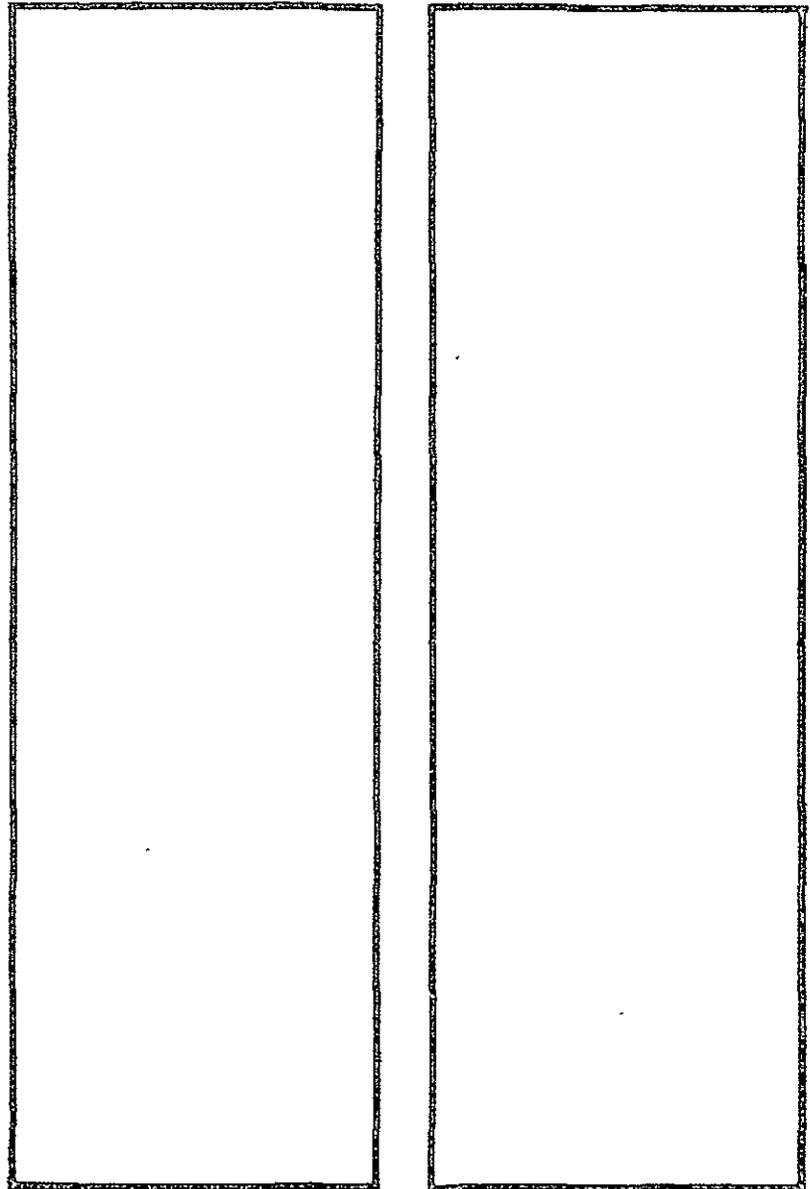


UTILIZATION OF TROPICAL FORESTS
(A Review of the Forestry Literature
in the Agency for International
Development Reference Center)



Office of Science and Technology
Agency for International Development
Washington, D.C.

NOVEMBER 1973

TA/OST 73-20

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PREFACE

The tropical forests of the world comprise a large but underdeveloped natural resource. Most of them are located in developing countries. It is generally recognized that if these forests could be more completely and more efficiently utilized under sound conservation principles they could make a far greater contribution than they are now making to the economic growth of the tropical countries.

Typically, the tropical hardwood forests are made up of a large number of species growing in mixture and only a relatively few preferred species are used in commerce. The removal of the choice species, and often the best logs of the trees that are cut, leaves a large number of unmarketable trees to occupy the land. This process of "highgrading" is generally considered to be destructive and wasteful of potentially valuable natural resources.

The reasons for uneven utilization of tropical forests appear to be as complex as the heterogenous forests themselves. One of the obstacles to more complete utilization most often cited is the lack of knowledge of the physical and technological properties of the so-called secondary species. There is indeed a lack of information about many species and it seems logical that increased knowledge would be useful in developing market outlets for little-used or unused woods. But there are other obstacles. Lack of adequate transportation facilities, remoteness, inadequate administrative and marketing mechanisms and other factors combine to inhibit efficient management and use of tropical forests.

In 1973, A.I.D. contracted with the U.S. Department of Agriculture, Forest Service to make a study of factors influencing the utilization of tropical wood species. In support of this study, a survey was made of forestry reports and other literature in the A.I.D. Reference Center to determine what information relating to this problem is available in A.I.D. files. This report is a summary of that survey.

The list of literature cited at the end of the report includes only those publications from which specific statements were quoted.

The report was prepared by Edward P. Cliff, a forestry consultant with A.I.D., employed by the Office of Science and Technology for this particular study. Mr. Cliff was Chief of the U.S. Forest Service until his retirement in 1972.

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I. INTRODUCTION

This report summarizes the results of a review of forestry reports, publications and other documents in the A.I.D. Reference Center to determine what information is available in A.I.D. files on problems of utilization of the so-called secondary tree species in the developing countries. This review was made concurrently with and in support of a study made by the United States Forest Service for A.I.D. on "Factors Influencing the Utilization of Tropical Wood Species."

The objective of the review was to determine if the forestry workers and contractors employed by A.I.D. and its predecessor organizations over the years had assembled information on the secondary species problem; had identified the constraints or "road blocks" preventing greater utilization of the presently unused or underutilized species; or developed recommendations for overcoming the constraints.

A total of 135 reports and publications relating to forestry problems and A.I.D. supported forestry activities in 43 countries were reviewed. Most of these were written by A.I.D. employees or contractors. A few, about a dozen, were reports prepared by the United Nations Food and Agriculture Organization (FAO), by other international organizations, and by country forestry agencies.

A large number of other reports were checked by title and table of contents but were not studied further when it appeared that they contained nothing pertinent to the review.

The span of time covered by the reports which were reviewed was 27 years. The earliest reports were written in 1946 (Chile and Paraguay), 10 were written in the decade of the 50s, 119 in the 1960s and four since 1970.

II. SUMMARY OF IDENTIFIED PROBLEMS AND RECOMMENDATIONS

The forestry and land use problems identified and discussed in the reports and recommendations or suggestions for their solution were tabulated. These were classified by major categories and sub categories and are listed in the following tabulation. The number of reports in which a problem was identified or discussed or recommendations made for its solution is shown in the right hand column.

Secondary Species Problems

Lack of utilization, uneven utilization, absence of markets, highgrading, wasteful logging, lack of knowledge of wood properties etc.	70
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Strengthening Forestry Institutions

Development or revision of forest policy	9
Enactment or revision of forestry laws	6
Organization and Administration - general	42
- Education and training of forestry personnel	31
- Funding - inadequate budgetary support - low salaries	20
- Personnel management and improvement of working conditions	5
- Staffing - lack of technically trained personnel	18
Extension and public education, including assistance to farm forestry and small owners	9
Lack of interest and support of Government leaders	4

Political interference	5
Law enforcement to control illegal logging	19
Administration of timber sales and concessions	
- Supervision and enforcement of contracts	6
- Improvement of concession agreements (revision of fee structures and excise taxes, requirements for more domestic manufacture, etc.)	6

Land Use

Shifting cultivation and agricultural clearing	47
Land classification and land tenure, including intensification of agriculture on suitable land to reduce need for shifting cultivation	9
Establishment of national forests, also referred to as forest reserves and permanent forest estate	15

Improvement of Knowledge of the Resource

Forest inventories and management plans	26
Research on wood properties, utilization, marketing, silviculture, and forest management	32

Industrial Development

Capital requirements (shortage of venture capital)	8
Expansion, diversification, and integration of forest industries	24
- Development of pulp and paper industry	15

- Development of panel products industries, a.e. hardboard, particle-board, chipboard, flakeboard, plywood and veneer	9
- Encouragement of secondary manufacture - furniture, joinery, etc.	3
- More local manufacture and discouragement of excessive export of logs	5
Improvement of domestic manufacturing and marketing of lumber	9
Encouragement of greater local use of wood preservation to increase use of non-durable species	4
Cooperatives and trade associations	3

Infrastructure

Transportation systems-rivers, harbors, and roads (mostly roads)	24
Communications and equipment	2
Land surveys, maps and marking boundaries of forest reserves	10

Other Program Recommendations

Afforestation and reforestation	21
Watershed protection and erosion control	9
Prevention and control of fires	11
Control of livestock grazing	10

A. Appraisal of the Summary Table - Significance of the Numbers

The numbers in the right hand column cannot be construed as a reliable weighting of the importance of the various problems identified. There is wide variation in the scope and quality of the reports, considerable repetition for some countries and a lack of broad coverage for others. For example,

there were fourteen reports on conditions in the Philippines, ten on Liberia, eight on South Vietnam, and most of the reports for those countries discussed the same major problems. On the other hand, there was only one report for each of 22 countries. Some of the reports were written by specialists in reforestation, forest inventory, cartography, a particular phase of research, or some other specialty. Naturally, the writers commented primarily on problems in their areas of competency. Even so, some of the specialists expressed opinions on such things as the need for trained personnel, and improved organization, administrative management, and personnel management.

Another important factor is that some progress has been made and conditions have changed since some of the reports, particularly the earlier ones, were written. A number of countries have adopted new forestry legislation and established forest services. Forest inventories, tree planting, fire protection, and other projects have moved forward in a few countries, usually with the help of A.I.D., FAO, and other international organizations. Forestry education for technicians and professionals has improved in several of the developing regions. Demand for tropical woods has increased and trade has expanded, but almost exclusively for species well established in world trade. There has been some, but still far too little, progress in research.

Considering all of this, the above listing of problems and recommendations and the number of times they are identified appear to present a reasonably good profile of the most important issues facing forestry and the development of forest industries in the emerging countries of the world, particularly the tropical countries. It represents the combined judgement of a large number of well-qualified foresters and industrial consultants. In support of this judgement, the more recent reports in A.I.D. files, the FAO, the participants in the recent VII World Forestry Congress, all continue to recognize the same hard-core problems inhibiting forestry and forest-based industry in the developing nations, i.e., the need for strengthening forestry institutions, lack of knowledge of the resource, lack of markets for secondary species, shifting agriculture, inadequate transport facilities, shortage of capital for industrial development.

III. UNEVEN UTILIZATION OF TIMBER RESOURCES IS A MAJOR PROBLEM IN ALL TROPICAL REGIONS

Over half of the reports reviewed (70 out of 135) recognized lack of utilization of the majority of species growing in tropical forests as a major obstacle to forestry development in tropical countries. This included practically all of the tropical countries in which studies were made. Problems related to heterogeneity of forests are greatest in Latin America, least severe in Asia with Africa falling in between. The pattern in all three regions is similar. The forests are composed of large numbers of species growing in mixture and only a few are used in commerce. Examples cited where there may be a hundred or more species per hectare (as many as 200 in some instances) with as few as one or two trees of the preferred species being felled per hectare and only the best logs removed. In some of the Southeast Asian and African countries a relatively few preferred species frequently make up a substantial part of the forest and larger volumes per hectare are removed but most of the species are left behind to dominate the forest if they are not damaged or destroyed in the process. In all regions these practices are described as wasteful, destructive, degrading.

To make things worse, there has been very little progress in developing sound silvicultural systems to insure regeneration of the preferred species in tropical forests. Also uncontrolled shifting cultivation frequently follows logging and the forests are further degraded or destroyed.

Lack of adequate transportation facilities, particularly for land transport, often compounds the problem. In most tropical countries logging has taken place first along the water courses. Typically, logs are floated from the forest to shipside or to manufacturing plants located on navigable water. Thus, only logs that are light enough to float and which have other desirable properties are harvested. Many tropical species will not float, consequently some which are known to have desirable properties have not found a place in international commerce. The exceptions are the so-called "luxury woods" some of which are

too heavy to float but are of sufficient value to justify logging individual trees by arduous ground methods or a combination of land transportation and barging to a shipping or manufacturing point.

IV. REVIEW BY MAJOR GEOGRAPHICAL REGIONS

The following selected citations and quotations present an overview of the secondary species problem as reported by A.I.D. employees and contractors and other workers in international forestry, whose reports were examined in this literature review.

A. Latin America

Renshaw (25), reporting on forestry and forest products in northern Brazil, states that there are 7,000 species in the tropical Amazon rain forest, only 200 of which are considered suitable for commercial use with 60 being utilized. He concludes that, "More detailed and specific information is needed on Brazil's myriad tree species. Much piecemeal information is available, but it needs to be brought together and augmented. Properties and uses need to be developed for many species. Only a relatively few are now being used. Some species have unusual properties, possibly not yet recognized...."

Senft (26) describes the huge forest resources in the Amazon, estimated to contain 50 percent of the world's broadleaf forest resources but contributing only one percent of the world export market. He states "... in some localities only one species (of perhaps 100 species commercially available) is used for a given purpose." Furthermore, only the highest quality material, essentially defect-free, is used. This is leading, not to research to solve the problem, but to use of competitive materials." He suggests lumber grading, marketing studies and revision of building codes as important measures to get greater use of wood.

Laurence J. Cummings (3) said of Panama in 1955, "It is a generally recognized fact that one of the principal reasons for the tremendous waste and destruction of the timber resources of Panama is lack of knowledge of the qualities and possible uses of most of the woods which grow here. Of the several hundred species of trees which are found in the forests of Panama only a few of the high-quality woods are marketable and no more than 15 or 20 have found use in the local markets....Although considerable information is available as a result of previous

studies of Panama woods, this, to be of most value, must be translated and interpreted in terms of conditions which prevail in Panama.

"Due to the fact that several agencies have at one time or another carried out studies of properties of Panama woods, the importance of coordinating the work ... in order to avoid duplication and to supplement information whenever possible was emphasized."

Greenacres, Inc. (11), reporting to A.I.D. on "Forests of the Republic of Panama" in 1963, made the following statements: "Wasteful logging procedures - selective as to species taken - leave a forest of cover not wanted by the logger...." "The complexity of the species composition of the forest is such that local industry has been unable to utilize and market from 80 to 85 percent of the available volume in most areas on which operations are conducted...." "Forest industry cannot advance without greater utilization of the existing species."

For Nicaragua, Haines (12) in 1961 recommended the encouragement of more use of more timber species and assembling and distributing information on properties and use of native timbers.

In 1964, Bennett O. Hughes (14), reporting on technical assistance in forestry in Latin America, recommended that first priority be given to study of the means for utilizing and marketing the vast storehouse of unused raw material in the tropical forests through industrial development. Among the problems discussed was "the great variety and dispersion of timber species and insufficient knowledge of potential uses." Hughes also stated, "A forest products research program would find a warm welcome and hearty cooperation, and the study results would find prompt application....In order to carry industrial development beyond the initial rudimentary stage, and provide the degree of utilization that will permit good forest management, a broad range of utilization research is required....If little is known about identity and volume of tropical forests, still less is known about their management."

In 1962, Kukachka and Saeman (21) observed that there is a billion acres of forest in South America, mostly inaccessible, heterogeneous with many species which have not found a way into world markets or industrial utilization. They reported that of the estimated 5,000 to 12,000 species in these forests only 400 have been investigated and reported in the literature and that much of the available data on mechanical and physical properties are not comparable because of differences in testing equipment, procedures, uncertainty of identification, etc. Of the 400 species, 50 are exotics. Another 75 woods were identified to genus only.

Freas, Kukachka and Landt (7), reporting on the survey of improved forest products utilization in Latin America in 1965, stated, "Throughout the trip, we found agreement that the greatest deterrent to increased utilization of the Latin American forest resources was lack of knowledge of the resource, in terms of both quantity and properties...."

Spillers (28) said of Paraguay in 1966, "The number one problem is lack of information. There are over 500 species identified and many more yet to be botanically described. Only one is well known in the States....Seven species make up 75 percent of the commercial use....The nomenclature is confused...."

B. Africa

In 1954, Torkel Holsoe (13) of FAO reported that 150 or more species of trees reach commercial size in the evergreen forests of Liberia but that the species available are comparatively unknown on the commercial market. He stated that, "Because they are unknown in world trade it will be necessary to carry out various seasoning, strength and machining tests of many of these coastal Liberian species to establish their probable usefulness, and to much promotional work before they will be accepted on the commercial market."

In 1959, Jeanette Kryn and E. W. Fobes (20) of the U.S. Forest Products Laboratory compiled for the International Cooperation Administration all available data on the woods of Liberia and some of the neighboring countries. They observed that, "In order to make the best use of these forests it is necessary to know the trees." This report points out that scientists from a number of coun-

tries have studied the trees of Liberia and West Africa and the results appear in a number of publications in several languages. They conclude that, "While the report contains considerable data on a few species there is a definite need for additional data on most species."

Corland James (17) in his termination of assignment report makes a number of recommendations for a forestry program in Liberia. He lists as an unfavorable factor the abundance of species with little use or demand on local or world markets. He says, "Uses must be found for these species."

This is echoed by Witherow (32) who stated in his report on Liberia that, "The problem exists of finding uses for the multitude of species which are unknown in the world timber trade." He recommends that special emphasis be placed on utilization and research toward developing markets for lesser used tree species.

The Battelle Memorial Institute (1) in its report on Liberian Forest Policy in 1969 calls attention to the large number of species, many of which are unusable, but sees this as an asset because the secondary species protect the land after the favored species are removed. They also endorse rapid liquidation of the valuable species and recommend against sustained yield and expenditures for silviculture.

Arthur D. Little, Inc. (22), in its comprehensive report on "Opportunities for Upgrading Nigeria's Forest Products," 1965, states that of the 600 or more species, 30 to 40 and often as few as 10 to 12 are considered marketable. Two species, obeche and abura, account for 75 percent of log exports and about 35 percent of lumber exports. They say that although export of logs will continue to be important, "Nigeria's forest potential will not be fully realized, however, until the processing industry becomes more completely diversified and each log coming from the forest finds its end use in the highest value product that is possible at any given time...."

R. W. Wellwood of FAO (31) describes the problems of utilizing the lesser known Nigerian

species and the efforts by the government and commercial companies to increase use. He points out that 30 different species are exported, 22 to 25 are listed in the trade statistics, but that 10 species account for 90 percent of log and sawn-wood export. He says that, "Expansion of use of secondary species is essential if Nigerian timber trade is to meet the needs of the country."

In reporting on the Forest Resources of the Southwest Region of the Ivory Coast in 1967, the Development and Resources Corp. (4) states that, "Compared to tropical high forests in general in West Africa, these southwestern forests have lower total volume but higher volumes in commercial sizes and very much higher volumes in commercial species." Nevertheless one of their five major recommendations was to "...find markets for what the forests produce." They also recommend research into the technical qualities and marketing of Ivory Coast woods, including preservation, drying, grading and factors which determine choice of building materials, as well as cooperation with importing countries in finding markets for a variety of species and grades.

C. Asia

In 1953 Winslow L. Gooch (10), reporting on forest industries of the Philippines, pointed out that there are over 2,000 species of trees, that wood-working qualities are known for less than 200 and that 70 percent of the lumber products come from six species of dipterocarps. He also said the high drain of export logs to Japan is a matter of concern.

Paul W. Bedard (2), reporting on Philippine forestry in 1957, raises the ante on Gooch. He asserts there are more than 3,000 species which reach a diameter of one foot or more; that 70 percent of lumber comes from 7 species; and that two-thirds of the wood is wasted.

The late Tom Gill (9), a preeminent world forester, reported in 1959 that probably three-fourths of the wood on an average hectare in Philippine forests is unutilized and that this could be reduced by proper supervision and planning.

For Cambodia in 1962 Corland L. James (18) tells of the numerous species of trees with no commercial value. He says, "Research is needed to determine commercial use for species of trees whose commercial value is unknown...." "Good planning and management will replace non-commercial species."

In his report on Thailand's forest development in 1967, D. F. Gienty (8) states that of 2,000 species of trees in that country, 250 are protected species, 40 species are common commercial trees, and 15 are listed as export species.

A report written by the Thailand Forest Service in 1953 (29) states that they are doing some work in identification and wood technology to improve knowledge of little-known or little-used species.

In its forestry sector evaluation in 1970, the A.I.D. International Development Mission to Laos (30) reported that of 64 species of trees believed to be suitable for commercial purposes, only 21 are suitable for milling with existing equipment. (This implies that improved milling equipment would result in using some of the presently unused species.) The Mission stated that "If and when the species now left become acceptable to loggers, the favorable effects on forestry...will be far reaching."

Payne and Nordwall (24) reporting on Indonesia in 1971 discuss the mixture of many species in the forests, the highgrading now going on, and the "sinker" problem which restricts use of denser woods where floating in water is the principal means of transport. In discussing research needs, they recommend improved forest inventories, silvicultural research, which they term "a major need" and state that "...a third area urgently in need of research effort is in the field of utilization. While some limited data is available as regards the presently preferred species, very little is known about the hundreds of species currently in the category of undesirable, uneconomic, or inferior...." They also

reported that the Forest Products and Chemistry Research Institutes are woefully underfinanced.

The earliest report of the Forests of Vietnam found in the AID library was by McKinley in 1957 (23). He describes the heterogeneous forest of more than 1,500 species of woody plants varying from small shrubs to forest giants. In many cases a great number of species are found on a single hectare. He states that "...unfavorable views are held in many quarters of so called unpopular species that should serve the same purpose as popular species...." McKinley's report lists 165 species from which lumber is produced. Eleven species are classified as "luxury woods," 27 as Class I and the balance in Classes II and III. The latter presumably include some of the lesser used woods.

Kernan (19), in a preliminary report on forestry in Vietnam, 1968, says that dendrology and ecology are well enough known, much less is known about area, location of types, volume and impacts of man. He states that, "The wealth of species and technical qualities is also a handicap in that relatively few are used at present." Also that "...there is very little exact knowledge of growth and regeneration of tropical forests, including those of Vietnam."

The most discerning and well reasoned analysis of the marketability of tropical woods and problems of marketing secondary species in Southeast Asia and particularly in Vietnam included in this literature review, and also the newest, appears in a preliminary draft of a report entitled "Markets for Vietnam Timber Products in Japan, Korea, Taiwan and Singapore" by S. Blair Hutchison, et al. (15). This report was prepared for A.I.D. and released for review in May 1973. Because they describe the issues so well, the following pertinent quotations are extracted from this report: "There are hundreds of different tree species in Southeast Asia but the overwhelming attraction has been the lauans-- also known as Philippine mahogany, Malaysian hardwoods, meranti, and by other names. These species (of which there are eight in the Republic of Vietnam...) brought timber industry development to Southeast Asia and have largely sustained

it. For example, 92 percent of Japan's hardwood plywood is lauan. In the non-lauan woods, the dipterocarpus species (apitong, dau, keruing) have enjoyed a fairly good market and ramin has been a best seller. However, most of the other species have been only lightly used.

"The development of the hardwood forests of the Philippines, Malaysia and Indonesia has been spurred by the fact that...the lauans are abundant. Unlike the very heterogeneous tropical forests of Africa and the Amazon, there are heavy stands containing a high percentage of lauan, thus reducing development and logging costs.

"Lauan logs are in general large; they are easy to peel and work; the wood is light in weight and soft with uniform texture; and the wood is dimensionally quite stable. Not the least of lauan's attributes is that most logs will float. This has been particularly important because much of the logging in Southeast Asia is in roadless or nearly roadless areas, requiring that the logs be floated to shipside.

"This isn't to say that all lauan is equally desirable for they vary considerably in their properties. White meranti allegedly has a high silica content and yellow meranti can't be used for concrete forms because it inhibits the curing of the cement. Philippine lauan is heavier and harder than Indonesian lauan and can be used for lumber whereas Indonesian lauan is primarily suited for plywood. There are variations between species and variations according to latitude and altitude. Trees grown further north are denser and heavier and timber grown between 500 to 2,000 feet elevation tends to be superior to lower grown timber because it has less defects and it tends to be superior to higher elevation timber because it isn't so hard and brittle. Trees grown in monsoon-prone areas are less desirable because they tend to be twisted.

"Much of the lack of popularity of many of the other species can be attributed to inadequate information, market preferences and other factors which have no particular relation to the qualities of these species. In other words, many of the under-utilized species have a market potential

that hasn't been exploited. Much more information is needed before we can judge how great that potential is. For example, periodically new species are being 'discovered' to have desirable features and are brought into the market...."

"There has been a tendency to ignore the secondary species because there has been enough of a supply of proven species to satisfy needs. It is only since some of the established species have been less abundant that more serious attention has been given to the others.

"Timber dealers have been reluctant to promote attractive new species that come to their attention when they know little about the supply and their technical and technological characteristics.

"In localities where the road system is inadequate and log transportation has to be by water, logs that sink are expensive to handle and are generally left behind for that reason..."

"An overriding factor in the unbalanced utilization of Southeast Asia's hardwood timber has been the incompleteness of the information about the resource. Data on timber volumes have been sparse but more important has been the shortages in the information about strength, density, color, texture, etc. of many timber species. A few species are well documented and there are bits and pieces of information about others in various countries. No technical information is available at all about many kinds of trees.

"It cannot be proven that the lack of a catalog of species properties has prevented the use of any species but the spottiness of the data has certainly played some part in the failure to develop systematic programs to develop the tropical forests. One of the most constructive steps that could be taken would be to establish an international program to gather such data and to follow that with an effort to publicize the lesser known species and their attributes. In the absence of such an overall attack on the problem, improvements in utilization will continue to come in a piecemeal fashion.

"Most of the Vietnam woods are sinkers....But this disadvantage may be more apparent than real. What the opportunities really are cannot be determine until more complete information is available on the volume and properties of the timber."

V. EXAMINATION OF RECOMMENDED MEASURES TO UPGRADE FORESTRY PROGRAMS AND IMPROVE UTILIZATION OF UNUSED AND LITTLE-USED SPECIES

A. Research on Properties of Wood and Correlation of Existing Information

The one measure to improve utilization of unused or little-used species most frequently recommended in the literature reviewed is to increase research on the physical and other properties of the woods. In some cases, this is expanded by pointing out the need for assembling, cataloging and making existing information on wood properties available in readily usable form to forest managers and processors and traders of wood products. A number of the reports discuss the wood technology research already accomplished or underway in the developing regions. But it is readily apparent that this research covers only a small proportion of the species, usually the better known and most valuable ones. Several authorities point to the lack of uniformity of the data, lack of standardization of collection and testing procedures, confusion or uncertainty about identification, and recommend international standardization and coordination of data collection and recordation.

B. Strengthening of Forestry Institutions

While there is no doubt that more knowledge of wood properties is desirable and necessary for improving utilization of tropical forests, it is clear that lack of this knowledge is only one of a number of factors impeding development of forestry and forest industries in the tropical regions. Freas, Kukachka and Landt (7), strong advocates of more research on wood properties and utilization, state "... a full library of fundamental information on properties of forest tree species will not insure utilization either of the information or the forest resource itself."

Many others who recognize the need for more information on wood properties place priority on the strengthening of forestry institutions as the most essential first step. As illustrated earlier in this report, recommendations and suggestions on institution building appeared a total of 180

times in the literature reviewed. This is far greater than any other general category of recommended measures. These institution building recommendations covered a wide range of measures including development or revision of forestry laws; education and training of personnel; more adequate funding and salaries; improvement of personnel management, working conditions, staffing, organizational arrangements and administrative management, extension and public education; and various measures to improve administration of timber sales and concessions.

These recommendations are aimed mainly at strengthening overall country forestry programs, but, obviously they would have an important, perhaps a crucial, bearing on improvement of secondary species utilization. Without a sound statutory and policy base and organizations of trained people with adequate funds to protect and manage the forests, promote their greater use, make and administer sales and concessions and conduct necessary research, little progress can be expected in attaining more efficient and complete use of the timber resource.

Many authors pointed to shifting cultivation and lack of land planning and classification as major obstacles to progress. For example Dr. Hardy L. Shirley (27), the eminent former Dean of the New York College of Forestry at Syracuse, said of the Philippines, "Unless illegal cutting, squatting and Kaingin making on public lands are stopped, all other forestry measures will be of no avail." He also said that "...forestry education is the key to better forest use."

The Development and Resources Corporation (5), reporting on Liberia, recommended that a more realistic forest policy be adopted with regard to concessions in order to induce investments in timber enterprises. This should include review and revision of fees and taxes. It points out that lack of differential in stumpage fees between high-value and low-value species discourages use of the low-valued ones and offers only small encouragement for local processing. This report concludes that, "The Liberian Government can count on losing increasing amounts

of potential revenue...unless it strengthens its ability to negotiate and manage its relations with timber operators."

C. Industrial Development

A large proportion of the reports suggested or recommended measures, other than research and institution building, to speed up industrial development and make more complete use of forest resources. No attempt will be made to list all of these, but the following quotations, excerpts and listings illustrate the measures which many of the forestry experts and industrial consultants feel are necessary.

1. Expansion, diversification and integration of forest industries. Twenty-four of the authors recommended expansion, diversification and integration of forest industries in the developing countries as ways to increase utilization, expand domestic employment, improve foreign exchange positions and obtain more use of native timber.

No less than 15 of the authors discussed the possibilities of, or recommended that, pulp and paper industries be established. Nine reports recommended or suggested the establishment of panel products industries to utilize mixed species, and logging and mill wastes. These would include facilities to manufacture particle-board, hardboard, chipboard, flakeboard, plywood and veneer.

There were nine recommendations for improvement of domestic manufacturing and marketing of lumber, and fifteen covering an array of other measures to strengthen and diversify domestic forest industries.

As early as 1953, Gooch (10) suggested the possibility of making pulp and paper from Philippine woods, also panel products. He said, "There accumulates in the woods and mills large quantities of wood waste that could be utilized for manufacture of pressed fiber board." Shirley (27) echoed this in 1960, pointing out that a pulp and paper industry is needed to utilize mill waste and secondary species. He also sug-

gested the improvement of inter-island transport, increase of stumpage fees, and improving (lengthening) concession agreements.

In 1962 James (18) recommended that Cambodia pool its interests with other Indo China countries to establish a pulp and paper industry.

The Development and Resources Corporation (5) in its report on the Development of Southeast Liberia, says that completely integrated wood-processing industries is "not urgent now but may become more important in the future." But later in the report it recommended that "The Government should encourage the development of integrated forest industries. Only in this way will the fullest use be made of Liberia's timber...."

Greenacres, Inc. (11) concludes that large-scale integrated industry is needed to properly utilize Panama's forests. They suggested the establishment of pulp and paper, hardboard and waferboard manufacturing facilities.

For Vietnam, the Development and Resource Corp. (6) recommended mechanization of logging, and expansion of the plywood industry. It points out, however, that "logs capable of being peeled for veneers and plywood are, of course, only a fraction of the output of the forests. One good alternative is pulp...."

A report prepared in 1969 for the International Bank for Reconstruction and Development and the International Development Association (16) states that in Papua and New Guinea problems of utilization created by multiplicity of species in coastal forests appear to be reduced since problems associated with production of pulp have been resolved.

In its 1967 report on "Forest Resources of the Southwest Region, Ivory Coast", the Development and Resources Corporation (4) suggested the possibility of making bleached sulphate pulp from mixed tropical hardwoods for export as well as for domestic needs. It stated that research shows that about half of the mixed tropical hardwoods in the Southwest Ivory Coast can be pulped, also that the average specific gravity of the wood must be kept below 0.8.

2. Investment capital. Eight of the authors discussed the importance and the difficulties of obtaining adequate venture capital to install and operate integrated industries including pulp and paper and panel products.

Arthur D. Little, Inc. (22) is one who recognizes that shortage of capital is a major problem and suggests that U.S. manufacturing firms acquire an equity interest in Nigerian production facilities.

Green-acres, Inc. (11), reporting on Panama, emphasized that establishment of pulp and paper and hardboard and waferboard manufacturing facilities requires large amounts of venture capital, which requires tenure adequate to support investment; which in turn requires improved laws and administration.

3. Transportation. A total of 24 of the reports reviewed identify lack of adequate transportation systems (mostly road systems) as a major obstacle to industrial development and more complete utilization of forest resources. Typical of the comments and recommendations are those of the Development and Resources Corporation (4,5). Of Liberia, it stated, "Lack of knowledge of the timber resource is an impediment but it is less important as a limitation than transportation and policy at present." It recommended that work should be started at once on roads which will facilitate timber exploitation. For the Ivory Coast, it recommended development of access, improved administration and cooperation with importing countries in finding markets for a variety of species and grades.

In their 1969 report on "Current Economic Position and Prospects of the Territory of Papua and New Guinea," the International Bank for Reconstruction and Development and the International Development Association concluded that land transportation (roads and bridges) is the most serious bottleneck and that the land tenure system is an impediment.

In its 1970 report on industrial possibilities in Vietnam, the Development and Resources Corp. (6) stated that development of a transportation system (roads) is most important.

Several of the reports previously cited discussed the "sinker" problem and the fact that reliance on waterways for floating logs sharply restricts the number of species and the amount of wood that can be marketed. Lack of adequate land transportation puts a premium on tropical woods that float and discriminates against woods with a specific gravity heavier than water. Breaking this barrier obviously could widen the marketing opportunities for a greater variety of tropical woods.

D. Market Development

Several authors suggested strengthening the ties with manufacturers and exporters as well as dealers in the importing countries as a means of promoting greater use of secondary species. For example, Arthur D. Little, Inc. (22), in its 1965 report on "Opportunities for Upgrading Nigeria's Forest Products," states that, "Marketing problems overseas can only be solved by utilizing the services of those companies with marketing organizations that are experienced in their respective countries." They suggest establishing companies composed of local know-how and overseas organizations with marketing know-how and outlets. This report says that "...expanded sales will involve the introduction of little-known or unknown species" and suggests trying to sell little-known woods to the U.S. and others. It states further that, "We realize that the introduction of new wood species into the U. S. at best is difficult and expensive but believe it can be successfully done if the enterprise is properly organized."

Hutchison, et al. (15) point out that world markets for tropical woods are changing - that a seller's market is developing. They suggest that, "The availability of timber concessions for wood export can and should be made contingent upon the fulfillment of specified performance in forestry, species utilization, and development of local manufacturing facilities."

LITERATURE CITED

1. Battelle Memorial Institute, Liberian Forest Policy, AID, 1969.
2. Bedard, Paul W., Development In Philippine Forestry, International Coop. Adm. 1957.
3. Cummings, Laurence J., Forestry in Panama, Institute of Inter-American Affairs and Int. Coop. Adm. 1955.
4. Development and Resources Corp., Forest Resources of the Southwest Region, Ivory Coast, AID, 1967.
5. Development and Resources Corp., The Development of Southeast Liberia, AID, 1965.
6. Development and Resources Corp., A Reconnaissance of Industrial Possibilities in the Five Northern Provinces of Vietnam, AID, 1970.
7. Freas, Alan D., Kukachka, B.F. and Landt, Eugene F., Report of Survey Team, Projected AID Research Program on Improved Forest Products Utilization in Latin America, 1965,
8. Gienty, D.F., Thailand's Forest Development and Its Effect on Rural Peoples, USOM/Thailand, 1967.
9. Gill, Tom, Forestry Proposals for the Philippines, Report to the ICA and the National Economic Council, 1959.
10. Gooch, Winslow L., Forest Industries of the Philippines, Mutual Security Agency, 1953.
11. Greenacres Inc., Forests of the Republic of Panama, AID, 1963.
12. Haines, Harry, Termination of Assignment Report - Nicaragua, AID, 1961.
13. Holsoe, Torkel, Forestry Opportunities in the Republic of Liberia, FAO, 1954,
14. Hughes, Bennett O., Technical Assistance in Forestry in Latin America, AID, 1964.

15. Hutchison, S. Blair, et al., Markets for Vietnam Timber in Japan, Korea, Taiwan and Singapore - A Report to the United States Agency for International Development by the Economic Research Service, U.S. Dept. of Agriculture (Preliminary draft), May 1973.
16. International Bank for Reconstruction and Dev., International Development Assn., Current Economic Position and Prospects of the Territory of Papua and New Guinea, 1969.
17. James, Corland L., Termination Report on Assignment in Liberia, AID, 1964.
18. James, Corland L., Termination Report on Assignment in Cambodia, AID, 1962.
19. Kernan, Henry S., Preliminary Report on Forestry in Vietnam, (Joint Dev. Group) AID, 1968.
20. Kryn, Jeanette M. and Fobes, W.E., The Woods of Liberia, Int. Coop. Adm., 1959.
21. Kukachka, B.F. and Saeman, J.F., Report on Investigation in South America Related to a Projected AID Program in the Field of Forest Products, 1962.
22. Little, Arthur D. Inc., Opportunities for Upgrading Nigerias Forest Products, AID, 1965.
23. McKinley, Thomas W., The Forests of Free Vietnam, USAID/Vietnam, 1957.
24. Payne, Burnett H., and Nordwall, David S., Review of Certain Aspects of the Forestry Program and Organization in Indonesia, U.S. Dept. of Agriculture, Foreign Economic Service in Cooperation with AID, 1971.
25. Renshaw, James F., Report on Forestry and Forest Products in Northern Brazil, USDA Pasa Team Report, AID, 1964.
26. Senft, John F., (Purdue Univ.), Report on Consultant Activities for the Dept. of Wood Technology and Utilization, School of Forestry, University Federal de Vicosa, Vicosa, Brazil, AID, 1970

27. Shirley, Hardy L., Some Observations on Philippine Forestry with Special Emphasis on Forestry Education, State Univ. of New York, College of Forestry, Report to AID and Nat. Econ. Council of the Philippines, 1960.
28. Spillers, Arthur R., Forestry in Paraguay, AID, 1966.
29. Thirawat, Sukhum, Brief Information on Forestry in Thailand, Ministry of Agr., Royal Forestry Dept., Thailand, 1953.
30. United States Agency for International Development, International Development Mission to Laos, Forestry Sector Evaluation for Laos, 1970.
31. Wellwood, R.W., Report to the Government of Nigeria on Forest Industries, FAO, 1966.
32. Witherow, Boyd M., Termination Report on Assignments to Liberia, AID, 1961 and 1964.