

AGENCY FOR INTERNATIONAL DEVELOPMENT  
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Utilization of secondary species from tropical forests; annual report, 1975

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(100) Auchter, R.J.  
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	14. CONTRACT NUMBER PASA TA(AG) 03-75 Res.
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## AID ANNUAL REPORT

By

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U. S. Forest Products Laboratory<sup>1</sup>  
Madison, Wisconsin 53705

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### A. Summary

The research objective of this project is to develop a feasible and appropriate system to utilize the secondary species in the tropical forests for the production of pulp, paper, paperboard, fiberboard and particleboard. Laboratory work with wood harvested in the Philippines shows that wood chips from different wood mixes can be classified on conventional specific gravity sorting equipment. Further evaluation of the output of this sorting process, confirmed that higher quality products are possible when using the lighter fraction. The heavy fraction can be used for fuel to power the processing equipment. There are no major changes in the research approach contemplated. In addition to pilot planting of the laboratory system, wood samples from Africa and Latin America will be evaluated to check universality of the application of the developed technology. Information will be used to prepare a preliminary feasibility report covering one or more of the forest products being studied.

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<sup>1</sup>Maintained in cooperation with the University of Wisconsin, Madison, Wis.

## B. Project Objectives

This project has two related objectives directed at full scale production of forest products in LDC areas of the world.

Objective No. 1: Through research, development and pilot plant testing develop a technically and economically feasible processing system for making pulp, paper and related products from naturally occurring mixtures of tropical hardwoods. Residues not acceptable for any of the forest products will be used to provide energy requirements for the processing system.

Objective No. 2: Design and assemble the elements of a "pre-investment package" based on Objective No. 1 as applied to three or more LDC sites (Latin America, Africa and Southeast Asia) and disseminate, publicize and demonstrate it to potential investors confirming the overall commercial viability of constructing and operating a mill based on the new approach using the naturally occurring mixed tropical hardwood resource.

Benefits expected on successful achievement of the ultimate goal of an operating facility include (1) new skilled and unskilled jobs, (2) production of forest products useful in local and world markets, (3) stimulation of ancillary industries and (4) sizeable savings in foreign currency exchange.

## C. Accomplishments to Date (1/1/76)

The basic premises of this research project is that there are no known full-scale operations where pulp and related paper products of export quality are produced from natural occurring tropical hardwoods and that by the application of appropriate available chemical engineering technology a commercially feasible process can be developed to provide the necessary quality factors. Selective log cutting and sorting problems would not be

essential in this new approach. The natural wood mixtures, however, would be harvested and processed with due regard to resource management, conservation principles and the utilization of the best available techniques for the protection of the environment.

Forest Products Laboratory in recent years confirms other evidence in the literature that fiber morphology (fiber length, fiber diameter and cell wall thickness) are governing factors in determining the quality of such forest products as pulp, paper, paperboard, fiberboard and even particleboard. Fiber morphology relates directly to wood density and thus our research is evaluating naturally occurring density distributions and developing procedures for enhancing those quality factors which govern the performance of the various forest products.

The thesis that "life zone" climatic and geographic factors determine the wood density distributions found in forested areas provides some "real life" density distributions for our study. Distributions representative of tropical dry, tropical moist and tropical wet areas were prepared from the hardwoods randomly harvested in the Philippines for our research work.

#### 1. Findings

(a) The wood supply from the Philippines ranged in specific gravity from 0.23 to 0.79 while the ash content was from as low as 0.09 percent to a high of 5.21 percent. Silica content was from none to a high of 4.55 percent. Chemical analyses of the three "life zone" chip mixtures showed little differences in ash, pH and extractives whereas silica ranged from 0.10 to 0.30 percent. Analysis of the various barks showed some extremely high silica contents and thus establishes the need for debarking of the logs prior to chipping and indicates some potential difficulties in adopting the whole tree chipping or utilization concept.

(b) Kraft pulp quality (48 percent yield - 29 kappa) from the three density distributions followed the expected pattern. Although the differences in quality would be statistically significant, all pulps could be accommodated in the production of one or more grades of paper.

(c) Kraft pulp quality from the mixtures simulating tropical dry and moist "life zones" can be enhanced at least 15-20 percent by the removal of the high and ultra-high density wood.

(d) A commercial unit which fractionates materials by specific gravity was 80 percent or better efficient in the removal of the less desirable high and ultra-high density woods from chip mixtures typical of "life zones" which have significant quantities at those densities.

(e) Neutral sulfite semichemical pulping of the three chip mixtures at 75 percent yield for corrugating medium followed the accepted pattern for two of the mixtures in that better performance properties were realized as wood density increased. For the third mixture with the greater percentages of ultra-high density wood, a significant loss in those property values took place. This would indicate that under present methods of paperboard manufacture there may be a critical maximum wood density where the combination of increased fiber stiffness and reduced number of bonding sites results in poor performance properties. This premise will be checked in a separate study to establish the cause(s) for this unexpected poor quality with the chip mixture simulating the tropical moist areas.

(f) In the chipping of wood, higher density species tend to produce a greater percentage of smaller sized chips. The removal of the small chips from each of the mixtures having significant amounts of ultra-high density wood via screening on a 3/8-inch rotex type screen did not significantly

improve kraft pulp (48 percent - 29 kappa) quality. This approach does not hold promise as a means to improve pulp quality.

(g) An alternate to the two-type (kraft and semichemical) pulpmill system where both linerboard and corrugating medium are to be produced is to produce high yield kraft in the 55 percent yield range. In this system, the coarse and fine screen rejects would be refined for use in making the corrugating medium and the fine screen accepts would be used for linerboard. Results with such a system producing 25-30 percent reject material indicate that this is a feasible first approach where available capital dollars are limited and both grades of paperboard need to be produced.

(h) Preliminary production and testing of laboratory produced fiberboards from the three "life zone" chip mixtures give results similar to those found for pulp and paper. The dry and wet "life zone" mixtures produced standard grade boards whereas substandard quality boards resulted from the use of the moist "life zone" mixture even though yield was reduced to 80 percent in some trials.

(i) In the production of mechanical pulp for newsprint, light colored woods are required. Attempts to classify chips from the "life zone" chip mixtures via color sorting has thus far been unsuccessful. The trial technique was based on transmitted light and the fluorescent nature of some of the woods caused the bright red chips to react the same as the light colored woods. Another technique used commercially to sort glass and potato chips will be tried before reaching a decision on the feasibility of optical color sorting for this pulp type.

## 2. Operational significance

The data relating fiber morphology to the performance characteristics of forest products supports previous findings but the possible reversal in

the ultra-high density area for products such as corrugating medium will warrant further study. In general our findings are in agreement with recent work by G. Petroff of the Centre Technique Forestier Tropical, D. Clayton et al at the Pulp and Paper Research Institute of Canada and by the Grenoble group who studied the woods in French Guiana for the French government. It would appear from their data that the wood mixes used by them contained woods of higher density than our preliminary maximum of 0.793.

We are not aware of any work where the higher specific gravity woods were separated from the chip mixture and the potential improvement in pulp quality established. This was a major premise of our proposal and it appears from the data at hand that this concept to fully utilize the secondary species has merit.

### 3. Side effects of the work

Except for the work using optical techniques to color sort the wood chips, all work has been within the scope presented in the proposal. There are, as yet no suggestions of complications which would interfere with or restrict the application of the findings to a commercial system.

### 4. Research design

As previously noted, optical sorting of the wood chips to obtain a light colored fraction for mechanical pulp was not a consideration of the original plan which called for log sorting for this grade of pulp essential to the production of newsprint. We shall further investigate a system used commercially to color sort glass and potato chips.

It also seems appropriate for us to further develop the thesis that there may be a critical maximum wood density which directly relates to each product's performance. We need this additional information to design a better processing system and make the mathematical model more precise.

Other than the above, the proposed research design is providing the information and data needed to meet the objectives of the project.

#### D. Dissemination and Utilization of Research Results

The research completed and in progress is of a preliminary nature to more clearly delineate the next phase which encompasses pilot plant trials producing pulp, paper, paperboard, fiberboard and particleboard for evaluation versus commercial standards and thus establish the viability of an enterprise in LDC areas of the world.

Formal dissemination and utilization of the research results to date is premature. In spite of this, numerous informal discussions exchanging pertinent information have occurred with representatives from industry, the academic community and institutes as well as consulting firms active in LDC areas of the world.

Reports related to this project have been limited to the travel to the Philippines and other countries in Southeast Asia to make arrangements for the necessary wood material and special research studies which can be done by organizations in the Philippines. These are:

1. J. F. Laundrie and R. C. Koeppen. "Report on Travel to Southeast Asia." March 1975.

2. R. A. Skok. "Philippine Trip on the Secondary Tropical Hardwood Project." April 24, 1975.

3. J. F. Laundrie and R. C. Koeppen. "Report on Follow-Up Travel to Southeast Asia." July 1975.

In addition to the contract for the procurement of the wood sample, we have a basic cooperative agreement with the Forest Products Research and Industries Development Commission of the Philippines (FORPRIDECOM). This basic agreement permits the execution of additional contracts. One for the study of chip storage by FORPRIDECOM staff has been established and two others are in the development stage. These latter cover sampling the market for the products covered in this project and to survey potential markets for minor forest products resulting from the recovery of the extractives in some of the wood species.

E. Work Plan for the Coming Year

With the preliminary work confirming the basic premise of the project, the work plan for the coming year is as follows:

1. Prepare pilot plant quantities of pulps from processed chip mixtures via the kraft, semichemical and thermomechanical pulping processes. These pulps will be used on pilot equipment producing semicommercial pulp, paper, paperboard and fiberboard. Completed by March 1, 1976.

2. Bleach, refine and produce pulp, paper and paperboard on the experimental machine at the Forest Products Laboratory. Products to be made are bleached market pulp, newsprint, tablet paper, corrugating medium and linerboard. Evaluation completed by September 1, 1976.

3. From the thermomechanical pulp made for fiberboard, produce boards on the pilot equipment at Miller-Hofft and evaluate by standard testing at the Forest Products Laboratory. Completed by June 1, 1976.

4. Particleboards from three or more mixes of tropical woods are being processed in the pilot equipment at the University of Minnesota. The bulk of the boards are being bonded with urea resin but at least one series will be made with phenolic resin. Urea-melamine mixes are apparently quite competitive with phenolics in Southeast Asia. Work under contract with the University of Minnesota forest products staff will be completed October 1, 1976.

5. Chip storage study by FORPRIDECOM in cooperation with PICOP is in progress and will continue during the year. Completion date has not been set due to early stage of the work and the uncertainty as to the length of the sampling period which will be governed by the rate of chip deterioration.

6. Survey of the literature under the direction of Drs. Smith and Ewel for information regarding harvesting, regeneration, soils, ecology etc. as a basis for formulating plans to utilize the secondary species without harm to the forest environment. To be completed in the Summer of 1976.

7. A review of the economic policies of the underdeveloped tropical countries which could affect opportunities for forest products enterprises is being done by a graduate student at the University of Wisconsin under the guidance of Prof. L. Christensen and T. H. Ellis (FPL staff economist). Plans for completion are September 1, 1976.

8. A survey team will visit Africa and Latin America to make preliminary plans for developing and harvesting new wood supplies which would be used to verify the results with the Philippine woods. This will be done in February and March 1976 with the wood supply scheduled for arrival at the Forest Products Laboratory in the Fall of 1976.

9. Discussions with consulting firms relative to the preliminary feasibility report will start in April 1976 and lead to a contract by about October 1976.

10. Budget proposed to support the work in calendar year 1976 is as follows:

A. Salaries and benefits	\$165,000
B. Consultants, etc.	35,000
C. Travel	8,000
D. Material and supplies	20,000
E. Other direct costs	10,000
F. Overhead (ERS)	12,000
Total	\$250,000

F. Involvement of Minority Personnel and Women

In connection with this project, two women in the Analytical Laboratory used 10 percent of their time this past year providing chemical analyses for the various wood samples and of the pulping liquors. One is a supervisory chemist, grade 12, and the other a grade 6 technician.

Also, in the Center for Wood Anatomy, three women technicians are being used gathering and analyzing anatomical data on the wood specimens harvested in the Philippines. On the average, they have spent nearly 10 percent of their time developing data for this project and will be increasing to nearly 20 percent this next year. The work involves the measurement of the dimensions of the wood cells (length, diameter and cell wall thickness) as well as locating the occlusions of such material as silica etc. One of the women is a black college student working part-time; her grade was recently increased on the basis of her performance.

The anatomical data and other pertinent information is put into our computer and analyzed via a program written by one of the women.

G. Expenditures and Obligations - Calendar Year 1975

This project was approved for AID funding in mid-January of 1975. Funds from AID for this research are primarily channeled through the ERS division of the Department of Agriculture for which they receive 8 percent. Since the processing of the first PASA which designates spending areas, AID has withheld certain funds for direct contracting by one or more of their missions located in countries where our research may be applied via the feasibility studies. The collection of the wood supply and the chip storage study are examples of funding through the local AID mission.

The expenditures and obligations reported below are those resulting from research activities in the United States by Forest Products Laboratory staff or subcontractors. They also include international travel by our staff to arrange for wood supplies and develop information required for our activities.

FY 1975 (Salaries, supplies, travel and overhead)	\$109,473
FY 1976 (Salaries, supplies, travel and overhead)	\$ 83,529
TOTAL for CY 1975	\$193,002

During the same period, the Forest Products Laboratory via technician and service operations time contributed \$77,949 in salaries to the success of this project.

APPENDIX A

ANNUAL REPORT SUMMARY SHEET

Secondary Woods Utilization, PASA TA(AG)03-75

Project Title and Contract Number

Richard J. Auchter - Forest Products Laboratory (USDA/FS)

Principal Investigator and Contractor

P. O. Box 5130, Madison, Wisconsin 53705

Contractor's Address

January 7, 1975 - September 30, 1979  
Contract Period (as amended) From - To

January 7, 1975 - January 1, 1976  
Reporting Period From - To

Total Expenditures and Obligations  
Through Previous Contract Year

None

Total Expenditures and Obligations For  
Current Contract Year

\$250,252

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Narrative Summary of Accomplishments and Utilization:

The research objective of this project is to develop a feasible and appropriate system to utilize the secondary species in the tropical forests for the production of pulp, paper, paperboard, fiberboard and particleboard. Laboratory work with wood harvested in the Philippines shows that wood chips from different wood mixes can be classified on conventional specific gravity sorting equipment. Further evaluation of the output of this sorting process, confirmed that higher quality products are possible when using the lighter fraction. The heavy fraction can be used for fuel to power the processing equipment. There are no major changes in the research approach contemplated. In addition to pilot planting of the laboratory system, wood samples from Africa and Latin America will be evaluated to check universality of the application of the developed technology. Information will be used to prepare a preliminary feasibility report covering one or more of the forest products being studied.

APPENDIX B  
**SMITHSONIAN**  
**SCIENCE INFORMATION EXCHANGE, INC.**  
 1730 M STREET, N.W. PHONE 202-381-5811  
 WASHINGTON, D.C. 20036

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## NOTICE OF RESEARCH PROJECT

<p><b>SUPPORTING AGENCY:</b>          Agency for International Development (AID)          U.S. Department of State</p>	<p><b>AGENCY'S NUMBER(S):</b>  <b>Contract No:</b> PASA TA(AG)03-75  <b>and/or</b>  <b>Control No:</b></p>
<p><b>TITLE OF PROJECT:</b>          Utilization of Secondary Species from Tropical Forest</p>	
<p><b>PRINCIPAL INVESTIGATOR, ASSOCIATES</b>          Richard J. Auchter          Forest Products Laboratory</p>	<p><b>School or Division</b>          Forest Products Laboratory</p> <p><b>Department</b>          U.S. Dept. of Agriculture          Forest Service</p>
<p><b>RECIPIENT INSTITUTION:</b>  <b>Name and Address:</b> U.S. Forest Products Laboratory          P.O. Box 5130          Including Madison, Wisconsin 53705  <b>Zip Code.</b></p>	<p><b>PERIOD FOR THIS NRP:</b>  <b>Start Date:</b> January 7, 1975  <b>End Date:</b> January 1, 1976  <b>Annual Funding:</b> \$250,252</p>
<p><b>SUMMARY OF PROJECT:</b> <b>Be brief-200 word maximum: (Include Objective, Approach, Current Plans and/or Progress)</b></p> <p>The research objective of this project is to develop a feasible and appropriate system to utilize the secondary species in the tropical forests for the production of pulp, paper, paperboard, fiberboard and particleboard. Laboratory work with wood harvested in the Philippines shows that wood chips from different wood mixes can be classified on conventional specific gravity sorting equipment. Further evaluation of the output of this sorting process, confirmed that higher quality products are possible when using the lighter fraction. The heavy fraction can be used for fuel to power the processing equipment. There are no major changes in the research approach contemplated. In addition to pilot planting of the laboratory system, wood samples from Africa and Latin America will be evaluated to check universality of the application of the developed technology. Information will be used to prepare a preliminary feasibility report covering one or more of the forest products being studied.</p>	

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 WASHINGTON, D. C. 20503  
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1. SUBJECT CLASSIFICATION	A. PRIMARY <b>Agriculture</b>
	B. SECONDARY <b>Secondary Wood Species</b>
2. TITLE AND SUBTITLE <b>Utilization of Secondary Species from Tropical Forests</b>	
3. AUTHOR(S) <b>Richard J. Auchter</b>	
4. DOCUMENT DATE <b>January 30, 1976</b>	5. NUMBER OF PAGES <b>11</b>
6. ARC NUMBER <b>ARC (For AID use only)</b>	
7. REFERENCE ORGANIZATION NAME AND ADDRESS <b>Forest Products Laboratory, USDA - FS P. O. Box 5130, Madison, Wisconsin 53705</b>	
8. SUPPLEMENTARY NOTES (Sponsoring Organization, Publisher, Availability)	

## 9. ABSTRACT

The research objective of this project is to develop a feasible and appropriate system to utilize the secondary species in the tropical forests for the production of pulp, paper, paperboard, fiberboard and particleboard. Laboratory work with wood harvested in the Philippines shows that wood chips from different wood mixes can be classified on conventional specific gravity sorting equipment. Further evaluation of the output of this sorting process, confirmed that higher quality products are possible when using the lighter fraction. The heavy fraction can be used for fuel to power the processing equipment. There are no major changes in the research approach contemplated. In addition to pilot planting of the laboratory system, wood samples from Africa and Latin America will be evaluated to check universality of the application of the developed technology. Information will be used to prepare a preliminary feasibility report covering one or more of the forest products being studied.

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