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TROPICAL DEFORESTATION

HEARINGS

BEFORE THE

SUBCOMMITTEE ON INTERNATIONAL ORGANIZATIONS

OF THE

COMMITTEE ON FOREIGN AFFAIRS HOUSE OF REPRESENTATIVES

NINETY-SIXTH CONGRESS

SECOND SESSION

An Overview
The Role of International Organizations
The Role of the Multinational Corporations

MAY 7; JUNE 19; AND SEPTEMBER 18, 1980

Printed for the use of the Committee on Foreign Affairs

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[1] Resigned June 3, 1980.
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PREFACE

The Subcommittee on International Organizations, which has legislative and oversight jurisdiction over international environmental policy, is the first congressional subcommittee or committee to conduct hearings on the importance of tropical moist forests, the causes and rates of forest alteration and loss, and options for resolving the problem of tropical deforestation. These hearings clearly indicate that this will be one of the most important international environmental issues facing the United States and the world during the 1980's and 1990's, and possibly into the 21st century. The timing and the way the United States and other nations choose to respond to this problem are crucial.

The accelerating alteration and loss of the world's tropical forests present the United States with a particularly difficult problem at a time when such major issues as dwindling energy resources, overpopulation, and slackening economic development tend to take priority in our foreign policy. However, these issues cannot be considered in isolation from the problem of tropical forest loss. Indeed, the continued, unchecked depletion of this valuable resource will have negative consequences not only for the countries where they are located, but for the major industrialized countries that depend on the tropical forests and their resources for items ranging from pulp and paper to hardwoods, anticancer treatments, cough and cold medicines, and staples like sugar and cocoa.

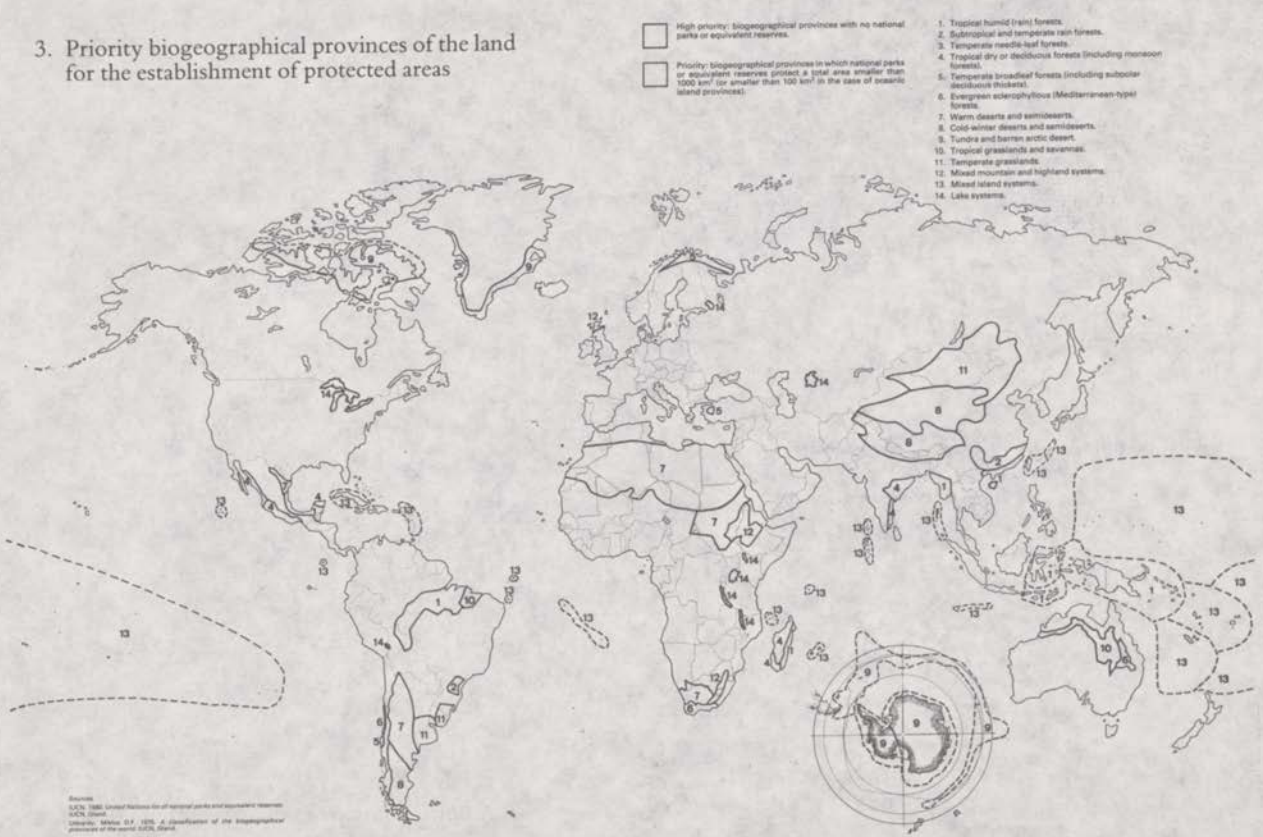
The subcommittee believes that these timely hearings served to increase public awareness of what is and what will continue to be an increasingly complex and difficult problem; namely, how to strike an equitable balance between providing for basic human needs and, at the same time, preserving our environment for future generations.

1. Tropical forests

2. Deserts and areas subject to desertification

Source
United Nations Conference on Desertification, 1977
Desertification Map of the World
UNEP/FAO/Unesco/WMO

3. Priority biogeographical provinces of the land for the establishment of protected areas



4. International river basins

Source
Centre for Natural Resources, Energy and Transport of the Department of Economic and Social Affairs of the United Nations. 1978. *Register of international rivers. Water Supply and Management*, 2: 1-59.

CONTENTS

Page

Preface III

Maps prepared for the World Conservation Strategy by the International Union for Conservation and Natural Resources (IUCN) with the advice, cooperation, and financial assistance of the United Nations Environment Program and the World Wildlife Fund and in collaboration with FAO and UNESCO, March 1980:

1. Tropical forests IV
2. Deserts and areas subject to desertification V
3. Priority biogeographical provinces of the land for the establishment of protected areas VI
4. International river basins VII

WITNESSES

May 7, 1980:

Douglas R. Shane, Center for Development Policy 2

R. Max Peterson, Chief, U.S. Forest Service, and Cochairman, Interagency Task Force on Tropical Forests 4

Bill L. Long, Director, Office of Food and Natural Resources, Department of State, and Cochairman, Interagency Task Force on Tropical Forests 8

James S. Bethel, dean, College of Forest Resources, University of Washington 59

Peter H. Raven, director, Missouri Botanical Garden 68

Hon. Robert O. Blake, chairman, Tropical Forest Working Group 92

June 19, 1980:

Norman Myers, consultant in conservation and development, and senior associate of World Wildlife Fund—United States 134

Robert Thomas Hoffmann, acting director, International Institute for Environment and Development 153

Thomas E. Lovejoy, vice president for science, World Wildlife Fund—United States 173

Donald R. King, Director, Office of Environment and Health, Department of State 200

Samuel H. Kunkle, forest hydrologist, Forest Service, U.S. Department of Agriculture 205

Stephen B. Preston, associate dean and professor of natural resources, School of Natural Resources, the University of Michigan 212

Thursday, September 18, 1980:

Carl Gallegos, senior research forester, International Paper Co 230

William Ladrach, manager of forestry research, Carton de Colombia (a partially owned subsidiary of Container Corp. of America) 244

Norman E. Johnson, vice president, North Carolina region, Weyerhaeuser Co 281

Douglas R. Shane, consultant in tropical forest development and conservation 308

MATERIAL SUBMITTED FOR THE RECORD

Text of presentation given at the U.S. Strategy Conference on Tropical Deforestation, June 12–14, 1978, by Dr. George Woodwell, entitled "CO_2 Deforestation Relationships" 46

Quantification of Tropical Deforestation Causes, with attached chart "Industrial Activities for Roundwood Production" submitted by Mr. Long 54

Page

St. Louis Post-Dispatch article of March 25, 1979 entitled "A National Commitment," submitted by Dr. Raven 86
Article by Peter H. Raven, entitled "The Destruction of the Tropics" 90
Text of article by Norman Myers, entitled "Whose Hand on the Axe" 138
Text of article by Norman Myers, entitled "Forests for People" 143
Text of article by Norman Myers, entitled "Foresters and Tropical Forests" 147
Text of paper presented by Norman Myers, October 26, 1978 to the Eighth World Forestry Congress in Jakarta 148
Declaration of Environmental Policies and Procedures Relating to Economic Development, issued by the World Bank and eight other multilateral institutions 156
Statement delivered by the International Union for Conservation of Nature and Natural Resources at the Experts Meeting on Tropical Forests, Nairobi, Kenya, February 25-March 1, 1980 181
Chart submitted by Mr. King, which shows estimated annual expenditure of U.N. agencies, share contributed by the United States, and percentage allocated to tropical forestry 205
Chart submitted by Mr. King which gives estimates of personnel employed in tropical forest programs in the United Nations system 205
List submitted by Dr. Kunkle identifying field projects in the FAO forestry program budgeted for 1980–81 209
Forest research reports, submitted by Carton de Colombia 246

APPENDIXES

1. U.S. policy recommendations of the Interagency Task Force on Tropical Forests 325
2. General overview of recently completed, ongoing, and proposed forestry activities in *Africa and the Middle East*, taken from a report entitled "Forestry Activities and Deforestation Problems in Developing Countries," prepared by the Forest Products Laboratory, Forest Service, U.S. Department of Agriculture, sponsored by the U.S. Agency for International Development 326
3. General overview of recently completed, ongoing, and proposed forestry activities in *Latin America and the Caribbean Region*, taken from "Forestry Activities and Deforestation Problems in Developing Countries" 333
4. General overview of recently completed, ongoing and proposed forestry activities in *Asia and Pacific Region*, taken from "Forestry Activities and Deforestation Problems in Developing Countries" 336
5. *Summary of Donor Agency Activities*, taken from "Forestry Activities and Deforestation Problems in Developing Countries" 339
6. Text of article entitled "Eco-crime on the Equator," by Janet Marinelli, which appeared in the March 1980 issue of Environmental Action 343
7. National Geographic article by Loren McIntyre entitled "JARI: A Billion Dollar Gamble," appeared in the May 1980 issue 353
8. Los Angles Times article of May 4, 1980, by Leonard Greenwood, entitled "Once-Lush Haiti—Close to Disaster" 360
9. Statement for the record submitted by Dr. Shelton H. Davis and Robin M. Wright of the Anthropology Resource Center, Cambridge, Mass. entitled "Human Consequences of Development Policies in the Brazilian Amazon" 363
10. Letter dated May 16, 1980, to Subcommittee Chairman Bonker from S. Dillon Ripley, Secretary of the Smithsonian Institution 371
11. May 7, 1980, letter to Subcommittee Chairman Bonker from Thomas L. Kimball, executive vice president, National Wildlife Federation with enclosed resolution entitled "Conservation of Tropical Forests" and article entitled "Doomed Jungles?" by Peter Gwynne which appeared in the July-August edition of National Wildlife Magazine 372
12. Letter dated May 9, 1980, to Subcommittee Chairman Bonker from Warren B. King, Chairman of the International Council for Bird Preservation, United States Section, Inc 379
13. Statement for the record submitted by A. Dexter Hinckley, senior ecologist, International Research and Technology Corp. entitled "Deforestation and CO_2" 381
14. Text of May 12, 1980, letter to Subcommittee Chairman Bonker from Dr. Peter H. Raven, director, Missouri Botanical Garden 388

	Page
15. Text of May 20, 1980, letter to Subcommittee Chairman Bonker from Dean Bethel, College of Forest Resources, University of Washington	389
16. Submission for the record by Bruce MacBryde, Ph. D., entitled "U.S. Possibilities for Plant Conservation Internationally"	392
17. Text of May 12, 1980, letter with attachment to Subcommittee Chairman Bonker from Hugh H. Iltis, director on the Herbarium and professor of botany, University of Wisconsin-Madison	396
18. Letter dated September 4, 1980, to Subcommittee Chairman Bonker from Rexford A. Resler, executive vice president, American Forestry Association	400
19. New York Times article of October 16, 1980, by Warren Hoge entitled "Ludwig May Cut Brazil Project"	404
20. September 25, 1980, letter from Lewis A. Engman, president of the Pharmaceutical Manufacturers Association to Subcommittee Chairman Bonker	406
21. Statement submitted for the record by Roger A. Sedjo, director, forest economics and policy program, Resources for the Future	408
22. Survival International (USA) statement submitted for the record	415
23. Statement submitted by Imported Hardwood Products Association, entitled "Tropical Reforestation"	422
24. Statement submitted by David L. Skole, Complex Systems Research Center, University of New Hampshire entitled "United States Foreign Assistance and Tropical Deforestation"	424
25. Statement of Dr. Clayton E. Posey, Jari Florestal, submitted by the National Forest Products Association, with attached article entitled "Jari" by John Kalish, which appeared in the January 1979 issue of Pulp and Paper International	428

TROPICAL DEFORESTATION

An Overview

WEDNESDAY, MAY 7, 1980

HOUSE OF REPRESENTATIVES,
COMMITTEE ON FOREIGN AFFAIRS,
SUBCOMMITTEE ON INTERNATIONAL ORGANIZATIONS,
Washington, D.C.

The subcommittee met at 10:38 a.m. in room 2255, Rayburn House Office Building, Hon. Don Bonker (chairman of the subcommittee) presiding.

Mr. BONKER. The Subcommittee on International Organizations will come to order. Let me say at the outset that we in this committee room are practicing energy conservation by having the lights off. Incidentally, we will have a slide presentation in a few minutes. Then the lights will go on and we will proceed with the testimony as scheduled.

Today, the purpose of this subcommittee meeting is to explore the ecological, economic and developmental importance of moist tropical forests to key U.S. interests as well as to the world community. Also, we are interested in looking into the principal causes of tropical deforestation; the rate of forest degradation and depletion; and the relationship between developmental and environmental concerns in the use of tropical forests.

The tropical moist forest biome is recognized as the richest, but least known ecological region on Earth. For example, some scientists believe that 70 percent of the plants that possess anticancer properties live in tropical moist forests. There is a 50-percent chance that any medication purchased at a pharmacy is derived from materials of natural origin.

I'm going to cite a few statistics because I think they provide the basis for our hearing today. Since 1950, according to the U.N. Food and Agriculture Organization, one-half of the world's forests have disappeared. Of the original number of tropical moist forest trees, Latin America has lost 37 percent, Central America 66 percent, Southeast Asia 38 percent, and Central Africa nearly 52 percent. Present data indicates that approximately 27 million acres per year are destroyed. If this trend continues, some experts estimate that all tropical forests in Malaysia and the Philippines, where one-fifth of the entire landmass has been deforested, could be totally depleted by 1990. Indonesia's forests, which still has 300 million acres—the largest timber resources in Southeast Asia—will be wiped out by the year 2000. Within 10 years, little will remain of Central America's tropical moist forest.

Global wood consumption is expected to increase by nearly 135 percent during the last quarter of this century. Our own imports of tropical hardwood products have grown at a rate of 7 percent per year over the last decade and are projected to double by the year 2000. Eighty-two percent of all American hardwood imports come from the tropics. Lower production costs are the primary reason for using tropical, rather than native hardwoods. Exported wood products annually provide approximately $4.7 billion worth of income to tropical moist forest countries.

While we are experiencing widespread depletion of this natural resource, on the other hand the commercial use of the product is on the increase.

As a result of tropical moist forest depletion, it is estimated that from 2 million to 5 million of the world's species located in tropical forests have vanished, along with 87 of the 230 original Amazonian tribes. Repercussions resulting from the elimination of tropical moist forests will include massive soil erosion, loss of nutrients, flash floods which could be followed by droughts. Tropical regions will not be the only areas affected. Climate changes could occur worldwide, resulting in less precipitation in parts of North America. The implications could be particularly ominous for our grain-growing regions.

During future hearings we hope to focus attention on the role of such international organizations as the FAO, UNEP, UNESCO and the World Bank—to take a hard look at their projects in tropical developing countries. Another hearing will concentrate on the utilization of tropical forest resources by multinational corporations. Over 50 U.S.-based corporations conduct timber and cattle-ranching operations in tropical countries. So this will be the first of a series of hearings on this particular subject. We are discovering that there is very little knowledge and interest in tropical deforestation, but it is one of those subjects that the more we explore, the greater the interest.

It is appropriate that we lead off today with witnesses representing the administration, Mr. Bill Long and Mr. Max Peterson, cochairmen of the Interagency Task Force on Tropical Forests, who will present the administration's view of the problem. Then we will receive testimony from Dr. Peter Raven, director, Missouri Botanical Gardens, Mr. James Bethel, dean of the College of Forestry Resources, University of Washington, and Mr. Robert Blake, chairman, Working Group on Tropical Forestry.

I believe we have an excellent slate of witnesses. I'm most anxious to hear from them; but before we begin with the official testimony, we do have a short slide presentation which I think will provide us with some insights to this issue. Mr. Doug Shane from the Center for Development Policy, has prepared a report for the State Department on tropical deforestation in Central and Latin America and has offered to present the slides. Mr. Shane, you may proceed.

STATEMENT OF DOUGLAS R. SHANE, CENTER FOR DEVELOPMENT POLICY

Mr. SHANE. Thank you Mr. Chairman. Tropical forests are found in the equatorial regions of the Earth. They are located in the Amazon basin of South America and in Central America along the Caribbean

coastal areas; in the Congo basin of Central Africa; and throughout Southeast Asia.

As we know, a rich diversity of plant and animal life are found in tropical forests, but the forests themselves constitute fragile ecosystems. The soils largely lack the necessary nutrients to support plant-life. To counter this, the vegetation has evolved methods of capturing and storing essential nutrients over some 60 million years.

Man derives a wide variety of benefits from tropical forests—water for drinking, transportation, and hydroelectric power; hardwoods like mahogany, cedar, and rosewood as well as resins, gums and other products; pharmaceuticals to cure disease and for medical research; and germplasm to maintain and improve important agricultural crops.

Many scientists warn that the destruction of the planet's tropical forests would have serious global environmental effects, including increased carbon dioxide levels, which could result in a general warming trend and in the desertification of the Earth's fertile areas.

Slash-and-burn agriculture, in which peasants and aboriginal peoples clear small areas of tropical forest for cultivation over a 2- to 4-year period, allows small numbers of people to sustain themselves in areas of tropical forest. When the nutrients supplied from the burned vegetation are exhausted, the land is abandoned, making it possible for the forest to regenerate itself. Farmers may then return to the area after 10 or so years to repeat the process.

But nations and men have bigger plans for the expansive areas of tropical forests in their countries. They seek ways to alleviate problems, such as high unemployment, high birth rates, stagnant economies, and the fact that the majority of the best lands are owned by a minority for the production of export crops like coffee, bananas, cotton, sugar cane, and cocoa.

With assistance from a variety of foreign sources, roads are built into wilderness areas to facilitate the exploitation of natural resources, such as timber and minerals. A road was built into Ecuador's Amazon basin a decade ago by Texaco and Gulf for the construction of an oil pipeline.

After the roads are constructed, business interests follow. The dramatic increase in beef production and export by Latin American and foreign interests are widely considered to be the foremost cause for the destruction of Latin America's tropical forests.

In all tropical countries, the landless poor follow the roads seeking a living. Usually they come of their own accord, but occasionally they are a part of a government-sponsored resettlement project.

While the lands are productive for the first 2 or 3 years, soon weeds, increasing insect vectors and declining soil fertility make it more and more difficult for the peasant to sustain himself and his family. Finally the people either sell their land to cattle interests or simply abandon it.

With the protective vegetation of the forest gone, the lands become severely degraded, resulting in erosion, the siltation of rivers and dams, and decreased rainfall in regions where large-scale deforestation has occurred.

There are ways that man can utilize tropical forests. Annually flooded areas adjacent to rivers can be farmed, since they regularly receive new deposits of rich topsoil. The natural food products of the

forests and river systems—if properly managed—could provide much-needed nutrition.

Foreign assistance must be "appropriate." There must be less emphasis and investment in projects which do not directly assist the poor majorities of the countries involved. And national and foreign business interests must operate within the environmental constraints dictated by tropical forest ecosystems.

The tropical forests of the earth must be recognized as a vital "international" resource, to be developed rationally so that mankind is not stranded on a planet without a biological future.

Thank you. Lights please.

Mr. BONKER. Thank you, Mr. Shane. That really gives us a good introduction to today's hearing. We appreciate your slide presentation and your comments.

Would the administration witnesses come forward please? I might add that the Subcommittee on International Organizations has jurisdiction over this issue in at least two areas. One, we oversee international environmental issues, and this, of course, is a significant environmental concern. And two, because of our jurisdiction over international organizations.

Also, as a Member of Congress from the Northwest, I have a continuing interest, as Mr. Peterson knows, in forestry matters in general, because that is the basis of our economy, and many of the corporations that are located in the Northwest are also involved in this issue.

So it is with a great deal of interest and expectation that we proceed with these hearings. We have as our leadoff witness Bill Long, who is the Director of the Office of Food and Natural Resources at the Department of State, and Cochairman with Mr. Peterson of the Interagency Task Force on Tropical Forests. It is with pleasure that I greet both Mr. Long and Mr. Peterson, who is Chief of the U.S. Forest Service. I am pleased to see that such a task force has been organized, and I'm anxious to hear about your findings.

In looking over the prepared statements, I note that some are 25 or 30 pages long. If you choose to summarize or selectively touch on important parts of your testimony, the entire statement will be included in the record.

So with that, we will proceed. Mr. Peterson, you may begin.

STATEMENT OF R. MAX PETERSON, CHIEF, U.S. FOREST SERVICE, AND COCHAIRMAN OF THE INTERAGENCY TASK FORCE ON TROPICAL FORESTS

Mr. PETERSON. Thank you, Mr. Chairman. As you have indicated, we have prepared a longer statement jointly, it is 33 pages long, which we would like to see, as you suggest, placed in the record. We are prepared to each give a brief abstract of the prepared statement if that is satisfactory.

Mr. BONKER. That is satisfactory and without objection the entire statement will be included in the record.

May I ask the people in the back if they can hear? Could you move the microphone a little closer, Mr. Peterson?

Mr. PETERSON. I have with me today Dr. Warren Doolittle, Associate Deputy Chief of the Forest Service, who's been a working representative for me most of the time on tropical forestry, and Dr. Robert Brandt, our Director of the International Forestry staff, who may help answer some questions, Mr. Chairman.

Mr. BONKER. Fine.

Mr. PETERSON. I'll lead off, if you like. We appreciate the opportunity to appear here today to testify on the subject of tropical deforestation, an important and exceptionally timely subject both for the United States and for the world community of nations. My remarks and those of Mr. Long will address the four issues raised in your letter of April 18 and touch on a few closely related issues that we believe are of interest to the subcommittee. Our comments today will be brief, but we have detailed statements that we wish to submit for the record.

We would like to note that the testimony relates to the task force report and should not be construed as necessarily reflecting the position of the administration. That report has not yet gone to press and does not yet have the administration's approval.

In June 1978 a conference on tropical deforestation was convened in Washington, D.C., by the State Department and the Agency for International Development to assess the dimensions and implications of the tropical forest loss problem, and to examine U.S. interests and responsibilities.

This conference and perspective served to energize a broad-based response by the U.S. Government, working in close cooperation with the non-Federal sector. We would like to report on this response today, and in so doing present what is emerging as a Government-wide consensus on the nature and implications of the problem, U.S. interests involved, this Nation's influences on the situation, the type of policy and program this country should undertake, and unresolved issues and needs.

This month a Federal Interagency Task Force on Tropical Forests will submit to the President a report recommending a comprehensive U.S. policy, strategy, and program on tropical forests. The report is a direct outgrowth of the 1978 national strategy conference cited earlier. We will be drawing on the findings of this forthcoming report to the President for the purpose of this testimony, along with the results of an international meeting on tropical forests convened in Nairobi 2 months ago by the United Nations Environmental Program.

Tropical forests constitute a major world resource, totaling 1.9 billion hectares. I believe this is 4.7 billion acres or about twice the land area of the United States. They cover 42 percent of all tropical lands. Of this 42 percent, 18 percent is "open" forest—woodland and semiarid shrubland such as the African Sahel—and 24 percent is "closed," a continuous forest canopy such as the Amazon rain forest. Africa has about 64 percent of all tropical open forest, while more than 50 percent of the closed forest is in South and Central America and 30 percent in Asia/Australia/Oceania. For your convenience, we have shown those areas on the map at the right, to indicate the closed forests and the open forests and the location of those forests in the tropics. As

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you note on the left, the U.S. tropical forests represent less than 1 percent of the world's total and are found mainly in southern Florida and Texas, Hawaii, Puerto Rico, the Virgin Islands, Guam, and American Samoa.

Forest environments are vital to human existence in the tropics. As has already been indicated in the slides, they provide food, fiber, fodder, fuel, building materials, and medicines. Forests also provide habitats for wildlife, as well as for indigenous human populations, and perform important protective functions by regulating water flow and by minimizing soil erosion.

In addition, tropical forests provide commodities important in international trade. Thus, people far removed from tropical forest ecosystems are affected by the integrity of this resource.

The amount of permanent forest cover being lost is difficult to measure precisely. Historical records are poor, our ability to monitor deforestation is limited, and changes in cover occur rapidly. It is estimated, however, that closed tropical forests have already been reduced by human activities by more than 40 percent.

The current annual rate of decrease is 10 to 20 million hectares a year according to the best available estimates. This decline means that 1 to 2 percent of the world's closed tropical forests is being cleared each year.

Mr. BONKER. Mr. Peterson, when you talk about being cleared, in citing these statistics do you take into account any natural regeneration or reforestation?

Mr. PETERSON. This is the amount being cleared. Some of it is being deforested.

Mr. BONKER. So you're just talking about the amount that is being cleared?

Mr. PETERSON. Right. In the worst case scenario, the closed forest area is projected to decline by one-half, to about 580 million hectares, by the year 2000—only 20 years away—that is, under the assumption that forest loss in 1979 is 20 million hectares, and that the rate of forest conversion will thereafter increase at the expected rate of population growth in the tropics.

In this case, most tropical countries will have little economically accessible forest remaining at the end of the century. Millions of people will be without wood for fuel, shelter, or fiber. Watersheds of the major agricultural areas largely will be denuded, and reservoirs needed for flood control, irrigation, and hydropower will be filling rapidly with silt. Hundreds of thousands of plant and animal species will literally vanish.

The best-case scenario also is plausible only if the conditions causing rapid deforestation change substantially.

If the current rate of deforestation is only 10 million hectares, and if all forestry plans and goals of tropical countries are fully successful over the next 20 years, then the deforestation rate may drop to less than 5 million hectares a year by 2000. Under these assumptions, the projections indicate that wood will still be abundant in some countries of Africa, South America, and Southeast Asia.

Turning to the causes of forest loss, the principal direct causes of tropical forest loss are: (1) conversion and use for agriculture; (2)

fuelwood gatherings; and (3) poorly managed industrial logging. But behind these direct causes are more fundamental problems. I think we're really making a great mistake if we do not deal with some of those fundamental problems. We have rapidly increasing population, great inequalities of land tenure, absence of advancement in agricultural technology, and lack of opportunities for employment on proven agricultural land or outside the agricultural sector.

Mr. BONKER. Most of that growth will be in areas where they're experiencing growth in population?

Mr. PETERSON. Yes. This is the tropical area I'm speaking of. The 2 billion people in the tropical areas will probably increase to 3 billion in those areas.

Mr. BONKER. I see.

Mr. PETERSON. Population growth rates of over 2 percent are common.

It is widely believed that shifting agriculture is the single most important contributor to the destruction of tropical forests worldwide. While this approach to food production has been used for centuries in a manner which also sustained the forests, the sheer numbers of poor people now seeking land to cultivate is overwhelming the forest resource.

Cutting wood for fuel is another important cause of deforestation, and in some places is the major cause. More than 1 billion cubic meters of wood are harvested each year in the tropics, and the rate is increasing. At least four-fifths or 80 percent of this harvest—some 825 million cubic meters—is used for firewood and charcoal; the rest for building materials and for export.

The relationships between deforestation and the removal of industrial wood for construction, fiber and manufactured products are complex and poorly understood. Most tropical logging is highly selective as to species and tree size. The use of heavy equipment for timber extraction can, however, cause substantial secondary loss. The immediate results of logging operations is thus more likely to be degraded forest than conversion to nonforest; but the roads and clearings made by the loggers are commonly used by farmers who complete the process of deforestation, as shown in the slides you just saw.

Looking at development and environmental relationships, the challenge in preventing deforestation is to provide for these human needs in ways that are more in harmony with nature. A purely protectionist approach will not suffice; neither will all-out exploitation. Both protection and rational exploitation must somehow be provided for in development. In other words, with this kind of an increase in population, you simply have to be able to meet the needs of the people involved, or you won't be successful in protecting the forests.

Many kinds of potential assistance have been identified by the U.S. Interagency Task Force on Tropical Forests, by international meetings of experts, and by the developing countries themselves.

There are many encouraging signs that governments are giving increased attention and priority to tropical forests. At the recent UNEP meeting in Nairobi, Kenya, participants indicated that national policies for the management of tropical forests were being developed in many countries where such forests occur. Most of these policies em-

phasize: (1) economic utilization of the resource; (2) conservation of the resource according to the principles of wise use; (3) protection of important water catchments and the environment in general; and (4) protection of indigenous forests and the wildlife by establishing parks, preserves, and refuges.

I might comment, Mr. Chairman, I recently attended a meeting of the Latin American Forestry Commission, which includes heads of the forest services from all Latin American countries, and they are giving much attention to this type of thing. There is concentration on the tropical forest in Latin America, and a real stress on the social and economic problems of the people as a part of that solution. These policies are an indication of high level government concern, and should help provide a sound basis for more effective international cooperation.

We believe it is important that we be alert to opportunities to contribute to alleviating these opportunities. The task force has developed a number of specific recommendations. We expect to carefully review these in terms of specific programs, resource commitments and their impacts on other policies and interests.

Mr. Long will summarize his statement.

Mr. BONKER. Thank you, Mr. Peterson, for both your comprehensive text and for the brevity of your statement. Your testimony today is as cochairman of the task force and you're speaking from the position of Chief of the Forest Service?

Mr. PETERSON. I have difficulty wearing those two hats. I will say cochairman of the task force.

Mr. BONKER. Mr. Long, please proceed.

STATEMENT OF BILL L. LONG, DIRECTOR, OFFICE OF FOOD AND NATURAL RESOURCES, DEPARTMENT OF STATE, AND COCHAIRMAN OF THE INTERAGENCY TASK FORCE ON TROPICAL FORESTS

Mr. LONG. Thank you, Mr. Chairman. In his 1977 environmental message, President Carter singled out tropical forest loss as a global problem of major importance to mankind in the years ahead, and called upon the Federal agencies to exercise leadership to try to deal with the problem. I would like to report on the response to date.

Mr. BONKER. Fine.

Mr. LONG. We have approached this at two levels, one domestic and the other international. Domestically, our efforts have been clustered around the work of the Federal task force which has pursued the following objectives. First, we have attempted to raise public awareness of tropical deforestation. Secondly, we have tried to establish tropical forest management as a focal point for attention by the U.S. public and private sectors. Third, we have tried to insure improved coordination of U.S. activities related to the subject. And fourth, we have tried to develop a rationale, a justification and a policy and program for an expanded U.S. effort, an effort that would be carried out within the framework of an emerging international program.

Mr. BONKER. I'm sorry, are these views taken from the task force report or from the State Department?

Mr. LONG. I am presenting the task force assessment, but the task force report has State Department support.

Mr. BONKER. It seems to me Mr. Peterson referred to task force recommendations which will be forthcoming.

Mr. PETERSON. That is right.

Mr BONKER. But you say these are the task force recommendations. Are these preliminary?

Mr. LONG. What I have been describing are the task force objectives. I'll get to the matter of recommendations later.

Mr. BONKER. All right, thank you.

Mr. LONG. One of the functions of the Federal task force is to serve as a contact between the Federal agencies, environmental groups, universities, and private industry. We think one of the strengths of our efforts to date is that we have been able to maintain close liaison with all these interested parties, and to come pretty close to unanimous consent on the nature of the problems and to some extent what should be done about them. This is an aspect of our work we would like to cultivate further in the future. But as I say, this is one of the high points to date.

Certainly if one is going to deal with the problem of the loss of tropical forests, one has to come to grips with international cooperation. As Mr. Peterson said, the U.S. possesses less than 1 percent of the world's tropical forests. The other 99 percent exists in countries which claim and exercise permanent sovereignty over the resource base.

The second graphic we have displayed indicates very dramatically who owns the tropical forests; and a quick look indicates why, for example, Brazil is so sensitive about outsiders making judgments on the tropical forests.

The U.S. strategy has therefore been to try to raise worldwide awareness of the scope, origins and consequences of tropical forest loss; and also to promote development of a coordinated international program on tropical forests, one which will attract support from governments and international organizations. We have been working very hard in a number of forums to raise the tropical forest loss issue and to press for international programs that a broad spectrum of countries and international organizations can subscribe to.

The United States has raised the tropical forest loss problem at the last two U.N. General Assembly sessions. We followed up our first statement in the General Assembly 2 years ago by requesting that the U.N. Environment Program (UNEP) take on responsibility for development of an integrated, coordinated international program.

The UNEP Governing Council subsequently approved a resolution calling for an international meeting of experts on tropical forest management, and such a meeting was convened in Nairobi, February 25 through March 1 of this year. We are pleased to note that the international experts were able to take what we consider to be important first steps toward shaping a global action program. Their recommendations were then submitted to the UNEP Governing Council that met 2 weeks ago, and they were approved by the council along with a mechanism to keep the momentum going, working toward a fully integrated program, much like the World Climate Program was devel-

oped. We think that this is a very positive international response to the problem.

But the hard task now is to keep the international effort going. Of concern to some of the governments is the sovereignty issue, and it is a problem to keep the many organizations pulling and working together. We therefore believe that the next subject you're dealing with in your hearings, namely, the role of international organizations, is a key to make sure that something positive happens.

In our efforts to develop a U.S. policy and program, we have addressed the issue of goals. What goals would we like to see reached internationally as we try to deal with the tropical forest loss problem? It is of particular note that we exposed the series of goals developed by the task force for discussion at the international experts meeting in Nairobi. These goals drew broad support from other governments. Some of them thought, in certain cases, that they were too idealistic. But nonetheless, they were willing to accept the U.S. goals as a good point of departure for further development of the international action program. The goals are described in some detail in the prepared testimony and I won't belabor this. I would, however, like to cite a few.

The task force developed near-term, medium-term and long-term goals. The types of goals we think the United States and other nations can realistically achieve in the near-term—within 5 years—includes such things as policy commitments by virtually all nations to improve tropical forest management, and the initiation of an internationally coordinated management program. The latter is the program we launched in Nairobi 2 months ago. Other near-term goals include doubling the current rate of reforestation worldwide, and completion of a comprehensive worldwide analysis of the causes and rates of tropical forest loss. We've heard a lot of statistics about forest loss, but we're still knowledge-deficient in this area and we need additional research.

By 1980 we think the following are achievable: A significant reduction in the present rate of tropical deforestation, with any large-scale forest clearing the result of deliberate, enlightened decisions by government (rather than loss through neglect); and an increased flow of wood and wood products, with expansion provided increasingly by plantation forestry. We think that it is necessary to recognize that we need to sustain and increase the flow of wood and wood products. In addition, we must develop an adequate understanding of forest-carbon dioxide-climate relationships on which to assess the impact of additional forest loss and reforestation on the global climate.

And for the long term by the year 2000 and beyond—let me cite just two of the goals. They are quite idealistic but nonetheless worthy of pursuit.

Mr. BONKER. The year 2000? I should be chairman of the full committee by then. [Laughter.]

Mr. LONG. The first goal would be a stabilized global situation in which a broad mix of forest types and values are maintained and where reforestation and afforestation efforts offset cutting. A second would be success by the international community in relieving pressures on the tropical forests by providing food and energy for the

poor and by slowing population growth and regulating land use patterns.

Clearly, there are difficult obstacles to achieving this. The most formidable lies in the fact that the greatest pressures on the forests come from the quest of poor people for land, food, and energy. And thus, our success will depend in large part on action taken outside the forest sector in such areas as food production and family planning.

A second major challenge is the problem of increasing the economic return from forests on a sustained basis while at the same time protecting and preserving noncommercial values. At international meetings we have heard time and time again from developing countries that they are willing to work with us toward improved forest management, but we must first realize they have to increase the economic payoffs.

Some developing country spokesmen are now saying that if the tropical forests are truly a "global" resource, then the rich countries should share in the cost of maintaining them. This leads us to a third issue: the role and responsibilities of the commercial forestry sector, including U.S. overseas industry. We believe, on the basis of what we have heard, that there will be new rules of the road for U.S. industry overseas as host countries try to expand the economic return from the resource and at the same time working toward improved management and reduction of waste. U.S. firms can expect different rules and different procedures governing their operations.

We agree that there is a need to insure the commercial forestry moves forward in a fashion that maintains wood production while affording greater protection to the forest environment. The international community, however, must press for an investment climate that provides incentives for corporations to pursue sound long-term management without damaging their competitive position vis-a-vis other firms.

We need more information on the extent and nature of commercial forestry activities on which to make determinations on whether this policy and another policy will help or hurt the situation. We also need more information on what firms of other countries are doing, principally the Japanese. This is one of the several areas in which we are knowledge-deficient; and thus will be a focus of the next phase of the Task Force's work.

Then, Mr. Chairman, there is the difficult problem of getting international agreement on the priority, funding, and coordination of the tropical forest program involving a multitude of governments, international organizations, and nongovernment organizations. We are faced with a need to find unique, complementary, and reinforcing roles for the range of U.N. organizations, such as the FAO, UNEP, and UNESCO. Of particular interest to the State Department, and I believe to the rest of the Government, is insuring that the FAO is prepared to assume a greater role.

Finally, Mr. Chairman, if we hope to achieve a successful international program, the United States must gear up to assert and maintain leadership internationally. We think the task force has made a start by putting together the elements of a coherent U.S. domestic policy, strategy, and program; and by getting the support of a range

of international agencies for new global action programs. I wish to note that a number of U.S. agencies—USDA, AID, Interior—have taken very significant steps over the last year to expand their tropical forest activities. However, we must pull together and everybody has to do more and that includes industry, the university community, and the Federal Government if we hope to solve the problem of tropical deforestation.

One can easily become very discouraged looking at the magnitude and causes of the problem. On the other hand, there is reason for optimism. Worthwhile awareness of the problem now exists, and important initiatives have been launched to deal with it. We now have to maintain the momentum and expand the effort.

Thank you very much.

[The prepared joint statement of Messrs. Peterson and Long follows:]

PREPARED JOINT STATEMENT OF R. MAX PETERSON, CHIEF, FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE, AND BILL L. LONG, DIRECTOR, OFFICE OF FOOD AND NATURAL RESOURCES, BUREAU OF OCEANS AND INTERNATIONAL ENVIRONMENTAL AND SCIENTIFIC AFFAIRS, U.S. DEPARTMENT OF STATE

MR. CHAIRMAN AND MEMBERS OF THE SUBCOMMITTEE:

We appreciate the opportunity to appear before this Subcommittee to discuss tropical deforestation and the activities of the Federal Interagency Task Force on Tropical Forests. The subject of this series of hearings is important and exceptionally timely, both for the United States and for the world community of nations. We would like to note that the testimony relates to the Task Force report and should not be construed as necessarily reflecting the position of the Administration.

In June 1978, a national conference on tropical deforestation was convened in Washington by the State Department and the Agency for International Development. The purpose was to assess the discussions and implications of the tropical forest loss

problem, and to examine U.S. interests and responsibilities. One-hundred twenty invited experts attended, representing U.S. Government agencies, universities, industry, the environmental community and several international organizations. The principal conclusion of this meeting was that...:

> "The world is being confronted by an extremely serious problem with immediate and long-range socio-economic consequences as the result of the accelerating loss of forest and vegetative cover in the humid and semi-arid lands within or near the tropical latitudes. Further, the community of nations must quickly launch an accelerated and coordinated attack on the problem if these greatly undervalued and probably irreplaceable resources are to be protected from virtual destruction by the early part of the next century".

This conclusion and perspective served to energize a broad-based response by the U.S. Government, working in close cooperation with the non-federal sector. We would like to report on this response today, and in so doing present what is emerging as a government-wide consensus on: the nature and implications of the problem; U.S interests involved; this Nation's influences on the situation; the type of policy and program this country should undertake; and unresolved issues and needs.

This month a Federal Interagency Task Force on Tropical Forests will submit to the President a report recommending a comprehensive "U.S. Policy, Strategy and Program on Tropical Forests". The report is a direct outgrowth of the 1978 national conference cited earlier. We will be drawing on the findings of this forthcoming report to the President for the purpose of

this testimony, along with the results of an international meeting on tropical forests convened in Nairobi two months ago by the United Nations Environment Program.

TROPICAL FORESTS: EXTENT AND DISTRIBUTION

Tropical forests constitute a major world resource, totalling 1.9 billion hectares.† They cover 42 percent of all tropical lands. Of this 42 percent, 18 percent is "open" forest (woodland and semi-arid shrubland such as the African Sahel), and 24 percent is "closed" (a continuous forest canopy such as the Amazon rain forest). Africa has about 64 percent of all tropical open forest, while more than 50 percent of the closed forest is in South and Central America and 30 percent in Asia/Australia/Oceania. The United States tropical forests represent less than one percent of the world's total and are found mainly in southern Florida and Texas, Hawaii, Puerto Rico, the Virgin Islands, Guam and American Samoa.

FOREST VALUES

Forest environments are vital to human existence in the tropics. They provide food, fiber, fodder, fuel, building materials, and medicines. Forests also provide habitat for wildlife, as well as for indigenous human populations, and perform important protective functions by regulating water flow and by

†hectare = 2.5 acres

minimizing soil erosion. In addition, since tropical forests provide commodities important in international trade, and regulate or influence critical environmental processes that occur on regional and possibly global scales, people far removed from tropical forest ecosystems are affected by the integrity of this resource. The following is a brief summary of major forest values:

- An enduring use of forests by tropical communities is a source of wood. One third of the wood removed from the world's forests for human use comes from the tropics, more than 1 billion m^3 per year. Some 80 percent of tropical wood is used for fuel, mainly to meet household cooking needs of a large majority of the populations of most tropical countries.

- The food supplies that sustain nearly 2 billion people who live in the tropics are produced on soils that generally owe both their existence and productive qualities to former forests. Tropical forests accelerate soil formation, retard erosion and silting, regulate streamflow, create favorable soil structure, and store nutrients useful for food crop production.

- Reliable supplies of fresh water in the tropics, whether from rivers or wells depend in most instances on forested lands. By stabilizing soils, maximizing their receptivity

to rainwater, and by retaining available minerals, tropical forests help regulate both the quantity and quality of useable water. The production of paddy rice and other irrigated crops in the tropics is especially dependent on forest-regulated water supplies. And this relationship is the basis for a new U.S.-Panama cooperative program to protect the forested watersheds that regulate water inflow into the Panama Canal.

- Tropical forests contain the greatest diversity of life on earth--probably more than 3 million species of plants and animals. In addition, thousands of migratory species seasonally inhabit these forests. This diversity is the source of an increasing number of valuable products for both local and worldwide use.

- Human populations in many tropical areas depend on wild animals and fish for protein. And both aquatic and terrestrial animals are dependent on healthy forest ecosystems.

- The integrity of forested watersheds is also critical to the functioning of downstream estuaries, mangrove swamps, and nearshore coral reefs--the principal nursery areas for many commercially important fish and shellfish.

- Besides supplying products used locally, forests provide many tropical countries with significant income from ex-

ported wood products. The aggregate value is about $4.7 billion annually. Currently, more than 70 percent of the tropical wood exports is from Asia and the Pacific and the rest primarily from Africa. The chief products are sawlogs and veneer logs, shipped mostly from Southeast Asia to Japan, Taiwan, and South Korea for processing, or from Africa to Europe; and sawed wood shipped from Southeast Asia to various temperate zone countries, from Africa to Europe, and from Brazil to North America.

- Other products derived directly or indirectly from tropical forests contribute significantly to export trade. Their aggregate value is unknown, but a wide variety, including latexes, gums, essential oils, medicines, nuts, and ornamentals, is included. Prospects for an expanding demand for such products are favorable. The U.S. National Academy of Sciences has screened 400 under-exploited tropical plants and identified 36 with special economic promise.

- To these values must be added certain exported agricultural products, most of which are, in one way or another, dependent on forest-generated soils and water or the clearing of forests for cropland. The aggregate value of exported agricultural products is now about $36 billion per year, apparently the largest single source of outside revenue for tropical developing countries from products generated locally.

- On the worldwide scale, the forests of the tropics have unequalled scientific and educational value. The complexity of tropical forest has for years attracted scientists and students in search of answers to basic questions about life processes. No other region on earth offers so much material for study.

- Forest cover influences ground temperature, soil moisture and rainfall on a local scale; weather patterns on a regional scale; and also may be an important factor in regulating global carbon dioxide levels and, hence global climate.

DEFORESTATION RATES

The amount of permanent forest cover being lost is difficult to establish. Historical records are poor, our ability to monitor deforestation is limited, and changes in cover occur rapidly. It is estimated, however, that closed tropical forests have already been reduced by human activities by more than 40 percent.

The current annual rate of decrease is 10 to 20 million hectares a year according to the best available estimates. This decline means that 1 to 2 percent of the world's closed tropical forests is being cleared each year.

The most optimistic estimate of annual loss is 7.3 million hectares. The most frequently cited estimate is 12 million hectares a year. Recent analyses of deforestation in specific countries suggest a current rate of 20 million hectares or higher; and a report by the U.S. National Academy of Sciences released last month cites the annual worldwide loss as 24.5 million hectares--a particularly high estimate. Due to limitations in the data base, assessments of forest loss are best given in terms of worst-case and best-case scenarios.

In the worst-case scenario, the closed forest area is projected to decline by one-half, to about 580 million hectares, by the year 2000--only 20 years away--i.e., under the assumption that forest loss in 1979 is 20 million hectares, and that the rate of forest conversion will thereafter increase at the expected rate of population growth in the tropics. In this case, most tropical countries will have little economically accessible forest remaining at the end of the century. Millions of people will be without wood for fuel, shelter, or fiber. Watersheds of the major agricultural areas largely will be denuded, and reservoirs needed for flood control, irrigation, and hydropower will be filling rapidly with silt. Hundreds of thousands of plant and animal species will vanish, and much of the potential for remedying agricultural, ecological, and medical problems will vanish with them. Although this case is possible, most analysts think it is not likely to occur over the next 20 years.

The best-case scenario also is plausible, but equally unlikely to happen over the next twenty years unless significant changes in policies and practices are made to ensure improved forest management.

If the current rate of deforestation is only 10 million hectares, and if all forestry plans and goals of tropical countries are fully successful over the next 20 years, then the deforestation rate may drop to less than 5 million hectares a year by 2000. Under these assumptions, the projections indicate that wood will still be abundant in some countries of Africa, South America, and Southeast Asia. Wood for fuel and for construction material will still be available for people living near the remaining forests and for relatively wealthy people elsewhere. Whether wood will be available for subsistence farmers away from the edges of forests and for the urban poor depends on whether plantations of fast-growing trees can be established in the next few years.

No comparable estimates are available on the rates at which open forests in the tropics are being denuded. The process of converting open forests is more subtle than that in closed forests, and thus is seldom accurately measured. Destruction of the trees in open forests is believed to be a causal factor in desertification, a process that is claiming an estimated 5 million hectares worldwide each year according to the United Nations Environment Program.

The very high deforestation rates cited from the few available studies cannot be extrapolated to the entire tropical forest resource. These studies, however, indicate some alarming national and regional problems, and even the best-case projection is cause for concern

CAUSES OF LOSS

The principal direct causes of tropical forest loss are: (1) conversion and use for agriculture, (2) fuelwood gathering, and (3) poorly managed industrial logging. But behind these direct causes are more fundamental problems--rapidly increasing population, great inequalities of land tenure, absence of advancement in agricultural technology, and lack of opportunities for employment on proven agricultural land or outside the agricultural sector. With changing world conditions and rapid loss of forests, the quantitative importance of the various causes of deforestation may be shifting, but the conversion and use of tropical forests to support agriculture is still considered to be a major contributor.

Agriculture: It is widely believed that shifting agriculture is the single most important contributor to the destruction of tropical forests worldwide. While this approach to food production has been used for centuries in a manner which also sustained the forests, the sheer numbers of poor people now seeking land

66-326 O - 81 - 3

to cultivate is overwhelming the forest resource. "Slash and burn" farmers generally work upland soils that cannot maintain fertility with continuous cropping and can support crops for only a few seasons before they must be left fallow. The system is ecologically sound if the fallow period is long enough and the cleared area relatively small. In many places, however, the length of the fallow period is too short to restore the fertility of the site. The most common reason for inadequate fallows is population pressure.

Typically, rapid and widespread deforestation occurs where roads are constructed into formerly inaccessible areas. The clearing of land thus made accessible usually is done by landless people who must concentrate their main efforts on the current season's crops. As a result, little labor or capital may be left for investment in land maintenance necessary for sustained agriculture. The farmers must work whatever accessible site is not claimed by someone else. They have no alternative investment for their labor, and while they may be well aware of the poverty and impermanence of the soils they use, they have no choices.

Often the users of the land are illegal squatters who seldom get agricultural advice or aid from government sources. On other occasions, they are colonists who are encouraged by their governments to settle in forested areas. Furthermore, new agricultural techniques that might let settlers

prolong the use of their sites are often unfamiliar or risky, and there is little incentive or margin to assume extra risks.

To get to the fundamental causes of deforestation, it is necessary to understand why so many people are without job opportunities and why so many seek marginal land to cultivate. In many countries, the traditional agricultural lands simply cannot absorb the rapidly growing population. Intensified production, which might increase both yields and employment opportunities on land already cleared, often depends on the availability of technical assistance and material inputs, such as irrigation water, fertilizer, and credit, that are beyond the reach of most farmers. In some areas land ownership systems keep productive agricultural land from absorbing as many workers as it profitably could; in others, farm workers are displaced by modernization that substitutes capital for labor, by construction of reservoirs, or by other non-agricultural land uses. With urban labor already in surplus, many of the displaced people must move to the forests. Others who move are refugees from war or from political oppression.

Shifting cultivation is not the only agricultural practice that leads to deforestation. The processing of agricultural products, such as grain drying, food preservation, tobacco curing, and rubber preparation, require large amounts of fuelwood.

Fire also contributes significantly to deforestation in the tropics. It is not only a widespread problem, but reportedly

is increasing at an accelerating rate. In most instances it is man-caused. Fire is a primary tool of primitive and shifting agriculture to dispose of felled trees, and is also used to "renew" pastures and to prevent invasion of shrubs and trees. In terms of forest destruction, fires are of greatest significance in the dry forest areas, having converted millions of hectares into derived savannas where chronic burning makes reinvasion of trees virtually impossible. Except as employed by man in certain cases, fire is not an important cause of destruction of rain forests which are generally not readily flammable.

The production of beef has become increasingly important worldwide, particularly in the more humid tropics. In some cases, the conversion of forests to grazing land is not sustainable, but the international demand for beef is strong enough, and the price high enough, that it has become profitable to convert to pasture even on poor soils that deteriorate rapidly and must be abandoned after a few years. Although data on the acreage converted from tropical forest to permanent or temporary pasture are not available on a worldwide or even regional basis, the large increase in beef exports from forested tropical countries, particularly in Central and South America, suggests the scope of the changes in land use.

Fuelwood Gathering: Cutting wood for fuel is another important cause of deforestation, and in some places is the major cause.

More than 1 billion cubic meters of wood are harvested each year in the tropics, and the rate is increasing. At least four-fifths of all the wood harvested annually in tropical countries (some 825 million cubic meters) is used for firewood and charcoal; the rest for building materials and for export.

Industrial Logging: Industrial wood (i.e., wood for construction materials, fiber, and manufactured products) accounts for one-fifth of the total volume removed from tropical forests. Of this fraction, one-fourth, only about 6 percent of total removals is exported each year. The relationships between deforestation and the removal of industrial wood are complex. Most tropical logging is highly selective as to species and tree size. The use of heavy equipment for timber extraction can, however, cause substantial secondary loss. The immediate result of logging operations is thus more likely to be degraded forest than conversion to nonforest. But the roads and clearings made by the loggers are commonly used by farmers who complete the process of deforestation. Industrial logging often depletes or destroys valuable resources of people living in or near the forest, with most or all of the benefits going to distant companies, governments, or foreign consumers.

New techniques of logging and wood use, including whole-tree harvesting and on-site chipping, are making clearcutting -- the removal of all trees -- more common in the tropics. On some

clearcut sites, the forest will not regenerate naturally. Thus, the new harvesting techniques may lead to greater resource loss if the sites are not replanted immediately with appropriate species. Replanting after industrial logging, even after clear-cutting, is uncommon, however.

The reasons for the lack of reforestation in the tropics are a complex array of economic, political, cultural, and environmental factors that vary from place to place. Some partners in multinational logging firms are unwilling to invest profits in efforts that will have no immediate payoff. Insecure tenure is a major constraint on reforestation investments, both for large companies and small farmers, and this is often more a political than an economic issue. Concessionaires commonly are unable to protect reforested areas from people seeking land to cultivate. Site-specific cultural factors may inhibit tree planting, as in Papua, New Guinea, where local people object to tree planting by timber companies because planting, unlike cutting, implies permanent ownership of the land. Depredations by domesticated, feral, and wild animals cause some reforestation efforts to fail.

CONSEQUENCES OF FOREST LOSS

Although many consequences have been alluded to above, it is useful to summarize by indicating that the impacts of uncontrolled loss of tropical forests are many and serious.

They include rising prices and shortages of wood in tropical countries, as well as a diversity of ecological problems. Floods of unprecedented severity, with large losses of life and property, have been reported recently by Asian nations, and attributed largely to the loss of vegetation on upland watersheds. Lakes, reservoirs, and irrigation systems are adversely affected by siltation. In the semiarid regions of Africa and Asia, woody vegetation used for fuel by up to 90 percent of the rural population is receding ever farther from human settlements. Fuelwood prices, the family time taken to collect wood, and the suffering from doing with less, continue to increase. With no other substitutes available, people are burning dung and crop residues which previously were used to maintain soil fertility. The process of "desertification", triggered by removal of vegetative cover and overgrazing in semiarid regions, now threatens the productive capacity of the resource base over large areas of the tropics.

Consequences of forest loss also include the extinction of indigenous plant and animal species which is occurring at a rate never before experienced during the history of this planet. According to a recent National Academy of Sciences report, fully one-third of all tropical organisms -- almost a million species -- may become extinct by the end of the century as a result of deforestation. As an additional source of concern, recent investigations of the carbon cycle have suggested that

continuing tropical forest losses on the current scale may contribute to destabilization of the earth's climate in the 21st Century.

DEVELOPMENT AND ENVIRONMENT RELATIONSHIPS

The underlying cause of deforestation in the tropics is the unremitting pressure for food, fuel, shelter and capital in the developing countries of the world. These pressures tend to relegate environmental concerns and values to a secondary role, with development being primary.

In some cases, the forests were regarded, and may still be regarded, as obstacles to development, with minimal regard for their present environmental values or their future economic and environmental benefits.

The challenge is to provide for these human needs in ways that are more in harmony with nature. A purely protectionist approach will not suffice; neither will all-out exploitation. Both protection and rational exploitation must somehow be provided for in development.

Strategies for improved management of tropical forests must also recognize the sovereign rights that nations have to use and manage their resources as they see fit. National programs to meet perceived national needs should be the cornerstone of such strategies. However, international, bilateral, and multilateral arrangements can do much to assist nations as they develop programs to both use and protect their tropical forest resource. Many kinds of potential

assistance have been identified by the U.S. Interagency Task Force on Tropical Forests, by international meetings of experts, and by the developing countries themselves.

There are encouraging signs that governments are giving increased attention and priority to tropical forests. At the recent UNEP meeting in Nairobi, Kenya, participants indicated that national policies for the management of tropical forests were being developed in many countries where such forests occur. Most of these policies emphasize 1) economic utilization of the resource, 2) conservation of the resource according to the principles of wise use, 3) protection of important water catchments and the environment in general, and 4) protection of indigenous forests and the wildlife they contain by means of parks and preserves.

These actions indicate high level government concern, and should help provide a sound basis for more effective international cooperation.

UNITED STATES INFLUENCES

The United States affects tropical forests both positively and negatively through a variety of public and private sector policies and practices. Major influences include: (1) United States consumer demand for wood and beef, the latter associated with conversion of forested land to pasture, particularly in Central and South America; (2) United States tariff policies and quotas on wood and meat imports; (3) domestic environmental

policies that restrict cutting of temperate forests, regulate international trade in endangered species, and require environmental assessments of certain types of United States overseas activities that might impact tropical forests; (4) United States development assistance projects in tropical countries which may modify, restore or protect forests; (5) commercial forestry activities, with some 30 United States firms currently involved, mostly in southeast Asia; and (6) private investment in cattle ranching operations in other countries.

In many cases, the precise nature and magnitude of United States influences have not been adequately described or quantified, as is the case of beef and wood imports; but studies are about to be undertaken to help fill these knowledge gaps.

As pointed out above, only 6 percent of total wood removals in the tropics is exported. Harvesting of wood for in-country use and large scale conversion of forest land to other uses, mainly agriculture, are by far the principal sources of tropical forest loss.

Further, although United States imports of tropical hardwood and hardwood products are substantial in terms of value, in terms of volume they amount to only 1 to 2 percent of the total softwoods and hardwoods used in this country. Tropical wood imports are used mainly for decorative purposes and thus are not limiting in terms of strategic applications of wood.

U.S. INTERESTS IN TROPICAL FORESTS

Why should the United States be concerned about tropical forests when it exercises sovereignty over less than 1 percent of the world's total resource? The answer involves a combination of political, humanitarian, economic, developmental, environmental, educational, and scientific considerations -- each with proponents within the diverse United States public and private sectors:

- United States commitments to world peace, economic and social stability, and the maintenance of the earth's basic life support system all require concern about the productivity of the natural resource base, including forests.

- The United States is party to international agreements which call for sound resource management and environmental protection.

- Economic and social progress in less developed countries, a basic United States foreign policy goal, is influenced by the integrity and use of indigenous forest resources.

- The influence of tropical forests on global physical, biological, and geochemical processes -- including the stability of world climate -- is poorly understood.

- One-third of the United States export market is with non-oil-producing developing countries, and their purchasing

power is affected by the health of their natural resource base. Further, the United States earned more than $16 billion from direct investments in the developing world in 1978 alone.

- United States economic growth is aided by a sustained supply of wood and other tropical forest products at reasonable prices. Imports of tropical wood averaged $430 million annually from 1974 to 1978.

- Closed tropical forests contain large numbers of uninvestigated plant and animal species, many of which are likely to have important uses as food, medicinal or industrial products. The United States already imports medicinal plants valued at $25 million annually, as well as primates used for medical research and various natural products such as rubber and gum arabic.

- The United States share with tropical countries hundreds of animal species including migratory birds, mammals, insects, and turtles whose survival depends, to varying degrees, on tropical forests.

- Unique tropical flora and fauna provide outstanding scientific and educational opportunities.

- United States assistance to the international community for improved forest management is increasingly in demand.

In sum, although the United States share of the world's tropical forests is small, our overall stake in their sustained productivity is substantial.

UNITED STATES RESPONSE

Mr. Chairman, we would now like to turn to the paramount matter of the U.S. response to the situation we have just described. Two types of responses are in fact involved: one, domestic; the other, international.

At the domestic level the efforts of the Federal Task Force have been designed to accomplish the following objectives: (1) raise public awareness of the tropical deforestation situation; (2) establish "tropical forest management" as a focal point for attention by the public and private sectors; (3) ensure improved coordination of U.S. Federal activities related to this subject; and (4) develop a rationale, justification and program proposals for an expanded U.S. effort to be carried out within an emerging international tropical forest management program.

Following the 1978 national strategy conference on tropical deforestation, the State Department established an Interagency Task Force on Tropical Forests which is co-chaired by State and the Forest Service. It is this body that prepared the report to the President and it will assume responsibility for coordinating the follow-up activities the Government undertakes pursuant to the President's direction.

The Federal Task Force also serves as a point of contact with environmental groups, universities, private industry and other private sector interests. During preparation of the Report to the President, the Task Force worked closely and productively with a counterpart nongovernmental task force chaired by Mr. Robert Blake and also with the National Forest Products Association. We intend to continue our close interaction with these groups in the future. One of the successes to date has been the high degree of interest that the U.S. Government and the various non-federal interests share in pursuing improved management of the tropical forest resource base to meet a wide range of needs and values.

International cooperation is, however, essential for achieving sound stewardship of the world's tropical forests. Over 99 percent of such forests exist outside the United States in countries which exercise sovereignty over the development and management of their resources, including forests.

The U.S. strategy has therefore been to raise worldwide awareness of the scope, origins and consequences of the tropical forest loss problems; and to promote development of a coordinated international program on tropical forests which would attract support from governments and international organizations.

Consequently, the U.S. has raised the tropical forest loss problem at the last two UN General Assembly sessions, calling upon the nations of the world to join together in efforts to preserve this valuable resource for use by current and future generations. As a follow-up, the U.S. delegation to the 7th Session of the Governing Council of the UN Environment Program (UNEP), in May 1979, introduced a resolution calling for an international meeting on tropical forests to begin development of an integrated "global plan of action". The resolution drew

broad support, and led to the convening of an experts meeting in Nairobi from February 25 to March 1 of this year. In opening the meeting, UNEP Executive Director Mostafa Tolba referred to the world's tropical forests as "one of the great development challenges of the 1980's"...and emphasized the importance of addressing the situation through creation of "a comprehensive detailed programme of activities, co-ordinated among governments and international agencies, in conjunction with those nongovernmental organizations that possess specialist skills in this field". This call echoed one made by President Carter in his Environmental Message of 1979 in which he identified the loss of tropical forests as one of the major global problems which will confront mankind in the years immediately ahead.

As the U.S. had hoped, the international experts meeting in Nairobi reached agreement on a series of program recommendations to improve tropical forest management. These recommendations were presented in the report of the meeting as an "important first step" toward development of an internationally-coordinated global plan of action. We are pleased to note, Mr. Chairman, that last week the UNEP Governing Council approved the report of the experts group and -- most important -- a procedure

which guarantees that the existing program framework and recommendations will be further elaborated and developed over the next year.

In the coming months it will be necessary to ensure that the momentum for this emerging international program is sustained. It will also be essential for the United States to determine exactly what and how it will contribute to the international program.

In our efforts to define an appropriate and meaningful U.S. program on tropical forests, the Federal Task Force confronted the important issue of program goals. Specifically, we addressed the questions: What conditions do we wish to see reached with respect to the world's tropical forests within the next 5 years (by 1985)? Over the subsequent 10 years (by 1995)? and by the year 2000 and beyond? It is especially significant that the answers to these questions -- developed by the Task Force in the form of "short-term", "medium-term"; and "long-term" goals-- were presented by the U.S. delegation at the February international experts meeting, and they drew strong support. The U.S. goals will be further examined internationally, but we believe that they will ultimately be adopted, with some modification, as proper goals for the overall international plan of action.

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The following are the goals that we believe the United States and other nations can realistically achieve within the next five years:

- policy commitments by virtually all nations to the concept of improved forest management;
- initiation of an internationally coordinated action program, involving research, monitoring, training and education, information exchange, technical assistance, and management demonstration;
- doubling of the current annual rate of reforestation and afforestation worldwide;
- completion of a comprehensive worldwide analysis of the causes and rates of tropical forest loss;
- substantial increases in international research and development in tropical forest management, ecosystem dynamics, and commercial forestry operations;
- launching of a major international effort to develop and introduce alternative low-cost energy and food production systems into rural areas;
- initiation of an international program to inventory and catalog unique forest, plant and animal types;

- expansion of national parks, wildlife refuges, ecological and biosphere reserves, and similar protected areas by at least one-third.

By 1990, the Federal task force believes that the following can be achieved internationally:

- significant reduction in the present rate of tropical deforestation, with any large-scale forest clearing the result of deliberate, enlightened decisions by governments and local communities;

- availability in virtually all tropical forest countries of revised policies and laws, and improved management capabilities, dedicated to sound forest management;

- additional commitment and programs by nations for the preservation and study of representative and unique forests, protection of forest peoples, and continued expansion of biosphere reserves and protected areas;

- increased flow of wood and wood products, with expansion provided increasingly from plantation forestry;

- adequate understanding of forest-carbon dioxide-climate relationships on which to assess the impact of additional forest loss and reforestation on global climate.

And, by the year 2000 and beyond, the following goals have been recommended by the Task Force:

- a stabilized global situation in which a broad mix of forest types and values are maintained, and where reforestation and afforestation efforts offset cutting;
- adequate knowledge of biological and soil characteristics, ecosystem dynamics and land-use effects on which to conduct sound forest management;
- and, success by the international community in relieving pressures on the tropical forests by providing food and energy for the poor, and by slowing population growth and regulating land-use patterns and practices.

Clearly, there are difficult obstacles to achieving the goals. The most formidable lies in the fact that the greatest pressures on the forests come from the quest of poor people for land, food and energy. In this regard the solu-

tions will in large part depend upon efforts undertaken outside the forest sector--actions involving increased food production on existing lands, development of energy alternatives for rural areas, and family planning programs.

A related challenge involves the problem of increasing the economic return from the forests, and on a sustained basis, while at the same time protecting and preserving wildlife, ecological and other non-commercial values. While international discussions reveal a willingness by tropical countries to consider and introduce measures to improve forest management, their representatives say that this must not be at the expense of sacrificing the economic return. Indeed, some developing country spokesmen are suggesting that if the tropical forests are a resource of global importance, then the rich countries must share the cost of protecting and maintaining them.

This, in turn, leads us to a third area wherein both problems and opportunities exists: namely the role and responsibilities of the commercial sector, including U.S. overseas industry. With the demand for wood and wood products for domestic and international markets projected to increase significantly, governments of tropical countries will be seeking to expand commercial cutting of timber. They indicate that

their objectives include both obtaining increased prices per unit of wood harvested, and requiring concessionaires to exercise improved harvesting and processing techniques to eliminate waste and to protect adjacent forest areas. This means that U.S. and other foreign firms may face different "rules of the road" governing their overseas operations dictated by host governments.

There is, consequently, a need to ensure that commercial forestry in the tropical countries moves forward in a fashion that maintains wood production while affording greater protection to the forest environment. There is, in particular, the need to move vigorously toward plantation forestry that will enable other forest areas to be reserved for non-timber uses. To achieve this, the international community must press for an investment climate that provides incentives for corporations to pursue sound, long-term management without damaging their competitive position viz-a-viz other firms.

Finally, there is the difficult problem of gaining international agreement on the priority, funding and co-ordination of a tropical forest program involving a multitude of governments, international and regional institutions, and non-governmental organizations. On the basis of the international experts meeting in Nairobi, and subsequent supportive action by the UNEP Governing Council, there is a rapidly emerging worldwide

consensus that the loss of tropical forests demands high priority attention. However, the matter of mobilizing the necessary financial resources during a period of inflation and tight budgets is yet to be faced, as are the issues of overall program leadership and coordination. Still to be worked out are the appropriate roles of the array of international and regional bodies with relevant tropical forest mandates and interests.

Mr. Chairman, we are pleased to see that the Subcommittee plans to devote the second in its series of hearings on this subject specifically to international organizational issues. In the view of our Federal Task Force, one of the key needs is to encourage and assist the UN Food and Agriculture Organization to strengthen and expand its tropical forest activities and to assume the central coordination function for the international program we are working toward. Significant contributions from UNESCO, UNEP, the World Bank, the OAS and a host of other organizations will also be required if an effective program is to be launched.

As noted earlier, the U.S. has broad-based and vital interests in ensuring that the viability of the tropical forest resource is sustained--this despite the small amount of tropical forest this country possesses. We have, to date, managed to play a lead role internationally in raising awareness of the tropical forest

loss problem, and the range of values being sacrificed. We have also participated actively in the initiation of an international program designed to achieve the goal of conservation of the world's tropical forests to serve man's long-term needs. Domestically, a variety of Federal agencies have already taken steps to strengthen and expand their tropical forest activities; and U.S. Federal and non-federal sector institutions have demonstrated a desire and ability to join forces to develop an effective U.S. response to international needs. We believe it important that we be alert to opportunities to contribute to alleviating these problems.

The Task Force has developed a number of specific recommendations. We expect to carefully review these recommendations in terms of specific programs, resource commitments and their impact on other policies and interests.

Thank you very much for the opportunity to present this statement. We look forward to continued discussion with the Subcommittee on this important matter.

Mr. BONKER. Thank you Mr. Long. I thank both of you for excellent testimony. This gives us a basis upon which to proceed. It is also significant that the President has highlighted this problem and that an interagency task force has been established within the executive branch.

May I ask what other departments are represented on this task force?

Mr. LONG. I'll read them. We have a list right here: AID, the CIA, Council on Environmental Quality, the Forest Service, the Department of Commerce—both the Industry and Trade Administration and NOAA—the Department of Interior—including the Bureau of Land Management, Fish and Wildlife Service, and National Park Service—the Department of State, the International Development Cooperation Agency, NASA, National Science Foundation, the Peace Corps, and the Smithsonian Institution.

Mr. BONKER. You haven't left out very many. [Laughter.]

Mr. LONG. There's quite a range of mandates and interests in this field.

Mr. BONKER. How often do you meet? With any regularity or just when the cochairmen call?

Mr. LONG. It has really been the latter, but also rather regular because we've been working concurrently on two tasks—to get our policy report prepared for the President, and to develop positions for various international meetings that have been held. But it has not been once a month on a regular basis, for example. Sometimes the task force has met three times a month as we have come down the stretch on our report.

Mr. BONKER. I'm surprised you're meeting that frequently.

Mr. LONG. It's been very frequent.

Mr. BONKER. Obviously the United States has considerable interest in this subject. I can think of several reasons: our role in working with international organizations; environmental concerns we have worldwide; the growing import of hardwood products to the United States; and perhaps lastly, U.S. multinationals are heavily involved in forestation and in harvesting tropical forests.

Can you think of any other reasons why the United States is or should be involved?

Mr. PETERSON. At least a couple of others besides the ones you mentioned. We have a lot of medicines, for example, from the tropics. Some of the world's germ plasma is unique to the tropics. A lot of animal populations are unique to the tropics. The peace and stability of those countries are dependent to a large extent on helping solve this overall problem of meeting the basic human needs of the people.

So we have a lot of interest in it. If we were not importing the large amount of lumber from those countries or if we were not involved directly on import-export positions, there is a lot of U.S. investment and assistance in those countries of various kinds right now and we are concerned about the coordination of that assistance and effort. So these are additional reasons.

Mr. LONG. Let me throw in one more comment on this, if I may, Mr. Chairman. There is a question in some people's minds which may be somewhat marginal, but we are interested in finding an answer to

it. That is the relationship between tropical forest loss and climate. There has been a lot of speculation about this. A lot of people are not willing to believe there is much of a relationship; but nonetheless we should at least find out what the situation is—given the magnitude of the potential risk.

I have also been reminded that I made one serious omission from the list of institutions which cooperated with the Federal task force. The Office of Technology Assessment, an arm of the Congress, has also been working with us. So I'd like to amend my list.

Mr. BONKER. We'll hold the record open in case there are others. [Laughter.]

Mr. PETERSON. On the subject of CO_2, deforestation and possible relation to climate, there's a fairly brief article on this in the Proceedings of the U.S. Strategy Conference on Tropical Deforestation. It is only about six or eight pages long and is a fairly good definition if you want to put it in the record or read it at your leisure.

Mr. BONKER. That is an excellent idea. We will instruct the staff to have that portion of the publication included in the record.

[The material follows:]

EXCERPT FROM PROCEEDINGS OF THE U.S. STRATEGY CONFERENCE ON TROPICAL DEFORESTATION

Response to Date—Scientific and Technological State-of-the-Art[1]

CO_2-Deforestation Relationships

DR. GEORGE WOODWELL, Marine Biology Laboratory, Woods Hole, Massachusetts

The relationship between the world's forests and the atmospheric problems associated with carbon dioxide (CO_2) is not unanimously agreed upon by the scientific community. However, there is a problem with carbon dioxide in the atmosphere.

The best data we have come from a series of studies conducted by David Keeling, a chemical oceanographer at the Scripps Institute of Oceanography, in La Jolla, California. In 1958, Dr. Keeling began measuring the carbon dioxide content in the atmosphere on an island in the Hawaiian Islands and accumulated, over the following twenty years, the best data we have on the changes in CO_2 that have occurred in that period. Based largely on these measurements the following conclusions can be drawn. First, without much

[1]Panel discussion moderated by Dr. Warren Doolittle, Associate Director for Research, Forest Service, U.S. Department of Agriculture, Washington, D.C.

question, there is an upward trend of roughly one part per million (ppm) per year in the atmosphere. The second point is that there is an obvious winter/summer oscillation. The peak concentration of CO_2 occurs at the end of the northern winter in April, and the minimum concentration at the end of the northern summer in September or October. This trend occurs regularly throughout the study. There is a series of other fluctuations in the level of CO_2 which remain substantially unexplained. These may well be due to the changes of surface currents in the Pacific Ocean, but we have to say that we really don't know why they occur. There are various other records, including one that was taken by Dr. Keeling and his colleagues at the South Pole.

Some variance in the oscillation seems to be related to the cycle of photosynthesis. Fixation of carbon and removal of carbon from the atmosphere results from photosynthesis during the summer, and its release through the respiration of plants and animals during the winter, when photosynthesis is very much less than respiration. When we examine this in a variety of critical ways and try to figure out just what part of the biota might be causing that oscillation, the temperate zone forests—not the tropical forests—appear to be the cause. The temperate zone forests—the largest vegetation mass in the world—store carbon in the summer and release it during the winter through respiration.

The oceans, if they were doing this at all, would probably be storing the carbon as a dissolved element in the water, not in the biota. The oceans don't really have a place to store carbon in living systems, so the algae in the oceans are probably not causing this. If the oceans, through temperature changes, were causing this oscillation, we'd expect the amplitude to be greater in the southern hemisphere than it is in the northern hemisphere. So we rule out the oceans as a cause of this oscillation and we focus on temperate zone forests.

This point is important because it means that forests loom large in the CO_2 balance of the atmosphere. It means that in the short term they have the potential for changing the CO_2 content of the air worldwide. There are several other reasons for pointing to forests. One of which is that the amplitude is greater in the northern hemisphere than it is in the southern hemisphere. Looking at a map of the world, one sees that most of the forest area lies in the northern hemisphere. There exists a variety of other analyses that also point to forests.

In considering the sizes of the pools of carbon that are exchanging carbon with the atmosphere, we find the atmosphere with about 700 billion metric tons, with 10^{15} grams of carbon in it. The land, with the biota, has about 830 billion metric tons, with 10^{15} grams of carbon present. This represents the same carbon units as occur in the atmosphere.

As to whether Whittaker and Likens are correct or not in their appraisal of the magnitude of the carbon pool held in the biota, I have personally tested various elements of their analysis and am pretty well convinced that it's as good an analysis as one can do at the moment, based on the data that are available. I have seen the carbon pool tested by others, and I have participated in one test in Europe a year ago in which a group of ecologists tabulated the various appraisals of the carbon held in the biota. We came to the conclusion that the range of appraisals was from roughly $400\text{–}500 \times 10^{15}$ grams to about $1{,}100\text{–}1{,}200 \times 10^{15}$ grams. The Whittaker-Likens data, which is the analysis that I am using here, falls right in the middle of that.

Another very large pool of carbon, even larger than that held in the biota, is found in the humus. However, the magnitude of the earth's humus is difficult to appraise, with the appraisals varying from less than $1{,}000 \times 10^{15}$ grams to about $3{,}000 \times 10^{15}$ grams. The atmosphere is, of course, receiving carbon from the combustion of

fossil fuel—an amount that is thought to be currently about 5×10^{15} grams—and it travels as a net movement of carbon from the atmosphere into the oceans. First, it moves into the mixed layer, which contains another pool of carbon that's roughly the same size as the pool in the atmosphere. Most of the dissolved carbon dioxide in the ocean is in the mixed layer. That pool is very small, but represents a long-term exchange, so there is a slow flow of carbon from the atmosphere into the mixed layer and then into the abyssal waters. This represents a pool of carbon—most of it inorganic—stored in the abyssal waters.

There is quite a bit of organic carbon which may approximate the humus of the land. With the major pools of carbon that interact, the pool of carbon held within the plants is large enough to affect the CO_2 content of the atmosphere appreciably. The metabolic activity of the plants also affects the CO_2 content of the atmosphere appreciably, month by month.

Looking at this in slightly different terms, the atmosphere has about 700 carbon units. The biota is divided into the continental land plants with about 827 units. Humus is variously estimated as up to 1,000 to 3,000 of these units. Marine populations, however, are very small in stature. They have a high rate of fixation with a small pool of carbon being held within the plants of the ocean, but another pool of carbon is held as dissolved organic matter which occurs as maybe one ppm throughout the waters of the abyss. The mixed layer has about 580 inorganic carbon units and the abyssal waters have a very large quantity. This doesn't mention the carbonates at all.

Now we will consider only the carbon that's stored in the plant population, because that is what's in immediate exchange. How much is it and where is it? There's probably less carbon in the biota now than twenty years ago because of the continuing destruction of forests, but that point will no doubt be argued by some of my colleagues. I would like to call your attention to where most of the carbon is. Of some 829 billion metric tons in the world, 827 billion of those units are in the land biota. So the land biota is very important. This does not include the humus. This is only the living plants. I distinguish here between the standing crops of organic matter, which is just a pool of carbon held on land, and the capacity of plants for fixing carbon in excess of the needs of the plant populations for their own metabolism. This is called net primary production by ecologists. It represents the energy that is left over after the metabolic needs of the plants have been met. It is what is available to support people and other consumers. There are approximately 50 billion of these units on land and about 25 billion in the oceans. This set of data represents one of the absolutes of the earth and, as far as supporting life is concerned, this amount of carbon determines the limits for the number of people and other consumers which the earth's atmosphere can support.

Most of this stored carbon occurs in the forests. Whittaker and Likens estimate that some 55 percent of the stored carbon occurs in the tropical forests. Thus, the tropical forests are viewed as being particularly important. What is the rate of change in the tropical forests? We came to the conclusion, after reviewing the available literature, that the annual rate of harvest probably lies somewhere between 0.5 percent to 1.5 percent of the remaining standing crop of carbon in the world's tropical forests. What we're really interested in is the net release for the total for the world, including the humus. The net release may average somewhere around 8 billion of these units, but the range is very large. Most of the release occurs in the tropics. For a world total, the release is roughly equivalent to the release of carbon from fossil fuels. This means that most of the models that have been used in the last decade to predict the future CO_2 content of the atmosphere are probably incorrect because these models have assumed that the biota was not a source of CO_2 for the atmosphere, but a small sink. We now think that the biota is not absorbing carbon dioxide out of the atmosphere but that it is

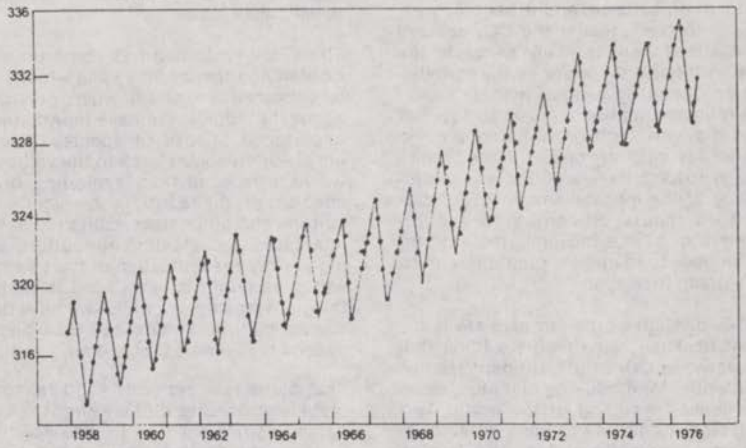
releasing carbon dioxide into the atmosphere. Thus, we have no really adequate explanation for the details of the world carbon balance, and it becomes impossible to predict what the CO_2 content of the atmosphere is likely to be in the future. Although there are various predictions produced by various models based on various assumptions, I have to say that at the moment there is substantially no basis for favoring any one of these predictions. We don't have a sufficient understanding of the mechanisms involved pertaining to inputs of carbon to the atmosphere or of the movement of carbon into the oceans to make a prediction as to what's going to happen.

The CO_2 content of the atmosphere is important because climatologists think that an increase in CO_2 in the atmosphere has the potential for modifying climates, causing a general warming of the earth. As I understand it, this will cause a differential warming towards the poles. The tropics will not necessarily get hotter, but the climate zones, and therefore the vegetation zones, will move poleward. This would probably result in a substantial destabilization of agricultural areas to the detriment of agricultural production. If I read the data correctly, when this occurs in a period of intensified land use of the earth by ever-increasing numbers of people, it means a substantial disruption of human interests.

What is the time scale of this? Of course, it is occurring at the moment, but if we wait until there is absolute proof that the increase in CO_2 is causing a warming of the earth, it will be twenty years too late to do anything about it. If we decide that this is a substantial problem and that something should be done about it, then it is clear enough what we should do. One of the things we do, of course, is to stop the destruction of the largest forests of the world, the tropical forests, if we can. We must preserve them and start programs of reforestation, because the storage of carbon in the vegetation and in the humus which is associated with the forests is a substantial pool of carbon, and deforestation of the tropics has the potential for affecting the CO_2 content of the atmosphere. At the same time, we should restrict the use of fossil fuels.

There is a topic that has come up at this Conference several times and which I think is extremely important when one thinks about the tropics. We have mentioned the importance of loss of species. The emphasis often comes back to the values that we have realized from exploiting diverse species of the earth in medicine, agriculture, and other areas. Certainly, if we're interested in sustaining agriculture under increasing intensification of the use of the earth, we ought to work hard to preserve the germ plasm from which we have drawn our agricultural strains and on which we depend to maintain those strains.

That alone is a perfectly valid reason for preserving species. But we might ask what happens when we start to lose species in large numbers? What kinds of species survive? What is the character of the habitat that is left? Many of us are familiar with the species that occur in roadsides and other constantly disturbed places. Some of us have seen the landscapes around big smelters where fumes of sulfur dioxide and toxic metals have accumulated to the point where the vegetation has become impoverished. This is not just an aesthetic matter, because the vegetation has become toxic and just doesn't support life. In this we lose not simply species but the capacity for fixing carbon—for producing the net primary production for supporting any life. At the same time, what happens is that the species which do survive are the hardy, small bodied, rapidly-reproducing species which we often recognize as pests. Impoverished landscapes are hard to live in, not simply because the number of species is low or because the primary productivity is low, but because they are plagued by organisms that are pestiferous. So, from the standpoint of making it easy for man to live, we need to preserve the full diversity of the earth's species—because it is this diversity itself which most successfully controls life on this planet.



TREND IN ATMOSPHERIC CARBON DIOXIDE has been measured since 1958 at the Mauna Loa Observatory on the island of Hawaii by Charles D. Keeling of the Scripps Institution of Oceanography. The dots indicate the monthly average concentration of carbon dioxide. The seasonal oscillations are caused by the removal of carbon dioxide by photosynthesis during the growing season in the Northern Hemisphere and the subsequent release during the fall and winter months. The Mauna Loa measurements and those made elsewhere show that the average carbon dioxide content of the atmosphere has risen more than 5 percent since 1958. Rate of increase has varied from year to year from causes not yet known. Current rate is one part per million per year, equivalent to 2.3 × 10^{15} grams of carbon.

Figure 3. "The Carbon Dioxide Question," by George Woodwell, Scientific American, Vol. 238, No. 1, p. 37, Jan. 1978

Mr. BONKER. Mr. Peterson, I thought you outlined adequately some of the direct causes of deforestation, with the three most prominent being conversion of use for agricultural purposes, fuel wood gathering, and industrial management for logging these areas. Then there is the problem of population increase.

It seems to me that only one of the three prominent causes can really be addressed directly within a short period of time, and that is improvement in industrial management. Conversion and use for agricultural purposes and fuel wood gathering seem to be causes that are related to developing countries. They are struggling with the basics of survival.

I just don't see any short-term solution. It will take time and steady progress toward better economic conditions in developing countries. Is there any time frame that the Interagency Task Force is looking at, to confront this problem directly? If you have villages in Africa that are heavily dependent on wood for a source of fuel, and/or if you have countries that are attempting to develop, like in the Sudan, and are expanding their agricultural production, all that comes with the cost of a diminishing forest.

So how can you relate to those problems without solving the more fundamental problems of development?

Mr. PETERSON. I doubt that you can. In fact, it is very difficult to separate even one problem that you mentioned. Let's review again the 80 percent of wood removals in the tropics that is related directly to use of the wood for fuel. Another 14 percent is for local in-country use in the form of wood products.

Mr. BONKER. Let me get those down again, Mr. Peterson. Eighty percent?

Mr. PETERSON. Of all removals, 80 percent is used for fuel; about 6 percent is exported, and the remaining 14 percent is for local use.

Mr. BONKER. Fourteen percent local.

Mr. PETERSON. We have 94 percent that is used locally for fuel and wood products. Some of the export income in most of the countries—in fact, the bulk of it—is being used to provide some money to try to improve the economic condition of the people, to help them practice better agriculture, to help them get better data, do those kinds of things. These earnings are linked with other efforts to try to improve their livelihood.

So it seems to us that several things are immediately apparent. One, of course, is to have better information on tropical forests. Where are the tropical forests? How can you work with them? What is some of the definitive information on the soils underlying these forests? Are there areas, for example, where you can practice a more stable kind of agriculture? Are there soils in some places where you can do this? Can you learn how to use those tropical forests without the amount of permanent destruction that's going on now? Can you reforest them successfully and can you perpetuate the forests? In some places if you can perpetuate you can provide a continuing source of fuel wood

without fuel wood removal being a permanent cause of deforestation. But that requires finding a solution to the agriculture problem.

For example in Thailand, they were able in parts of Thailand to find some areas that you could practice sustained agriculture on the land, instead of just slash and burning and moving. Also, if you could provide a more stable location you can provide some basic human education on nutrition, and some of the other things that are necessary to meet some of the basic human needs, which makes it beneficial to the local people and not something that has been imposed on them.

Another obvious thing is the move to some types of plantation forestry in some locations, where you produce a continuing supply of materials that you can perpetuate. But I think the bottom line on all this is that we know precious little about the tropical forests; so basic research on soils, the hydrology, the flora and fauna of the tropical forests, and a better understanding of the CO_2 situation are all going to be essential to make plans that are technically sound as well as meet social and economic objectives.

Mr. BONKER. Your submission of these percentages is significant I think, because it is important that we keep our perspective on the major causes of the problem and what proportion is represented in the depletion of the tropical forests. Now you say that 80 percent is for fuel, 6 percent exports and 14 percent for local use. I assume the local is primarily agricultural?

Mr. PETERSON. It can be local building materials. In other words, most of the time in the building of housing, and so on, building of fences.

Mr. BONKER. Let's go back to your statement, on page 10, in which you say the principle direct causes are: (1) direct conversion and use for agriculture; (2) fuel wood gathering; and (3) poorly managed industrial logging. I'm just trying to digest the principal causes that you have submitted. The principal causes, such as fuel wood gathering and export, which I imagine would be the industrial logging—looking at this local 14 percent, where would you put conversion for use in agriculture in the percentages?

Mr. PETERSON. One of the great difficulties is most of the conversion use for agriculture is a follow-on from gathering fuel. In other words, the forest is depleted and then it is converted to agriculture or vice versa. So there is a considerable overlap between those two. So we have lumped that 14 percent into local use.

Mr. BONKER. In any case, 6 percent is exported, so that is how much is involved in industrial logging. I think it is important to keep that statistic in mind because the temptation will always be to single out the industry as a major violator or principal cause of deforestation. We can see if these percentages hold up that the problem is more local than it is international at this stage. It is going to be more of a fundamental problem to deal with on our part.

Mr. PETERSON. Yes. If you, for example, took the United States, where only about 1 percent of our total softwoods and hardwoods, or about 3 percent of our total hardwoods, come from the tropics, if we should cease importing any material from those countries it would

not have a major effect on our own situation. We know it could be counterproductive for the countries involved in terms of trying to meet the socioeconomic objectives.

Mr. BONKER. Mr. Peterson, are most tropical forests hardwood? I did see in the slides that we had some cedar, precious cedar, which is very close to us in the Northwest, but are there any softwoods that come from tropical forests?

Mr. PETERSON. Yes; we mentioned a couple that are found there. Do we have the percentage?

Mr. DOOLITTLE.[1] I don't think we have a percentage. Most of them are hardwoods, but there are some softwoods.

Mr. PETERSON. We can find them in Indonesia and so on. We found quite a few softwoods. We found some softwoods in Latin America, but the large bulk are hardwoods.

Mr. BONKER. How many other industrial countries are involved in logging, or to use another term, exploiting the forest resources of other countries? Japan is heavily involved. Do we have a breakdown of percentages in Western Europe, Japan, United States, the Soviet Union? Is the Soviet Union involved in logging developing countries?

Mr. PETERSON. The difficulty in getting that figure is that most of those companies are jointly owned companies.

Mr. BONKER. Joint ventures?

Mr. PETERSON. Yes, joint ventures. But you primarily find the United States, Japan, a few European countries, Korea, and Taiwan. You can just about say the developed countries that need the raw material are involved either in importing or in joint ventures to try to get some of those imports.

Mr. BONKER. So we won't see a situation in the future with the growing scarcity of this resource, if it becomes another valuable resource that has both superpowers or various industrial block countries competing for it, as in some of the other precious resources like oil?

Mr. PETERSON. No, I would doubt it. The U.S.S.R. has large forest resources in Siberia and so on, and the United States, of course, between the U.S. resources and Canadian resources that are immediately available for import, the United States is not a major importer from these countries.

Mr. BONKER. Mr. Long, you wanted to say something?

Mr. LONG. I want to agree with your point on the need for a broad perspective on the nature of the forest loss problem, particularly to establish the role of industrial operations. It should be noted, however, that worldwide average figures disguise much higher figures at the local level. In some countries—in Southeast Asia in particular—the amount of deforestation caused by industrial activities is quite significant.

Mr. BONKER. Do you have any breakdown for the committee record on that?

Mr. LONG. Do you mean the extent of it? Not percentage figures.

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[1] Warren Doolittle, Associate Deputy Chief, U.S. Forest Service.

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Mr. BONKER. By region or by country, the principal causes of deforestation.

Mr. LONG. We can try to pull together such information for the record, but these figures are very slippery. It's hard to get two people to agree on them; but we will do the best we can and submit an analysis for the record.

Mr. BONKER. We don't want to work with slippery figures. [Laughter.]

[Subsequently Mr. Long submitted the following information:]

QUANTIFICATION OF TROPICAL DEFORESTATION CAUSES

DATA BASE PROBLEMS

The Federal Task Force on Tropical Forests attempted without success over many months to quantify the contributions of the various principal sources of tropical forest loss (i.e., conversion to agriculture and cattle ranching, fuel wood gathering, commercial logging, human settlement). The data base is incomplete and incompatible from country to country, and global extrapolations or estimates reported by various UN bodies and national and private institutions vary widely. Indicative of the situation is the fact that the Task Force eventually resorted to reporting the total worldwide annual loss on the basis of "best case" and "worst case" scenarios.

INDICATIVE STATISTICS

Certain available data does provide, at least in a relative sense, good insights into the contributions of particular types of deforestation causes—and also the impact of in-country social and economic pressures on the forest resources compared with external (foreign) pressures. For example, the Food and Agriculture Organization estimates that more than 1 billion cubic meters of wood are harvested each year in the tropics, with some 825 million cubic meters used for fuelwood and charcoal, and the rest for building materials and export. This, however, can't be converted into meaningful figures on acreage of forest modified, since the harvesting is highly selective.

Analyses of industrial logging activities often state that this accounts for about one-fifth of the total volume of wood removed from tropical forests, only 6 percent of which is exported. There is no reliable data on the amount of clear cutting involved, as opposed to selective logging.

U.S. NATIONAL ACADEMY STUDY

The Committee on Research Priorities in Tropical Biology of the National Research Council, U.S. National Academy of Sciences, has recently published a report on "Conversion of Tropical Moist Forests," prepared by Dr. Norman Myers. The report indicates that the total amount of tropical moist forests lost each year may be as high as 210,000 km^2 per year, of which permanent conversion by individual "forest farmers" accounts for over half. Some 85,000 km^2 is estimated to be lost in Southeast Asia; and 40,000 km^2 in Africa. Myers does not give figures for the individual contributions of cattle ranching, commercial timber operations, or conversion for human settlements or large-scale agricultural production. He does list the following areas undergoing "broad conversion at rapid rates", and identifies the principal causes (unquantified):

Australia's lowland tropical forests (timber exploitation and planned agriculture).

Bangladesh's lowland and upland forests (timber exploitation, forest farming and population pressure).

India's upland forest (forest farming and population pressure).

Indonesia's lowland forests (timber exploitation, forest farming and transmigration programs).

Sumatra-Sabah lowland forests (timber exploitation).
Malaysia's lowland forests (timber exploitation and planned agriculture).
Philippines' lowland forests (timber exploitation and forest farming).
Sri Lanka's upland forests (timber exploitation and forest farming).
Thailand's upland and lowland forests (timber exploitation, especially illegal felling, and forest farming).
Vietnam's upland and lowland forests (forest farming, timber exploitation, and immigration from north).
Brazil's east and south sectors of Amazonia (cattle ranching, colonist settlement, forest farming).
Brazil's Atlantic Coast moist forests (timber exploitation, and cash-crop agriculture, notably sugarcane).
Central American forests, most upland and lowland (forest farming, cattle ranching, timber exploitation).
Colombia's lowland and rainforests (colonist settlement, and cattle ranching).
Ecuador's Pacific coastal forests (plantation agriculture and some timber exploitation).
Madagascar's upland and lowland rainforests (forest farming and timber exploitation).
East Africa's montane forests (timber exploitation, firewood cutting and forest farming).
West Africa's seasoned forests (timber exploitation and forest farming).

ONE RECENT APPROXIMATION

In his 1979 book, "The Sinking Ark" (Pergamon Press), Myers presents these estimates of annual loss of tropical moist forest attributed to specific causes:
Agricultural Conversion (including cultivators following-on commercial loggers) 200,000 km² (range 165,000–300,000).
Timber Exploitation, 10,000–29,000 km².
Fuelwood Cutting, 25,000 km².
Cattle Ranching Conversion (only in Latin America), 20,000 km².
Myers total of upwards of 245,000 km² for worldwide annual tropical forest loss is significantly higher than FAO figures which have ranged from 120,000–170,000 km².
Regardless, the above breakdown is at least indicative of their relative contributions of the principal sources of tropical forest loss.

ROLE OF INDUSTRIAL LOGGING

Although agricultural land use and conversion is by far the major contributor to tropical forest loss worldwide, industrial logging is also an important factor—directly and also indirectly by opening up forests to cultivators through logging roads. On a *local* scale, it may well be the most significant factor, although on a worldwide basis only one-fifth of the wood harvested from the forest is industrial timber. Attached is a table (based on FAO's 1978 "Yearbook of Forest Products") which shows industrial production of roundwood from tropical countries for 1967, 1973 and 1978, along with the amount exported. The figures reveal where the most intensive logging is carried out; the principal sources of tropical timber exports; and the fact that most of the wood is used locally.

DATA DEFICIENCIES

At the international meeting of experts on tropical forests convened by the UN Environment Program last March in Nairobi, the U.S. delegation called attention to the need for better quantitative information on rates of tropical forest loss and on individual causes. The U.S. intends to press FAO and other United Nations and regional organizations to help improve the data base, thereby providing a better foundation for selecting program priorities and considering policy changes.

INDUSTRIAL ACTIVITIES FOR ROUNDWOOD [1] PRODUCTION [2]

[In thousands of cubic meters]

Tropical forest country	1967		1973		1978	
	Total production	Exported	Total production	Exported	Total production	Exported
Africa:						
Cameroon	7,049	279	8,152	703	9,392	621
Central African Republic	2,040	11	2,823	155	3,060	82
Congo	2,236	504	2,506	312	2,521	180
Equatorial Guinea	845	413	422	18	455	18
Gabon	2,589	1,180	3,495	1,749	2,289	1,200
Ghana	8,604	504	12,338	1,387	13,058	620
Guinea	2,620	----------	2,998	----------	3,370	----------
Guinea Bissau	447	----------	476	----------	516	----------
Ivory Coast	7,164	2,173	10,287	3,497	10,397	2,760
Malawi	3,944	----------	4,533	----------	5,079	----------
Nigeria	63,205	333	73,601	333	84,902	93
Uganda	14,609	----------	17,275	----------	20,004	----------
Zaire	15,757	69	18,519	43	20,691	30
Central and South America:						
Belize	105	----------	113	1	120	1
Cuba	2,039	----------	1,885	----------	1,885	----------
Guatemala	4,146	3	5,015	8	5,606	8
Haiti	3,005	4	3,533	1	3,782	1
Honduras	3,770	15	4,434	15	4,175	16
Jamaica	7	----------	6	2	6	1
Mexico	13,124	10	13,580	8	14,814	2
Panama	1,323	3	1,500	----------	1,696	1
Brazil	106,763	79	127,505	426	160,464	8
French Guinea	84	10	53	7	51	4
Guyana	257	33	258	45	240	19
Surinam	244	21	168	17	294	14
Venezuela	6,444	----------	7,523	----------	8,636	----------
Southeast Asia and Pacific:						
Burma	14,749	52	21,170	172	3,976	118
East Timor	456	----------	553	----------	615	----------
Indonesia	95,387	590	131,608	18,737	147,723	20,590
Laos	2,657	----------	3,062	1	3,318	38
Malaysia	19,620	9,180	30,100	13,746	38,449	17,364
Philippines	29,862	7,266	33,366	7,794	34,345	2,215
Sri Lanka	4,226	84	4,496	----------	4,773	----------
Thailand	18,046	209	20,481	299	21,797	278
Vietnam	16,295	----------	18,814	----------	21,288	----------
Papua New Guinea	4,289	114	5,333	425	6,186	560

[1] Roundwood includes saw logs, veneer logs, pit props, pulpwood, other industrial roundwoods and fuelwood.
[2] Figures taken from 1978 Yearbook of Forest Products, Food and Agriculture Organization of the United Nations.

Mr. PETERSON. I think you might also keep in mind that sometimes the export of material which causes the construction of roads may lead, as was pointed out in the slides, to agriculture moving into an area which may do a lot of deforestation because agriculture is now able to move into that area. So that is a secondary cause of deforestation. It might be right behind road construction and is based on the export market. So these are not separable things.

Mr. BONKER. But the fuel wood gathering is the principal cause that you might find in Africa, for instance. It is in effect an energy source, and we are discovering just how important that is in a country's development. There appear to be no incentives to substitute that energy source for another because oil is just prohibitively expensive, and there is no hydro potential. There is potential but not the capital investment and so forth. So I think it is going to be a long time before we develop an adequate alternative to fuel wood in some of these areas.

Mr. PETERSON. In fact the trend is in the opposite direction right now. In some countries, where they have been able to get to an economic level so that the peasant could use liquid fuel and so on in some places,

that now has been reversed by the high cost of liquid fuel. So the trend is actually in the other direction now.

Mr. BONKER. Except in the Northwest, where I've been advocating wood waste as an energy source. [Laughter.]

Mr. PETERSON. Yes, sir.

Mr. BONKER. At one time in the Northwest, wood was the principal energy source.

Mr. PETERSON. That is right. It was in most of the United States, even as late as the turn of the century.

Mr. BONKER. Well, it just seems like we are coming back to it as an energy source, but wood waste is different from chopping down a dead fir just for fuel purposes. The waste that comes from it, is a possible use because what is left behind is not used for anything else.

Mr. PETERSON. In fact, one of the best opportunities is to get some kind of community forest that may be managed to produce both fuel wood and building products. Agricultural work and so on can produce the fuel and the wood can be used for houses on a managed basis. That is probably one of the more reasonable ways to meet some of these fuel needs.

Mr. BONKER. I'd like to get together with you sometime to discuss that further because when one looks at a clearcut area, there is a lot that is left behind.

Mr. PETERSON. That is right.

Mr. BONKER. There are companies involved that are coming out with ways to convert this waste which makes it quite competitive as an energy source.

Mr. PETERSON. Right.

Mr. BONKER. Not necessarily just putting it in the fireplace or the wood stove, but actually use it as fuel for generating purposes.

Mr. PETERSON. Yes. In fact one of the obvious things in these areas, if you had a little more efficient method of using the fuel that is being used, you might fairly dramatically reduce the amount of fuel consumption just by better stoves to use the fuel in. Get right down to basics.

Mr. BONKER. Let's see, one further question, Mr. Peterson, one that I hesitate to ask, but I am just too tempted. That is, the common statement or the sentiment in the Northwest among the industry, maybe we'll hear from witnesses later on regarding this subject, is that the industry is much further advanced than the technology and forest management, reforestation, all these things are much further advanced than the Federal Government or the U.S. Forest Service.

We now have a situation where the industry is involved in logging in other areas of the world. We are going to be asking them to improve their forest management practices. In fact, you state clearly that it is "poorly managed industrial logging."

So in the Northwest I always hear that the industry is far advanced and very responsible, but it is the Forest Service that is not properly managing the timberland. Could you respond?

Mr. PETERSON. Well, it is true that on some industrial forest land, more wood per acre is being grown. There are several factors that are related to that. First, by and large industry has more productive land because they used some good judgment in selecting the land they have.

Second is that industry investment in that land is several times the investment level of Federal forests. I think that is fairly well known. Statistics are available.

Mr. BONKER. Actually, I'm trying to drag you into this by saying that if the Federal Government or the OMB would quit cutting the Forest Service budget, you would have better resources to work with.

Mr. PETERSON. There is no question that in much of the United States, there is a considerable amount of land that would give an economic rate of return for higher investment. Most of that is owned by private nonindustrial forest landowners. Those lands are only producing at about 60 percent of capacity.

Before we paint all industry one way or another, I would point out there is a substantial part of industry lands that are being managed at a very high level, even though there are about 35 million acres that are in need of reforestation.

Mr. BONKER. In my district?

Mr. PETERSON. Not in your district, I don't believe. Maybe some of it. There is also a great deal of reforestation, for example, in southwest Oregon on national forest lands.

Mr. BONKER. We really have a problem. I don't know if you are familiar with the Quinault Reservation, but there are thousands of acres that were poorly logged years ago in the 1920's and 1930's. All the land there was slashed and nothing grows there now. It is ideal soil for reforestation.

Mr. PETERSON. If you would like to do so, we can give you a brief on our new assessment which is just out and which outlines the economic opportunities and where they are. It also defines what kind of land and so on.

Mr. BONKER. Good. We would love to have that. I'd like to apologize to the others who are here. I get fairly parochial once in a while on the topic of forestation.

On another subject, it appears as though the Federal Government is not realizing its full investment in the timber industry, simply because we're always cutting back the budget and that curtails your operations. On a larger scale, we're doing the same thing through our voluntary contributions to various U.N. agencies who are attempting to deal with this problem. I was very disappointed when the administration came before this subcommittee recently with a drastic reduction in our contributions to UNEP, the United Nations Environmental Program, while maintaining current levels of funding for a whole range of other international organizations.

It seemed to me shortsighted that the administration would choose out of some 20 different agencies to which we contribute, the Environmental Program to be the one that receives reduced contributions. It is another example of how President Carter is trying to spread himself too thin. On the one hand he says we've got to do much more to curtail this problem of tropical deforestation, which has to be done principally through international organizations; then, on the other hand, drastically reduces our contribution to that same agency.

Would you care to comment? [Laughter.]

Mr. LONG. I guess my only comment on this is I wasn't a party to the decision, and can't interpret the reasons for the action. [Laughter.]

But as a member of the Bureau of Oceans and Environment and Sciences in the State Department, I hope that we can maintain strong support for UNEP. I was, therefore, pleased to see that Congress came to the rescue several times on funds for that purpose.

Mr. BONKER. Yes; this subcommittee is responsible for that.

Mr. LONG. I know there was concern on the part of some people about aspects of UNEP's performance in the past. But I must say that UNEP deserves high marks for the way they have picked up on the tropical forest problem. We hope that they will continue to strengthen their overall performance.

Mr. BONKER. Last year when I went to New York and paid a visit to almost all of the agencies that we contribute to, I found the people at UNEP were as impressive in their commitment and their personnel as any of the agencies. I came away more impressed with UNEP than any of the others. So I think they should have the resources to work with.

Well, I want to thank both of you for your personal appearance today, and applaud the work of the Interagency Task Force. We will be looking forward to your publication. I'm anxious to see the recommendations. Carole Grunberg of the subcommittee staff is presently involved in this and will be working with the executive branch as we proceed with these hearings.

Once again, thank you for being here.

Mr. PETERSON. Thank you, Mr. Chairman. As soon as the recommendations are available, we will be glad to go over them with you if you'd like.

Mr. BONKER. Thank you.

We'll now have the next panel of witnesses, which includes Dr. Peter Raven, Mr. James Bethel, and Mr. Robert Blake.

I would like to begin with Dean Bethel, who is a fellow northwesterner, and dean of the College of Forest Resources at the University of Washington, who is very prominent in this field.

STATEMENT OF JAMES S. BETHEL, DEAN, COLLEGE OF FOREST RESOURCES, UNIVERSITY OF WASHINGTON

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Date and place of birth: August 13, 1915, New Westminster, B.C., Canada.

EDUCATION

B.S., 1937—University of Washington;
M.S., 1939—Duke University;
D.F., 1947—Duke University.

PROFESSIONAL EXPERIENCE

1935–38—Special Forest Technician and Forest Guard, U.S. Forest Service, Washington and Oregon.
1937–38—Fellow and Research Assistant, Duke University, North Carolina.
1939–41—Instructor in Forestry and Botany, Penn State University.
1941–42—Assistant Professor in Biology and Forestry, Virginia Polytechnical Institute, Blacksburg, Virginia.
1942–46—Captain, U.S. Army Air Force, Wright Field, Oregon.
1946–49—Plant Manager, Tidewater Plywood Co., Brunswick, Georgia.

1949–59—Professor of Wood Technology and Director of Wood Products Laboratory, School of Forestry, North Carolina State College, Raleigh, North Carolina.
1952—Advisor to government of Yugoslavia on Modernization of Veneer and Plywood Industry, United Nations.
1956—Advisor to government of Puerto Rico on Industrial Development of Forest Resources, Economic Develpment Administration, Commonwealth of Puerto Rico.
1958–59—Acting Dean, Graduate School, North Carolina State College.
1959–62—Head, Special Projects in Science Education, National Science Foundation
1962–64—Professor of Forestry, Associate Dean of Graduate School, University of Washington, Seattle, Washington
1964 to present—Dean, College of Forest Resources, University of Washington, Seattle, Washington.

PROFESSIONAL ACTIVITIES

Member, Society of American Foresters; Fellow, American Association for the Advancement of Science; Member, Society of Wood Science and Technology; Member, American Institute of Biological Sciences; Fellow, Institute of Wood Science (British); Fellow, Society of American Foresters; International Academy of Wood Science; Phi Sigma; Sigma Xi; Xi Sigma Pi; Gamma Sigma Delta.

Mr. BETHEL. Thank you, Mr. Chairman. I will submit a written statement and briefly comment on it verbally.

I think it is important to note that concerns for deforestation are not new and they are not unique to the tropics or to tropical forestry. We have a long history in the United States of similar kinds of concerns, dating back to the period immediately following the Civil War when we had very widespread predictions and prognostications about forestry depletion and forestry exhaustion. Very prominent individuals like Carl Schultz, President Theodore Roosevelt, and Gifford Pinchot, were worried about the disappearance of our forests within 20 years or 30 years.

That kind of forest famine that was predicted by individuals of their prominence really in fact did not occur. We are today producing more wood than we use. I say this——

Mr. BONKER. When you say we are producing more wood than we use——

Mr. BETHEL. In the United States. In spite of the fact that it was predicted in the 1850's that we would run out of forests in 25 years.

Mr. BONKER. I suppose that before we had advanced forest practices and reforestation methods, what happened traditionally in Minnesota and places in the Midwest where companies actually cut and went on to new forest, was a phenomenon of the times.

Mr. BETHEL. Yes. Historically, worldwide, we never practice intensive forest management any place until most of the natural forests have already been used once. One might hope that that could be changed some places in tropical areas where there are still large areas of natural forests, but historically it hasn't occurred anywhere.

How can one justify large investments in managing and growing trees in the presence of a natural crop that is going to compete with it and that doesn't have the growing costs already associated with it.

I'm not suggesting that the people who are currently concerned with the depletion of the tropical forests ought not be so concerned. I think the fact that people worried about these issues back in the 1800's in the United States and the 1700's in Europe probably led to the ac-

tions that made it possible for us to produce adequate supplies of wood here and in Europe.

But I will expose some personal biases. I do not believe the tropical forests are going to disappear. I do believe there are some very serious problems related to their use and to their exploitation.

Mr. BONKER. You don't agree with the statistics that were referred to earlier of the Food and Agricultural Organization that one-half of the world's forests have disappeared and by the year 2000, or by 1990 they could be totally depleted? Do you agree with those?

Mr. BETHEL. No; I don't.

Mr. BONKER. You have a set of statistics that you can offer that are different?

Mr. BETHEL. I have some definitions.

Mr. BONKER. I can tell you are from the academic community. [Laughter.]

Mr. BETHEL. It's entirely a matter of how you define disappearance and depletion. That is part of the problem that we had before.

Mr. BONKER. We conducted hearings on this subcommittee about the disappearances of people. [Laughter.] We got into certain definitional problems. [Laughter.]

Mr. BETHEL. Hopefully this isn't the same thing.

Mr. BONKER. I hope not.

Mr. BETHEL. It has already been pointed out that demand on tropical forests is very great. Max Peterson said that 80 percent of the timber harvested in tropical countries at the present time is cut for fuel. As a matter of fact, it has been that way for many years.

Mr. BONKER. You agree with that set of statistics?

Mr. BETHEL. Yes; that set I agree with. The use of wood for fuel is increasing and is likely to continue to increase. It is primarily a local problem. I don't agree with the proposition that this is a problem that is insoluble. I think things can be done to correct some of the difficulties that originate out of the use of tropical wood for fuels.

The next most important use of tropical forests from a material standpoint is for lumber and structural uses. Again, Mr. Peterson indicates that this use represents about 14 percent of the harvest. Then the remaining 6 percent is in industrial wood of one kind or another, harvested for sale in the international market to produce income to the country.

What is deforestation? First, it can be thought of as conversion to other land use. This is certainly a very important part of the problem of reduced acreage of forest land in the tropics and elsewhere, deriving from conversion to permanent agriculture, expanded urban areas, roads, railroads and other uses of that sort. And certainly the total land area of the forest in the tropics has been decreasing as a result of conversion away from forest use to other kinds of land uses. This form of exploitation can in my judgment be called deforestation.

But second, the tropical forest is used to provide fuel, housing and other commodities for domestic use. Here the forest is used. It isn't managed, but it also isn't destroyed. It doesn't cease to be a forest. It is changed very dramatically from what it was. Without further intervention it will normally recover to second growth and if allowed the time, to natural forest. This I suggest is not deforestation under any reasonable definition of the term.

Then there is the situation where the natural forests are removed, the land used for agriculture, abandoned and then allowed to come back to forest.

Mr. BONKER. I was going to ask you about that. It seems to me that there is some natural regeneration that takes place after an area has been depleted of its timber resource. I know how some of that works in the Northwest. But what about the tropical area and natural regeneration, and the time frame between natural regeneration and reforestation programs in this instance?

Mr. BETHEL. It depends a lot on the particular forest, but certainly natural regeneration occurs in tropical forests as it does in Washington forests. For the purpose of our own research at the University of Washington, we have arbitrarily classified tropical forests into four categories that are helpful to us in taking a look at the impact and utilization of tropical forests and on their productivity.

One is the natural forest. This is the forest that has not been heavily impacted by any kind of human use. This is what most people think of as a virgin forest. It usually has been used but used very lightly. This is the sort of forest that is the best protector of the gene pool. It is often prized as a recreation forest. Some areas of natural forest need to be saved as a base for long-term scientific research. These natural forests are also useful to local communities for fuel wood and for round wood that local natives need, if the population density is low and the requirements are not great.

The second type of forest that we recognize we have called secondary forest. This type emerges when a natural forest is harvested or where it has been impacted by a similar kind of natural event like a major disease or insect epidemic or a volcano, hurricane, typhoon, or other natural phenomenon of the sort that would have represented a major impact on the forest. And where this event has been followed by essentially no further impact or human intervention, and simply allowed to return to forest. A secondary forest generally derives from natural regeneration. Very often secondary forests come back in very much the same form as the original forest and look very much like it.

Some data on forests in Borneo, where nothing is done for 40 years following logging, indicates that the secondary forest is very much like the original natural forest. A secondary forest provides some protection for gene pools. It tends to have a greater net growth rate than is achieved in the natural forest, which is usually zero or minus. The growth, however, isn't great in that kind of a forest. There are many secondary forests in the tropical regions.

The third forestry development status we refer to as recovery forests. This is the situation in which you harvest the natural forest or the secondary forest and then you have some kind of significant postharvest nonforestry use which is later abandoned permitting a return to forest. This is the situation where you have slash-and-burn agriculture, the land is farmed after cutting, the farm abandoned, permitting a recovery to forest.

Some temperate zone counterparts of recovery forests are the old field pine stands in the South that were converted to growing cotton, corn or tobacco, later abandoned to emerge through natural regenera-

tion as old field pine stands. Generally speaking, the forest that recovers after some sort of major nonforestry, postharvest use, is not the same as the forest that was cut down. The more intense the nonforestry use and the more it persists before abandonment the greater is the difference between the recovery forest and the original natural forest.

Sometimes when the intervention is too long and too severe there is little recovery to a forest at all. Most of the tropical deforestation horror stories are related to tropical forests emerging from a temporary nonforestry use as recovery forests. Examples are prevalent throughout Southeast Asia. Imperata grass occupies tremendous areas in the Philippines, Indonesia, Thailand, and Malaysia. It usually represents an episode of nonforestry use leading to a recovery forest.

The productivity in these kinds of forests is usually poor. Gene pools are not protected. Recreation values are lost. Watershed values are very poor.

The fourth kind of forest that we are concerned with, in our studies is the managed forest. One that is deliberately designed to produce a tropical forest to meet a specific set of objectives, a plantation forest produced through intensive cultural operations. Here there is heavy investment and there have to be high crop values to justify the investment. The managed forest can emerge following the harvesting of a natural forest or a secondary forest or a recovery forest if degradation is not too great.

Some of the examples of managed forests in the tropics are a eucalyptus plantation in Brazil to provide wood for steel industry to convert to charcoal, some of the teak plantations in Southeast Asia and the Caribbean pine and Gmelina in Brazil. You get the best growth rate generally in managed forests. You get relatively poor protection of gene pools. These tend to be single species forests. Generally they provide good watershed protection but are more vulnerable to insect and disease. They provide good yield of product.

To summarize, it seems to me that what happens in the forestry development process in the tropics is not unlike what happened in the temperate zone. In the first instance, you get a rapid conversion of the natural forest to something else, and you get a slow development of a managed forest out of that. In between this period of rapid conversion of the natural forest and development of the managed forest, you have the secondary forest and you have the recovery forest. These may be the principal forms of forestry for a long, long period of time.

What some people are arguing, and perhaps properly, is that what one needs to do is shorten this transition period, at least with respect to those lands that are going to be dedicated to production of materials. To move the forest rapidly from natural forest status to managed forest status, with a relatively short period of time in the status of secondary or recovery forest.

What to do and what not to do with respect to these developments as far as the United States is concerned? We are not the custodians of most of these forests? What not to do I think is to try to impose our culture and our values arbitrarily on other countries. What I think we need to do is first of all to help to provide the basis for wise decision-making, particularly where we're asked to help in the decision process.

We need to encourage sound research.

I think it is unfortunate that large timber concessions tend to be used as experiments to learn about forestry when there are much better ways to do this.

Second, it seems to me important to develop a group of tropically knowledgeable professionals in the United States to provide help if they are asked. We have made a relatively minor contribution through the Federal Government toward the solution of tropical forestry problems. It is clear that there is now an interest in this. Most of our contributions come through investing in international agencies and not directly out of actions of the U.S. Government itself.

I urge that we not advocate, as people sometimes have in the past, that the tropical countries ought to do nothing until the forests are fully understood. In the first place, I think if we tell the tropical countries this they won't pay any attention to us. Secondly, I expect they will call our attention to the fact that we didn't behave that way ourselves. We went ahead and used Douglas fir before we knew all about it and we still don't know all the things we ought to know about it.

[Mr. Bethel's prepared statement follows:]

PREPARED STATEMENT OF DR. JAMES S. BETHEL, DEAN, COLLEGE OF FOREST RESOURCES, UNIVERSITY OF WASHINGTON

Mr. Chairman, I am James S. Bethel, Dean of the College of Forest Resources, University of Washington, and Director of the Tropical Forest Utilization Research Group in the Washington Institute of Forest Resources. I appreciate the opportunity to testify before your committee regarding the matter of tropical deforestation. This issue has been the subject of debate for a long time. The intensity of the debate has increased substantially since the Stockholm Conference in 1972.

Discussions and concerns about deforestation are, of course, not new. They certainly are not new in the United States. Henry Clepper, former executive secretary of the Society of American Foresters, reviewed some of the predictions of timber famine that were made in the United States. "In 1868, Joseph N. Wilson, Commissioner of the General Land Office, predicted that in forty or fifty years our own forests would have disappeared and those of Canada would be approaching exhaustion."

"In October 1889, at a combined meeting of the American Forestry Association and the Pennsylvania Forestry Association held in Philadelphia, Carl Schurz was a featured speaker. Lawyer, writer, newspaper editor, former Senator, and former Secretary of the Interior, Schurz in his time was one of the best informed men in America. His widely publicized address carried this warning: 'If the present destruction of forests goes on for twenty-five years longer, the United States will be as completely stripped of its forests as Asia Minor is today'."

S. H. Olson notes that in 1905 President Theodore Roosevelt addressing the American Forest Congress stated: "If the present rate of forest destruction is allowed to continue with nothing to offset it a timber famine in the future is inevitable." The freely predicted forest famine did not materialize in the United States. We produce today, from our forests in the United States, more wood than we use and far more than we grew a century ago.

Tropical forests are different from temperate forests and it would be a mistake to assume that history will repeat itself; but, by the same token, it will be a mistake to assume that it won't.

One of the problems to be faced in dealing with the current tropical forest depletion question is a recurrence of one associated with the earlier forest famine issue; namely, one of definition. What is meant by tropical forest depletion? Indeed, what is meant by tropical forest?

Half of the forests in the world are located between the Tropic of Cancer and the Tropic of Capricorn. These forests are collectively referred to as tropical

forests. They include the dense and varied forests of the humid lowlands, the cloud forests in the high mountains, the savannah's of the arid tropical regions, and many other forests types. Some tropical wet forests, such as those of the Choco area of Colombia or the Amazon basin in Brazil, are biologically very complex and comprised of hundreds of species that reach tree size. The savannah forests of the humid tropics are much less complex from a biological standpoint. Forests such as the pine forests of Honduras or the mangrove forests that inhabit the estuaries and river bottoms throughout the tropics are very simple in terms of tree diversity and organization.

Some tropical forests have been used and misused for centuries. Others are essentially untouched in terms of significant human impact. Tropical forests, like temperate forests, are often substantially impacted by natural events such as fire, volcanic eruption, hurricanes and typhoons, and floods. These natural events are sometimes more disruptive than all but the most severe of human impacts.

Historically, as human populations have increased everywhere in the world, land occupied by natural forests has been cleared for conversion to agriculture, roads, railroads, or for the constuction of towns and cities. Sometimes these conversions have been permanent but sometimes they are temporary. The pine stands growing on old cotton and corn fields in the South and the second-growth Douglas-fir growing on the stump ranches of the Pacific Northwest are examples of this temporary conversion. Similar temporary forest conversions are occurring in the densely populated tropical countries and more are likely to occur as experiments in farming submarginal agricultural lands prove to be failures.

A cyclic pattern of repeated efforts at farming interspersed with a forest fallow period is often referred to as shifting agriculture, slash and burn farming or swidden agriculture.

Just as growing human populations provide the incentive to clear natural forests for food production, so do they provide the incentive to harvest some of the wood from other natural forests to provide structural materials for constructing the rural homes, producing the furniture for town and city houses, and fuel for cooking and heating.

Where the natural forests contain raw materials for the production of commodities that are valuable in distant markets they are also harvested in whole or in part to provide increased income for the population of the region or the nation.

As forests near large population centers become inadequate to meet the needs of the inhabitants, the unfulfilled demand for wood and the accompanying increase in price make the growing of wood for local consumption a financially rewarding enterprise, and intensive forest management becomes commercially feasible. It should be noted that intensive forest management for the continuous production of wood has rarely begun in any area of the world until the original natural forests are essentially all converted.

These forest conversion activities vary in their impact on the environment. They create different problems that require different solutions and it is a mistake to lump them all together under a single term such as forest famine or forest depletion.

For the purpose of analyzing the status of tropical forests and their utilization potential, in our research at the University of Washington, we have recognized four levels of forestry developments defined as follows:

1. NATURAL FOREST

The natural forest is a biologically stable forest similar to what silviculturists have typically called a climax forest. It has generally received little human impact or dramatic natural disturbance for decades; certainly within the life span of the oldest trees. It is the sort of forest that represents many people's view of a virgin forest and is the reservoir of the forest gene pool.

2. SECONDARY FOREST

A secondary forest stand is one that develops from the natural forest following substantial timber harvesting or major disturbance such as fire, hurricane, insect, or disease, flood, etc. It results from a major impact such as a clearcut logging operation followed by a period of minimum human intervention. It can result from repeated high grading or selection harvesting of the forest. If a secondary forest

is allowed to reappear naturally without significant human impact or natural disturbance it often returns to the status of the natural forest. Indeed, most of today's natural tropical forests were undoubtedly secondary forests at one time.

3. RECOVERY FOREST

A recovery forest is one that develops from either a natural forest or a secondary forest after that forest has experienced substantial timber harvesting or other major disturbance followed by a significant post event nonforestry use. Examples of recovery forests are the forest fallow part of a swidden cycle, the forest that emerges from natural succession if a logged area is heavily burned or the forest that emerges after a period of annual burning to improve hunting or domestic livestock forage or after a period of heavy overgrazing by large mammals.

4. MANAGED FOREST

A managed forest is a forest stand developed as a deliberately designed crop of forest trees produced by the manager or managing agency to meet a particular need or market. This is the forest that emerges as a result of the application of intensive silviculture. It may be a single species, even-aged; or a multispecies all-aged forest depending upon the objectives of the owner. It can emerge from bare ground or from existing natural, secondary, or recovery forests.

In the tropical regions of the world, all of the levels of forestry development are present. Forests are constantly moving through the developmental stages. If the development process follows the pattern of the temperate world of the developed countries, it should be expected that the area of tropical natural forest would decline very rapidly and the area of managed forest would increase slowly and steadily over time. That is a process that seems to be taking place in the presence of a growing demand for wood.

Forest utilization has always been appealing to developing countries as a means of advancing their development. Forests are often readily available and easy to exploit with simple tools. The ships that brought the colonists to New England as often as not carried lumber back to Europe to produce essential currency. Forests produce easily obtainable fuel and structural materials for domestic use. Many of the developing countries of the tropics use wood in advancing their own development and as a source of income just as the American colonists did. The demand for wood will surely increase over time and the pressure on the tropical forests will increase as well.

Information on the use of wood from the tropical countries is very limited. The best data are from the inventories of forests and forest products produced by FAO. In 1977, 80 percent of all the timber harvested in the developing countries was for use as fuel. This fuel inventory is very conservative. It is likely that the percentage associated with fuel is even larger than indicated by FAO. Most wood fuel does not enter the marketplace where it can be measured and counted. In fact it is usually used within a few kilometers of its point of collection. Given the rapid increases in the prices of fossil fuels in the developing countries, the use of wood for fuel will undoubtedly increase in the future. In many of the arid tropical areas the supply of wood fuel is critically short now and rural poor often have to go farther for fuel to cook with than for the food to be cooked. Second, in the level of demand for wood from tropical countries are the structural products, lumber, and plywood. Much of this is also used for domestic consumption, but much more of this material is produced for the international markets often with the participation of multinational forest products corporations.

The issues generally raised among botanists and zoologists in the ecological community are identified with the way in which forests are used. Concern about the loss of species from the gene pool, excessive nutrient depletion, loss of nontimber values, increase in water runoff from watersheds accompanied by increased erosion and lowland flooding and the like is generally focused upon the extent to which forest utilization departs from the natural forest status. That is to say, the extent of forestry development. Retention of the natural forest intact, i.e., no use at all, is the optimum situation from the standpoint of retaining botanical and zoological values.

In some cases this may be essential where sites are particularly fragile or where watershed protection on steep slops is needed to protect agricultural values in the flood plains. The price of this level of forestry development will be

loss of sources of fuel and structural materials and of income derived from these commodities. It will also represent loss of the important food supplies derived from marginal swidden agriculture. It seems to be undeniable that some sites should receive this sort of protection in the long-term national interest. The critical questions that have to be asked are: How much land should be dedicated to this level of development, and which areas of land are selected? Is there an agreement on the part of the country that has custody of the land that this level of development is appropriate? If there is such agreement can the custodial country in fact enforce its decision? The answers to these questions will vary from country to country but clearly the decision cannot be imposed from outside it must be taken by the country in question.

The second level of development is the harvesting of natural or secondary forests without additional management; thus resulting in the return of the stand to secondary forest. This level of forest development is the least severe perturbation involved in forest use for materials supply. If it represents clear-cutting, the harvesting may be dramatic for some years, but in the long run the forest can return to the original status. The loss of significant fractions of the gene pool is not likely to occur. Erosion and nutrient loss is likely to be minimal and of short duration. Since no investment is made in site preparation, planting, and silviculture, the costs carried over the length of a rotation are minimal.

The utilization must recover the cost of harvesting the product and transporting to the market or the point of use. Where fuel is the product these costs are born by the user since the commodity does not usually enter the marketplace. In the case of structural materials the harvesting and transport cost may be substantial and the yield of commodity may be very small indeed. This is particularly true of situations in which the forest and the conversion and marketing facilities are poorly matched. Studies of a low elevation tropical hardwood natural forest in Costa Rica where the only utilization facility available was a sawmill indicated that out of 370 m^3 of volume per hectare of the stems of standing trees only 48 m^3/ha would actually be recovered as lumber where the eight most numerous species acceptable in the market were identified for harvest. If the remaining trees were not also cut, the secondary forest that would emerge would be biased in favor of the non-merchantable species. A similar analysis of a secondary moist evergreen forest in central Thailand yielded 39 (cm^3) of lumber from an initial total stand tree stem volume of 476 m^3/ha. A dry dipterocarp recovery forest in northern Thailand provided a utilization efficiency of 5 percent, and a mixed deciduous forest in northern Thailand a utilization efficiency of 11 percent. In contrast, a secondary pine forest in Honduras gave a utilization efficiency of 44 percent even though the original standing volume was much less than for any of the hardwood stands.

The managed forest represents a greater departure from the natural forest than the secondary forest. Since there is considerable investment in stand establishment and in culural treatment it must recover much more in income from sale of commodities. This means that the utilization efficiency must generally be high. To achieve this usually requires that the stand be much less complex than the original natural forest. Often it means that an exotic species will be chosen for planting. The Eucalyptus plantations maintained by the steel industry in Brazil for the production of charcoal are cases in point. The teak plantations of Java and the Gmelina and Caribbean pine plantations in the Amazon valley are other examples.

The recovery forests are often the most difficult forests to deal with. If the nonforestry human intervention that occurs between harvesting and new forest stand establishment is too long in time and too severe in character, the forest may indeed be lost for a very long time if not forever. Long overgrazing following forest harvesting has resulted in the desertification in the many arid regions. It is doubtful that recovery will occur in many cases without massive human intervention and in some severe cases it is not clear that we have the technology to bring about recovery in any case. The substantial loss of nutrients associated with the growth of repeated crops of opium poppies and of cassava without fertilization in Southeast Asia often result in very slow recovery to a viable forest. On the other hand, the development of very productive pine and Eucalyptus forests on depleted wheat lands in Chile is a forestry success story.

Often the impact of the human intervention after initial forest harvesting is so severe that the recovery cycle must start far back in the domain of ecological

succession. The millions of hectares of impirata grass are testimony to this problem. Studies that we have conducted with colleagues at Kasetsart University in Bangkok indicate that these grass areas do eventually recover to forests but many decades of productive use may be lost in the process.

What should the United States do about this problem? What should we not do? I should like to address the last question first. In my judgment we should not attempt to tell the citizens of tropical countries what to do with their lands and forests. We should not assume that the American experience is automatically transferable or that current U.S. technology is necessarily applicable to tropical settings. We should not try to impose U.S. value systems on the peoples of tropical countries.

We can help the citizens of some of the developing tropical countries to use the power of science to solve their forestry problems just as the scholars and professionals from Europe helped the United States eighty to one hundred years ago. We need to develop a cadre of U.S. scientists and technologists that have a real understanding of tropical forests to help the developing countries when they ask for help. The number of such individuals in the science and technology community for this country is very small indeed. We need particularly to help some of the countries in the tropics to learn to evaluate the viability of developmental options before undertaking the developments. In far too many instances the sale of a concession represents a very large scale and expensive experiment. We try to avoid engaging in this sort of experimentation in the United States and we should help our colleagues in the tropical countries do the same.

I will, however, finish with a word of caution. We cannot afford to advance the proposition that the countries of the tropical region should do nothing with their forests until they fully understand the consequences. Eager for development they will not accept this advice. They may point out that as a nation we did not wait to use the southern pines or Douglas-fir until we had a complete understanding of the appropriate silviculture. We have not reached that stage yet.

Mr. BONKER. Thank you, Mr. Bethel. Now we will move to our second witness on the panel, Dr. Peter Raven, who is the director of the Missouri Botanical Garden. He's also a member of the Committee on Research Priorities in Tropical Biology of the National Research Council.

STATEMENT OF PETER H. RAVEN, DIRECTOR, MISSOURI BOTANICAL GARDEN

Peter H. Raven, director, Missouri Botanical Garden, 2345 Tower Grove Ave., St. Louis, Mo. 63110, and Engelman Professor of Botany, Washington University, St. Louis; adjunct professor of biology, St. Louis University, and adjunct professor of biology, University of Missouri, St. Louis.

Born, Shanghai, June 13, 1936, married, three children.

A.B. (highest honors), University of California, Berkeley, 1957. Ph.D., University of California, Los Angeles, 1960. National Science Foundation Postdoctoral Fellow at British Museum (Natural History), 1960–61. Taxonomist and Curator, Rancho Santa Ana Botanic Garden, Claremont, 1961–62. Assistant, then Associate Professor, Stanford University, Stanford, 1962–71. Associate in the Department of Entomology, University of California, Berkeley, 1964–. Research Associate in Botany, California Academy of Sciences, 1970–. Senior Research Fellow, New Zealand Department of Scientific and Industrial Research, 1969–70. John Simon Guggenheim Memorial Fellow, 1969–70. National Academy of Sciences, 1977–. Fellow, California Academy of Sciences, 1964–. Fellow, American Academy of Arts and Sciences, 1977–.

Officer of the following societies: President, Botanical Society of America (1975); president, American Society of Plant Taxonomists (1972); president, Society for the Study of Evolution (1978); vice president, California Botanical Society (1968–69); interim vice president, Association of Systematics Collections (1972–74); president, Japan America Society of St. Louis (1976–78).

Editorial: Editor in chief, Brittonia (1963–66); editorial board, Memoirs of the New York Botanical Garden (1966–), Flora of Ecuador, Stockholm (1974–), Flora North America (1966–74), Flora Neotropica (1965–), American Naturalist (1967–70), Annual Review of Ecology and Systematics (1971–75), Evolution (1963–65, 1975–), Adansonia, Paris (1976–), Evolutionary Theory (1975–).

Committees: Association of Systematics Collections Council on Systematics Collections and Environmental Quality (chairman, 1973–75); Systematics and Biogeography Subcommittee, US–IBP (1967–76); NRC Committee on "Systematics in Support of Biological Research" (1968–69); Steering Committee, ICSEB–I (1971–73); Smithsonian Foreign Currency Advisory Committee (1972–74); U.S. Committee for I.U.B.S. (1973– , secretary, 1975– , delegate to General Assembly, 1973); North American Regional Group for IUCN Threatened Plants Committee (1974–); NSF Systematic Biology Panel (1973–76); U.S.-Israel Binational Foundation review panel (1973–); Scientific Advisory Board, Pacific Tropical Botanical Garden (1975–); Arnold Arboretum Visiting Committee (1974– , chairman, 1976–); Board of Overseers, Morris Arboretum, and Associate Trustee, University of Pennsylvania (1977–); Board of Directors, Association of Systematics Collections (1977–78); Board of Directors, American Association of Botanical Gardens and Arboreta (1976–80); Council of OPTIMA (Organization for the Phyto-Taxonomic Investigation of the Mediterranean Area (1975–); Commissioner of Tower Grove Park, St. Louis (1971–); University of Missouri School of Forestry, Fisheries and Wildlife Advisory Council (1974–); Chairman, Committee on Research Priorities in Tropical Biology, National Research Council (1977–).

Member of the following additional societies: Phi Beta Kappa, Sigma Xi, Missouri Academy of Sciences, Society of Systematic Zoology, Geological Society of America, International Association of Plant Taxonomists, Botanical Society of the British Isles, A.I.B.S., Nature Conservancy, Audubon Society, Sierra Club, Société de Biogeographie, A.A.A.S., and Sociedad Botánica de México (life), American Association of Museums, Association of Science Museum Directors, American Horticultural Society.

Miscellaneous: Program director, Flora North America (1966–71) and Chairman of the Council (1976–).

Six books and over 200 scientific papers.

Dr. RAVEN. Mr. Chairman, I'd like to speak in a second capacity, as chairman of the National Research Council Committee on Research Priorities in Tropical Biology. I have submitted a written statement with two short articles, which I'd like to have permission to include in the record. Our committee has produced two reports which we have submitted to your staff, which we would not like to have put in the record but which we would like to have used for the purposes of your subcommittee.

The first of these reports, which was published in early April 1980, is a comprehensive study of the rates of forest conversion worldwide. It is one of two studies of the rate of forest conversion worldwide that have been completed in the last 2 years, the other being that for the Global 2000 study for the administration, which is still unpublished but which agrees with ours as to overall conclusions. While there is a problem of definition when we are talking of forest conversion, we're talking about alteration of the forest from its original unaltered form to something else, not necessarily cutting out the forest and leaving a bare field in its wake. I think that is the principal reason for the confusion.

The rate that our study indicates is about 60 million acres a year, in other words an area about 2½ times that which you mentioned in the opening statement, an area about the size of Great Britain each year

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being removed from an area of tropical closed forest which now approximates the size of the continent of Europe. This amounts to an area about the size of the State of Delaware being converted each week.

Mr. BONKER. Excuse me, Dr. Raven. We are going to have various statistics and data submited at some point I hope the staff can sort it all out so that we can come up with some common numbers.

Dr. RAVEN. Right.

Mr. BONKER. Until we understand more fully and accurately the extent of the conversion——

Dr. RAVEN. As I said, our study, which was published about 4 weeks ago and which goes through it country by country with figures, has been submitted to your staff.

Mr. BONKER. OK, we will see if Mr. Bethel agrees with that set of figures. [Laughter.]

It is like most of the issues that we deal with. If we can't agree on a data base it makes it more difficult for policy decisions.

Dr. RAVEN. Our conclusions are the same as those in the Global 2000 study which will be published later this spring. They both indicate that by the year 2000 essentially all tropical closed forests, with the exception of two areas, one in the western Brazilian Amazon and the other in Central Africa, will have been converted.

If these figures are even approximately correct, and I think everyone will agree that they are, they indicate a great urgency to the situation and they suggest that each year we spend in deliberating, results in the loss of a very large further extent of tropical forests. One of the great fallacies about this is that the development of tropical forests is the same as development of forests in temperate regions and like the development of forests in temperate regions, it relates to the production of stable systems that will support human beings.

In fact, this is not the case and the comparison is very dangerous. It is a leading example of attempting to transfer temperate zone technology to the tropics in an inappropriate manner. The current Brazilian estimate is that 0.3 of 1 percent of the land in forests in the Amazon basin can be put into sustainable agriculture using currently available technology. And our estimate would be that approximately 95 percent of all the land in the tropics that can be put into sustainable agriculture is already in cultivation.

Viewing this against the population growth in the tropics makes the picture especially frightening. Populations of tropical countries on the whole are doubling every 24 years on the average, and this indicates, for example, that since 40 to 50 percent of the people of tropical countries are under 15 years of age, even with the most stringent and immediate adoption of population control measures, nothing whatsoever can be done to slow down the process of population growth for about 70 or 80 years, at which time the population of the world will be about 16 to 18 billion people. That is the lowest ultimate projection that anybody in the United Nations or a comparable competent body has come up with.

This means very simply that by the year 2000, something on the order of 125 million people will be added to the population of tropical countries each year. And in thinking about the ability of disturbed ecosystems to recover, one has to keep in mind the fact that this popu-

lation pressure will by and large not allow, in view of the next factor I'm going to mention, using Latin America for example, in Latin America 7 percent of the people own 93 percent of the arable land. In Latin America as a whole, one-third to one-half of the population is undernourished by U.N. standards at the present time. In the United States the comparable figure would be 7 percent of the people own 20 percent of the land.

Since it has already been brought out that these large holdings of land are used mainly for the production of export crops, it is not far from the truth to say that the remaining 93 percent of the people must find their food from not much more than the remaining 7 percent of the land.

As an example of this, I mention the fact that one-third of the forests in Central America have been cleared in the last 20 years, largely to produce beef for the American market and keep the prices down here. During this period of time the consumption of beef per person in Central America has dropped each year and now is at an alltime century-long low.

Brazil plans to produce alcohol as an energy source and solve its energy problems that way, by growing large amounts of sugarcane and this is widely applauded. But it should be remembered that in thinking about this, if they meet their goals, one-sixth of the currently cultivated lands in Brazil will be taken out of production for food to produce alcohol so that people can drive their cars and operate their machinery.

Brazil is a country where about 30 million people are malnourished at present and where the population of 90 million people will double in the next 23 years.

As an example of what we know about tropical forests, and I'm disappointed that very little has been said about the necessity for gaining additional knowledge so far, let me point out that our committee has estimated that there are about 3 million kinds of organisms in the tropics and something on the order of one out of six of these have ever been cataloged and given a name.

To bring this a little closer, down to specifics, it is estimated that in the Amazon and its tributaries, there are about 5,000 kinds of fishes and that around 2,000 of these have never been cataloged and given a name, never have been seen by any scientist and studied or dealt with in any way. Yet we are all too apt to talk lightly about the potentiality of creating great fisheries in the Amazon Basin, which would be roughly analogous to trying to make an airplane or computer when you only know about three-fifths of the parts when you are beginning. You only knew they existed.

The U.S. and worldwide efforts in providing basic information for floating all the development schemes in which we are interested is pitifully small. Starting with the NSF investment of about $9 million in fiscal 1979, total U.S. efforts in the area of producing basic information about our tropical forests amounts to no more than $20 million, which is undoubtedly over one-half of the world's total.

There are no more than 4,000 people who are expert in tropic biology and ecology in the entire world, and these are the ones who are supposed to solve the problem.

Now various programs, as the man and biosphere (MAB) program, which is a very good program, the efforts of the National Science Foundation, and new and very impressive efforts under U.S. AID are beginning to either work on this or take cognizance of the facts. But unfortunately when they try to get budget allocations, they run across a double antipathy—the hidden antipathy in the United States to fund environmental research, so that the total Government expenditure in this area is extremely low, I would estimate scarcely over $50 million as opposed to applications of environmental research, and an antipathy to foreign activities as such as opposed to dealing with more pressing domestic problems.

Now to summarize, during the next 30 years, at the end of which a majority of the people who are alive today will still be living, the proportion of people in the world living in the tropics will be close to two-thirds. Of the rest, about one-sixth will be living in China and about one-sixth will be living in the United States, Canada, Europe, the Soviet Union, Japan, Australia, New Zealand, and temperate South America and Africa combined.

Since about 95 percent of the arable land in the tropics is already cultivated, there is only about 5 percent to add and to gain any further efficiency as the populations virtually double. The 400 million people who now make their living in tropical forests by cutting them and growing a few crops will have doubled to about 800 million people, and they will be essentially out of luck, out of more resources to cut. Undisturbed tropical forests will have essentially been eliminated as a global resource, and we estimate, in company with the Worldlife Wildlife Fund, U.S., and other institutions, that about 1 million species and organisms, plants and animals, mostly unknown, will become extinct during this 30-year period.

In addition, in the relentless search for sources of energy, I think it is inevitable that unless we do some quick thinking and some quick helping, nuclear power is likely to proliferate through the developing countries of the world as the only short-term inexpensive means by which they can overcome the need to expend vast sums for petroleum or something else, which they haven't got.

I would hope that in these brief remarks I have made it clear that I do not consider this just or even principally a matter of wood supply or forestry or management of a resource. I think that except in the very broadest sense of the word, the whole world, including the United States, is now suffering from inflation, stimulated in part by the lowering productive capacity of many ecological systems simultaneously. That is a factor we often ignore, while our new failure to obtain raw materials, many of them of tropical origin, as cheaply as formerly, we are beginning to feel the effects of this.

Now you asked for reasons why the United States should be involved. Given the sort of scenario I've just presented, isn't it a matter of vital interest for the United States to redouble its efforts in this area while there is still some time? And put differently, can we in our institutions really expect realistically to survive in something like their present form into the 20th century if we don't get busy on this problem and regard it as a matter of national priority, starting right now?

[The prepared statement of Dr. Raven follows:]

PREPARED STATEMENT OF PETER H. RAVEN, DIRECTOR, MISSOURI BOTANICAL GARDEN

My name is Peter H. Raven, Director of the Missouri Botanical Garden in St. Louis, one of the leading institutions involved in the study of tropical plants. I appear before you today primarily, however, in my role as Chairman of the National Research Council Committee on Research Priorities in Tropical Biology which, for some two and one-half years, has been attempting to formulate a policy for the acquisition of basic knowledge about tropical plants and animals and the ecological systems in which they occur over the course of the next few decades. The deliberations of our Committee, which has included scientists from the United Kingdom, the Federal Republic of Germany, Brazil, Mexico, and Costa Rica in addition to the United States, with consultants from throughout the world, have resulted in the production of two reports. One, entitled "Conversion of Tropical Moist Forests," was published in April 1980; and the second, to be entitled "Research Priorities in Tropical Biology," will be published on approximately May 24, 1980. The first of these is the most recent and comprehensive study of its subject matter; the second, a broadly based plan for action.

The points I wish to emphasize today are concerned with (1) the biological complexity and richness of tropical forests; (2) our lack of knowledge about these forests; (3) the limited effort being undertaken on an international scale to learn more about them; (4) the speed of destruction of the forests and the reasons for this destruction; (5) the consequences of this destruction for the United States and other industrialized countries; and (6) the steps that, in my opinion, ought to be taken on an urgent basis to alleviate these consequences.

In connection with these points, I would like to ask the Chairman's permission to enter into the record two short essays: "The Destruction of the Tropics," from Frontiers 40: 22-26, July 1976, and "A National Commitment," from the St. Louis Post-Dispatch of March 25, 1979.

As to the biological richness of tropical forests, it is estimated that there are collectively in the temperate regions of the world some 1.5 million species of plants and animals, of which over a million have been catalogued to date. For the tropics, it is estimated there are approximately 3 million species of plants and animals, of which only about 500,000 have yet been recognized and catalogued. A large majority of virtually every known group of organisms occurs in the tropics, and tropical forests therefore comprise the richest and most diverse association of plants and animals found anywhere on earth. For example, there are about as many kinds of plants in the tiny country of Panama as there are in the entire continent of Europe, and nearly as many kinds of fishes in the drainage basin of the Amazon River as in the whole Atlantic Ocean - - some 5,000 kinds. The diverse kinds of plants and animals in the tropics represent a potentially inexhaustible source of raw materials for human commerce, only a minute fraction of which has been utilized or even tested up to this point.

Not only are the natural ecological communities of the tropics extraordinarily rich in plants and animals, the organisms that make them up are linked together in ways that are extremely complex. Ecologists speak of the flow of energy originally from the sun, through the ecosystem, following its fixation in the leaves of green plants by the process of photosynthesis. The energy, now in chemical form, is passed along through a series of plants and animals until finally, following the death of the ultimate member of the chain, it again is radiated into space. The cycling of mineral nutrients from the soil, which takes place in all ecosystems, involves a kind of a balance by which essential elements such as calcium and phosphorus pass into the roots of plants, become incorporated in the plants themselves, are taken from the plants into the animals that consume these plants, and again are passed along in the ecological system through a series

of steps until they are returned ultimately to the soil by the decomposition of living matter.

These processes - - the flow of energy and the cycling of minerals - - which are complex and poorly understood even in temperate regions, are virtually unknown for the tropics. The rich and diverse communities of plants and animals that occupy tropical soils are relatively stable when undisturbed. They have remained stable for millions of years, and are as appropriate to the climate and soils of their areas as are our forests, swamps, and prairies in the United States. When we plow up a prairie in our own Midwest, we modify a natural ecological system to produce another productive system from which we can obtain on a sustained basis products useful to us. When we cut down a forest in the humid lowland tropics, we are often trying to accomplish the same thing. There is, however, a vast difference between the ecological processes initially involved in each case, and this difference has potentially tragic consequences for a large and rapidly growing portion of the human race. Cutting down the sorts of forests that occupy most tropical areas usually makes possible a reasonable agricultural yield for only a few years, following which the cut-over area, depleted of its fertility, often becomes a virtual wasteland, impossible for all practical purposes to restore to its original state or to use for any productive purpose.

Our knowledge of tropical organisms is such that only about one in six of the estimated three million kinds has been catalogued. Although the vast majority of these are insects, mites, nematodes, fungi, and other relatively small organisms, our lack of knowledge applies also to many others which are larger and more familiar. To give just a few examples, we estimate that something on the order of 10-15 thousand kinds of plants in Latin America, including many trees, have not yet been described and listed. Since these trees, which constitute perhaps

an eighth of the total, are unknown, there is no way in which they can be utilized rationally for human benefit. The approximately 5,000 kinds of fishes believed to occur in the Amazon Basin and its tributaries has been mentioned above. We count on being able to manipulate the populations of these fishes to produce more abundant human food in the future. Competent students estimate, however, that approximately 40 percent of them are still to be recognized and catalogued. In other words, we are attempting to manipulate a system in which only somewhat over half of the elements have even been registered, much less understood. Imagine trying to build a computer or an airplane from such a starting point! To provide an example of another sort, the functioning of the basic coupling relationships known as mycorrhizae which involve fungi and the roots of trees and which are of essential importance in the recycling of minerals in tropical forests, has been demonstrated experimentally only within the past five years during the course of research conducted under the auspices of the very progressive and valuable, but poorly funded, international Man and Biosphere Program (MAB). Despite its recent discovery, this relationship is of profound importance, both for the stability and proper functioning of the forests themselves, and also in connection with our ability to convert these forests for other productive purposes. The coupling is so tight that only a thousandth of the nutrients that reach the top of the layer of leaves on the forest floor penetrates even two inches to the subsoil beneath. It is a small wonder indeed, given this profound lack of understanding of the tropical forests and their functioning, that our efforts to manipulate them for human advantage have so often resulted in total failure.

Objectively, it is of great importance to know more about tropical plants and animals and the functioning of the productive systems in which they occur, not only

because of the basic scientific importance of this knowledge, but also because of the role that it might play in promoting human welfare. Kinds of plants that have not yet been discovered might well contain chemicals that would assist in the cure of cancer, for example, and approximately 45 percent of the prescriptions written in the United States contain at least one product of natural origin. Many important crops have been brought into cultivation only recently. For example, the oil palm, which has become a multibillion dollar industry on a world scale, has come into widespread cultivation only during the past half century. Many other examples of new crops and of useful purposes to which wild plants might be put are documented in a series of publications recently published that are based on reviews conducted by the National Research Council.

In contrast to these potentially useful purposes to which wild organisms can be put, there are many such organisms that are potentially harmful. For example, the brown leafhopper, a small insect that has caused several billion dollars of damage to the rice crops in Southeast Asia during the past five years and reduced millions of people to starvation, is a member of a group of insects comprising more than 20,000 known species which can be identified competently by only about a dozen people in the entire world. This pest was virtually unknown until it appeared, literally by the billions, on the rice fields of Southeast Asia three years ago. In general, in the tropics the pressure from pests and diseases is so great that it is very difficult to grow single crops in pure stands over any but the smallest areas; this is only one of the difficulties standing in the way of the creation of productive agricultural systems or of reforestation projects like those that are common in temperate regions. At any rate, without basic knowledge of tropical plants and animals we shall be unable either to find useful ones to serve our purposes, or to understand the potentially harmful ones well enough to prevent their depredations on our crops and domestic animals.

Against this background, it is literally an embarrassment to catalogue the tiny effort that is being undertaken to learn more about tropical plants and animals and the natural communities in which they live. Worldwide, it is estimated that there are no more than 4,000 scientists primarily concerned with studies of this kind. The total for the United States amounts to some 1,500 individuals. Worldwide, there are probably no more than 1,500 scientists who are able to catalogue and describe tropical organisms, or even competent to make professional identifications of them. Recall that five out of six kinds of tropical organisms are unknown to science and have never been seen by any professional student. These unknown organisms amount to a staggering total of some 2.5 million species, or about twice as many as all those that have been described during the past 225 years.

Only a handful of individuals in the United States is competent to supervise and undertake large-scale studies of tropical ecological systems involving experimental modification, and no more than three of these individuals are engaged in studies in the tropics at present. Worldwide, the total of scientists competent to undertake such studies amounts to no more than two dozen. Notwithstanding this great lack, every single one of the forestry and agricultural systems that is being proposed for the tropics rests for its ultimate success on an understanding of the functioning of the undisturbed ecological systems that are being replaced.

Current estimates indicate that in Fiscal 1979, the total U.S. expenditure for basic knowledge in tropical biology was roughly as follows: National Science Foundation, $9 million; Smithsonian Institution, $4.7 million; U.S. Forest Service, $1.8 million (Puerto Rico and Hawaii); Department of Energy, $1.6 million (mainly in Puerto Rico). The amount of additional funding by other government agencies, such as the Department of Interior, and by private institutions of all kinds, would

bring the total for basic research in tropical biology for the U.S. to no more than $20 million. Worldwide, this almost certainly represents more than half of the total, especially in view of the fact that the tropical countries themselves are rarely able, for reasons I shall review shortly, to divert significant funding into research or even development. Viewed for any conceivable direction, it is clear that our collective human effort to learn more about tropical plants and animals and the associations in which they occur is very limited indeed.

The extremely serious nature of these deficiencies can be understood properly only when viewed against the background of tropical deforestation. Briefly, the lowland tropical forests that a century ago comprised an area twice the size of Europe have now been reduced to about half of their former extent. From the present area, a piece of tropical lowland forest about the size of the island of Great Britain is being removed every year and an area about the extent of the state of Delaware every week. Such a rate of destruction, if applied uniformly, would result in the disappearance of all unaltered tropical forest in approximately 30 years, but of course the rate is not evenly distributed around the world. Our Committee has estimated that within 20 years, the only extensive tracts of undisturbed tropical lowland forest anywhere will be those in the western Brazilian Amazon and in Zaïre in central Africa; these will be altered and deforested during the course of the first ten to twenty years of the 21st Century.

In my opinion, this process of alteration is essentially irreversible for the following reasons. First, it is closely connected with population growth in tropical countries, the great majority of which are growing at such a speed that the numbers of their people will have doubled within 25 years. Because of the fact that in most tropical countries between 40 and 50 percent of the population consists of individuals less than 15 years of age, even the immediate adoption of consistent and sustained population control policies would not bring the situation into stability

until the latter part of the 21st Century, at which time we would have a world population of some 16-18 billion people, or about four times the present level. Second, the patterns of land use and exploitation of tropical regions are such that a very small proportion of the land is used to feed the hungry poor. In the United States, the largest 7 percent of the land owners own 27 percent of the arable land; in Latin America, the largest 7 percent of the land owners own 93 percent of the arable land. Since most of this land is utilized for reproduction of cash and export crops to earn foreign credit, the remaining 7 percent of the land must in general produce sufficient food for the vast majority of the people. It is the operation of international commerce in conducting and guiding the exploitation of the 93 percent of the land controlled by large land owners that plays such a significant role in structuring the economies of tropical countries.

At any event, about two-thirds of all destruction and alteration of tropical forest is caused by forest farmers - - poor people who cut out a section of forest and grow a crop or two before the soil deteriorates to the point where further cultivation is no longer feasible. The remaining destruction of tropical forests depends upon a variety of other factors. In Southeast Asia, the wholesale exploitation of forests for timber by foreign-owned corporations without more than a gesture towards the replacement of the forests is the major factor. In Latin America, it is often the relentless effort to produce cheap beef for the United States and other developed countries that is causing the disappearance of the forests over vast areas. In this connection, it is ironical to note that while more than a quarter of all the forests in Central America, for example, has been destroyed during the past 20 years to produce beef for the American market, the average consumption of beef in the countries concerned themselves has declined

steadily during the same period.

Everyone who reads the popular press nowadays is aware that tropical forests are being destroyed rapidly. There is, however, a general attitude that the destruction of these forests is warranted, since it is thought that it will lead to the implementation of productive forms of agriculture which in turn will help to feed the hungry people of the world - - much as the clearing of the forests in Europe and North America made possible the wide spread of productive agricultural systems in these regions over the centuries. Unfortunately, the comparison is totally without basis in fact. For example, the current estimate of many Brazilian officials is that of the vast area in the Amazon Basin occupied by lowland forest, approximately 0.3 percent can be put into sustainable agriculture using currently available technology. In Brazil, a country of some 90 million people, of which about a third are malnourished at present, about 95 percent of the land that is capable of being put into sustained agricultural productivity is already under cultivation. The steps by which malnutrition might be held even at the same proportionate level as it is now, while the population of Brazil doubles during the next 23 years, are unclear to me. Indeed, if the current plans of the Brazilian government to alleviate their energy shortage, which is acute, by planting sugarcane for the production of alcohol are implemented, approximately one-sixth of the currently productive agricultural land of Brazil will be taken out of production, a sacrifice that surely cannot be sustained in a country where a very large number of people are malnourished.

The kinds of cattle ranches that have been developed with such enthusiasm throughout Latin America during the course of the past 20 years have now been shown to be ecologically unstable; in those that have been developed on the vast majority of soils occupied by tropical lowland forest the fertility declines over

a period of 10-20 years to the point where profitable cattle production is no longer possible. For most tropical soils, the application of fertilizer - - even if energy and funds could be found to purchase such fertilizer - - does not restore the fertility of the soils. Under the influence of beating tropical sun and high precipitation, the structure of many tropical soils simply disintegrates to the point where they are unable to retain nutrients. A number of kinds of tropical soils harden into cementlike layers called laterites which then become impervious to the plow and which are essentially useless for agricultural purposes. Only much greater attention to the functioning of undisturbed tropical ecological systems coupled with the experimental manipulation of these systems to try to find productive agricultural systems that could be based upon their properties will succeed in alleviating this problem. Despite this, probably well under $5 million a year worldwide is being spent to try to learn about the basic properties and functioning of tropical ecological systems.

Everyone knowledgeable about the field recognizes that the conservation and the wise use of natural resources in the tropics must go hand in hand. The World Conservation Strategy, recently promulgated by the International Union for the Conservation of Nature and Natural Resources, makes this point explicitly and well. What people often fail to realize, however, is that the basic component in such wise use and development - - basic knowledge - - is often lacking. It is all too easy to assume that the information is there and that the implementation of schemes of development proceeding on currently known principles will not meet any insurmountable obstacles. It is all too easy to assume that productive systems can be put in place and all too attractive to try to put them in place without making an investment in finding out just why they would or would not work, and in trying to find ways to improve the results in the future.

Aside from anything else, the loss of biological diversity in the tropics will have serious consequences for the human race. Assuming an essentially irreversible destruction and conversion of tropical forest such as that outlined above, I estimate that approximately a million kinds of plants and animals will become extinct over the next 30 years, and possibly another million during the course of the 21st Century. Such a rate of extinction is postulated not only upon the destruction of the natural communities in which these plants and animals occur in nature, but also because many of them simply do not reproduce themselves outside of undisturbed tropical forest. Although we are gaining in sophistication in this area, current efforts in the field of conservation tend still to concentrate on a few obvious or well known kinds of plants and animals such as the Furbish lousewort, the snail darter, or the California condor, while tens of thousands of other species, doubtless including many of potential usefulness, go extinct without fanfare as the years go by. Probably 20 times as much is being spent annually to try to preserve the roughly 30 surviving individuals of the California condor as is being spent to try to find new kinds of tropical plants which may provide important sources of food, fuel, or medicine for human populations: yet which kind of action has the greatest potential for alleviating human misery and helping to create a stable world?

Each species that occurs in nature is genetically unique. When any species is extinct, it is gone forever and there is <u>nothing</u> that can be done about it. We cannot study it; we cannot use it; and we cannot develop it into something better. Viewed in these terms, the loss of a quarter of all the kinds of plants and animals that exist in the world during the next thirty-year period, and of another quarter during the following century, ought to be a matter of the most extreme concern for every human being, not only as a matter of intellectual curiosity, but also because the potential of all of these kinds of organisms to aid in the amelioration of the human condition is being lost irrevocably.

By the end of this century, within just 20 years, three-fifths of all of the people in the world will be living in the tropics and one-fifth in China. The remaining fifth of the world's population will include all those people living in the United States, Canada, Europe, the Soviet Union, Japan, Australia, New Zealand, temperate southern Africa, and temperate South America. The proportion of people living in the tropics of the world will become progressively higher during the course of the 21st Century. Since current technology has not indicated a way to bring into cultivation more than five percent additional arable land in the tropics; since the world's fisheries are badly depleted and declining; since the roughly 400 million people who currently make a living by clearing and farming small plots in tropical forests will have doubled in number and be essentially without any place to turn by the end of the present century; since there is no obvious source for energy for most tropical countries other than continuing to burn up their forests, displacing productive agricultural systems with energy-producing crops, or developing their nuclear capabilities; and since the total excess food productivity possible in temperate regions will be patently unable to feed the roughly 125 million people that will be added to the populations of tropical countries each year during the first part of the 21st Century, the world picture is by no means a promising one. The shortages of many kinds of commodities formerly obtained by the developed countries of the world from the tropics at very low prices certainly are beginning to contribute to worldwide inflation already, and they will do so to an even greater extent in the future. I have referred above to the fact that whenever we in the United States increase our quotas for imported beef, for example, additional large areas of tropical forest in Latin America are converted to pasture and thus for all intents and purposes "expended" permanently during a period of 20 years or less.

The United States and all the other temperate, developed countries of the world, which collectively will comprise only 20 percent of the world population

by the end of the century and an ever-decreasing proportion thereafter, ought as a matter of self-interest and national security to begin to contribute in a substantial way to the development and emplacement of sustainable productive agricultural and forestry systems in the tropics. We must fund adequately appropriate programs to learn more about the functioning of tropical ecosystems and about the organisms that occur in them. We must utilize this knowledge for human benefit as directly as possible. We must take steps to increase the number of scientists competent to deal with such problems, both in the United States and in the countries directly concerned. Legal authority to conduct programs overseas must be granted to branches of government such as the Department of Interior which have the capability to make a strong contribution in this area. Greatly increased funding needs to be provided for studies in environmental biology, especially in the tropics, for agencies such as the National Science Foundation and programs such as MAB which have a proven track record in this area. Increased attention ought to be paid in our foreign-aid programs to the importance of building local capabilities to provide appropriate factual input so as to avoid launching ill-conceived development programs doomed to failure from their inception.

The ways in which we are all using an ever-smaller supply of natural resources worldwide is properly a subject of concern for everyone. The United States can exist and prosper only in a relatively stable world made up of relatively stable countries, and we must contribute on an urgent basis to the preservation of this stability if we are to enjoy its benefits in the future. Indeed, it is difficult for me to see how our way of life and the institutions it comprises can survive, much less prosper, during the course of the 21st Century unless we seize the opportunities that are available to us at present but which will be greatly diminished.

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A National Commitment

(By Peter H. Raven)

By the time a child born this morning reaches his 21st birthday, about 1.8 billion people will have been added to the world population, for a total at that time of roughly 6 billion human beings. Three-fifths of these people will be in the developing countries of Latin America, Africa, and tropical Asia; one-fifth in China; and the remaining fifth in the United States, Canada, Europe, the U.S.S.R. Australia, New Zealand, and Japan together.

As the 20th century comes to a close, the world production of petroleum will be falling steadily behind the demand. We shall be much more dependent than we are now on foreign countries for minerals and other materials crucial for our economy, and both food and energy will cost much more than they do now.

In view of what the future holds in store for us, it is clear that our actions during the few remaining years of this century will determine whether and in what form the complex of institutions, aspirations, and concepts that we know as civilization will survive in the next century. Only by helping to promote the stability of Third World countries can nations such as the United States provide for their own future.

There are many signs that the natural productivity of the earth has been severely and perhaps irreparably damaged by the activities of the 4.25 billion people that make up the population of the world. Lester Brown of the Worldwatch Institute pointed out in his recent book, "The Twenty-Ninth Day," that four of the most important ecological systems which sustain human life—oceans, forests, grasslands, and croplands—are showing clear signs of stress under what amounts to full occupation, if not already overexploitation.

The annual world catch of fish, at 70 million tons, is greater than the annual yield of beef. This catch grew from 21 million tons in 1950 to the present level in 1970, but it has not increased subsequently, even though there has been a 50 percent increase in the gross tonnage of large ships engaged in fishing during the last eight years. Sharp declines in local catches of fish strongly suggest that the increasingly polluted oceans are already being fished beyond their total capacity to produce.

Trees provide the principal source of energy for a third of the world's population, some 1.4 billion people. They are also the focus of enormous and growing demands for building materials and for pulp to make paper. Hungry people are felling trees all over the warmer parts of the earth, even though the shallow, newly exposed soils of these regions can usually provide crops for two or three years at best. Nearly 2.5 million square miles of tropical forest, comprising over 40 percent of the total, has been cut in the last 150 years, and the remainder is expected to last not more than 50 years. When all the forests are gone, the more than 250 million people who make their living by slash-and-burn agriculture in the tropics, and their children, will have no place to turn.

Throughout the world's 10 million square miles of grassland, overgrazing has led to erosion, new deserts are being formed, and the fertility of the soil is being depleted on a vast scale. In the Sahel, fragile grasslands that were formed during the unusually moist early decades of this century, were so heavily exploited that the resulting crash led to the famines of the 1970s. At the eastern end of this region, the results of overgrazing and reforestation led directly to the overthrow of Emperor Haile Salassie of Ethiopia, where a million people are currently reported to be starving.

During the 20th century, as the world population has shot upward, farmers have increasingly been forced onto unsuitably steep slopes, or into dry areas. In consequence, spectacular examples of erosion are seen throughout the warmer regions of the world. The steep cultivated slopes of countries such as Ethiopia and Nepal are losing topsoil at an alarming rate, and major floods are frequent on the plains below. Even in the U.S., there are indications that the long-term productivity of our wheat lands is being decreased as the rise in world prices brings more and more areas into steady cultivation for short-term gains. Worldwide, topsoil is being lost faster than it is being replaced.

Despite these clear indications of worldwide ecological stress, population is growing at a rate that experts project will lead to a doubling of the world population in just 41 years. During the remaining years of this century, 1.4 billion people will be added to the 2.2 billion who live now in the poorest areas of the world—Latin America, Africa, and tropical to subtropical Asia.

In contrast, "only" 177 million people will be added in the developed countries during the remaining years of the century for a total population in these countries of about 1.3 billion people in the year 2000. To illustrate what population growth will mean in some specific developing countries, consider three examples: India, Brazil, and Mexico.

India, with a current population of 640 million, has an annual growth rate of 2 percent and a per capita income of $635. Two out of five Indians are less than 15 years old, and well over 150 million are chronically poor and undernourished. Former Prime Minister Indira Gandhi's attempts to promote population control by introducing compulsory sterilization in some of the more overpopulated areas of India contributed directly to her overthrow. The poorest third of the population in India has apparently been little affected by U.S. or other foreign aid, or by the so-called "Green Revolution"; such efforts have largely improved the lot of those who were more fortunate initially. Between now and the end of the century about 300 million people will be added to the population of India.

Brazil is extremely poor in energy resources, importing more than half of its total consumption through the 1970s. Forests, the traditional source of fuel in Brazil, have been ravaged near all of the cities, and serious inroads are being made into the forests of the Amazon Basin. Only about 5 percent of the land of Brazil can be cultivated successfully with present technology, and crops are being grown over this entire area. Virtually no research is being done, either by Brazilians or by foreigners, into how to make the remaining 95 percent of the country more productive on a sustained basis.

The population of Brazil will roughly double to over 200 million people in the next 25 years. If sufficient capital is found between now and the end of the century to duplicate every unit of housing, every road, every liter of fresh water, all of the food productivity, all schools and institutions of every kind, and all of the other elements involved in determining the quality of human life in this energy-poor country, the Brazilians of that time would be only as well off as those who are alive today. There would then be more than 30 million malnourished and neglected children, and all of the other problems of the country would have multiplied at least in proportion to the growing population.

Bolstered by recent major oil discoveries, Mexico nevertheless faces problems similar to those of Brazil, including one of the fastest rates of population growth anywhere. By the end of the century, Mexico City is projected to have more than 30 million people, and to be the largest city in the world. Reflecting Mexico's population pressures as many as six million Mexicans are now living illegally in the U.S. A million more illegal immigrants are turned back at the border every year, while approximately 800,000 from Mexico and elsewhere are successful in entering. Together with the 400,000 legal immigrants who enter the U.S. annually, they contribute almost as much to our annual rate of population growth as does the natural increase of the resident population (1.3 million annually).

If present trends continue, one out of eight people in the U.S. at the end of the century will be either immigrants or the children of immigrants who enter in the 21 years between now and then. The number of illegal aliens employed in the U.S. at present is thought to be about 6 million, roughly equal to the total of Americans who are out of work and actively seeking jobs.

Even with our current levels of destructive exploitation of the world's productive capacity, one in four of the people in Latin America, Africa, and tropical Asia is undernourished. This amounts to more than 500 million people. At least 15 million children die each year of malnutrition and related diseases, and in some countries three out of five children die before they reach their fifth birthday. For the past 20 years the production of food in developing countries has barely kept pace with population growth, indicating that about twice as many people are undernourished and starving in these countries as 20 years ago.

The future looks even bleaker. The United Nations has estimated that population will grow faster than food production in each of the three main developing areas of the world for each year for the next decade. Even if the growth in food supply continues to equal growth in population, the absolute numbers of malnourished and poor people will increase with the growth of the general population, and therefore double by early in the next century.

The kinds of major ecological stresses that have become evident worldwide during the 1970s have already placed severe limits on our capacity to squeeze more food production from a badly wounded earth. Since food production in the U.S. is nearing its limits, significant increases can take place only within the developing countries.

The lands now under cultivation in these countries can probably be increased by no more than 1 percent, and possibly less. Therefore, the yield per acre in Third World countries will have to grow at between 3 and 4 percent per year between now and the end of the century if any progress is to be made in reducing malnutrition. Such a goal could be approached only with massive assistance from the U.S. and other developed countries. Whether the reward is calculated in terms of prices in our own supermarkets, the alleviation of human misery, or the world stability that is ultimately the only source of national security, it is clearly a matter of urgent priority to increase greatly our financing research into food production and nutrition worldwide.

Any effort to assist developing countries in achieving self-sufficiency in food production must be linked with population control assistance, if stability is the ultimate aim. Although 81 percent of the Third World's people live in countries whose governments have adopted a policy of limiting population growth, many people in the U.S. believe that it is immoral for us to provide assistance in this area—even though millions may be starving to death annually in the same countries. Since 1965, we have spent about 5 percent of our total foreign development aid, some $1.2 billion, on population control assistance. We are now encouraging countries such as West Germany and Britain, which devote a much smaller proportion of their efforts to such assistance, to come up to at least our level.

Another ecologically based problem which threatens world stability is that of energy. One of the most incredible phenomena of the age we live in is our apparent inability to act on the well established fact that world supplies of both petroleum and natural gas, our two most important sources of fuel, will begin to fall behind the demand for them within the next 20 years. Unless major alternative sources of energy have been developed and are in place by 1990, crippling economic disruption will certainly result. In this light, President Jimmy Carter was absolutely accurate when, in his energy message to Congress in the spring of 1977, he declared that finding a solution to the energy problem was the moral equivalent of war.

Both nuclear power, the traditional "cure-all" for future energy shortages, and the exploitation of coal reserves present anxious problems. The disposal of waste from plants utilizing nuclear fission technology has been described aptly by Paul Ehrlich of Stanford University and his colleagues in their excellent and comprehensive "Ecoscience" as a "million-year" problem, and one which we are nowhere near solving. Uranium, the principal fuel for nuclear power plants, is in short supply, and largely imported. The danger of nuclear fuels falling into the hands of terrorists, or proliferating in the form of weapons, is enormous. As Lester Brown of the Worldwatch Institute has pointed out, even one nuclear catastrophe, statistically certain to happen eventually, would set off a widespread demand for the closing of nuclear plants everywhere.

As a result of these severe problems, the spread of nuclear technology and the rate at which it will be able to contribute to the world's energy needs have both slowed considerably over the past few years. John Holdren, University of California scientist, concluded after a careful study of the alternatives that no substantial and safe contribution to the world energy budget from this source could be made until at least 40 years of large-scale investment in research and development had been made.

The problems with increasing our consumption of fossil fuels, including coal, have mainly to do with their environmental effects. Many of these effects, such as sulfur dioxide pollution or the environmental consequences of strip mining, are familiar, and can be solved, although the solutions will be expensive ones.

A more fundamental problem has to do with the effect of burning fossil fuels on the proportion of carbon dioxide in the earth's atmosphere. Our atmosphere acts like a huge greenhouse, trapping a portion of the sun's heat. The amount of heat trapped increases with the proportion of carbon dioxide in the atmosphere, and this in turn makes the world's climate warmer. Consequently, most scientists are concerned about the rise in carbon dioxide in the atmosphere from about 290 parts per million in 1850 to 330 now. They predict that this proportion might be doubled in the next 40 years if the burning of fossil fuels and the cutting of forests continue at their present rate.

If that is allowed to happen, the world's climate would be warmed enough to cause less rain to fall over the main agricultural areas of the American Midwest. At least part of the South Polar Ice Cap would probably melt, leading

J. H. Mercer of the Institute of Polar Studies at Ohio State University to predict a worldwide rise in sea level of about 16 feet—sufficient to drown large sections of all coastal cities. Such probable consequences led L. Machta of the National Oceanic and Atmospheric Administration to predict that by the turn of the century the concentration of carbon dioxide in the atmosphere would be the most important factor controlling the patterns of global energy usage. Massive reforestation schemes may then prove to be necessary, as one method of removing carbon dioxide from the atmosphere and reversing these trends.

Against the background of these problems, the sun stands out as a source of energy that is renewable, inexhaustible, and harmless to the environment. Earlier this year, the President's Council on Environmental Quality estimated that, if properly subsidized in its developmental stages, solar energy, including the harvesting of plants, could supply a quarter of the nation's energy needs by the turn of the century, more than half by the year 2020, and virtually all subsequently.

Even Saudi Arabia, mindful of its dwindling petroleum supplies, has set a goal of complete dependence on solar energy within 20 years. In Tabuk, Saudi Arabia, Sverdrup & Parcel of St. Louis is developing the world's largest solar energy plant, which will have nearly one and a quarter acres of solar collectors. Despite the emerging consensus about the potential importance of solar energy, the U.S. Administration has yet to take a clear position on a national policy concerning it.

The greatest increase in the supply of energy in the United States, however, and one with major economic advantages, could be obtained simply by energy conservation. On a per capita basis, our consumption of energy is roughly double that of any other nation in the world, including Sweden, West Germany, and the Netherlands, which have a standard of living as high or higher than ours. Experts in energy agree that using a third less energy would not reduce the U.S. gross national product or employment.

The problem of energy conservation was brought into sharp focus recently in a study of the energy needs of California by the Lawrence Berkeley Laboratory. The study concluded that simply by improving the efficiency of new refrigerators in California, enough energy could be saved to make a controversial proposed nuclear-power plant unnecessary. A 10-year program for energy conservation in California, with capital costs of about $5 billion, would provide an average annual return on investment of 40 percent, enough to create about 60,000 new jobs in the state when redirected to more labor-intensive uses.

Our present trade deficit, due entirely to oil imports, is accelerating inflation and unemployment, threatening the world monetary system, and destroying the value of the dollar. We collectively accept this deficit to allow ourselves to import somewhat more than a tenth of our total energy needs, all of which is clearly wasted by any standard that has ever been applied, and therefore is totally unnecessary to support the economy or to maintain our standard of living. The Administration must propose and Congress must implement, as a matter of the greatest urgency, a clear and inclusive energy program based on incentives for energy conservation, the development of solar energy, and continued research into nuclear fusion.

In order to promote stability and prosperity in the Third World, we must actively work for development in the rural areas of these countries, where most of the labor force and the highest concentrations of unemployed, undernourished and socially uninvolved people live. Without agricultural employment, most of the rural populations will not have funds to purchase the products of industry. Such employment depends upon research and the spread of technology.

Although the consequences of the worldwide slowdown in the production of petroleum and natural gas will be severe in the U.S., for most of the world they will be catastrophic. One of the most important contributions that we could make to the economic stability and prosperity of the Third World, and consequently to our own national security, would be to accelerate the development of solar energy.

Since solar energy works best at a local level and does not depend upon the import of expensive fuels or technology from abroad, it would be ideal for the sunny tropical and subtropical countries of the Third World. Creating local supplies of energy would help to curtail the cutting of forests for wood. This in turn would help to prevent soil erosion and flooding, and to protect the natural fertility of the land. The poor countries, however, generally lack the capital and scientific expertise to develop solar energy.

Increasing the availability of solar energy would discourage the spread of nuclear technology throughout the hungry nations of the world, with all of its attendant military risks.

The destruction of virtually all of the remaining 3.5 million square miles of tropical forest before an onslaught of hungry people will certainly occur within the lifetime of those born in the 1960s and 1970s. Since about two-thirds of the world's several million kinds of animals and plants are found only in the tropics, we can be sure that hundreds of thousands of species, most of them unknown to science, will become extinct during this period. Intellectual curiosity alone ought to make us want to learn about them, since we are the last generation that will have the opportunity to do so, but there are also compelling economic reasons for studying them.

For one thing, an understanding of the way in which these highly productive natural systems function presumably holds the key to the development of suitable, long-term agricultural systems in the tropics. For another, the individual plants and animals may be of great interest. Thus, 40 percent of all prescriptions written in the U.S. today include at least one product of natural origin, and yet not one in a hundred of the tropical plants that will become extinct during the next few decades has been examined chemically at all.

In addition, the development of important new tropical crops such as rubber and oil palm during the past 150 years should make us not want to lose the others before they have even been seen by a single scientist, much less examined for their economic potential. Countries such as the United States therefore have every reason to increase greatly the level of their funding, currently a few million dollars annually, in support of research in the world's disappearing tropical forests.

To promote our own security, we need to:

Help all of the countries of the world achieve their own goals in limiting the growth of their populations.

Greatly increase our level of funding for research into the plants, animals, and ecological communities of tropical countries, and use the knowledge we gain thereby for research into the development of sustained-yield agricultural systems in these countries.

Help to increase mutually beneficial interchange between these countries and drastically limit our own waste of energy while actively developing solar energy technology for ourselves and for everyone.

We must make a full national commitment to the realization of these goals, because there is no way in which we and the other developed countries of the world can survive massive starvation and social instability affecting two-thirds of the world's people. Nothing less will insure our destiny as a free people in the 21st century.

The Destruction of the Tropics

(By Peter H. Raven)

The notion that humans could, and indeed should, attempt to classify and name all other kinds of organisms goes back some three centuries. Even in the 16th century, naturalists had begun to write books including several thousand kinds of plants or animals instead of the several hundred that would be familiar in any one local area.

The Swedish botanist Carolus Linnaeus began our modern system of naming plants and animals in the mid-18th century. Linnaeus and his contemporaries, from the vantage point of northern Europe, thought that the number of species of plants and animals in the world was relatively limited—probably more than 50,000 in all. Exploration of the tropics, where probably two-thirds of all species of organisms occur, had barely begun, and collecting was mostly confined to the vicinity of the seaports, where weeds and a few aggressive kinds of animals had spread widely all over the tropical portions of the world.

So far, names have been given to approximately 1.5 million kinds of plants and animals, but for the great majority of these, we know only a name, a very few characteristics and a locality. Probably fewer than half of these species have been mentioned anywhere in the literature even once following their original description.

In order to assign a name to a plant or animal it is necessary to publish a description with the name and to associate the name with a particular specimen.

This specimen becomes the type of the species and, like the standard meter, becomes a reference point for assigning that name to any individual collected subsequently.

How many species remain to be named? Estimates vary, but the number of new species that are routinely encountered in many groups of organisms, particularly in collections from the tropics, suggests that there are at least twice as many yet to be named as have already been given names. Naturally, the distribution of these unnamed and mostly unknown species is not equal. In temperate regions, perhaps a million of the estimated 1.5 million species have been named; but in the tropics, no more than one in six—perhaps 500,000 of an estimated three million species—have been brought to the attention of science.

Our chances of collecting and naming these "missing" species, so that any record of their existence might be made available to future generations, or so that anything about their potentially useful or other properties might be known, is decreasing rapidly. The reason is the rapid growh of human populations, especially in the tropics. The Food and Agriculture Organization of the United Nations (FAO) estimates that about 40 percent of the tropical forests of the world have been destroyed during the past 150 years. Virtually all of the remainder will have been cut before the end of this century, during which time the populations of all tropical countries will at least double, given present rates of growth.

According again to the FAO, by the year 1985 some 26 tropical countries, with an aggregate population of 365 million people, will be unable to provide sufficient food to allow their inhabitants to avoid gradual starvation. In addition, there is a rapidly increasing population of some 400 million people who make their living by slash and burn techniques in tropical forests, growirg crops for a year or two and then moving on. Since all of the tropical forests will be destroyed during the next 25 years, it is difficult to avoid the conclusion that up to a billion people will starve to death in the tropics during the next three decades. During this period all natural communities in the tropics will be totally destroyed before we can even begin to understand them or to learn how to use them for human benefit.

It was not until the exploration of the great German scientist Alexander von Humboldt in Latin America from 1799 to 1804 that the immense richness of tropical life began to be appreciated. In the American tropics alone, the richest in terms of species of plants and animals of the world's three major tropical areas, there are probably over a million unnamed and mostly uncollected species of organisms. A majority of these will become extinct during the next 25 years, and most will never have been collected even once by the time they disappear from the face of the earth. Most tropical countries, struggling under the burden of explosive population growth and inadequate food supplies, a severe energy shortage and runaway inflation, simply do not have the resources to study the biological communities upon which they are dependent, or to build up the kinds of institutions that would allow them to do so. The so-called developed countries of the world, a few of which have the capacity to produce an excess of food, are devoting relatively insignificant levels of effort to the tropics, even though world stability ultimately depends on what happens there.

Billions of dollars have been spent on the exploration of the moon, and we now know far more about the moon than we do about the rainforests of say, western Colombia. The moon will be there far longer than these forests, and perhaps longer than the human race also. In the forests are found the most complex interacting systems on earth, systems which might even hold the key to our survival, and about which we know practically nothing. Would it not be prudent, during this our Bicentennial Year, to consider allocating more funds for the study of tropical plants and animals while we are still able to do so?

Mr. BONKER. Thank you, Dr. Raven. The information you have given us is so grim, I don't know whether I want to continue with these hearings. [Laughter.]

Our final witness comes by way of the State Department, where he retired with the rank of ambassador. He has extensive background in environmental organizations and is currently chairman of the Tropical Forestry Working Group, which is an organization made up of 100 different groups and individuals concerned about the problems of

tropical deforestation. You bring a wealth of information with you, Ambassador Blake. We are very pleased to have you here today.

STATEMENT OF HON. ROBERT O. BLAKE, CHAIRMAN, TROPICAL FOREST WORKING GROUP

Mr. Blake is an environmentalist working particularly on international environmental problems. He is the chairman of the Tropical Forestry Working Group, an organization made up of some 100 organizations and individuals concerned about the problems of deforestation. He is a member of the United States-Panama Environmental Commission. He is a senior fellow of the International Institute for Environment and Development. He is a member of the International Committee of the Sierra Club. He is a director of the International Society of Tropical Foresters.

Mr. Blake is active in a number of environmental organizations. He is a member of the Board of Trustees of the Natural Resources Defense Council, of the Board of Governors of the Nature Conservancy, and of the Governing Council of the Wilderness Society.

Mr. Blake recently retired after 30 years in the Foreign Service with the rank of Ambassador. He had served in Mali, France, Zaire, Tunisia, Japan, the Soviet Union, Nicaragua, and at the U.S. Mission to the United Nations in New York. He also served as Senior Adviser on International Environmental Affairs to the Administrator of the Environmental Protection Agency.

Mr. Blake was born in Los Angeles, April 7, 1921. He graduated from Stanford University and later received a masters' degree from the School of Advanced International Studies. He served in World War II in the Navy. He is a member of Phi Beta Kappa.

Mr. BLAKE. Thank you, Mr. Chairman. Most of the things I was going to say today have already been said, so I will try to give you just a few basic ideas and a bit about what our working group is trying to do about them.

First of all, Mr. Chairman, I would like to thank you for calling these hearings and to say how important the people in our working group consider these hearings to be. The Congress can play a major role in focussing attention on the tropical forest problem. We welcome the fact that your committee is beginning to ask very good questions about what the U.S. Government and what international organizations can do to help.

Our working group is in some ways trying to accomplish the same things that you are trying to do. We are trying to help focus urgent attention on this problem, and particularly to focus attention on what the U.S. Government can and should do.

We have published an action program which you might include as part of your record. It is too complex to discuss in detail today, but I have it here if it would be useful to your committee and to the record.

Mr. BONKER. Ambassador Blake, we will have that report included in the official record.[1]

Mr. BLAKE. Thank you very much, Mr. Chairman. I would like to emphasize my lack of agreement on one major point which some of the speakers who have come before your committee made today, and that is that I don't agree that the international organizations are going to make the great difference in saving the tropical forests. I have spent a good many years working on United Nations affairs during my career, and I must emphasize that these organizations are under constraints that will not let them put the kind of money or the kind of

[1] The report is on file in the subcommittee office. Due to the length of the document it was not possible to include it in the published hearings.

attention that is really needed right now to bring about the right kind of forest management in developing countries.

I believe, in contrast, that there's a very, very great role to be played by the U.S. Government, by the American people. The United States is looked to for leadership, scientific and technical leadership, on issues such as the tropical deforestation problem. I believe that the U.S. Government must play a very much more active role in trying to raise consciousness about tropical deforestation and in trying to give the leaders of the tropical forestry countries the will and the means to cope with these problems. Neither the will nor the ability to control deforestation really exists in some of the tropical forest countries. It is an enormous challenge but I believe that we can do it. The politically timid international organizations can play a role but they cannot do this job alone.

Mr. Chairman, I would like to start off by offering congratulations to the Department of State, my old alma mater, to the Department of Agriculture, and to AID for what they have done so far to bring the tropical deforestation issue to the attention of the American Government and American people. We in our group have seen and have commented on early drafts of the policy paper which is being prepared by the Interagency Task Force, and we think that this is an outstanding piece of work. I particularly direct your attention to the rather sophisticated analysis in that paper of what can be done to help alleviate the deforestation problem in various time frames. It is awfully good work.

This being said, I would also like to emphasize that the work on tropical deforestation that the U.S. Government is now doing or is contemplating is so small that it has very little relevance to the seriousness of the problem. Also there is, except in very limited circles, very little of the sense of urgency about what needs to be done if deforestation is to be stopped before it adversly affects the lives of millions of people.

It is important to state clearly that the very good, if theoretical, set of goals that the interagency working group has set out, must now be translated into money, must now be translated into jobs in the Federal Government, must now be translated into action programs. Often these programs must be funded instead of other programs, as we are in a period of budgetary difficulty.

These will be hard choices, but I don't believe the executive branch has begun yet to face up squarely enough to how it's going to put into effect what they say must be done. I know very well that the generators of this report, with whom I've been working, have every intention of trying to direct the necessary attention to action, but they're going to need a lot of help. They will, I'm sure, get lots of help from Congress, and they're going to need help—and pressure—from the 5 million members belonging to the organizations which we represent today here.

Mr. Chairman, I have spoken of U.S. leadership. I believe that we should just look at another reason why U.S. leadership is so important. We must work fast, for it is in the next 20 years that will be determined what percentage of the tropical forests is going to be saved, at least in their original form. U.S. leadership is always important when there is an urgent time factor to a problem.

One important task is to give the leaders of the tropical forest countries the will to do something about the devastation. Part of that determination will be generated only when those leaders believe that there is some possibility that something can be done to save the forests, and when they are convinced—as political men—that there is some alternative, that they can stand in front of their people and say there is a more rational way to go.

The United States can play an important role in creating such an atmosphere if it acts tactfully, if it acts by offering assistance, if it acts basically on the central belief that the tropical forest countries themselves must do most of the work to save the forest. What we in the United States can principally do is to give them means to do something about it. I don't know any other country and I don't know any international organization, acting singly or together, that can play as important role as the U.S. Government and the U.S. Congress in this regard. But in the end the essence of any successful program has to be collaborative work in which we involve the people of the tropical forest countries in every stage.

Now part of this effort involves research. Dr. Raven's report represents a very, very important beginning. It shows what must be done most urgently, particularly if we are to protect our planet's gene pool. That is not a line of argumentation that has received enough attention today. It should receive more attention in your hearings. But they cannot wait for the results of research before we start working very hard to achieve other objectives.

One important and immediately doable task for the United States is to help countries learn how to manage their forests, and the land around forests, so that enough food can be produced if the forests are to be saved.

The second aspect that must be started urgently is to set aside areas which should be protected as undeveloped biomes in order that we can in the future have time to explore them and to find the products which can be developed for new medicines for the solution of cancer problems, as you suggested, Mr. Chairman—which might help as sources of new food crops.

The other day I saw a plant which had been discovered by a scientist at the New York Botanical Gardens, a cannon lily which they discovered just recently in the forests of Thailand. This plant produces four times the amount of starch of any similar plant yet found. It was found in the wild forest. Such opportunities must not be foreclosed by failure to protect some representative areas intact.

Mr. Chairman, I think I will stop at this point. I would like to make just a few more remarks. One is I agree with you very much that the Congress should appropriate more money for UNEP. We shouldn't cut now; we should help UNEP do more. UNEP can't accomplish any scientific work and cannot save the forest by itself, but it is a very, very important organization which can do more to raise the consciousness of the people of the tropical forest countries to persuade them to do some of the hard things that they must do.

I disagree to a certain extent with some of the remarks I heard today about the sources of destruction of forests. A very, very large amount of the forests is not cut willfully for fuel wood or for lumber,

rather it is cut by slash and burn farmers. They burn the wood right there merely to clear the land. That probably is by far the largest source of destruction.

Mr. Chairman, I can assure you that our working group is going to follow what the U.S. Government does in the tropical forest realm with great care. We are going to be in close touch with each one of the agencies responsible for action. We're going to encourage them to include elements of research assistance on tropical forests in their projects in tropical forest countries.

You have in the Interagency Task Force an outstanding bunch of thinkers. Now we have to get the budgeteers and the people who look at personnel questions in those departments to be just as enthusiastic about playing a leadership role as the gentlemen sitting behind me are.

We are going to give them help, even pressure if you will, of the right kind because ours is a political action movement dedicated to trying to accomplish a very difficult objective in time. This is one of the great challenges which we face in this period.

Your hearings are going to help a lot and I know that many of the members of our working group who are really great experts in this area are going to want to testify in your future hearings. Thank you, Mr. Chairman.

[Ambassador Blake's prepared statement follows:]

PREPARED STATEMENT OF HON. ROBERT O. BLAKE, CHAIRMAN, WORKING GROUP ON TROPICAL FORESTRY

Mr. Chairman:

My name is Robert O. Blake. I am the Chairman of the Working Group on Tropical Forestry. This is an organization made up of 18 environmental and conservation organizations with a combined membership of 5.3 million and of 84 scientists, foresters, and specialists in third world development. A list of member organizations and experts is attached. My statement today could obviously not be cleared with our members. However, it does reflect the action program we developed earlier this year. I request that the action program be included in the record because of its importance to the development of our own and the Inter-Agency Task Force's thinking.

At the outset, Mr. Chairman, I wish to thank you and your Committee for scheduling these hearings on tropical forest destruction. This is a welcome indication of the urgency which you attach to this problem.

Our Working Group was formed with two principal purposes: To help focus American attention on the urgent need for action to stop the devastation of the world's tropical forests and, more concretely, to focus attention on what the United States Government can and should do. Most of the tropical forest experts and the conservation

and environmental organizations that make up our Group have been working for many years on the problems of tropical forestry. Their calls for action are not new. Their individual, very impressive efforts continue unabated. The decision to join forces to form a Working Group and to launch a campaign of political action reflected their recognition of the need for more dynamic leadership and more concern on every level and in every responsible government agency. We are convinced that only the United States Government is in a position to provide the leadership, at home and abroad, and resources to help stop the destruction of tropical forests.

What The United States Government Has Done

Mr. Chairman, a word about what the U.S. Government has already done about the tropical forests would seem to be in order. We recognize that, over the years, the United States Government has sponsored a number of laudable individual scientific and agricultural efforts. For example, work financed by U.S. agencies - notably the National Science Foundation - has generated some of the best research data about tropical forests and about the management of previously forested areas. However, until very recently - and in too many parts of the Government

even today - there appears to have been very little understanding of the tragic significance of the disappearing forests for the United States and for the world, or of the urgent need for action. To the contrary, too often the American Government through its military and developmental programs in tropical forest areas has itself been responsible for mindless forest destruction.

Fortunately, a very hopeful change in governmental attitude has begun to take place. The Tropical Deforestation Conference sponsored by the State Department and the Agency for International Development in June of 1978 and the formation soon thereafter of the Inter-Agency Task Force on Tropical Forests were very positive steps. We all look forward with great anticipation to the Task Force's report and policy recommendations, which we understand will appear shortly. The drafts of that report on which we were asked to comment incorporate excellent observations and policy recommendations. I was particularly glad today to hear the representatives of the Departments of State and Agriculture outline their five, ten, and fifteen year goals for a tropical forestry program. These goals are ambitious but well thought out. Their achievement will require great effort on the part of many U.S. agencies.

We are not able to comply completely with your request that we comment specifically on the Inter-Agency Task Force's report, since it has not been published. We do, I believe, have a good idea of the Task Force's thinking since our Working Group has maintained close contact and has submitted to it detailed proposals for action. We particularly applaud the Bureau of Oceans and International Environmental and Scientific Affairs of the Department of State for its leadership in tropical forest matters. There is growing evidence, too, that in our diplomacy and in our developmental efforts, concern about the rapid rate of deforestation is beginning to bear practical fruits.

However, Mr. Chairman, we would be wrong if we did not state very clearly at the outset our view that all of this - the Tropical Deforestation Conference and the Inter-Agency Task Force's report and its announced goals - still involves only planning, and is still at an abstract level. All the U.S. agencies involved must now translate goals and recommendations into action programs involving real money and real people. Very specific responsibilities must be assigned to specific agencies. Only a beginning has been made in this, and outside very limited government circles there is still little of that sense of urgency that must characterize the American approach.

The Problem And The U.S. Role In Solving It

Mr. Chairman, in your invitation to our Group to testify, you underlined your interest in hearing, among other things, our views on the importance of the tropical forests, the causes of deforestation, and the rate of forest degradation and depletion. We have listened with care to the views already given to this Committee on these points, most of which we share. I would like, however, to underline several points to which our Group attaches special importance:

(1) First, we are impressed by the data which suggest that if present rates of destruction and degradation continue, by the year 2000 most tropical forests as we have known them will disappear as a major worldwide biome, except for patches in the Western Amazon Basin and in the Congo River Basin. Elsewhere it will be mostly reduced much sooner to scattered, degraded remnants on steep slopes, to severely flooded delta areas, and to a few parks and reserves. The obvious conclusion is that whatever is to be done to save key forested areas must be started in the next few years.

(2) Second, we recognize the difficulty under the best of circumstances of stopping the des-

truction of large parts of the tropical forests. Since all but a tiny fraction of these forests are located in other countries, our efforts to stop this destruction must be exercised largely through perusasion. We must also realistically recognize that few of the dozen countries in which the principal tropical forests are located have at present either the political will or the physical ability to control deforestation.

(3) Third, the principal underlying cause of forest destruction and degradation is the population explosion in tropical countries. Each year hundreds of thousands of farmers and cattlemen move into the forest edges, up rivers or along roads built by loggers or developers, and hack out plots and pastures. Too often the soils are so weak that crops can be sustained for as little as two or three years, after which the process must be repeated. The process of shifting cultivation which formerly was ecologically sound is becoming increasingly destructive as poorer and poorer areas are cut and as fallow areas are reduced. Moreover, the new

66-376 O - 81 - 8

settlers often come into conflict with native forest peoples; as a result, some tribes, isolated for centuries, have been devastated by disease, armed clashes, cultural disintegration, and other violations of fundamental human rights. In many countries the police and local authorities, anxious to avoid the movement of farmers into crowded urban areas where there are no jobs or houses, cannot, do not, and in most cases could not stop this cutting even if they are in principle committed to do so.

The principal point I would like to make here is that population pressures in almost all tropical forest countries are so strong and will remain so strong well beyond the turn of the century, that only heroic efforts and timely cooperation among the world's scientists, planners, and development agencies will make possible the twin tasks of saving key tropical forest areas and developing appropriate areas to meet desperate human needs.

(4) In the longer run, programs of population control, of land redistribution, and of increased agricultural productivity can take the pressure

off the forests. These programs we strongly support. But we cannot wait for their success, for if we do, the forests will be largely gone, and with them may disappear the very resource base required for these longer-range efforts to succeed.

It must be emphasized that in the short- and medium-term, the solution to the tropical forest problem lies in effective land management. Tropical forest countries must recognize the urgent need for wise management of forest areas, must determine which lands can be developed and which must be saved. With the help of aid agencies and others, they must acquire and apply the knowledge required for land classification and management. They must develop institutions capable of developing and enforcing good management plans. And in providing for the short- and medium-term needs of their populations, they must do so in ways which do not undermine the land management effort.

(5) Fifth, without strong American leadership and without United States Government assistance for tropical forest countries on a scale far

beyond anything presently planned, efforts to save key tropical forest areas and to use the rest to meet the needs of the peoples of those countries could well prove to be "too little" or "too late."

But why, you may ask, must the United States take upon itself this leading role? We agree that there are many other countries that can and should help. And in the last analysis it is the responsibility of the countries in which these forests are located to dispose of their resources as they deem wise. Won't tropical forest countries resent any attempt at U.S. leadership as interference in their domestic affairs? The answers to these questions can be summed up in one simple observation. In the last decades, a very large part of the non-communist world, whatever their political views, has come to look to the United States for leadership on scientific and technical matters. Because we have usually been able to exercise constructive and disinterested leadership in this area, others who are ready to assist Third World countries - and those countries themselves - have come, too often, to

await our lead before undertaking independent moves. With the notable exception of a few tropical forest countries, this pattern seems to be holding for the problem of tropical deforestation. U.S. leadership will be, I am convinced, welcomed if it is exercised in the right way: Modestly, generously, with a special concern to insure that all we do is done in partnership with the government and peoples of the Third World countries concerned, and with clear recognition that final decisions must be made by these countries. I want to share with you a surprising fact about American tropical forest capability: Where a decade ago by far the greatest number of tropical forest scientists and technicians were Europeans - particularly British, French, Dutch, and Belgians, who had had experience in their own former colonies, today the situation is reversed. Of the roughly 4,000 persons working on the scientific problems of tropical forests worldwide, roughly one-third are Americans. This gives our American scientists a special responsibility and a special challenge.

A Tropical Forest Action Program For Americans

If we Americans have special responsibilities and special opportunities for leadership, then what should our priorities be and what kinds of action should we urge on our Government and our scientific establishment? And, as you asked, Mr. Chairman, how well does the thinking and planning of the Inter-Agency Task Force conform to those needs? As you have very wisely scheduled a later hearing on United States Government actions, I will not attempt to present our Working Group's ideas on policies and programs but will concentrate on principles.

Our Group, in its earlier recommendations to the Inter-Agency Task Force, pointed out that a high priority should be given to getting our own house in order as far as tropical forests are concerned. This is a precondition for giving credibility to American leadership and advice. As we see it, setting our own house in order involves at least three important types of actions:

First, we must insure that our own limited tropical forests, principally in Puerto Rico and Hawaii, are as well managed as possible. Although a start has been made in this direction, much remains to be done and much needs to be appropriately documented.

Second, the United States must insure that American development assistance and military programs in tropical forest countries do not involve any unnecessary destruction of forest areas. The most careful assessment is now required by law and regulation. No forest area should be disturbed without assurance that no preferable alternative exists, and without the taking of careful ameliorative actions. We must never be tempted to compromise on this important principle just to support American commerce or just to gain some short-term political advantage from a tropical forest country. Too much is at stake in the long-run.

Third, the United States must do everything possible to insure that American corporations do not contribute to the devastation of remaining tropical forests. This applies particularly but not solely, to American timber and pulp companies, which can in our view set a crucial pattern by employing proper cutting, forest management, and replanting techniques. They should do more in training local experts and in sponsoring research on tropical forest

management. For many reasons, most of our corporations still have a long way to go and some are guilty of "cut-and-run" techniques.

The means at the U.S. Government's disposal to bring about compliance by our companies include (but are not limited to) "jawboning" with U.S. companies, and, potentially, the withholding of tax and trade advantages should the dialogue fail. For its part, the United States Government must be ready to intervene on behalf of cooperating American companies with other governments which have timber and pulp companies working in tropical forest countries to insure that American companies are not put at a competitive commercial disadvantage. So far the United States Government seems to have done next to nothing in this area and seems reluctant to move ahead. Our Working Group feels strongly about the importance of the United States Government taking an active role in persuading American timber and pulp companies to do a better job, and we look forward to your Committee's hearings on this subject.

A Tropical Forest Action Program:
Help To Tropical Forest Countries

Mr. Chairman, direct actions which the United States can take are significant but are obviously less important than efforts by Americans to help tropical forest countries conserve and properly develop their forest areas. We should also try to persuade these countries to stop the devastation. American persuasion must be exercised both privately and publicly. It must be both tactful and straightforward. Any intervention must be aimed at giving leaders of tropical forest countries the will to stop forest devastation and the means and knowledge to manage their forests.

First, a word about persuasion. Strange as it may seem, the leaders of some tropical forest countries do not know - or, if they know, do not acknowledge - the importance of stopping forest devastation. Reluctant or unknowledgeable leaders will act to stop aimless cutting, to start proper forest management, and to seek necessary outside help only when their own people - particularly their governing and intellectual elites - are convinced for one reason or another that their interests will thereby be served. Low-key but high-level dialogues by our senior government leaders with tropical forest government leaders in which both sides agree on the mutual interests

to be served in stopping forest destruction and in which we offer help to this end are very important. However, to date we have seen little evidence that our diplomats in the countries involved attach - or have been instructed to attach - the necessary priority to dialogue on this problem.

At another level, the United States Government can do more worldwide to raise the level of knowledge and consciousness about the dangers of tropical forest degradation. Some good work has been done by the State Department in sensitizing tropical forest specialists and conservationists around the world -- I note here again the Tropical Deforestation Conference of 1978. But efforts to date have largely involved preaching to the converted. The aim must be to get through effectively to a broader stratum of opinion leaders in both developing and developed countries. Speeches (and articles) by our leaders and our scientists both at home and in international fora must be generated and publicized.

Mr. Chairman, as important as it is to try to stiffen the will of the leaders of forest countries, the bigger problem is to give these leaders and these countries the means to cope with their forest problems. Our Working Group has studied this matter carefully. We have submitted

detailed written recommendations on this subject to the Inter-Agency Task Force. We have followed up by discussing these recommendations with the Task Force and with the Agencies which make it up. We therefore have a good idea of the thinking of the agencies in this regard.

I would characterize their attitudes towards help for tropical forest countries as positive in principle, but not positive enough. What they propose will not insure that enough money is made available soon enough to make the vital difference in stopping tropical forest devastation in the coming decade. Here, one thing should be clear to all of us: a dollar spent wisely on tropical forestry in 1980 will be worth at least $100 spent in 1990. We must recognize that it takes years to build up local management capacity. And the lesson we have heard today is that we do not have that kind of time before the better part of the forests disappear.

Research

Mr. Chairman, as I have already indicated, our group attaches importance to early government funding of research on tropical forests of various kinds. Acquiring better knowledge about forest situations often must precede other actions. But to place the subject in perspective,

it should be emphasized that research is not a substitute for other urgently needed actions. Nor can action be delayed pending the completion of research. In many cases, if present trends are allowed to continue, research results will come too late to affect forest managmeent because the forests will be gone. However, lack of knowledge severely restricts our ability to manage tropical forest ecosystems, and a number of kinds of research are badly needed.

You have already heard an eloquent statement by Dr. Peter Raven emphasizing the need for action to launch research into very specific areas while there is still time. Our Group strongly endorses the recommendations of the committee which Dr. Raven chaired for and within the National Academy of Sciences. Their report outlined priorities for research in tropical biology, particularly for inventorying plants and animals in specially threatened areas, for in-depth ecological studies of key tropical forest areas, and for in depth studies of aquatic systems. These studies of tropical life systems plus the setting up of associated systems to monitor what is happening in and to the world's tropical forests are important because they will tell us which actions to take to construct and properly manage forest areas. And, as I will discuss in more detail later, there is also an urgent need for

practical, work-linked research on many aspects of land planning and management and on agro-forestry.

Another essential area of research, covered only in passing in this report, is research on the economic botany and zoology of the tropics. This involves the systematic examination of plants and animals -- particularly those threatened with extinction -- to determine whether they might serve as new sources of food, medicines, and energy.

I am happy to report that our Working Group has found that United States Government agencies, particularly the National Science Foundation, clearly recognize the need for expanded research on tropical forests. However, we also find people scratching their heads about where the money for this research is going to come from as against "established" research programs. In our view, this is not good enough. We must insure that a greater priority is given this year for research associated with the tropical forests because to postpone it or underfund it could mean that it might never be done, given the rate at which tropical plants and animals are becoming extinct. Major programs will come from the National Science Foundation and the Smithsonian Institution. However, there are also great opportunities for AID, the Forest Service, the National Park Service, the Fish and

Wildlife Service, NOAA and NASA, to name only a few agencies, to integrate important projects for research on tropical forests into many of the projects they are doing or contemplating. The encouragement of this Committee could help a lot in this regard. We must always remember that the results of much of this research must be assimilated before some aspects of tropical forest management and use can go forward.

Again, Mr. Chairman, our Working Group would like to emphasize the importance, which we found accepted in the right places in U.S. Government, of involving scientists and technicians from tropical forest countries in this research and monitoring. We also wish to underline the importance we attach to giving assistance to universities and research organizations in those countries. Every effort must be made to strengthen the capacity of those institutions.

Conservation And Development

Our Working Group strongly endorses one of the basic approaches taken by the Inter-Agency Task Force's draft report: One must recognize both the need to protect intact biomes within tropical forest areas (I will discuss this subject later) and the need to insure that tropical forest areas which must be developed to meet pressing human

needs are carefully selected and managed. Proper development cannot take place without proper conservation. Equally, proper conservation depends on the achievement of proper development. As a practical matter the political support for setting aside and protecting key ecological systems can be mobilized only when and if sufficient land can be developed which will sustain the waves of new farmers. In this regard, I would call the Committee's attention to the recent World Conservation Strategy, prepared by the International Union for the Conservation of Nature. This excellent strategy, which deserves your Committee's careful study, documents very well the vital interconnection between conservation and development, and suggests what must be done to serve these twin goals.

It is more and more widely recognized that sustainable development in tropical forest areas is very difficult to achieve. The keys to success are careful planning to determine which areas have soils and which will sustain agriculture; knowing which areas should be kept under forest cover, knowing what crops to plant and in what combination with tree cover (techniques commonly grouped under the public of agro-forestry); and knowing what areas can be used for planned rotation of trees for timber and pulp.

Very little is still known about many aspects of agroforestry, about sustained management of timber, and about how to plan in a cost-effective way for good management of forested areas. Much urgent research remains to be done, just as it is equally important to apply the knowledge we have.

Our Working Group believes that the United States Government must assign the highest and most immediate priority to finding ways to help countries plan for the management of tropical forest areas. This means more collaborative research in the field to gather data required for land planning; more training, particularly "in-country" training; more help in building institutions which will allow tropical forest countries to undertake important research and management tasks themselves; and, finally, more and better collaborative projects for agroforestry development and for sustained yield forestry by AID, by other U.S. agencies and by American companies. Some of the best work in this area has been carried out by the United States, and such efforts are strongly supported by the Inter-Agency Task Force. But to date these programs have usually involved scattered efforts, not a coherent, planned program or strategy. Certainly they have not added up to a program with the critical mass to make a major impact. Again, the lesson is that we have

to do much more, much better, and much sooner if we are to have any real success in stopping forest devastation. The 1979 amendments to the Foreign Assistance Act mandated AID to undertake activities of this type. Our Working Group believes that the Committee should carefully examine what AID and other United States agencies are doing to carry out this mandate.

Protection Of The World's Genetic Heritage

The conservation side of the conservation-development equation also demands priority attention by the United States, again working very closely with the tropical forest countries themselves. What is involved here? Nothing less than saving a very major part of the world's genetic heritage of plants or animals. At stake is the fate of nearly half of the plants and animals of the world, most of which are threatened with extinction by the rapid devastation of their tropical forest habitat, even before their usefulness for man as food, medicine and energy can be probed.

The immediate task before us then is to save as much of our genetic heritage as possible by helping countries to identify tropical forest areas which contain maximum concentration of endangered species (it is safe to assume that almost all tropical species -- most of which have still to be identified -- should be considered endangered),

66-326 O - 81 - 9

and those which are representative of tropical ecosystems, and then to set them aside and protect them. Experience and scientific study have taught that such areas, to be viable, must be large (we still need to know how large) and ideally should be remote enough or buffered enough from human pressing to be defensible.

Happily, the protection and proper management of these areas can serve other ends than the protection of genetic diversity as essential as that in itself. If the forest cover remains intact, such areas can also provide the benefits of watershed protection. If these areas are not protected, the destruction of forest cover may well have, as we have heard today, devastating effects in changing the world's climatic patterns, particularly in the major temperate agricultural areas on which so much of the world increasingly depends for food. Our own interdependence with the tropical forests - particularly in Latin America - is also demonstrated by the fact that so many of our migratory birds depend for part of each year on the tropical forests for their habitat. If their tropical habitat - their food and their shelter - disappear, what will happen to these species?

The question then is: What can the United States do to help tropical forest countries identify, set aside, and then properly manage the right number and the right kind

of tropical forest preserves? Here we should clearly recognize that the United States has very special capabilities. The national park is largely an American concept, and while everyone including ourselves has much to learn about exactly what tropical forests need protection, both governmental and non-governmental experience in managing natural areas, in protecting wildlife, and in training people to do these jobs is the best to be had. We also have the capability, and in our view the responsibility, to help tropical forest countries build up their own institutional capacity to manage protected areas. This could mean, given our own self-interest in seeing major forested areas protected, not only help in training and institution-building, not only help in building and equipping facilities, but also in the longer-run some form of financial assistance for poorer countries where this would make a vital difference.

Our Working Group is happy to see that the expansion of many such programs is foreshadowed in the draft Inter-Agency Task Force report. The key again is to move ahead rapidly, for not much time is left. Americans must also find ways, through practical support for the program of the International Union for the Conservation of Nature and UNESCO's Man In The Biosphere Program to motivate

tropical forest countries to take earlier and effective action to protect their own tropical forest areas.

But this, Mr. Chairman, is largely another topic. We need to define for ourselves what international organizations can and should do to help tropical forest countries and then press for more effective action by these organizations. We applaud your decision to hold hearings in June on this subject. I know from my discussions with members of our Working Group that some of the organizations and experts belonging to our Group would appreciate the opportunity to testify both at that hearing and the later hearing you have scheduled on the role of the multinational companies in tropical forest protection.

As I indicated earlier, however, the principal focus of our Group's activity is on what United States Government agencies can and should do to help meet the urgent problems of tropical forest devastation. In the coming months, the organizations and the experts which belong to our Working Group will be contacting United States agencies urging them to translate into action the welcome pledges reflected in the earlier drafts of the Inter-Agency Task Force report. Somehow, even in these times of budgetary tightness, these agencies must find the resources to do our share - and more - in the urgent task of stopping the devastation of tropical forests.

Mr. Chairman, I know I speak for the organizations and experts of our Working Group when I say that they look forward to testifying before your Committee when you consider the programs of United States agencies. I know, too, how much all of our members appreciate the impetus towards earlier and more effective actions which today's hearing will give.

Appendix A

Members and Current Institutional Affiliations of The Nongovermental Tropical Forest Working Group

RAUF ALI, National Zoological Park

EMMANUEL A.O. ASIBEY, Department of Game & Wildlife, Ghana

PETER ASHTON, Arnold Arboretum, Jamaica

E.S. AYENSU, Museum of Natural History, Smithsonian Institution

JAMES BARNES, Center for Law and Social Policy

J.W. BARRET, Department of Forestry and Wildlife, University of Tennessee

KATHY BARTOLONI, Friends of the Earth

SPENCER BEEBE, The Nature Conservancy

WILLIAM BELTON, International Council for Bird Preservation

CHARLES F. BENNETT, Department of Geography, University of California, Los Angeles

PAUL BENTE, Bio-Energy Council

JACK H. BERRYMAN, International Association of Fish and Wildlife Agencies

JAMES S. BETHEL, College of Forest Resources, University of Washington

ROBERT O. BLAKE, Working Group Chairman

HUGH BOLLINGER, Plant Resources Institute

GERARDO BUDOWSKI, Centro Agronomico Tropical de Investigacion y Esenenza, Costa Rica

BILL BURLEY, The Nature Conservancy

ARCHIE CARR, Florida Audubon Society

LOUIS S. CLAPPER, National Wildlife Federation

ROBERT COATS, John Muir Institute for Environmental Studies

BRADLEY CROSS

DIANA CROWLY

CLARENCE DAVIES, Conservation Foundation

M.B. DICKERMAN, Society of American Foresters

MARC DOUROJEANNI, Universidad National Agroria, Peru

NICOLE DUPLAIX

BROCK EVANS, Sierra Club

JACK EWEL, University of Florida

MARY FALLEN, Missouri Botanical Garden

ANITA FINLAYSON, Rare Animal Relief Effort

PETER FREEMAN

THOMAS FRICKE, International Scientific & Technical Institute

J.I. FURTADO, Department of Zoology, Lembah Panta, Malaysia

J. STEPHEN GARTLAN, Wisconsin Regional Primate Research Center

HUGH GIBSON

EDWARD GOLDSMITH, The Ecologist, United Kingdom

FRANK GOLLEY, Institute of Ecology, University of Georgia

*ROBERT GOODLAND, World Bank

LINDSEY GRANT

LAWRENCE S. HAMILTON, Environment and Policy Institute, West-East Center

GARY HARTSHORN, Tropical Science Center, Costa Rica

LINDA HAVERFIELD, Friends of the Earth

PETER HAZLEWOOD, Library of Congress

WATER HECOX, Economics Department, Colorado College

THOMAS HOFFMAN, International Institute for Environment and Development

WILLIAM F. HYDE

HUGH ILTIS, Department of Botany, University of Wisconsin

BARONESS JACKSON of Ladsworth, United Kingdom

BRIAN JOHNSON, International Institute for Environment and Development

CARL JORDAN, Institute of Ecology, University of Georgia

F. WAYNE KING, New York Zoological Society

WARREN B. KING, International Council for Bird Preservation

WILLIAM KNOWLAND, Crane-Rogers Foundation

GEORGE LEDEC

THOMAS E. LOVEJOY, World Wildlife Fund, U.S.

*ARIEL LUGO, Institute for Tropical Forestry

OLGA H. MACBRYDE

CRAIG MACFARLAND, Centro Agronomico Tropical de Investigacion y Ensenanza, Costa Rica

CYNTHIA MACKIE

PETER MARTIN, Institute for Current World Affairs

R. MICHAEL MCGONIGLE, Center for Law and Social Policy

ROBINSON MCILVAINE, African Wildlife Leadership Foundation

ROBER MCMANUS, Council on Environmental Quality

JEFFREY MCNEELY, World Wildlife Fund, Indonesia

WILLIAM MEIJER, College of Arts and Sciences, University of Kentucky

KENTON R. MILLER, School of Natural Resources, University of Michigan

LEE MILLER, Remote Sensing Center, Texas A&M University

JOHN MILTON, Threshhold

STEPHEN MOHAMMED, Trinidad Naturalist Magazine, Trinidad & Tobago

HAROLD A. MOONEY, Department of Biological Sciences, Stanford University

DAVID MUNRO, International Union for the Conservation of Nature and Natural Resources, Switzerland

NORMAN MYERS

RICHARD PARDO, American Forestry Association

*WALTER PARHAM, Office of Technology Assessment

GLENN PAULSON, National Audubon Society

DUNCAN POORE, United Kingdom

RAFE POMERANCE, Friends of the Earth

RICHARD POUGH, Natural Area Council

JAMES H. POWELL, JR.

GHILLEAN F. PRANCE, New York Botanical Garden

ROBERT PRINGLE

ALLEN D. PUTNEY, Eastern Caribbean Natural Areas Management

PETER RAVEN, Missouri Botanical Garden

NICHOLAS ROBINSON, School of Law, Pace University

MICHAEL ROTHERBERG

MICHAEL ROYSTON, Centre d'Etudes Industrielles, Switzerland

IRA RUBINOFF, Smithsonian Tropical Research Institute

PATRICIA SCHARLIN, Sierra Club International

RICHARD SCHULTES, Botanical Museum, Harvard University

ROGER SEDJO, Resources for the Future

DOUGLAS SHANE

GURMIT SINGH, Environmental Protection Society, Malaysia

THOMAS SLEYNN

ANTHONY WAYNE SMITH, National Parks and Conservation Association

S.H. SOHMER, Department of Biology, University of Wisconsin

ELVIS STAHR, National Audubon Society

HANSJORG STEINLIN, Albert-Ludwigs Universitat, Germany

HILGARD O. STERNBERG, Department of Geography, University of California

THOMAS B. STOEL, JR., Natural Resources Defense Council

DONALD E. STONE, Organization for Tropical Studies

THOMAS STRUHSAKER, New York Zoological Society

*JAMES TALBOT, National Research Council

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JAMES TARRANT, Overseas Development Council

JOSEPH TOSI, Centro Cientifico Tropical, Costa Rica

E.L. TOWLE, Islands Resources Doundation

RUSSELL TRAIN, World Wildlife Fund, U.S.

CRAIG VAN NOTE, Monitor

ANDRES P. VAYDA, Department of Human Ecology and Social Science, Cook College

FRANK WADSWORTH, Institute of Tropical Forestry, U.S. Forest Service

CHEW WEE-LEE, International Union for the Conservation of Nature

*GARY B. WETTERBERG, National Park Service

GILBERT WHITE, Institute of Behavioral Science, University of Colorado

LYNDA WILLIAMSON

GEORGE M. WOODWELL, Woods Hole Marine Biological Laboratory

R. MICHAEL WRIGHT, The Natural Conservancy

PAUL ZINKE, School of Forestry and Conservation, University of California, Berkeley

* In a personal capacity

Mr. BONKER. Thank you, Ambassador Blake. You have provided us with an excellent wrapup of today's official testimony. We will be looking forward to working with you on the subjects of mutual interest in the days ahead.

You suggest that it is not necessarily true that the international organizations can confront this problem. Others say it should not really fall on the backs of industry engaged in logging and agricultural activities in the less developed countries, but suggest instead that perhaps the U.S. Government, through Congress and various agencies, will have to carry that burden.

I wonder if ultimately it is the developing countries themselves who have to establish policies and be more sensitive to what is an important yet diminishing resource.

You have served as a member of the Foreign Service in a variety of countries, including Zaire and Tunisia; with the U.S. mission to the U.N., and you were the senior adviser of international environmental affairs to EPA. I think there are few who can match your expertise in the area of working with Third World countries.

Would you share with the subcommittee what your perception is of the developing countries as they approach this problem? Is the issue so low on their list of priorities? Is there such a lack of information and commitment, or is there just merely a lack of economic incentive to more directly confront this issue of tropical deforestation?

Mr. BLAKE. Mr. Chairman, each country is a little bit different. Let's take a couple of important examples. In Zaire, the leadership is hardly aware of the tropical forest problem. That is because they are not faced with terrible problems of destruction at this time, although it will come in the future.

Mr. BONKER. Problems of terrible destruction?

Mr. BLAKE. Absolutely, but the problem in Zaire is very different from what is happening in Brazil. Brazil is very sensitive to criticism from overseas about destruction of the Amazon. But even though criticism has made them very sensitive, it has had some effect in mobilizing people there. This is a time of some important turnarounds in the Brazilian attitude toward the relationship between development and forest protection. Even so, there is still a long way to go.

In all the tropical forest countries there is need for help of the kind we can give. There is need for help in building institutions in which they can address the problems of how to plan and manage their own land. They need help in building institutions which can do a lot of the needed scientific research themselves.

I'm very happy to note the heavy emphasis in Dr. Raven's report on collaborative work between American scientists and scientists of the countries involved.

So while you can't make many generalizations that will hold for all of the organizations, and all of the countries involved and as you suggest it is the work and the attitudes of the tropical forest countries measures that count most. Sometimes their lack of will—sometimes they couldn't stop the cutting of the forests even if they wanted to because they have no alternative to offer to farmers. Until they learn

better systems of cropping and better ways of exploiting lands that are not under forest cover, until they find lands still under forest cover where the soils are strong enough to sustain agriculture, they will be hard pressed to stop general devastation.

Mr. BONKER. The developing countries could have reforestation policies that would require greater care of the lands that are being converted by the multinationals. There are agribusinesses and timber companies who could help shape a policy requiring better management and reforestation.

Is that taking place at all? You'd think in the more sophisticated countries of Latin America, that they could see the economic benefits and long-term investment which would come with such policies.

Mr. BLAKE. It has just started. There are hopeful signs. The question is of getting more going faster, more urgently, before it is too late.

I would just like to say one thing about the American timber and pulp companies. In the first place, our information about what they are doing—and how well—as Bill Long indicated, it is not that good. As a whole the American timber companies have done some good scientific work. They differ one from another on how well they have managed their forest concessions. But at least one company has indicated that it would like to do much more reforestation in their areas.

They're not doing it. The reason is that they can't get their local partners to agree to spend money on reforestation at this stage. The locals are only interested in taking the profits.

The American companies also say that they don't want to be put at a comparative disadvantage when they do all the things that cost money and their Japanese competitors don't.

Mr. BONKER. Mr. Bethel, you are familiar with forest practices and with the multinationals that are involved in developing countries. Regarding our own indigenous wood resource, it has taken a number of years to research and develop programs that bring about better reforestation, and they're highly advanced now in our country.

When they tried to apply these methods to reforestation practices in tropical areas, is it a whole different type of expertise? Do the corporations have to make major investments in the genetics of wood products and the need for proper management activity?

Mr. BETHEL. Somebody has to make major new investments because you can't transplant technology.

Mr. BONKER. Those trees don't plant well in Indonesia?

Mr. BETHEL. No, and Indonesia trees don't plant the same as Douglas fir. That is part of the problem. The Ambassador responded to your question about provisions in concession contracts for rehabilitation. I think every concession contract I've ever read, whether it is from a Southeast Asian country or a Latin American country, has had lots of rhetoric about the necessity of the concessionaire providing regeneration when information concerning the reproductive biology of the species was simply not available.

I looked at the contract between a firm and a country in South America that had very specific requirements concerning obligations to insure regeneration in a situation where there had been no research conducted on any of the species to learn how you reproduce them.

The concessionaire couldn't do it. The government didn't know how to accomplish regeneration. The result, of course, is that regeneration hasn't been accomplished.

Mr. BONKER. Dr. Raven, is it possible for some of these international organizations, who are preoccupied with ecosystems and reforestation, to provide the level of expertise from which can be drawn benefits by multinationals in those countries? I mean somebody has to do it. It is not very efficient for each of these countries to make a single investment or for a multinational. It seems to me there ought to be a pool of information that would be available for everyone who is engaged in this business.

Dr. RAVEN. In a sense, the very deficiency of the information is the problem. You talked for instance of northern Colombia but in western Colombia we estimate that there are about 7,500 kinds of plants in the forests of western Colombia. Of those, we have 3,000—by we I mean anybody in the world. That means we have another 4,000 or so which nobody has ever seen, many of which are trees, which are things you ought to log, and to go from that step, and you are logging them——

Mr. BONKER. As a scientist, I think, you are seeing the full dimensions, but in the Northwest we have a large variety of species involved in a natural forest. When we log we replant just one or two species in a given area that will grow rapidly.

Shouldn't we try to regenerate all the indigenous species in a specific area, and replant trees for fuel sources and export.

Dr. RAVEN. That is true, the general direction things are going in. The reason I started in that direction is to indicate that the basic knowledge is so limited, it is difficult to find and put them in successfully. As the other speakers indicated, efforts are just beginning. For a number of technical reasons, species poor in stands are very difficult to maintain in the tropics.

Mr. BONKER. Are there a few species that are fairly common for harvesting purposes, for export? Again in the Northwest, we have a variety of species, Douglas fir and cedar. Do we have the same in say northern Colombia?

Mr. BETHEL. No; you have hundreds of species down there, rather than two, three, four, or five. That is one of the difficulties.

Mr. BONKER. Hundreds of species are usable as a wood source for export, for instance, of hardwood?

Mr. BETHEL. No. They might be if we knew enough about them but at the moment there aren't markets for them. They aren't known. They could be used for fuel but a small fraction of them would get into the international market.

Mr. BONKER. If, in Indonesia, Weyerhaeuser is logging a certain area for the purpose of taking hardwood for export to the United States or the Japanese market, and they go in and cut everything of value, my question is, after they cut, is it not possible to do what they do in the United States? That is, clear the area and replant these species that are of particular interest or economic value for export purposes.

Mr. BETHEL. I think they are. What they are doing in Indonesia and I've only been on the operation once, is dealing with a forest that

is quite different from the Colombian forest. It is much less diverse. There are a number of similar species in the Indonesian forest which are useful for export.

When they take the marketable species in Indonesia out of the forest, they're taking a much larger fraction of the total volume than would be the case if one were operating in the Amazon basin of Colombia or Brazil. Regeneration is not accomplished in Indonesia in the same way as in the Douglas fir region, but Weyerhaeuser has a research program there. There are good scientists there. I'm not going to defend their operations because I don't know whether it is effective or not, but it ought to be done and hopefully they are finding out whether this is successful. Certainly I would think they would want to get more firs because that is where the money is.

Mr. BONKER. Speaking of Indonesia, you are on your way there now, aren't you, to attend a conference on this subject?

Mr. BETHEL. Yes.

Mr. BONKER. Are you going as a representative of the University of Washington or in some other capacity?

Mr. BETHEL. The National Science Foundation.

Mr. BONKER. I see. So they're interested in the subject, too.

Mr. BETHEL. Yes; they are.

Mr. BONKER. Well, Dr. Raven, I believe it was you—there may have been several witnesses who pointed out that we need to raise the level of consciousness in the United States to more effectively deal with this problem, but my experience has been as a Member of Congress, that the American public is not going to be aroused by a subject like this. Only when a problem has a direct, immediate impact or if it is a great crisis do we see any kind of consensus and commitment to approach an issue. So I wouldn't hold my breath for congressional action.

But I do think that the level of awareness ought to be raised in the governments and institutions of developing countries who have the most at stake and the most to lose. The United States can get along without the hardwood in our own economy, and we will find some substitute or we will just do without it.

Ultimately when a country is faced with the depletion of its ecosystem, it is not going to be a U.S. law, program or even congressional amendment which helps these countries develop the awareness and programs to deal with the problem in their own areas.

Dr. RAVEN. In many ways it is just like a small version of the whole problem of foreign aid, which is how do you provide money for the really poor people and how do you fix up the countries and make them stable, which we all know is very much in the U.S. interest? We need a stable world to be able to operate, but the question is how do you induce or involve or become involved with the countries of the really poor and hungry people to enter into the economy and therefore don't go off and cut off the forests?

Mr. BONKER. And we all have a stake in the globe as one huge ecosystem, and we see what is hapening worldwide. I was in the Sudan a few years ago and there's a problem with the desert expanding, such as we saw in the film, where you don't see the trees as a buffer and you have soil erosion and the other things.

So we do have a stake in this topic but I'm not sure we're going to rally the American public for a solution.

I wanted to conclude the hearing by 12:30, but I will proceed with one more question. You were talking about agribusiness, Dr. Raven, and about the fact that much of the forest area is being depleted for grazing purposes so that we can supply the American public with more cattle. It was referred to in our report as a cash crop for export and for the more affluent in other countries. In the last two decades, per capita beef consumption in Central and Latin America has declined by 13.5 percent and you mentioned that there is an increase in the consumption in the United States.

At the same time, the cattle industry here is suffering economically and we are importing from these other countries. You are probably a free trade person. How would you feel about a ban on U.S. imports from these regions?

Dr. RAVEN. I would feel fine about it personally. [Laughter.]

Mr. BONKER. How would you feel about it, Mr. Bethel?

Mr. BETHEL. Well, I am a free trade person.

Mr. BONKER. I know you are.

Mr. BETHEL. I would be against that. I know there are problems in this but I don't think that is the way to solve them.

Dr. RAVEN. The real problem is that when they clear the pastures and grow the beef, within about 20 years what they have is worthless land which in effect is expended, it is finished.

Mr. BONKER. Yes; that becomes the desert that we saw in the slides.

Dr. RAVEN. It isn't possible to keep the beef down here meanwhile.

Mr. BONKER. So, Mr. Bethel, your commitment to free trade is so strong that you wouldn't deal with the issue of having a ban on beef imports?

Mr. BETHEL. No; I don't think that would solve the problem. There are other people who buy beef. Can I give you an example of a situation? I think maybe you described this. I was on a ranch—I won't identify it—in the coastal area of Costa Rica several years ago, a big ranch, where they were producing a lot of beef, a terribly ineffective way to use very valuable land.

The particular people who owned this property simply wanted to be ranchers. They wanted to be cattle ranchers and ride horses and so on. They don't want to farm and produce the kind of food crops that would have really taken advantage of the productivity of the land.

I asked the man how many horses he had out there. He had 16 head of horses. He had 20 head per cowboy and the rest were just growing there. Each one of them was consuming as much food as a head of cattle. That was not of concern to him. He was producing all the cattle he needed anyway.

I don't think a ban on imports is going to change that fellow a bit. He will find some place to send that beef. I think it is a serious problem to be dealt with somehow in Costa Rica, but I don't think we are going to solve it by shutting the door on importation of beef. I agree with you that a better way to use that land in the countries that need the productivity of the land is needed.

Mr. BONKER. Ambassador Blake, would you care to comment?

Mr. BLAKE. Yes. I am frankly ambivalent about this question, but I end up with Dr. Bethel. I don't think it will stop the cutting to put a ban on these MCAS importations. There are too many other side problems. But I would say that we can do a lot of other things to help,

that we should be more active in trying to help the people of Costa Rica, in showing them how they can do things better.

I personally am involved in a rather dramatic example of what has happened where areas have been cut for cattle raising. This is in the Canal Zone, where much of the canal's watershed, has been cut for cattle raising and for agriculture. As a result of the cutting of the watershed, in the dry season the canal will no longer take the heavy ships that want to pass through. There simply isn't enough water retained by the deforested land.

This is a wonderful example of the kind of problem which the Panamanians had not planned for or thought about—incidentally the U.S. Army had not planned and thought about; we shouldn't blame the Panamanians entirely.

Mr. BONKER. It's going to be their problem now, since the canal is theirs. [Laughter.]

Mr. BLAKE. Now Panama wants us to replant the canal watershed for them. We probably will.

Mr. BONKER. As a side issue, I have been informed by staff that one of the reasons we are having this mass influx of Haitian refugees to the United States, is because of economic problems in that country, due in part to deforestation.

Mr. BLAKE. That is right. It is very interesting to see, Mr. Chairman, as you have probably seen, an aerial photograph of the border line between the Dominican Republic and Haiti. You can actually see this line from the air because all the forest is cut down on the Haitian side but on the Dominican Republic side most of it is standing. We're not getting the people from the Dominican Republic here in the United States as refugees. And yet, it is the same island, roughly the same kinds of people.

Mr. BONKER. That's very interesting. Recently, I returned from a trip to China, and was pleased to see that they are on a new program of reforestation. That country has been so overburdened with people and abuse, you just don't see any trees. I went all the way to Peking looking for a blade of grass. No grass, no trees, nothing. It's pretty dismal. But they're starting to realize now the importance of trees to their environment, and they're on a fairly strong program. Maybe we could export some trees to China, Mr. Bethel. [Laughter.]

I would like to say that the people in the audience are obviously interested in this subject since you have stayed here for nearly two hours. If you want, you can leave your name and address or a card with our subcommittee staff assistant, Sande, and we will put you on a mailing list to keep you informed of future hearings in this series on tropical deforestation.

I want to thank all the witnesses, who have presented excellent testimony today.

The subcommittee will stand adjourned.

[Whereupon, at 12:50 p.m., the subcommittee adjourned to reconvene at the call of the Chair.]

TROPICAL DEFORESTATION

The Role of International Organizations

THURSDAY, JUNE 19, 1980

HOUSE OF REPRESENTATIVES,
COMMITTEE ON FOREIGN AFFAIRS,
SUBCOMMITTEE ON INTERNATIONAL ORGANIZATIONS,
Washington, D.C.

The subcommittee met at 10 a.m. in room 2255, Rayburn House Office Building, Hon. Don Bonker (chairman of the subcommittee) presiding.

Mr. BONKER. The Subcommittee on International Organizations will come to order.

We meet this morning for the second in a series of three hearings on the issue of tropical deforestation. This is the first time any congressional committee has undertaken an examination of the causes and effects of tropical deforestation and the possible solutions to this problem.

The hearing today will focus on international organizations which have important roles to play in developing sound scientific and management systems for tropical forest resources.

Through their development assistance programs in equatorial countries, where nearly 99 percent of the world's tropical forests are located, multilateral organizations can contribute to greater national and international understanding of this complex ecosystem and to furthering balanced development of this vast resource.

The purpose of today's hearing is to investigate the policies and projects of international organizations in dealing with the problem of tropical forest depletion and degradation.

According to several leading experts in this field, international agencies, including the multilateral lending institutions, have traditionally pursued socioeconomic development schemes without regard to ecological considerations. This is especially true with respect to the environmental impact of converting tropical forests to agricultural and grazing land.

International organizations and tropical countries alike have found that the conversion of tropical forests to other uses have served short-term developmental goals.

But the haphazard depletion of this resource could well have devastating effects in the long run, not only within tropical countries, but for the major grain-producing nations and the world as a whole.

Our distinguished witnesses have been asked to address their remarks to the tropical forest activities of the U.N. Food and Agriculture Or-

66-326 O - 81 - 10

ganization, the U.N. Environment Program, UNESCO, the World Bank, the Organization of American States, and other international organizations with which they are familiar.

I wish to welcome to the subcommittee our distinguished witnesses, all recognized experts in the field of tropical forestry.

Due to time constraints with several of our private witnesses, I ask that Dr. Myers, Mr. Hoffmann, Dr. Lovejoy, and Dean Preston present their testimony first. The subcommittee will then hear from the administration witnesses: Dr. King, of the State Department, and Dr. Kunkle, of the U.S. Forest Service.

Before we begin the hearing, we are fortunate to be able to present a short film, produced by UNEP, entitled "Firewood." The film deals with the relationship between deforestation and the growing demand for, and shortage of, fuelwood in developing countries.

This film, I understand, is 10 minutes—so welcome to the afternoon matinee. It will be short. Then we will proceed with our witnesses.

[Whereupon the film, "Firewood," was presented.]

Mr. BONKER. Thank you. That was an excellent film. I think it is a good place to begin with today's hearings.

Would Dr. Norman Myers, Mr. Hoffmann and Dr. Lovejoy please come up to the witness table?

Dr. Myers is a consultant in conservation and development, author of "The Sinking Ark," and a former consultant to UNEP who resides in Nairobi, Kenya. Mr. Hoffmann is acting director of the International Institute for Environment and Development and coauthor of "Banking on the Biosphere." Dr. Lovejoy is vice president for science at the World Wildlife Fund.

Welcome, gentlemen. If you wish, you can submit your written testimony for the record and summarize.

STATEMENT OF NORMAN MYERS, CONSULTANT IN CONSERVATION AND DEVELOPMENT AND SENIOR ASSOCIATE OF WORLD WILDLIFE FUND—UNITED STATES

Mr. MYERS. Mr. Chairman, my name is Norman Myers. I work as a consultant. I am very glad, sir, to be here with you today to address what I believe is one of the most urgent topics in the entire development field.

I am also very glad to be here with you because I warmly welcome the strong initiatives that the U.S. Government has taken to tackle this topic during the past 2 or 3 years.

Sir, I think you are familiar with the basic background which I have reviewed in my paper, and which I would like to put into the written record.

I would just like to review one angle and say that it is becoming plain that tropical moist forests represent some of the most valuable natural resources we have on Earth. The abundance and variety of their biotic materials offer multiple utilitarian benefits to society right around the world, now and forever.

Apart from their more obvious products, such as industrial timber and fuelwood, they make many thousands of contributions through their genetic resources to modern agriculture, medicine, and industry.

When we go to our neighborhood pharmacy with a medical prescription there is one chance in two that the medication we collect owes its origin to materials derived from tropical moist forests.

To that extent, the existence and the survival prospects of these forests impinge upon the daily welfare of the lives of Americans and Europeans, as well as of Brazilians and Indonesians.

In terms of industrial products, a number of rain forest trees provide oils of diverse sorts. Some contain hydrocarbons, opening up the possibility of growing gasoline in the form of petroleum plantations.

We have all heard of the recent discovery of a strain of corn in one of Mexico's moist forests, offering prospects of revolutionizing corn growing in many parts of the world.

On the basis of experience to date, and during the course of which a mere 1 percent of tropical forest species has been subject to intensive screening for its potential benefits, it seems a statistical certainty that these forests offer vast reservoirs of materials to serve humankind, and from this standpoint alone, I believe these forests can be considered to rank among society's most valuable raw materials with which to confront the unknown challenges of the future.

Yet, these forests and natural resources are being depleted more rapidly than some of our most precious minerals. I believe this situation represents one of the most promising challenges for the international development decade of the 1980's.

Within that context, Mr. Chairman, I would like to suggest that the tropical forests have hitherto been overexploited and underutilized. Most forms of exploitation do not take sufficient account of the broad spectrum of material goods and environmental services that these forests have to offer.

I would like to see the main development agencies involved taking greater account of the full range of products and services that these forests have to offer, rather than concentrating, as these development agencies tend to do, on only a pretty narrow segment of materials.

Mr. Chairman, I would like to move on now very briefly to talk about the three international agencies with which I am acquainted in this field; notably, the Food and Agriculture Organization, the United Nations Environment Program, and UNESCO.

I have worked as a full-time staffer with FAO and with UNEP. I would like to emphasize that we have only one United Nations, and I wish to support that entire organization in whatever way possible.

I think there is no doubt that in the forestry field we would have been a good deal worse off without the existence of FAO. But, at the same time, Mr. Chairman, I would like to say, based on my experience of those organizations, that they could do a more substantive job in the tropical forest field, and that they could exert far more assertive leadership.

I believe they are too inclined to take an approach which says that they must reflect a consensus of opinion among their member governments.

Now, there is some point in that approach. They are, after all, the creatures or children, if you wish, of their member governments, and they are bound by the wishes of their member governments.

But, at the same time, they could exercise more assertive leadership, take more initiatives, present new ideas more regularly, more systematically, more substantively to their member governments. After all, other U.N. agencies are capable of doing this.

We have the notable example of UNICEF, which has a good track record in this regard. There is the record of the World Bank, which takes a pretty tough stand sometimes with member governments.

I believe that if these international agencies, with their institutional constraints, can exert even aggressive leadership, then I don't see why FAO, UNEP and UNESCO could not follow on the same track.

I would like to add in conclusion, Mr. Chairman, that I believe these agencies would positively respond to more forceful guidance from member governments, including the United States, in this tropical forest field.

It may be difficult for the U.S. Government to offer much of a lead insofar as the United States is not even within the tropical forest biome. But I do believe that there is room for a tougher stance—and I use that phrase in considered fashion—a tougher stance on the part of member governments which these agencies would in the long run appreciate.

They might not say so. They might not like it immediately, but in the long run I think they would respond positively.

Mr. Chairman, I have dealt with various topics quickly and briefly. I would be glad to come back to any of them and deal with them in more detail in answer to your questions. I would like to say very briefly in conclusion, if I may, a word about the International Council for Research in Agroforestry [ICRAF]. Is this pertinent to your hearing?

Mr. BONKER. Yes, please.

Mr. MYERS. The number 1 cause of destruction of tropical moist forests is the forest farmer. I believe, according to my researches for the National Academy of Sciences. Forest farmers are accounting for three-quarters of the destruction of tropical forests now occurring, and that that proportion will increase in the future. We are talking about a quarter of a billion cultivators. That is a fair proportion of the whole humankind.

To tackle this problem, a small coordinating catalytic agency, ICRAF, was established in Nairobi a couple of years ago, in the town where I live. I am familiar with that agency. I recognize its strengths and weaknesses.

ICRAF, Mr. Chairman, is about to go on to the back burner and may even go down the tubes through lack of funding and lack of support by member governments, by the international community.

I believe this will be a major setback to the entire tropical forest field.

[The prepared statement of Norman Myers follows:]

PREPARED STATEMENT OF NORMAN MYERS, CONSULTANT IN CONSERVATION AND DEVELOPMENT, AND SENIOR ASSOCIATE OF WORLD WILDLIFE FUND—UNITED STATES

My name is Norman Myers, and I work as a Consultant in Conservation and Development, also as Senior Associate of World Wildlife Fund—U.S., from my address at P.O. Box 48197, Nairobi, Kenya. I appear before you today having worked generally on the subject of tropical moist forests during the past several years, under the auspices of Rockefeller Brothers Fund, the U.S. National Acad-

emy of Sciences, the United Nations Environment Program (UNEP) and the World Wildlife Fund—U.S. During that time I have produced a number of publications on tropical moist forests, dealing notably with the issue of undue depletion of these forests. My writings have focused on the causes of depletion processes and patterns. Who is actually wielding the chainsaw and the axe, who is motivating these tree fellers, how far do people right around the world (not just in the tropical countries concerned) contribute to depletive processes through their marketplace consumers' demand for tropical forest products such as hardwood timber and fuel-wood, what is the role of giant timber corporations based in developed nations? My writings have also looked at the consequences of gross degradation of tropical moist forests, notably in terms of loss of species and genetic reservoirs, climatic dislocations at both local and global levels, and other "ecological backlash" effects, plus economic repercussions for tropical forest countries and for the entire community of nations.

My two main publications in this area have been "Conversion of Tropical Moist Forests", being a report for the National Academy of Sciences, published by the National Research Council in April 1980; and "The Sinking Ark," Pergamon Press, Oxford and New York, September 1979. I have also published a lengthy number of papers and articles in both the professional literature and in popular publications; I enclose copies of these writings, which you are welcome to enter into your record.

In brief review of my findings, tropical moist forests (TMFs) cover some 9 million sq. kms. or 3.6 million square miles, in the three major regions of the tropics. Ecologically they constitute the most complex and diverse biome on earth. Biotically they constitute by far the richest biome on earth, harbouring some 40–50 percent of earth's 5–10 million species. In terms of commercial raw materials, they contain earth's largest stocks of hardwoods, making specialist timber one of the leading commodities in export trade from the entire developing world.

At the same time, TMFs are less known to science than any other biome. We understand next to nothing of their ecological workings, not even of their most basic physiobiotic relationships, community dynamics, and energy flows. In 1972, the Tasady tribe was discovered in Philippines' rainforest, separated from the outsde world by a mere 15 miles of forest, and apparently isolated since neolithic times. We now know more about certain sectors of the moon's surface than we know about the depths of many TMFs.

It is becoming plain that TMFs represent some of the most valuable natural resources on earth. The abundance and variety of their biotic materials offer multiple utilitarian benefits to society now and forever. Apart from their more obvious products such as industrial timber and fuelwood, they make many thousands of contributions, through their genetic resources, to modern agriculture, medicine and industry. Examples include vincristine, a drug from a rainforest plant that now allows a child with leukemia an 80 percent chance of remission as compared with only 20 percent in 1960. TMFs offer many other anti-cancer drugs, together with compounds that assist with heart disorders and other major categories of human sickness. The World Health Organization is currently searching for materials to manufacture a safer and more effective contraceptive pill; the agency believes that its best prospects lie with anti-fertility compounds from plants of TMFs. A host of new foods are available from TMFs, while many improved varities of existing crops are to be found only in TMFs, such as the perennial strain of corn that has recently been discovered in Mexico's montane forests, with prospect of revolutionising corn growing (by eliminating the need to plough and re-plant) in broad regions of the world. A number of TMF tree species produce oils of diverse sorts, opening up the possibility of "growing gasoline" in the form of petroleum plantations.

On the basis of experience to date, during the course of which a mere 1 percent of TMF species have been subject to intensive screening for their potential utilitarian benefits to society, it seems a statistical certainty that TMFs harbour vast reservoirs of genetic material that could serve many pragmatic purposes of humankind. From this standpoint alone, TMFs can be considered to rank amongst society's most valuable raw materials with which to confront the unknown challenges of the future.

Yet TMFs and their species stocks are being depleted more rapidly than some of earth's most precious materials. Considering that the potential contribution of TMFs to humankind's long-term welfare has scarcely been tapped in comprehensive and systematic fashion, this surely represents one of the most promising challenges for the International Development Decade of the 1980s.

This dimension of the TMF situation has been dealt with in some detail in order to emphasise that the impending demise of TMFs would mark a significant economic setback to society, in both the developing and developed worlds. The decline of TMFs is a concern not for researchers into abstruse biology and other forms of esoteric-seeming science. It should be a priority interest of political leaders, economist planners, development technocrats, and whoever else is charged with the survival prospects of an exceptionally valuable sector of earth's land surface.

Despite the extensive stocks of valuable materials they have to offer, TMFs have been widely exploited in less than rational fashion. In fact they are now undergoing disruption and depletion more rapidly than any other biome. So broadscale are some patterns of mis-use and over-use, that if present trends persist—and they are likely to accelerate—substantial tracts of the biome will become grossly degraded, if not destroyed outright, by the year 2000; and still larger tracts may survive only in impoverished form beyond another few decades. It is not too much to say that TMFs are undergoing depletion, in both quantitative and qualitative senses, at a rate surpassing that for virtually any other high-value stock of natural resources. In the view of many authoritative observers, another half century could well see most of these forests reduced to degraded remnants, if not eliminated altogether.

As noted, there is a difference between quantitative and qualitative depletion—a difference that it is important to recognize. A useful generic term is "conversion", meaning any kind of broad-scale exploitation of TMFs that results in marked modification of primary (sometimes known as "virgin") forest, to the extent that it is reduced to a secondary or some other form of significantly altered forest. In other words, "conversion" can entail any kind of a substantial change for a primary forest, especially insofar as it depletes the abundant and diverse ecosystems of the forests with their extraordinary rich biotic stocks of species. Thus "conversion" is a term that need not be limited to outright elimination of the forest, but can include various degrees of degradation, disruption and impoverishment of primary forests and their ecosystems.

If one wishes to come up with a figure for "depletion per minute," one could suppose that the current conversion rate is somewhere between 40 and 50 hectares per minute (100–125 acres). This is about twice the rate that has been previously proposed. True, in many areas a primary forest will have been converted to a secondary forest, and will thereby remain a forest, albeit of severely impoverished sort. Thus there is validity to a recent EAO report by Lanly and Clement, 1980, to the effect that total and permanent elimination of forest cover amounts to only 10–12 hectares (25–20 acres) per minute.

If present conversion patterns persist—and they are likely to accelerate—the TMF biome will undergo fundamental transformation within the foreseeable future of the next few decades. This will represent a biological debacle to surpass virtually any other that has occurred since life's first emergence on the planet 3.6 billion years ago. At around the same point in time, viz, about 3 decades into the next century, the earth's known stocks of oil deposits look likely to become exhausted; and it is difficult to envisage which event—the end of the earth's fossil petroleum reservoirs or the end of TMF's—will engender the greatest impact on society's ultimate well-being.

[From Development Forum, U.N. publication]

WHOSE HAND ON THE AXE?

(By Norman Myers)

Tropical rain forests are declining in area. How fast is debatable. Some observers believe they could be virtually gone by the end of the century, others think some could last a good while longer. Beyond doubt, however, is the fact that they are being steadily depleted.

Does it really matter if they are disappearing? Matter to whom? And how much does it matter, in comparison with other things that matter? Whose needs are served by destruction of tropical rain forests, and at what cost to whose opportunities for a better life in other ways? Were we to try to reverse the process and conserve tropical rain forests, should we pursue this as an overriding objective, or should we rather do what we can within the framework of trying to enhance long-term human welfare in all manner of directions?

Against a background of these questions, there is need to consider tropical rain forests as natural resources of significance not only for the countries where they are located but to the community at large—both now and in the longer-term future. It is within this context that the challenge of what to do about tropical rain forests can be perceived as part of the problem of global interdependence, with all that implies for the north-south dialogue.

AGENTS OF FOREST DESTRUCTION

In recent years, there has been booming demand on the part of the developed world for the kind of timber that makes up over ninety percent of tropical forests—hardwoods. Hardwoods are favoured for housing construction, for finished products such as furniture, paneling, fixtures and packing and transportation materials, and also for wood-based panels such as plywood, veneer, particle board and fibre board. Hardwood forests of temperate zones have been steadily depleted, or are coming under greater protection in order to meet environmental interests and, as a result, exploitation pressure is increasingly directed towards the tropics (tables 1 and 2). In 1950, the developed world imported 4.2 million cubic metres of tropical hardwood timber, and in 1973, 53.3; it is projected to take 95 million by the year 2000. Of course, tropical regions use a lot of hardwood timber themselves, but the amount has little more than doubled since 1950, whereas developed-world imports have increased fourteen times, until the total has recently surpassed consumption by all tropical countries combined.

TABLE 1.—CONSUMPTION OF TROPICAL INDUSTRIAL TIMBER

Country/region	Million cubic meters				Projected		
	1950	1960	1970	1973	1980	1990	2000
Japan	1.5	4.6	20.1	28.9	35	38	48
United States	.8	2.2	5.1	7.2	10	15	20
Europe	1.9	6.2	10.5	17.2	21	27	35
Total: 3 importing regions	4.2	13.0	35.7	53.3	66	80	95
Tropical producing regions	21.0	34.0	42.6	46.5	66	117	185
Rest of world	1.0	2.1	4.2	9.0	13	18	23
Grand total	26.2	49.1	82.5	108.8	145	215	303

Source: Cliff, 1973, and Pringle, 1976.

Tropical forest countries earn an appreciable amount of foreign exchange through their wood exports, over $3000 million in 1974. So the countries in question have good reason to believe that forest exploitation contributes to their welfare, and could contribute far more. Given the impoverished state of most of their citizens, it is difficult to argue with this aim—provided that efforts to meet immediate goals do not pre-empt opportunities to accomplish long-term goals of similar sort, and provided that other legitimate interests, such as humanity's natural heritage in tropical rain forests, are not unduly or necessarily diminished.

It is this trade-off between immediate development and long-term conservation that raises major questions. Does selective logging of a few commercially attractive tree species leave the forests in a permanently impoverished state? Present logging techniques often lead to many of the remaining trees being damaged beyond recovery. Surveys in southeast Asia reveal that average logging can leave between one-third and two-thirds of residual trees effectively wrecked. With greater care (for example, cut trees could be extracted by helicopter) the damage could be reduced by half. But less destructive exploitation would raise timber prices for the principal consumer, the developed-world citizen—and to that extent, this consumer, who is presumed by the timber corporation to prefer prices as low as possible, is implicitly involved in once-and-for-all "mining", instead of sustainable exploitation, of the forests.

Moreover, the timber companies in question are often multi-national corporations based in North America, Japan and Europe. These corporations supply the capital, skills and technology without which Indonesia, the Ivory Coast and other countries would not be able to exploit their forest resources at such headlong rates.

From these various standpoints, then, developed nations bear a degree of responsibility for what is happening to tropical rain forests.

TABLE 2.—SUPPLY OF TROPICAL HARDWOOD TIMBER

[In millions of cubic meters]

Region (with area of hardwood forests in thousands of square kilometers)	1950			1973			1980			1990			2000		
	Production	Export	Percent	Production	Export	Percent	Production	Export	Percent	Production	Export	Percent	Production	Export	Percent
Asia-Pacific (3,200) [1]	14.3	22.0	14	72.5	48.5	67	93	65	70	130	82	63	150	80	53
Latin America (7,320)	15.5	.8	5	20.0	3.0	15	32	4	13	60	7	12	7	12	118
Africa (6,800)	4.7	1.5	32	16.5	11.0	67	20	12	60	25	9	36	35	10	29
Total (17,320; world total, 24,000) [2]	34.5	4.3	13	109.0	62.5	57	145	81	56	215	98	46	303	118	39

[1] Over ⅔ in Southeast Asia.
[2] North America's hardwood forests account for just over 1/10 of this total.

Note: As tropical developing countries themselves start to consume more of their hardwood output, there will be (except in the eventual case of Latin America) a smaller share available for export to developed countries. At the same time, developed countries' demand will steadily expand. So there will be compounded pressure to exploit tropical hardwood forests.

Source: Pringle, 1976, and other FAO documents.

THE CATTLE RANCHER

A major factor of forest elimination in Latin America is the cattle rancher. To meet growing demand in the affluent world for beef, rain forests are being replaced with artificial grasslands. As an instance of foreign-inspired exploitation, several fast-food chains in the U.S.A. find it is cheaper to obtain hamburger beef from parts of Central America that were recently virgin forests but are now cattle-raising pasturelands, than to purchase their meat from conventional sources in the U.S.A. During the 1960s, Central America's beef production increased by almost one hundred per cent. Not that the additional beef went into local stomachs; almost all the extra output was exported to the U.S.A.

A similar scene applies in the Brazilian Amazon. An increasing number of ranching enterprises there are foreign owned, for example, the King Ranch of Texas, Mitsui from Japan, Liquigas from Italy, and Volkswagen from West Germany—all producing beef in part to meet export markets.

This trend of increasing beef exports again highlights the relationships between developed-world lifestyles and the changes overtaking developing-world environments. Not that the affluent consumer in North America and Europe wittingly stimulates the spread of ranching in the rain forests of tropical America; yet he does it effectively and increasingly.

THE SLASH-AND-BURN CULTIVATOR

A further major agent in forest destruction is the slash-and-burn cultivator. Before he became so numerous, this man could operate as a shifting cultivator, applying a style of agriculture that allowed him to make sustainable use of the foreign environment. However as human numbers, have increased to a point where cultivator communities find themselves with less space to move around in, they have tended to make intensive as well as extensive demands on the forests, until local ecosystems can no longer recover. Occupying around two million square kilometres in the tropical forest zone, they are accounting for an additional 100,000 square kilometres each year. That, at least, is the minimum estimate; the actual areas could be far greater. To stem this tide of slash-and-burn destruction, it is necessary to increase the sustainable productivity of the cultivator's croplands, so that he senses less cause to move into fresh tracts of forests every few years. But improved agriculture requires a number of inputs, notably fertilizer to make a patch of cropland productive year after year. When fertilizer prices have been pushed high due to the price hike on the part of the oil-producing countries, and are kept high due to excessive demand on the part of rich countries (Americans use as much fertilizer on their gardens and golf courses and cemeteries as all slash-and-burn cultivators put together), the forest farmer sees little opportunity to alter his style of agriculture.

These are the resource relationships among the global community—and the economic-ecological linkages between cultivators who chop down the forest and people living many horizons away. Whose hand is really on the axe?

CONSEQUENCES OF DEPLETION

If the tropical rain forests are substantially wiped out, or grossly degraded, the consequences will be many and varied.

For starters, the tropical countries in question will lose a source of potentially renewable foreign exchange earnings through hardwood exports. If these countries, however, decide that they prefer to liquidate their forest capital in order to finance other more pressing, or apparently more suitable, forms of development, that is their sovereign right. Similarly, rich-world countries, through fostering exploitation of hardwood forests to the extent of excessive cutting, will lose the prospect of supplies of specialist timbers in the future. If these affluent nations, however, decide they prefer to rely on potential substitutes after tropical hardwoods give out, that is their sovereign right.

Regrettable as they are, these considerations are far from the whole story. From the standpoint of interdependency relationships among the global community, some further, and ultimately more important, issues arise. Were tropical rain forests to be largely wiped out, this could have a major impact on climates. Apart from probable consequences on a local scale (such as reduced rainfall and greater runoff), there are possible consequences for regions further afield. For example, it is considered on the cards that cleared forestlands would reflect

greater solar heat than when under thick vegetation, and in turn this could lead to changes in the global picture of air circulation, wind currents and convection patterns—with, as a not unlikely outcome, a decrease in rainfall in the zone between 40 and 85 degrees north, including the great grain-growing territories of the temperate regions.

At the same time, elimination of the tropical rain forests could contribute to a build-up of carbon dioxide in the earth's atmosphere. Until recently, it was believed that although increased combustion of fossil fuels was releasing growing amounts of carbon dioxide into the atmosphere, the increase was being absorbed partly by the oceans and partly by the earth's biota, especially by forests. Now, however, the destruction of forests in the tropics could be contributing to a build-up in the amount of carbon dioxide released into the atmosphere—with all that entails for a "greenhouse" warming of the earth's climates.

PRAGMATIC REASONS FOR CONSERVATION

A further critical consequence could be the loss of a large portion of the earth's stock of species. Of perhaps ten million species that are thought to exist on earth, between two and four million live in tropical rain forests. It is not unrealistic to suppose that, within the foreseeable future of, say, three or four decades, we could lose at least one million species, possibly many more. This would represent an irreversible loss of the unique resources of humanity's natural heritage. Aesthetic and ethical arguments aside, there are strong economic factors in favour of safeguarding species. Wild animals and plants serve many pragmatic purposes of immediate utilitarian benefit to mankind. Genetic reservoirs make a significant contribution to modern agriculture, to medicine and pharmaceuticals, and to industrial products.

To consider agriculture first, tropical rain forests contain many wild relatives of modern food crops. Modern crops, that have been developed through a refined process of "genetic engineering" on the part of crop breeders, require constant "topping up" with fresh germ plasm in order to resist new types of disease, environmental pests and the like, as well as to increase productivity and nutritive content. If tropical forests were to disappear, then gone too would be wild genetic reservoirs for several staple items of modern agriculture. To give an idea of economic values involved, groundnuts worldwide have suffered from leaf-spot diseases—a problem that proved surmountable by using resistant varieties selected from wild forms in the rain forests of the Amazon among other areas. The annual value of eliminating the diseases is estimated, by the International Crop Research Institute for the Semi-Arid Tropics, at $500 million. Similar large-scale benefits could be documented for rubber, coconut and palm oil.

To consider a further aspect of agriculture, pest control is assisted through certain plants that produce chemicals to repel insects or inhibit their feeding. The main areas to locate these plants are tropical rain forests, with their exceptional variety of plant species. Pest control can likewise be advanced through selective breeding of adapted species of insects (see *Mazingira* No 3/4, p 92)—a method that could prove more effective and economic in the long run, and result in less environmental disruption, than broad-scale application of persistent toxic chemicals. For instance, the little-documented ichneumonid wasps in tropical rain forests comprise possibly one quarter of a million species, certain of which could be used as predators and parasites of insect pests.

LEADING SOURCE OF ENERGY

As for medicines and pharmaceuticals, many of the starting materials are found in wild plants and animals. One group of important drugs, alkaloids, are derived from the nitrogenous substances in certain plants. To date, a mere two per cent of the planet's estimated 200,000 flowering plant species have been screened for alkaloids, producing about 1,000 different forms—and the most abundant sources of alkaloid-producing plants are tropical rain forests. Several alkaloids seem likely to prove active against various forms of cancer, while others are used for cardiac complaints, and still others show therapeutic promise against hypertension.

In terms of industrial processes, a single example will suffice. Tropical forests could serve as a leading source of energy. Green plants capture the energy of sunlight and convert it into food and fuel. It was this process of photosynthesis that originally gave rise to materials which now appear as oil, natural gas and coal.

How to cut out the 3,000 million years that have been required to transform ancient green plants into petroleum, and to harvest the stored solar energy of present day plants? Photosynthetic plants are by far the simplest way for man to collect and store solar energy, and tropical forests, with their higher rates of photosynthesis (they fix carbon at a rate of approximately one kilogramme per square metre per year), could supply appreciable amounts of energy on a sustainable basis. Indeed, some estimates suggest that the total energy available in the new growth of tropical forest material each year could match almost half the world's present consumption of energy. Among the techniques for extracting energy from forest material is pyrolysis, or the heating of organic material in air-free containers. The process releases a crude light oil, a mixture of gases, and a flaky char. Especially promising for this purpose could be hardwood plantations for ultra-rapid production of biomass, utilizing close-spaced plantings, coppice regeneration, and mechanical harvesting after the style of row-crop agriculture. Within tropical rain forests there could be a range of hitherto little-appreciated tree species, with a capacity to be genetically adapted for super-swift growth under varying environmental conditions.

All in all, it seems a statistical certainty that the genetic reservoirs of tropical rain forests contain source materials for many pesticides, improved crops, new foods, medicines, contraceptives and abortifacient agents, and industrial goods. These benefits could accrue to the whole of mankind in perpetuity, provided the species survive. Equally to the point, however, is that many of the benefits would accrue, for the foreseeable future at least, to fat-cat communities way outside the tropical forest zones. After all, most developing-world citizens do not live long enough to contract cancer or heart disease.

WHEN USING KLEENEX

So the decline of tropical rain forests implies a situation where we either all win together or we lose together. At any rate, in the long run. In the shorter term, some may win more than others. So maybe the lucky guys, the rich nations, should subsidize those countries that feel great pressure to over-exploit and eliminate their forests; in other words, the outside community should offer inducement to tropical-forest countries to safeguard at least a part, perhaps one-third of their forest tracts in the form of parks and of conservation units where limited and sustainable exploitation is permitted. After all, most of the developing countries in question are in no position to designate extensive tracts of forest land as "off limits" to development; and thus they are unlikely, through their own efforts, to meet a pressing conservation need—the setting aside of representative examples of forest ecosystems, in order to safeguard a significant slice of mankind's natural heritage.

It is right and proper for developed-world conservationists to bewail the decline of tropical rain forests. But while doing so, they might use fewer Kleenex.

Forests for People[1]

(By Norman Myers)

In front of the podium of the recent Eighth World Forestry Congress, held in Jakarta, stood a tree stump with an axe sunk into it. In this enlightened day and age, when much is heard about planting forests rather than cutting them down, one might have expected a more suitable symbol of the forester's profession, for example a pine seedling. Still, perhaps it was not so out of place in the host country, Indonesia, which, with the second largest bloc of tropical moist forest, 480,000 square miles or 13 percent of the entire biome, has leased out most of its forest estate to international timber corporations.

By contrast with this visible token, the UN Food and Agriculture Organisation, which sponsored the congress, struck a different note when it selected the theme: "Forests for People". Most of the 2000 delegates from more than 70 countries followed this line of thought right from the start. The opening session, on Forestry For Rural Communities, emphasized that forestry should not be viewed as an arcane art practised by a few technocrats with an eye to timber-

[1] First appeared in New Scientist, London, England, Dec. 21–28, 1978.

hungry markets many horizons (if not continents) away. Rather, and especially in developing countries, forestry should be perceived as an activity that potentially impinges, directly and daily, on the lives of human communities in forests' immediate environs.

For one thing—and pretty obvious at that—forests could offer a sustainable source of fuelwood for the two billion peasants of the Third World who often find it costs as much to heat the supperbowl as to fill it. Forests do not generally perform this function, but they could do so if foresters were to broaden their focus from production of industrial wood to establishment of village woodlots. True, this could prove an expensive proposition: at a minimum cost of $100 per hectare for fast-growing eucalyptus or pine, the outlay would be in the order of $2 billion. But the price tag does not seem so large when it is regarded in relation to something more than "just forestry". Developing world peasants who cannot find fuelwood often burn cattle dung instead. According to FAO estimates, one tonne of dung used as fuel instead of as fertiliser may mean a loss of 50 kg of food grain; so 400 million tonnes of dung used in this manner in parts of Asia, the Near East and Africa each year, could be costing 20 million tonnes of grain, enough to supply the protein needs of around 60,000 people—a price that puts a fresh perspective on the investment figure for village woodlots.

For a second, and not so obvious, thing, forests can help rural communities through their watershed effects. Forty per cent of developing-world farmers live in valley lands, and so depend heavily on the "sponge effect" of forests in surrounding catchment areas. When forests disappear, rainy-season supplies of water tend to be released in floods, followed by months-long droughts. In parts of Indonesia, Malaysia and Philippines, the green revolution is losing momentum as farmers in these forested zones find they can no longer look for regular supplies of irrigation water for their multiple crops of bumper-harvest rice each year. In one third of the rice-growing lands of Southeast and Southern Asia, it is now common for floodwaters to flow deeper than 0.5 metres at some stage of the growing season, more than can be tolerated by the high-yielding varieties of rice with their short stems.

PROBLEMS OF EROSION

In addition, rural communities find that deforestation affects not only their agriculture. Their prospects for locally generated energy likewise decline when reservoirs and hydropower installations suffer through erosion-caused sedimentation. The Mangla Reservoir in Pakistan receives about 100 million tons of sediment each year, four-fifths from the deforested catchment of the Jhelum River. The reservoir was built to last for one hundred years, but most of its capacity could well be lost within half that time. Moreover, reforestation of watersheds can readily be shown to be a paying proposition. In the Poza Honda River basin in Ecuador, economists believe that the life of 71 silting-up reservoirs can be extended by an average of 25 years through watershed conservation measures costing $1 million, producing benefits worth $2 million. Regrettably, this kind of cost-benefit reckoning is still in its early stages, and only 1 per cent of measures required for watershed rehabilitation worldwide are under way.

If watershed conservation assist downstream communities living many miles away from the forests at issue, something similar applies to people living still farther afield. Several major cities of Colombia have to put up with electricity rationing as a consequence of widespread deforestation. Inhabitants of Panama City are threatened with epidemics due to inadequate supplies of good-quality water. As the Panama Canal fills up with washed-off soil, it grows less able to handle outside cargoships. In Thailand, waterways that once provided an energy-efficient transportation have become too choked with silt debris to be navigable; now that additional deforestation-caused troubles, notably disastrous floods, are spreading to broad sectors of the country, the Thai government has decided to use extraordinary powers of summary judgment, even execution, to punish unauthorised cutting of forests.

The second session of the congress, "Forests for Food", pursued the same theme of community-wide benefits available from forests. Delegates heard how 70 per cent of animal protein consumed by the people in forest areas of southern Nigeria is made up of forest wildlife, worth $27 million a year. In the Toneslap area of Kampuchea (Cambodia), fish output in flooded swamp forests can be 10 times higher per unit area than in some of the best fishing grounds of the Atlantic. Moreover, forests produce not only food for humans but also feed for livestock. In Nepal, tree leaves make up about 25 per cent of the annual intake of cattle and 40 per cent of buffalos. Similar examples abound.

This amounts, however, to little more than a hunter-gatherer type of food production. A more systematic form, albeit pretty haphazard, is practised by the shifting cultivator. At least 200 million of these people farm three million square kilometres. They clear away patches of forest, raise crops for a few years until the soil loses its fertility, then move on to another patch of forest. Their growing numbers now make intensive as well as extensive demands on forests, to a point where local ecosystems no longer enjoy a sufficient fallow period to recover. Shifting cultivators now constitute the prime source of forest destruction; even if all lumbering and fuelwood collecting were halted, many tropical forests would still be headed for terminal trouble within just a few decades. The most hopeful strategy to tackle this problem lies with agroforestry. The rationale is to encourage the shifting cultivator (also other peasant farmers) to plant trees rather than chop them down. Mainly through financial incentives, it persuades the cultivator to establish a plantation of fast-growing trees on a patch of already-cleared forestland at the same time as he plants his food crops. When the cultivator is ready to move on, the plantation trees will have closed their canopy: result, a restored forest cover. In order to promote this new concept, a pioneer organisation has just been set up in Nairobi, called the International Council for Research in Agroforestry.

Eventually, the congress got round to the beloved theme of old-time foresters, industrial wood, meaning primarily timber and paperpulp. There were the usual statistics, about how global timber needs for solid wood are projected to increase, during the last quarter of this century, from roughly 1500 million cubic metres to something over 3000 million cubic metres. Demand for woodpulp is likely to expand from around 265 million cubic metres to something over 1000 million cubic metres, the increase due mainly to the spread of literacy in developing countries. Both categories of demand are certain to direct increased exploitation pressures toward tropical forests, which, for the past two decades, have been steadily declining in both quantity and quality due to misuse and over-use. Although they comprise 55 per cent of the Earth's forest stocks, tropical forests currently contribute only 15 percent to world trade in forest products, and the countries in question believe they have good cause to increase their proportion. Countries such as Brazil and Indonesia which have extensive forests, still spend millions of previous foreign-exchange dollars each year on imports of paperpulp, so they can hardly be blamed if they wish to convert increasingly large portions of their virgin rainforests—biotically the richest of Earth's ecosystems—into newspapers and schoolbooks.

To the chagrin of traditional foresters, however, the discussion of "Forests for Industrial Development" soon moved on to innovative forms of industrial use. Minor forest products, such as essential oils and gums, turn out to be not so minor in certain countries: India produces flavourings and perfumes, shellac, essential oils, exudates, resin, rattans and drugs worth $125 million per year. Other Asian countries export waxes, insecticides and weedkillers, latexes of various forms, disinfectants and other medicinals and a host of additional phytochemicals. The potential to establish "forest industrial complexes" in tropical regions is great and growing. Lignin, available in abundant forms among the extraordinary diversity of tropical forests, is used in the manufacture of plastics, ion-exchange resins, rubber reinforcers, fertilisers, vanillin, emulsions, asphalt strengtheners, dispersants for oil-well drilling, ceramic processors, and soil stabilisers. Cellulose is used to produce rayon and plastics, phenols, furfural, and formaldehyde, and serves as a raw material for hydrolysis to sugar. "Wood engineering", or synthesis of various wood components (particles, fibres, strands, flakes) with non-wood components (plastics, metals, minerals), points the way to entirely new types of products; for example, the yellow handle of the everyday screwdriver is made from a mixture of wood and plastics, and the same for spectacle frames. Scientists have even developed a "paper swimsuit". Possible new products along these lines already total 3000.

Many innovative approaches of similar sorts could encourage forest exploiters to make more efficient and systematic use of tropical forests—in marked contrast with present practices, which have been described by Dr. K. F. S. King, former director of FAO's Forest Department, as "primitive, costly and wasteful". In the light of these possibilities, plus many more that are not yet identified but are almost certainly on the cards, there is prospect that tropical forests could eventually feature nodes of industrial development, where manufacturing

and processing industries utilise raw materials drawn from a surrounding sea of relatively undisturbed forest.

Finally came a session on "Forestry for Quality of Life"—a topic distinct, presumably, from "Quantity of Livelihood". Apart from obvious items such as tourism and recreation, scientific research, education, and environmental amenity, the congress considered a few left-over items that had not been conveniently included under any other heading. So much for the hierarchical ranking of "Quality of Life" in the congresses' pecking order of subjects for discussion.

AN IMPORTANT GENETIC POOL

Yet this session brought up what some observers consider to be among the most important of all "products" of forests, genetic resources. Tropical moist forests in particular are rich in animal and plant life, probably harbouring half, if not more, of the Earth's species. If, in accord with a not pessimistic prognosis, present patterns of overexploitation persist, the next few decades could see gross degradation if not outright destruction of most tropical moist forests. This could mean the elimination of hundreds of thousands of species, conceivably many more—we do not yet know how many species exist in these forests, only that they total several millions. It is hardly unrealistic to suppose that we are losing one species per day right now. This represents the irreversible loss of a unique resources that could offer utilitarian benefits to global society now and forever.

When we take a drug prescribtion to a chemist, there is one chance in two that the medical preparation we pick up owes its production to startpoint materials derived from wild plants and animals. The US National Cancer Institute believes that if tropical moist forests disappear, this could represent a major setback to its anti-cancer campaign, on the grounds that tropical moist forests are a principal repository of anti-cancer drugs. Almost all natural materials that go into current contraceptive pills derive from a wild yam in Mexico, a plant that resists domestication; the World Health Organisation is searching the planet for source materials for new contraceptive pills, more effective and safer than the present types, and believes that the most abundant stocks of potential antifertility materials occur in tropical moist forests. A similar story could be told for modern agriculture. The situation for industrial raw materials has already been outlined.

The best way to safeguard tropical forests' genetic reservoirs is through setting aside representative examples of forest ecosystems. According to the theory of island biogeography, we need to think in terms of comprehensive networks of protected areas, totalling as much as 10 percent of the entire biome (equivalent to the United Kingdom setting the whole of Wales aside, plus some).

So far, the amount of tropical moist forests set aside amounts to only 1.5 per cent of the zone. Recent plans on the part of the three largest countries in question, Brazil, Zaire and Indonesia, could raise the proportion to 2.5 or even 3 per cent. A good way to go.

Already the practical application of genetic reservoirs suggests that tropical moist forests rank among humankind's most precious natural resources. If current rates of destruction continue, let alone accelerate, there may be little left of these forests within another three to five decades. That is roughly the timespan during which the Earth's estimated oil deposits are likely to run out. Two critical resources, apparently due to be exploited to exhaustion within the foreseeable future (though one of them is a potentially renewable resource): it is difficult to know which event would have the more serious repercussions for humanity's welfare.

CLIMATIC CONSEQUENCES TOO

Moreover, apart from the genetic resource benefits, which hitherto have tended to accrue to those communities that have the technological know-how to exploit them, there is a further dimension to the tropical forest issue and one that surprisingly was not raised at the World Forestry Congress. Widespread deforestation in the tropics could lead to increased reflectivity of sunlight in the equatorial zone (the "albedo effect") and to a build-up of carbon dio ide in the Earth's atmosphere. Both these processes could upset global climatic patterns, and result in warmer drier weather for certain northern latitudes, notably for the US grain-growing belt. The US could then find itself with too little food, rather than too much, in what could be a far hungrier world.

Meantime, responsibility for deforestaton in the tropics cannot be placed solely at the door of the tropical countries in question. They are encouraged to over-harvest their forest stocks in order to feed developed-world appetites

for tropical hardwoods and other specialist timbers. They could be dissuaded from over-rapidly converting their virgin rain forests into sources of paperpulp if, for example, the US, by far the largest consumer of paper products, were to recycle more than 20 percent of the 46 million tons of wastepaper that it discards each year—an amount greater than all the paper utilised by the entire developing world. Tropical forest countries are offered strong incentives by multinational corporations (non-timber concerns such as Volkswagen, Liquigas and Goodyear among them) to eliminate their forests in favour of man-made pasturelands, on which to raise cattle for export to beef markets in affluent nations; according to marketplace prices, which do not consider environmental costs, it is "cheaper" to produce beef in Amazonia for hamburger chains in North America than to grow the meat in the United States. Long-term progress in the shifting-cultivator front is less likely to be achieved as long as certain prerequisites of stabilised agriculture, for example, fertiliser, are kept beyond the purchasing power of improverished peasants, through inflated demand on the part of developed nations that utilise more fertiliser on their golf courses, truck gardens and cemeteries, than is consumed by all 200 million shifting cultivators put together.

Scarcely any other natural resource, with the possible exception of oil, reflects the interdependent relationships of one-Earth living than is so far tropical moist forests. A suggested theme for the Ninth World Forestry Congress, to be held in another six years' time, could be "All Forests for All People".

Comments Foresters and Tropical Forests[1]

(By Norman Myers)

Tropical forests seem headed for a new lease of life. They need it. For years they have been declining in quantity and quality, partly due to loggers and fuelwood gatherers, partly due to shifting cultivators and other farmers who convert forests into croplands. If present patterns of misuse and over-use persisted, there could be little left of tropical forests within just a few decades.

All the more welcome are four recent initiatives. First, the Food and Agriculture Organization has launched a programme for community forestry. This aims to highlight ways in which developing-world forests (primarily tropical forests) contribute not just to sectoral interests, such as timber production, but also to community-wide needs through, for example, their capacity to limit soil erosion and flooding. To relieve haphazard exploitation of natural forests, the programme proposes a broad-scale effort to establish man-made forests, notably in the form of village woodlots. There is strong emphasis on local consultation. The people who, through fuelwood gathering, have depleted natural forests are to be closely involved in establishing and maintaining "their" forests.

Secondly, the World Bank has published a sector Policy Paper on forestry which stresses the non-wood products of forests, notably their environmental services. Through their "sponge effect", forests help to safeguard watershed systems, and thereby promote the regular release of water downstream for the benefit of farmers who need dependable water supplies for crops and livestock, and city dwellers who require clean water for domestic use. After allocating only $240 million to forestry between 1963 and 1976, the bank is to beef up its lending to $500 million over the next five years.

Thirdly, the International Council for Research in Agro-Forestry has been set up in Nairobi. Its rationale is to encourage shifting cultivators, among other peasant farmers to plant trees rather than chop them down. Mainly through financial incentives, it persuades cultivators to establish plantations of fast-growing trees on patches of already cleared forestland at the same time as they plant food crops. By the stage when a cultivator has exhausted the fertility of his crop patch and is ready to move on, the plantation trees have closed their canopy: result, a restored forest cover. The strategy aims to tackle the number one cause of tropical forest destruction: 200 million shifting cultivators with their growing numbers now make intensive as well as extensive demands upon forests, to a pont where local ecosystems can no longer recover.

Fourth, the Eighth World Forestry Congress, held recently in Jakarta, focused on the entire spectrum of products available through forestry. It looked not only at timber and fuelwood, but also industrial materials such as oils and gums, drugs and a host of organic chemicals, genetic resources, food of myriad sorts, livestock

[1] First appeared in New Scientist, London, England, Nov. 30, 1978.

fodder, and diverse environmental services. Titled "Forests For People", the congress devoted only a small part of its time to the timber industry, preferring instead to deal with society at large and a bevy of benefits derivable from forests. In marked contrast with the past, the congress emphasised an expanded form of forestry—a multiple-sector activity that offers many things to many people.

All this means that foresters need no longer operate as apparent rivals to agriculturalists and other development practitioners. Hitherto, there has been a tendency to view one dollar allocated to forestry as one dollar less for "true priorities" such as good production. Far from being competitive with other development interests, the forester should serve a complementary function. For example, by helping to ensure year-round flows of good-quality water, he can support the green-revolution agronomist, the livestock expert, the hydropower engineer, the public health official, technocrats of a dozen sorts and conditions. The forester can make a greatly increased contribution to two leading strategies for the Third World—meeting basic human needs and integrating rural development.

In many instances, however, a new kind of forester will be required—a professional who instinctively sees the entire forest as well as stock of board feet and who can keep in view the needs of the throngs of people living near forests. Equally, the new-style foresters should bear in mind the needs of human communities—for example, urban residents, who live many horizons beyond their immediate purview but whose levels of living likewise depend on the healthy functioning of forest ecosystems. A new type of forestry, about and by people, is emerging. Forests are too important to be left to the conventional forester.—*Norman Myers.*

Conservation of Forest Animal and Plant Genetic Resources in Tropical Rainforests

(By Norman Myers)

A SPECIAL PAPER PRESENTED AT EIGHTH WORLD FORESTRY CONGRESS

INTRODUCTION

When forests are exploited for their products, some disturbance ensues for the forestland ecosystems. In particular, disruption can be significant if not severe for plant and animal species that find their habitats in the forest. The more complex are forest communities, the more susceptible they are to disturbance—and this applies especially to tropical rainforests, which feature a much richer array of species than temperate-zone forests. In fact, tropical rainforests contain a greater abundance and diversity of species than any other biome on earth, between 2 and 4 million of the earth's endowment of 10 million species (Baker, 1974; Farnsworth and Golley, 1974; Golley and Medina, 1975; Lowe-McConnel, 1969; Meggers et al., 1974; Myers, 1976 and 1978; Raven, 1974; and Richards, 1966 and 1973).

The same comments apply of course to the genetic resources represented by these species. Beyond doubt, tropical rainforests constitute by far the richest stock of genetic reservoirs on earth. For convenience in this paper, however, the analysis that follows will deal with species rather than with genetic resources per se; and, by the same token, will restrict itself primarily to genetic diversity among rather than within species.

The paper will also confine its focus to the tropical rainforests, rather than consider all forms of forest. This is further pertinent insofar as tropical rainforests are undergoing more basic and rapid modification at the hand of man than any other biome. Tropical rainforests are certainly declining in total expanse. Just how fast they are declining is debatable, though most observers agree that a large proportion could become grossly altered, if not outright destroyed, by the end of the century (Gomez-Pompa et al. 1972; IUCN, 1975; Persson, 1974 and 1977; Prance and Elias, 1977; Sommer, 1976; and Whitmore, 1975). Moreover, considering that many forest species, notably insects, exist at low densities and with localised distributions, a tract of forest does not have to be entirely wiped out for a number of its resident species to be eliminated.

Thus it is not unrealistic to suppose that, within the foreseeable future, the fundamental modification of tropical rainforests could lead to the disappearance

of as many as one million species. In fact, it is likely that, right now, at least one species is disappearing in tropical rainforests each day, and before many more years go by, we may face a situation where one species goes extinct each hour.

Extinction of species represents an irreversible loss of a unique resource. This type of environmental impoverishment differs from other more common types such as pollution; when water bodies are fouled or the atmosphere is treated as a garbage can, we can, if we change our minds about the process, clean up the pollution. By contrast, species extinction is final—and the consequence falls not only on present society but on all generations to come.

This is not to say, of course, that conservation of species should be considered an absolute value. When tropical forests are exploited, their products generate many benefits, such as foreign-exchange earnings, for the countries concerned. So a question of tradeoffs arises: conservation of species should be perceived within a context of development needs overall. The central issue is not "Let's save species, whatever the cost"; rather, we should ask whose needs are served by conservation of species, and at what cost to whose opportunities for a better life in other ways. In other words, should we seek to conserve species as an over-riding objective, or should we rather do what we can within a framework of trying to enhance long-term human welfare in all manner of directions?

PRAGMATIC PURPOSES OF SPECIES CONSERVATION

Fortunately species offer many utilitarian services of immediate benefit to society. These pragmatic purposes enable conservation of species to rank as a mode of forest use that merits regard alongside other forms of forest use.

Throughout the world, people increasingly consume food, take medicines, and employ industrial materials that owe their production to genetic reservoirs and other startpoint materials of animals and plants from tropical rainforests. Given the needs of the future, species can be reckoned among society's most valuable raw materials. Any reduction in the diversity of resources narrows society's scope to respond to new problems and opportunities. To the extent that we cannot be certain what needs may arise in the future, it makes sense to keep our options open, provided that a strategy of that sort does not unduly conflict with other predominant purposes of society. This conservation rationale applies to humanity's endowment of species more than to virtually any other category of natural resources.

In fact, the problem of disappearing species could eventually be seen as one of the greater "sleeper issues" of the late 20th century. It is difficult to visualise a challenge more profound in its implications, yet less appreciated by the general public, than that entailed in the wholesale elimination of species and their genetic resources.

Present utilisation of species runs into many thousands of forms. The main categories are modern agriculture, medicine and pharmaceuticals, and industrial processes.

(*a*) *Modern agriculture*

Tropical forests offer a range of entirely new food sources (Biotrop, 1976; Cacanindin, 1976; Jong et al., 1973; Meijer, 1969; Rifai, 1977; Whitmore, 1971; and Williams et al., 1975). In Indonesia alone, around 4000 plant species are thought to have proved useful to native peoples, yet less than one tenth have come into wide use (Kartawinata and Atmawidjaja, 1974). A hitherto uncultivated fruit of Southeast Asia's forests, the mangosteen, has been described as "perhaps the world's best tasting fruit" (U.S. National Academy of Sciences, 1975). Also in Southeast Asia, the winged bean, a tropical counterpart of the soybean, could offer a first-rate source of protein (Masefield, 1975). In Malaysia, a number of crops—ramutan, mango, lime and durian—have wild relatives surviving in the forests, many of them with potential to become economic plants in their own right, while a new citrus fruit has recently come to light (Stone, 1972). A vine from tropical forests of southern China, known as the Chinese gooseberry, bears fruit with juice 15–18 times richer in vitamin C than orange juice (U.S. National Academy of Sciences, 1975). Numerous leafy vegetables are available from tropical fore ts (Oomen, 1971; and Samson, 1971).

Moreover, tropical moist forests contain many wild relatives of modern food crops. These crops, the refined products of genetic engineering, require constant "topping up" with fresh germ plasm in order to resist new types of diseases and pests, environmental stresses, and the like, as well as to increase productivity

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and nutritive content. To give an idea of economic values involved, groundnuts worldwide have suffered from leaf-spot diseases—a problem that proved surmountable through resistent varieties from wild forms in the rainforests of the Amazon among other areas. The annual value of eliminating the diseases is estimated, by the International Crop Research Institute for the Semi-Arid Tropics, at $500 million. Similar large-scale benefits could be documented for rubber, coconut and palm oil.

To consider one further aspect of modern agriculture, pest control can be assisted through certain plants that produce chemicals to repel insects or inhibit their feeding. The main areas to locate these plants is tropical rainforests, with their exceptional variety of plant forms that have co-evolved in balance with their insect associates.

Pest control can likewise be advanced through selective breeding of adapted species of insects—a method that could prove more effective and economic in the long run, and result in less environmental disruption, than broad-scale application of persistent toxic chemicals (Borror and DeLong, 1971; Huffacker, 1975; Huffacker and Messenger, 1977; U.S. National Academy of Sciences, 1976; and Van Den Bosch and Messenger, 1973). For instance, the little-documented ichneumonid wasps, comprising possibly one quarter of a million species in tropical rainforests, could offer much potential as predators and parasites of insect pests.

(*b*) *Medicine and pharmaceuticals*

Plants and animals from tropical rainforests have contributed a wide range of drugs and pharmaceuticals, including analgesics, antibiotics, cardio-active drugs, anti-leukaemic agents, enzymes, hormones and anti-coagulants (Altschul, 1973; Clause et al., 1970; Kreig, 1964; Krochmal and Krochmal, 1975; Schery, 1972; Swain, 1972; Thomson, 1975; Treose and Evans, 1972; and Ucko and Dimbleby, 1969). As many as one half of all prescriptions written in the United States each year contain a drug of natural origin as sole active ingredient or as one of two or more main ingredients, while the growing value of higher plant medicinals in the United States is presently put at well over $3 billion (Farnsworth, 1973; Farnsworth and Morris, 1975). The United States is especially dependent upon imported plant materials for most of its botanical resources for medicines—these imports coming especially from tropical rainforests. Of 76 major medicinal compounds obtained from higher plants, only seven can be commercially produced at competitive prices through synthesis.

An exceptionally valuable group of drugs comprises the alkaloids. These organic alkaline compounds, including strychnine, cocaine and nicotine, derive from nitrogenous substances found in certain categories of plants, notably in tropical rainforests (Robinson, 1974, Webb, 1969). To date, only two percent of the earth's 250,000 flowering species have been screened for alkaloids, producing nonetheless about 1000 substances. Among the more valuable are the glycoside alkaloids, used for cardiac complaints, and a number of related alkaloids that show therapeutic promise against hypertension. The pyrrolozidine and acronycine alkaloids look likely to prove active against several forms of cancer, and other recently-discovered alkaloids help in the treatment of leukaemia.

A further group of drugs is of increasing importance—those that serve as contraceptives and abortifacients (Applezweig, 1975 and 1976; Farnsworth et al., 1975; Munshi, 1972; Swain, 1972). Well known are the steroid precursors, isolated from various plants of tropical rainforest origin. Many forest-living peoples are acquainted with plant products that serve as contraceptives (Kostermanns, 1963; Salcedo, 1970; Schultes, 1972; Tamson, 1974). For example, Indonesia's National Biological Institute has found a tree that is used by local people as a spermicide, while certain forest plants of South Pacific islands serve as a first-month abortifacient (Wenkham, 1974). The World Health Organization is reviewing 4000 plant species that are used to regulate fertility in different parts of the world (World Health Organization, 1977).

(*c*) *Industrial processes*

A range of industrial items are available from a single rainforest region, Southeast Asia. Notable are gums, latex, camphor, dammor, resins, dyes, waxes, tannins, rattans, bamboos, guanos and ethereal oils (Bene et al., 1977; Cacanindin, 1975; Murphy, 1974; Robbins and Matthews, 1974; Stout and Schultes, 1973). In the wake of the cyclamate controversy, there is greater need than ever for a suitable non-nutritive sweetening agent, and many plant pigments, such as

carotenoids in fruits, serve as attractants in nature, so almost certainly are non-toxic to mammals including man; there is prospect of several sources of sweeteners among plants of forests in Southeast Asia, whose fruits have exceptionally suitable tastes (Baker, 1970). The natokely tree of Madagascar, threatened with extinction, contains a rot-resistent oil that could prove useful for tropical furniture among many other purposes (Tinker, 1971).

Especially important forest products are oils, in view of the present cost of petroleum-based lubricants. Of 6400 plants recently screened for new oils, waxes and gums, promising leads have been revealed by 460 (U.S. Department of Agriculture, 1976). Principal candidates include a number of palms and other tree species of the Amazon rainforest (U.S. National Academy of Sciences, 1975).

Perhaps most important of all, tropical rainforests could contain plant species that offer potential as sources of energy. Green plants capture the energy of sunlight and convert it into food and fuel. It was this process of photosynthesis that originally gave rise to materials for geologic formation of oils, natural gas and coal. How to cut out the one third of a billion years that have been required to transform ancient green plants into petroleum, and to harvest the stored solar energy of present-day plants? Photosynthetic plants are by far the simplest way for man to collect and store solar energy, and tropical forest plants, with their high rates of photosynthesis (the forests fix carbon at a rate of approximately one kilogramme per square metre per year) could supply appreciable amounts of energy as a sustainable basis (Alich and Inman, 1974; Bassham, 1976; Brown, 1976; Calvin, 1976; Chiang et al., 1976; Clifton and Tatum, 1976; Earl, 1975; Hayes, 1976 and 1977; Hammond, 1977; Inman et al., 1977; Lichtin, 1974; Pollard, 1976; Poole and Williams, 1976; Sarkonen, 1976; Schauffler, 1976; Szego and Kemp, 1974; U.S. Energy Research and Development Administration, 1976; Wilke, 1975; Williams, 1975; Young, 1975). Indeed, some estimates suggest that the total energy available in the new growth of tropical forest material each year could match almost half the world's present consumption of energy (Bene et al., 1977; Earl, 1975; Hibler, 1976). A foremost technique for extracting energy from forest materials is pyrolysis, or the heating of organic material in air-free containers; the process releases a crude light oil with around 75 percent calorific value of ordinary oil, also a mixture of gases and a flaky char.

Especially promising for this purpose could be hardwood plantations for ultra-rapid production of biomass, utilising close-spaced plantings, coppice regeneration, and mechanical harvesting after the style of row-crop agriculture. Among tropical rainforests could be a number of tree species with little-recognized capacity for super-swift growth under varying environmental conditions; one example to reach recent prominence is the giant ipilipil (Benge and Curran, 1976; Brewbacker, 1975; U.S. National Research Council, 1977).

In Ghana, a U.S. AID-supported research project suggests that a 40,000-hectare plantation of fast-growing trees could produce energy equivalent to 500,000 tons of coal per year (together with food crops interplanted among the trees, around 60,000 tons of peanuts and 54,000 tons of corn). A capital-intensive plantation of the same size but with sophisticated processing facilities, could produce 50,000 tons of methanol, 12,000 tons of pyrolytic oil, 150,000 tons of ammonia fertiliser, 17,000 tons of char, and 80,000 kilowatt hours of electricity per year (together with 60,000 tons of peanuts and 50,000 tons of corn) (Chiang et al., 1976).

All in all, it seems a statistical certainty that tropical rainforests, with their vast genetic reservoirs of plant and animal species, contain source material for many new goods, improved crops, pesticides, medicines and drugs, contraceptives and abortifacient agents, and industrial goods. These benefits could accrue to the whole of mankind in perpetuity, provided the species survive.

Some conservation proposals

A principal way to safeguard species and genetic resources is through parks and reserves.

Regrettably, tropical rainforests feature few such protected areas: in South America, only 0.67 percent of the forest zone, in Southeast Asia 1.8 percent, and in Africa 2.67 percent (almost all in one country, Zaire), (Dourojeanni, 1975). By contrast, preliminary estimates suggest that as much as 20 percent of tropical rainforests need to be preserved, in select localities covering distinct ecosystems, in order to ensure preservation of biotic communities with their endemic components. Moreover, since many species in this highly differentiated biome are characterised by localised distribution, a few large parks and reserves would not

suffice to protect the range of biotic diversity. An extensive and strategically sited network is needed.

Indeed, according to the theory of island biogeography (Cody and Diamond, 1975; Diamond, 1975 and 1976; Diamond and Jones, 1978; Diamond and May, 1976; Lack, 1976; MacArthur, 1972; MacArthur and Wilson, 1967; May, 1975; Mayr, 1977; Simberloff, 1976; Simberloff and Abele, 1975; Slatyer, 1974; Sullivan and Schaffer, 1975; Terborgh, 1973 and 1974a and b; Willis, 1974; and Wilson and Willis, 1975), a critical minimum size for a tropical-forest park could sometimes be large indeed. If, say, 90 percent of an original habitat is grossly disrupted through man's activities, and the remaining 10 percent is protected as a park or reserve, we can expect to eventually save no more than about half of the species restricted to the particular area. Even in protected areas covering several thousand square kilometres, some species with specialised characteristics will have negligible prospects of ultimate survival. In fact, it is probably that some species, notably wide-ranging predators, will be eventually doomed even in parks as large as 10,000 sq. kms.

To consider a few examples, wild fruit trees in Malaysia's lowland rainforest occur at low densities. A sample survey of 676 hectares has revealed few species with more than 24 individual trees per 100 hectares, while 11 out of 18 species have fewer than 13 trees per hectare. So if, as is likely, each species requires 10,000 trees to provide an adequate gene pool, considerable territories will have to be set aside to safeguard these species (Whitmore, 1975). In the same region, hornbills, possibly requiring minimal populations of 5000 individuals to ensure adequate gene pools, will need between 2000 and 10000 sq. kms, and monkeys, with similar-sized populations, anywhere from 250 to 3000 sq. kms. (Medway and Wells, 1971). Certain forest animals must move long distances to find the resources they need; for example, a number of butterflies depend on amino-acids from pollen in certain kinds of plants in order to sustain their egg production, and they sometimes have to travel several kilometres to find sufficient pollen stocks (Ehrlich, 1974); so an area of less than several hundred sq. kms. is likely to be inadequate for these butterflies.

All in all, one can surmise that an absolute minimum size for a tropical rainforest park should be 1000 sq. kms., and 2500 sq. kms. a working minimum, until such time as we achieve better understanding of forest ecosystems.

The Amazon

Considering the importance of the Amazon—the region is believed to be the richest single biotic zone on earth, with at least one million species—it is worthwhile to review the situation in some detail. We now know that the Amazon is a highly heterogeneous region. Far from being one vast wet forest, only limited sectors receive year-round rainfall. The lowland basin is divided among several ecological zones, such as the varzea floodplains, the igapo swampforests and the upland forests of the terra firme. In view of this diversity, a considerable number of ecosystems will need to be brought under protection if a representative network is to be established.

The prospect has been illuminated by a number of studies of the Amazon's recent past. Following the climatic changes of the late Pleistocene with their periodic drying-out of the forest zone, a series of sixteen "refuges" for surviving species merged—and these refuges still feature high levels of endemism (Brown, 1975; Haffer, 1969 and 1974; Prance, 1974; Vanzolini and Williams, 1970; Van der Hammen, 1972; and Wing, 1973).

Clearly, conservation should focus on these priority areas. Still more recent research has identified eight phytogeographic zones, or sub-divisions of the Amazon, with characteristic floral—and thus faunal—communities (Prance, 1974, 1976 and 1977). These zones require representative protection.

Translating these research findings into a conservation programme works out somewhat as follows (Wetterberg et al., 1976a and b). Suppose each of the eight sub-divisions merits three protected areas, each park or reserve comprising 2950 sq. kms. (1000 sq. miles) (the optimal size would vary with the natural communities at stake); this would amount to 62,160 sq. kms. In addition, a number of smaller parks and reserves would be required, notably to protect species of highly limited range, unique micro-habitats, and exceptional localities such as turtle- or bird-nesting areas; three such additional areas in each sub-division, comprising 1000 sq. kms each, would amount to 24,000 sq. kms. Certain protected areas would need buffer zones around their perimeters, to hold off man-derived

disturbances from outside; if each such strip were 10 kilometres wide, the area involved would be 98,460 sq. kms. The overall total would be just under 185,000 sq. kms., an appreciable amount of territory—but less than 3 percent of the Amazon region's 6.5 million sq. kms.

To date, Brazil has established one major Amazon park, of approximately 10,000 sq. kms., and a further park is proposed for the region, of 50,000 sq. kms. But neither of these areas would do much to meet the conservation priorities indicated by the pattern of "refuges". Peru's Manu Park, 15,000 sq. kms., and Venezuela's Canaima Park, around 10,000 sq. kms, are more suitably located in this regard. In addition, Brazil plans to create a series of new parks and reserves totaling 175,000 sq. kms. by 1979 (Wetterberg, 1977), though how far this major extension will afford protection to critical areas, cannot be judged todate. By contrast, it is known that a number of pockets of spices endemism, in fact four of the Pleistecene refuges, fall entirely within those parts of the Brazilian Amazon that have been designated as growth poles for intensive development through cattle ranching and smallholder cultivation, while major parts of other high-priority conservation foci overlap with development areas (Prance, 1977). If any one of these refuges were to be eliminated, a large number of species would go with it.

Conclusion

Thus the challenge of conserving species concentrations and genetic reservoirs in tropical rainforests. Not only is the tropical rainforest zone considered to be, from an ecological standpoint, by far the most diverse zone on earth; from a scientific standpoint, it is by far the least known of the major biomes; and, from a conservation standpoint, it is undergoing more rapid disruption and destruction than any other biome.

Mr. BONKER. The subcommittee will take note of what you say on that matter.

Mr. Hoffmann.

STATEMENT OF ROBERT THOMAS HOFFMANN, ACTING DIRECTOR, INTERNATIONAL INSTITUTE FOR ENVIRONMENT AND DEVELOPMENT

Thomas Hoffmann, the Acting Director of the International Institute for Environment and Development's Washington office, is an international lawyer specializing in development and energy questions. He has written, spoken, and testified before Congress recently on international energy issues ("Fuel for the Fire: the Reappraisal of Multilateral Energy Aid" in "Energy Policy," December 1978; and with Brian Johnson, "Bypassing Oil and the Atom: the Politics of Aid and World Energy" in "Energy Policy," June 1979). He is an Executive Director of the International Development Conference, and has law degrees from the University of Oxford and New York University, where he was a Root-Tilden Scholar.

Mr. HOFFMANN. Thank you, Mr. Chairman.

Perhaps I should begin by stating that as an organization, the International Institute for Environment and Development has 3 or 4 years' experience of researching and working closely with the World Bank and other major multilateral development organizations on the whole range of issues associated with environmental problems and natural resources management in developing countries.

I was asked to speak generally to that question, as well as to the question of the World Bank's tropical deforestation program. I will begin with the issue of forestry and finish with the more general topic.

I would like to put the World Bank's program in perspective by saying a bit more about the nature of the problem that Norman Myers was just describing; namely, the problem of farmers moving into forested areas.

There are a lot of different reasons why the people living on the forest frontier are in motion, but I think I can sum up two or three of them.

One is that mobile farmers move into new areas, grow crops for a few years, and move on to previously forested areas because they are moving into areas where the soil is not good and it will support forestry but not crop agriculture.

A second type of example occurs when farmers take over what looked like very well-conceived government-sponsored settlement programs. These people will ordinarily ignore boundaries, so that forest preserves will be forgotten. An area is meant for gradual agricultural expansion—suddenly the area is overwhelmed.

A third type of case occurs where nobody was really planning on agricultural development at all, but a road will be built into an unpopulated area, maybe to bring out minerals or timber. But it is almost inevitable in most of the countries we are talking about that settlers follow roads, to move into new areas. So sometimes areas are colonized which are totally unsuitable for agriculture. There are no controls, no forestry service, no management, no planning at all, that would have been established in an area like that.

Perhaps the thing to say about the World Bank—in response to all this—is that the World Bank is not a conservation organization. It is a development finance organization. So we will certainly be disappointed if we expect the World Bank to exercise global leadership in conserving what remains of the world's forests.

But we can expect—and I hope this committee and the U.S. Government will demand—that the Bank's development programs in the agricultural areas and rural development show much greater sensitivity to the global conservation challenges that are emerging, and help countries with their conservation problems, whenever they are making agricultural loans or forestry loans in these countries.

I don't think the World Bank can be asked to set up a global program to respond to something like tropical deforestation, but its country programs should have a cumulative impact on a widespread problem.

I also think the Bank could be more responsive in countries where forests are particularly threatened. I think we can expect financing of specific conservation components in all World Bank projects that utilize forest areas.

I would even include in this assistance and encouragement, perhaps aggressive encouragement, as Dr. Myers suggested, to countries in the tropics to set aside protected areas of forests that are adjacent to or contiguous with the forest areas that they are developing with settlers or agriculture.

The World Bank is beginning to do all of these things. A lot of it is laid out in their forestry policy paper, which you have. They can do a lot more, a great deal more.

I would like to say something about that and the very nature of the World Bank's programs. A lot of things that the World Bank does are sector-oriented or topic-oriented. But the problem is often that an area of activity will be narrowly conceived. This is certainly true of the World Bank's approach to environment.

It is also, I am afraid, true of the World Bank's approach to forestry. That forestry sector paper is really almost a model of forestry development policy. It has had a major impact in the World Bank on forestry projects, which is to say those projects that they call forestry projects.

I am not sure it has had a major or even significant impact on agricultural projects, and on rural development projects.

The forestry lending program over the last 3½ years has totaled about $500 million. The agricultural development program is $3 billion in 1 year alone. So the factors of scale are very important. In the internal workings of a bureaucracy as large as the World Bank, it becomes a matter of getting the right people to ask the right questions.

I would like to mention the three types of programs that the World Bank does that can have a direct impact on the general problem of deforestation.

One is their general program, which is about to grow, I understand, by a significant order of magnitude, for firewood replenishment projects, reforestation, and afforestation with fast growing species, the problem discussed in the film. I understand that they are planning a new program that may reach about $200 million a year beginning next year.

The second type of World Bank loan that should be mentioned today is the establishment of large forestry plantations to provide timber for forestry projects, industrial forestry, or pulp and paper mills and so on. Really, they are becoming a lot better at this in the last few years.

It is terribly important to emphasize that replanting and planned land management is almost always called for if a forest is being clear cut. They do this in most of their projects, but not always. It tends to be expensive.

I think in some projects perhaps—one in Guyana, as an example—there is such an element of scientific uncertainty as to what will happen to the forest areas as they are cut, and there should be more attention to replanting than has been given.

The third—and returning to the most difficult—area is what the World Bank should do when it is involved in agricultural activity, and what once was forest area. The main thing is to know what is going to happen agriculturally before you move in—to have land management activity, measure the soil, measure the water, understand the agricultural carrying capacity of the land so once the forest begins to be cut, there is some idea of what controls are needed.

I don't think we want to go into the whole range of specific programs—some of it is in my statement. Just let me say, very specific questions need to be asked by the World Bank in planning these projects, and they are not asking them early enough in the planning of large agricultural and population settlement projects.

For example, a quite well-known example, in Indonesia is that there is a vast Government project moving people from the island of Java to the island of Sumatra. There really is some question as to whether anybody, the Bank, the Government, anybody, has done adequate planning as to the characteristics of the areas they are moving the people into.

I think we will leave it at that on the question of the World Bank's programs which could have an impact on the tropical forestry problem.

I was asked by the subcommittee to make specific recommendations. I would just like to submit four for your consideration about the World Bank's programs generally.

One, I think they are going to do anyway; that is, a great deal more reforestation and afforestation.

The second is the World Bank should support a great deal more research in association with its forestry projects. The Bank has been a leader in helping launch the Consultative Group on International Agricultural Research, which sponsors technical research, but the Bank has not done nearly enough to finance the research which should precede its own projects, nor to identify the institutional and managerial needs in developing countries.

The third area is, I think they need to devote a lot more attention to the institutional management aspects of developing country governments, so that when they begin to cut forests or begin to have agricultural development in an area, there will be forest legislation in place or land management legislation or what have you, whatever is called for in the particular situation.

The World Bank can be very, very helpful with its technical expertise in getting people from all over the world to set up agencies and train the people to staff them.

The fourth area I already mentioned. The overriding issue as far as I am concerned in the World Bank program is advanced evaluation of the sustainability of settled agriculture before they introduce it into an area.

That is all I would like to say on forestry. I would like to make one very brief comment about the general question on the World Bank that I was asked to address, the relationship between resources and environment and development and economic considerations.

You may know, Mr. Chairman, that this past February the World Bank and eight other multilateral institutions signed in New York a joint declaration of environmental policies and procedures relating to economic development.

I would be happy to make copies available.

[The information follows:]

DECLARATION OF ENVIRONMENTAL POLICIES AND PROCEDURES RELATING TO ECONOMIC DEVELOPMENT

Whereas, economic and social development is essential to the alleviation of major environmental problems by providing for an integral relationship between societies and their environment, realizing also that economic development and social goals should be pursued in such a manner as to avoid or minimize environmental problems peculiar to it.

Recognizing that, the major environmental problems of the developing countries are not necessarily of the same nature as those of developed countries in that they are problems which often reflect the impacts of poverty which not only affects the quality of life but life itself.

Convinced, that in the long run environmental protection and economic and social development are not only compatible but interdependent and mutually reinforcing.

Acknowledging, that the need for environmentally sensitive and responsible development has become more important and urgent in light of increasing population and concomitant pressures on the Earth's resources and life-supporting ecological systems in some areas.

Acknowledging, the sovereign right of governments to determine their own priorities and development patterns,

Recalling, that the states which adopted the Declaration of the United Nations Conference on the Human Environment (Stockholm, 1972) stated their common conviction (principle 25) that they will ensure that the international organizations play a co-ordinated, efficient and dynamic role in the protection and improvement of the environment.

Considering, furthermore, that international development assistance institutions have, along with their member governments, a responsibility to ensure the sustainability of the economic development activities financed by them.

Therefore, the undersigned declared that they,

I. Reaffirm their support for the principles and recommendations for action of the United Nations conference

II. Will, to the best of their abilities, endeavour to:

1. Institute procedures for systematic examination of all development activities, including policies, programmes and projects, under consideration for financing to ensure that appropriate measures are proposed for compliance with section I above;

2. Enter into co-operative negotiations with governments and relevant international organizations and agencies, to ensure integration of appropriate environmental measures in the design and implementation of economic development activities;

3. Provide technical assistance, including training, on environmental matters to developing countries, at their request, thus developing their indigenous capacity, and facilitating technical co-operation between developing countries;

4. Give active consideration and, if appropriate, support project proposals that are specially designed to protect, rehabilitate, manage or otherwise enhance the human environment, the quality of life, and resources thereto related;

5. Initiate and/or otherwise co-operate in research and studies leading to improvement of project appraisal, implementation and evaluation methodologies, including cost-benefit analysis, of environmental protection measures;

6. Support the training and informing of operational staff in the environmental dimension of economic development;

7. Prepare, publish and disseminate documentation and audio-visual material providing guidance on the environmental dimension of economic development activities.

Adopted at New York on 1 February 1980.

The African Development Bank, Kwame Donkor Fordwor, President; The Arab Bank for Economic Development in Africa, Chadli Ayari, President; The Asian Development Bank, Taroichi Yoshida, President; The Caribbean Development Bank, William Demas, President; The Inter-American Development Bank, Antonio Ortiz Mena, President; The World Bank, Robert S. McNamara, President; The Commission of the European Communities, Roy Jenkins, President; The Organization of American States, Alejandro Orfila, Secretary-General; The United Nations Development Programme, Bradford Morse, Administratior; the United Nations Environment Programme, Mostafa K. Tolba, Executive Director.

Mr. HOFFMANN. I would certainly submit that the problem of tropical deforestation as a result of this declaration, logically, should receive vastly increased attention in these banks, and the World Bank should be a leader.

For a lot of reasons, related to the internal questions of operations that I mentioned at the outset, I don't think this will necessarily happen. As a result, the crucial issue is finding ways of elevating the problems to an adequate level of priority within the institutions.

I think that is where the U.S. Government can lead—where this subcommittee can be active, the American directors, the Department of the Treasury, State—in showing some sense of priorities.

My institute has suggested that the Bank's name be changed to the International Bank for Resources and Development—as you know, it is still anachronistically reconstruction and development—just as a way of reminding itself that development depends fundamentally on the physical resources they are developing.

I will conclude with that.

[The prepared statement of Mr. Hoffmann follows:]

PREPARED STATEMENT OF ROBERT THOMAS HOFFMANN, ACTING DIRECTOR, INTERNATIONAL INSTITUTE FOR ENVIRONMENT AND DEVELOPMENT

My name is Thomas Hoffmann. I am the Acting Director of the Washington office of the International Institute for Environment and Development. We are a policy research organization concerned with questions of critical resource use and management, particularly insofar as these questions arise in developing countries. We have an office in London as well as in Washington. I would like to emphasize that we are a genuinely international, albeit small organization. We have many Directors and staff members who are nationals of developing countries.

As an organization, we have considerable experience researching the activities of international development banks and foreign aid programs. In 1978 we published a report called Banking on the Biosphere?, in which we evaluated the environmental policies and procedures of multilateral development institutions. We studied nine institutions, including the World Bank.

I was asked to testify concerning "the activities of international organizations relating to the problem of tropical deforestation" and in particular the activities of the World Bank. So first, I'd like to define how we in IIED look at this problem. It is possible to construe "tropical deforestation" fairly narrowly, as involving cutting of trees or general loss of forest cover. But the real issue is broader than that, and involves all aspects of use of forests in the tropical zone, illustrating the close relation between environment and development management, agricultural expansion, population pressure, and of course the compelling problem that at present rates of depletion, by the year 2,000 there will be little tropical forest left except in the remote areas of the Amazon

River Basin and in the Congo River Basin. Can this process be stopped or even reversed?

The key to effective action is to understand why forests are disappearing. Although a great deal of wood is cut for timber and even more is cut for fuel, the vast preponderance of forest clearing is done by farmers seeking new land on which to grow mainly subsistence crops. They clear forest land, grow crops for a few years, then move on further into the previously forested area. In other cases, small farmers take over seemingly well-conceived, government sponsored settlement schemes: boundaries are ignored, forest preserves are forgotten, and an area which was meant for gradual agricultural expansion is suddenly overwhelmed. In still other cases, a road will be built into an unpopulated tropical forest area, perhaps to bring out timber or minerals. But settlers invariably follow roads, so frequently new areas are colonized which are not suitable for agriculture, and where no controls or back-up services have been established.

We must recognize, therefore, that the disappearance of the world's forests is linked unavoidably to the pressure of fast-growing populations, and the needs of these people to farm successfully for subsistence and income. It is perhaps helpful to compare today's expansion on the world's forest frontiers to the westward expansion of the early 19th century in our own country: people move to new land in search of a better life. And unfortunately, Will Rogers was correct when he pointed out why land is so valuable: "They ain't making any more of it."

If the problem of deforestation is so broad--and I am sure it must be viewed this way--it follows that programs to remedy today's trends will have to be equally broad. The World Bank and other financiers

of development projects will have to emphasize positive approaches to rural development, which encourage cropping patterns and forms of rural land use that will lead to settled communities. Extension services will have to teach stable farming methods and small scale forest management. Sustainable agriculture in new areas requires planned water use for whole watershed areas. It also requires careful mix of crops; if monoculture takes hold in tropical areas, it can too easily be wiped out by a single pest. In short, all of this adds up to the need to observe one imperative of agricultural planning in the tropics: farmers will respect planned development systems if they are making a reasonable income from year to year. If not, they will move on, clearing more land.

Farming on the forest frontier cannot be stopped. It will have to be modified so as to allow for agricultural expansion that cuts the forest in sensible locations, controls the process, and leaves forest reserves that are protectable.

That is how I would characterize the problem of tropical deforestation. Now, I will turn to the two specific topics I was asked to address: the tropical forest policies of the World Bank, and the relationship in Bank policy between environment and development. Let me begin by discussing the second topic in general terms.

First, I would like to emphasize that what the World Bank and the other international financial institutions do (or don't do) in the forested areas of the tropics is very important. This is because the international development banks <u>as a whole</u> have become so large and so influential in the developing world. The sums of money lent or granted by them--over $17 billion in 1978--are very large but they have an influence far greater even than their scale implies, for two reasons.

First, multilateral aid is frequently "seed capital" that stimulates other investment in the same or related projects, including private investment. Second, the development patterns set by these agencies in carrying out development projects exerts a great deal of influence on private and, particularly, governmental policies in recipient countries.

Among the multilateral development banks and organizations, the World Bank is a clear leader. It has been a leader in conceiving and carrying out new programs. When it starts or redirects a program, other banks usually follow within a few years. For example, it began to shift its lending program towards direct aid to the poorest people a few years ago, and other multilateral institutions have recently been doing likewise. Meeting the fundamental needs of the world's poorest people is slowly becoming an agreed objective of multilateral development assistance. But surprisingly, the World Bank has sometimes been slow to rethink many large questions about the pattern of development as a whole; for example it has been slow to reconsider the relationship between modern, large-scale agriculture (which is capital-intensive and energy-intensive and must be done on good land) and smaller-scale, small farmer agriculture which often occurs in marginal areas. The World Bank's view is changing as it increasingly recognizes the importance of resource conservation and management for the small farmer, but it has a long way to go in adjusting all its programs.

Although the World Bank is <u>usually</u> a leader among development banks in practical terms, its leadership in natural resource management and resource conservation and restoration as such has not been felt until quite recently. To me, this indicates a problem in the way natural resources and the environment have traditionally been perceived in

development agencies: they have been regarded as a luxury, an "add-on" to the real business of development lending. If this has been so in the World Bank which has had a visible environmental office and has adopted policies requiring the environmental soundness of all projects, it is even more so in the regional banks which have not taken this so seriously.

I say all this as background to one critical issue which you asked me to discuss--the relationship between ecological, economic and developmental concerns, and in particular how it has evolved at the World Bank. I believe it is fair to say that such thinking has evolved further and more constructively there than in any of the other development organizations, except perhaps the Agency for International Development. The World Bank's tropical forestry policies and projects should be seen in light of this complex relationship. What specifically can be said about it?

First: The World Bank certainly acknowledges the importance of assuring that its projects do not result in unintended environmental degradation. It has an increasingly good record of avoiding, or correcting, adverse environmental impacts of most "modern sector" development projects (industry, electric power, etc.). The record in this regard is however still flawed by occasional oversights and failure of experts in one field to anticipate side effects in another.

Second: World Bank officials increasingly emphasize the importance of promoting "sustainable development"--indeed the phrase has become a kind of catchword--which means planning development activity so that the natural resources on which it depends are not depleted, but

instead continue to be available for ongoing development activity. "Sustainability" as a criterion for sound development hinges on the belief that projects which pollute or deplete their resource base will not prove economically, let alone socially, acceptable except in the short term.

Third: Less encouraging, however, is the fact that concern about the sustainability of natural resource utilization has not yet spread widely enough through the World Bank's staff. This situation in part reflects the history of the World Bank's environmental concern. They began narrowly, in 1970, by focussing on problems of industrial pollution and occupational health and safety. Now, even though they have adopted a very broad working definition of "environment", they have not concentrated adequately on the environmental problems of degradation and poor resource management which are, in many poor countries, fundamental characteristics of poverty.

Fourth: I am by no means entirely pessimistic. In the last two or three years, some of the critical environmental problems of poor countries have received increased attention in the World Bank's program. Among these are environmentally sound river basin management, air and water pollution control projects, soil protection and restoration, protection against desertification, and of course a growing forestry program. All these new sectors of "natural resource management", as they might be called, need a rising level of funding and better visibility within the World Bank, and their importance needs to be emphasized regularly, at high levels, to borrower governments and within the Bank itself.

That concludes my remarks about the relationship of environment and development in World Bank policy. I will now turn more specifically to its activities related to tropical forest depletion.

First, we have to realize that the World Bank is not a conservation organization, but a development bank. So we will certainly be disappointed if we look to the World Bank for global leadership in conserving what remains of the world's forest. What we can expect, and should demand, are development programs that show real sensitivity to the global conservation challenges we face and help countries with their conservation problems when possible. The World Bank has no reason to set up a "program" in response to a global problem like tropical deforestation, because it is fundamentally geared to funding specific projects in specific countries. But it is certainly fair to expect the World Bank's program to have a cumulative impact on a widespread problem like tropical deforestation and also to expect it to be very responsive in countries where the forests are particularly threatened. I think we also should expect the financing of specific conservation components in all World Bank projects that utilize forest areas. I include in this assistance encouragement to countries in the tropics to set aside protected areas of forest adjacent to newly developing areas. The World Bank is beginning to do this. It can and should do more.

But the main thrust of bank activity cannot be protection. It must be—and is—the proper use of resources for human welfare. In 1978 the World Bank's Board of Executive Directors approved a Forestry Sector policy paper that was exemplary in the candid way it addressed the need to shift thinking about the forestry needs of developing countries. The Bank committed itself to carry out environmental evaluations of

all forest related projects, and also to increase its support for the gathering of data on forest resources. The new policy emphasized the problems of diminishing firewood supply and deforestation of marginally forested areas, and the consequent need to shift lending away from forest milling and industrial projects towards environmental and rural forestry. It set as a goal to lend $500 million in the five year period, 1979-83. In fact it has already committed all that money. Since 1978, there have been forestry loans in about 20 countries, about 2/3 of which have been for forestry programs that included a substantial conservation component and/or provision of fuelwood, fodder and other basic forest products that had been ignored in the past in large industrial forestry loans.

In these circumstances, with an expanding lending program that is operating under a very recently established policy, I would say that it is possible to distinguish three types of World Bank loans which should have a direct impact on the problem of tropical deforestation.

First, the World Bank is increasingly lending money for firewood replenishment projects. In the near term, these projects will not have a major effect in stopping deforestation, which is not really caused by fuelwood-cutting. Firewood shortages don't occur in forests, obviously, but along the forest frontier. Forest cutting is followed by firewood scavenging which denudes entire areas. Firewood projects -- by which I mean the planting of fast-growing species -- should have a dramatic effect on deforestation in the long term, because they will help to stabilize wood cutting on the frontiers. The World Bank appears to be planning for a large expansion of its firewood lending. That would certainly be one logical consequence of its detailed evaluations of Third World

66-326 O - 81 - 12

energy needs. This initiative is badly needed, I endorse it wholeheartedly, and I urge this Subcommittee to give it the full weight of its support.

The second type of World Bank loan which should be mentioned here can have a more direct effect on tropical deforestation and that is the establishment of large plantations to provide timber or pulp. Fast-growing tree species can be planted whenever there are projects that involve tree-cutting, or even in areas where forests have long since been cut and were not replanted. An example of this type of project is found in the Philippines, where the World Bank financed a project to encourage small farmers to plant trees as a cash crop. This was done on degraded cut-over lands, where any valuable timber had long since disappeared. In general, careful and early replanting programs are always called for if forest is being clear-cut, commercially or otherwise. This procedure is now World Bank policy.

Third, the most difficult and by far the most important type of project involves Bank assistance in establishing proper planning and proper land management in tropical forest areas. Whenever farmers and settlers are on the move, it is important to gather a great deal of data about the new frontier areas and if possible direct them to areas where development has the best chance to be sustainable. The developers must ask: What areas are cultivatable? How good is the soil? How will watershed be protected? Can a sufficient forest area be maintained to preserve gene pools for developing new plant species, and a variety of other purposes? All of these questions should be asked before farmers begin to clear forest area, before roads are built that will encourage migration. The World Bank needs to expand, improve

and encourage countries to adopt proper land management work in all its agricultural and rural development projects. Before I turn to that problem, however, let me give an example of the type of good project that the World Bank is funding.

In the Jengka Triangle Settlements project in Malaysia, the World Bank supported the development of a master plan for that area. Sixty percent of the project area -- about 80,000 hectares of forest -- was excluded from agricultural settlement, and hilly areas and river banks were also protected. The World Bank judges this project to be a success for several reasons. In effect, a new rural economy was created, based on the palm oil and rubber industries. So the settling farmers have good incomes (which increased four-fold), and as a result the village communities are very stable. The protected forest was kept safe from unplanned settling. It can only be hoped that it stays that way. And finally, the crop patterns used appear to be sustainable, if fertilizers are used properly, so farmers will not have to abandon depleted soil to cut more forest.

This type of project is very encouraging. I want to emphasize that it is probably in its agricultural and land management work that the World Bank can have its greatest impact on controlling deforestation. During the last three years, the World Bank lent about $500 million for forestry projects. During last year alone, the Bank lent about $3 billion for agriculture and rural development projects, including agricultural settlement projects and migration projects, and livestock projects.

Unfortunately, there is some evidence that some people on the World Bank staff do not always observe principles of sound forestry in non-

forestry projects. In Indonesia, for example, the World Bank is helping to finance government-sponsored programs to move people from the over-crowded island of Java, to Sumatra. A great deal of forest land has been cleared, although it is now argued that forest land which has already been cut, for some other reason, it equally well suited to settlement. Indonesia has thousands of hectares of semi-forested grasslands which may be suitable, if rehabilitated, for settlers.

I mentioned earler that the World Bank needs to do a better job of keeping governments and settlers to their commitments to conservation. I also want to say that the Bank (or a government) inevitably finds project supervision to be a difficult and delicate task. The Caqueta Settlement project in Colombia, for example, has been designed to establish farmers with small herds of cattle. But the soil in the area is poor, and new farmers have not been settling into a stable lifestyle. The reasons are numerous -- the point I want to make here is that forty-five percent of the farmers, in a sample survey, wished to move elsewhere. The farmer's life in that area continues to be one of shifting cultivation of subsistance crops. As I have explained, deforestation principally occurs in these circumstances.

Despite the World Bank's good intentions, expansion and continued redirection of its forestry and forestry-related projects will be difficult. The reasons for this are worth mentioning here.

First, forestry loans, especially those with social or environmental objectives, have been economically questionable: the direct commercial benefits--wood and wood products--can not be realized because of the slow maturation of most standing timber, while the social and environmental benefits tend to redound to a country or a whole region rather than

principally to the growers of the trees. Moreover, the indirect benefits—to soils, to rivers, to downstream inhabitants of riverbasins--tend to be long-term.

Second, the amount of foreign exchange needed for forestry plantation loans is small. Since the banks have very limited ability to cover local currency costs, this makes for small loans with high administrative costs of the kinds that banks try to avoid. Conversely, developing country governments seeking outside assistance for development are not attracted to forestry loans because of the low foreign exchange component and because the lender's local currency contributions are so small, leaving most of the financial and substantial administrative load in their hands.

Third, forestry management and forestry development often impinge on governments' policies regarding forestry concessions. This raises highly sensitive political questions, since very often these concessions are a prime source of foreign exchange funds for governments in power.

Fourth, areas of sufficient size available for forestry development per se tend to be composed of land not good enough for agriculture, which are isolated geographically from activities in the modern economic sector. Forestry projects often require the construction of expensive access roads, which open areas to "spontaneous" colonization with all its consequences.

Against all of these difficulties, and some I have not mentioned, stands the absolute need of developing countries--and the world as a whole--to preserve and wisely utilize forest resources. The World Bank is uniquely able to mobilize the necessary response, particularly in countries where local laws and policies have to be changed because

its leverage on borrowers is extremely effective. We applaud the expansion of its forestry program, and urge that the new policies and new attitudes be disseminated throughout the Bank, to touch all forestry-related projects.

SPECIFIC RECOMMENDATIONS

The Subcommittee has indicated that it would welcome recommendations for improvements in the World Bank's program. I would like to make four suggestions:

1. The World Bank should continue to expand the number, scope and amount of money dedicated to forestry projects, particularly emphasizing reforestation and afforestation in degraded areas. Currently, reforestation in the developing countries as a whole is proceeding at less than 20 percent the rate needed to ensure domestic self-sufficiency, particularly for firewood, by the year 2000. Without a vastly increased effort by all development agencies and by the countries concerned, the rate of deforestation will overwhelm many countries.

2. The World Bank should support a great deal more research in association with its forestry projects. The Bank has been a leader in helping launch the Consultative Group on International Agricultural Research (CGIAR), which sponsors technical research. But the Bank has not done nearly enough to finance the research which should precede its own projects, nor to identify the institutional and managerial needs in developing countries.

3. There already seems to be a trend in the World Bank in the last 18 months, towards so-called "institution-building", by which I refer to the effort to help countries manage their own problems. This trend should be accelerated, so that forestry services, agricultural

extension services, local research, manpower training and other activities are adequately funded.

4. In its forestry-related projects, particularly rural development and population migration projects, the World Bank needs to conduct much more thorough evaluations of the sustainability of settled, stable agriculture in the project areas. Soil quality and other related factors should be considered at the earliest possible opportunity, before these large ventures gather momentum.

CONCLUSION

The World Bank's expansion of its forestry program takes place in the context of considerable international activity on environment and development issues. Just this past February the World Bank and eight other multilateral institutions signed a joint Declaration of Environmental Policies and Procedures Relating to Economic Development (I attach a copy to my testimony). They are now trying to work out programs to implement that Declaration. I submit that the problem of tropical deforestation logically should, as a result of the Environmental Declaration, receive vastly increased and improved attention from these banks and agencies. For many reasons, I also question whether this will happen, but the hearings of this Subcommittee could have a propitious influence during coming months.

The real issue is to find ways of elevating natural resource problems among the many priorities of development assistance. My Institute has suggested that the World Bank's name be changed to the "International

Bank for Resources and Development" (it is now anachronistically the International Bank for Reconstruction and Development), to remind itself, donor countries, and borrowers, that development depends fundamentally and inextricably on the sound management of physical and natural resources. Another idea might be to expand the World Bank's annual country economic surveys, into country economic and resource surveys. These ideas are just symbolic, of course, but alone or together they might help to break a logjam. The logjam is this: large institutions, particularly banks, change slowly. The World Bank--even though it is not just a "bank" but is in fact the world's largest, multi-faceted development promotion, management, and financing institution--is no exception.

But suddenly we are all aware that the world is changing rapidly. Resources are disappearing or becoming prohibitively expensive due to overuse. Development can't take place if the necessary resources are destroyed or used up. So, somehow, these slow-changing institutions have got to find a way to change their responses at the same pace as the world in which they operate. The world Bank will have an increasingly important role to play in this regard, and it must have strong American support.

Mr. BONKER. Thank you, Mr. Hoffmann, for excellent testimony. I see we have a vote on the House floor. The subcommittee will stand in recess for 10 minutes.

[Whereupon a brief recess was taken.]

Mr. BONKER. The subcommittee will come to order.

We have heard from two excellent witnesses thus far. We will now move to Dr. Thomas Lovejoy.

Dr. Lovejoy, would you proceed at this time?

STATEMENT OF THOMAS E. LOVEJOY, VICE PRESIDENT FOR SCIENCE, WORLD WILDLIFE FUND—UNITED STATES

Thomas E. Lovejoy received his Ph. D. from Yale University in 1971 and has been studying problems of tropical forest ecology, principally in the Amazon, since 1965. He joined World Wildlife Fund—U.S. in 1973 and is currently Vice President for Science. He aided in preparation of the recent National Academy of Sciences volume "Research Priorities in Tropical Biology," and helped represent IUCN at the UNEP Tropical Deforestation meetings in February. He is the American principal investigator in a major Brazilian/American research program on the minimum critical size of ecosystems in the Amazon.

Mr. LOVEJOY. Mr. Chairman, I am here on behalf of Russell Train, the president of the World Wildlife Fund—United States, who also serves as vice president for North America of the International Union for the Conservation of Nature and Natural Resources.

I would like to simply submit my prepared testimony for the record and note that it includes a document known as the "Tropical Forest Source Book," produced by IUCN, with a great deal of data about the problems of tropical deforestation, and also the statement that IUCN submitted to the UNEP tropical deforestation meeting in February.

Mr. BONKER. Fine. All of the statements will be part of the official record.

Mr. LOVEJOY. Thank you.

I particularly welcome the opportunity to testify at this hearing. I welcome the attention of this subcommittee to the tropical deforestation problem, for certainly it is the largest part of the problem of biological impoverishment of the planet which we are experiencing in the latter years of this century.

Conservative estimates—and I underline the word "conservative"—indicate that if present trends continue, something on the order of one-sixth to one-seventh of all species on the planet—plant and animal—are likely to be lost by the century's end. That certainly is a matter for great pause.

IUCN—a brief word about it—is bicameral in nature. It represents something on the order of 100 countries, with both state members and conservation organization members. The World Wildlife Fund was, in fact, largely founded to support IUCN as it addresses the issues of biological conservation and ecologically sound development.

I would like to just hit on two or three aspects of the problem which I don't think have been particularly brought out in the discussions of the past few years.

The first part of it is obvious. We don't know a great deal about these systems, obviously the most complex and diverse biological systems on the planet; also, the most productive biologically.

We often see attempts to take these incredibly rich systems and convert them to very simple systems, such as pasture—pasture which is likely even at the beginning to support only 1 steer per 3 hectares, and is openly acknowledged as likely to decline to something on the order of 1 steer per 10 hectares.

The real gap here is one in knowledge of how to use these forests. Right now, for example, when it would make a great deal of sense to start sustained yield natural regeneration forestry in the Amazon basin, we are faced with a state of ignorance such that, as of the moment, the largest area in the entire Amazon basin which has a reliable and published tree survey done for it is only 5½ hectares in size. I would note that 5½ hectares holds on the order of 300 species of trees.

This knowledge gap problem is in part a function of the structure of the agencies which support research. Agencies such as the National Science Foundation, which support pure research and shy away from applied research, never really address the question of what we need to know about tropical forests.

The agencies which by definition support applied research tend to shy away from the middle ground area where there is a great deal of knowledge to be gathered and transferred to the applied area. I think either these institutions need to broaden their spheres of interest or new institutions have to come into being.

IUCN attempts to fill this gap somewhat. It does attempt to aid nations in identifying key areas to protect, and in identifying key problems in terms of how tropical forests might be better used.

I should point out that IUCN most recently is noted for a document known as the World Conservation Strategy,[1] which much more than has ever been pointed out before, emphasizes the relationship between environment and development; emphasizes not only that the human, economic, and sociological play takes places in an ecological theater, but also emphasizes the fact that it is very hard to talk about resource conservation to people whose immediate worry is where they are going to get the next mouthful.

This is one of the reasons I am particularly pleased to see the growing interest of the U.S. Government in helping these countries with the problem.

There definitely is a need for international aid in these questions.

If you consider the problem of slash and burn agriculture, which has been referred to earlier today, it is not only a matter of trying to find some reasonable cash crop or substitute way of life for these individuals. It is also a matter of finding a system whereby they can market that cash crop and also of finding a system where they can spend that cash to get tomorrow's mouthful.

Similarly, there is need for international aid to focus on the problems of how to use already deforested, degraded land. It is not something that is particularly attractive to private economic interests. I think we need to pave the way to lead those interests into using those properties.

It seems that by and large most of the commercial pressures on the tropical forests could be met by using already deforested lands.

[1] See maps, pp. IV–VII, taken from IUCN document "World Conservation Strategy."

In the last analysis, I think one really cannot be too hard on the governments of these developing nations. They have to face the problems on a day-to-day basis of masses of poor, and if they don't address those immediate issues, they are going to be out of office almost immediately. I think it really does become everybody's business to aid the tropical forest nations in protecting this large section of the world's biological heritage.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Lovejoy follows:]

PREPARED STATEMENT OF THOMAS E. LOVEJOY, PH. D., VICE PRESIDENT FOR SCIENCE, WORLD WILDLIFE FUND—U.S.

I am Thomas E. Lovejoy, Vice President for Science of the World Wildlife Fund-U.S. World Wildlife Fund, with offices in over 25 nations, is the largest private international conservation organization and consults with and supports the International Union for Conservation of Nature and Natural Resources (IUCN). I am here on behalf of The Honorable Russell E. Train, President of World Wildlife Fund-U.S. and Vice President for North America of the IUCN. World Wildlife Fund-U.S. gives tropical forests the highest priority in its program.

The IUCN is an international organization in which governments, governmental agencies and non-governmental bodies cooperate. Its members are sovereign States, government departments and agencies, and national and international organizations concerned with conservation. IUCN's broad purpose is to promote the conservation of nature and natural resources — the maintenance of a healthy biosphere by widespread efforts to protect and enhance the diversity of the world's fauna, flora and habitats, and by encouraging rational use of natural resources. IUCN was founded in 1948 and today consists of more than 450 government agencies and conservation organizations representing more than 100 countries.

IUCN draws on a large pool of scientific talent worldwide which is organized into commissions. These include a commission on national parks and protected areas, the survival service commission which is concerned with species and their status and future on a species by species basis, a commission on ecology, one on environmental policy, law and administration, one on environmental planning, and one on education.

For example, in my scientific capacity I serve on the survival service and ecology commissions.

IUCN has most recently been noted for the preparation and publication of the World Conservation Strategy, a document which heralded the links between environment and development to a degree heretofore unprecedented. While part of the message was not all that new -- namely that the human play is enacted in an ecological theatre and that biological resources are the fundamental ones -- the strategy also articulated the need for development, albeit of the ecologically sensible sort, in order for conservation to proceed in developing nations. It is very hard to speak with an Andean farmer about the need to protect spectacled bears when one has just gone off with the farmer's last chicken, or try and discourage slash and burn farmers from cutting more forest when that is the only way they know to feed their families.

These issues are particularly pronounced in the tropical forest regions of the world, regions which may seem terribly distant, but which may seen much closer when economics or social problems born of the degradation of the biological resource base boil up in unrest. Basically when we are faced with the possible loss of a major fraction of the world's species, and with an unprecedented pressure on biological resources from a human population most recently estimated to peak at 6.2 billion, then proper biological management of the planet, and protection of biological productivity so it can support these large numbers of people, becomes everyone's business.

The tropical forest issue perhaps more than any other relating to biotic impoverishment suffers from a lack of knowledge about the forests and consequently how best to manage them. We do know they are incredibly rich in species, that biologically they are among the most productive of systems on the earth, and that they are both intricate and fragile. I dwell on this point, because even if we could stop tropical deforestation dead this moment, we would not have an adequate notion of how to manage tropical forests properly in support of people. The situation is a forest equivalent of the aquatic misery of Tantalus: we are surrounded by highly productive biological systems we cannot, for lack of knowledge, draw upon. In the Amazon, for example, the knowledge of sustained yield natural regeneration forestry is so meagre that plantation forestry with all its inherent perils appears as an easy answer.

The problem is partly a matter of tropical forest research not having seemed an issue of urgency, and partly a fault of the structure and programs of institutions which promote research. Those such as the National Science Foundation in this country (where at the moment there are a greater number of tropical biologists than elsewhere), are concerned only with basic research defined in broad terms, and, like NSF, do not have a specific program in tropical biology. If there is not high intrinsic "pure" interest in a particular question or series of studies, a tropical topic will not rate support; the system is not structured to automatically put value on research of urgency or importance in understanding and protecting tropical diversity and productivity. Such agencies have to be very careful to avoid directed research because

too much direction can easily stifle creativity and original exploration. This is important: one can in fact imagine a directed-science agency telling Fleming not to study moldy melons because they couldn't possibly be interesting or useful within the terms of the agency.

At the same time the agencies charged with supporting applied research, which would have been overjoyed to support Fleming after his serendipitous discovery, tend to support only the most clearly applied research. There is a critical gap between pure and applied research for which support is not easily available. There is an important role here for development agencies.

IUCN attempts to identify these critical areas and encourage support for them from other agencies. It attempts, too, to aid tropical forest nations in identifying critical areas for protection and in developing the capacity to protect them. IUCN attempts to identify and publicize the resource issues as they apply to or are unique to tropical forest regions. An example is the Tropical Forest sourcebook prepared for the World Conservation Strategy, a copy of which I would like to submit for the record, together with a copy of the IUCN statement for the UNEP tropical forest meeting in February.

The perils of tropical deforestation are clear:

1) a reduction in biological diversity perhaps as high as 20 percent of all species
2) concomitant reduction in biological productivity in the regions where biological productivity is naturally highest, resulting in perhaps the ultimate example of man-made deserts

3) possibilities of local climatic change, because of the rain-generating capacities of these forests -- the Amazon forest is said to create half of Amazonian rainfall, meaning that if too much forest is cut the rest could dry up

4) possibilities of global climatic change from the release of the 340 billion metric tons of carbon in tropical forests into the atmosphere, resulting in a warming trend (perhaps briefly masked by effects from Mount St. Helens) and displacement of rainfall patterns.

The answers are less clear, although the immediacy of the need for action is apparent. IUCN and World Wildlife Fund stand ready to help in any way they can.

Some aspects of the problem are clearly beyond their power to solve. If all aspects of the problem other than slash and burn are solved, the battle still will be lost. If adequate sustained yield cash crops can be substituted on the lands occupied by the slash and burn farmers, there still is a need to provide means of marketing the crop and of providing ways in which they can spend their cash for necessities, for such people are immediately motivated by the need to provide the next mouthful, and to a degree many of us never experience. The dimensions of this problem are such that only agencies like the development banks are capable of dealing with it.

Clearly a problem also is the inability of the governments of most tropical forest natious to address the problem in a substantial way. Pressed with immediate social and economic problems of the vast

numbers of poor, they must address those first for humanitarian reasons and for the simple expedience of remaining in power. Subsidies in manpower and actual dollars from the developed nations are indispensable if we are to properly address the tropical deforestation problem. This is really a matter of maintaining the greatest possible degree of habitability of our planet, which, while very practical, is really the most humanitarian cause of all.

ANNEX 1

STATEMENT OF THE INTERNATIONAL
UNION FOR CONSERVATION OF NATURE
AND NATURAL RESOURCES

Experts Meeting on Tropical Forests
Nairobi, 25 February - 1 March 1980

I. Introduction

The subject of this meeting -- the conservation and wise utilization of humid tropical forests -- is of great importance to the future of mankind. The International Union for Conservation of Nature and Natural Resources (IUCN) welcomes this meeting as an opportunity to share information and experiences, and to design a programme of actions which will ensure the long-term survival of tropical forests and the benefits which they confer upon humanity.

IUCN is an international non-governmental organization with more than 400 members throughout the world, including governments, government agencies, and national and international non-governmental organizations. IUCN carries out much of its work through six specialized commissions, which coordinate the efforts of more than 1000 individual experts all over the world.

IUCN's objective is to maintain and enhance the diversity of the biosphere by promoting rational management of the earth's natural resources. Humid tropical forests are among the most important of these. IUCN has recognized in the World Conservation Strategy (which will be released on 5 March) and elsewhere that conservation of natural resources can occur in the long run only if development efforts succeed in meeting basic human needs. But it is also clear that sustainable development can take place only if conservation measures succeed in maintaining the resource base upon which development depends. In short, development depends upon conservation, and conservation upon development.

IUCN's goal is to ensure that tropical forests are used wisely so as to yield the greatest benefits to humanity in both the short and the long term. The process of deforestation is accelerating. Too often, it is unwise and incompatible with sustainable development. Unless needed actions are taken soon and on a large scale, many of the benefits of tropical forests will be lost forever.

66-326 O - 81 - 13

II. Benefits of Humid Tropical Forests

Humid tropical forests supply many products and services both to tropical forest countries and to the rest of mankind. Moreover, these forests provide many of their benefits merely by existing in their natural state. They are the world's greatest storehouse of biological diversity. They are thought to contain nearly half the earth's species of plants and animals. Tropical forest species have already produced extraordinary benefits for mankind. Roughly one quarter of all prescription drugs are of biological origin; many came from humid tropical forests. The potential benefits are even larger, since the great majority of these species have never been screened for useful compounds. Many tropical forest animals, such as primates, are important in medical research.

Humid tropical forest species are of great importance to industry, providing tannins, resins, gums, oils, dyes, and other commercially useful compounds. There is a tremendous potential for new products from tropical forest species. These may even include hydrocarbons for an oil-short world: it was recently discovered, for example, that Copaifera langsdorfii, a tree that grows in the Amazon Basin, has sap that can be used directly in diesel engines.

The genetic resources of tropical forests are of great value in increasing food and fiber production. The now-famous perenial corn (Zea diploperennis) was recently discovered growing in a montane forest area of southern Mexico. A promising new food crop is the fast-growing, protein-rich winged bean (Psophocarpus tetragonolobus), which is native to the humid forest ecosystems of Southeast Asia. Tropical forests are also a source of many species of plants, fish, and wildlife that are an essential source of food for local people. For example, current research indicates that many important food fish of the Amazon Basin depend for their survival upon fruit fallen from floodplain (Varzea) forest trees. Tropical forest genetic resources also are important to advances in forestry and other fields of applied biology.

The benefits of these genetic resources accrue both to the people of the tropical forest countries that supply them and to the other people of the world. Yet it has been estimated that if current trends in deforestation continue, about one third of the species now found in humid tropical forests -- perhaps 15-20% of all species on earth -- will be extinct only 20 years from now, and many more in the ensuing decades. This would be one of the greatest impoverishments ever suffered by mankind.

These forests are also important to meeting the basic human needs of the more than 200 million people who live within them or on their margins. Forests provide food (e.g., fruits, nuts, honey, fish, and wild animals), fuelwood, and building materials for these people. Moreover, indigenous, forest-dwelling tribal people are totally dependent upon

natural forests for their livelihood. These people, who have learned over many centuries to utilize the forests in a sustainable manner, are an important source of information concerning the uses of tropical forest species.

In their natural state, humid tropical forests are the homes of some of the world's most unusual and spectacular plants and animals. Hence, they can be a source of tourist revenues, as they already are in a number of countries. These forests, and their wildlife, have aesthetic and cultural value for many people both in tropical forest countries and elsewhere. For example, many migratory birds that spend the summer in North America and Europe depend upon tropical forests during the northern winter.

Other benefits provided by tropical forests in their natural or near-natural state result from their relationship to a vital resource: water. By retaining water and releasing it gradually throughout the year, forests maintain reliable supplies of high-quality water. Watershed forests thus benefit downstream agriculture, industry, human health, and settlements. They allow more regular and sustained operation of hydroelectric facilities.

Forests benefit all who live downstream by reducing the frequency and extent of floods and droughts. In June 1979, for example, India suffered $2 billion in property damage and a tragic loss of human life due to floods in the Ganges Valley which were exacerbated by deforestation in both northern India and Nepal. The problem of flooding often is an international one, since the humid tropical forest biome contains many international watersheds.

Tropical forests confer enormous benefits by stabilizing soils and preventing erosion. Soil erosion renders lands, both in once-forested areas and downstream, unfit for agriculture or for production of fuelwood and commercial timber. Erosion may greatly reduce the output of hydroelectric facilities due to siltation. It has been observed that many tropical forest countries which would not wish to give up a square meter of their land are watching thousands of tons of soil wash away each year because of deforestation.

Many wood products are obtained from humid tropical forests. These include fuelwood to meet individual and commercial needs, paper, building materials, and lumber. The international trade in wood products is a major source of foreign exchange and employment.

Tropical forests also may play a crucial role in maintaining climatic stability. In some countries, it is likely that forests generate considerable local rainfall due to their role in evapotranspiration. At the global level, deforestation may affect climate by increasing the level of atmospheric carbon dioxide or by increasing the amount of sunlight reflected by the earth. The resulting climatic

changes could have catastrophic impacts upon agriculture, such as by reducing the productivity of the North American grain belt, and could raise the level of the oceans substantially by melting the Antarctic and Greenland icecaps. None of these climatic effects are fully understood, but if we wait until they are conclusively demonstrated, it is likely to be too late to prevent them.

All of these benefits will cease if forest exploitation is carried out in an unsustainable manner. The result will be a major setback to development, especially in rural areas, and profound losses to all mankind.

III. Rates and Causes of Deforestation

It should be emphasized that the rates and causes of deforestation vary considerably from country to country. In some countries, virtually all the primary tropical forests have already disappeared, and remedial measures are urgently needed. In other countries, some primary forests remain; in a few countries, these amount to a substantial proportion. In most countries, deforestation is proceeding rapidly, and all too often it is unplanned and unwise.

IUCN believes that the best available estimates of the rates of deforestation are those in the soon-to-be-released study of the United States National Academy of Sciences. This sobering study is said to estimate that about 200,000 square kilometers of primary humid tropical forest are eliminated or severely damaged each year. Many countries are likely to lose virtually all their primary forests in 20 years or less if current trends are allowed to continue. IUCN is skeptical of lower, more optimistic estimates of the rate of deforestation. Too often, these have been based on outdated or incorrect official figures, which bear little relation to actual conditions on the ground. These estimates also have tended to neglect the catalytic effect which even selective logging often has in exposing the remainder of the forest to shifting cultivation.

The causes of deforestation also vary from country to country. The most immediate causes include unsustainable shifting cultivation, conversion of land for cattle raising, resettlement projects, spontaneous migration to forest areas by landless people, gathering of fuelwood, and commercial harvesting of timber. These in turn reflect the efforts of rural inhabitants to meet basic human needs not satisfied at current levels of development (a deficiency often exacerbated by inequitable distribution of land); a lack of political will on the part of some tropical forest country governments; and an emphasis by some governments, and even individuals seeking personal gain, on short-term revenues from timber exports

instead of sustainable rural development. Less proximate but critically important causes include population growth and excessive consumption of tropical forest products, especially in developed countries.

IV. Needed Actions

While clearing and modification of humid tropical forests is often justified, in many cases it is incompatible with sustainable development, the preservation of genetic diversity, or even climatic stability. Tropical forest countries, developed countries, and international organizations need to take a variety of actions if humid tropical forests are to be conserved and wisely utilized.

It is essential that actions be taken to address the less proximate but critically important causes of unwise deforestation. A wide range of actions also is needed to deal with the more immediate causes. At the national level, tropical forest country governments should develop broad national policies spelling out their strong commitment to using natural resources on a sustainable basis. They should prepare and adopt sectoral policies, including those for forest management and rural development. These policies, and the plans based upon them, should pay careful attention to all the potential benefits of forests for sustainable development. Forest management policies should emphasize ecologically sound rural development rather than promotion of timber exports, a point stressed at the World Forestry Congress held in Indonesia in 1978.

There should be mechanisms to assure coordination among all relevant government agencies in policymaking, planning, and management. Laws governing forest management should be reviewed and, if necessary, revised. Their enforcement must have whole-hearted support at the highest levels of government.

Better planning is needed at the regional and local levels. No significant deforestation should be permitted without land-use plans based on evaluation of the capabilities of ecosystems, and especially of soils, to sustain the development which is proposed. Specific proposals for projects involving forest clearing should be carefully assessed for their likely environmental impacts, including effects on other resources such as water and wildlife. Proposals to construct penetration roads should be assessed to determine the consequences of providing entry to previously inaccessible areas. Development aid agencies and other international bodies should require ecosystem capability evaluations and environmental impact assessments as a condition of participating or assisting in development schemes involving forest clearing.

Because of the importance of biological diversity, national governments and development aid agencies should, like the World Bank, refuse to engage in activities that might destroy species habitats not suitably protected elsewhere. Economic analyses of proposed projects should take into account the adverse impacts on other resources, including those downstream of the project site. Suitable case studies are needed to demonstrate the economic and other values of well-planned, multipurpose use of humid tropical forests for the production of timber and other forest products, water management, wildlife, recreation, scientific use, and other benefits.

Steps must be taken to assure the wise utilization of forests designated for timber production. National plans for commercial forestry, and the terms of specific timber concessions, should ensure that desired revenues from forests can be sustained without short-sighted "mining" of timber. In some cases, the best course may be the establishment of plantations, though very careful planning is required. The activities of corporations should be controlled to assure that their incentive to make short-term profits does not result in unsustainable exploitation of forests.

Tropical forest conservation depends upon ecologically sound rural development that lessens the pressures for destruction of the remaining natural forests. It is essential to increase the productivity of lands which already have been cleared of primary forest, and to restore the productivity of degraded lands. One promising form of development is agroforestry, which combines trees and food crops in ways that help prevent nutrient depletion from tropical soils. Although additional site-specific research is needed, agroforestry may provide a sustainable alternative for many of the world's estimated 200 million forest farmers, whose number are expected to double by the year 2000. Intensive homestead gardens and irrigated agriculture, in areas with suitable soils, can also reduce pressures for agricultural encroachment on forest lands.

Other forms of ecologically sound rural development include community forestry, fast-growing fuelwood plantations, more efficient use of fuelwood, and utilization of alternative energy sources in place of fuelwood. Buffer zones featuring agroforestry, community forestry, or fuelwood plantations should be established adjacent to protected forests.

Forestry institutions in tropical forest countries must have additional resources to carry out needed activities. They particularly require adequate numbers of qualified personnel. There is an urgent need for more training, including a crash programme to develop a much larger corps of professional foresters in the tropics. Special emphasis should be placed on establishing and strengthening training institutions in tropical forest countries. A number of national and international institutions have done good training work, but they are hampered by a lack of funds.

Multilateral and bilateral aid agencies should increase greatly their support for all of these activities. For example, the United Nations Conference on Trade and Development has cited an FAO estimate that the cost of replacing wood being cut for industrial purposes and for fuelwood will be about $3.3 billion per year. Compared with this figure and with other requirements, even the World Bank's proposed expenditure of $500 million on forestry during 1979-83 seems small. The possibility of a special tax on imports of forest products from the tropics should be urgently explored, with the proceeds used to fund needed actions.

IUCN supports efforts by tropical forest countries to obtain the maximum economic return from their forests consistent with sound ecological principles, thus meeting human needs and lessening pressures for unsustainable forest development. For example, local processing of timber should replace the export of raw logs whenever possible. Developed countries should remove tariff barriers to wood processed in the country of origin, and should provide financial support for the creation of wood-processing industries.

It is important that forest development and management take full account of the needs of forest-dwelling indigenous people. Their human rights and unique cultures should be respected.

At the international level, in addition to the types of assistance already suggested, various kinds of agreements can be helpful. International conventions can assure sound management of international watersheds. Heavily exploited tropical timber species can be listed in the appendices to the Convention on International Trade in Endangered Species. An international code of practice should be developed to govern the granting of concessions and to regulate the conduct of harvesting operations by national and multinational corporations. International agreements can make possible the transfer of funds from developed to tropical forest countries for a variety of purposes.

V. Protected Areas and Research

All of these actions are essential to sound management and utilization of tropical forests. IUCN stands ready to contribute to their realization. However, two categories of actions will be discussed in greater detail in view of IUCN's role and capabilities: (1) actions to establish and maintain an adequate worldwide system of parks and protected areas, and (2) research activities.

A system of parks and protected areas in the humid tropical forest biome is needed for sustainable development. Protected areas are the only feasible way of preserving hundreds of thousands of tropical forest animal and plant species which will otherwise disappear, together with all the benefits of

genetic diversity mentioned above. Preliminary estimates by scientists suggest that at least ten percent of the earth's humid tropical forests may need to be protected, in selected localities covering representative ecosystems, in order to preserve genetic diversity. Since many species in this biome are characterized by localized distribution, a few large protected areas will not suffice: a strategically sited network is needed. In South America, less than two percent of the biome is now protected, in Southeast Asia less than two percent, and in Africa less than three percent.

Protected areas also are important for safeguarding water supplies, thereby serving the needs of agriculture, industry, and all the people who live downstream. Protected areas contribute to climatic stability, both locally and globally. They provide baseline data which is essential for important research and ecologically sound rural development. They can be sources of tourist revenues.

It follows that in every nation an integral component of land planning and development should be the establishment and management of an adequate system of parks and protected areas. Tropical forests countries have a strong interest in establishing such systems in order to meet their needs for sustainable development. The global community has an equally strong interest in preserving genetic diversity and climatic stability. Therefore, the developed countries should assist in meeting the costs of planning, establishing and maintaining parks and protected areas, both as a part of their foreign aid efforts and in their own self-interest. This assistance can come through U.N. agencies or multilateral or bilateral aid agencies; it is notable that FAO and the World Bank are engaged in activities of this kind. Support can also come through international programs such as UNESCO's MAB Project 8 system of Biosphere Reserves, the World Heritage Programme, and similar efforts. Although these programmes are a step in the right direction, they are grossly underfunded. If a tax is imposed on imports of tropical forest products, some of the proceeds should be devoted to parks and protected areas.

There is also an urgent need for well-trained managers of parks and protected areas. The U.S.-Canada National Parks International Seminars are an excellent method of training, but the demand exceeds by many times the 30 places per year now available.

It should be emphasized that research is not a substitute for other urgently needed actions. In many cases, if present trends are allowed to continue, research results will come too late to affect forest management because the forests will be gone. However, lack of knowledge severely restricts our ability to manage tropical forest ecosystems, and the following kinds of research are badly needed.

There is a need for detailed, systematic assessment and monitoring of forest cover. The UNEP/FAO pilot project in West Africa is a good start. It should be expanded. Surveys should be concentrated in major tropical forest countries that lack remote-sensing or aerial survey data and are experiencing rapid forest clearing.

Research is needed to determine which forest areas are of greatest value for preserving biological diversity and therefore deserve protection. Local species inventories are needed, since more than half of all humid tropical forest species have not even been described. However, species inventories are time-consuming, so many areas must be protected in the interim on the basis of existing data. Research into the minimum critical size for ecosystems is also important for planning protected areas.

Studies of specific ecosystems are also important. A few contrasting ecosystems must be studied in detail before management plans involving forest manipulation can be designed and implemented with adequate knowledge of the likely consequences. The benefits from ecosystem analyses include identification of ecosystems amenable and not amenable to development, and strategies for achieving maximum sustainable yield from agroforestry, plantations, and other management systems. These analyses should include experimental intercropping and agroforestry schemes using a variety of species and combinations of species, and exploration of new extraction techniques to minimize damage to the remaining trees.

Research is needed into plantations composed of native species as opposed to exotics, especially exotic conifers, and to identify the tree species most appropriate for rehabilitation of degraded lands. Research also is needed into natural regeneration forestry. In many cases, this type of forest management would be preferable to plantations because it renews valuable tropical hardwoods, is more biologically diverse, and requires fewer high-cost inputs such as fertilizer and pesticides. However, research is needed to identify specific management techniques which might permit efficient natural regeneration of commercial forests.

Research is needed into the management of remnant natural forest patches to support local people on a sustainable basis. For example, study is needed to determine rural demands for fuelwood, rattan, and other forest products, and into techniques for managing in a single area such activities as fuelwood gathering, subsistence hunting, and timber extraction for local use.

Research is needed into the interrelationships between freshwater resources, such as fish, and forests, in view of the findings in the Amazon mentioned previously. The relationship between mangrove forests and marine fish and shellfish also needs to be examined.

Research is required to understand better the economic value of natural tropical forests. This should include screening of tropical forest plants and animals for useful substances, using where possible the knowledge accumulated by forest-dwelling people. Economic models should be developed to estimate the value of the genetic diversity, watershed protection, and other functions of forests.

Additional research is needed into the role of forests in regulating climate. Research into the effect of forests on local precipitation is especially important. So is research into the carbon dioxide question, including modeling of the effects of changes in vegetative cover on atmospheric carbon dioxide, within the framework of the programme which resulted from the 1979 World Climate Conference in Geneva.

From an institutional point of view, UNESCO's MAB Project 1 is a good start on broad-scale tropical forest ecosystem research that integrates well the efforts of personnel from developed and developing countries. It needs much more funding to enable it to meet research needs. Other multilateral efforts on which research should be based include those of FAO, UNEP, and the International Union of Forestry Research Organizations. The International Centre for Research in Agroforestry deserves increased support. National institutions should engage in more research relevant to humid tropical forests, and aid agencies should fund more research of this kind. However, it should always be remembered that research cannot substitute for urgently needed actions of other kinds.

VI. The Role of IUCN

With the support of the United Nations Environment Programme (UNEP) and the World Wildlife Fund (WWF), one of IUCN's major activities for the past few years has been the development of the World Conservation Strategy. The Strategy will be officially announced on 5 March 1980. It is intended as a guide for governmental and non-governmental organizations to the actions needed for conservation of the world's living resources. Part of a chapter is devoted specifically to tropical forests, and much of the rest of the Strategy is relevant to wise use of forests.

A number of IUCN's other activities involve tropical forests. Some of these consist of surveys or planning efforts, reflecting IUCN's concern that planning be environmentally sound. For example, at the request of the Government of Thailand, and with the support of UNEP and WWF, IUCN prepared a conservation plan for that country. IUCN has published guidelines on the use of forests in Southeast Asia and Latin America. IUCN's current programme includes a number of on-the-ground projects in tropical forest areas, most of them concerned with establishing or maintaining protected areas.

IUCN recently established a new Conservation for Development Programme. This Programme, for which IUCN hopes to acquire financial support from bilateral and multilateral development aid agencies, will enable IUCN to provide technical assistance to national governments and aid agencies in planning for and evaluating the environmental effects of development projects, including those involving humid tropical forests. It will allow IUCN for the first time to work closely and systematically with development agencies to ensure that conservation becomes an integral part of development.

IUCN is willing to assist national governments and international bodies in taking actions to assure conservation and wise use of tropical forests. As part of the Conservation for Development Programme, IUCN will seek opportunities to cooperate with developing country governments and development aid agencies in preparing and implementing national conservation plans or strategies like that for Thailand.

IUCN will continue to make recommendations concerning the system of parks and protected areas which is needed to ensure the continued functioning of humid tropical forests as a source of genetic diversity. This information is badly needed by national governments and aid agencies. As it has in the past, IUCN will identify endangered species of forest fauna and flora which cannot be protected adequately within protected areas and propose alternatives to ensure their survival. IUCN will continue to assist governments in drafting laws and regulations for sound forest managment. IUCN will go on working with other interested insitutions in designing and obtaining funds for an adequate program of tropical forest research.

IUCN also intends to take actions to raise consciousness about the importance of wise managment of tropical forests and to influence decisions concerning them. IUCN intends to publish late in 1980 a "Source Book" on terrestrial ecosystems, including a chapter on tropical forests, to inform its members and others about the situation of the earth's humid tropical forests, and what needs to be done. IUCN's network of non-governmental organizations and individuals can influence the development of appropriate responses by governments and their agencies, especially the revision of policies concerning the use of natural resources. IUCN itself will continue, as in the past, to raise its voice in specific situations when there is danger that tropical forests will be unwisely destroyed or otherwise mismanaged.

VI. Conclusion

IUCN believes that national and international actions are urgently needed to achieve proper conservation and wise utilization of humid tropical forests. We call on those present here to increase their efforts toward this end. We look forward to working with you.

Mr. BONKER. Thank you.

I would like to thank each of the witnesses, both for the brevity and the content of their statements. I must apologize to you and to others who are here for the second interruption. We have final passage on a bill.

Once again I will have to put us into recess for 10 minutes. I will make a dash to the floor and back, and then pick up with questions.

The subcommittee will reconvene at 11:20.

[Whereupon a brief recess was taken.]

Mr. HALL [presiding]. The subcommittee will come to order.

As I understand it, everybody has concluded his testimony. So we can get to questions.

I have a couple of general questions, and then possibly we can get into specifics. They are not really aimed at any particular witness. So, feel free to comment at any time.

This is a terribly important issue. It is an issue that we as Congressmen and generally as citizens of the world ought to be concerned about. Nevertheless, it is not now a high priority issue. Unfortunately, it is a subject that very few people know about.

How, therefore, do we handle the problem, how do we make it a priority, and what can we do about it?

Mr. MYERS. Sir, forestry agencies in developing countries of the tropics tend to be Cinderella agencies. As you point out, forestry is looked on as less than a top priority. I have often heard it said in international agencies and funding organizations that $1 given to forestry means $1 less for a true priority like growing food.

But I don't think there is any economic sector that matches forestry in relating to other economic sectors across the board and supporting them. Forestry supports agriculture, hydropower generation, communications, public health, by virtue of its watershed services through regulating water flow.

Now, to be more specific, it is said that the number 1 constraint on food production in Southeast Asia between now and the end of the century is going to be water supplies. Already the green revolution in the Philippines and parts of Indonesia is running into trouble because there are no longer dependable regular supplies of irrigation water right around the year for three crops of green revolution rice.

The reason why there is no longer dependable water supplies is that the forests on the hilltops have gone.

I would like to see, let's say, the international agricultural agencies, like the International Rice Research Institute, giving more attention to a major support factor of agriculture in Southeast Asia.

Does this respond to your point?

Mr. HALL. It does. I guess to be more specific, how, say, is the world community going to tell the Philippines, "Quit cutting down your forests?"

Mr. MYERS. Sir, when you develop, let's say, an AID program for forestry in the Philippines could you not direct your staffers to pay particular attention to the cross-sectoral role of forestry insofar as it supports economic activities maybe hundreds of miles away from the site of the forests themselves?

Mr. HOFFMANN. Well, I think the question that you have raised, Congressman, is the tip of an extremely large iceberg. Since this is the Subcommittee on International Organizations, it might be appropriate to think out loud about it for just a second.

Thinking about the international organizations, leaving aside the question of what AID could do, for example, I think that most of the major banks, financing agencies, and U.N. agencies were set up in the post-World War II period to respond to specific problems, problems of a fairly short time horizon.

This is particularly true of the World Bank, which obviously was set up to operate in postwar Europe. But it is also true of the UNDP, which began to be really active in the early 1960's.

I think that since, say, 1968 or 1970, what has happened is that there is obviously an increasing awareness of the interconnectedness of resource problems and resource utilization, and how that is the fundamental underpinning of all of the development activities that are being financed by these agencies.

But I think we are in the state right now where everybody is recognizing the problem but not quite sure what to do about it. I think we may be on the verge of needing to rethink the fundamental purposes of all of the international organizations.

Governments, by their nature, are not very good at thinking about long-range problems, or at least not very good in doing something about them. Since we have a fairly structured and fairly thought-out international system set up, it seems to me it might be time to begin to adapt it, begin to get all of these institutions that have different terms of reference for some of the things they do, so that they stop being just responsive to short-run problems and start getting into the long-range things which they know have a great deal to do with their current operations.

One very brief example of what I mean in practice: The World Bank annually, or biannually, depending on the country that is involved, does a country economic review, sends out a team of economists, depending on the country—anywhere from 5 to 25 people—to review the whole state of the economy in the country, and do a sort of planning process for the World Bank program.

I think, for example, that could be expanded into a country economic and resource review to include a forester, an ecologist, a water expert, a food expert, whatever it is, so that this team which supposedly is taking a whole look at the country's problems, and how external finance can respond, begins to really look at the whole problem, and not just look at the problem in terms set up in the 1950's, when certain macroeconomic questions and industrialization were the root of the terms of reference for these missions.

That is a very specific example. I think one would have to come up with a very long list of that type of change to begin to tilt these organizations. But I think it is time to start doing that.

Mr. HALL. In your testimony you say they have been regarded as a luxury, an add on to the business of development lending. So we will certainly be disappointed if we look to the World Bank for global leadership in conserving what remains of the world forests.

That is in your testimony. It is a concern that we all share. I guess that is the problem. That is what I am trying to get at. What should Congress do? Anything? What does the world community look for us to do with respect to this question? Should we do anything? Just listen, be educated?

Mr. LOVEJOY. I would like to answer that, and also your first point.

There are always going to be problems of national sovereignty such as surfaced many times in the Tropical Deforestation Conference at UNEP held in February. I think there are two ways to get around that sort of attitude.

One is—and it is perhaps more the role of the private organizations—to be the goad on this. It is simply raising the issue and pointing out that a deforested Canal Zone or canal watershed in Panama is something that is going to produce 13½ million cubic meters of silt to be dredged every year, and that is a quantifiable thing economically.

Similarly when we are talking about water supplies, it is pointing out the tropical rain forest generates some of its own rain, that perhaps as much as 50 percent of the rainfall in the Amazon basin is generated by the forest itself, and in fact that some of the rain that falls in the more productive agricultural areas south of the Amazon comes from the Amazon itself.

It is just a matter I think of constantly trying to point out the importance of these resources.

Your second question is related to making it easier for these countries to do what in many instances they are inclined to do, but are constrained technically or financially from doing; that is, I think the United States and other developed nations can take the lead in providing technological help.

I would point out that the largest number of tropical biologists in any country in the world is right here in the United States, not in any tropical region—and in providing financial support for initiatives in the right direction.

Mr. MYERS. Sir, in response to your question, "What could Congress do," I have two suggestions. One is that in recognition of the fact that marketplace consumer demand in the United States is contributing to excessive use through timber harvesting of certain of these tropical forests, you may wish to take account of that fact and offer some kind of rehabilitation funding for logged-over forests.

Of hardwoods that are harvested in these tropical forests, 80 percent of the hardwoods go to the developed world, notably the United States, for fine furniture and weekend yachts.

I believe that the price the consumer pays for that hardwood in this country does not reflect all the costs that go into its production, especially the environmental cost, in let's say Indonesia or the Philippines.

Could Congress consider an initiative along the lines of one under consideration by the European Economic Community and by UNCTAD, which would be a 1-percent-value-added tax on hardwood imports coming to this country, those funds to go to support reforestation programs in the tropical forest countries?

The second suggestion I have is. could you try to regulate the harvesting operations of your giant timber corporations at work in the

tropics—Weyerhaeuser, Georgia-Pacific, a long line of them—their harvesting operations tend to be unduly destructive. It would not be all that difficult in some instances for them to be more environmentally sensitive in their harvesting.

True, this would put up the cost of the end product. It would mean the consumer in the United States would have to pay a little more for his hardwood, and to that extent it would be inflationary. But the citizen here would have to consider how far he is prepared to be not only a consumer, but also a conservationist, recognizing that if these forests go, his children are going to lose.

Mr. HOFFMANN. Also, in response to your second question, what can Congress do, I really would like to say, first of all, I had not thought about it in specific legislative terms. I thought of my testimony today as oversight testimony. But I would like to make one specific point—the problem of financing aid institutions in the Congress, getting foreign aid legislation through, getting the World Bank financed and so on. I think we all know why it is an easy target.

However, if we in the United States want to take initiative on issues that are increasingly important from our point of view in these institutions—if for example we want to exert leadership in the World Bank, to make sure they have a first rate forest program, to make sure that $200 million a year for firewood lending is available—then I think that the people in Congress who have an interest in these issues, whether it is forestry or all of these global problems that are emerging, could become more active on that basis.

I am not saying you are not active. I don't know. But I mean a visible active support for the role of the international financing institutions in addressing these problems.

Mr. HALL. Thank you.

Thank you, Mr. Chairman.

Mr. BONKER [presiding]. Thank you, Mr. Hall.

Mr. Hoffmann, in this sector policy paper published by the World Bank, chapter 3 talks about the role of the Bank in forestry, beginning with a section on past lending, and identifies not only the amounts, $240 million for 17 projects through fiscal 1976, but also categorizes the various types of projects.

Six categories are listed, three of which I believe are devoted to production and three vaguely to conservation: The first on industrial plantation, which is designed to supply logs and pulpwood for the domestic market; the second, forestry extraction projects; third, pulp and paper projects. They all emphasize the production end of the resource.

Then four, five, and six are devoted to world development forestry conservation, and technical assistance.

Just in reading this briefly, I conclude that almost all of the bank loans were devoted to production type projects, with very little emphasis on conservation. Is that basically true?

Mr. HOFFMANN. That is historically true—as far as I can tell—as a result of the policy discussion and decisions in that paper. I think it is changing in the last 2 years. I have some recent figures, although they are not official.

My impression from looking them over is that there is a real shift in priority toward environmental forestry, restoration, planting and so on.

Mr. BONKER. You say that there is a genuine shift, we see in past lending the emphasis has been on production. Under the section "Current Program," the publication implies that the bank now has under preparation 21 forestry projects. They include a significant forestry component.

Do you have any idea how many of those projects are oriented to production or extraction? Is there a discernible emphasis in terms of amounts or projects where the World Bank is now placing the emphasis on environment or conservation or restoration or something that would help regenerate the resource rather than extract it?

Mr. HOFFMANN. I may want to correct this in writing, but I think that in the current program, about $50 million is devoted exclusively to the industrial production type of project that you are talking about, and about $200 million is devoted to what I guess are mixed projects, which would include significant components.

I don't have a percentage breakdown on whether it is 20 percent that is restoration and planning or 40 or 50 percent of that $200 million.

But I think that the real change occurred about 3 years ago, when the World Bank began to try to identify projects where they could do planting and so on, and change the policy for replanting, and not just clearcut, for example, for a pulp and paper mill.

Mr. BONKER. That is the point. Production in and of itself is not bad, as long as there are controls and reforestation programs in place. Have the banks ever attempted to attach certain conditions, criteria, or requirements to go with the loans, so that companies just don't cut-and-run and leave an area devastated? Is there some attempt at reforestation, or sensitivity applied to local environments through these projects?

Mr. HOFFMANN. I only know of one recent World Bank loan that involves substantial cutting, which doesn't include some replanting. The reason it doesn't is they think they are moving into an area that is so vast and so undeveloped that it would be so uneconomical to plant there at the moment—for the next 20 years it is unnecessary.

This is in Guyana, which has really vast undeveloped forests. What I don't know is how these replanting provisions got into the other loans. I really don't know, for example, if companies found this disagreeable or whether they saw it as a long-range investment.

Mr. BONKER. What are some of the requirements that now go into a project involving a World Bank loan for forestry? Are there components for reforestation? Are there limits to the area that can be clearcut?

Mr. HOFFMANN. Yes. There will ordinarily be—and they are much stronger on that, I think. There will be limitations on areas that can be cut. Ordinarily, that problem of identifying protected areas and leaving it alone is a tougher problem when it is associated with the settlements, the population movement projects, because you really cannot control what people do once you move them into an area, or at least it is extremely difficult to do so.

They do set aside protected areas regularly now, although I don't want to be too optimistic without knowing the details of a few World Bank projects so I could get examples. But I have a feeling that their actual production projects, the narrowly defined old-fashioned forestry projects, have improved dramatically. It is the new style project, more innovative development of vast forest areas for agriculture, that they are really just groping to see how they can control it.

Mr. BONKER. The second question is directed to any of the panelists, and is taken from the publication; that is, how can we approach this issue in a fairly creative way?

As the film indicates, we know the need for fuel is a major factor; that the need for grazing areas is also a significant factor; that the multinationals and governments themselves that are trying to strengthen their economies see this as an important factor for lumber and pulp and some of the other benefits that come from the resource.

If we are going to have a strategy that deals with the problem, we are going to have to provide loans or assistance that would have a country develop its agricultural area, where it is not in competition with tropical forests, such as the establishment of fuelwood plantations in rural areas.

It seems to me, that with sufficient research, we could develop fast-growing species that would be acceptable for fuelwood.

Apparently vast population shifts are caused because of the need for fuelwood. It would be in a country's best interest, in controlling population shifts, if they made available this resource because it is the basis of their very existence.

Dr. Myers and Dr. Lovejoy, both of you have written articles which we have before the subcommittee. I wonder if there is anything that international organizations are now doing to emphasize programs that would take the pressure off the tropical forests.

Mr. MYERS. I would like to support a recent initiative on the part of FAO for community forestry.

Mr. BONKER. You said that in one of your articles. Could you elaborate on it, Dr. Myers?

Mr. MYERS. Yes. FAO started this broad program about 4 years ago. I believe that FAO was rather late in coming into this field. In fact, it was largely as a result of the writing of an American here in Washington.

This is symptomatic of the way FAO works, it did not look down the road and anticipate this program until after it had been in existence for quite awhile—FAO did not identify the problem.

In response to the problem, FAO has set up the community forestry program, trying to encourage village woodlots, small fuelwood plantations at the local level, trying to find out how the local people perceive the probem, and involving a lot of grassroots local activity.

I feel it is a fine program. It does not conflict or necessarily overlap with the work of ICRAF, which is something different.

Mr. BONKER. Is there a substitute to fuelwood? Are some of these areas blessed with coal deposits that could provide an alternative?

Mr. MYERS. It is an interesting question. It is very deficient in fossil fuel. There are other forms of bioenergy which are slowly coming on stream, but there is no shortcut answer.

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Mr. HOFFMANN. The traditional substitute for fuelwood has been kerosene, obviously, which has gotten so much more expensive. In Kenya, people who had switched off burning firewood to kerosene have been switching back to firewood in the last 3 or 4 years, and charcoal, which of course originates from wood. It exacerbates the problem in the long run, but the other thing is in China, which I gather there really isn't all that much known about, but there has been a massive national biogas program.

It is done at the village level. Our institute had a member of the staff of our London office lead a UNEP team on a biogas training mission into China a few months ago, brought back a lot of the documentation in Chinese which is now being translated, and so I really don't know that much about it yet. I have not been able to read the documents.

Mr. BONKER. I was in Shanghai and Peking a few months ago, and while in Shanghai we toured one of the rural communes near the city. There were 25 communes per county—and the resident population of the commune would be about 15 or 20,000. We toured a housing project, and looked at modest two-story houses which had a kitchen outside like we had in colonial days and we noticed that they had some form of energy, because they had a burner in the kitchen. We asked what the source of energy was, and they took us outside to the back and showed us the most rudimentary project I had ever seen. It was just a hole about 6 feet deep into which they placed pig droplets; it had a cover and a coil wire that led from that location into the house sufficiently producing enough methane fuel for two residential areas.

It is very rudimentary, but we are talking about the developing world. It seems to me that this is a natural resource that makes a splendid alternative to fuelwood. Has there been any research at all in this area?

Mr. MYERS. Can I mention research? AID has conducted several research projects in parts of Africa. I will just mention the findings of the one in Ghana. AID looked at the prospects for pyrolizing agricultural wastes and forestry residues to produce gas, char and oil, and the preliminary findings suggest that Ghana's entire energy needs for imported oil and fuelwood could be met by broad-scale utilization of what at present just goes to waste.

Second, Mr. Chairman, I have done some rough arithmetic, and I believe that the amount of wood which is currently burned in the moist tropics each year for cattle ranching and on the part of forest farmers and cultivators, and is now sent up in useless smoke, that amount of wood is roughly equivalent to the amount of fuel wood that is required each year by persons in the other parts of the developing world.

Now, if we can somewhow get that wood which is presently wasted into the hands of the people who are so desperately in need of fuelwood, it would meet two problems at one go. I suggest we need some urgent research on how to transform the wood in question into a form where it can be easily transported. I am talking about the field of densified firewood biomass, as it is technically known. I believe Professor Steve Preston knows something about it and maybe he could contribute on this topic.

Mr. BONKER. He is going to testify.

Mr. MYERS. Yes.

Mr. BONKER. That is the whole point. We need the research to learn what works and what doesn't and what may be more applicable to one continent than to another; that is what these international organizations should be doing. This subcommittee contributes or at least passes on authorizing bills, giving money to organizations like UNEP to do research for this very basic reason, and I can't think of anything in terms of environment and energy that deserves greater attention than this subject.

The movie is attractive, but we have to conduct the basic research to give us the answers, and alternatives so that legislators, and government officials, can then take the necessary actions sometimes with World Bank financial support, and sometimes through foreign aid programs. Although we contribute to these international organizations I don't know if I have anything in the way of important research that has given us some direction.

Mr. HOFFMANN. Mr. Chairman, I would like to submit for the hearing records the documentation on this group that we sent into China to survey their biogas programs, and I don't know how much detail it will be in. As I said, a lot of it is being translated, but it might be useful.[1]

Mr. BONKER. Please submit it in English. Dr. Lovejoy, would you care to comment on this,

Mr. LOVEJOY. I would like to make two or three comments. One is that the documents prepared by Peter Raven of the Missouri Botanical Gardens, who testified in the first of these hearings, certainly identifies numerous terribly important topics in the arena of tropical biology that need support. I would assert that until agencies such as the National Science Foundation actually establish sections within them that deal with the tropics as opposed to evolutionary or environmental biology, or whatever, they are not going to get the proper kind of attention.

I would like to go back to the slash-and-burn question, because I think that is probably in the last analysis the hardest part of the problem to solve. We do need some very innovative research in terms of substitute crops that will not force such people to move on after 3 years. There is a lot of potential here. There is a national academy document that was produced 2 or 3 years ago on under exploited plants of the tropics, which I think points up just how much potential there is. We really need to be looking at the problem of how do you deal with the most biologically rich and productive portion of this planet, and use it in a way that is not converting it to some of the least productive, which is what we are doing now.

When you solve that, you still have to worry about the marketing and supply problem, but I think that agencies such as the World Bank just have to give it their attention.

Mr. BONKER. Dr. Myers.

Mr. MYERS. Very briefly, sir. These international agencies tend, by virtue of their bureaucratic constraints, to be cautious and conservative. They don't like taking risks. They want to do more the conven-

[1] At the time of publication the translated document was not available.

tional thing rather than breaking into new territory, so that this is an institutional blockage against the kind of innovative research that you are talking about. I believe member governments should be tougher and more encouraging, and persuade these agencies to go to the limit and take risks and say if your research doesn't pay off, OK——

Mr. BONKER. We won't give you any money. That is the only lever I know that works. Well, it is very interesting. We could go on, but we have another panel. I want to thank all the witnesses for their testimony today, and for helping us to better understand this very important problem.

We will now have Dr. Donald King, Dr. Sam Kunkle, and Dr. Steve Preston come to the witness table. We shall begin with the second panel. The subcommittee is pleased to see this new publication, "The World's Tropical Forests," which will undoubtedly be a best seller for those who are interested in the subject, just released by the Interagency Task Force.

I would like to welcome our three witnesses, Dr. Kunkle, who is a forest hydrologist with the Forest Service at the Northeastern Forest Experiment Station in West Virginia. He has had previous experience with the FAO, stationed in Rome at the headquarters there. He has an extensive background on the subject.

Then, Dr. Preston, from the University of Michigan, Professor of Natural Resources at the School of Natural Resources, who also has an extensive background in the area of tropical deforestation.

Then Dr. Donald King, who is the Director of the Office of Environment and Health at the Department of State. I think we will proceed first with the administration witnesses. I don't know if you have discussed this previously, but Dr. King, we will start with the global view and move to the parochial view and then have the academician give us his analysis.

You can submit your written statements for the record and proceed in whatever form you wish.

STATEMENT OF DONALD R. KING, DIRECTOR, OFFICE OF ENVIRONMENT AND HEALTH, DEPARTMENT OF STATE

Name: Donald R. King.

Professional title and affiliation: Director, Office of Environment and Health Affairs, Department of State.

Education: Baldwin Wallace College, B.S., Zoology, 1949, Ohio State University, M.S., Ph. D., Entomology, 1952.

Professional experience: 1953–63—Assistant and Associate Professor of Entomology, Texas A&M University; teaching and research; 1963–66—Research Management Specialist, Department of Agriculture, Cooperative State Research Service; reviewed entomology and zoology research programs at land-grant institutions; 1966–70—Staff Member, Executive Office of the President, Office of Science and Technology; science and technology policy, particularly in agriculture, biological sciences, environment; 1970–present—Office Director, Department of State; international program management in environment, health. Chairman, U.S. National Committee for Man and the Biosphere (a UNESCO program).

Mr. KING. Thank you, Mr. Chairman. I welcome the opportunity to appear before this subcommittee. The last hearings you held were concerned with description of the problem of tropical deforestation.

At that time we mentioned that a Federal interagency task force was preparing a report.

Mr. BONKER. There is evidence?

Mr. KING. Yes, sir. I am pleased to say that last night this report went from Secretary Muskie to the President. We tried very hard to get it to the White House so we could give it to the subcommittee this morning; so we are pleased to have this available.

We are proud of the fact that we undertook this study and it turned out so successfully and has raised such a great deal of public interest around the country and the world.[1]

You asked that I cover particularly the UNEP and UNESCO activities, but I think it has become quite apparent that FAO is really a central organization in the tropical deforestation area. Until comparatively recently, FAO has been largely concerned with the production aspects, because a lot of the developing countries who have an interest in this area are concerned with the problems that you have identified; that is, they need foreign exchange and they need wood for domestic purposes. For those reasons, there has been a focus for a long time on the economic aspects of this issue.

It was FAO itself a while ago, along with UNEP, that got interested in this whole issue of deforestation, and in fact were commissioned to develop a monitoring program to see if we could get some better grasp of the extent of tropical deforestation. I think that is when the issue really came to the attention of the international community. It was determined that the issue was much larger than simply the question of how do you manage a resource for wood.

The questions that the previous panel raised I think are all applicable, and they don't need any more explanation. In effect, the whole emphasis is changing a good deal to the idea of the economic, the social kinds of consequences as well as simply the exploitation of the resources, so that we hear new words, such as forest management, multiple use, agroforestry, those kinds of things that are creeping into the world vocabulary and more specifically recently into FAO's vocabulary.

We did have, I hope, something to do with this. A document like this resulted from our earlier concern reflected by people like Erik Eckholm, mentioned earlier by Norman Myers.

The U.S. community began to recognize the extent of global deforestation. We are still suspect because we have no real extent of tropical forests in our own country and people wonder why we are so interested. I think that is something we all must keep in mind when we talk about why can't we go to these developing countries and get them to understand this issue.

We did decide that this was an important enough issue to take to the U.N. system. We considered for a long time what organization we ought to use to do this, and selected UNEP simply because it is a coordinating catalytic organization. It is not operational. Its function is to put together programs, find out what is going on, see what supplementation is necessary and convince someone to do it.

[1] See app. 1, p. 325, for the policy recommendations of the Interagency Task Force on Tropical Forests.

UNEP has a very small budget, so it is not possible for it to conduct work itself.

Mr. BONKER. You know the State Department, in submitting its budget recommendations in the last 2 years, has always recommended reduced amounts for UNEP, one of the few IO's that has been a victim of budget cuts, and we have had to restore it each time here in the Congress. I know they have a small budget, but what is UNEP doing in terms of tropical deforestation?

Mr. KING. I will hurry to that.

Mr. BONKER. If you are getting to it, fine.

Mr. KING. Yes, I am in fact. We have some grasp of the FAO program. We can certainly come back to that. I won't give a long speech at this point.

We did start with the idea, again, that we must describe the problem and should get UNEP involved in the exercise. We have to see what is going on first. For this purpose we, the United States, last year asked that a working group be established to see where we stood on this whole issue; what additional activities were necessary.

The international working group was established. It met. It will meet again, hopefully, to refine this discussion under FAO hostship next time. In effect, I think what we are doing is changing the emphasis and getting the other organizations involved. We go to UNEP for those things because they can address the issues in consonance with UNESCO, WMO, FAO, since no organization is responsible for all of these kinds of activity.

What has been done? Very little. We have had problems in coordination. UNEP has developed some documentation which I mention in my testimony and won't go into here. A state of the art report, for example, with UNESCO and FAO on where the forestry issue stands; some monitoring of tropical forests that they have supported in FAO; a number of UNESCO MAB projects which they are helping support now, concerned with forest management research training and management.

I think that is about the extent of effort by those organizations concerned. You have already heard that there are other organizations involved; WMO, for example. You have heard some discussion of IUCN and the International Council of Scientific Unions.

One point I should like to mention because I think we should come back to it, is that governments set priorities; international organizations seldom do. That is an issue, if you like, that we can take up later. Thank you, Mr. Chairman.

[The prepared statement of Donald R. King follows:]

PREPARED STATEMENT OF DR. DONALD R. KING, DIRECTOR, OFFICE OF ENVIRONMENT AND HEALTH, BUREAU OF OCEANS AND INTERNATIONAL ENVIRONMENTAL AND SCIENTIFIC AFFAIRS, DEPARTMENT OF STATE

Mr. Chairman and members of the subcommittee: I welcome the opportunity to appear before this Subcommittee to discuss the activities of international organizations relating to the problem of tropical deforestation. On May 7, 1980, Mr. Bill L. Long, my colleague in the Bureau of Oceans and International Environmental and Scientific Affairs, and Mr. R. Max Peterson, Chief of the Forest Service, made a presentation to you on the activities of the Federal Interagency Task Force on Tropical Forests. With that background, it is important that the

Subcommittee obtain complementary information on the policies and projects of the various international organizations concerned with deforestation. The United Nations Environment Programme (UNEP) and UNESCO's Man and the Biosphere (MAB) Program are major players in this arena, but I would like to cover briefly, first, the most recent actions which have taken place in the Food and Agriculture Organization (FAO).

This organization has been concerned for many years with forestry problems; and, consequently, its activities are central to the issue. Until comparatively recently, FAO was concerned largely with the development and utilization of forestry products, emphasizing traditional silviculture, forest industry, statistics and institution development. In effect, this focus resulted from a recognition that the developing countries needed wood products domestically and for foreign exchange as an essential element of their development programs. This is not to say that no attention was paid to such problems as slash-and-burn agriculture and soil erosion. However, as FAO surveys began to reveal the alarming rate of deforestation which was taking place throughout the world, the larger problem came into focus.

This has produced new attention in FAO on fuelwood, agroforestry, "community forestry, forest monitoring and genetics." As a result, at its meeting in Rome in late May of this year, the Committee on Forestry recommended that FAO (1) extend its assistance to member countries for more efficient production and use of fuelwood and charcoal; (2) continue to conduct and produce the results of regional and global forest inventory and outlook studies; (3) support programs aimed at development of innovative management models, dissemination of improved seed and species, production of nut crops and medicinal plants and of meat from wildlife, and aforestation in arid and semi-arid zones; (4) make a study of the characteristics and extent of shifting cultivation; (5) expand its training, education and extension activities, support research, and contribute to strengthening national institutions for forestry planning and administration; and (6) increase its efforts to secure the increased flow of financial resources needed to improve its forestry program. These recommendations will go before the FAO governing body for decision. They are concerned very largely with improved management of the resource itself.

In earlier testimony before this Subcommittee, Mr. Peterson and Mr. Long described the efforts of a Federal Task Force set up to determine what actions could be taken to lessen the impact of deforestation. They pointed out that the U.S. strategy has been to raise world-wide awareness of the scope, origins and consequences of the tropical forest loss problems and to promote development of a coordinated international program on tropical forests which would attract support from governments and international organizations. To further this strategy, the United States raised the tropical forest loss problem at the last two sessions of the United Nations General Assembly and called upon the nations of the world to join in efforts to preserve this valuable resource for use by current and future generations.

As a follow-up, it was decided that the United Nations Environment Programme, in its catalytic role, would be an appropriate forum for developing proposals for international action. As a general rule, the United States has taken issues which concern more than one agency, and a community of outside interests, to UNEP since that organization is expected to serve a coordinating function. Consequently, the U.S. Delegation introduced, at the Seventh Session of the Governing Council of UNEP, a decision calling for an international meeting on tropical forests, to begin development of an integrated, global plan of action. FAO expressed some reticence to co-sponsor the session with UNEP. It is important to recognize that UN organizations respond to the directions given to them by governments. Consequently, the activities they undertake will reflect the priorities of member nations. However, to a certain extent, these organizations may be given conflicting instructions by national delegations who represent different constituencies.

For the same reason, there are, on occasion, bureaucratic turf battles which crop up from time to time that are confusing to international organization secretariats which, incidentally, sometimes may be responsible for such battles themselves. Although this has caused some occasional, minor problems, to the best of our knowledge, it has not interfered significantly with the development of programs in the area of tropical deforestation. At any rate, the meeting was

held in Nairobi, and agreement reached on a series of program recommendations to improve tropical forest management. The report of the group was approved by the UNEP Governing Council in April. With the initial questions resolved, FAO has taken a positive role and will co-host with UNEP a small meeting early in 1981 to further elaborate and develop the program framework. In all, it is our view that UNEP has moved expeditiously in drawing together the concerned countries and international organizations and in developing recommendations for international action.

This is, of course, not the first effort UNEP has made in the area of tropical deforestation. It has, in cooperation with FAO, completed maps and reports resulting from a pilot project on monitoring of tropical forest cover in Benin, Togo and the United Republic of Cameroon. It has, in cooperation with UNESCO and FAO, published a state-of-knowledge report on "Tropical Forest Ecosystems." Also, UNESCO/MAB, with UNEP cooperation, has initiated twelve projects in Asia, Africa and Latin America as elements of an integrated program aimed at improving the proper management of tropical forests and strengthening and training local manpower.

These twelve projects are located in Latin America, West and Central Africa, and Southeast Asia. Linkages will be established among the projects which, taken as a whole, will cover the different problems involved in the use of humid, tropical zones—selective clearing; reforestation; aforestation, using rapidly growing trees; shifting cultivation; non-conventional use of the biomass of tropical forests; migration of populations from mountains toward tropical lowlands; colonization of cleared areas by communities practicing agro-forestry and biagro-industries; and balance between agro-pastoral zones and wooded areas.

Several institutions are involved in these MAB projects, such as the International Center for Tropical Ecology in Venezuela, the University Institute of Tropical Ecology in the Ivory Coast, and Mulawarman University in Indonesia. They will provide support for the network of projects, particularly through the training of specialists and technicians. A certain number of institutions in industrialized countries, such as the Institute of Ecology at the University of Georgia, the Institute of World Forestry in the Federal Republic of Germany, and the Technical Center for Tropical Forestry in France, will contribute to project activities or send individuals to countries to train scientists and resource managers. We believe this is a very worthwhile MAB effort and hope to strengthen U.S. participation in it.

Although the above agencies are the main players in the U.N. system, there are other U.N. agencies with concerns. These include the World Meteorological Organization (WMO) which is concerned with the impacts of deforestation on climate; UNCTAD, which is addressing the issues of reforestation, how world markets operate, developing-country wood processing, and use of lesser known species; the U.N. regional economic commissions; the World Bank and the U.N. Development Program.

There are also international non-governmental organizations concerned with the deforestation problem. For example, the International Union for the Conservation of Nature and Natural Resources (IUCN) is concerned with preservation of tropical forest areas, while the International Council of Scientific Unions (ICSU) is occupied with basic research studies on the global carbon cycle, which involves a contribution from the tropical forest ecosystem.

As a general comment on the approach that all these organizations are taking on the deforestation problem, there has been a shift in emphasis in recent years. This has occurred largely as a result of the attention which has been brought to bear on the potential harmful effects of global deforestation. Previous efforts were devoted largely to the exploitation of forests as producers of products. With the growth of global populations and the increasing concomitant demand on land, there was also a slow recognition that areas unsuitable for agriculture or grazing were being deforested, and that there were serious side effects such as soil erosion. As governments recognized these problems, the various governing bodies of the UN organizations concerned have redirected their efforts toward a recognition of the need for multiple-use management of forests. There is growing realization that "the forest" is not simply a source of wood products, but that it serves many other purposes. For these reasons, throughout the international organization network there is a growing incorporation of ecological concerns into economic and development goals.

Thank you very much for the opportunity to present this statement.

ESTIMATED ANNUAL EXPENDITURE OF UN AGENCIES, SHARE CONTRIBUTED BY THE UNITED STATES, AND PERCENTAGE ALLOCATED TO TROPICAL FORESTRY

Organization	Total expenditures (in millions)		U.S. total contributions (in millions)		Percentage of total expenditures for tropical forestry	
	Assessed	Voluntary	Assessed	Voluntary	Assessed	Voluntary
FAO	119.1	371.7	29.7	95.1	3.8	2.0
UNEP		30.1		10.0		2.6
UNESCO	142.5		36.3		1.0	
UNDP		691.6		126.0		4.3
WMO	17.8	.5	4.2	.15	<1.0	<1.0

ESTIMATED PERSONNEL EMPLOYED IN TROPICAL FOREST PROGRAMS IN THE UNITED NATIONS SYSTEM [1]

FAO—77 professionals at headquarters, more than 300 in the field working in 56 countries (or 77 if projects in planning stages are included).
UNEP—1 professional equivalent provides technical guidance.
World Bank—10 professionals at headquarters, 4 in the field (India and FAO).
UNDP—1 professional provides technical guidance.
UNESCO—1.5 professionals coordinating project development.
WMO—less than one professional equivalent.

Mr. BONKER. Thank you, Dr. King. Dr. Kunkle, you may proceed.

STATEMENT OF SAMUEL H. KUNKLE, FOREST HYDROLOGIST, U.S. DEPARTMENT OF AGRICULTURE

Background: During 1972 through 1977, Kunkle was with the Forestry Department, Food and Agriculture Organization (FAO), United Nations at its Headquarters in Rome. During early 1978–80, he was Conservation Coordinator for Peace Corps, Washington, D.C. He has served in various jobs with the USDA Forest Service. He has frequently worked on the ground in tropical countries to establish or review forestry projects or to work as a technical specialist in conservation; these include field consultancies in Nepal (twice), Haiti (twice), Tunisia, Libya, Somalia, Zambia, Costa Rica, Honduras, Cyprus, Turkey, the eastern Caribbean, and technical visits to other countries in Asia and Africa. Earlier, he was a resident in five European countries as a forestry employee for the Swiss Forestry Service and the Danish Forestry Service and a student in Germany. He is familiar with and has close personal contacts with persons in various European bilateral programs in forestry.

Dr. KUNKLE. Yes, thank you for the opportunity to be here today. I would like to give a few of my personal viewpoints, having worked with FAO, the Peace Corps, and other organizations over the last few years.

Mr. BONKER. Are your personal viewpoints consistent with the administration's?

Dr. KUNKLE. I think by and large they are, but I am here primarily presenting my personal viewpoints today.

Mr. BONKER. All right.

Dr. KUNKLE. Rather than go into the whole workings of FAO, I would just like to pick out a couple of areas where I think that we could do something concrete, and make note of these. FAO, as Don King has already pointed out, is the largest of the U.N. organizations in the forestry area. It ranges from 300 to 400 people working in the field. This depends on the number of projects that are active at the time.

[1] All organizations also make use of consultants.

Mr. BONKER. Specifically on forestry matters?

Dr. KUNKLE. Specifically on forestry.

Mr. BONKER. 300 to 400 people?

Dr. KUNKLE. In the field. Then to that is added another 77 who are working in FAO headquarters.

Mr. BONKER. What do they do?

Dr. KUNKLE. The ones in the field or the ones in FAO headquarters, or both?

Mr. BONKER. The ones in the field.

Dr. KUNKLE. They have projects in community forestry, afforestation, monitoring of forest stand conditions, wildlife surveys, and other various sorts of technical activities. They put together projects. They have a project manager and a coproject manager from the host country, as well as younger people with them on the project at the local level, actually working with the growing trees, establishing nurseries, and work of this type. The 77 or so who work in headquarters are primarily administrative people; but they also are writing or editing technical books—books, referring to books, that are of value and use to the member nations of FAO.

Mr. BONKER. What is the title of that publication?

Dr. KUNKLE. This one is the "Yearbook of Forest Products." They put out a number of publications which summarize information on forest products and forests of the world. They also put out a number of technical publications, on how to inventory forest stands, establish nurseries, and other technical aspects of forest management.

Mr. BONKER. Regarding the 300 or 400 who are in the field, how many of them are primarily involved in direct forest management or in reforestation programs?

Dr. KUNKLE. Most of them would be. There are a few who are involved in teaching at technical schools. Most of them, however, are directly involved in forestry development projects—establishing nurseries, planting trees and improving management practices.

Mr. BONKER. Can you describe for the subcommittee what a typical project would be like?

Dr. KUNKLE. A typical project would last for 3 or 4 years although it might be extended. It would have a project manager who would be a U.N. person and a coproject manager who would be the local person. A typical project might have perhaps three to six so-called experts. These would be people who would be hired as specialists for short periods of time, or for full duration of the project. Projects normally employ a number of local people as forestry technicians and as laborers. Typically, there might be two or three host country project workers selected for fellowship studies, sometimes abroad. That would be part of the project package as well.

With permission of the committee, we would like to indicate for the record that FAO carries out many of the forestry programs reported on activity lists of UNEP, UNESCO, UNCTAD, and United Nations organizations other than the UNDP. Also, we call attention to a list of FAO/forestry field projects which we wish to submit for the record which displays that conservation-oriented field projects, 98; outnumber industry-oriented projects, 43 by a ratio of more than 2:1.

Mr. BONKER. In looking at this publication, this is from 1967 to 1978, it looks like it has the same emphasis that the World Bank used to have, and that is on commodity production. You have here figures and descriptions of ground wood, industrial wood, sawn wood, wood-based panels, plywood, particle board, woodpulp, and various chemical applications of woodpulp, paperboard, and so forth. I don't see anything in this report that relates at all to environmental conditions, to reforestation, to intensive forest management, to protection of the resource.

Is the FAO falling into the same pattern that the World Bank used to, and that is emphasis entirely on production?

Dr. KUNKLE. No. FAO forestry is basically in three parts. There is the Forest Industries Division, and there is a Forest Resources Division—which includes conservation—as well as a Policy and Planning Service unit.

Mr. BONKER. And you have a publication on resources?

Dr. KUNKLE. Yes; here is one, for example, "Shifting Cultivation in Latin America." This is the one that Dr. Myers had mentioned in connection with "Forestry for Local Community Development." I think this one is probably one of the nicest new programs that they have, one that has been very active in the last few years, "Forestry for Local Community Development."

Mr. BONKER. That is what Dr. Myers referred to.

Dr. KUNKLE. Yes; that's right.

Mr. BONKER. Of the budget for technical and economic programs for forestry, you have a summary of estimates by program. You have categories for industries and trade, for investment, institutions, for management, for world development and one for resource and environment. Could you give the subcommittee an approximate percentage of how much of the budget goes for industrial production versus conservation and resource management?

Dr. KUNKLE. I don't have the figure, however, I can supply it. I can also give you a list of field projects which are listed by title, if you would like that.[1]

Mr. BONKER. I guess what I am fishing for, Dr. Kunkle, is this: The Agriculture Committee here in the Congress is concerned primarily with production, and there are considerable interests involved in the production angle, because there is always a profit, monetary value with that. There is not much in the way of conservation, so we have to set up a committee on environment or on interior resources, and I rather imagine that FAO functions pretty much the same way. They are production oriented, and that is understandable, but do they sense that there is not an infinite supply of the resource, and that there has got to be a dramatic shift of emphasis?

We were told earlier that the World Bank is beginning to see the importance of conservation and of programs that will help preserve the resources. Do we see those same trends in FAO, or are they just symbolic and negligible, or are they dramatic, and if they are, what are they?

[1] This document is on file in the subcommittee staff office.

Dr. KUNKLE. No, I think they were real trends when I was there. Before I left there was a definite swing to do more conservation types of projects. The emphasis started with the Stockholm meeting on the environment in 1972, but you could see it also in the World Forestry Congress of 1978, which FAO put together. The title of the Congress was "Forestry for People."

Mr. BONKER. That was the one in Djkarta?

Dr. KUNKLE. Yes. If you look at the activities in the headquarters of FAO, or if you look at their field projects throughout the world, there are many more projects now on local community level than previously. They have had a lot of criticism on being too much production oriented, so there is a definite shift in the direction of more conservation.

Mr. BONKER. Is the U.S. Government placing its priorities before the various international organizations, such as UNEP and FAO? Are we becoming real advocates, placing greater emphasis on the resources and how we can preserve them, or is it just symbolic?

In other words, these organizations probably need leadership and direction, and since we are a large contributor to these international organizations, are we making it crystal clear that this is a major problem that we have got to deal with in a more creative way, and not just have total emphasis on production, but on preservation of the resource? Are we providing that kind of leadership?

Dr. KUNKLE. I think we could do a lot more, and I think the new Interagency Task Force Report that has just come out on tropical forestry is certainly a good start. We should certainly do more.

Mr. BONKER. I am sorry, I have interrupted your testimony.

Dr. KUNKLE. If I could just continue. I wanted to make a few points, and then I will be glad to try to answer any other questions.

FAO makes very fine use of the associate expert program in their forestry program. Associate experts are young professionals assigned by their governments to United Nations organizations such as FAO for work at field projects. They work for typically 3 years, and they gain experience necessary for full professional work in international development. This could provide young Americans with ground level opportunity in FAO, so that we can have the kind of influence that you are looking for, that is, having Americans directly involved in FAO.

Mr. BONKER. So we do have people directly involved?

Dr. KUNKLE. No. This is the point I am coming to. The United States is virtually the only Western country that is not involved in the associate expert program of FAO.

Mr. BONKER. Why?

Dr. KUNKLE. This is a matter of budget.

[Subsequently the following FAO budget information was submitted for the record:]

FAO FORESTRY PROGRAM (1980–81 BUDGET)

[In thousands of dollars]

	Regular program	Extra budgetary	Total
Forest resources and development:			
Development and management of forests	415		415
Tree improvement and plantations	433		433
Conservation and wildlife	270		270
Field programs	505	15,083	15,588
Total	1,623	15,083	16,706
Forest industries and trade:			
Development of forest industries	876		876
Trade and marketing	231		231
Logging and transport	226		226
Field programs	383	9,096	9,479
Total	1,716	9,096	10,812
Investment and institutions:			
Training and institutions	351		351
Investment planning and statistics	1,015		1,015
Forest policies and information	921		921
Field programs	323	21,597	21,920
Total	2,610	21,597	24,207
Forestry for rural development:			
Community forestry	263		263
Agri-Silvi-Pastoral Development	230		230
Fuelwood	377		377
Field programs	303	7,235	7,538
Total	1,173	7,235	8,408

Mr. BONKER. You are not going to put that back in our court?

Dr. KUNKLE. I am putting it back in your court. Certainly there has been support from the technical people. We would like to see this sort of thing done. As I understand it, it hasn't had the funds to get the program off the ground. This is a program that I think would be very useful.

Mr. BONKER. Has the United States approached any of the multinational companies to see if they would loan or make available some of their specialists for this purpose?

Dr. KUNKLE. They have on occasion put people on loan to FAO. I am not sure if it has been approached lately.

The other point, if I can just move along to make, regards the so-called trust fund programs. That is the sort of thing you are looking at in the booklet on "Forestry for Local Community Development"—a Swedish trust funded project, primarily. The "donor" nation designates the type of project it wants, provides the funds, and gets its own people involved in project execution. This gives you a lot of direct involvement in what we would like to do within FAO.

Mr. BONKER. Is this a bilateral program?

Dr. KUNKLE. No; it is an FAO program funded specifically by Sweden.

Mr. BONKER. I didn't know that international organizations allowed countries to design their own programs.

Dr. KUNKLE. They are directly involved in the design and talking about what sorts of activities will be going on, and they support the program.

Mr. BONKER. If the United States were to attach conditions to its contributions for a specific program. I am not sure we would get very far. I am pleased to see the Swedes are doing it, though.

Dr. KUNKLE. Agreed. This is an example, and I think it could be done.

Mr. BONKER. The Swedish program is where?

Dr. KUNKLE. It is working in several countries around the world. They have activities in Indonesia and in other countries. These two points, the associate expert program and the trust fund projects, are two examples where some of the other countries get very closely involved in the FAO projects, and I think the United States could look to those two examples as ways by which we could get more involved.

Without taking more time, I will just summarize a few recommendations I would make: One is that we certainly could look into trust fund type of programing. The second is we could certainly take part in the associate expert scheme. These would be good ways to get Americans more directly involved.

I think also we could make one final point. From the Peace Corps viewpoint—and I worked with the Peace Corps for 2 years—I think a lot of the volunteers return and they have experience that we could put to better use.

I think the cooperative program between Peace Corps and AID is a good example of how we can do this. I can see good possibilities of the Forest Service, AID and Peace Corps working together on these types of programs.

Mr. BONKER. That is an excellent idea. We will be discussing this with staff. We will be following through on it.

Dr. KUNKLE. In summary I think to build up our U.S. expertise in the associate expert program, to employ trust fund programs, and to make better use of our Peace Corps volunteers are three possibilities for strengthening U.S. leadership in world forestry development.

Thank you, Mr. Chairman.

[The prepared statement of Samuel H. Kunkle follows:]

PREPARED STATEMENT OF SAMUEL H. KUNKLE, FOREST HYDROLOGIST, FOREST SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE

Mr. Chairman and members of the subcommittee: My name is Sam Kunkle. I am presently Project Leader, Forest Hydrology Research, at the Timber and Watershed Laboratory, Parsons, West Virginia. I am here at the Subcommittee's request to present some impressions based on my ten years experience in tropical forestry and international development with FAO, the United States Peace Corps and the United States Department of Agriculture, Forest Service. This experience included many technical consultancies in Asia, Africa and Latin America. I am not appearing as an official spokesman for the Forest Service or the Administration.

I shall concentrate my brief presentation on a discussion of selected points relating to the international forestry activities of FAO, based on my experience with that organization. I then would like to point out some ways in which, in my personal opinion, the United States can work more fruitfully with FAO in forestry. Finally, I will add a few comments on United States bilateral efforts in tropical forestry.

The FAO Forestry Department comprises by far the largest single staff of foresters within the various international or bilateral assistance organizations. It has approximately 400 forestry professionals in field projects around the world, plus a group of 77 professionals at FAO Headquarters. Currently, about 55 tropical countries are hosts to FAO forestry field projects. For comparison of staff sizes, there are about 20 or less full-time forestry professionals in each of the major organizations such as the World Bank, UNESCO, United Nations Environmental Programme (UNEP) or the U.S. Agency for International Development (AID). Some of these, of course, use consultants, including FAO staff, as needed.

FAO Forestry activities include: (1) Community level forestry, (2) Agro-forestry, (3) Conservation, (4) Commercial forestry and (5) Monitoring and forestry inventory efforts. In the last few years, special emphasis has been placed on community level forestry, that is, forestry for the rural poor. A similar shift of emphasis, incidentally, has occurred within the World Bank.

An especially important aspect of FAO, in my opinion, is the United Nation's "Associate Expert" program. Under this program, young professionals under the sponsorship of their home country are assigned for two to five years to FAO projects in developing countries, where they gain on-the-job experience and—most importantly—gain critical language skills. The Europeans have made profitable use of this program to assure their direct technical involvement in FAO forestry programs. At the same time, they build up their pool of tropical forestry experts. The United States is practically the only Western industrial country not participating in this program. As a result, we are not adding to our short supply of tropical foresters in the United States.

Another type of FAO involvement used advantageously by some countries are "trust funded projects". Trust funded projects, as used by Sweden and other major donor nations, are a form of bilateral assistance where the donor nation designs the project, complete with staffing and equipment purchasing requirements and "contracts" with the international organization (FAO) to execute the project for cost plus and an administrative overhead fee. Sweden, for example, has a major program called "Forestry for Local Community Development". Most importantly, this type of program allows the Europeans to have much involvement in the day-to-day activities of FAO. As far as I know, the United States does not conduct bilateral development assistance in this manner.

To my knowledge, only two American foresters are now on the staff of 77 at FAO Headquarters, Foresty Department. Also noteworthy, the few Americans who have served in FAO Headquarters positions over the years rarely have been in any of the leadership posts. It must also, of course, be remembered that internationally qualified American candidates are rare. To be qualified, candidates need: (a) technical expertise, (b) tropical experience, (3) international and cross-cultural experience, and (d) language skills.

One could summarize by saying that the United States has very little direct technical involvement in the operations of FAO forestry activities, despite being a major financial contributor to the FAO programs.

The United States can make additional substantial contribution by more effectively combining its particular technical capabilities with those of FAO. At the same time, we can expand our pool of American experts through experience in FAO activities, including tropical forestry.

Some of the actions that I think would help expand our efforts in forestry abroad are as follows:

1. Develop some trust fund programs with FAO in those disciplines where the United States is recognized as especially strong, for example, in the areas of soil and water conservation, wildlife management, forest inventory and remote sensing.

2. Take part in the FAO Associate Expert Program. This is an excellent way to develop some tropical forestry experts for United States forestry, and to build the groundwork for a solid technical United States involvement in FAO activities in the future.

3. Ensure forestry representation on the U.S. delegation to the FAO Council and Conference.

Not directly linked to FAO, but related, I would like to point out the need to make better use of Peace Corps Volunteers. These volunteers return home with valuable language, tropical forestry and cross-cultural skills, but often these

skills are wasted as the ex-volunteers re-enter domestic forestry programs—primarily because there are no real job opportunities for them in the international arena. The United States should also consider intensive training in foreign languages for certain types of technical specialists. The United States has a vast reservoir of technical expertise, but this resource often cannot be used because essential foreign language skills are lacking.

The above actions would help the United States to build a cadre of qualified persons to assist in the tropical forestry effort—and other areas of cooperation in international forestry.

Another recommendation that I would suggest is to strengthen the working ties between the Peace Corps, Forest Service (and its Institute of Tropical Forestry) and AID in the community forestry topic. By combining these efforts, the right package of technical language skills and funding can be put together to build our international forestry expertise.

Thank you for the opportunity to appear here, Mr. Chairman. I'll be happy to answer any questions that you may have.

Mr. BONKER. Thank you. Dr. Preston you may proceed.

STATEMENT OF STEPHEN B. PRESTON, ASSOCIATE DEAN AND PROFESSOR OF NATURAL RESOURCES, SCHOOL OF NATURAL RESOURCES, THE UNIVERSITY OF MICHIGAN

Dr. Preston is Associate Dean and Professor of Natural Resources, School of Natural Resources, The University of Michigan, holds the bachelors and masters degrees in forest management from Colorado State University and masters and doctoral degrees in wood technology from Yale University. After joining the Michigan faculty in 1950, Professor Preston served until 1965 as a professor and department chairman in wood technology. Since that period he has held a variety of teaching and administrative positions in the School, including his present position since 1971. Professor Preston served for four years as the executive director of the Organization for Tropical Studies, two years as president, and is currently on the board of directors of that organization. Professional activities have included service as the president of the Society for Wood Science and Technology, membership on the board of directors of the Forest Products Research Society and the forest science board of the Society of American Foresters. His research and consulting activities and published works have been largely associated with wood as an industrial material and the utilization of tropical forest resources.

Selected publications relating to tropical forestry include:

The Need for Wood Technology Education in English-speaking West Africa Unasylva, Vol. 24(1), No. 96, 1970.

The OTS and its Forestry Related Programs, Forest Products Journal, Vol. XIX, No. 10, pp. 18–20, 62, 1969.

Information needs in expanding markets for Tropical Hardwoods. VII World Forestry Congress, 1972.

Industrial Uses of Increasing Numbers of Tree Species, Trends, Opportunities and Cautions. Tropical Forestry Conference INTERCIENCIA, October 1979, Costa Rica (In Press).

Characteristics of Wood from a Heterogeneous Forest Resource in Relation to Utilization. IUFRO All-Division V Conference, Oxford, April 1980. (In Press).

Dr. PRESTON. Thank you. I, as my colleagues, very much appreciate this opportunity of meeting with the subcommittee and providing testimony. I hope you will understand that my testimony is very much as that of an observer of these organizations rather than as an affiliate of theirs. My work with FAO has been very short, as a guest affiliate in the Rome office and also as a consultant in some field projects. My association with OAS has been much more limited, primarily with one joint program at the University of Michigan.

I was asked to assess the FAO and OAS programs in relation to their impact on the problem before us. Very much of what I had wished to say, as it is in my written testimony, has been covered very well by Dr. Kunkle. There are a few things that I could perhaps add to elaborate on some of the statements that he has made and to bring one or two new dimensions into the picture.

It is very true that in the early stages of the development of the forestry programs in FAO, back in 1945, the emphasis was clearly on production forests to meet product needs for an expanding world economy, and to provide assistance to economic development. I think that this was certainly a very appropriate emphasis at that time, and as a matter of fact I would like to also state that I feel it is very appropriate as a continuing part of an overall program, which has very substantially broadened in recent years. As Dr. Kunkle has pointed out, we have seen now the FAO programs expand to encompass the management and use of forests for both consumptive and nonconsumptive uses covering a broad array of human needs.

It might be useful, in answer to one of your questions to Dr. Kunkle, to look at some of the subprogrammatic areas that are embedded within FAO. As Dr. Kunkle has pointed out, there are three major programmatic areas.

One is the forest resource program, a second is the forest industries program, and a third is institutions, planning, statistics, and trade. The subprogrammatic areas that are encompassed within these might give a little better overview of what FAO is about.

Within Forest Resources, the subprograms include surveys, silviculture, tree improvements and plantations, argoforestry and community development, arid-zone conservation, and wildlife and national parks. Certainly within that milieu both consumptive and nonconsumptive uses are well attended to.

In Forest Industries, the subprogrammatic areas are pulp and paper, mechanical and related products, and harvesting; and Institutions Planning, Statistics, and Trade include forestry planning, forest statistics and economic analysis, trade promotions, training extension and employment, and administration and legislative research. So in all, it looks as though FAO does have a very broadly based, all-encompassing program that does relate to the sound management of forests, which in turn has a positive impact on deforestation.

I think that many people may not realize the impact that FAO has had on forestry in the tropics. Without question, in my view, it has been the single most potent factor in the development of any types of forestry practices in the tropics since its very inception, and this is certainly continuing today. One of the areas in which it has had particular influence has been in the development of educational institutions to provide trained manpower in the tropical countries. With the notable exception of the Dehra Dunm Forest Research Institute in India, it is very difficult to think of any forestry school in tropical countries that has not developed with the leadership, or support, of FAO. It certainly has been an extremely important factor in this area, and also in leadership in the management of forests for all users.

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One other point that I would like to make relating to FAO that I think may have been missed in the discussion so far is the importance of its industry program, and as a matter of fact its forest-management-oriented program, from the standpoint of the prevention of waste in the exploitation of the forests, and the meeting of local needs as well as world needs for a material resource. It is very difficult to conceive of any developing country maintaining a natural forest in any form other than under the condition of a biological reserve or park, unless that forest is providing some economic return to the land and at the same time is providing such social services as increased employment and/or protection of watersheds and soils.

FAO has had a very positive impact on assisting developing countries in managing their forests for production, to meet the needs for materials, and at the same time to maintain forest cover through either natural or plantation forest.

Mr. BONKER. What form does that take? I mean, if they are doing an excellent job on commodity production, what are they doing to apply better management practices as they relate to reforestation or the environment?

Dr. PRESTON. It has a very strong program in forest plantations for example, it has been a leader in bringing together and distributing information in the establishment of forest plantations, particularly in the tropics. From the standpoint of the management of the land, one of the current programs within FAO is the encouragement of the development of technologies which are appropriate to the countries, namely the small-scale conversion technologies, which can be, in turn, used to make some of these forested areas economically viable when managed under silvicultural treatment.

Mr. BONKER. Dr. Preston, if FAO is doing such an excellent job, why do we have such an awesome problem?

Dr. PRESTON. I do not mean to imply that it is doing the whole job. I simply want to leave the impression that its total emphasis has not been on exploitation without concern for the environment. I think it has had concern for the environment.

Perhaps I could very briefly touch on the Organization of American States, which I believe has not been mentioned at all in the discussion today, as another international organization that does have some impact on the problem of deforestation. OAS is roughly analogous to the United Nations on a regional basis focused on the Americas. In its main secretariat, there are two major divisions. One of them is education, science, and culture, which is oriented primarily toward institutional development, research, and education, and impacts only peripherally on tropical forests. The other is economic and social development, which is subdivided into two components, regional development and rural and urban development. Both of these units identify projects, help in their planning, and assist in developing the funding for them on a broad regional basis or within smaller rural areas. Many projects have some segments that involve the forestry sector. In this sense, OAS is involved in activities which do impact on the tropical forest.

To the best of my knowledge, OAS has never had any specific organization within the secretariat that is concerned with the tropical for-

est. It has, however, through one of its affiliates, the Inter-American Institute for Agriculture Science, developed in Costa Rica a regional training center and research station in tropical agriculture that has had continuously a very strong forestry program. This is now an autonomous unit, but OAS does maintain position on the board, and provides some funding. This station is now CATIE, the Center for Tropical Agriculture Research and Teaching. The forestry program has continuously educated foresters for all of Latin America, has had some very effective research programs, particularly in plantation forestry, is now emphasizing agroforestry, and also has a unit in watershed management and wildland planning, which promises to be effective in this field. Although it is not a part of OAS now, it is interrelated.

I believe that concludes my remarks. There are some recommendations that I would like to make.

Mr. BONKER. Dr. Preston, we are facing another vote, and I do not have enough energy to make it over there and back, so I am going to conclude the subcommittee hearings. If you have recommendations, we would welcome them, and maybe you could submit them in written form so they become part of the record.

Dr. PRESTON. Yes.

[The prepared statement of Stephen B. Preston follows:]

PREPARED STATEMENT OF STEPHEN B. PRESTON, ASSOCIATE DEAN, SCHOOL OF NATURAL RESOURCES, THE UNIVERSITY OF MICHIGAN, ANN ARBOR, MICHIGAN

Mr. Chairman, I am Stephen B. Preston, Professor of Natural Resources and Associate Dean, School of Natural Resources, The University of Michigan, Ann Arbor, Michigan. I am very pleased to have this opportunity to testify before your committee on deforestation in the tropics, now a problem of worldwide concern. It is particularly gratifying to see the intensified interest of the U.S. government in this matter in recognition of its impact on a large segment of the world population.

International organizations have, without question, been potent factors in influencing the manner in which human activities have impacted tropical forests. Both of the organizations which I have been asked to assess - the Food and Agriculture Organization of the United Nations (FAO), of worldwide scope, and the Organization of American States (OAS), with regional focus on the Americas, have played important roles in the status of tropical forests, but to very different degrees. I make no pretense of understanding fully the organizational complexities of these two institutions nor of familiarity with all of their policies and programs. My knowledge of FAO is based on one six-month period a decade ago as a guest affiliate of the Forestry Division in the Rome headquarters, as a consultant to forestry programs in West Africa, observations over many years of a variety of field projects in Africa, Central and South America, literature, and personal contacts with professional employees. My more limited knowledge of OAS stems primarily from a ten-year association with its Regional Development Department in connection with an OAS-supported fellowship program at the University of Michigan for natural resource professionals from member countries, familiarity with the forestry

programs of Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), formerly an OAS affiliate, documents and reports relating to OAS-sponsored projects, and personal acquaintance with professional personnel. My assessment is based on a broad understanding of the level, of and factors influencing, tropical deforestation and within the framework of the indicated knowledge of the organizations under discussion.

The Food and Agriculture Organization of the United Nations

Forestry and forest-related activities of FAO were initiated in 1945 with the broad objective of assuring the supply of forest products required by an expanding world economy. Early programs in tropical forestry focused primarily on utilization of the forest resource as related to economic development of the largely underdeveloped countries in which they occur. Within this context, emphasis was placed on inventory of the forest with particular respect to timber utilization, timber harvesting, integration of forest and industrial management, marketing forest products with emphasis on world trade, and institution building, including importantly capability for forestry education. This emphasis was unquestionably appropriate to the prevailing social and economic conditions at that time, and continues to be important as a component of a much broader scope of activities now included in the FAO programs.

As populations have expanded, technology has advanced, and political, social, and economic conditions have changed, FAO forestry policies and programs have expanded and broadened. They now encompass,

in addition to timber, all of the basic benefits that humans derive from the forest including protection of agricultural lands, regulation of surface and ground water, wind and water erosion control, integration of agriculture and forestry, wildlife habitat, recreational and cultural amenities, gene pool preservation, and importantly fuelwood production, community development, and other services to meet human needs. Organizational adjustments have accompanied changing philosophies, policies, and programs.

Currently, the FAO forestry activities are conducted within the organizational framework of a Department of Forestry, headed by an Assistant Director General. Work is divided among three programmatic areas - Forest Resources, Forest Industries, and Forestry Institutions, Planning, Statistics, and Trade. The Forest Resources program is concerned with the biologically related aspects of forestry and includes such sub-programmatic areas as surveys, silviculture and management, tree improvement and plantations, agri-forestry and community development, arid zone conservation, and wildlife and national parks. Sub-programs of Forest Industries are pulp and paper, mechanical and related industries, and logging and transport. Those of Institutions, Planning, Statistics, and Trade include forestry planning, forest statistics and economic analysis, trade promotions, training, extension and employment, and forest administration and legislative research. Program budgets for 1978-79 were reported to be approximately: Forest Resources, $1.65 million; Forest Industries, $1.36 million; Forest Institutions, Planning, Statistics, and Trade, $2.33 million. The total budget including program management was $6.3 million.

The regular program of the department concentrates on acquisition and dissemination of forestry information, economic and related analyses, program planning including guidance from committees, symposia, expert meetings, etc., and importantly technical support to field projects. Field programs, which extend through regional headquarters and country offices, are funded largely by the United Nations Development Program (approx. 80%). They respond to requests by member nations with projects often catalyzed by regular program activities. Activities are concentrated on developing countries in which tropical forests occur.

Without question, the forestry arm of FAO has been the most dominate factor by a substantial margin in the development of forestry and forest-related programs in the tropical countries of the world during the past 35 years. Recognizing early the need for definitive forest policies, institutions to implement them, and the urgency of training forestry professionals, it has exerted leadership and provided guidance to these considerations since its inception. Until very recent years, essentially every forestry school in developing tropical countries was developed with FAO leadership and support. Although still inadequate to meet the needs for professionally educated manpower, forestry education is now available in essentially every forested tropical country or sub-region. FAO has been an important source of information relating to most aspects of tropical forestry, forest-related development, and forest and forest product statistics through reports, bulletins, books, and miscellaneous papers. It has catalyzed or conducted meetings and symposia dealing with forestry-related problems and has provided a leadership role in, and served as the secretariat for, the World Forestry Congress, held at six-year intervals.

Because of the dearth of information about the extent, composition, and volumes of tropical forests, FAO initiated as one of its earliest programs a systematic assessment of the tropical forest resource, an activity which has continued and is now receiving increased emphasis and, in conjunction with UNEP, becoming more sophisticated. Through its field programs, it has provided direct assistance to member countries in developing forest inventories, an essential early step in any form of forest management. Field projects directed toward management of forest resources for both goods and services and toward efficient utilization of timber resources commensurate with country development plans have been numerous and effective. Work directed toward improving the role of the tropical forest resource in economic and social development of countries in which they occur has been continuous.

In recent years, FAO attention to non-consumptive uses of tropical forest resources has substantially increased, as is indicated by its sub-programmatic areas. Additionally, increasing emphasis is being given to the interrelationship between the natural and man-made forest resource and human needs for food, water, and shelter appropriate to in-country cultures. This is evidenced by intensified programs in tree improvement and plantation development for both industrial materials and fuelwood which relieve pressure on natural forests, community forests directed toward community needs and development, abatement of desertification, and water resource protection.

The activities of FAO have been perceived by some observers as disproportionately oriented toward forest exploitation for economic development without adequate consideration to ecological consequences or

or regard for non-consumptive uses including preservating of intact ecosystems for scientific purposes and species perpetuation. Clearly, one of its primary functions has been to enable the developing countries to derive economic benefit from this resource which otherwise would be wasted under the pressure of alternative land uses. Moreover, sound, product-oriented forestry programs are essential to insure the wood supply required in increasing quantity by developing countries. The early emphasis by FAO on production forestry and its continuation as an important part of the overall program are both justifiable and appropriate.

It should be noted that management to sustain forest cover on areas that are not protected as parks or biological reserves is unlikely unless economic return and such social benefits as increased employment opportunities, supply of needed building and industrial materials, and fuelwood can be demonstrated. FAO programs to encourage management for these benefits from the forest are positive steps to impede deforestation.

The current policies and programs of FAO appear to provide a balance of attention to consumptive and non-consumptive uses of forest resources and, importantly, integration among themselves and with social and land-use programs under the auspices of other FAO departments and international agencies, in harmony with country development plans. Some encouraging joint activities between FAO and other organizations, as, for example, with IBRD related to forestry investments and with UNESCO, UNEP, and IUCN to coordinate activities on environmental conservation now exist. There does, however, appear to remain a need for further strengthening the linkages between FAO and U.N. and other

agencies impacting directly and indirectly on tropical forests. Additionally, a holistic approach to the managment of forested wildlands to include the spectrum of human benefits provided by scientific and genetic preserves, recreational lands, protection forests, production forests, and agri-forestry and related complexes does not appear yet to be fully realized. Policies and programs, however, appear to be heading in that direction.

The Organization of American States

The Organization of American States (OAS), headquartered in Washington, D.C., is directed toward economic and social development in the Americas and may in many ways be considered roughly a regional parallel to the United Nations from the standpoint of objectives and programs. Although the programs of the parent organization and those of at least one of its affiliated organizations, the Instituto Interamericana de Ciencias Agricolas(IICA), impact on the status of the American tropical forests, there is not now an organizational component specifically concerned with the tropical forest resource, nor does there appear to be definitive policies relating to the forestry sector or the effect of programs on tropical deforestation. Forest-related activities are, however, included as part of regional and sub-regional programs incorporated in the OAS sphere of activities.

Within the OAS General Secretariat, there are two major divisions of activities: Education, Science, and Culture and Economic and Social Development. The first of these is oriented toward institution building, research, and education and impacts only peripherially on

tropical forests. The second, with two major departmental areas, Regional Development and Rural and Urban Development, conduct projects which may include forest-related activities and may incorporate forestry experts in their work.

The Department of Regional Development responds to requests from countries and groups of countries for formulating integrative regional development plans, as, for example, river basin development, which may embody many economic sectors. These are carried through the pre-feasibility stage. All projects are analyzed by a staff ecologist or others for environmental impacts, including possible effects on tropical forests, before being finalized.

The Department of Rural and Urban Development assists in project formulation and planning activities at sub-regional and community levels, which may include specific forestry components of the system under consideration, and assists in procurement of funding for their implementation. In addition to consideration of the impact of the planned project on forests incorporated in the planning area, plantation projects, including nursery establishment, for fuelwood and other uses is an integral part of some development plans. Agri-forestry models have also been developed. Forestry experts are recruited as needed.

Many of the professional personnel in the General Secretariat have a background in forestry and ecology, bringing a continuous awareness of ecological considerations to development planning.

The Interamerican Institute for Agricultural Science (IICA) is a largely autonomous organization under the OAS umbrella. Its primary objectives are increasing agricultural productivity, increasing employment, particularly in rural areas, and participatory involvement

of local personnel in project planning and implementation. IICA is headquartered in Costa Rica with four regional offices in zones of activity.

Forest-related activities are now treated as a part of the total environmental system in project areas, but no mechanism to give special attention to forestry-related matters appear to exist. IICA has played an important catalytic and advisory role in the development of projects relying heavily on reforestation and forest protection, e.g. the Panama Canal Watershed project recently funded by U.S.A.I.D.

An important function of OAS has been its fellowship and other training programs. In addition to general fellowship which have been awarded to students in preparation for forestry careers, the Regional Development Department has for the past decade maintained a block fellowship program for graduate studies in natural resources for resource professionals from institutions responsible for the development of natural resource sectors in member countries. Participants must be nominated by their government, which assures them the same or a more responsible position upon their return, and must be accepted as qualified master's candidates by the cooperating institution. Among the fifty or more participants in this program since its inception, many have been from forest-related governmental branches and have moved into leadership positions in governmental programs and with international agencies which influence forest management and maintenance of forest environmental quality.

In the recent past, the current Center for Tropical Agricultural Research and Teaching (CATIE) in Costa Rica was a part of IICA under whose auspices it was initiated and developed. A very effective tropical

forestry research, teaching and demonstration program has been a part of this center since its inception. Many of the professional forestry leaders in Latin America received their training at this regional institution. The currently agressive movement toward the establishment of parks and other types of wildland reserves in Central and South America to a very large degree originated here. The most complete library of tropical forestry and related literature in the American tropics is housed at CATIE. Research at the station has been instrumental in the successful equatorial plantation of forest trees, particularly pine which does not occur naturally south of Nicaragua and promises to become an important source of long fiber for pulp manufacture. Silvicultural research directed toward sustained management of natural production forests has been an on-going program. The forestry department now includes a wildland and watershed management unit oriented toward management of forested wildland systems to span the full array of goods and services derived from forested lands. Agri-forestry is an important part of the department's activities.

Although CATIE is now an autonomous institution, IICA is represented on its board of directors and provides partial funding. CATIE provides support services on request to IICA.

Although specific OAS policies concerning relationships between ecological, developmental and economic programmic activities are not evident, there appears to be adequate positive attention given to ecologically sound development. Many programs and activities include components of reforestation, forest protection, and establishment of wildland conservation areas.

There is no visible international organization with specific concern for fostering an integrative approach to managment of American tropical forested areas. This would appear to be a viable role to be included in the array of OAS activities.

Suggested Action by the U.S.A.

As a positive step toward sound management of tropical forests and abatement of tropical deforestation, the U.S.A. might consider strong encouragement to both FAO and OAS to emphasize sustainable multiple use development of tropical forests for all benefits to be derived from them including the in situ maintenance of genetic resources. This encouragement could be greatly strengthened by provision of special trust funds, in addition to regular allocations, specifically to foster this emphasis.

Mr. BONKER. I have just one question that I wanted to ask before we adjourn, and that is what is FAO doing to provide a substitute or an alternative to wood as a fuel source? I get the impression that while we emphasize commodity production, maybe overly emphasize it, the real problem is the tremendous demand for fuel wood and grazing areas for agricultural purposes that is depleting the resource. Is FAO doing anything to provide alternatives to wood as a fuel source?

Dr. PRESTON. I am not knowledgeable of anything in the sense of alternatives to wood. As has been mentioned, FAO has several programs which are related specifically to wood as a fuel source, but I do not know of programs relating to alternatives.

Mr. BONKER. I think fuel wood is what, 80 percent of the consumption of the wood resource? If we could find a system such as that being used in China then we might find an alternative that takes the pressure off.

Well, I want to thank each of the witnesses. I wish we had more time for questions, but it has been a long session. The record will remain open should you want to comment or make additional recommendations.

The subcommittee will stand adjourned.

[Whereupon, at 12:20 p.m., the subcommittee adjourned, to reconvene at the call of the Chair.]

TROPICAL DEFORESTATION

The Role of Multinational Corporations

THURSDAY, SEPTEMBER 18, 1980

HOUSE OF REPRESENTATIVES,
COMMITTEE ON FOREIGN AFFAIRS,
SUBCOMMITTEE ON INTERNATIONAL ORGANIZATIONS,
Washington, D.C.

The subcommittee met at 10:50 a.m., in room 2200, Rayburn House Office Building, Hon. Don Bonker (chairman of the subcommittee) presiding.

Mr. BONKER. The subcommittee will come to order. This morning, we meet for the third in a series of hearings on the problem of tropical deforestation.

At the first two hearings, the subcommittee looked into the causes and effects of tropical forest loss, possible solutions to the problem, and the role of international organizations. Today, the subcommittee will examine the activities of multinational timber and beef companies in tropical countries.

I would like to mention for the record that the subcommittee had extended invitations to the pharmaceutical industry and the National Cattlemen's Association to appear today; hopefully, they will provide a statement for the record. An invitation was also extended to Jari Corp. and they have submitted a statement which is enclosed with the presentation of the National Forest Products Association.

The subcommittee acknowledges the definitional difficulties raised by the industry panel with respect to the word "deforestation," and will not object if the industry witnesses use other terms.

The subcommittee has received extensive testimony and material on the complexity of the tropical deforestation problem and its possible solutions. We first discussed the issue at the beginning of the year, and since that time the Interagency Report on Tropical Forests and the Global 2000 Report have presented an excellent, detailed analysis. I would like to mention that currently there are at least 50 American corporations active in the tropics. A number of European and Japanese firms are also engaged in tropical timber and related industries.

In view of the fact that 82 percent of all American hardwood imports come from the tropics, that U.S. demand for tropical hardwood sawtimber is expected to increase 75 percent by the year 2000, and that combined tropical timber exports total over $4 billion annually, it is clear that the tropical forests' resources will only become more valuable to U.S. economic productivity as we enter the 21st century. The ex-

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pertise and technology developed by, and the cooperation of American industry is crucial to proper management, utilization, and conservation of this resource.

The subcommittee appreciates the assistance of the National Forest Products Association, especially the work of Mr. Mark Rey, in putting together this excellent panel of representatives from American multinational timber corporations.

At this time, I wish to welcome to the subcommittee Dr. Carl Gallegos, senior research forester for the International Paper Co., Mr. William Ladrach, director of forestry research for Carton de Colombia, a subsidiary of the Container Corp. of America, and Mr. Norman Johnson, vice president of Weyerhaeuser Co.'s North Carolina region, who I understand is the former Asian regional director of Weyerhaeuser.

I might also note that Weyerhaeuser's main office is located in my congressional district, and it is a responsible corporation as it relates to timber products and the modern timber production industry.

I would also like to welcome Mr. Douglas Shane, consultant in tropical forest development and conservation, who presented a slide show on tropical deforestation at the subcommittee's first hearing.

We will begin with the NFPA panel. Mr. Gallegos will be our leadoff witness this morning, and Mr. Johnson will show some slides.

STATEMENT OF CARL GALLEGOS, SENIOR RESEARCH FORESTER, INTERNATIONAL PAPER CO.

Personal: Born—Silverton, Colorado.

Education: Silverton Public School—Diploma 1961; Doane College, Nebraska (Biology)—BS 1965; Duke University, North Carolina (Tropical Forest Ecology—MF 1969; North Carolina State University, North Carolina (Forest Genetics and Forest Soils)—Ph.D. 1977.

Work experience: Doane College—Biology Teaching Assistant; Duke University—Research Assistant in Tropical Forest Ecology (Republic of Panama); Universidad Austral de Chile, Valdivia, Chile (Peace Corps Volunteer)—Professor of Silviculture and Tree Improvement; initiated nationwide Tree Improvement Program with Radiata Pine; North Carolina State University—Research Assistant in Tree Improvement; International Paper Company (since 1976)—Senior Research Forester, Central and South American Species—

1. Oversee biological aspects of International Paper Company ventures abroad in Latin America.
2. Coordinate biological research for International Paper Company in the Southeast.
3. Coordinate and conduct operational tree improvement research in the Southeast (Seed Orchard Specialist).
4. Member of various international forestry and tree improvement committees.

Fourteen years experience in tropical forestry in Latin America, Asia and Australia/Oceania.

Publication topics: Tropical forest ecology, silviculture, tree improvement and seed orchards, plus forest soils.

Mr. GALLEGOS. Mr. Chairman and members of the subcommittee, I am Carl Gallegos, senior research forester at the International Paper Co. in Mobile, Ala.

I am appearing on behalf of the Tropical Forestry Subcommittee of the National Forest Products Association. NFPA represents over 2,500 companies engaged in growing timber and in the production and distribution of solid wood products. A number of NFPA members have

operations in tropical countries and are vitally interested in the problems of tropical forest management.

Appearing with me are Dr. Norman Johnson, vice president, Weyerhaeuser Co., and Mr. William Ladrach, director, Forest Research, Carton de Colombia. Together, we represent over 25 years of experience in tropical forest management.

At the close of my statement, my colleagues on the panel will describe tropical forestry operations with which they have experience.

I would like to include in the record a paper describing my company's tropical forest management efforts, and a statement prepared by Dr. Clayton Posey of the Jari Corp., describing Jari's Brazilian forest management program.

We commend the subcommittee for holding these hearings. The report of the Interagency Task Force on Tropical Forests and the recently released Global 2000 Report underscore the critical nature of the problem of tropical forest loss. We will discuss these documents later.

Five baseline principles must form the basis for any initiatives dealing with tropical forest alteration.

First, threshold principles of tropical forest alteration. U.S. efforts must be premised on a clear understanding of what "tropical deforestation" really means. Several of the land use activities associated with the loosely defined term "tropical deforestation" do not result in a loss of forest land. Rather, these activities result in an alteration of the tropical forest resource. For example, many reports include all commercial logging as "deforestation." Selective logging does not deforest an area.

Forest alteration activities can be divided into at least seven categories, such as: One, partial harvest; two, clearcutting with natural regeneration; three, clearcutting with plantations; four, shifting agriculture; five, permanent agriculture; six, other removals; and seven, afforestation.

These can be beneficial or disadvantageous depending upon the circumstances involved. Confusing them, as we discuss later, makes it more difficult to articulate a coherent U.S. policy on tropical forests.

The second principle, tropical forest alteration must be focused in light of a much broader problem.

The fundamental problems confronting many tropical countries include the need for food, fuel, and shelter to fulfill basic human needs of burgeoning populations. Forest alteration is only one manifestation of these problems. Until immediate subsistence needs are met, tropical countries are not likely to focus on the problem of tropical forest loss.

The problem cannot be solved in isolation from the other problems facing less developed countries. For example, the final Interagency Task Force Report notes that "Fuelwood removals * * * make up more than 80 percent of all tropical wood utilization."

U.S. initiatives dealing with tropical forest loss must be grounded in a recognition of the economic realities of third world countries. U.S. tropical forest policy should be developed in accord with all relevant U.S. foreign policy and economic assistance goals.

Third, straight-line projections of current rates of tropical forest loss cannot provide an accurate index of future rates of forest alteration.

Too often reviewers of the problem use straight-line projections of current rates of forest loss to predict that forest cover will be virtually gone early in the next century. Such projections cannot reflect changes in the differing situations faced by individual less-developed countries over the next several years.

To provide a more accurate understanding of the problem of tropical forest alteration, the United States should place a high priority on research to assist in more accurate definition of rates of tropical forest loss. U.S. policies should encourage the use of remote sensing data to derive accurate rates of tropical forest loss on an individual country basis. U.S. action programs should be based upon the results of this type of data analysis, and should be sensitive to the unique problems of individual countries.

Fourth, the United States must be able to clearly articulate a consistent goal concerning management of tropical forest resources.

Much of the discussion of tropical forest alteration reflects an inconsistent philosophy of forest management and related goals. In some cases, the loss of productive timber base is emphasized as a major international problem. In other cases, the preservation of endangered species or the maintenance of ecological or genetic diversity are stressed as primary world needs.

Too often, intensive forest management maintenance of natural diversity, and preservation of endangered species are discussed as though they always represent nonconflicting forest uses. Often these resource values may be in direct conflict in tropical countries.

Tropical forests in less developed countries will be essential sources of timber-based products. Until basic economic needs are met, it is unlikely that host country governments will manage large forestered areas for forest uses unrelated to wood commodity production.

To encourage less developed countries to recognize both wood commodity and other forest uses, the United States should assist these countries to develop programs for intensive forest management. This will result in greater production on a smaller number of acres. Moreover, intensive forest management will facilitate the setting aside of truly unique or fragile areas of uncut forest.

U.S. initiatives on tropical deforestation should carry a dual emphasis on: one, assisting less developed countries to develop programs to intensively manage appropriate forest lands; and two, assist less developed countries to identify, and preserve, truly unique areas.

Fifth, the role of American industry must be placed in the proper perspective. In assessing the impact of multinational corporations, the final report of the Interagency Task Force on Tropical Forests points out that only about 6 percent of all wood removed from tropical forests finds its way into the export trade. In addition, the report notes that the extent of American wood product industry activity in tropical countries is small compared with that of other countries.

The activities of American companies have favorably influenced the management of tropical forest resources. In many cases, where host governments have been supportive, American companies have initiated programs of intensive forest management and extensive reforestation. In other cases, American companies are now engaged in reforesting areas where the forest resource was depleted decades ago.

U.S. policies on tropical forest management should encourage American industry to invest in long-term forest management in tropical countries, especially where the host government has a demonstrated interest in sustained yield forest management.

However, U.S. policies must be premised on a proper understanding of the respective roles of the U.S. Government, U.S. industry, and the host government of a tropical country. U.S. policy on tropical deforestation should encourage cooperation between American companies operating in tropical countries, the host government, and the appropriate elements of the U.S. Government.

To date, the most comprehensive U.S. effort to better understand tropical forest management is the final report of the Interagency Task Force on the World's Tropical Forests. The subcommittee has heard a great deal of testimony from the interagency task force. Thus, we will not review the report in great detail.

However, we do believe that the report represents a useful starting point for U.S. efforts. As an industry, we support many of the objectives of the report.

We encourage the subcommittee to endorse the final report as an initial blueprint for U.S. action. Implementation of the report's objectives should be assisted through periodic oversight and review.

The July 1980, Global 2000 Report to the President provides a more recently released treatment of the problems of tropical forest alteration. This report offers a pessimistic, albeit general, view of the status of the world's forest resources as we move into the 21st century. We do not concur with the report's principal findings in the forestry area.

In our view, the Interagency Task Force on Tropical Forests provides a much better qualified view of the problem of tropical forest loss, as well as a general reasonable program to deal with the problem. We are pleased that the Interagency Task Force has been designated as the implementing group for U.S. efforts in the area of tropical forest management. The task force membership contains the appropriate agencies and expertise to insure the development of an effective U.S. program.

U.S. efforts must be framed around an increased U.S. commitment to tropical forestry research and education. Both reports note the lack of U.S. research, education, and training programs related to tropical forestry. U.S. Government efforts in this area have lagged behind those of other countries and industry.

The subcommittee should review U.S. programs involved in tropical forestry research. We recommend an expansion of unilateral U.S. efforts as well as greater U.S. commitment to research sponsored by international organizations. In addition, more professional exchange opportunities must be created to provide foreign nationals with forestry training and U.S. professionals with tropical experience.

What part can U.S. industry play in better tropical forest management?

The final report of the Interagency Task Force outlines a number of areas where Government and industry can cooperate to foster improved tropical forest management. NFPA intends to work closely with the task force to realize a number of these opportunities.

Before I conclude, I would like to briefly outline one area of cooperation between NFPA and the Interagency Task Force. One of the next steps in the task force effort is a data collection exercise concerning the role of U.S. forest products industry activity in tropical countries.

NFPA has agreed to participate in the data collection effort. We are confident that the results will demonstrate that we are not a major part of the problem, but that we can work to provide a major part of the solution through the proper application of scientific forest management.

I appreciate the opportunity to offer these views. After my colleagues complete their presentations, we will be pleased to respond to questions from the subcommittee.

Mr. BONKER. Thank you very much, Mr. Gallegos, for a very nice statement.

[The prepared statement of Carl Gallegos follows:]

PREPARED STATEMENT OF DR. CARL GALLEGOS, NATIONAL FOREST PRODUCTS ASSOCIATION

Mr. Chairman and Members of the Subcommittee, I am Carl Gallegos, Senior Research Forester for the International Paper Company in Mobile, Alabama. I am appearing on behalf of the Tropical Forestry Subcommittee of the National Forest Products Association (NFPA). NFPA is a national trade association representing over 2,500 member companies engaged in growing timber and in the production and distribution of solid wood products. A number of NFPA members have operations in tropical countries and are vitally interested in the problems of tropical forest management.

Appearing with me on the forest industry panel are Dr. Norman Johnson, Vice President, Weyerhaeuser Company and Dr. William Ladrach, Director, Forest Research, Carton de Colombia, a joint venture two thirds owned by Container Corporation of America. The three of us together represent over 25 years experience in tropical forest management. At the close of my introductory statement, my colleagues on the panel will offer statements describing tropical forestry operations with which they are familiar and have experience. In addition, at this time I would like to include in the record a paper I have prepared describing our company's tropical forest management efforts. I would also like to include in the record a statement prepared by Dr. Clayton Posey of the Jari Corporation, describing Jari's Brazilian forest management program.

We commend the Subcommittee for holding this series of oversight hearings on the important issue of tropical forest alteration. Both the final report of the Interagency Task Force on Tropical Forests and the recently-released Global 2000 Report underscore the critical nature of the lack of management of the world's tropical forest resources. We will discuss both of these documents later in greater detail.

In coming to a better understanding of the causes of, and possible solutions to, the problem of tropical forest alteration, the forest industry believes that five underlying principles must be appreciated. These principles should form the basis for any initiatives designed to deal with tropical forest alteration.

THRESHOLD PRINCIPLES OF TROPICAL FOREST ALTERATION

U.S. efforts must be premised on a clear understanding of what "tropical deforestation" really means

A basic problem that seems to confound a clear discussion of the tropical forestry issue is the loosely defined, and poorly understood, term "tropical deforestation." Several of the land use activities and problems commonly associated with tropical deforestation do not actually result in a loss of forest land. Rather, these activities result in an alteration of the tropical forest resource (in some cases with a depletion of the quality, and in other cases with an increase in quality—i.e., younger, faster growing forests produce more oxygen). For example, many reports include all commercial logging as "deforestation." Obviously, selective logging does not deforest an area.

A more general concept of "forest alteration" accurately describes man-caused land use changes from an otherwise climax forest. This general definition can be more specifically divided into at least seven categories such as: (1) partial harvest; (2) clearcutting with natural regeneration; (3) clearcutting with plantations; (4) shifting agriculture; (5) permanent agriculture; (6) other removals (perhaps for more intensive development purposes); and (7) afforestation. These forms of forest alteration can be either beneficial or disadvantageous depending upon the individual circumstances involved.

Some tropical forests have been used and misused for centuries. Others are still in an essentially virgin condition. The impact of alteration of these forests will obviously vary in each case. Confusing these impacts, as we discuss later, makes it more difficult to articulate a coherent U.S. policy on tropical forests.

Tropical forest alteration must be focused in light of a much broader problem

The fundamental problems confronting many tropical countries include the need for food, fuel, and shelter to fulfill basic human needs of burgeoning populations. Forest alteration is only one manifestation of these basic problems. Until immediate subsistence needs are met from the use of nonforested lands or imported commodities, tropical countries are not likely to focus on the problem of tropical forest loss.

We do not believe that the deforestation problem can be solved in isolation from the other problems facing less developed countries. For example, the final Interagency Task Force Report notes that, "fuelwood removals * * * make up more than 80 percent of all tropical wood utilization." Rapidly increasing populations (and greater concentration in urban areas) will exacerbate this situation in the future. Certainly, any control of the United States forest industry abroad—or any other country's forest industry—is not going to reach 80 percent of the tropical deforestation problem.

Similarly, the 20 percent of the tropical harvest that appears to be used for industrial purposes is not simply an issue of resource exploitation. Rather, this wood production contributes directly or indirectly to economic growth goals, and supplies an important foreign exchange commodity to offset the large trade deficits that many tropical countries experience.

We believe that any United States initiatives dealing with tropical deforestation must be grounded in a recognition of the economic realities of individual third world countries. The demand for food, fuel, and shelter will increase along with the related pressures on the forest land base. In most countries, forest alteration as a result of basic needs of the population is destined to continue. In these cases, reforestation projects will be of most use.

In summary, we suggest that U.S. policies on tropical forest management should be responsive to the needs of individual cooperating countries requesting United States assistance. Tropical forest alteration should be viewed, in most cases, as a result of the larger problem of providing adequate supplies of food, fuel, and shelter for the populations of the less developed countries. In this context, U.S. tropical forest policy should be placed in perspective and developed in accord with all relevant U.S. foreign policy and economic assistance and development programs and goals.

Straight-line projections of current rates of tropical forest loss cannot provide an accurate index of future rates of forest alteration

We concur that the lack of tropical forest management is a serious problem facing many less developed tropical countries. However, too often reviewers of the problem use straight-line projections of current rates of forest loss to predict that forest cover will be virtually gone by the early to middle part of the next century. In addition, problems are caused by poor data collection and analysis concerning current rates of tropical forest alteration. For example, some estimates of forest loss do not include the net effect of reversion of some lands used for shifting agriculture back to forest cover.

Straight-line projections of current rates of deforestation cannot be used to accurately predict conditions into the next century. Such projections cannot reflect changes in the differing situations faced by individual less developed countries over the next several years. Indeed, we concur with Dean James Bethel's assessment at an earlier hearing that predictions of impending tropical forest famine are not helpful for achieving a clear understanding of the problem.

To provide a better and more accurate understanding of the problem of tropical forest alteration, we recommend that U.S. policies on tropical forests should

place a high priority on research to assist in more accurate identification of rates and trends in tropical deforestation. U.S. policies should encourage the use of (and development of new techniques for acquiring) satellite-based remote sensing data to derive current, and project accurate, future rates of tropical deforestation on an individual country basis. U.S. action programs should be based upon the results of this type of data analysis, and should be sensitive to the unique deforestation problems of individual countries.

The United States must be able to clearly articulate a consistent goal concerning management of tropical forest resources

Our perception is that much of the concern over tropical forest alteration is so unfocused as to provide an inconsistent philosophy of forest management and related goals. In some cases, the loss of productive timber base is emphasized as a major international problem. In other cases, the preservation of endangered species or the maintenance of ecological or genetic diversity are stressed as primary world needs.

Too often, participants in the controversy over tropical forest loss discuss intensive forest management, maintenance of natural diversity, and preservation of endangered species as though these always represent nonconflicting forest uses, as well as logical goals for a less developed country. Very often these resource values (all of which depend upon the maintenance of a forest land base) will be in direct conflict in tropical countries, just as they sometimes are in the United States.

We believe it is fair to say that tropical forests in less developed countries (to the extent they are not converted to nonforest uses) will be essential sources of timber based products, both industrial roundwood (for domestic use and export) and fuelwood. Until basic economic needs are met, it is highly unlikely that host governments will manage large forested areas for forest uses unrelated to wood commodity production.

The most effective way to encourage less developed countries to recognize both wood commodity and other forest uses is to encourage and assist these countries to develop programs for intensive forest management. This will result in greater timber production on a smaller number of acres. Intensive forest management will, in turn, help these countries overcome the basic problems outlined earlier. Moreover, intensive forest management will facilitate the setting aside of truly unique or fragile areas of indigenous, uncut forest as wilderness, wildlife, or natural diversity preserves. In the absence of a program of intensive management of some areas to meet timber needs and realize the associated economic benefits, we believe host governments will not allocate resources to protect longer term environmental values (including the basic soil resource).

We recommend that any U.S. initiatives on tropical deforestation carry a dual emphasis on: (1) encouraging and assisting interested less developed countries to carry out necessary forestry research and to develop programs to intensively manage and efficiently harvest appropriate forest lands for maximum wood fiber production consistent with maintaining the long-term productivity of the site and the associated environment; and (2) encouraging and assisting less developed countries to identify, preserve, and manage truly unique areas for the protection of endangered organisms, and the maintenance of genetic and biological diversity consistent with other national and world goals.

The role of American industry must be placed in the proper perspective

We are pleased to note that the hearings thus far have struck a positive note concerning the role of American-based corporations in tropical forest management. In assessing the impact of multinational corporations in general, it is important to bear in mind, as the final report of the Interagency Task Force on Tropical Forests points out, that only about 6 percent of all wood removed from tropical forests finds its way into the export trade. In addition, the report notes that the extent of American wood product industry activity in tropical countries is relatively small compared with that of other countries. Thus, United States industry operations in tropical countries represent some relatively small fraction (less than one sixth) of the 6 percent of tropical wood that is exported.

The activities of American companies working in the tropics have, for the most part, favorably influenced the management of tropical forest resources. In many cases, where host governments have been supportive, American companies have initiated programs of intensive forest management and extensive reforesta-

tion. In other cases, American companies are now engaged in reforesting areas where the forest resource was depleted many decades ago. My colleagues on the panel will provide examples of such U.S. corporate programs.

From our perspective, any U.S. policy on tropical forests should encourage the involvement of American companies in tropical countries. Any examination of the activities of American companies operating in tropical countries should be evaluated in light of: (1) the small percentage of the problem attributable to U.S. operations; and (2) the prospect that unilateral U.S. restrictions will place American-based corporations at a disadvantage and serve to assist foreign companies, perhaps less sensitive to environmental values, to increase the scope of their operations. In many cases, corporations from other countries are aggressively expanding their tropical operations with the encouragement of their home governments.

We recommend that U.S. policy on tropical forest management should encourage American industry to invest in long-term forest management in tropical countries, especially where the host government has a demonstrated interest in sustained yield forest management. Unnecessary unilateral restrictions or additional administrative requirements on American companies operating in tropical countries should be discouraged. The United States should support and pursue an international policy on sustained yield management of tropical forest ecosystems. This policy should be pursued through appropriate international bodies with the cooperation of U.S. government and industry experts.

In addition, any U.S. policy on tropical forestry must be premised on a proper understanding of the respective roles of the U.S. government, U.S. industry, and the host government of a tropical country. In some cases, the United States government can work together with foreign industry, and as an advisor to the host government, in establishing sound forest management programs in tropical countries. However, such a partnership must always be based on the premise that the host country will ultimately control all resource management decisions.

We suggest that U.S. policy on tropical deforestation should encourage cooperation and coordination between American companies operating in tropical countries (including the locally controlled subsidiary companies through which American companies participate), the host government, and the appropriate elements of the U.S. government. These arrangements should encourage the development of sound forest management programs.

More specifically, the U.S. government should encourage the host government to provide the kind of investment environment which fosters a long-term commitment to forest management. To this end, the U.S. government (including U.S. embassies), should provide the same type of active support to U.S.-based corporations that is provided to foreign-based companies by their foreign service institutions.

REPORT OF THE INTERAGENCY TASK FORCE ON TROPICAL FORESTS

To date, the most comprehensive U.S. government effort to better understand, and set forth a program for, tropical forest management is the final report of the Interagency Task Force on the World's Tropical Forests. The Subcommittee has heard a great deal of testimony from representatives of the Interagency Task Force. Thus, we will not review the report in great detail.

However, we do believe that the report represents a useful starting point for U.S. efforts in this area. Many of the principles outlined above are included in the Task Force's final report. Further, as an industry, we support many of the objectives of the report. We support efforts to promote and guide an expanded dialogue within and between the U.S. public and private sectors about the nature and significance of tropical forest loss and especially about the responsibilities and future activities of each sector related to improved tropical forest management and protection. We concur that there is a need to recommend policy for an expanded U.S. effort on tropical management—along with specific goals, a strategy, and a program framework—to assist both Federal and non-Federal institutions with the design, justification, and implementation of their future activities in this sector.

We encourage the Subcommittee to endorse the final report as an initial blueprint for U.S. action. In addition, the Subcommittee should monitor and assist in the implementation of the report's objectives through periodic Congressional oversight and review.

THE GLOBAL 2000 REPORT TO THE PRESIDENT

The July, 1980 Global 2000 Report to the President provides a more recently-released treatment of the problems of tropical forest alteration. The forestry chapter of the Global 2000 Report offers a pessimistic, albeit general, view of the status of the world's forest resources as we move into the twenty-first century. We do not concur with the Report's principal findings in the forestry area.

One major problem with the forestry-related findings of the Report is that the projection of future situations is based upon straight-line projections of current trends in forest alteration. Earlier, we outlined the difficulties with this type of methodology. We do not view the future viability of the world's forest resources as gloomily as do the Global 2000 authors. Many of the problems described in the Report can be solved by wise forest management designed to meet increased demands for fiber.

In our view, the Interagency Task Force on Tropical Forests provides a more accurate and much more specific view concerning the problem of tropical forest loss. For example, the projections of future rates of tropical forest loss are more carefully qualified (in light of the limitations of current data) in the Interagency Task Force Report.

Further, the Interagency Task Force Report was the subject of extensive peer review before it was issued in final form. The Global 2000 Report was not subjected to such a review. Consequently, the editor of Science Magazine noted, in the August 15, 1980 issue, that, "outdated material and inaccuracies detract from its value."

Finally, (and most importantly), the more accurate and specific findings of the Interagency Task Force are used to generate a detailed action program to begin to deal with the problem of tropical forest loss. For the most part, the recommended program outlined in the Interagency Task Force Report represents a reasonable strategy for United States efforts through the next 20 years and beyond.

We are pleased that the Interagency Task Force has been designated as the implementing group for United States efforts (including those precipitated by the Global 2000 Report) in the area of tropical forest management. We believe that the Task Force membership contains the appropriate agencies and expertise to insure the development of an effective United States program.

U.S. EFFORTS MUST BE FRAMED AROUND AN INCREASED U.S. COMMITMENT TO TROPICAL FORESTRY RESEARCH AND EDUCATION

One finding of both reports that deserves special attention is the relative paucity of U.S. research, education, and training programs related to tropical forestry. U.S. government and University efforts in this area lag behind those of other countries and industry. For example, much of the forestry training provided by the U.S. to foreign nationals is the result of industry-sponsored efforts.

We believe that the Subcommittee should review, and perhaps increase, U.S. programs involved in tropical forestry research. We recommend an expansion of unilateral U.S. efforts (e.g., U.S. Forest Service, AID) as well as greater U.S. commitment to research sponsored by international organizations (e.g. FAO). In addition, more professional exchange opportunities must be created to provide foreign nationals with forestry training and U.S. professionals with tropical experience. Until we develop an adequate base of knowledge, and a pool of qualified professionals, our efforts to promote better tropical forest management will bear little fruit.

WHAT PART CAN U.S. INDUSTRY PLAY IN BETTER TROPICAL FOREST MANAGEMENT?

The final report of the Interagency Task Force outlines a number of areas where industry can cooperate, and where the U.S. Government can encourage American industry investments, to foster improved management of tropical forest resources. NFPA intends to work closely with the Interagency Task Force to realize a number of these opportunities. In addition to these areas of potential cooperation, my colleagues will shortly describe industry efforts already underway.

However, before I conclude, I would like to briefly outline one area of cooperation between NFPA and the Task Force effort. One of the next steps in the Interagency Task Force effort on tropical deforestation, is a data collection exercise concerning the role and extent of U.S. forest products industry activities in tropical countries. Neither we nor the Task Force were able to identify an easy method for compiling this information during the development of the Task Force report. Thus, a second stage effort is being initiated.

NFPA has agreed to participate in the data collection effort with members of the Interagency Task Force. We hope that the products of our joint efforts will provide us with a better understanding of the activities of multinational corporations in tropical forest management, as well as with ideas for additional areas of cooperation in developing programs to foster wise utilization of the tropical forest resource. We are confident that the results of this research will demonstrate that we are not a major part of the problem, but that we can work to provide a major part of the solution through the proper application of scientific forest management.

I appreciate the opportunity to offer these views on behalf of NFPA's Tropical Forestry Subcommittee. After my colleagues complete their presentations, we will respond to questions from the Subcommittee.

PREPARED SUPPLEMENTAL STATEMENT OF DR. CARL GALLEGOS, SENIOR RESEARCH FORESTER, INTERNATIONAL PAPER CO.

Mr. Chairman, and Members of the Subcommittee:

For the past year, I have served as Chairman of the Advisory Board of the Central America and Mexico Coniferous Resources Cooperative (CAMCORE). CAMCORE is a cooperative effort between forest industry and the North Carolina State University, School of Forest Resources, to preserve, test and utilize the valuable genetic resources present in the coniferous forests of Central America and Mexico. Certain tree species native to Central America and Mexico are already recognized as some of the most important plantation trees grown in the tropics, but a vast majority of these species are in danger of being erradicated by man before their attributes have been adequately tested.

Within the past decade, forestry and the establishment of a viable forest products industry have received increasing attention in the developing countries of the world. This has come about largely as the result of increased population pressures and the resulting greater demand for wood and wood products. Several of the less developed countries are located in the tropics, and

many of them have vast expanses of native forests. However, the rate of growth and productivity of these forests is generally inadequate to supply the amount of wood required to satisfy internal demands. Because of this, many tropical countries have begun to establish plantations of fast growing trees.

Some of the most important tree species planted in the tropics are pines that are not native to the countries where they are grown. Tree species such as oocarpa pine, Caribbean pine, Jelecote pine and Mexican cypress, which are major timber species throughout the tropics, are native to Central America and Mexico. However, studies show that in addition to these four trees, there are fifty-one other species and varieties of pines in Central America and Mexico. It is quite possible that any one or several of these unproven species and varieties might have equal or greater potential than the four trees already widely planted, but extensive studies need to be conducted before this is known.

An increasingly important complicating factor threatening the existence of this genetic resource is the fact that, throughout the world, population pressures are expanding at alarming rates, and great pressure is being placed on the forest by shifting agriculture farmers, woodcutters, subsistence livestock growers, and local lumbermen. In fact these increased uses of the forest have caused much damage and stress in the remaining live trees, and the old enemies of the forest, such as insects and diseases, have become more virulent and are destroying

larger numbers of trees. Nowhere is this more evident than in Central American and Mexico, where indiscriminate cutting and damaging of the forests is resulting in the loss of many proven and potentially valuable timber species.

For the above reasons, six forest industry companies, including Aracruz Florestal, S.A. of Brazil, Corporacion Nacional de Reforestacion of Venezuela, Container Corporation of America, Mead Corporation, Weyerhaeuser Company and International Paper Company, plus North Carolina State University, School of Forest Resources, have joined together to form the Central America and Mexico Coniferous Resources Cooperative (CAMCORE). This group will also include forestry organizations from host countries as affiliate or full members. The stated objective of CAMCORE is to preserve, test and utilize the coniferous resources of Central America and Mexico for the purpose of increasing the productivity of tropical and subtropical forest land.

The CAMCORE Cooperative has been founded to collect and preserve disappearing gene resources, as well as to help improve proven species and to help evaluate and develop additional species for use by forest industry in the tropics. For this reason, a two-staged program is visualized for the Cooperative. The most immediate goal will be to prevent the extinction of endangered genetic resources and to provide for immediate collection and testing of this material. The second stage will involve the initiation of support activities necessary to produce sufficient

quantities of seed for large-scale planting of the desired species. These operational activities are to be done separately by the members, and the Cooperative will supply technical expertise along with suitable genetic stock. CAMCORE will also directly sponsor the research activities of graduate students (both national and foreign) of the NCSU, School of Forest Resources. This will undoubtedly prove of great value to the Cooperative in accomplishing its two primary goals.

The Cooperative will be headquartered at North Carolina State University in Raleigh. The Director, Mr. W.S. Dvorak, and his staff will direct the Cooperative's activities from this location. Field offices are to be established in the countries of Central America where major collections and investigations are being conducted. The Advisory Board, consisting of one person from each member organization, has been formed to work with the Director. The Board will also vote on any changes to be made in the organizational bylaws. Each Cooperator contributes annual dues for an initial minimum commitment of three years. All research results are to be published and made available to the public. Basic collections of information and plant material will also be available at a reasonable cost.

Guatemala will be the first country in which CAMCORE will initiate its activities, because of the large number of conifer tree species that are native to the country. Furthermore,

population pressures and the resulting rate of cutting are acute in this country, and there is an urgent need to protect valuable genetic resources from being permanently lost. Investigations have already been initiated in Guatemala by students from NCSU, School of Forest Resources, and many valuable contacts have already been made in that country which will greatly facilitate the Cooperative's work.

Eventually, CAMCORE's activities will be expanded to include Mexico and other Central American countries. Many valuable timber species grow in these countries, and the rate at which these irreplaceable genetic resources are being lost due to excessive population pressures is nearly as bad or worse than in Guatemala.

Mr. Chairman, CAMCORE is a unique Cooperative in that the primary driving force behind its organization and formation has come from the forest industry community. In this sense, it is exemplary of the industry's genuine concern to preserve and develop a valuable natural resource for the benefit of all mankind.

Mr. BONKER. I believe now we will move to Mr. Ladrach, who will represent—I guess the container industry is the main one you represent, but you represent a subsidiary that is active in Colombia?

STATEMENT OF WILLIAM LADRACH, MANAGER OF FORESTRY RESEARCH, CARTON DE COLOMBIA, A PARTIALLY OWNED SUBSIDIARY OF CONTAINER CORP. OF AMERICA

Born: March 6, 1941, Dover, Ohio.
Education: B.S., Forestry, University of Michigan 1963; M.S., Forest Soils; University of Michigan, 1964.
Professional experience: Plywood production; U.S. Plywood Corp., Orangeburg, S.C.; Iquitos, Peru, 1964–65; forestry research and operations; Westvaco Corp., South Carolina, Virginia, 1965–73; director, forestry research, Carton de Colombia, Cali, Colombia, 1973–present.
Professional society membership: Society of American Foresters; Xi Sigma Pi, Forestry Honor Fraternity.

Mr. LADRACH. Yes. My voice isn't quite that strong. I need a little help.

Mr. BONKER. We want to make sure the people in the back can hear, so move closer to the microphone. If you can't hear, raise your hand, and we will turn up the amplifier.

Mr. LADRACH. I am William Ladrach. Since 1973, I have worked for Carton de Colombia, a pulp and paper company which supplies the Colombia national market with packaging products. Container Corporation of America maintains controlling ownership of Carton de Colombia.

The company began making paper in 1944, using wastepaper as the sole raw material. Today, we continue to be the major user of wastepaper in Colombia, processing over 50 percent of all wastepaper collected nationally.

In 1959, because of an insufficient supply of wastepaper, we began to manufacture woodpulp. We were the first, and until recently, the only company in the world that has been able to produce a uniform paper product from mixed tropical hardwoods. Of the more than 250 tree species classified in our concession on the Pacific coast, we use all but a few in our pulp mill.

The rain forest is clearcut by means of cable logging systems. Dr. Tim Whitmore, with the Oxford Unit of Tropical Silviculture, stated that our cable logging methods are among the best logging systems that he has seen in use in the tropics. They do not destroy the soil surface and allow for abundant natural regrowth.

In 1969, we began a reforestation program, planting tropical tree species on marginal or wornout farmland. We have planted 27,500 acres primarily with tropical conifers, as a means of replacing imported long-fiber pulp with a nationally produced forest product. This is a major industrial area where jobs are scarce and people have traditionally been migrating to the city in search of work.

In 1973, we initiated a formal forest research and development program which today has a budget of $240,000 or 16 percent of the total noncapital forestry budget of the company. Dr. Bruce Zobel, of North Carolina State University, has called our forest research program one of the best in industry in all Latin America.

The company forest research reports are written in both Spanish and English, and distributed to 55 noncompany scientists worldwide. The University of Oxford, England, asked us for permission to include these reports in their Forestry Abstracts, the largest forestry indexing service in the world.

I would like to contribute two of these reports as a part of my testimony.

Mr. BONKER. Thank you. That will be included in the official record.

[The material referred to follows:]

Carton de Colombia S.A

investigación forestal

GENETIC GAINS WITH CUPRESSUS LUSITANICA THROUGH SIX YEARS OF TREE IMPROVEMENT IN COLOMBIA 1/

November, 1979

Research Report No. 50

SUMMARY

Cypress has been in Colombia since the last century as an ornamental and for reforestation. The wood is in demand today near Medellín, where the most extensive plantations are to be found. A cypress tree improvement program was initiated by Carton de Colombia in 1973 and has the support and cooperation of several national entities and organizations.

The objectives of the program are: To develop insect and disease resistant trees, improve the adaptation of this species to different environments, increase the growth rate, improve tree form and develop wood that is better suited to the final products. The value of such genetic improvement programs has been demostrated in other parts of the world. Presently there exist similar programs in more than 14 tropical and sub-tropical countries including Brazil, Cuba and Colombia in Latin America.

To date, 43 of the best cypress trees have been selected in the country and in 1977 the first forest seed orchard was established in Colombia near Popayán. The first abundant seed crop is expected in 1982 and with this will begin a new era of reforestation with genetically improved trees.

As research backing for the project, progeny tests have been planted since 1975 in order to evaluate the potential of the seed produced by the select trees on typical reforestation sites in the Departments of Antioquia, Cauca, Cundinamarca and Risaralda. After just three years the results of these tests are very promising. The overall advantage of the progeny of select trees compared with commercial unselected seed is 50% in volume and 13% total height.

1/ Submitted to the contest, "Bavaria Environmental Award". The Bavaria Beer Company offers a million pesos (about US$25,000) for the best work in 1979 on the environment.

The reforestation with genetically improved conifers has other benefits for the country including the national production of long fiber, whereby the expensive importation this raw material can be reduced, the recuperation of marginal agricultural soils through reforestation, the reduction of the pressure to cut natural forests by meeting the demand for forest products with fast growing planted species, and by creating a new source of employment in the country-side.

An important aspect of the program is the spirit of cooperation that exists between the different entities involved in the effort and without which the full extension of this program would not have been possible. The goals of the program extend into the next centry, being thus the longest range forestry program in the country. It is hoped that this will be a model so that other national-scale forest programs will be of a longer range and will have a similar cooperation between all forestry organizations.

INTRODUCTION

The Origin of Cypress

Cypress is a species originally from Guatemala and Mexico and it grows naturally between 2,300 and 3,300 meters altitude. It is utilized as an ornamental and the wood is used for construction, for furniture, for pencils (Popenoe, 1941) and for pulp and paper. Some centuries ago it was carried to Europe where it received the name Cupressus lusitanica Mill., because of the plantations in Portugal.

Due to the great variety of form in cypress, different botanists had called the tree by different names: C. benthami Endl, C. coulteri Forbes, C. glauca Lamarck, C. knightiana Knight & Perry ex Gordan and C. lindleyi Klotzsch ex Endl. Today the general consensus of the botanists is that all these names refer to the same species, C. lusitanica Mill (Harcharik & Vaccarone, 1974)

Cypress is found planted sucessfully in many parts of the tropical and sub-tropical world, being most common in Costa Rica, Kenya, Uganda and Colombia. It is appreciated as an ornamental species, for its wood, for reforestation of municipal watersheds and also for its capacity to grow in and recuperate soils severely eroded by agriculture (Sapriza, 1945). In the last few years its value as a pulp and paper species has been proven (Guha et al., 1971) and it is presently used for pulp and paper in Kenya and Colombia.

Cypress in Colombia

Cypress is a species that has been used as an ornamental in Colombia since the past century and it is found frequently in the parks and along the streets of Bogota, Medellin and Cali. In addition, cypress was one of the first species used for the reforestation at the beginning of the twentieth century and currently it is the species with the most extensive area reforested in the country. According to Delgado (1970) it is promising for planting between 650 and 2400 meters a.s.l.; there are large extensions of cypress forest in the Departments of Antioquia, Cauca, Cundinamarca, Old Caldas, Nariño and Valle among others. Today there are plantations with ages ranging from 1 to 60 years.

Plantations of cypress are used to improve the watersheds that supply drinking water to the cities of Bogota and Medellin as well as for such simple things as the green fronds in boquets of flowers. The wood of cypress is important in the Department of Antioquia for mill work, interior paneling and many other uses to the point that the demand exceeds supply (Berrio, 1976). What is more typical of an Antioqueño restaurant that benches and tables of cypress? Recently, due to its rapid growth, adaptation to soils abandoned by agriculture and for its wood quality, industrial plantings of cypress have been increasing to meet the raw material needs of the country for pulp and paper, construction woods and for furniture.

With the large acreage of plantations already in existence as a base, a genetic tree improvement program was initiated so that future plantations would be of the best quality possible through the selection of the best parent trees in Colombia. These would then become the seed producers for future generations of forests in the country. The purpose of this work is to summarize the various steps of this program through its first six years of existence and to underscore the gains achieved.

Why a Genetic Improvement Program with Cypress?

A genetic tree improvement program has as its end the production of improved seed. This fact implies that there must be a large-scale reforestation program in order to take advantage of the genetic gains obtained through the program. Without massive reforestation the genetic research has absolutely no value.

Genetic improvement can have several objectives but almost always one of these is to improve the yield of a product derived from the species under study. Logically, it is important to have a species to start with that already has a good

yield that can be improved even further. To the contrary, working with a species of mediocre yield it is much easier and cheaper to change species to improve yield than to try to genetically improve the yield of a species with inferior growth.

In 1960, Lopez wrote that cypress had adaptd well in Colombia. It has been studied for reforestation since the decade of the twenties and in a study in comparison with 45 other species, cypress has shown to be a good growing species in the Andean zone (Falla, 1967). Thus, cypress is a good growing species, it has a wide base of plantations in the country to be improved and is of importance for future planting programs; all these aspects being necessary to bear in mind when contemplating a genetic improvement program.

Another important factor in the selection of cypress is its adaptability to grow in marginal and eroded soils which have been abandoned by agriculture (Sapriza, 1945). At times the layman blames the conifers for causing erosion when actually what happens is that the conifers are very often planted in soils already eroded because they are the trees that grow best in eroded soils where little other vegetation grows. In the great majority of the cases, the reforestation in Colombia occurs on eroded or marginal soils for agriculture where cypress is one of the preferred species.

An important aspect of genetic improvement, compared with other forestry activities, is that a genetic improvement is permanent. For example, lets say that a 50% growth gain can be obtained through genetic tree selection, and also by fertilization. In the case of the genetic improvement this 50% is a permanent gain that continues forest after forest, once it is obtained. To the contrary, the fertilization requires a new application or investment for each plantation. Another example: if a genetic resistance is obtained to an insect attack, this resistance continues year after year fo all plantations, whereas without this resistance the alternatives such as chemical control, biological control or silvicultural control require a new treatment or effort each time there is a new attack. For such reasons as these, several analysts have concluded that genetic improvement of trees is the best possible investment in the forestry field (Zobel, 1977).

Brief Summary of Tree Improvement in the World

Due to the great consumption of forest products in the United States, a critical supply situtation was predicted for the decade of 1980 to 1990. For this reason a tree improvement program was initiated in the Southeast in 1951 to try to increase wood production and increase wood quality in the shortest period of time. The Cooperative Tree Improvement Program of N.C.

State University works with 26 companies and 3 state forestry departments in the Southeast. Through 1976 the Cooperative had selected 4,104 trees of 9 conifer species, principally P. taeda, and 468 trees of 22 hardwood species. These are grafted into 170 seed orchards that cover 1450 hectares, and had produced 27,000 pounds of improved seed in 1975 (N.C. State, 1976). In 1970 there were one hundred million improved seedlings produced and between 1970 and 1980 the three hundred million seedlings per year required by members of the Cooperative are being produced from improved seed. The first generation seed orchards are giving a 12 to 20 percent increase in tree volume and the second generation is expected to have volume increases on the order of 30 to 45 percent.

In Kenya, working with Cupressus lusitanica, the same species with which we work in Colombia, volume increases have been achieved in the order of 50 to 67 percent through genetic improvement compared with seed from unselected trees (Paterson, 1968; Dyson 1969). . In Malawi, Paterson (1969) estimated a total volume gain of 93% through the genetic selection of Cupressus lindleyi. Starting in 1966 the first tree seed orchards were established in Kenya with 6.7 hectares in commercial production of Cupressus lusitanica (FAO/DANIDA, 1974). Currently there are 11 hectares in production of improved seed. In South Africa the genetic improvement of Pinus patula was begun in 1957. This program was initiated with the mass selection of candidate trees by technicians in Rhodesia and South Africa, achieving a selection intensity of one in 70,000 trees (Denison, 1968). Currently 50% of the seed orchards are producing seed with some clones producing up to 500 cones per tree per year. This has allowed the country to be self-sufficient in improved seed and to begin the exportation of excess seed (Denison, 1973).

Forest tree seed orchards have been reported in 14 tropical and sub-tropical countries with more than 10 different tree species, covering more than 700 hectares (Table I). In the tropical regions of the Americas there are tree seed orchards established in Brazil, Cuba and Colombia.

ESTABLISHMENT OF A TREE IMPROVEMENT PROGRAM IN COLOMBIA

Colombia had 76,000 hectares of trees planted through 1978 and among the species planted, C. lusitanica is the most common with 30,000 hectares. Today there are sufficient mature plantations of this species to justify an intensive selection process with the purpose of improving the genetic base population.

Several characteristics of cypress point to a good potential for improvement. Cypress varies substantially in tree size between individuals within the same stand; some cypresses are three to five meters taller than the best neighbors nearby and it isnt rare to find trees with double the volume of the other nearby dominantes. There are cypresses with big limbs and small limbs and they vary greatly in bole straightness as well. The variations tend to indicate that a good genetic gain can be obtained in volume and form through intensive genetic selection.

There have been some disease and insect problems in Colombia which affect cypress. Often there are infestations of the "striped canker". Although this canker is not of epidemic proportions, there a few plantations where more than half the trees show symptoms of the disease and a reduction in wood quality due to the infection. The defoliating insects Glena bisulca and G. megale have attacked plantations of C. lusitanica in the Department of Antioquia, defoliating nearly all the trees in uniform lots until they are dead (Velez, 1974). In these attacked plantations there are some trees completely green and resistant to the defoliators. The selection of trees resistant to the attack of these insects and the cypress canker would be the first step in the process of improving the resistance of this conifer to disease and insects.

The benefits of a tree improvement program are many. As mentioned, there will be more resistance to disease and insects due to the selection of resistant trees in infected plantations. Due to the selection of trees over wide range of stands and provenances, a wide genetic base will be maintained for the future improved plantations. There will also be more uniformity in the size of the trees by eliminating the inferior genotypes, which will result in less rejected seedlings in the nursery and more uniform stems in the plantations, which will in itself permit easier thinning and logging at a lower cost. Selecting for faster growing trees would permit earlier thinnings and might also reduce the rotation length, within limits. From another point of view, the number of hectares necessary to supply a sawmill or pulp plant could be reduced by using faster growing trees. With bigger and straighter trees the yield of lumber and veneer is greater per cubic meter of stumpage due to less waste and slabs. With intensive improvement of wood quality there would be better quality pulp with greater yields as well.

In 1973 Carton de Colombia, S.A., initiated a genetic improvement program with Cupressus lusitanica; this program is the product of a joint effort of several companies and Colombian institutions, including INDERENA, Reforestadora del Cauca, C.A.R., the Secretary of Agriculture in Antioquia, the Public Utilities of Medellín and Pereira, and the Archdiocesis of Medellín among others. These entities have cooperated in the location of candidate trees, the establishment of progeny tests or have made available their plantations for the selection of trees for the program.

SYSTEM OF EVALUATION OF THE TREES IN THE FIELD

The tree selection for this program has been carried out principally in the Departments of Antioquia (Medellín) and Cundinamarca

(Bogotá) where the most plantations over 12 years of age, required for this selection, are to be found. It was decided to limit the tree selection to five physical or phenotypic criteria:

1) Resistance to disease and insect attack

2) Tree volume

3) Bole straightness

4) Crown form

5) Wood quality

Resistance to Disease and Insects

The most important phase of the program is the selection of trees resistant to disease and insects. Losses due to these factors could erase any other genetic gains if this phase was not taken into account. This type of tree selection and improvement is the most detailed and difficult part of the program. Nevertheless, the resistance to disease and insects has been achieved in agriculture and in other forest tree species. In the Slash Pine Tree Improvement Cooperative in Florida, the selection of trees resistant to the fusiform rust has resulted in progeny with four and a half times more resistance to the rust by selecting resistant trees within forests that have over 90% infection (N.C. State, 1975).

Tree Volume

A select tree always has a greater volume and height than the best neighboring trees (Figure 1). Big trees grow faster and are better able to compete with weeds and brush when planted, besides producing more wood per hectare.

Bole Straightness

The heretability of stem straightness is a very strong genetic characteristic in trees. This factor is important in reducing waste in sawmilling because there is less slab wood from straight trees than from crooked ones. Crooked or curved trees produce inferior fiber quality for pulp, consume more chemical in pulping and yield less pulp as well (Zobel, 1974).

Crown Form

Trees are selected with narrow crowns, small branches and those that have a natural tendency to prune themselves. A small crown on a large tree indicates that the tree is highly efficient in producing sugars and celulose through photosyntesis and that it needs less growing space. In addition, a tree with small branches produces smaller knots, and important factor in structural wood, so that it will not fail under stress as a joist or beam in a house or other building.

Wood Quality

When a select tree is measured, a wood sample is also extracted for analysis in the laboratory (Figure 2). With this sample the wood density and the traqueid length is evaluated. High density is important for lumber so that it is strong and resists rot. Traqueid or fiber length

also affects certain qualities in the paper produced from the tree.

Field Selection of Trees

In the process of field selection, a trained forest ranger makes an initial check of a given plantation, selecting the best trees and marking them. Afterwards, the ranger and a forester trained in tree grading return to the stand. The forester makes an inspection of the preselected trees with the ranger and decides which are those worth grading. The trees to be graded are called "candidates". Simultaneously with the field grading and tree measurements, wood samples are extracted to take to the lab. Later, points are awarded to the tree for each of the characteristics of the tree and the wood. With all the field and laboratory data in hand a grading sheet is filled in for the tree. The candidates that are good in all five categories (volume, form, resistance to disease and insects, straightness and wood quality) are selected to be used in a seed orchard. When a tree has been accepted it is then called a "select tree".

The field evaluation of the tree is basically a comparison between the candidate and the five best nearby dominantes. The height and diameter is also measured for the five check trees, and they are used as a comparison for grading the form of the candidate tree. In the laboratory the wood of the candidate is also graded in comparison with the wood of the five check trees. The evaluation system takes into account the following norms as well: the candidate tree has to be taller than, have more volume than and also have higher density wood than the average of the five check trees. The candidate tree can have no indication of disease or insect attack to be graded.

The characteristics of the candidate tree are registered by means of a point system. A perfect tree in every sense and superior to the five best checks would be said to be 100% better or have 100 points on an emperical scale.

To date there are 43 trees selected of C. lusitanica in Colombia. According to the number of hectares reviewed and the number of trees per hectare, a selection intensity of approximately one tree in 82,000 has been acheived. In addition, there have been two selections made of trees resistant to the defoliator Glena bisulca and one selected free of the striped canker in a plantation that has over 50% infestation.

ESTABLISHMENT OF THE FIRST SEED ORCHARD IN COLOMBIA

According to Zobel (1958) "A seed orchard is a plantation of genetically improved trees, isolated to reduce pollinization from genetically inferior sources to a minimum and with intensive management to produce frequent and abundant crops of seed that are easily collected".

Once the 43 best cypresses were selected according to our grading system (Table II), they were reproduced asexually by grafting. A study of agamic reproduction of cypress was initiated in 1974 and the initial results in 1974 and 1975 with common grafts of cypress were not very satisfactory. Later, using the system of Dyson (1967) as shown to us by Dr. Fred Owino in his visit to Colombia in 1975, the results were much better and were considered sufficiently good to begin a series of grafts of the trees selected from all over the country. Thus, 1800 grafts of the 30 clones to be included in the first orchard were made so that we would have at least 50 ramets of each clone necessary for planting in the seed orchard. These grafts were made using a side veneer grafting technique in the Popayan nursery under partial shade (Figure 3). For these 1800 grafts the average take or success was 92%.

At the same time the seed orchard site was selected, taking into account the recommendations cited by Kellison (1969) of establishing it on a flat site to permit better mechanization, within reach of hand labor, with good road connections, water facilities for possible irrigation, fire control, isolation from outside pollen of the same species, soils with an average fertility, as well as being located in an area with ecological conditions similar to the average required for the species. According to these norms, a site was selected on the farm, La Arcadia, near Popayan. The ecological data for this site are listed in Table III.

According to studies by the Agustin Codazzi Geographic Insitute (1943), the soils of this region are formed from thick volcanic ash deposits, lavas and conglomerates. They are deep with good physical conditions and good drainage, a high organic matter content at times, but with low assimilation of soluble phosphorus due to fixation by aluminum and iron. the pH varies between 4.5 and 5.5 which is considered ideal for conifers. The ecological classification of the orchard site, according to Holdridge, is based on the data in Table III and is between the humid premontane and humid lower montane forest formations.

A seed orchard of five hectares was considered sufficient to supply improved seed for the planting of 2000 hectares per year and it is expected that the seed production will begin in three years, in 1982. In Kenya, Owino (1975) gives a production of 0.7 kilos per tree per year for cypress orchards at 10 years of age; this figure has been our reference point since there is no other data on seed orchard production of this species in the world.

The planting design was developed by N.C. State University by computer where the distribution of the clones has the following advantages:

1) When roguing of undesirable clones is initiated based on the progeny tests, there will not be large open areas left in the orchard, which will give a better distribution of trees after this thinning.

2) The grafts or ramets of the same clone are separated by at least two trees of different clones to avoid self pollination.

The site was prepared by plowing and discing and the trees were planted in May of 1977. Total cost of establishment of the orchard was US$12,000, including land, grafting, planting and other costs. The orchard is now two years old and some grafts already have seed (Figure 4). The seed orchard should produce its first abundant seed crop in 1982.

This orchard is also of great value for showing to the public the practical application of genetic theories, although its principal objective is the production of the greatest quantity and quality of seed. It has been designed in such a way that demonstrations and instructions can be given to interested parties.

CYPRESS PROGENY TESTS

It is necessary to test the progeny of selected phenotypes in order to identify those that are genotypically superior and to eliminate those that do not produce consistently good progeny. The sequence of these tests can be seen in Figure 5. The initial step in progeny testing is to collect seed from the mother tree in the field where the pollen that fertilized the female flowers came from unimproved wild sources. Such seed is called "open-pollinated seed" and it is used to test "open-pollinated progeny".

The first of these studies was established in 1975 on three different sites: the farm Los Guaduales near Popayan, the farm La Laguneta near Pereira and the nursery of the Secretary of Agriculture near Rionegro, Antioquia. The first year results of the study in the farm Los Guaduales were very promising with an average increment of 25% in height of the progeny compared with commercial unselected seed.

Another study was established in 1977, also on three sites: The farm La Arcadia near Popayán, the Seminary of Medellín and near the Neusa Dam, Department of Cundinamarca. This study has more progeny than the previous one and is on different forest sites.

First Year Results

At the end of the first year there were large variations between the tests on the six sites as well as between progeny on each site (Table IV). In general, the progeny of the select trees were superior to the commercial seed (T-1) but in the two tests in the Department of Antioquia the commercial check was in the upper half of the progeny distribution. Certain progeny such as C5, C27, C46 and C53 are nearly always in the tallest lots, regardless of the study location (Explanation of codes

in Table II). In other cases as with C61 and C65, which had been selected at 3000 meters a.s.l. in Neusa, their growth was good at Neusa but was poor in tests at lower altitutes. Tree C8 which was selected in the Seminary of Medellin is doing well in tests in the Departments of Cauca and Risaralda but poor in Antioquia where the parent tree was selected.

By analysis of variance the differences in height between progeny were significant in four of the six tests at the end of a year. Survival, on the other hand, was not significantly different in any of the tests, and was good in general with very few trees lost.

Third Year Results

The analyses of variance were significant the third year for height, volume and straightness between progeny, but not in crown form nor survival (Table V). Tree height in the farm La Laguneta which was not significant the first year did show statistical differences the third year, which implies that the differences between the progeny are increasing with time.

Differences between progeny heights are not very great, but the differences in volume are substantial. For example, in the Rionegro test, the commercial check (T-1) in in fifth place in total height (Table V) but falls to seventh place in volume (Figure 6). In other words, the selection of parent trees with good volume as well as good height is reflected in the differences in these two data.

In the evaluation of tree straightness between progeny, the order of the trees for straightness was very similar to the order for volume and height: the tallest and biggest trees were in general the straightest. However, at three years of age it is still difficult to evaluate this characteristic and these values could change somewhat as the trees become older.

In Table VI the average progeny data is compared to the commercial check trees for those parameters and tests that had a significant analysis of variance at the 95% level or better. This comparison gives a good idea of the gain that exists in the progeny tests to date. The difference is greater for volume than for height or straightness at three years of age and the differences by site are great. Since all the progeny are not as tall as the commercial checks, the gain for just the progeny greater than the check vs. the commercial check is always greater than the gain for the average of all the progeny. For example, the average volume difference at three years is 50% for all the progeny but is 70% better for just those that are better than the checks.

The results of these trials are very similar to those of progeny tests with Cupressus lusitanica in Tanzania at seven years of age. Dyson and Raunio (1977) found that the height, volume and bole straightness had significant correlations between families, but crown diameter and survival were not correlated with the progeny, the same has occurred in these tests.

Dyson (1969) estimated a genetic advantage of 50% in volume to be feasible through the selection of cypress in East Africa, compared to commercial seed

stand seedlings. Such a difference in Kenya in young progeny seemed very high, as in the progeny tests in Colombia, and Paterson (1966) expected that the differences would diminish with the age of the studies. To the contrary, when the studies reached ten years of age they revealed differences between progeny of equal magnitude (Dyson and Raunio, 1977).

POLITICAL AND SOCIAL BENEFITS OF THE PROGRAM

In 1978 Colombia imported more than US$54,000,000 in long fiber wood, pulp and paper according to data from INCOMEX. The reforestation with conifer species is necessary in Colombia in order to replace these importations of long fiber with nationally produced forest products, which cant be done with the natural hardwood forest. By increasing the productivity of cypress by genetic improvement the importation of coniferous wood products can be reduced more and faster.

The reforestation with fast growing species such as cypress has, in addition, a direct benefit to the natural forest: The demand for wood products can be supplied from plantations of fast growing species thus reducing the pressure to commercialize the native forests.

For example: In Antioquia professor Guillermo Illencik calculated a cypress yield of 275 M^3/hectare at 15 years of age. This gives a yield of 275 ÷ 15 = 18 M^3/Ha./year.

The native primary forest varies a lot in volume per hectare but there exist three examples in the literature:

in the Amazon (Falla, 1979)	130 M^3/Ha.
in Caquetá (Cáceres et al., 1975)	61 M^3/Ha.
on the Pacific Coast (Pulpapel, 1972)	169 M^3/Ha.

This gives an average of: 120 M^3/ha. for the native forest.

It is estimated that the natural forest can regenerate itself on the Pacific Coast near Buenaventura in approximately 30 years and a recent study confirms this figure (Mazuera, 1979). Therefore, the growth of the native forest would be:

$$120 \div 30 = 4.0 \ M^3/Ha./year$$

Comparing the natural forest with the cypress plantation it can be calculated that one hectare of cypress plantation can produce the same quantity of wood as 4.6 hectares of native forest (18.3 ÷ 4.0 = 4.6). From another point of view, the production of wood on one hectare of cypress plantation can reduce the pressure to cut 4.6 hectares of native forest.

By means of a tree improvement program with an improvement of 50% in the productivity of cypress, this replacement figure increases so

that one hectare of improved cypress plantation would reduce the pressure to cut 6.9 hectares of native forest.

In addition, the cypress and other fast growing species are generally planted on marginal soils for agriculture, not by destroying the native Colombian forest as some uniformed persons argue. In these marginal lands in the Andean Zone there is a general condition of low income for the local farmers and the reforestation of these areas offers a new source of employment for these people which will improve their standard of living.

This program is important in another aspect which is the cooperation which already exists between the private industry, the government, individuals and non-profit institutions for carrying out a common goal: the reforestation in Colombia based on locally improved seed sources. This type of cooperation is a must if we are to achieve large scale reforestation and this program proves that it is feasible to obtain this type of cooperation between diverse entities at a national level. All of the field sheets of the select trees, all of the research reports on progeny test results, all of the details of establishment of the seed orchard with its costs are already in the hands of all parties that cooperate in this effort and in addition, are available to those that have not participated in this operation but have interest in reforestation.

When other organizations wish to establish their own cypress seed orchards, all information that exists regarding this program will be available so that these orchards are a complete success. With the new information that is being obtained from the genetic studies in progress, recommendations will be made for the best mix of mother trees for each seed orchard, depending on region and site conditions. This cooperation as well as the technological advances achieved are the true hope for the future of reforestation in Colombia.

As the project to put a man on the moon has had many technological benefits not imagined when John F. Kennedy first dreamed of his space goals for the United States, in a similar manner the tree improvement program has already had additional benefits not expected at the beginning: There exists today an awareness among foresters of the necessity to improve the productivity of the forest, to select the best kinds of seed, to colaborate one with another. There are forest research studies throughout the country that are giving not only genetic information, but also information with respect to silvicultural practices such as fertilization, site preparation and the effect of altitude on a species. We already have a new appreciation for the effect of hormones on the flowering of cypress; new volume and weight tables for trees have been developed and there are growth studies underway through international seed exchange to test superior trees from other countries including Kenya, South Africa, the United States and Costa Rica.

The tree improvement program is the longest range program that exists today in the forestry field in Colombia. The cypress improvement program has steps planned for two generations up through the

year 2001 (Figure 5). At the same time there is another program underway for the improvement of Pinus patula the second most widely planted species in the country. There are trees already selected and the first seed orchard of this species is planned to be established in May of 1980.

The forestry planning at all levels has to be very long range and the tree improvement program is an example of this type of planning. National forestry planning has to continue through and go beyond not only one change in national government but several! Well defined forestry programs are required as well as dedicated persons and a spirit of cooperation at all levels in this great national effort. It is hoped that the cypress genetic improvement program will lend a ray of hope in this respect and demonstrate that this is possible in Colombia.

REPORT BY:

William E. Ladrach

Millan Gutierrez V.

SPECIAL RECOGNITION

We would like to express our sincerest thanks to Dr. Bruce J. Zobel, professor emeritus of North Carolina State University for his generous counseling and help as special advisor to this program. We would also like to thank our various colleagues, and especially Gilberto Pereira of INDERENA, for their collaboration in the selection of trees and in the establishment and maintenance of the progeny tests.

Carton de Colombia, S.A.

investigación forestal

COMPARATIVE STUDY OF THE FAUNA IN AN AREA REFORESTED WITH PINES AND IN A NON-REFORESTED AREA NEAR LA VENTA DE CAJIBIO, CAUCA

Research Report N° 40 December, 1978

By Jose Ignacio Borrero H.

SUMMARY

With the reforestation of pines, cypress and eucalyptus in Colombia has come a division of opinion concerning the effect of these plantations on the wildlife. This study was designed to help learn whether these plantations affect the wildlife or if the wildlife will adapt to them, as well as to discover the state-of-being of the fauna in the study zone.

Thirty years ago the fauna was abundant in this region but the environment has been changed radically. The original forest has disappeared, being replaced by agriculture and pastures. Currently the area is considered highly degraded from an ecological point of view.

Research observation stations were established in 13 sites representing the different habitats that exist in the area. Direct observation, trapping and hunting were employed in identifying the wildlife. Overall, it was noted that only those mammals survived that could adapt to agricultural conditions. In the degraded remnants of the forest that remained, small carnivores were not found as had been expected. The total number of mammals species identified was 12 or approximately 3 % of the original number that existed. Of the reptiles, only one lizard was found. The most numerous group was the birds (69 species) but about 80% of the bird species have disappeared as well. The study was conducted by periodic visits to the area over a period of six months during 1978.

There was no evidence of the wildlife adapting to the pine plantations. It was concluded that a reforested and a non-forested farm could not be compared as far as fauna is concerned, only one habitat with another. There should be a greater number of species present where there is a greater variety of habitats. It is very probable that the reforestation with exotic or native species within which are left areas of natural vegetation would be the most recommended method of initiating a program for increasing wildlife populations.

INTRODUCTION

Since the beginning of the century, exotic tree species and especially pines, cypress and eucalypts have been planted in Colombia at different climatic levels. Today the reforestation continues at an increased scale, not only by private entities with commercial motives, but also by public agencies with a desire to reforest or preserve areas which were deforested previously by one cause or other. Indications are that this activity will continue to increase.

Opinions about the effect of this are divided basically in two antagonistic groups. The first maintains that the exotic species which are being used are the only species which will achieve the purposes mentioned and the second group wants to suspend the use of these species because they are damaging the environment, especially because they are destroying soils, water and the fauna.

The two positions, are of course extremes, and it is necessary to study in a more precise form the pros and cons of both points of view, given that the plantation of exotic species is filling the needs for wood which the country is urgently demanding and for which there does not apperar to be a feasible substitute at the moment.

With respect to the destructive or creative effect on the fauna, it is also necessary to make more precise studies, looking at the possibilities of these same forests being able to increase the fauna populations, be it with native or exotic tree species.

Important areas in the Departments of Cauca Antioquia, Cundinamarca and Córdoba have been selected by diverse entities for reforestation and thereby are important in their relationship to the fauna, which up till now has not been considered.

This preliminary study constitutes, then, a support in understanding the effect that planting homogeneous forests has upon the wildlife and in defining if there is in fact an adaptation of the fauna to this new type of forest or not.

Based on the analyses that are made, then, we will be able to conclude whether or not this type of forest is noxious, beneficial or simply neutral concerning the wildlife. Also it will serve to define whether the fauna is richer or poorer in the properties of Reforestadora del Cauca, S.A., than in the neighboring areas that are not reforested.

RETROSPECTIVE LOOK AT THE AREA

The hacienda San Jose and the adjoining farms that were studied during this project are situated in the locality known as the Venta de Cajibío in the Department of Cauca (see map).

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The altitude above sea level is 1,700 meters and the temperature 19 degrees C. According to Holdridge's classification the area is in the humid subtropical forest (bh-ST). It was originally covered by great oak forests (Quercus humboltiana) intermixed with other valuable wood species. The general aspect of these forests is represented in the residual forest that is conserved in a few places nearby. Water was abundant and very pure, not only in the major rivers but also in the streams which are very reduced in their flow at present.

There are no studies of the flora which would indicate which species were to be found years ago, but one can pretty well ascertain this from the collections which were made in nearby areas, such as La Capilla, only 30 years ago. From the study of these collections and reports it can be concluded that the area was rich in fauna, mammals as well as birds.

Two facts give evidence to the past richness of the wildlife. First, the people of the region dedicated much time to opening new lands for agriculture and cattle farming and simultaneously produced charcol, which gives some idea as to the quantity of forest that existed. Additional evidence comes from the fact that, during many years, the hunters were able to obtain enormous quantities of deer, guaguas, and other large mammals. Among the birds, the turkeys and collared morning doves offered opportunities for permanent hunting, especially the doves which congregated in huge numbers in the then extense grain fields.

This author remembers this abundance of wildlife since I had the opportunity to visit the hacienda La Capilla in 1940. Because of this I can establish a comparison between the exuberance of wildlife in that period and the lack of it in the present.

PRESENT LOOK AT THE AREA

An overlook at the area between La Capilla and the Venta de Cajibío shows us a region in which the original forest has totally disappeared to make room for agriculture and cattle production. The area was totally deforested for grazing and for charcoal production and remained in pasture after the forest was removed. Currently, the use of the area for agriculture or pasture is very diminished.

The forest was respected only along the length of the water courses, but the larger timber was removed from these as well, leaving only a degraded residual forest.

Pastures are found which range from a few with cut grass to natural grazed pasture covered with poor species to large pasture areas covered with bracken fern. In a few cases and along the fences, trees and bushes have been left in place. Other areas, certainly very few, are planted with small household gardens where there is coffee, plantain, and fruit trees. There may also be a little cassava or sisal grown.

Accordign to information given by the local residents the area has been subjected to periodic burning caused by the railroad or by individuals, especially to control the ferns, which has brought on a considerable degradation of the habitat.

Today the area can be considered as highly degraded from an ecological point of view, with the forest gone and the wildlife represented by only a few tolerant species and by only a few individuals in the case of the mammals and reptiles. The soils are impoverished although there is no marked erosion process observable.

HABITATS

Pine Forest

All the pine forests in the region are young and the older ones reach four years of age. The oldest, situated in the San Jose farm are seven years old. The species used are all of tropical origin and the seed imported to Colombia came from plantations established in countries which present similar ecological conditions to our own and where the species had the best yield.

The greatest extension of conifer plantations is within the farms San Jose, La Unión, La Selva, Los Guaduales and El Pital. The peripherical areas are not planted to conifers except for a few trees in the hacienda San Gabriel, owned by the Spiritual Culture Foundation and which appears on the map with the number 13.

Eucalyptus Forests

The only plantation found is on the San Jose farm. When the study was initiated, this was cut and is presently in a process of sprouting. It was not studied in connection with this project. The small groups of eucalypts that were planted in other farms were also felled during the time of this study, and they were not studied either. Since there was a very small total area in eucalyptus they were not important in this area anyway.

Native Forests

This occupies a very reduced if not important part of the complex. It is restricted to the hollows and water courses and is in general secondary bushes and residual trees of poor form.

Scrub and Brush Forest

A large part of the area that is seen covered with trees is in reality a highly degraded forest, possibly forest that had been partially burned and later left alone. These are areas in which the biggest trees can only be classified as bushes.

Bracken Fern

These are pastures, usually extensive, that were invaded by ferns and have remained this way for years. They occupy an important

area in the region.

Common Pastures

These occupy a large part of the area. These were initiated when the forest was removed, some were first cultivated for a while and then maintained as pasture by periodic cleaning of the ferns and bushes that try to reinvade. The grass is low and the quantity of cattle that graze is reduced.

Cut-grass Pastures

These occupy a small area. They consist of pastures where the soil has been disced and then seeded to tall grasses which are cut for green fodder. No other vegetation is permitted to grow in these fields.

Other Crops

Temporary crops of corn and cassava can be observed as well as permanent fields of sisal, but all these occupy a small area.

Gardens and Orchards

Around all the houses can be found small planting of coffee with legume trees for shade, some fruit trees, and plantains. The total area covered is very small.

PROCEDURES FOR STUDY

Observation Stations

In order to have a panoramic view of the vertebrate wildlife and its ecological distribution, typical places were selected for making samplings and observations of wildlife during this research project. As can be seen in the map, 13 sites were selected which are denominated as stations 1 to 13.

Within the area of Company properties, observations were made in the pine forests as well as in the other types of vegetation near the boundaries of the farms so that these boundary areas would be representative of both the forested farms and of the condition of the neighboring farms. It was planned to sample the birds, mammals, amphibians and reptiles.

Systems

Working systems were employed in this case which were recommended for this type of study, namely: Direct observation, hunting and trapping.

For studying birds and flying animals, nylon nets were used which were hung in the forest areas. The birds caught were examined for identification and afterwards set free. During the period when the net were being used (daylight hours) trips were made through the field with binoculars and a telescope looking at places which could be seen easily from a distance. Simultaneously, the species that were impossible to identify directly with lenses or that had not been captured in nets due to their higher life zone in the trees were shot for identification.

For studying the mammals, traps were set; rat traps and small mammal live traps made of wire

mesh. The traps were set at the various stations and left there during periods of a week. The maximum number of traps set at a time was 150, the minimum was 43. These traps, obviously, work day and night.

To identify larger mammals, which are today very few, a search was made for tracks, food kill spoils, fecal material, or any other indication which would aid in identification. Forested areas were visited as well in the night with the use of lanterns.

By the same manner, as much information as possible was obtained from the houses of the local residents, which are few in the area, and from hunters in the area, the majority of which could give little help.

These methods were identical for the forested areas, natural and pine, the same as in the pastures. It is worthwhile noting in the case of the bats, which are flying mammals, that the nylon nets were used at night the same as they were used for birds.

DISCRIPTION OF THE OBSERVATION STATIONS

As can be seen in the attached map, some of the stations were located in boundary areas so that the captures and accounts would serve to establish clearly what was the difference between a reforested farm and a non-forested farm with respect to the fauna, which is the stated purpose of this research.

Station N° 1

The area around the house at San Jose with an extension of 200 meters, but not the pine forest the other side of the road.

Station N° 2

A pine plantation with several species.

Station N° 3

A degraded original forest in which there are still some old large trees; this woods runs along a small stream.

Station N° 4

Scrub forest area which runs along a creek; there are few large trees. This type connects to that of N° 3. Large areas along the edge of the woods is covered by ferns.

Station N° 5

This is a secondary residual forest which borders on a creek. On the opposite side, on the property of Guillermo Cobo, are some large oak trees.

Station N° 6

A pure pine forest from the railroad to the boundary with Humberto Muñoz.

Station N° 7

Situated in the property of Guillermo Cobo. It is a residual oak forest which runs along the creek. Undoubtedly it is the best residual forest in the area and which has the most fauna.

Station N° 8

Corresponds to a narrow strip of residual forest that runs parallel to a creek which separates it from station N° 3. At the time of writing this report this woods was felled leaving only the larger trees.

Station N° 9

This is a wide strip of residual forest and brush which runs around a creek. This zone is located on the property of Domingo Cucuñame and touches that which is in station 10.

Station N° 10

Corresponds to an extension of pines which touches station N° 9 and the property of Pedro Cucuñame.

Station N° 11

An orchard around the old field-house, formed by a semi-abondoned coffee plantation, some legume trees, plantains, orange and avocado trees. Adjacent to the coffee had been a previous corn field, now cultivated and more-or-less clean. Around these pastures are residual forests overtop of the creeks and a wide zone of scrub forest that extends to La Capilla.

Station N° 12

Formed in part by the hacienda of Guillermo Maseck. It has a small orchard near the house, with coffee, plantain and legumes. There is a small plantation of sisal, some pastures, with brush, and an extensive area covered with scrub forest. In the lower parts of the scrub forest near the creek it is denser and has larger trees.

Station N° 13

This is the hacienda San Gabriel, property of Spiritual Culture Foundation. Near the road is a strip of pine and cypress. A strip of residual forest separates this farm from the Company lands. The interior of the farm has some pastures which were not visited as part of this station.

CONSIDERATIONS CONCERNING THE STATE OF THE WILDLIFE IN THE PAST AND TODAY

Looking at the region as a whole one has the sensation that, in spite of the destruction of the original habitat observable everywhere, which has been more intense in the last forty years, the presence of small patches of original forest would be sufficient to preserve

many native species characteristic of this environment. However, it is not this way.

In the case of the mammals, this group has been destroyed in at least 97%, i.e. the only species that survive are those which can multiply under conditions of agriculture or cut forest. The larger species such as the deer (Mazama sp.) and the guaguas (Cuniculus paca) have totally disappeared due to uncontrolled hunting. Species such as the fox (Duscicylon thous) and the weasel (Mustela frenata), due to the reduction in their kill, being carnivores, and species such as the armadillo (Dascypus novencinctus) and the porcupine (Echinoprocta refescens) are found in reduced numbers, due to the lack of organisms in the soil associated with forests and crops. The opossum (Didelphis marsupialis) is abundant as is also the common rat (Ratus norvegicus). Also abundant numerically are the bats (Chiroptera) but the number of species is very few.

Given the presence of those forest and scrub forests that were mentioned earlier, it was hoped to find some quantity of lesser carnivores (insectivores and marsupials) as well as rodents, but the evidence was to the contrary. In spite of locating 150 traps, not one individual was caught and not even the baits were robbed, which indicates that the existing population is extremely low or absent in these forests. The author is inclined to believe that the population is very low rather than completely absent.

The only rodents that were found in numerous populations were the squirrels (Sciurus granatensis) and the rabbits (Sylvilagus brasiliensis). This latter has possibly increased rather than diminished, since the reduction of the forest and the increase in pasture is a better habitat for the rabbit. These two mammals and some birds such as the partridge could support a medium population of foxes and weasles, which are their natural predatores. It appears that the population of wildcats is also important. In summary, it can be concluded that the mammals have been nearly eliminated.

The birds constitute, without any doubt, the most numerous group, even though at least 80% of the original species have been eliminated from the region. The species characteristic of mature forest habitats have disappeared completely and those birds survive which have the widest spectrum or adaptability to habitat. On the other hand, some species which did not exist in the forest habitat previously now appear in the new agricultural habitats.

However, all habitats are so degraded that even for the species that persist their populations in most cases are very reduced. Here are missing many species which undoubtedly exist in other parts of the country and subsist under a similar physionomy.

In spite of the effort made, it was not possible to locate reptiles of any kind, save for one small lizard identified as Anolis antonii. Although it is said that there are snakes, it was not possible to find any, nor obtain any from local workers. Some farmers interviewed commented that it had been years since they had seen any snakes.

Since it was not considered important for this study, no collections were made of amphibians or fish. The amphibians in any case are reduced to a few small frogs species that are abundant along the water courses and of the fish there are only a few tiny species.

In summary, it can be said without any fear, that the wildlife in general has been severely castigated and that the region supports a population extremely diminished in both number of species and in number of individuals.

ADAPTATION OF NATIVE ANIMAL SPECIES TO THE PINE FORESTS

There exists no evidence to indicate any process of adaptation of the local animals to the pine forests. An intensive observation during a day and a night and the compilation of data from the local people gives sufficient assurance that there is no adaptation taking place.

Now and then, passing through the pines, a hawk can be seen (Buteo magnirostris) flying along an opening or firebreak. These are simply individuals that have found these pathways adecuate for their individual activities, but it cannot be said that the species is adapted. The cerrajas or quinquinas (Cyanocorax yncas) can be found at times in the pine plantations, but are normally found in the natural forest. This could not be alleged adaptation either. It is possible that they find some food temporarily, such as larvae from insects that are affecting some trees or that use the pines for crossing from one woods to another. The doves of the genus Leptotilla are occasionally found in the pines, towards the edge. Possibly the presence of an open understory attracts them, but since there is no food, it would not be classified as adaptation. The blackbirds (Turdus fuscater) frecuent the edges of the pines, presumably because they like to perch on the tips of the highest trees, but this is not adaptation either.

Finally, there were some porcupines (Echinoprocta) which eat the bark of the cypress. Due to their diminished number this cannot be called adaptation, but it would be worthwhile to check their frequency and the amount of damage done because here exists a potential pest in the presence of a considerable amount of food and a low density of predators.

The bats did not use the pines as a place to sleep, this fact confirmed from the lack of bats captured in the nylon nets left at night in the pines, but that were captured in nets

at the edges of the same plantations. Visual observations did not indicate any bats at night in the pines either. It should be pointed out however, that in Piedras Blancas, Antioquia, an owl (Asio stygius) did live permanently in a mature pine forest and feed exclusively on bats. Anyway, that was in a mature forest and this is a young plantation.

The conclusion derived from this is that up till now there is no form of adaptation of the native vertebrates to the planted forests.

DIFFERENCE BETWEEN A REFORESTED FARM AND A NON-FORESTED FARM WITH RELATION TO THE WILDLIFE THAT BOTH SUPPORT

There is no doubt that the difference is significant, as can be seen in the graphs that demonstrate the distribution of animals within the area in general. Looking at the column PINES, there are few species recorded and in the majority of the cases these were seen in an accidental form. When the forests mature, produce seed and permit the growth of an understory the situation should vary somewhat, although a considerable increase in the number of species is not expected.

In some non-forested areas the number of species of fauna is even lower than for the pines, for example, in the bracken fern. As it is, a reforested and a non-forested farm cannot be compared, only one habitat with another. A native forest can be compared with a pine forest or a scrub forest with a fern field.

It is evident that there should be a greater quantity of species in the area where there ~~is~~ is more diversification of habitats.

RECOMMENDATIONS

It is recommended to continue the policy of preserving areas of native forest within the conifer plantations and since this is being done, it would also be convenient to plant in these forests a certain quantity of native trees which produce fruit or flowers which could attract wildlife, in order to create a richer habitat from the standpoint of food. It would also be advisable to introduce some mammal and bird species that have been eliminated due to uncontrolled hunting, and which would hopefully multiply on their own. The intermixing of pine and native hardwood forests as well as open fields could produce a great quantity of deer such as Odocoileus virginianus and other animals.

Thinking about the future of these forests and before there is a threat of plagues or insects without natural controls, it would be prudent to study the possibility of transplanting some animals, possibly birds, typical of a mixed habitat, which would have the well defined function of consuming plagues and freeing the forest of them.

It is worth remembering the following: The degradation of the environment in the region has reached such a condition that there is practically nothing left to defend or lose and that some artificial forests which are valuable and more - so than any other crop in the area, should be defended against any diseases which affect or could affect them in the future. Since chemicals are expensive and at times impossible to apply, thought should be given to methods which tend to stabilize, in a preventive manner, the new habitat created by man. It should also be made clear that this is not to suggest a rash of species introductions, but rather to make careful studies of these that are the most recommendable for transplanting.

It is very possible that the practice of planting homogeneous forests with native or exotic species, within which are respected sizeable areas of native local vegetation and the conditions of local habitats for the fauna are improved, will be the best system, or one of the best recommendable for initiating a program for improving the wildlife, so indispensable in our country.

It should also be observed that this is not only a problem for the Company, but for all of Colombia in reforestation programs.

TRANSLATED BY

William E. Ladrach

Mr. LADRACH. We maintain an open door policy with respect to forestry and forest research. We show visitors our work by means of field tours, through annual meetings, and by giving an average of 30 conferences on forestry or ecology each year.

Forest gene resource conservation in Central America. In chapter 8 of the Interagency Task Force Report, one of the medium-term goals "* * * for preservation and study of representative and unique forests * * *" has direct application for tropical reforestation now.

The primary need on the world market is for coniferous fibers. The conifers are also a group of species which are capable of growing on marginal sites, wornout farmland, and on eroded soils; precisely what is needed for reforestation in many tropical areas.

With the increased interest in tropical reforestation, Central America has become an invaluable source of tropical seed to carry out such programs. Without immediate measures to preserve some of these pine areas, tropical forests worldwide could be seriously handicapped by a lack of seed to meet reforestation goals and by the long-term loss of as yet unproved species and good genotypes.

In May of this year, the Central America and Mexico Conifer Resources Cooperative (CAMCORE), was formed between North Carolina State University and several forestry companies, including ours, to preserve, test, and utilize the coniferous resources of Central America and Mexico to increase the productivity of tropical and subtropical forest lands. This is the first time that the forest industry has initiated an international gene preservation program.

However, there are still not enough qualified personnel or funds directed at this problem, given the urgency of the situation. Research on species identification and testing, funded by scholarships or study grants from the United States, would be most valuable. Additional efforts to help perserve good genotypes through the formation of local forest preserves, seed banks, gene preservation plantings in other regions of the world would be invaluable in improving tropical reforestation.

A bilateral forestry development center. The Interagency Task Force Report describes the tropical forestry efforts of several nations, including the Commonwealth Forestry Institute, CFI, in Oxford, England, which has long been a world leader in tropical forestry.

I urge that the United States develop something similar to this organization. A team of U.S. forestry experts should be available to work on world tropical forestry problems. They should have facilities for research, travel, and publication, and be closely associated with any U.S. forestry schools.

Education. In education, the National University at Medellin, Colombia, and Michigan State University were part of the point 4 program between 1952 and 1959. MSU sent professors to Medellin for 2- and 3-year periods, and Medellin sent students to MSU for advanced training. A program of professor and student interchange valuable so that U.S. as well as foreign students could do research in the tropics and earn a degree at a U.S. university. Forestry scholarships would be a necessary part of such a program.

Fire control and fire management. One topic underemphasized in the Interagency Task Force Report involved fire control and fire management. Fire is a basic land-clearing tool for subsistence agriculture. Continued burning of agricultural and pasture lands combined with overgrazing and other soil management practices results in soil degradation. These same burning practices are a threat to reforestation efforts.

The United States' recognized expertise in fire prevention and fire suppression should be made available to tropical countries by means of the translation and distribution of reports, and through technical assistance in the area of personnel training, regional organization, and fire prevention.

Nonforest problems associated with tropical deforestation: Population pressure on forest land. One is population pressures on forest lands. In Colombia, 90 percent of all forest destruction is due to agricultural clearing practices by colonists. In the city of Armenia, Colombia, there is a monument to the ax, a symbol of development and progress, which stands to this day. Land reform laws do not distinguish between forest and agricultural use. The Government personnel that administer land reform and those that administer the national forests often do not agree on land development problems.

We need: (1) coordination of traditional land reform programs for agricultural use with more recent forest conservation and preservation programs at a national level; (2) detailed studies of forest soils to determine their adaptability to agricultural use before permitting colonization; and (3) a concentrated effort to convert colonists from clearing everything, to establishing integral forest and agricultural management programs. This can be achieved through better small farm management programs, and programs which give incentives to forest conservation at a homestead level.

Agricultural pressures on forest land. The single most important factor in forest destruction is the pressure to open more land for agricultural production. A program of fertilizer subsidy and distribution would reduce the rate of deforestation by making already-cleared land more productive.

Typically, when land is depleted of soil nutrients and will not support crops, it is converted into pasture. Finally, when cattle production falls to less than one head per 6 acres, the land is abandoned. People in these areas are forced to migrate into the city or into other areas to search for work. The reforestation of such areas will create needed jobs immediately.

In Venezuela, the Government reforestation agency will plant a private farm and manage the plantation without cost in areas of severe soil degradation. Such programs of landowner assistance are a valuable means of soil recuperation and should be extended. Coupled with available and inexpensive fertilizers, this would go far to reduce the rate of deforestation and promote better land use.

Similarly, Carton de Colombia began reforestation efforts in 1969, near Popayan, in an area with almost no previous reforestation, on marginal agricultural land. We also promoted reforestation by other landowners through a policy of below-cost sale of tree seedlings from

our nurseries and the development of a local forestry corporation. We are also involved in the formulation of forestry loans and incentives at the national level.

Through our encouragement just 10 years later, other private landowners planted jointly more area near Popayan than we did for the first time. This is one example of how U.S. forest industry in the tropics can encourage reforestation activities. This type of work should be increased.

Thank you for this opportunity to testify.

[The prepared statement of William Ladrach follows:]

PREPARED STATEMENT OF WILLIAM E. LADRACH, CARTON DE COLOMBIA, S.A. CALI, COLOMBIA

INTRODUCTION

Since 1973 I have worked for Carton de Colombia, a pulp and paper company, which supplies the Colombian national market with packaging products. Container Corporation of America maintains controlling ownership of Carton de Colombia.

My testimony is based upon my knowledge of tropical forestry in Colombia, northern South America and Central America, and also on my contacts with international experts in tropical forestry.

First of all, I would like to commend the U.S. Interagency Task Force on Tropical Forests for their Report. It is a well balanced document that briefly describes a complex tropical forestry situation worldwide and lays a good foundation for further work.

My testimony is divided into three parts: first, a brief discussion of what is being done in forestry by Carton de Colombia, secondly a discussion of forest management problems associated with tropical deforestation and reforestation, and finally, non-forest problems associated with tropical deforestation.

WHAT IS BEING DONE IN FORESTRY BY CARTON DE COLOMBIA

Carton de Colombia began making paper for the local packaging market in 1944 using wastepaper as the sole raw material. Today we continue to be the major user of wastepaper in Colombia, processing over 50% of all wastepaper collected nationally.

In 1959, because of an insufficient supply of wastepaper to meet local packaging demands, Carton de Colombia began to manufacture woodpulp through its subsidiary company, Pulpapel, S.A. The pulpwood for this mill comes primarily from the tropical rainforest along the Pacific Coast where the rainfall averages 7000 mm. (23 feet) per year. Near the city of Buenaventura we also have logging rights on a government

concession of 60,000 ha. (150,000 acres.) We were the first, and until recently, the only company in the world that has been able to produce a uniform paper product from mixed tropical hardwoods. Of the more than 250 tree species classified in this region, we use all but a very few in our pulp mill.

The rainforest is clearcut by means of cable logging systems which do not destroy the surface soil, according to a 30 year management plan and under government supervision. Because of our logging methods, this forest regenerates itself naturally from seed in the soil and from sprouts. The natural regeneration in this area has been proven superior to any planting technique through continuing research. Dr. Tim Whitmore, world recognized botanist with the Oxford Unit of Tropical Silviculture, stated that our cable logging methods are among the best logging systems that he has seen in use in the tropics, in that they do not destroy the soil surface and allow for abundant natural regrowth.

In 1969, Carton de Colombia began a reforestation program whereby we are planting tropical tree species on marginal or worn-out farmland. To date we have planted 11,000 ha. (27,500 acres) primarily with tropical conifers, as a means of replacing imported long-fiber pulp with a nationally produced forest product.

In 1973, Carton de Colombia initiated a formal forest research and development program which today has a budget of US$240,000 or 16% of the total non-capital forestry budget of the Company. Dr. Bruce Zobel, world recognized forest geneticist and professor emeritus of North Carolina State University, has called the forest research program of Carton de Colombia one of the best in industry in all Latin America and second only to a Brazilian company which is considerably larger. Our research includes not only plantation studies, but also studies of fauna, erosion control, fire control, natural regeneration of the tropical rainforest and species classification. We are directing forest genetic research which includes participation by INDERENA (Colombian Forest Service) and by the public utilities companies of Bogota, Cali and Medellin. In addition we have designed a forest genetics course for the University of Tolima and have written a book to serve as a text for this course.

The Company forest research reports are written in both Spanish and English and are distributed to 25 non-company scientists within Colombia and to 30 other scientists worldwide. The University of Oxford, England, asked us for permission to include these reports in their Forestry Abstracts, the largest forestry indexing service in the world. Through Forestry Abstracts these reports are now available to forest scientists in all countries.

Carton de Colombia maintains an "open door" policy with respect to forestry and forest research. We show visitors our work by means of field tours, through annual meetings and by giving an average of 30 conferences on forestry or ecology each year. We feel that this policy has been valuable for stimulating reforestation in Colombia in general, for improving the company image locally, and for advancing the scientific knowledge of tropical forestry worldwide.

FOREST MANAGEMENT PROBLEMS ASSOCIATED WITH TROPICAL DEFORESTATION AND REFORESTATION.

Forest Gene Resource Conservation in Central America

In Chapter 8 of the U.S. Interagency Task Force Report on Tropical Forests one of the medium-term goals"...for preservation and study of representative and unique forests..." has direct and immediate application for tropical reforestation now.

According to Zobel (1978), "The primary need (on the world market) is for coniferous fibers." The conifers are also a group of species which, on the whole, are capable of growing on marginal sites, worn out farmland and on eroded soils; precisely what is needed for reforestation in many tropical areas.

Pinus caribaea, Pinus oocarpa, Pinus patula, Pinus kesiya and Cupressus lusitanica are among the most widely planted tropical conifers in the world and all except Pinus kesiya are indigenous to Central America and/or Mexico. Mexico has more species of native conifers (72) and more species of pines (39) than any other country in the world (Martinez, 1948).

With the increased interest in tropical reforestation, Central America has become an invaluable source of seed to carry out such programs. Simultaneously, the best seed sources are being destroyed by shifting agriculture, cutting for firewood, beetle kill, grazing, the tree seed collectors themselves, highgrading and to a minor extent, logging in general. Additional pine species are still being identified in Central America, but their value for operational reforestation is still unknown. Without immediate measures to preserve some of these pine areas, tropical forestry worldwide could be seriously handicapped by the immediate lack of sufficient seed to meet reforestation goals and by the long term loss of as yet unproved species and good genotypes.

Work is already in progress to study and conserve these genotypes in Central America. The Commonwealth Forestry Institute at Oxford, England, has been studying these species and distributing seed for research purposes since 1963 (Kemp, 1973). FAO has done considerable work in this area (Mittak, 1977) and local governments and other outside interests have been studying these species as well. My Company also started a tree selection and research seed collection program with Pinus oocarpa in Belize in February of this year.

In May of 1980, the Central America and Mexico Conifer Resources Cooperative (CAMCORE) was formed between North Carolina State University and several forest indutries including Carton de Colombia, with its purpose being "to preserve, test and utilize the coniferous resources of Central America and Mexico so as to increase the productivity of tropical and subtropical forest lands" (CAMCORE Bylaws, 1980). This is one of the first if not the very first time

that the forest industry has put into action a gene preservation program at an international level. All information forthcoming from this cooperative will be available to the public, including publications in both Spanish and English as well as research results of trials done on a cooperative basis.

In spite of this work already in progress, there still are not enough qualified personnel nor funds directed at the Central American pine problem, given the urgency of the situation. Basic research on species identification and testing, funded by scholarships or special study grants from the United States would be most valuable. Additional efforts to help preserve good genotypes through the formation of local forest preserves, seed banks and through seed distribution for gene preservation plantings in other regions of the world would be of invaluable aid in improving tropical reforestation worldwide.

A Bilateral Forestry Development Center

The U.S. Interagency Task Force Report on Tropical Forests describes the efforts of several nations in tropical forestry. The Commonwealth Forestry Institute (CFI) in Oxford, England, as stated in the report, has long been a world leader in tropical forestry. Colombia in general and my company in particular have had a close working relationship with CFI. We have received several research seed lots from CFI collections in Central America, have had forestry experts visit at both their expense and our own, have had special wood quality analysis performed at Oxford and receive research reports from CFI regularly.

In return we have sent CFI locally collected seed for international research trials, made pine resin samplings for their studies and send them all of our company forest research reports.

From my point of view, the Commonwealth Forestry Institute, along with it's associations with the University of Oxford, the Tropical Products Institute in London and other government agencies is the most effective national organization working in tropical forestry anywhere in the world. CFI's approach is based upon simplicity, dedication and personal contact through visits and correspondence. My company has never made a formal agreement with CFI, but we maintain a working relationship that has been valuable to both parties.

I would strongly urge that the United States look closely at this organization and develop something similar, whereby a team of U.S. forestry experts are available to work on world tropical forestry problems, have facilities for research, travel and publication, are closely associated with one or more U.S. forestry-oriented universities such as North Carolina State, Georgia, Florida or Mississippi State, and also maintain close ties with other U.S. agencies such as the Forest Products Lab in Madison, Wiscosin, and the Forest Tree Seed Lab in Macon, Georgia.

Education

Forestry is, for the most part, written in the English language. Reports for international distribution from North America, Europe, Africa,

Southeast Asia, Australia and Japan, normally appear in English although the original language may be another. At international forestry meetings English is usually the common language. Forestry textbooks and journals are for the most part written in English. Local foresters in tropical countries who do not speak or read English are at a severe disadvantage in studying forestry at the university level and later on, in keeping abreast of current forestry developments worldwide.

My point is simple, and has been stated by many others; there is an urgent need to have forestry documents translated into other languages and to have reports in languages such as Spanish, Portugese and French translated into English, in order to encourage a professional interchange of ideas.

A U.S.D.A. Forest Service report by Frank Freese on statistical design was translated into Spanish by A.I.D. and has been extremely valuable for forest research (Freese, 1970). This is an excellent example of what is needed, but more copies with better distribution are necessary and many more forestry documents should be translated and dispersed worldwide. As a research forester, I also see a real need for improved training in research design and statistical methods for professional research personnel in tropical forestry.

Operationally speaking, there is a lack of forestry professional and subprofessional training in the management of personnel and mechanical equipment. Tropical forestry schools generally give good instruction in the scientific names of tree species, but there is very little taught, for example, on how to collect seed, run cost-efficient nurseries, handle fire suppression operations, organize contractors, or how to inventory and harvest forest plantations.

The National University at Medellin, Colombia and Michigan State University were part of the Point Four program between 1952 and 1959, whereby M.S.U. sent professors to Medellin for 2 to 3 year periods and Medellin sent students to M.S.U. for advanced training. A program of professor and student interchange would be valuable so that U.S. as well as foreign students could do their thesis research in the tropics and earn their degree at a United States university. Forestry scholarships would be a necessary part of such a program.

Fire Control and Fire Management

One topic which I felt was underemphasized in the Interagency Task Force Report on Tropical Forests was that of fire control and fire management. Fire continues to be the basic land clearing tool for subsistence agriculture and continued burning of agricultural and pasture lands combined with overgrazing and other soil mismanagement practices results in soil degradation and erosion. These same burning practices are a threat to reforestation efforts and plantation management.

I would like to make very clear that fire by itself is not inherently bad, but rather it is the misuse of, and excessive use of fire by man that is the root problem. Because of this, one of the first

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priorities for reforestation is to develop a fire control program. United States expertise in fire prevention and fire suppression is, in my opinion, the best in the world and should be made available to tropical countries by means of the translation and distribution of reports, and through personal technical assistance in the areas of: personnel training, regional organization, and fire prevention.

NON-FOREST PROBLEMS ASSOCIATED WITH TROPICAL DEFORESTATION

Population Pressures on Forest Lands

Traditional land clearing practices by colonists or homesteaders continue today as they have in the past. Although city dwellers and the informed public are concerned with the high rate of tropical deforestation, landless country dwellers with large families and facing daily hunger continue to clear forest land for their agriculture needs. The forest to them is a barrier and the more area cleared the better their economic situation. This is the typical pioneering spirit which was an integral part of the United State's own development. In the city of Armenia, Colombia, there is a monument to the axe, a symbol of development and progress, which stands to this day. In Colombia it is estimated that 90% of all forest destruction is due to agricultural clearing practices by colonists.

Land reform laws, designed to distribute lands to the landless, do not distinguish between forest and agricultural use, and most of the land suitable to agriculture is already under cultivation. The government personnel that administer land reform and those that administer the national forests often are not sympathetic to the viewpoint of the other. Mr. Sergio Duran, head of INDERENA, the Colombian forest service, stated in March of this year, "On one hand we are creating forest reserves and trying to avoid forest cutting and simultaneously the colonists come with titles (to homestead within the reserves)" (El Tiempo, 1980).

In Ecuador, the new access roads to petroleum reserves in the eastern rainforests are also being used by the government for colonization. Initial colonization, at least, was based upon a parcelization program in which land titles were awarded in 50 hectare (125 acre) blocks defined on maps irrespective of land contour, watercourses or soil adaptability to agriculture.

There does exist an awareness of the deforestation problem, there are estimates of the scope of the problem, and there are governmental agencies assigned to the problem, but the deforestation continues virtually unchecked due to a lack of effectiveness in the implementation of programs such as land reform and forest preserves. There is a need for 1) the coordination of traditional land reform programs for agricultural use with more recent forest conservation and preservation programs at a national level, 2) detailed studies of forest soils to determine their adaptability to agricultural use before permitting

colonization and 3) a concentrated effort to change the traditional homesteading tendency of clearing everything, to one of integral forest and agricultural symbiosis, that is, agroforestry. This can be achieved through better small farm management programs, and improved legislation which gives incentives to forest conservation at a homestead level instead of current incentives to total land clearing.

Agricultural Pressures on Forest Land

The single most important factor in forest destruction is the pressure to open more land for agricultural production. This is obviously due in part to increased population pressures, which will not be discussed in this testimony. An agricultural solution to the problem is to make agricultural lands more productive so that less additional forest land is needed to meet the needs of the population.

Fertilizer use in agriculture is limited due to its high cost, lack of understanding of its use and importance, and a lack of availability. Soils in many parts of the tropics are deficient in phosphorus and this is especially true in Colombia. A relatively inexpensive local phosphorus source is the basic slag from the steel mill. Unfortunately, whenever there is a national shortage of cement, this basic slag is in demand as an extender for mortar for construction and is not available for agricultural use. Even when basic slag is available, the small landowner often cannot afford it and, when his soils are depleted, clears new land, or migrates to the city.

A program of fertilizer subsidy and distribution, in my opinion, would be a most effective means of reducing the rate of deforestation by making already cleared land more productive, thereby reducing the need to clear more forest land.

Typically, when land is depleted of soil nutrients and will not support crops, it is converted into pasture, and finally, when cattle production falls to less than one head per 2.5 hectares (6.3 acres), is largely abandoned. Overgrazing is common on such lands, which in turn results in soil compaction and erosion on the steeper slopes.

In Venezuela, the government reforestation agency, CONARE, will plant a private farm and manage the plantation without cost in areas of severe soil degradation, as a means of recuperating the soil. One such project is being conducted near the town of Nirgua, west of Caracas. Such programs of landowner assistance are a valuable means of soil recuperation and need to be encouraged and extended. This, coupled with available and inexpensive fertilizers would go far to reduce the rate of deforestation and promote better land use.

Similarly, Carton de Colombia began reforestation efforts in 1969, near Popayan, in an area where almost no reforestation had been done previously and where much of the land was considered marginal for agriculture. At the same time we promoted reforestation by other landowners through a policy of below-cost sale of tree seedlings from our nurseries and the development of a local forestry corporation. We are also involved in the formulation of forestry loans and incentives at the national level.

Through our encouragement, our example, and the promise of a future market for their forest products, in 1979, just 10 years later, other private landowners planted jointly more area near Popayán than did the Company for the very first time. (We planted 1126 hectares in this area in 1979). This is just one example of how U.S. forest industry in the tropics can influence reforestation activities positively. This type of promotional work can be done and should be increased.

Thank you for this opportunity to testify before the House Oversight Hearings of the Subcommittee on International Organizations.

WILLIAM E. LADRACH
September 18, 1980

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Mr. BONKER. Thank you, Mr. Ladrach. It certainly helps the subcommittee to have the benefit of your experience in forest practices in several Latin American countries.

We now shall move to our third and final witness, the representative from the Weyerhaeuser Co., Dr. Johnson.

Do you want to begin with the slide presentation, or use that at the end?

STATEMENT OF NORMAN E. JOHNSON, VICE PRESIDENT, NORTH CAROLINA REGION, WEYERHAEUSER CO.

Dr. Norman E. (Norm) Johnson is currently Vice President of Weyerhaeuser Company's North Carolina Region. He is responsible for all forestland management operations, manufacturing of both solidwood and pulp and paper products and administrative services to support these operations.

He joined Weyerhaeuser in 1956 working with the company's forestry research center in Centralia, Washington as a group leader in forest bioprotection research. He has worked with Weyerhaeuser since that time except for two years during which he was on the faculty of the Department of Entomology at Cornell University, Ithaca, N.Y.

In 1969 he began development of the company's southern forestry research program starting in New Bern, N.C. and which now covers North Carolina, Mississippi, Alabama, Oklahoma, and Arkansas. In 1974 he became manager of Tropical Forestry Research based in Balikpapan, Indonesia.

He was appointed vice president of Weyerhaeuser's Southeast Asia Region and President of the International Timber Company of Indonesia, a Weyerhaeuser subsidiary, in 1976.

He came to the North Carolina position from Indonesia in January, 1980. Dr. Johnson is a native of Arizona and is the son of a retired forester. He has lived and worked in most of the major timber producing areas in the United States including the Pacific Northwest, Rocky Mountains, Northeast and Southeast United States.

He received his BSF and MSF degrees in forestry from Oregon State University and Ph. D. in forest entomology from the University of California at Berkeley.

Mr. JOHNSON. I think I will begin with it, if you don't mind.

Thank you very much for this opportunity, Mr. Chairman and members of the subcommittee.

Mr. BONKER. Dr. Johnson, before we proceed, I would like the committee record to note the presence of Congressman David Bowen of Mississippi.

[Whereupon, Dr. Johnson proceeded with the slide presentation.]

Mr. JOHNSON. Weyerhaeuser Co. started operations in the tropics about 12 years ago in Indonesia, primarily on the island that was one time known as Borneo, now known as Kalimantan, in both Indonesia and the Malaysian parts.

I am going to talk a little bit about the Indonesian project that we have that is located near Balikpapan on the island of Kalimantan, the fifth largest island in the world.

The uncut tropical forests, when you fly over them, look like a green mat, a green carpet, and appear to have a great deal of timber, usable timber on the land. When you get down to look at the forest itself, you will find that there may be 5 to 8, maybe 10 trees like this per hectare, a hectare being 2½ acres, approximately, that are commercial, and a great many other tree species of varied and sundry kinds. There may be as many as 300 different kinds of trees on a single hectare, many of which with current technology are not usable.

A lot of the lands were opened up there 12 years ago for exploitation, the Government being primarily interested in just getting production out of the area, and there were a lot of small companies that came in with small equipment, low-cost infrastructures, and started logging and providing export of logs and income for the Indonesian Government.

Other companies, such as some of the American multinational corporations, Japanese companies, Korean companies came in there with larger equipment, built villages such as that one or this one, permanent structures, added schools—the Kalimantan school that we have there has over 750 students—hospitals, and other more permanent types of infrastructure, including sawmills and plywood mills.

The objective of the government there was to get a 60 percent in-country manufacturing after 7 years of concession life. A lot of these materials are shipped to the United States, to Europe, and most of the logs shipped from there, however, go to Korea, Japan, and Taiwan.

Still, a great majority of the lumber that is cut in Indonesia is still cut this way, by hand. When the forest is logged—and this is a slide that shows some of the good and bad. After logging, after 5 to 10 trees per hectare have been taken off, the forest looks like this. If left to grow, it will return to its original condition in about 35 years. The Indonesian cutting practices indicates 35-year rotation.

Now, logging is one form of forest alteration that is certainly taking place in the tropics. Another form of forest alteration is primarily due to the population increases. Indonesia has 140 million people, 90 million of whom live on the island of Java, one of the most densely populated areas in the world, and an island that at one time was also a tropical rain forest some 3 to 4 centuries ago.

The land is essentially all used up at the present time, again, in farming. It is a very rich country, a very rich island, the soil being primarily from the many volcanoes there. In contrast, on the outer islands, the soils are very poor. Nevertheless, people are moving to the outer islands to set up their farms so that they can get enough food to eat. They essentially do so by clearing the jungle, burning it, planting it for 1 year in rice.

You see some banana trees in here. At the end of 18 months, they will move on to another area, giving this sort of appearance from above, either like that or like that.

If carried far enough—this has happened in a great many areas, the Philippines, New Guinea, Indonesia, Malaysia, the lands can turn to permanent grassland, such as this, and this is by far the greatest threat that we see to the tropical rain forests.

However, there are other factors affecting it also, including logging, as I mentioned, altering it somewhat. When we went over there, we decided as a company, since we have an interest in worldwide plantations, to do some experimentation. We put in a research center in southeast Asia at a cost of about $1 million a year. We were interested in increasing the yields there.

A partially cut rain forest will grow about two cubic meters per hectare per year. Plantations in Pinus Caribaca Melina, Albizia, other tree species will grow anywhere from 15 to 40 cubic meters per hectare per year. So, we are very interested in experimenting.

We set up a nursery. We put in plantations. We now have about 4,000 hectares of plantations out of a 600,000 hectare concession, which means less than 1 percent of the land has been cleared to put in experimental plantations. All the rest of the land is cut, taking four to six trees per hectare, following the Indonesian guidelines, their so-called select-fell system of management.

Trees grow very rapidly. These are 1-year-old pine trees. This is a 4-year-old pine tree. This is a 10-year-old pine tree. That is a 2-year-old eucalyptus tree, 80 feet tall. Here is a 10- to 11-year-old eucaplytus tree. This is a native tree to Indonesia and to the Philippines in a plantation.

You can begin to gather why companies would be interested and why the host country would be interested in plantations. Actually, these are 14-month-old albizia, also a native tree, a native hardwood. This is about an 8-year-old anthocephalus tree, a native tree to Kalimantan that we are very much interested in. You see a lot of plantations in the back.

Mr. BONKER. That tree is 8 years old?

Mr. JOHNSON. Yes.

Mr. BONKER. That is an incredible growth rate, isn't it?

Mr. JOHNSON. Yes.

Mr. BONKER. That is through intensified management or natural regeneration?

Mr. JOHNSON. That particular tree is natural, alongside a roadway that was 8 years old. It comes in only on very clear land. It is a pioneer species. That is one of the reasons we are interested in it. We know that tree to be 8 years old because it came in—it only comes in along the roadways that we put in.

Mr. BONKER. At what point is it mature?

Mr. JOHNSON. We feel that in 12 to 15 years, most of these trees will be ready to harvest.

Mr. BONKER. What is the diameter?

Mr. JOHNSON. The diameter of a 15-year-old tree could be up to 20 inches. What we are doing there is not so unlike what has been done on tropical soils for many years. This is an oil palm plantation. Rubber, as you know, grows in Malaysia and Indonesia in plantation form. We feel that on the heavy uplifted sedimentary soils, the tree crops, either forest plantations or oil palm, rubber, coffee, cloves, tea, tree crops that stay on the soil for periods of 15 to 30 years are probably the best alternative use of some portion of the tropical rainforest, in order to provide more material and more produce on less space.

Tropical soils, however, are delicate, and you have to watch them very carefully. Most of the rooting is on the surface. We have done extensive studies there on nutrient cycling, to see how much nutrient is lost when you put it into soils, what kind of nutrients are necessary for the growth of the tree.

We have laboratory tests and field tests right there in the jungle. We have done extensive studies on the growth of the partially cut Dipterocarp forest, a mature Dipterocarp forest, and compared this to plantations. We have done some biomass studies. We have experimented with some more permanent agriculture, planting corn and soybeans in soils that normally are abandoned after a few years, and with proper care, you can extend the life of some of these soils.

Tropical plantations are elsewhere in the world. I just wanted to show what some of the other companies are doing. This is in Brazil, in an area that was primarily a fire-caused Savannah—treeless for centuries—now growing timber, producing a product now from those plantations on about a 17- to 18-year rotation.

This is another company in Brazil, Arracruz, growing eucalyptus. Fifteen years ago, this was a bare, open, flat area. The trees were planted. The pulpmill was put in 5 years ago. That pulpmill is producing and selling short fiber pulp on the world markets in a 15-year period.

Most of you have heard about the Jari project. These are 5-year-old melina trees, 6-year-old pine trees. They have a pulpmill that they floated in there from Japan in a barge, put it together, and it is producing pulp, again, in a very short period of time.

Venezuela: Again open land that has been converted, so the tropical plantations that you hear so much about are not all replacing tropical rainforests. Many of them are growing on land that shifting agriculture has deforested. This is land that over the centuries has been nonforested.

In Queensland, Northern Queensland, there is also a tropical area, and there are plantations growing there, very excellent plantations. So many companies are interested in tropical plantations that we have begun to do some selection, some tree improvement, and we have some cooperative efforts going on worldwide to get even better trees that will grow in tropical latitudes.

This is a superior tree, the one that the man is leaning against, growing among some not so good trees. From these trees, you climb them, you take off small scions or twigs, graft those twigs in the greenhouse, on a root stock, put them out in a seed orchard, and then take the seeds from these superior trees—this happens to be in Colombia, one of Mr. Ladrach's areas, but the concept is equally applicable anywhere in the tropics—and then plant those out.

This series of slides I want you to look at particularly carefully. This is a plantation of Pines *Caribbea* from wild seed, nonselected seed.

This next plantation is the same age, growing on the same soil, after one selection, selecting good parents. You can see the difference in the nature of the stand. You don't need to be a geneticist to see the improvement in that case.

We have enlisted some of the world experts. The man on the right is Dr. Zobel, probably the number 1 pine geneticist in the world, to help us work on this.

In the host country—again, this is in Colombia—the local scientists, the local government officials, working very closely with the companies there, are seeing the benefit of a tree improvement program and of a plantation program.

It is our contention that if the countries that have tropical forests want to retain some portion of that native forest for its intrinsic values that we are all aware of for the medicinal values, the botanical interest, looking at the unique flora and the unique fauna in these areas, that plantations growing on some 15 to 25 or 30 percent of the areas will grow enough additional wood that will allow areas to be

set aside permanently for some of the values that people are talking about.

I would say, and I say this on my own, not as a representative of Weyerhaeuser, that without some intensive management on some portions of the tropical rainforest, you can just count out any options for preserving them, because the local people need the money, they need the jobs. Plantations are a highly labor-intensive enterprise, and I submit that intensive forestry is as much as anything else going to be the salvation of some portion of the tropical rainforest.

I think that is all I would like to say. I think you have my testimony. You can read it as easily as I can read it to you.

Thank you, Mr. Chairman.

[The prepared statement of Norman E. Johnson follows:]

PREPARED STATEMENT OF NORMAN E. JOHNSON, VICE PRESIDENT, WEYERHAEUSER CO.

MR. CHAIRMAN, MEMBERS OF THE SUBCOMMITTEE: I AM DR. NORMAN E. JOHNSON, NORTH CAROLINA REGION VICE PRESIDENT FOR WEYERHAEUSER COMPANY. BEFORE ASSUMING MY PRESENT DUTIES, I SERVED FIRST AS MANAGER FOR WEYERHAEUSER'S TROPICAL FORESTRY RESEARCH CENTER IN INDONESIA AND LATER AS VICE PRESIDENT FOR WEYERHAEUSER'S FAR EAST REGION OPERATIONS. I WAS RESPONSIBLE FOR THE DEVELOPMENT AND IMPLEMENTATION OF INTEGRATED FORESTRY AND AGRICULTURAL RESEARCH ACTIVITIES AT WEYERHAEUSER'S JOINT VENTURE COMPANY IN INDONESIA, INCLUDING STUDIES OF THE ESTABLISHMENT AND SILVICULTURE OF SELECTED TROPICAL TREE SPECIES AND THE ASSOCIATED PRODUCTIVITY OF EAST KALIMANTAN SOILS. IT IS FROM THIS PERSPECTIVE THAT I WILL COMMENT ON THE TOPIC BEFORE THE SUBCOMMITTEE.

WE WOULD LIKE TO THANK THE SUBCOMMITTEE FOR THIS OPPORTUNITY TO GIVE OUR VIEWS ON TROPICAL FORESTRY. WEYERHAEUSER COMPANY RECOGNIZES THE IMPORTANCE OF TROPICAL FORESTS IN THE CONDUCT OF OUR NATION'S DOMESTIC AND INTERNATIONAL AFFAIRS. AS AN ADVOCATE FOR THE PRACTICE OF SOUND FORESTRY, WE VIEW THE TROPICAL FORESTS OF THE WORLD AS HAVING THE POTENTIAL FOR MAKING MAJOR CONTRIBUTIONS TO THE ECONOMIC AND SOCIAL WELL-BEING OF MANY NATIONS. BEING FULLY COGNIZANT OF THE BIOLOGICAL COMPLEXITY OF THE TROPICAL FORESTS AND THE NEARLY UNLIMITED POTENTIAL ASSOCIATED WITH ITS WISE MANAGEMENT, WE ACCEPT THE CHALLENGE BEFORE US.

MUCH ATTENTION HAS BEEN FOCUSED ON PROBLEMS IN THE WORLD'S TROPICAL FORESTS. THESE INCLUDE SHIFTING AGRICULTURE, UNCONTROLLED FUEL WOOD GATHERING, AND POOR FOREST MANAGEMENT PRACTICES. THE PURPOSE OF MY BRIEF COMMENTS TODAY, HOWEVER, IS NOT TO DEVOTE FURTHER ATTENTION TO THE PROBLEMS. INSTEAD, MY PURPOSE IS TO SUGGEST THAT: 1) THE OPPORTUNITY FOR INTENSIVE MANAGEMENT OF TROPICAL FOREST PLANTATIONS MAY OFFER A SOLUTION TO SOME OF THE FORESTRY PROBLEMS IN THE TROPICS; AND 2) BROAD-BASED SUPPORT IS NEEDED FOR RESEARCH ON TROPICAL FOREST MANAGEMENT AND ITS SOCIAL AND ECONOMIC EFFECTS.

THE OPPORTUNITY FOR INTENSIVE MANAGEMENT OF TROPICAL FOREST PLANTATIONS

WORLDWIDE DEMAND FOR FOREST PRODUCTS IS GROWING. BY THE YEAR 2000 THE WORLD DEMAND FOR PAPER AND PAPERBOARD PRODUCTS ALONE WILL HAVE INCREASED BY AN ESTIMATED 200 PERCENT OVER 1970 LEVELS. TROPICAL FOREST AREAS, COVERING NEARLY A HALF BILLION HECTARES, PROMISE TO BE A SIGNIFICANT SOURCE OF RAW MATERIALS TO MEET THE INCREASING DEMAND. THROUGH SOUND MANAGEMENT, TROPICAL FORESTS CAN BENEFIT THE WORLD ECONOMY, THE DEVELOPING COUNTRIES INVOLVED, AND THE POOR UNDEREMPLOYED INHABITANTS OF MUCH OF THE TROPICAL FOREST REGIONS. BECAUSE OF FAVORABLE CLIMATIC CONDITIONS, THE TROPICAL FORESTS ARE CAPABLE OF PRODUCING 15 TO 40 CUBIC METRES PER HECTARE

OF WOOD GROWTH PER ANNUM. THIS COMPARES WITH AN AVERAGE OF 5-8 CUBIC METRES IN THE INTERIOR OF CANADA AND 10-15 CUBIC METRES IN THE COASTAL AREAS OF THE PACIFIC NORTHWEST. THERE IS GREAT POTENTIAL FOR THE SUSTAINED MANAGEMENT OF TROPICAL FOREST PLANTATIONS ON SOILS THAT ARE UNSUITABLE FOR PERMANENT AGRICULTURE. IN OUR EXPERIENCE SUCH PLANTATIONS ARE BIOLOGICALLY, ECONOMICALLY, AND SOCIALLY FEASIBLE.

OUR RECOGNITION OF THE POTENTIAL PRODUCTIVITY OF TROPICAL PLANTATIONS IS BASED UPON SEVERAL YEARS OF INTENSIVE FORESTRY RESEARCH AND MANAGEMENT IN INDONESIA AND MALAYSIA. AT OUR JOINT-VENTURE OPERATIONS OF P.T. INTERNATIONAL TIMBER CORPORATION INDONESIA IN EAST KALIMANTAN, OUR FORESTRY RESEARCH WORK HAS INCLUDED: METHODS FOR IMPROVED GROWTH AND YIELD FOR TROPICAL SPECIES; BREEDING OF IMPROVED PLANTING STOCK; SOIL PRODUCTIVITY TECHNIQUES; CONTROL MEASURES FOR UNDESIRABLE VEGETATION; CONTROL MEASURES FOR FOREST INSECTS AND PESTS; AND ESTABLISHMENT OF TREE HARVESTING TECHNIQUES SUITABLE TO PROTECT RESIDUAL TREE STANDS AND IMPROVE FOREST REGENERATION. IN ADDITION, WE HAVE AND ARE CONTINUING OUR AGRO-FORESTRY RESEARCH TO DETERMINE THE FEASIBILITY OF GROWING FOOD CROPS ALONG WITH TREE CROPS IN RESPONSE TO LOCAL FOOD NEEDS.

LET ME ILLUSTRATE THE POTENTIAL OF TROPICAL FOREST PLANTATIONS WITH A FEW SPECIFIC EXAMPLES OF FINDINGS FROM OUR RESEARCH EXPERIENCE IN INDONESIA:

- SOILS RESEARCH HAS INDICATED THAT MOST OF THE SOILS IN OUR HARVEST LICENSE AREA IN EAST KALIMANTAN ARE IN THE ULTISOL GROUP, DERIVED FROM SEDIMENTARY ROCK. THEY ARE GENERALLY HIGH IN CLAY, LOW IN NUTRIENTS SUCH AS PHOSPHOROUS, AND RELATIVELY SHALLOW IN MAJOR ROOTING HORIZONS. THESE CHARACTERISTICS MAKE THE SOIL MORE SUITABLE FOR THE MANAGEMENT OF FAST GROWING TREE SPECIES THAN FOR PERMANENT AGRICULTURE.

- GROWTH AND YIELD STUDIES ENSURE THAT PLANTATIONS CAN PRODUCE MAXIMUM COMMERCIAL WOOD VOLUME YIELDS PER HECTARE. EARLY EXPERIMENTATION IN INDONESIA CAUSED US TO REJECT CERTAIN SPECIES BECAUSE THEY DID NOT GROW WELL, THEIR WOOD QUALITY WAS INFERIOR, OR THEIR USE WAS IMPRACTICAL FOR OTHER REASONS. OUR RESEARCH HAS LED TO THE SELECTION OF THE BEST THREE OF FOUR PLANTATION SPECIES TO MAINTAIN FLEXIBILITY IN END USE AND REDUCE THE RISK OF LARGE SCALE PLANTATION FAILURE.

In our silvicultural management research, extensive tests have already indicated that the growth rates of both the harvested and the undisturbed natural forest are far lower than those of selected species under plantation management. This plantation management will produce harvestable wood in 15 - 20 years while a natural forest system will require 50 - 70 years.

Our research and management experience convinces us that tropical plantations of fast-growing trees provide an alternative to problems of shifting agriculture and the uncontrolled harvesting of the unmanaged natural forest. Intensive forestry on a portion of the area will produce enough wood so that other areas can be set aside for less intensive uses and reserves. Yields from plantations can satisfy wood demand and provide the time necessary for logged stands to develop again toward a climax forest. These prolonged periods of restoration will permit development of the full range of intermediate stands and forest diversity important to maintenance of tropical forest eco-systems. More importantly, high yields from plantations greatly reduce the land base necessary for a given wood supply, thus relieving harvesting pressure on selected natural forest areas.

By concentrating production on a smaller land base, plantations also permit more consolidated management, harvesting and transport activities, reducing operational costs and increasing earnings. They also can contribute to a stabilized labor force, which can slow down the pace of shifting agriculture in many countries, and allow permanent settlements for workers in select areas.

With the opportunities to sustain volume production, conserve and restore natural forests, and stabilize rural agricultural communities, forest plantations should be an attractive opportunity for governments in tropical countries. Some governments and industrial ventures have already made gigantic strides in plantation programs, and the future offers even greater opportunity.

Additional Research is Needed on Tropical Forest Management

Our knowledge and understanding of tropical forest problems and solutions is increasing, and the basic technology for establishing plantations is now well documented. However, new programs will require additional evaluation of species and soil conditions. In many areas optimizing yield production will require further experiece and research with silvicultural treatment in established stands.

WE ARE CONVINCED THAT THERE IS A POTENTIAL FOR INTENSIVE PLANTATION MANAGEMENT AS ONE OF MANY USEFUL TOOLS IN THE RESOLUTION OF TROPICAL FORESTRY PROBLEMS. SUPPORT ON THE PART OF LOCAL GOVERNMENTS, INTERNATIONAL AGENCIES, INDUSTRIES, AND OTHER INFLUENTIAL BODIES IS ESSENTIAL IF THE POTENTIAL OF THIS TOOL IS TO BE REALIZED. THIS CAN BEST BE GENERATED BY EXPOSURE TO INFORMATION AND DEMONSTRATION BASED ON RESEARCH DESIGNED TO: (1) IDENTIFY AND MINIMIZE THE RISKS ASSOCIATED WITH TROPICAL PLANTATION MANAGEMENT; (2) DEVELOP PLANTATION SYSTEMS FOR TREE SPECIES OF DIVERSE ORIGIN AND UTILITY; (3) ESTABLISH OR REFINE MULTIPLE-USE SILVICULTURAL AND MANAGEMENT SYSTEMS FOR THE NATURAL FORESTS; (4) OPTIMIZE THE DISTRIBUTION OF TROPICAL LAND-USE FOR AGRICULTURE, FORESTRY AND COMBINATIONS THEREOF; AND (5) DETERMINE THE TYPE OF LOCAL GOVERNMENT INCENTIVE PROGRAMS WHICH CAN BEST PROVIDE FOR THE CONTINUED PRODUCTIVITY OF TROPICAL FOREST LANDS.

THE DEFICIENCIES IN THE TECHNOLOGY, HOWEVER, SHOULD NOT INFLUENCE MAJOR DECISIONS TO INVEST IN TROPICAL FOREST PLANTATIONS. IF ONE HAD WAITED UNTIL ALL QUESTIONS WERE ANSWERED BEFORE PROCEEDING WITH LARGE SCALE PLANTATIONS, MANY OF THE SUCCESSFUL PLANTATIONS OF THE WORLD WOULD NOT EXIST.

A NUMBER OF FACTORS OTHER THAN TECHNOLOGY WILL BE MORE CRITICAL IN CREATING A FAVORABLE INVESTMENT ENVIRONMENT. FIRST, GOVERNMENT POLICY MUST ENSURE LAND OWNERSHIP (OR SUFFICIENTLY LONG-TERM LAND LEASES) TO RECOVER THE COSTS OF INVESTMENT. THE RELATIVELY SHORT LIFE OF MOST GOVERNMENT-GRANTED HARVEST LICENSE AREAS DOES NOT ENCOURAGE USE OF PRIVATE CAPITAL BECAUSE OF THE HIGH RISK OF LITTLE OR NO RETURN IF HARVESTING RIGHTS CHANGE OR REVERT TO THE GOVERNMENT. THIS APPLIES TO SILVICULTURAL MANAGEMENT OF BOTH PLANTATIONS AND NATURAL STANDS. LICENSE AGREEMENTS MUST EITHER GIVE LONGER TERM RIGHTS TO HARVESTING OR AT LEAST A PROMISE OF CONTINUED HARVEST RIGHTS IN RETURN FOR SOME LEVEL OF COMMITMENT TO PLANTATIONS.

GOVERNMENT POLICY CAN ALSO STIMULATE PLANTATION PROGRAMS BY PROVIDING INCENTIVES FOR THE HIGH COST OF THEIR ESTABLISHMENT. IN SOME COUNTRIES THIS POLICY HAS TAKEN THE FORM OF SUBSIDIES FOR A CERTAIN PERCENTAGE OF THE ESTABLISHMENT COSTS. ELSEWHERE, IT MAY INVOLVE REDUCED ROYALTIES ON TIMBER HARVESTED FROM THE ORIGINAL STAND BEFORE SITE PREPARATION, A WRITEOFF OF COSTS IN CALCULATING TAXES, OR SOME OTHER COMBINATION OF INCENTIVES. IT IS IMPORTANT THAT GOVERNMENTS REALIZE THAT THEY ARE A PARTNER IN THE LONG-TERM BENEFITS OF PLANTATIONS. THEY CAN DEVELOP THAT PARTNERSHIP THROUGH AN ACTIVE INCENTIVE PROGRAM WHICH WILL FREE THE CAPITAL NECESSARY FOR INVESTMENTS IN PLANTATIONS.

FOR EXAMPLE, BRAZIL, CHILE, AND THE PHILIPPINES CURRENTLY HAVE PLANTATION INCENTIVE PROGRAMS, AND THEIR FOREST MANAGEMENT SUCCESSES ARE ALREADY EVIDENT.

NATIONAL AND REGIONAL GOVERNMENTS MUST ENCOURAGE LAND USE POLICIES WHICH PERMIT INTEGRITY OF FOREST HARVEST LICENSE AREAS WHILE RECOGNIZING THE NEED FOR SUSTAINING AGRICULTURAL PRODUCTION IN ADJACENT AREAS. AREAS MUST BE DESIGNATED FOR AGRICULTURAL AND FOREST INDUSTRY DEVELOPMENT AND BOUNDARIES OF THESE AREAS MUST BE PROTECTED BY REGIONAL GOVERNMENTS.

WITH HOST-GOVERNMENT COMMITMENTS AT ALL LEVELS TO ECONOMICALLY SOUND PLANTATIONS, INDUSTRY CAN HAVE A SIMILAR COMMITMENT AT ALL LEVELS OF MANAGEMENT. WITHOUT THESE COMMITMENTS, CONSISTENT MANAGEMENT PLANS CANNOT BE FORMULATED BECAUSE OF UNCERTAIN CASH FLOW SITUATIONS, POLITICAL OR LABOR PROBLEMS, AND OTHER SHORT-TERM INDUSTRY CONTINGENCIES. A SERIOUS PROGRAM OF SUSTAINED YIELD BY FORWARD-LOOKING MANAGEMENT MUST BE AS FREE AS POSSIBLE FROM SUCH SHORT-TERM CONSTRAINTS IN ORDER FOR CONSISTENT DEVELOPMENT OF NEW PLANTATION AREAS. AT THE SUPERVISORY LEVEL IN BOTH GOVERNMENT AND INDUSTRY, A LACK OF COMMITMENT WILL RESULT IN POOR QUALITY CONTROL OVER SILVICULTURAL OPERATIONS.

WITH FAVORABLE GOVERNMENT POLICIES, WISE LAND USE DECISIONS, AND INDUSTRY COMMITMENT, ECONOMICALLY FEASIBLE FOREST PLANTA-

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TION PROGRAMS WILL EXPAND IN TROPICAL FOREST REGIONS OF THE WORLD. THEY WILL INCREASE OR MAINTAIN THE FLOW OF WOOD PRODUCTS TO A FIBER-HUNGRY WORLD, WHILE ALLOWING A PORTION OF THE REMAINING NATURAL FORESTS TO BE MAINTAINED FOR FUTURE GENERATIONS.

DEFORESTATION IS A MISLEADING TERM IN DISCUSSING TROPICAL FOREST MANAGEMENT ISSUES

THE BROAD APPLICATION OF THE TERM "DEFORESTATION" TO THE TROPICAL FORESTS PROBLEM IS MISLEADING. IT DISCREDITS AND IGNORES THE FOREST MANAGEMENT PROGRESS AND ACTIVITIES THAT ARE SUCCESSFUL IN MANY TROPICAL REGIONS OF THE WORLD. MORE IMPORTANTLY, IT SUGGESTS WE ARE IMPOTENT TO PRODUCE SOLUTIONS THAT PROVIDE STABLE TIMBER SUPPLIES TO MEET WORLD NEEDS. I SUBMIT THAT OUR UNDERSTANDING OF THE PROBLEMS AND SOLUTIONS OF TROPICAL FORESTS IS INCREASING NOT DECREASING.

MANY PEOPLE SIMPLISTICALLY LABEL ALL HARVESTING ACTIVITIES AND OTHER FOREST MANAGEMENT EFFORTS IN THE TROPICS AS "DEFORESTATION." IN FACT USUALLY LESS THAN A HALF DOZEN TREES ARE SELECTIVELY REMOVED FROM EACH HECTARE LEAVING DOZENS TO GROW. WITHIN FIVE YEARS THE FOREST CANOPY CLOSES. THIS IS HARDLY "DEFORESTATION." I URGE WE DROP THE TERM "DEFORESTATION" AND PLACE TROPICAL FORESTRY ISSUES IN THEIR PROPER PERSPECTIVE.

HUMAN INTERVENTION IN THE ALTERATION OF TROPICAL FORESTS IS AN IMPORTANT QUESTION BUT NOT A NEW ONE. SOME TROPICAL FORESTS HAVE BEEN USED WISELY AND OTHERS MISUSED FOR HUNDREDS OF YEARS. SOME ARE ESSENTIALLY UNTOUCHED FROM THE STANDPOINT OF HUMAN IMPACT. OTHERS ARE PRESSURED BY EXPANDING POPULATIONS AND INCREASING DEMAND FOR FOOD, WATER, WOOD, SPACE, AND OTHER FORCES WHICH REPLACE THESE FORESTS WITH AGRICULTURE, UNPRODUCTIVE GRASSLANDS, OR LOW-GRADE SECONDARY FORESTS.

CONCLUSION

THE CONTINUING QUEST BY DEVELOPING COUNTRIES FOR CAPITAL AND A HIGHER STANDARD OF LIVING IS RESULTING IN THE RAPID HARVEST OF COMMERCIAL FORESTS. COMPOUNDING THIS EFFECT IS THE REMOVAL OF WOOD FOR ENERGY USES FROM THE NON-COMMERCIAL FOREST AS WELL. THESE PRESSURES ILLUSTRATE THE NEED FOR SOUND LAND USE AND FOREST MANAGEMENT PRACTICES TO ENSURE SUSTAINED FOREST PRODUCTIVITY WORLDWIDE.

DEVELOPMENT OF FOREST PLANTATION PROGRAMS MAY BE ONE USEFUL TOOL IN THE RESOLUTION OF TROPICAL FOREST PROBLEMS. WE BELIEVE RESEARCH IS A KEY ELEMENT IN MEETING THE CHALLENGES OF THE TROPICS. ROTH GOVERNMENTAL AND NONGOVERNMENTAL SUPPORT FOR TROPICAL FORESTRY AND AGRICULTURAL RESEARCH ARE ESSENTIAL FOR UNDERSTANDING CURRENT AND FUTURE DEVELOPMENT IN THE TROPICS.

WEYERHAEUSER'S FOREST MANAGEMENT SUCCESS IN OUR TROPICAL FORESTRY REGION IS A RESULT OF OUR RECOGNITION OF THE TROPICAL FORESTRY ECO-SYSTEM AND OUR AWARENESS THAT WE MUST MAINTAIN EFFECTIVE PERSONAL RELATIONSHIPS WITH HOST COUNTRY OFFICIALS AND THE COMMUNITY AT LARGE. WE ARE EAGER TO BROADEN OUR KNOWLEDGE OF THESE FACTORS AND STAND READY TO SUPPORT OTHER EFFORTS IN THIS ARENA.

Mr. BONKER. Thank you, Dr. Johnson, for that visual presentation, and for your written statement that, of course, will be included in the record.

I think, given the time schedule, that we will ask Congressman Bowen to lead with questions.

Mr. BOWEN. Thank you, Mr. Chairman.

I want to commend Chairman Bonker for calling these hearings. I think they are very constructive, and I am happy to be able to be here.

Just a few short questions.

Dr. Gallegos, I know that there have been at times recommendations from a number of reporters to perform environmental impact assessments before undertaking development projects in tropical forest areas. Do you think the U.S. Government should require companies contemplating overseas investments in these tropical areas to prepare environmental impact statements?

Mr. GALLEGOS. Thank you for your question. This is a topic that does concern industry.

There are several aspects I would like to respond to in answering this question. First of all, as a matter of course and as a matter of developing forestry projects in these countries, we collect baseline information concerning the climate, soils, wildlife, et cetera, of the country. These are data that are normally required in environmental impact statements.

This is just a matter of course in conducting good forestry practices. Thus far, we have been spared the procedural requirements, delays, and litigation that an environmental impact statement would cause in our development projects.

Second, I would like to say that a majority of these countries already require environmental statements that are very similar to U.S. environmental impact statements, and we are normally required to gather this data by the host governments. This is something that is not required of indigenous corporations operating in these countries.

Third, I would like to say that environmental impact statements would provide a disincentive for U.S. multinationals which would be inclined to invest in these tropical countries. In fact, it would favor competitors from other countries to develop these projects.

Fourth, the question of preparing Federal environmental impact statements is an open question. Thus far, it is something that has never been required of U.S. industry. For equity considerations, if it is to be required, consideration should be given to requiring it of all industries, both small businesses and major corporations, both domestic enterprises and foreign investment.

Fifth, U.S. multinationals often operate through third parties and subsidiary companies in these countries, and the question of how EIS requirements would apply to these third parties is something that would have to be answered.

Finally, I would like to say that in our testimony, we are stating methods whereby these U.S. multinationals can be encouraged to invest in other countries to foster sustained forest management. The requirement of environmental impact statements would discourage this sort of investment. We feel that we can make a very concrete con-

tribution to the development of natural resources in these countries, and this would only provide another disincentive for this contribution.

Mr. BOWEN. So you feel you have, in effect, your own in-house environmental impact statement that you do for your own purposes?

Mr. GALLEGOS. Yes.

Mr. BOWEN. This documentation, is it available on any kind of limited basis or otherwise, for outside sources to review, or is this strictly confidential?

Mr. GALLEGOS. A lot of this data is gathered from records available in the host countries. The compilation and the work involved in gathering it is something that requires investments by these companies.

To answer your question, yes, it would be available.

Mr. BOWEN. It would be available. That is very encouraging.

Dr. Johnson, let me ask you a question. I might say that you have a fine Weyerhaeuser Co. in my district also.

What are the causes, if you could just be brief about it, of tropical deforestation in the tropical areas where your company operates? I might just ask you if there are any opportunities in the temperate zone for forest technology to abate or remedy the effects of these tropical deforestation activities.

Mr. JOHNSON. The main cause of deforestation is population pressure; people needing the land to grow food to survive. Slash and burn agriculture, I think has been shown to be the primary cause. Timber industries go into these areas to open them up but they do not deforest. We selectively harvest them. We do contribute, though. As we open these areas up, we do make it a little bit easier for shifting agricultures to move into the areas.

Then there is just the sheer pressure for urbanization. That is a very rapidly growing part of the world, and I think anyone who has been in Singapore and Hong Kong, in Taipei and into Jakarta, and just seen what is happening in Southeast Asia, the pressures are horrendous.

So, I think those are the primary causes. Fire is not a significant factor. Even storms are not a significant factor. It is primarily people caused.

As far as the applicability of temperate zone forestry, yes, there are a lot of things that we can do, the same as in your area, a lot of the growth rates are similar to the pine plantations in your area. What we have to be careful of, however, is the soils are much more fragile. They have to be taken—you have to take more care in handling them.

Mr. BOWEN. What is the basis of that fragility in soil structure?

Mr. JOHNSON. First of all, very low nutrient content. As you get into areas where you have higher and higher rainfall, a lot of the nutrients are leached out. You also have very high temperatures. As you take the cover off, these soils can be hardened by the Sun and the elements.

Mr. BOWEN. I have one final question.

Mr. Ladrach, I wonder if you might be able to suggest any programs that our Government could foster to increase professisonal training and exchange opportunities for both U.S. and tropical country professionals.

Mr. LADRACH. I think something like the Point Four program which was in existence is valuable. I have cited examples in Colombia. My colleague I worked with was in MSU on that program. I think it is necessary to get better education for foreign nationals. We have forestry schools in Colombia and we have an excess of forestry graduates, but we don't have enough qualified people.

I think it is necessary to have training from the United States and from other developed countries in tropical areas to help initiate forestry projects and to do basic research. The combination of the two. The foreign scientists can initiate work and then get educated nationals to continue such work locally.

Mr. BOWEN. You say some of this work was done at Mississippi State University?

Mr. LADRACH. Michigan State University.

Mr. BOWEN. You said MSU. I didn't know which MSU you were talking about.

Mr. LADRACH. They did a lot of the original work. I have also worked closely with the Commonwealth Forestry Institute in Oxford, England, and I am impressed by their operation. They run on a limited budget. They have a dedicated group of people who work outside the university in tropical fields. They have been very helpful to me. They require no contract. They send me seed. They don't expect anything back for it but I give them our research reports in return.

I think this is a good example. Of course, I think the United States would have to look at maybe a different way of doing it, not exactly the same, but it could be a pattern to see if we could set up some similar type of organization with a U.S. university. I think that Georgia, Florida, North Carolina State, or Mississippi State would be ideal universities to work with, especially for the Latin American countries.

I think another area which is important, especially to Latin America is language. AID has done translations in the past. Currently I understand they are not doing them. I have information and some reports from AID which have been very valuable, translated into Spanish.

One reason I translate my research reports to English is to create an interchange, because there is a very limited interchange between many Latin Americans and the rest of the world. English is the world forestry language, and Latin America is isolated because of this language barrier.

Mr. BOWEN. When you say around the rest of the world, there is no problem with English being the universal forestry language?

Mr. LADRACH. At the professional level, internationally, no, but many locals do not speak English. They have to use texts to read and to study which may be in English or another language, but it is extremely difficult, and often when they go to an international meeting, they cannot converse freely. They cannot get to know their international colleagues personally. They may be able to understand technical language, but they can't converse and create the close ties which are necessary to do international work.

Mr. BOWEN. Thank you very much, Mr. Ladrach.

Mr. Chairman, thank you for letting me ask these questions.

Mr. BONKER. Thank you for being with us this morning, Mr. Bowen.

I would like to cover several key issues which surfaced in your testimony, so that we have a clear understanding of the basis upon which we will be considering this issue.

First are the reports. We have before us the Interagency Task Force Report on Tropical Forests. Then we also have the Global 2000 Report. I have to agree with your assessment that the latter report is one of gloom and doom as it relates to information on forests. It was taken primarily from the Council on Environmental Quality, and didn't, as I understand it, refer to the Interagency Task Force and the work they have been doing.

The subcommittee has had an opportunity to look at the Task Force Report and agrees that it is a better representation of the worldwide tropical forest problems. The subcommittee will rest its case upon that report, but I think it is worth noting, though, that in the Task Force Report, there is outlined a worst case and best case scenario which I think is worth reviewing.

In the worst case scenario, the task force states:

> The forest areas are projected to decline by one-half to 580 million hectares by the year 2000. Assuming that the forest loss in 1979 is 20 million hectares, and the rate of tropical forest conversion will thereafter increase the expected population growth rate, most tropical countries will have economically accessible forests remaining at the century's end.

It goes on to point out that these people will be without land for food, shelter, and fiber. Watersheds are the major agricultural areas which are denuded and needed for flood control, irrigation, and will rapidly fill with silt. Hundreds of thousands of plant and animal species will vanish, and much of the potential for limiting cultural, ecological, and medical problems will vanish with them. That is the worst case scenario.

The best case scenario equally plausible, but equally unlikely to happen:

> Unless the conditions causing rapid deforestation change substantially, if the current deforestation rate is only 10 million hectares in all forestry plans and goals in tropical countries are fully successful over the next 20 years, then the deforestation rate may drop to less than 5 million hectares a year by the year 2000.

Under these assumptions, projections indicate that wood will be abundant in some countries of Africa, South America, and Southeast Asia; so there are the worst case and best case scenarios, I guess, depending on how we proceed at this point, which makes these hearings timely. Much depends upon what not only international companies and international organizations do, but also what host country policies will be, and U.S. assistance over the next few years.

So, I think a lot of the information is there. The opportunities are there, and the challenges, depending on what we do at this point.

The second issue concerns the term "deforestation." I think industry has expressed legitimate concerns about the use of that term, but I think it is important to point out that while the causes of tropical forest loss are multiple, and the report points out diversion and use for agricultural and fuel wood gathering are probably the major causes, and the report also points out, as you know, Dr. Gallegos, 80 percent of the loss is due to these reasons.

Poorly managed industrial logging, and some of the other related activities are a very small contributor. The report points out that less than 6 percent is actually exported from these countries. So, industrial logging has a small impact on the overall list of contributing causes to deforestation, but I think that is why the term is there.

Deforestation represents much more than just industrial logging. It represents fuel gathering. It represents the agricultural use, and other contributing reasons for why our tropical forests are diminishing.

So, the subcommittee ought to look closely at this term, but I don't think the industry ought to be defensive about it. Simply because it is a collective term, doesn't necessarily mean that we are trying to single out the industry for deforestation. In fact, your contribution has been positive in the sense that in many areas where there is high volume there is a plantation or management program that will accelerate the growth of tropical forests. It is an important point, and I am glad you raised it at this time.

I want to proceed with a few questions, Dr. Gallegos, regarding statements that you make on page 7 of your prepared text. The last sentence states "Many of the problems described in the reports can be solved by wise forest management designed to meet increased demands for fiber."

I think that comes on the heels of your statement about the Global 2000 Report. Some companies depend on the host countries and their own requirements for proceeding with forest management programs, but in other instances maybe there is no forest management program, depending on the circumstances. Is forest management a universal part of a multinational's policy in a given country, or is it only done when it is required or seems economically feasible?

Mr. GALLEGOS. By and large, a vast majority of the U.S. multinational forestry companies are conducting intensive forest management in the lesser developed countries. There are exceptions, but I would say a vast majority do practice intensive forest management.

One of the things that we are concerned with is the development of the natural resources that these countries have. An economist will tell you that there are three forms of capital which are required for this industrialization. First of all are the natural resources. Secondly, are the human and technological expertise. And thirdly, the financial resources.

The U.S. companies in practicing intensive forest management are offering these countries the latter two forms of capital, the technological expertise and the financial capital, and in this sense we are encouraging wise development of the natural resources that are there.

Mr. BONKER. In the Northwest, intensive management makes a lot of sense for the landowners. They see it as a long-term investment, and it has been a very wise one, and Weyerhaeuser has been a leader in this field. The U.S. Forest Service has fallen behind, and we have had to encourage them to adopt forest management plans that are similar to the private sector, and we have had to convince our colleagues in the Congress that it is a wise investment. But we also find the private landowners do not necessarily find that it is a wise investment, that they can log the trees on their lands and receive a good

profit. It is just not practical to reinvest in a product that is going to take 30 or 40 years to mature and be ready for another round of harvesting.

Are you encountering these situations in the tropical areas? The long-term investment in forest service management, and the expense? Is it much more expedient and profitable just to cut and let natural regeneration take over?

Mr. GALLEGOS. One of the very concrete advantages that forestry in the tropics has is that, first of all, introduced trees native to other environments grow extremely fast. For instance, we can have some of our southern U.S. pines that grow two to three times as fast in tropical and subtropical environments, for example in Brazil. You also have other species such as the anthocephalus, albizia and eucalyptus that Dr. Johnson referred to.

Mr. BONKER. The tree on the side of the road, in the slides, what was that?

Mr. GALLEGOS. That is anthocephalus, which is a native species in Indonesia. These species do have the advantage that rotations can be considerably shortened, so the problem of long-term investments is not as acute in these lesser developed tropical countries.

The problem within these countries is, again, the technological expertise, and the capital necessary to develop the resource.

Mr. BONKER. Mr. Ladrach, in your statement on page 2, you state, "The natural regeneration in this area has been proven superior to any planting technique through continuing research."

What you are saying here is contrary to what has been our experience in the Northwest, that is, that with intensive forest management we can grow at an accelerated pace. You are saying that natural regeneration in this case is preferable to intensive management. Is that true?

Mr. LADRACH. Yes. This area where we are logging has a rainfall of about 23 feet a year. It is one of the highest in the world, near Buenaventura. We have done research in this area, trying to plant. We have tried to plant 50 species native to this area or introduced, and we have invariably found that the natural regeneration is superior to anything we have tried to plant.

In fact, if the trees are not from this area, they won't even survive the first year. This area is unique compared to the upland Andean zones, where plantations of pines and eucalyptus and other species are much better than any of the native hardwoods, but in the particular area where we are logging on the Pacific coast, which is a very humid tropical forest, natural regeneration is successful.

Mr. BONKER. Is it an exception to this area?

Mr. LADRACH. I think the difference between what we have in Buenavista and what happens in some other countries is this: If the area is left after logging it comes back to forest naturally. I think in many areas of the world, if the forest is cut and there is no migratory agriculture afterwards, it will regenerate itself and come back as a good forest.

Mr. BONKER. But a lot depends on the logging practices.

Mr. LADRACH. Logging is critical.

Mr. BONKER. And the soil conditions. You can log in such a way that a regeneration is very difficult, or in such a way that it is more compatible with the natural state of the soil and growing conditions.

Mr. LADRACH. This comes back to the old concept of clearcut versus selective cutting. We are probably one of the few companies that are cutting in the tropics on a clearcut basis. We use everything in our mill that comes from the forest. The few trees we don't use are taken out by other woodcutters.

Mr. BONKER. What about slash? Do you burn it? Do you make the soil conditions conducive to regrowth? Do you just cut what you want and take it out?

Mr. LADRACH. There is very little left on the ground standing after we are done, and after the local cutters are done. It does not burn, because it is so wet.

Mr. BONKER. Are you using this as pulp, or are you cutting up everything?

Mr. LADRACH. The trees are debarked on the ground. The bark is left in the forest.

Mr. BONKER. Why? It seems to me the bark becomes quite a valuable resource for pulp or paper production.

Mr. LADRACH. Bark has very little fiber, and it has a lot of nutrient. It is better left in the forest to recycle.

Mr. BONKER. So you take it off in the field.

Mr. LADRACH. Yes.

Mr. BONKER. Do you really?

Mr. LADRACH. We haul the wood 130 kilometers, which is about 75 miles, over a mountain range to our mill. The less weight we carry, the better.

Mr. BONKER. How do you debark the tree in the field?

Mr. LADRACH. Most of it is done by hand, by machete, and by shovels, and similar instruments.

Mr. BONKER. That is very intensive labor, isn't it?

Mr. LADRACH. The city of Buenaventura is very near our concession, and they have an extreme problem of unemployment. Most of our labor is not actually colonists or jungle people. They are people from the city who come in on buses and work. It is a big source of labor. We are not trying to mechanize until we absolutely have to. We are trying to use a minimum of mechanization. We use small winches to log but most of the work is by hand labor. Trucks are loaded by hand and people work in the field cutting by hand. They cut some trees by axes. We have introduced chain saws, but some of them still prefer to use axes in some cases.

Mr. BONKER. If you allow this area to be regenerated without planting and silviculture methods and so forth, what are the seeds that are used?

Mr. LADRACH. That is something we are studying. We know that most of the regeneration comes from seed and not from sprouts, whereas many forests in the United States, when cut regenerates from sprouts instead of seeds. We know the forest regenerates from seed, and that the species composition does change. The early forests, the pioneer forests, are different in species composition from the old forests. With time, it begins to change to a species composition similar to the original forest.

Mr. BONKER. What is the difference between pioneer and old forests?

Mr. LADRACH. Trees have different growth rates. Some are quick starters others slow starters.

Mr. BONKER. Just like humans.

Mr. JOHNSON. Like red alder out your way coming in earlier, and the other species coming in later.

Mr. LADRACH. Many people see this, and they are shocked thinking that we are losing the genetic base, but we have studies going on now that project that this forest will renew itself from a volume standpoint in about 30 years or less, and by 15 years, the forest has a very similar species composition in the clearcut areas to that of the original forest.

I would like to point out that this isn't all roses. There is a problem, because when these trees get up to about 4 or 5 years of age, they are of an optimum size for poles, and there is a great demand for such poles. We have a problem with colonists coming in on our concession and cutting poles and selling these. This destroys much of this area.

That is the conflict I mentioned between land reform and forestry. The land reform people are encouraging colonization in this area where it will not support agriculture, so these people have to work the wood.

We are trying to reforest it. We want to cut the second, the third, the fourth rotation. We want to stay in this area. We have a big infrastructure. This is a serious problem, and we are looking at possible solutions, such as growing poles near the cities where they are needed, and a massive, intensive plantation program to try to take some of the pressure off the forest.

The forest will regenerate if man stays out, but unfortunately, man does not stay out when there are access roads, and this is a problem.

Mr. BONKER. Mr. Johnson, Weyerhaeuser has a 20-year contract which commenced in 1970.

Mr. JOHNSON. Right.

Mr. BONKER. We talked about the benefits of intensive management of forests so that there is an opportunity to harvest the new crop when it matures, but that is a 20-year contract which began in 1970, and yet the Indonesian Government expects timber corporations to abide by a 35-year cutting cycle.

What happens if you make a substantial investment in Indonesia and you find that after 20 years the contract expires, and you can't go back and cut for another 15 years, and have no guarantee that you will have that contract when the forest matures?

Mr. JOHNSON. That is certainly a major issue. The 20-year contract came before the regulations on the 35-year cycle, so that is progressive; one followed the other. So, it puts us into a basic conflict. Land tenure in our minds, whether it is land ownership or some sort of contract tenure on the land, is a big issue that we have in developing plantations in the tropics.

Some of the countries, like Brazil and Venezuela, have, I think, solved this quite well. In addition to giving tenure, they have come up with some incentives that make it very attractive to industry, and as I pointed out in the slides, some industries have started from bare land and are already producing pulp within 15 years. It gets back to your

concern about long-term investment. Indonesia has not gotten to this point yet. We have been working with them. There was essentially no forest research done on Kalimantan until we did it. I think they will follow suit with other countries, whether we do it or whether they do it. They will see the benefit of long-term concessions to somebody and long-term licenses, because even the local people don't own the land there. It is all owned by the Government.

Mr. BONKER. Let me ask you a general question. I think this worst-case scenario is valid because with an increase in population and with the rather primitive but desperate need for wood as a fuel source, and for the land as agriculture, we are beginning to appreciate in a far more sophisticated way the benefits that come with the forest in terms of soil and vegetation, and the multiple uses that it has.

Yet these trends are well established. Third World countries may not be sufficiently prepared to protect their forests. We have roads going into forested areas, spreading population and creating urbanization. It contributes to the decline of the forests, and has nothing directly to do with international corporations involved in massive logging projects. Perhaps the Global 2000 Report is based on inflated statistics.

My question is, in working with some of these countries, the leadership, those who are involved in the forestry practices, do you get an indication that there is more sophistication, more consciousness, and new policies that are being developed by these countries to protect their forests? Or are they fairly oblivious to the ultimate consequences of forest depletion?

Mr. JOHNSON. I think it varies by country. I think some of the South American countries have, through their incentive programs, begun to realize that they need to develop forests. New Zealand has gone through that same sort of stage of deforestation, and then has come back with good forests. I think Indonesia is going through that stage now. I think they will get there, but only after the problem becomes so obvious.

It is not unlike what we faced in our own country. The Southeastern United States 50 or 60 years ago was essentially abandoned farmland. It is essentially timber of some kind now.

I think there are some things we can do to help the situation. I don't think there is any one of us sitting here who is not concerned about the demise of the tropical rainforest. We certainly don't want to come here and say that we are not concerned about that, because we think it is going to happen. It is going to fall somewhere between those two scenarios that you mentioned.

A lot of things can be done—one right here in this country. Just keeping our forestry and our agriculture in top condition is going to help the world situation, whether they take care of theirs or not.

Second, demonstrating to them on as low key a basis as we can that they are making the same kinds of mistakes that we made in this country. A lot of the things that Bill mentioned about education and cooperation we need to do.

To answer your question, there are some of these countries that are not yet fully aware of what is happening to them. Some of them are aware, but it is the dollars, the income, that is affecting their thinking.

Mr. BONKER. This subcommittee heard from representatives with international organizations, such as UNESCO, FAO, and the World Bank.

There is a consciousness among these organizations, but I think, however, that they can do much more to educate, train, and assist these countries in dealing with this problem. I imagine there are places in Africa, for instance, such as the Sudan, where there has been a tremendous depletion of the forest and the desertification problem is taking over. When that occurs, there are really dire consequences.

For a stable government to inform a village that they can no longer have access to trees for their fuel supplies and for their grazing, and so forth, is very difficult. They have their own constituency to deal with. But energy is emerging as a major issue as it relates to forests.

As mentioned before, I was impressed by what I saw in China in one of the communes. We were touring a new residential area, and I asked what the source of energy was, because they appeared to have fuel for a little stove burner, and a light. They took me out back, and they had a little hole in the ground about six feet deep in which they placed pig droppings, and that made possible methane fuel, which provided enough energy for the entire neighborhood.

So, there are alternatives, but a lot of education is necessary.

Now, one recommendation that you have, Dr. Gallegos, recommendation No. 4, is that the United States needs to make a major commitment to research and education in tropical forests. I think that ought to be a component of the program, but I think these international organizations have a primary responsibility, and we are going to press our representatives to these agencies to accelerate their forestry programs.

I am pleased to note that you have industry-sponsored efforts that play a role in some of this education.

Let's see, I have two remaining questions. One is on the point raised by my colleague, Mr. Bowen, about environmental impact statements, and the other regards requirements that we would place upon U.S. industries who engage in these practices.

I am informed that Germany and Japan are two countries with corporations involved in logging activities in developing countries, and that they appear to be totally insensitive to environmental concerns and reforestation programs. Would it really put the U.S. multinationals at a competitive disadvantage if we were to make demands upon our own industry and not have equal responsibilities placed on other countries, specifically Japan?

Does the Government of Japan require its multinational corporations to adhere to any specific environmental policies regarding forestry projects?

Mr. JOHNSON. There is one Japanese company that was a neighboring company to ours. They were doing some forestry research. There are also funds available through the Japanese Government for Japanese companies to tap into to do some of this research. So, in that respect, they are really ahead of us.

Mr. BONKER. That is in terms of research, but in terms of actual practice, how would you rate the Japanese and United States industries engaged in forestry projects in other countries?

Mr. JOHNSON. If I were rating them, I would say the American companies I know were probably near the top. I would rate the Japanese fairly high, too, because they have a long-term interest in timber over there. Some of the other companies, the Korean companies, the Taiwanese companies, I would rate further down the line. They seem to have less interest.

The Japanese have a fair degree of interest.

Mr. BONKER. Well, I would greatly disappoint Mr. Smith of Weyerhaeuser Corp. if I didn't ask this final question.

Mr. JOHNSON. Are you going to ask it of Art? [General laughter.]

Mr. BONKER. I noticed that your slides showed some of the logging practices used in the forest. I didn't see many logs being exported from Indonesia. It looks like the emphasis was on local or domestic processing. What is the state of Indonesia's policies these days on requiring domestic processes for export?

Mr. JOHNSON. When they first opened up the forest 10 years ago, the primary interest was to see that companies produced as much log export as they could to get income for the nation; and some of the companies who didn't produce their quotas actually had their concessions taken away from them.

The push by the Government was on log export. They had a law on the books which said, in 7 years—and I said in my comments 50 percent, but the actual figure is 60 percent—would be processed in the country within 7 years.

I would say that within the last 3 years, there has been a great deal of push by the Indonesian Government to get into manufacturing. They are probably approaching somewhere around 30 to 40 percent now, and will get their 50 to 60 percent within a couple of years.

As a consequence, the big industries that were built in Japan, Korea, and Taiwan will go down as a result of no logs.

Mr. BONKER. Say that again.

Mr. JOHNSON. The industry, plywood and lumber industry, is built up in Taiwan, Japan, and Korea.

Mr. BONKER. Yes.

Mr. JOHNSON. They will not get logs any more, either from Malaysia or Indonesia. They will get a very small amount. Some of those industries are in serious trouble right now.

Mr. BONKER. That is hardwood primarily?

Mr. JOHNSON. Yes.

Mr. BONKER. So they won't be able to come to the United States for those logs.

Mr. JOHNSON. I don't know what they will use as alternatives, whether they will go down or try to seek alternatives. But Indonesia is moving to regulate its log exports, to try to get around 50 or 60 percent in country manufacturing.

Mr. BONKER. I would ask the question whether Weyerhaeuser is fighting that policy as vigorously as it is fighting my efforts to change the policy here.

Mr. JOHNSON. I would let Art answer that.

Mr. BONKER. Well, it does make sense for a host country government to do that.

I guess that concludes my questions, and we have to be out of here by 12:30. The National Forest Products Association has been very responsive to the needs of the subcommittee, and we look forward to working with you and with the Interagency Task Force to develop something of a policy. The hearings have been timely, considering the reports note that the export of hardwood from these countries will increase by 75 percent between now and the year 2000. We ought to proceed in such a way that is responsible, but also consistent with other efforts to protect tropical forests.

I think it is short-sighted to concentrate on the 6 percent and ignore the other contributing factors to deforestation. The subcommittee will use its imagination and come up with a different term. I am not sure we can, but I don't think—"alternate"? Is that what you said in your testimony?

Mr. JOHNSON. "Forest alteration."

Mr. BONKER. Forest alteration. What is afforestation? That term was used.

Mr. GALLEGOS. It is reforesting an area where a forest did not previously exist.

Mr. BONKER. That is why I have never heard of the term. The Northwest has so much forest that you couldn't find an acre.

Mr. GALLEGOS. Planting the Venezuelan grasslands that Dr. Johnson referred to demonstrates afforestation.

Mr. BONKER. I see. Well, I want to thank each of the witnesses for your appearance and your testimony today. We will be working with you as we proceed to develop policy regarding tropical deforestation. Thank you, gentlemen.

Mr. GALLEGOS. Thank you.

Mr. BONKER. We will now hear from Mr. Douglas Shane. You may proceed now, Mr. Shane.

STATEMENT OF DOUGLAS R. SHANE, CONSULTANT IN TROPICAL FOREST DEVELOPMENT AND CONSERVATION

Mr. SHANE. Thank you Mr. Chairman.

What I intend to do is try to condense remarks of this 11-page statement which I have submitted to the subcommittee, which has been a condensation of a 200-page report which I did for the Department of State, turned in this March. It was a 9-month study on cattle ranching in the tropics of Latin America.

Mr. BONKER. We appreciate very much having the comprehensive report, which will go into the record, and I appreciate the brevity of your statement.

Mr. SHANE. First of all, I would just like to note that while I have to limit my present remarks this morning to the subject of multinational corporations and the beef cattle industry in the humid tropics, I must leave untouched other equally important and related concerns. But I would like to note that there are other problems that cannot be divorced from the destruction of the tropical forests.

These include unequal land distribution in the lesser developed countries and the use of those countries' fertile lands for the production of export crops, which often results in domestic food shortages.

I would like to note also the extractive nature of the relationships of the industrial nations, the international lending and assistance institutions and transnational businesses in their dealings with the less developed countries.

The last point I would like to note is the failure of all these outside interests to seriously designate and transfer appropriate technology and assistance which could ultimately result in national and regional self-sufficiency.

I would also like to point out that most of these less developed countries would have little or no economic growth if it were not for the presence of foreign investment and the subsequent export of the nation's bounty.

In the testimony that I submitted to the subcommittee Mr. Chairman, I talked about some of the problems of cattle ranching in the humid tropics. Very briefly outlined, I would like to go over them. The problem essentially is that there are generally poor soils throughout the humid tropics. These soils cannot sustain large-scale intensive agriculture and other widespread deforestation activities.

Of course, in addition to cattle ranching and the forestry industry, there are petroleum and other mining activities occurring throughout the humid tropics.

I have compiled a list of 59 corporations that have interests in cattle ranching.

Mr. BONKER. U.S. corporations or all corporations?

Mr. SHANE. Mostly United States, but some are from Belgium, Japan, Switzerland, West Germany——

Mr. BONKER. These are not industrial forestry. This is cattle ranching.

Mr. SHANE. Yes.

Mr. BONKER. Are there non-U.S. corporations engaged in cattle?

Mr SHANE. Basically, United States. There is one here from Belgium. It is Belgium-based. The Adela Investment Co.

Mr. BONKER. What are some of the largest U.S. companies involved in cattle raising?

Mr. SHANE. Albertini International, Armour, Blue Spruce International, Brazilian Land Cattle Packing, which is a U.S. corporation, Brazilian Meat Co., also United States, and Castle & Cooke of Hawaii. Caterpillar machinery manufacturers also have cattle interests in Brazil's Amazon. The list goes on. It is in my prepared statement.

I have also noted international institutions. They range from The World Bank to the Agency for International Development, which lends money and technical assistance for cattle-related activities, although in a declining fashion over the past few years. There is an organization, for example, called the Latin American Agribusiness Development Corp. (LAAD). It was formed in 1970 by the Bank of America and 11 other U.S. corporations. During the 1970's, LAAD received $17 million from the Agency for International Development to promote LAAD's agribusiness interests in Latin America.

Mr. BONKER. Is that particular project in conflict with the deforestation issue?

Mr. SHANE. Many of LAAD's activities are in conflict with conservation or rational exploitation in tropical forest areas.

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Mr. BONKER. I am talking specifically about forestry, because we have one arm of the Federal Government that says, we want to do something about deforestation. We have another arm, in fact, even two fingers in the same AID arm that have policies that are in contradiction. That is my question. Are those agricultural products in contradiction to our efforts to minimize deforestation?

Mr. SHANE. They are in contradiction with our efforts to minimize deforestation, but they are in perfect harmony with our efforts to exploit and extract the natural resources and the agricultural products of the countries involved.

Mr. BONKER. For whose benefit?

Mr. SHANE. For the benefit of the developed countries, as with the case of beef cattle production. I hope that at some point you will have a chance to look over this testimony. You will find that of the beef exported from Central America alone, 90 percent goes to the United States. Central America exports over 50 percent of its beef production. During the last 20 years, most of the tropical Latin American countries have more than doubled beef production and more than tripled beef exports, most of which goes to the United States.

Mr. BONKER. That in itself isn't a problem. The question is, How significantly does that contribute to the deforestation problem? If it doesn't contribute, it is a good enterprise. It is regenerative. It helps economically both that country and our consumer needs here. But if it is a major contributor to deforestation, then that is relevant.

Mr. SHANE. Some authorities working in Latin America estimate that more than one-third of the region's tropical forests have been lost in the last 25 years. In Central America, it is believed that more than two-thirds of the tropical forests have been destroyed over the last three decades, largely due to cattle ranching.

Mr. BONKER. Who states that?

Mr. SHANE. Geographer William Denevan from the University of Wisconsin, among others. And it is expected that at the current rates of deforestation, better than half of the remaining area of Central America's tropical forests will be gone by the end of the century.

Mr. BONKER. So you are saying that America's beef guide is related to deforestation?

Mr. SHANE. Most directly related. It is a cause and effect situation. Our beef imports have risen 137 percent in the last 20 years.

Mr. BONKER. I am wondering whether people within AID exchange notes on these things. It kind of reminds me of when I was a staff assistant in 1964. The Surgeon General's report came out on smoking, to make it very clear that smoking contributed to people's poor health and was a hazard. That is when the label went on the cigarette package. At the same time, the Department of Agriculture produced a movie for $200,000 called "The Wonderful World of Pleasure," to promote cigarette smoking abroad. It is just not very consistent policy. That is something maybe the staff could look at.

Mr. SHANE. If you want to consider the effects of the U.S. beef imports, consider those effects abroad. Beef consumption in those beef-producing countries of Latin America has fallen on an average of 13.5 percent. But in the main beef exporting nations like Costa Rica, Nicaragua, and Honduras, domestice consumption has fallen as much as 47 percent over the last 20 years.

Mr. BONKER. But it has increased here?

Mr. SHANE. That is right. It has increased here at the expense of those nation's domestic consumption, and the U.S. Department of Agriculture noted that as early as 1967 that our increase in importing the beef has been at the expense of the exporting nations. They recognized that, and of course, a nation's health is judged by the way it eats, its diet.

Mr. BONKER. I would like to see more people eat seafood, because I represent a coastal area.

Mr. SHANE. Well, I have no special interest, other than doing what I can to see that tropical forests are utilized along rational guidelines.

Mr. BONKER. A young man the other day consumed an entire tree for which he got a $10,000 award. I wonder if Weyerhaeuser is looking into ways in which it can put the timber resource into our diet.

Mr. SHANE. I wonder if I might ask you to accept my statement that cattle ranching is the main factor in the deforestation of Latin America's tropics. I would like to continue and go over the recommendations that I have.

Mr. BONKER. I just have a few minutes. I won't interrupt you.

Mr. SHANE. The United States, with major political and commercial interests in Latin America, has a number of important roles to perform with respect to the region's economic development and environmental well-being. The Federal Government must recognize and deal with the fact that its trade policies and U.S. private business interests, which often operate with assistance from quasi-public agencies like the Export-Import Bank and the Overseas Private Investment Corporation, directly and indirectly promote the destruction of Latin America's tropical forests.

If the United States and other governments will take responsibility for the rational exploitation of the Earth's tropical forests and other valuable international resources, they must devise ways to control the activities of their own and transnational companies.

The U.S. Government can provide a significant impetus in this direction. First, it must make its policy and rationale known to its private overseas sector. Then, it must insure compliance with the stated U.S. foreign policy objective. U.S. businesses operating abroad should be required to submit environmental impact statements on planned activities and sales of products and technical assistance to the governments of the United States and the host country.

I might also add here that I think U.S. and other transnational corporations have responsibilities that perhaps the U.N.'s new agency on multinational corporations should monitor. These corporations must obey the environmental laws of the countries in which they operate.

I myself have seen situations in Latin America where, despite a country having reforestation laws, logging concessions held by U.S. and other foreign interests were abandoned and left to natural regeneration. But that is not what the law says. The forestry companies were, by law, supposed to reforest. Of course, there are problems in Latin America as there are problems here with enforcing those laws. I understand that. But I think some degree of conformance is absolutely necessary. The seriousness of regional and global environmental

problems has already produced a number of national and international laws and acts. They must be honored.

The United States, under provisions of the Export Administration Act of 1979, the National Environmental Protection Act, Executive Order No. 12114, and other mandates should require private companies operating overseas to be more responsible U.S. representatives and global citizens.

Similarly, the United States and the governments of the other industrial nations should support the activities of the United Nations' Center on Transnational Corporations, and its code of conduct for multinational companies, as well as other U.N. environmental goals.

Congressional legislation and executive action have already determined that U.S. Government agencies with activities abroad must comply with recent amendments to the Foreign Assistance Act. By extension, it seems appropriate that any agency or business receiving U.S. public moneys—from the banks to private agribusiness interests—should be required to comply with U.S. environmental mandates.

Those international financial institutions and private concerns receiving U.S. grants and loans should also be required to make their operations data accessible to the public. For example, trying to get information on the World Bank is like trying to find a needle in a haystack. Even a written request from the State Department on my behalf to obtain information on the Bank's policies, projects and project reports, received no response.

Congress and the executive branch should conduct further investigations on the problems of tropical deforestation and take appropriate actions to aid in correcting this critical situation.

The United States imports approximately 17 percent of the beef it uses domestically each year. Of that, 1.7 percent comes from tropical Latin America. I suggest that the United States consider banning the import of beef raised in tropical areas of Latin America.

Mr. BONKER. That would mean a corresponding increase for the consumer.

Mr. SHANE. In tropical Latin America it could mean that. Or better yet, it could encourage Latins to use their land more productively. Cattle ranching is one of the poorest ways to use land. One gets more protein yield from crops.

Mr. BONKER. To be fair, when we moved westward in this country, and as we developed our agricultural base, a lot of it came at the expense of deforestation. It has really helped to make us one of the agricultural wonders of the world.

Mr. SHANE. I think that wonder is based on the good soils which this country has been blessed with.

Mr. BONKER. Mr. Shane, I hate to do this, but I am going to have to leave.

Mr. SHANE. I'm sorry.

Mr. BONKER. But you are the only witness to have two appearances before this subcommittee.

Mr. SHANE. Thank you very much.

[The prepared statement of Douglas R. Shane follows:]

Prepared Statement of Douglas R. Shane, Consultant in Tropical Forest Development and Conservation

On the Role of Multinational Corporations in the Conversion of Tropical Forests for Cattle Ranching and Related Concerns

MR. CHAIRMAN AND MEMBERS OF THE SUBCOMMITTEE:

My name is Douglas R. Shane. During the past four years I have been involved in the problems concerning the development and conservation of the world's tropical forests, particularly those of Latin America. In 1977-78, on behalf of Canada's National Museum of Natural Sciences, I conducted a survey of development projects and conservation efforts in the tropical forest areas of thirteen Latin American nations. During the nine months which I spent in the eight nations of Middle America and five Amazon Basin countries, I met with more than 150 individuals - government planners and administrators, scientists, businessmen, colonists and workers, and foreign assistance officials from industrialized nations. Since returning to North America in January of 1978, I have written three reports pertaining to the destruction of tropical forests and assisted with the compilation of two others; consulted with government and private agencies as well as numerous individuals; and on many occasions I have presented an illustrated lecture before the public, U.S. government officials, and members of the academic community which graphically depicts the myriad problems concerning the development of the humid tropics.

My concerns for the future of tropical forests are essentially two-fold: one, because of the critical roles they play in regional and global environments, and because of the known benefits which they yield, as well as their yet-undiscovered potential - points which have already been presented before these hearings - I am convinced that the preservation of the earth's tropical forests is essential to Mankind's survival on this planet; and second, as a naturalist, I believe that all forms of life must be protected from man-made extinctions.

We are here because the earth's vital tropical forests are threatened with total - or near total - destruction within our lifetime. The Food and Agricultural Organization of the United Nations estimates that globally some 50 acres of tropical forest are destroyed every 60 seconds, totalling 27 million acres per year.

The causes of this destruction include forestry-related industries; spontaneous and government-sponsored colonization by the landless poor of the nations involved; engineering projects, which include the flooding of large tracts of forest for hydroelectric projects, exploration for petroleum and other minerals, and the construction of roads which increase access to what were previously wilderness areas; and efforts to utilize the poor soils of the humid tropics for the production of agricultural crops and pastures for beef cattle.

While many of the projects undertaken in tropical forest areas are viewed by their proponents as necessary - and even feasible - in the short term, large-scale tropical deforestation has repeatedly been shown to be productively unsustainable while producing severe negative environmental effects in the regions where it has occurred. Of all the aforementioned development activities, the conversion of tropical forests for agrarian purposes - particularly for cattle ranching - is generally thought to be the most pervasive element in the destruction of Latin America's tropical forests.

I have been invited before this Subcommittee to present testimony on the role of multinational corporations in the conversion of tropical forests for cattle ranching. In March of this year I completed a nine month study for the U.S. Department of State's Office of Environment and Health. The result of this effort was a report entitled Hoofprints on the Forest: An Inquiry Into the Beef Cattle Industry In the Tropical Forest Areas of Latin America. During the course of the study more than 80 individuals were interviewed and some 330 references consulted. I sought answers to what seemed liked straightforward questions concerning the nature of the beef cattle industry in the humid tropics of Latin America: what national and international agencies, businesses and individuals are involved; is it, or can it be made to be, productive over time on the same pasture lands; what are the problems encountered by cattlemen in the humid tropics; how much tropical forest is actually being converted into pasture land and what, if any, are the environmental consequences; and how much beef is being exported from Latin America, where does it go, and how is it used? The answers to these questions, I found, are often obscured by a lack of factual knowledge, misconceptions, and a secrecy which sometimes shrouds the interests of both the producers and the users of Latin American beef.

I must limit my present remarks to the subject of multinational corporations and the beef cattle industry in the humid tropics, and leave untouched other equally important - and related - concerns. But I must say that the problems

of unequal land distribution in the less developed countries (LDC's) and the use of those countries' most fertile lands for the production of export crops, which often results in domestic food shortages; the extractive nature of the relationships of the industrial nations, the international lending and assistance institutions, and transnational businesses with the LDC's; and the failure of all outside interests to seriously designate and transfer appropriate technology and assistance which could ultimately result in national and regional self-sufficiency, cannot be divorced from the destruction of the earth's tropical forests. Each of these issues deserve the attention of this Subcommittee and other relevant bodies of the legislative and executive branches of the United States government.

Multinational corporations and foreign individuals operate within a host country with that government's permission. Indeed, many LDC's believe it to be in their national interest to encourage the development of their natural resources and frontier lands for the purposes of creating much needed foreign exchange and alleviating high unemployment. To this end, many tropical nations - most notably Brazil - have offered lucrative tax incentives to businesses, both foreign and domestic, and individuals, to extract minerals and timber products and to convert forests to pasture lands for beef cattle. But as a new awareness of the economic and environmental consequences of these actions dawns on the Third World, an increasing number of nations are finding themselves caught in the terrible dilemma of having to export or beg. In today's world, most LDC's would have little or no economic growth if it were not for the presence of foreign investment and the subsequent export of their nation's bounty.

Before 1960, the beef cattle industry in Latin America was largely confined to the region's temperate zones. But three factors, then as now, caused cattle ranching to expand into the tropical forest areas of Latin America: 1) the best lands were already in use for the production of crops and permanent pastures; 2) a growing demand for beef for both domestic and export markets; and 3) government encouragement to open up and utilize inexpensive tropical forest frontier areas.

Until recently it mattered to few that an activity like cattle ranching could not be sustained on the same lands for longer than a few years. The cattlemen simply cleared new sections of forest, planted their exotic grasses, and moved the herd - leaving behind a "red desert" which had little or no chance to support vegetation of value to man or animal. Often the new pasture lands were purchased - or taken from - colonists who could no longer scratch a living from the poor laterite soil.

While cattle raised in the humid tropics generally require from 2.5 acres per head in the best of situations to 17 acres per head as the land loses its fertility, converting vast areas of forest to pasture has presented little problem. Ranching interests use large tractors, chainsaws and herbicides to clear vegetation. The

problems come later when declining soil fertility produces grasses with little or no nutritional value; when one or a combination of the numerous infectious and parasitic diseases and poisonous weeds so common in the tropics decimate the herds; and finally, when dangerous chemicals like DDT and "Agent Orange" are found in the cattles' flesh.

But still cattlemen can maintain that their operations are "profitable." This is so because tropical forest lands are relatively inexpensive; because cattle ranching provides few jobs for Latin America's cheap labor force; because while beef brings good prices on domestic markets for those who can afford it, it earns even more in international markets; and because the generous tax incentives offered by governments like Brazil's allow individuals to use some 50 percent of their income taxes for cattle-related development.

Opponents to cattle ranching in the humid tropics view it as a "quick and dirty" activity, likening it to mining, in which "men extract as much as they can with as little input as possible." And like other development activities occurring throughout Latin America's tropical forest areas, it is bitterly noted that cattle ranching encroaches on the lands of colonists and aboriginal peoples, with dire consequences for both.

In addition to these views, it is also argued that cattle ranching is a poor converter of energy to protein and that it is a less productive form of land use than other forms of agriculture such as multiple-cropping systems, the harvesting of natural forest products, or sustained-yield forestry operations. Proponents for these and other methods of tropical forest utilization maintain that the large areas of land necessary for grazing cattle throughout Latin America would benefit the population of each country considerably if they were used to produce food for the region.

While numerous private and public foreign interests are involved directly and indirectly with Latin America's beef cattle industry, the majority of the cattle ranchers and exporters of the region's beef appear to be native Latin American individuals and companies with the capital to invest in and/or operate cattle ranches and slaughterhouses. There exists, however, a question as to what percentage - if any - of the lines of credit extended for cattle ranching activities are derived from loans and grants made to the national banks and businesses in the countries involved by foreign sources such as the World Bank, the Inter-American Development Bank, private banks in the developed nations, and foreign assistance loans from United Nations agencies and countries like the United States. It seems reasonable to assume that the increasing demand for beef in the developed nations would permit - if not encourage - assistance funds to be applied toward the production of desired commodities for export.

In addition to direct loans and grants for the development of cattle ranching, numerous indigenous and foreign government and private agencies and interests are involved in promoting Latin America's beef cattle industry through research and the provision of technical assistance.

Among those international institutions and bilateral assistance agencies providing funding and/or technical assistance for beef cattle ranching to Latin American nations with areas of tropical forest are the World Bank; the Inter-American Development Bank; the Organization of American States; various United Nations agencies such as the Food and Agricultural Organization, the United Nations Development Programme, the Economic Commission for Latin America (CEPAL), the United Nations Environment Programme, and the United Nations Conference on Trade and Development; the U.S. Agency for International Development; the U.S. Department of Agriculture; the Peace Corps; the Export-Import Bank of the United States; and the Overseas Private Investment Corporation.

Among the private sector based in the United States, those stimulating cattle ranching in the humid tropics of Latin America include the Latin American Agribusiness Development Corporation (LAAD), which was formed in 1970 by the Bank of America and eleven other U.S. corporations. During the 1970's, LAAD received three loans totalling some $17 million from the U.S. Agency for International Development to support its activities in Latin America. Other private organizations promoting Latin America's beef cattle industry are the Council of the Americas; the Chamber of Commerce of the United States and its International Division; the Association of American Chambers of Commerce in Latin America; and the Brazil - U.S. Business Council.

A detailed, and often incredible, analyses of the dealings of these public and private sector institutions may be found in Part Three of the report, Hoofprints On the Forest.

Material reviewed and individuals consulted relate that the following U.S. and other foreign interests are among the thousands of companies and individuals engaged in cattle-related activities in the tropical forest areas of Latin America. This rudimentary list also includes financial and technical support given by international banking institutions and assistance agencies. Few private banks can be listed with certainty; doubtless many more provide financing for cattle projects. Also not listed are the rural development and colonization projects with cattle components promoted by individual Latin American governments which may receive foreign assistance. It should be noted that the corporations listed below generally control dozens of subsidiaries in one or more countries, with interests ranging from financing and ranching to processing and marketing.

Among those corporations with interests in cattle ranching in Latin America's humid tropics are: ADELA Investment Company (Belgium); Agrodinamica Holding Company (Costa Rica); Albertini International (USA); Armour (USA); Barclays Bank (Great

Britain); BCN (Great Britain); Blue Spruce International (USA); Brascan (Canada); Brazilian Land Cattle Packing (USA); Brazilian Meat Company (USA); John W. H. deBuys Roessingh (Switzerland); CARNIC (formerly Somoza of Nicaragua); Castle and Cooke (USA); Caterpillar (USA); Chamber of Commerce of the United States (USA); Commerzbank A.G. (West Germany); Council of the Americas (USA); Deltec International (USA); Dow Chemical (USA); Ester Research Instruments (Panama); Export-Import Bank of the United States (USA); Gestrus Reemtsma (West Germany); Heublein (USA); Iamooka Realty (Japan); Inter-American Development Bank; International Chamber of Commerce (Paris headquarters) International Foods (USA); International Packers (USA); International Research (USA); Kanamatsu Gosha (Japan); King Ranch (USA); Latin American Agribusiness Development Corporation (Panama-USA); Le Tourneau (USA); Liquigas (Italy); Marubeni (Japan); Georg Markhof (Austria); Massey-Ferguson (USA); McDonald's (USA); Mercedes Benz (West Germany); Mitsui (Japan); National Bulk Carriers (USA); Nichimen and Grupo Bradesco (Japan); Ogden (USA); Organization of American States; Overseas Private Investment Corporation (USA); Peace Corps (USA); Ralston Purina (USA); Seminole Steel Erectors (USA); SIFCO Industries (USA); Standard Brands (USA); Swift (USA); Tsuzuki Spinning (Japan); Twin Agricultural and Industrial Developers (USA); United Brands (USA); United States Agency for International Development; United States Department of Agriculture; Volkswagen (West Germany); World Bank; and W. R. Grace.

What this information about the scale of foreign investment in Latin America's beef cattle industry actually "means" - apart from the environmental consequences - can be seen in the following information, gleaned from U.S. Department of Agriculture statistics.

Beef production in tropical Latin America has generally doubled in the last two decades while production in the region's temperate countries - the traditional producers of Latin American beef - has grown little and, in some cases, has actually declined. Several tropical countries, including Costa Rica, Guatemala, Honduras and Nicaragua, have more than doubled beef production and tripled beef exports since 1961. Conversely, beef exports to the industrial nations of the West have risen sharply over the last 20 years.

Despite the increases in beef production in tropical Latin America during this period, some authorities show that per capita consumption of beef in the region has generally declined between 1960-74 by 13.5 percent while the region's population grew at a rate of 2.9 percent. Of the major beef producing countries, the percentages by which per capita consumption has fallen are: Bolivia, 15.4; Colombia, 19.0; Costa Rica, 41.2; El Salvador, 37.5; Guatemala, 12.5; Mexico, 22.2; Nicaragua, 12.5; Paraguay, 44.7; and Peru, 12.5. Only Ecuador, Panama and Venezuela showed increases in domestic per capita consumption of beef while Brazil, Honduras and Guyana showed no change. Information for Belize, French Guiana and Surinam was not available.

Other sources, in agreement that per capita consumption of beef has declined due to increasing exports and rising populations, note that countries like Costa Rica, Honduras and Nicaragua have, over the last decade, consistently exported 50 or more percent of their total beef production. As a result of increasing domestic scarcity, the cost of beef in the exporting countries continues to rise beyond the purchasing power of the majority of local populations. As long ago as 1969, the Foreign Agricultural Service of the U.S. Department of Agriculture recognized that "the considerable growth in meat exports in recent years has been at the expense of domestic beef consumption."

Beef is exported from Latin America to a number of developed nations, notably the United States, Japan, and the countries of Western Europe's Common Market. Most Latin American beef comes to the United States because of attractive prices and tariffs and because of its geographic proximity. Indeed, some 90 percent of Central America's beef exports are shipped to the U.S.

U.S. beef imports have risen by 137 percent over the last 20 years. U.S. Department of Agriculture figures reveal that 7.6 percent of all beef consumed in the United States during the past decade had been imported. In 1979, the United States imported ten percent of the beef which its inhabitants consumed, with 17 percent of all imports coming from tropical Latin America.

U.S. cattlemen have long considered beef imports to be deleterious to domestic production and prices, a view which was shared by the Senate Committee on Finance in 1963. However, a 1977 study - conducted by the U.S. International Trade Commission concerning competition in U.S. markets between domestic and foreign live cattle and cattle meat - concluded that beef imports did not cause "serious injury" to the U.S. cattle industry.

An official of The Meat Importers Council of America, who is also president of the Tupman Thurlow Company - one of the largest U.S. users of imported beef - says that because of escalating domestic demands for beef, U.S. prices would skyrocket without imports. A spokesman for the National Cattlemen's Association, which represents U.S. beef interests, noted that the United States is the world's largest producer of beef and could produce all of the country's beef needs, "at a price." If beef prices were to rise too high, he speculated, American consumers would purchase more pork and poultry.

Once imported beef is cleared by U.S. authorities, it goes either directly to the manufacturer or to a meat broker who sells it to the meat processing trade. Following its acceptance to the U.S., imported beef is no longer monitored by the federal government. Upon its arrival at the manufacturer's or the brokers, the beef literally loses its imported "identity" and gains U.S. status.

Beef imported by the United States is used in hamburger and ground beef, as stew and corned beef, as inexpensive cuts of meat in supermarkets and in family-style steak houses, and in a variety of processed meat items like frankfurters, bologna, salami, pepperoni and other luncheon meats and sausage products. Cooked and canned beef imports - which come from South America -are used in the manufacture of frozen and canned processed foods. Products using this type of beef include canned stew, soup, chili, frozen precooked dinners and pot pies and baby and pet foods.

Increasing food costs and the phenomenal growth of the U.S. fast food industry have led to a shift by consumers toward less expensive, lean meat - such as that imported from Latin America. Fast food franchise outlets in the United States rose 81 percent in number from 32,000 units in 1972 to 59,000 units in 1978. Asked what, if any, of imported beef is used in their product, the majority of national hamburger chain representatives responded that their companies used only U.S. beef. There is the possibility, however remote, that some vendors of hamburger and other beef products may be unaware of the geographic origin of the beef which they use. As previously noted, once imported beef enters the manuafacturing trade, it essentially becomes a grade of U.S. beef.

The problem of who uses imported beef becomes something of a non-issue when considered against the accelerating destruction of Latin America's tropical forests by cattle ranching and other interests and the ever increasing demand for beef in the United States and throughout the world.

The importance of the earth's tropical forests and the implications of their threatened demise are beginning to be understood by decision-makers in both tropical countries and in the developed nations. But unless immediate actions are taken to forstall their destruction, the tropical forests - which provide man with hardwoods, pharmaceuticals, genetic stock for the maintenance and improvement of the world's major agricultural crops, fresh water, and thousands of other products - could be largely gone by the early 21st Century, their benefits denied to future generations.

The United States, with major political and commercial interests in Latin America, has a number of important roles to perform with respect to the region's economic development and environmental well-being. The federal government must recognize and deal with the fact that its trade policies and U.S. private business interests, which often operate with assistance from quasi-public agencies like the Export-Import Bank and the Overseas Private Investment Corporation, directly and indirectly promote the destruction of Latin America's tropical forests through forestry, mining, cattle ranching and other agribusiness activities.

If the governments of Latin America, the United States and other involved nations will take responsibility for the rational exploitation of the earth's tropical forests

and other valuable "international" resources, they must devise ways to control the activities of their own and transnational companies. The U.S. government can provide a significant impetus in this direction. First, it must make its policy and rationale known to its private overseas sector. Then, to ensure compliance with a stated U.S. foreign policy objective, U.S. businesses operating abroad should be required to submit environmental impact statements on planned activities and sales of products and technical assistance to the governments of the United States and the host country.

The seriousness of regional and global environmental problems has already produced a number of national and international laws and acts. The United States, under provision of the Export Administration Act of 1979, the National Environmental Protection Act, Executive Order No. 12114 and other mandates, should require private companies operating overseas to be more responsible U.S. representatives and global citizens. Similarly, the United States and the governments of other industrial nations should support the activities of the United Nations Centre on Transnational Corporations and its code of conduct for multinational companies as well as U.N. environmental goals.

Congressional investigation and Executive action have already determined that U.S. government agencies with activities abroad must comply with recent amendments to the Foreign Assistance Act. By extension, it seems appropriate that any agency or business receiving U.S. public monies - from the banks to private agribusiness interests - should be required to comply with United States environmental mandates. Those international financing institutions and private concerns receiving U.S. grants and loans should also be required to make their operations data acessible to the public.

Both Congress and the Executive should conduct further investigations into the problems of tropical deforestation, and take appropriate actions to aid in correcting the situation.

While the demand for beef in all countries of the world continues to increase, the United States - as the principal importer of Latin American beef - must adpot a stringent policy toward the problem of cattle ranching and its relation to tropical deforestation. What must be understood is that although beef imports from tropical Latin America comprise only about 1.7 percent of all beef consumed annually in the United States, cattle ranching in the humid tropics is generally unsustainable and environmentally destructive.

Unless cattle ranching can be shown to be a sustainable activity, the United States should consider banning the importation of beef produced in tropical Latin America. In his 1980 State of the Union message, President Carter noted that in 1979 the United States reduced overall petroleum consumption by eight percent and gasoline consumption by five percent below the previous year. While it is recognized that petroleum conservation is necessitated by higher prices and reduced supplies, if the United States used only two percent less beef, or imported it from non-tropical producers, tropical Latin countries may be encouraged to diversify their agricultural

production while making more beef available for domestic and regional consumption. Whether other current importing nations would then use the "excess" beef is questionable. Japan obtains most of its beef from Australia and New Zealand while Western Europe imports some 7.8 percent of the beef which it consumes from various countries which include the United States, Canada, Australia, New Zealand and Latin America. Transportation costs and the high tariffs on beef currently imposed by European nations would probably not make beef production in tropical Latin America as profitable as it is at present.

An alternative to a total import ban on beef produced in Latin American countries with areas of tropical forest would be a government restriction that only beef raised on non-forest lands may be exported to the United States. This would be possible, although admittedly difficult to enforce, since the origins of all beef to be exported to the United States must be documented by processors in each country. This is done primarily to enable inspectors to trace the sources of meat showing unacceptably high residues of chemicals. Even if a partial ban of Latin American beef exports were not effected, such monitoring would provide much needed information on how much beef is actually being exported from ranches in tropical forest areas. It is realized that if a full or partial ban were placed on Latin American beef and U.S. consumer demands continued to rise without the difference being absorbed by other beef exporting nations, higher domestic meat prices would result. Certainly, the higher price to pay would be world without a biological future.

In recent years many of the major lending institutions and assistance agencies have developed environmental guidelines for the projects which they undertake with host governments. Yet each continues their involvement by the construction of new roads and rural development projects with cattle ranching components, bringing man and forest together in a mutually destructive confrontation. Unfortunately, attempts at promoting economic growth and striving for increased standards of living for a larger segment of the world's population almost always seems to preclude environmental stability - no matter where it occurs on the planet.

If the issue of tropical deforestation is accepted as a global problem, the leading institutions - including the World Bank, the Inter-American Development Bank and the other regional banks, the United Nations Development Programme and the Food and Agricultural Organization, the Organization of American States, and bilateral assistance agencies like the U.S. Agency for International Development - must continue to seek more innovative and appropriate programs which will directly benefit the people of the less developed countries.

In recognition of the mounting economic problems of donar nations, it has been projected by the World Bank and others that aid to the Third World will decline over the next several years. Thus, not only must less developed nations pursue more rapid growth of trade among themselves and diversify their exports to industrial nations -

to include products processed from indigenous raw materials - but international agencies must largely abandon programs that continue to bolster traditional commodities and non-labor intensive development.

While multinational corporations and other foreign companies operating in Latin America facilitate the dissemination of technology - usually pertaining to agriculture - the focus of their activities has largely been directed at extractive enterprises. Since rising Gross National Products make several Latin countries ineligible for U.S. economic assistance, and because the needs of all less developed countries continue to exceed the funding capabilities of public institutions, investment from the private sector remains a necessity. Unfortunately, a combination of foreign debts, misguided government development policies and international market demands have resulted in a gap between self-sufficiency and economic ruin. It cannot be emphasized enough that the world's less developed countries will probably never be able to improve their domestic well-being so long as their economies are oriented to the production and export of food products and raw materials for the industrial nations.

While it is expected that the relationship between private business and the LDC's will continue to expand, there are several steps that should be considered to help alleviate the problems of Third World economies and environmental degradation. In regognition of their importance, the developed nations should increase and stabilize prices for Third World commodities and lower tariffs on processed and raw materials. Because the debts of the less developed nations continue to rise - by 16 percent since 1976 - consideration should be given to forgetting past debts, as already done by Canada, Sweden and the United Kingdom in some instances.

The concept of a New International Economic Order, which entails a restructuring of exchanges and the more equitable sharing of global resources, presently offers an improved vision for man's survival on this planet. Until the new opportunities are realized, all governments have a responsibility to resist economic exploitation by business interests, both domestic and foreign, and to ensure that large profits realized from their activities are not exported to be invested elsewhere.

Other recommendations dealing with the problems of cattle ranching in the humid tropics and the international order may be found in Part Five of Hoofprints On the Forest. Much of the commentary which I have offered today has been taken from this report. Because a deeper examination of these and other related matters are considered in the report, I ask that Hoofprints On the Forest be considered for inclusion in the record of this hearing.

I thank you for the opportunity to make these remarks and for your consideration. In closing, I would like to quote the slogan of the Ecology Party of Great Britain: "We do not inherit the earth from our fathers - we borrow it from our children."

Mr. BONKER. Thank you very much.
I know that on the staff level, we will continue to work with you.
The subcommittee stands adjourned.
[Whereupon, at 12:35 p.m., the subcommittee adjourned, to reconvene at the call of the Chair.]

APPENDIX 1

U.S. Policy Recommendations of the Interagency Task Force on Tropical Forests [1]

This Nation's aspirations and commitments for improved tropical forest management should be set forth in a general statement of U.S. policy. Such a policy statement would have both symbolic and pragmatic value. It would help U.S. officials proclaim U.S. interests and positions on tropical forests in international fora. And, it would encourage and assist U.S. public and private institutions in designing and justifying new programs in this field.

The following general statement of U.S. policy is thus recommended—a statement that subsumes and directs U.S. goals, strategies, and programs proposed in Chapters 8 and 9.

It is the policy of the United States to:

1. Recognize the importance and vulnerability of tropical forests in the conduct of this Nation's domestic and international affairs.
2. Pursue, in concert with other nations, policies and programs to sustain the integrity and benefits of tropical forests, as part of a broader effort to protect and maintain basic life-support systems.
3. Collaborate internationally, working through both bilateral and multilateral channels, to increase the social and economic benefits obtained from tropical forests, while concurrently protecting environmental values.
4. Support other nations' efforts to improve their standards of living in a manner that will reduce destructive pressures on the forest resources on which they depend.
5. Encourage an international investment climate for private and public capital which stimulates and rewards sound forest management practices and efficient forest resource use.
6. Contribute to the international effort to designate and maintain representative tropical forest areas, such as biosphere and ecological reserves, national parks, wildlife refuges, natural areas, and multiple-use forests.
7. Seek to protect and manage U.S. tropical forests in an exemplary fashion.
8. Conduct a strong domestic research and development program designed to help the international community maintain, protect, and manage tropical forests—and share the results widely.
9. Expand training and educational programs in U.S. public and private institutions to increase the pool of U.S. expertise on tropical forests, and to provide expanded opportunities for participation by specialists and students from other countries.
10. Encourage and assist U.S. public and private institutions to pursue their overseas programs and activities in a manner that promotes good stewardship of the host countries' forest resources.
11. Promote a strong partnership between U.S. public and private sectors in support of this policy.

[1] Taken from a report to the President, released May 1980.

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APPENDIX 2[1]

Africa and Middle East

For political and ecological reasons the Africa and Middle East region was subdivided into the following four categories: Sahel, other West Africa, East Africa, and North Africa and Middle East.

Sahel

The Sahelian countries are plagued with serious deforestation and desertification problems. The depletion of the forests is rooted in overcutting for firewood and charcoal production, overfarming, overgrazing, and fire. Economic, climatological, and social factors such as clearing land for agricultural settlements, urbanization, higher petroleum prices, animal grazing in ecologically marginal zones, and prolonged drought all contribute to the shrinking supply of fuelwood and to a shrinking forest base.

Numerous donor organizations are involved in the Sahel countries, usually coordinated through two counterpart organizations, Comité Permanent Interétats de Lutte Contre la Sécheresse dans le Sahel (CILSS), and Club des Amis du Sahel. CILSS, established in 1973 in Ouagadougou, Upper Volta, is an organization composed of recipient countries to identify project needs and secure donor financing. The Club des Amis du Sahel is a part of the Organization for Economic Cooperation and Development (OECD), which is composed of 24 donor countries. Most project activities in the Sahel countries are cleared through these organizations.

Table 1 shows the summary of Sahel projects taken from Appendix I. The dominant emphasis is clearly on conservation projects with nearly $37 million in ongoing projects and about $45 million in the proposal stage. In terms of total funding (aggregate of completed, ongoing, and proposed activities), conservation projects account for 43 percent. The second largest category is reforestation (33 percent), followed by integrated development projects (11 percent). In a total sense, proposed activities far outweigh those ongoing and recently completed. This is clearly a reflection of a strong, renewed interest in forestry among the donor community. The countries receiving most ongoing forestry aid are Senegal, followed by Mauritania and Cape Verde. Proposed activities are greatest for Mali and Senegal.

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[1] Appendixes 2 through 5 contain a general overview of recently completed, ongoing, and proposed forestry activities by each geographical region. Tables 1 through 6 summarize the recently completed (after 1976), ongoing, and proposed forestry activities by individual countries. The summaries, taken from the Appendix I list of projects, show relative weights given to each major activity category in individual countries. The relative weight is measured in terms of the aggregate amount of money spent or projected to be spent for projects within each category. These dollar magnitudes are rough indications only, as they sometimes represent annual budgets and other times the total budget for the entire project. Furthermore, cost figures for some projects are not available, nor is accurate information usually available on the amount of money earmarked for forestry components of larger scale, integrated development projects. In the latter case, the assumption is made that 5 percent of the total amount shown represents the cost of the forestry component. Based on interviews with several donor organizations this assumption is realistic. The intent of the tables is to say, with some degree of assurance, that relatively greater emphasis is placed on certain countries within a region and on certain categories of projects.

Other West Africa

The other West African countries are not organized as are the Sahelian countries, and hence do not have the benefit of a group such as CILSS to coordinate donor activity. Table 2 shows the forestry activities carried out by donor organizations in these West African countries. Proposed activities outweigh the ongoing ones by more than 6 to 1. Industrial activities are more prominent, followed by reforestation projects. In terms of total funding, industrial projects account for 44 percent and reforestation projects account for 36 percent. Liberia is by far the major recipient of ongoing forestry assistance, followed by Nigeria as a distant second. Ivory Coast and Cameroon will boost their forestry activities substantially if current proposals are implemented.

East Africa

Table 3 summarizes the forestry projects carried out by donor agencies in the East Africa region. Total funding for recently completed, ongoing, and proposed forestry projects is slightly over $1 billion. The three main recipients are Malawi, Tanzania, and Zambia, which together account for slightly more than 86 percent of total funding. Most of the funds are for industrial projects which account for almost 88 percent of the total funding. Overall, proposed activities far out-weigh both those recently completed and ongoing. Although Uganda has donor-assisted forestry programs, funding levels were not available and are not included in this report.

North Africa and Middle East

Table 4 is a summary of the forestry projects carried out by the donor agencies in the North Africa and Middle East region. Total funding for recently completed, ongoing, and proposed forestry projects is nearly $140 million. Main recipients are Turkey, Tunisia, Egypt, and Morocco, which together account for over 90 percent of the total funding.

Industrial and integrated development activities account for over 90 percent of the total funding. Overall, ongoing activities far outweigh both recently completed and proposed activities. Although Syria and Lebanon have donor-assisted forestry programs, funding levels were not available and are not included in this report.

Table 1.--SAHEL. Summary of donor agency expenditures by country, forestry activity, and project status (in $1,000 U.S.)

Forestry activity	Cape Verde	Chad	Gambia	Mali	Mauritania	Niger	Senegal	Upper Volta	Sahel Regional	Total
Industrial:										
Completed	--	--	--	--	--	--	--	--	--	--
Ongoing	--	180	--	--	--	--	--	--	--	180
Proposed	--	220	--	7,091	--	--	--	--	--	7,311
Conservation:										
Completed	--	24	20	--	7	520	4	--	--	575
Ongoing	4,518	--	--	--	8,561	2,636	15,850	5,343	--	36,908
Proposed	1,116	7,715	--	16,926	10,415	4,439	2,320	2,500	--	45,431
Education:										
Completed	--	--	--	--	--	--	--	--	--	--
Ongoing	--	--	--	--	355	300	300	2,635	3,075	6,665
Proposed	97	759	--	600	--	--	1,696	--	2,210	5,362
Research:										
Completed	--	--	--	270	--	--	--	--	--	270
Ongoing	--	--	--	190	38	141	--	--	--	369
Proposed	124	--	--	--	--	--	--	--	4,150	4,274
Reforestation/ afforestation:										
Completed	--	--	--	--	--	--	--	3,500	--	3,500
Ongoing	9,885	935	--	2,674	6,021	3,115	2,658	5,281	--	30,569
Proposed	--	2,400	2,500	10,410	10,000	2,842	5,041	--	--	33,193
Integrated development:										
Completed	--	--	--	--	--	--	--	--	--	--
Ongoing	--	366	--	--	--	262	1,292	--	--	1,920
Proposed	--	--	1,500	--	--	1,772	18,669	--	--	21,941
Technical/ administrative/ management assistance:										
Completed	--	--	--	--	--	--	--	--	--	--
Ongoing	--	--	--	--	--	--	--	--	--	--
Proposed	--	--	--	--	--	--	--	--	--	--
Total:										
Completed	--	24	20	270	7	520	4	3,500	--	4,345
Ongoing	14,403	1,481	--	2,864	14,937	6,454	20,100	13,259	3,075	73,694
Proposed	1,337	11,094	4,000	35,027	20,415	9,053	27,726	2,500	6,360	117,512

Table 2.--OTHER WEST AFRICA. Summary of donor agency expenditures by country, forestry activity, and project status (in $1,000 U.S.)

Forest activity	Benin	Cameroon	Central African Republic	Congo	Dahomey	Gabon	Ghana	Guinea	Ivory Coast	Liberia	Nigeria	Sierra Leone	Togo	Zaire	Total
Industrial:															
Completed	29	--	--	--	--	--	--	--	--	815	--	173	--	--	1,017
Ongoing	592	--	--	--	--	948	2,404	--	--	9,600	--	--	--	--	13,544
Proposed	1,100	37,000	--	15,000	--	--	--	--	--	--	--	--	--	--	53,100
Conservation:															
Completed	--	--	--	--	--	--	--	--	--	--	44	--	--	--	44
Ongoing	674	--	--	--	18	--	25	--	--	6	151	--	--	--	874
Proposed	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Education:															
Completed	--	--	--	--	--	--	--	659	--	823	334	3	--	--	1,819
Ongoing	--	--	--	--	--	343	--	--	--	--	677	--	--	--	1,020
Proposed	--	1,680	--	--	--	--	--	--	--	--	--	--	--	--	1,680
Research:															
Completed	--	--	--	--	--	--	--	--	--	--	242	--	--	435	677
Ongoing	--	221	--	--	--	--	280	--	3,400	--	1,370	--	--	--	5,279
Proposed	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Reforestation/ afforestation:															
Completed	--	--	--	--	--	--	--	--	--	--	124	--	--	--	124
Ongoing	--	--	--	--	--	--	--	--	--	--	400	--	501	--	901
Proposed	--	--	--	--	--	--	--	300	54,400	--	--	--	--	--	54,700
Integrated development:															
Completed	--	--	--	--	--	--	--	--	--	330	1,691	--	--	--	2,021
Ongoing	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Proposed	--	2,650	--	--	--	--	--	--	--	--	3,965	10,100	--	--	16,715
Technical/ administrative management assistance:															
Completed	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ongoing	--	--	180	222	--	--	--	--	--	165	1,004	72	--	--	1,643
Proposed	--	--	--	--	--	--	--	2,000	--	--	659	--	--	--	2,659
Total:															
Completed	29	--	--	--	--	--	--	659	--	1,968	2,435	176	--	435	5,702
Ongoing	1,266	221	180	222	18	1,291	2,709	--	3,400	9,771	3,610	72	501	--	23,261
Proposed	1,100	41,330	--	15,000	--	--	--	2,300	54,400	--	4,624	10,100	--	--	128,854

Table 3.--EAST AFRICA. Summary of donor agency expenditures by country, forestry activity, and project status (in $1,000 U.S.)

Forest Activity	Botswana	Burundi	Djibouti	Ethiopia	Kenya	Lesotho	Madagascar	Malawi	Mauritius
Industrial:									
Completed	--	--	--	--	--	--	--	--	--
Ongoing	--	2,897	--	--	100	--	49	--	--
Proposed	--	--	--	--	--	--	--	500,000	--
Conservation:									
Completed	--	--	--	10	19	--	--	--	--
Ongoing	162	2,100	--	19,908	--	--	27	--	20
Proposed	--	--	1,100	--	--	1,600	--	--	--
Education:									
Completed	--	--	--	--	--	--	--	--	--
Ongoing	170	450	--	--	--	--	254	--	--
Proposed	--	--	--	--	--	--	--	--	--
Research:									
Completed	--	--	--	--	--	--	--	--	--
Ongoing	--	120	--	--	191	--	--	--	--
Proposed	--	--	--	--	--	--	--	--	--
Reforestation/ afforestation:									
Completed	--	--	--	--	--	--	--	--	--
Ongoing	--	490	--	3,085	--	--	13,500	--	--
Proposed	--	7,700	--	--	--	--	20,000	19,000	--
Integrated development:									
Completed	--	--	--	--	--	--	--	--	--
Ongoing	--	830	--	4,900	20,000	--	--	--	--
Proposed	--	--	--	37,300	--	--	--	--	--
Technical/ administrative/ management assistance:									
Completed	--	--	--	--	--	--	--	--	--
Ongoing	--	--	--	573	288	--	1,417	--	--
Proposed	--	--	--	181	270	--	--	--	--
Total:									
Completed	--	--	--	10	19	--	--	--	--
Ongoing	332	6,887	--	28,466	20,579	--	15,247	--	20
Proposed	--	7,700	1,100	37,481	270	1,600	20,000	519,000	--

Table 3.--EAST AFRICA. Summary of donor agency expenditures by country, forestry activity, and project status (in $1,000 U.S.)--con.

Forestry activity	Mozambique	Rwanda	Seychelles	Somalia	Sudan	Swaziland	Tanzania	Zambia	Regional	Total
Industrial:										
Completed	--	--	--	--	--	--	--	--	--	--
Ongoing	52,613	--	190	--	--	--	--	1,000	--	56,849
Proposed	--	--	--	--	--	--	252,000	154,000	--	906,000
Conservation:										
Completed	--	6	--	--	--	--	--	--	--	35
Ongoing	--	33	--	--	--	--	15	--	20	22,285
Proposed	--	244	--	--	--	--	250	--	--	3,194
Education:										
Completed	--	--	--	--	--	--	--	--	--	--
Ongoing	--	--	--	--	461	--	--	--	--	1,335
Proposed	--	--	--	399	--	--	--	--	--	399
Research:										
Completed	--	--	--	--	--	--	--	--	88	88
Ongoing	--	--	--	--	165	--	14	--	172	662
Proposed	--	--	--	--	--	--	--	--	250	250
Reforestation/ afforestation:										
Completed	--	--	--	--	--	--	--	--	--	--
Ongoing	298	700	--	--	100	--	200	--	--	18,373
Proposed	140	243	--	--	--	--	--	--	--	47,083
Integrated development:										
Completed	--	--	--	--	--	--	--	--	--	--
Ongoing	--	1,100	--	--	--	--	5,900	--	--	32,730
Proposed	--	9,000	--	15,000	--	--	--	--	--	61,300
Technical/ administrative/ management assistance:										
Completed	--	--	--	--	--	--	--	--	--	--
Ongoing	--	--	--	--	--	--	--	--	--	2,278
Proposed	--	--	--	--	--	--	--	--	--	451
Total:										
Completed	--	6	--	--	--	--	--	--	88	123
Ongoing	52,911	1,833	190	--	726	--	6,129	1,000	192	134,512
Proposed	140	9,487	--	15,399	--	--	252,250	154,000	250	1,016,200

Table 4.--NORTH AFRICA AND MIDDLE EAST. Summary of donor agency expenditures by country, forestry activity, and project status (in $1,000 U.S.)

Forestry activity	Algeria	Cyprus	Egypt	Iraq	Jordan	Libya	Morocco	Oman	Tunisia	Turkey	Yemen Arab Republic	Yemen	Total
Industrial:													
Completed	--	291	--	--	--	--	--	--	--	--	--	--	291
Ongoing	--	--	--	--	--	--	10,000	--	--	509	--	--	10,509
Proposed	--	--	24,000	--	--	--	--	--	--	--	--	--	24,000
Conservation:													
Completed	9	--	--	--	25	--	832	--	1,621	--	--	--	2,487
Ongoing	--	--	--	--	--	--	--	--	--	--	--	--	--
Proposed	--	--	--	--	--	--	--	--	--	--	--	--	--
Education:													
Completed	--	--	--	--	--	--	1,934	--	--	--	--	--	1,934
Ongoing	--	1,170	--	--	1,104	--	77	--	--	--	--	--	2,351
Proposed	--	--	--	--	--	--	250	--	--	--	--	--	250
Research:													
Completed	--	--	--	--	--	--	--	1	--	--	--	--	1
Ongoing	--	--	134	955	168	--	--	--	213	--	--	--	1,470
Proposed	--	--	--	--	--	--	--	--	--	--	--	--	--
Reforestation/ afforestation:													
Completed	--	--	--	--	--	--	--	--	--	--	--	--	--
Ongoing	--	--	--	--	--	--	588	--	--	--	--	--	588
Proposed	--	--	100	--	--	--	--	--	--	--	--	--	100
Integrated development:													
Completed	--	--	--	--	--	--	--	--	--	--	--	--	--
Ongoing	4,233	--	--	--	--	--	--	--	--	86,200	--	--	90,433
Proposed	--	--	--	--	--	--	--	--	--	--	--	--	--
Technical/ administrative/ management assistance:													
Completed	--	--	--	--	--	--	--	--	2,435	--	--	--	2,435
Ongoing	--	--	--	--	--	--	150	--	--	--	--	--	150
Proposed	--	--	--	--	--	--	--	--	--	--	--	79	79
Total:													
Completed	9	291	--	--	25	--	2,766	1	4,056	--	--	--	7,148
Ongoing	4,233	1,170	134	955	1,272	--	10,815	--	213	86,709	--	--	105,501
Proposed	--	--	24,100	--	--	--	250	--	--	--	--	79	24,429

APPENDIX 3

Latin America and Caribbean

The Latin American and Caribbean countries provide examples of forests ranging from very good condition to very seriously depleted. Haiti has the most deteriorated forest lands in the Western Hemisphere and some of the world's most pressing forestry problems. On the other hand, Honduras, Colombia, Bolivia, and Peru, for example, have very extensive pine and mixed hardwood forests that can be saved and effectively managed for the future if proper steps are taken now. This includes the necessity to improve cutting practices, which have been initiated in sawmill projects sponsored by donor agencies, and controlling colonization by natives.

Unfortunately, according to FAO (1979) the forests of Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama will suffer the largest relative decrease--29 percent--by the year 2000. Even greater depletion in total area is forecast to occur in Colombia, Ecuador, and the Amazon Basin.

A.I.D. has a regional organization, ROCAP (Regional Organization for Central America and Panama), which is set up to coordinate A.I.D.'s activities in Central America and Panama. Their forest-related activity has been minimal. In Haiti, there are over 200 missionary groups and about half of them are providing forestry assistance, particularly in the production of tree nursery stock. Other agencies peculiar to Haiti for providing forestry assistance are CARE and HACHO (Harmonisation de l'Action des Communautés Haitiennes Organisees). HACHO was funded by the Government of Honduras, Germany, and A.I.D., but the A.I.D. support ended in 1979.

Together with the multilateral and bilateral donor agency activity, industrial investment has also had some impact on stand regeneration and plantation establishment. Swedish Match was instrumental in establishing poplar plantations in Chile, and International Paper has sponsored plantations of Caribbean pine in French Guiana. The Cartón de Colombia Co. in Colombia manages both plantations and natural forest.

The FAO-sponsored "Food for Work" program has been applied widely throughout the region and appears to be quite successful. Other donors are also trying the "Food for Work" approach.

Table 5 is a summary of the forestry projects carried out by the donor agencies in the Latin American and Caribbean region. Total funding for recently completed, ongoing, and proposed forestry projects is nearly $200 million. The main recipients are Jamaica, Honduras, Paraguay, Panama, and Bolivia, which together account for nearly 70 percent of the total funding. Emphasis is placed on industrial, conservation, and education activities, which together account for nearly 75 percent of the total funding. Overall, ongoing activities far outweigh both recently completed and proposed ones. Although Argentina and Uruguay have donor-assisted forestry programs, funding levels were not available and are not included in this report.

Table 5.--LATIN AMERICA AND CARIBBEAN. Summary of donor agency expenditures by country, forestry activity, and project status (in $1,000 U.S.)

Forestry activity	Belize	Bolivia	Brazil	Chile	Colombia	Costa Rica	Cuba	Dominica	Dominican Republic	Ecuador	El Salvador	French Guiana	Guatemala	Guyana
Industrial:														
Completed	134	--	--	--	--	--	--	--	--	--	--	--	--	--
Ongoing	--	4,000	3,576	1,997	469	--	--	--	--	--	--	--	--	7,492
Proposed	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Conservation:														
Completed	--	90	--	--	--	32	--	29	--	86	--	--	--	--
Ongoing	--	--	12	--	--	35	15	15	--	47	--	--	--	--
Proposed	--	--	--	--	--	--	--	--	--	--	1,279	--	--	--
Education:														
Completed	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ongoing	--	1,500	1,500	--	--	7,050	--	--	--	--	--	--	--	2,052
Proposed	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Research:														
Completed	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ongoing	--	809	--	--	--	1,466	--	--	--	210	--	1,800	32	--
Proposed	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Reforestation/ afforestation:														
Completed	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ongoing	--	--	100	--	200	--	--	--	--	--	280	--	--	--
Proposed	--	--	--	--	--	--	--	--	--	--	50	--	--	--
Integrated development:														
Completed	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ongoing	--	2,000	--	--	700	453	--	--	200	--	--	--	--	--
Proposed	--	2,800	--	--	--	--	--	--	--	--	--	--	--	--
Technical/ administrative/ management assistance:														
Completed	--	1,140	--	--	--	--	--	--	--	--	--	--	111	--
Ongoing	--	--	--	--	--	844	--	--	--	--	--	--	--	--
Proposed	--	--	--	--	--	--	--	--	--	4,535	--	--	--	--
Total:														
Completed	134	1,230	--	--	--	32	--	29	--	86	--	--	111	--
Ongoing	--	8,309	5,188	1,997	1,369	9,848	15	15	200	257	280	1,800	32	9,544
Proposed	--	2,800	--	--	--	--	--	--	--	4,535	1,329	--	--	--

66-326 O 16

Table 5.--LATIN AMERICA AND CARIBBEAN. Summary of donor agency expenditures by country, forestry activity, and project status (in $1,000 U.S.)--con.

Forestry activity	Haiti	Honduras	Jamaica	Mexico	Nicaragua	Panama	Paraguay	Peru	St. Lucia	Surinam	Trinidad and Tobago	Venezuela	Regional	Total
Industrial:														
Completed	--	--	--	--	--	--	--	1,372	--	2,100	--	--	--	3,606
Ongoing	--	1,097	32,000	--	--	--	--	--	--	--	--	--	--	50,631
Proposed	--	30,000	--	--	--	--	--	--	--	--	--	--	--	30,000
Conservation:														
Completed	--	--	--	--	--	* --	--	--	--	--	--	--	--	237
Ongoing	1,550	694	--	--	300	16,805	--	3,227	--	60	--	--	185	22,945
Proposed	1,161	--	--	--	--	--	--	--	--	--	--	--	--	2,440
Education:														
Completed	--	--	--	--	--	--	179	7	--	--	--	--	--	186
Ongoing	--	200	4,893	--	--	--	15,000	810	--	--	--	--	--	33,005
Proposed	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Research:														
Completed	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ongoing	--	252	--	--	300	--	--	2,300	--	950	--	--	88	8,207
Proposed	--	--	--	--	--	--	1,000	--	--	--	--	--	--	1,000
Reforestation/ afforestation:														
Completed	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ongoing	1,804	--	--	--	--	--	--	490	--	--	1,038	--	--	3,912
Proposed	--	--	--	--	--	--	14,500	1,600	--	--	--	--	--	16,150
Integrated development:														
Completed	--	--	--	--	--	--	--	74	--	--	--	--	--	74
Ongoing	--	2,000	775	--	--	--	--	--	--	--	--	--	--	6,128
Proposed	--	--	--	--	--	1,900	--	--	--	--	--	--	--	4,700
Technical/ administrative/ management assistance:														
Completed	--	86	--	--	--	50	--	88	--	2,400	--	--	--	3,875
Ongoing	294	--	670	--	--	--	831	--	--	--	--	--	--	2,639
Proposed	--	--	--	--	--	--	--	--	--	--	--	--	--	4,535
Total:														
Completed	--	86	--	--	--	50	179	1,541	--	4,500	--	--	--	7,978
Ongoing	3,648	4,243	38,338	--	600	16,805	15,831	6,827	--	1,010	1,038	--	273	127,467
Proposed	1,161	30,000	--	--	--	1,900	15,500	1,600	--	--	--	--	--	58,825

APPENDIX 4

Asia and Pacific

Table 6 summarizes the forestry projects carried out by the donor agencies in the Asia and Pacific region. Total funding for recently completed, ongoing, and proposed forestry projects is nearly $600 million. The three main recipients are Viet-Nam, Burma, and India, which together account for almost 80 percent of the total funding. Most of the funds are for industrial projects, which account for slightly more than 75 percent of the total funding. Ongoing industrial projects far outweigh both completed and proposed projects. This is largely because of one large-scale pulp and paper project financed by Sweden in Viet-Nam. Similarly, the overall ongoing activities far outweigh both the completed and proposed ones. Although much of the land in the region is in need of reforestation, this category receives only about 10 percent of the total funding. Current emphasis in reforestation is in the Philippines, Viet-Nam, Korea, and Sri Lanka, while proposed reforestation activity will be concentrated in India, the Philippines, and Thailand. Although Cambodia has donor-assisted forestry programs, funding levels were not available and are not included in this report.

Table 6.--ASIA AND PACIFIC. Summary of donor agency expenditures by country, forestry activity, and project status (in $1,000 U.S.)

Forestry activity	Afghanistan	Bangladesh	Bhutan	Burma	Fiji	India	Indonesia	Iran	Korea	Laos	Malaysia	Mongolia
Industrial:												
Completed	--	--	--	--	--	36	--	--	--	--	155	--
Ongoing	1,345	12,790	3,120	26,300	--	10,000	2,200	--	--	2,000	1,322	--
Proposed	--	--	--	35,000	--	50	--	--	--	--	153	--
Conservation:												
Completed	--	--	--	--	--	--	316	35	--	--	--	--
Ongoing	67	--	86	--	6	189	3,200	4,834	--	--	--	--
Proposed	--	--	--	--	--	--	--	--	--	--	--	--
Education:												
Completed	--	--	--	--	--	23	589	268	--	--	--	--
Ongoing	--	870	--	1,318	--	4,535	1,554	--	566	--	--	--
Proposed	--	--	--	--	--	287	7,000	--	--	--	--	--
Research:												
Completed	--	--	--	--	--	--	--	--	--	--	--	--
Ongoing	--	--	--	--	--	5,834	1,582	--	--	--	619	--
Proposed	--	--	--	158	--	--	--	--	--	--	--	--
Reforestation/ afforestation:												
Completed	--	--	--	--	--	--	--	--	--	--	--	--
Ongoing	--	--	--	--	--	--	--	--	3,000	--	--	--
Proposed	--	--	--	--	--	21,150	--	--	--	--	--	--
Integrated development:												
Completed	--	--	--	--	--	--	--	--	--	--	--	--
Ongoing	--	--	1,122	--	--	--	7,600	--	2,161	--	--	--
Proposed	--	--	--	--	--	3,900	--	--	--	--	--	--
Technical/ administrative/ management assistance:												
Completed	--	--	--	--	162	28	152	--	--	--	--	--
Ongoing	--	--	--	--	711	--	30	--	--	74	--	--
Proposed	--	--	--	--	--	--	200	--	--	--	--	--
Total:												
Completed	--	--	--	--	162	87	1,057	303	--	--	155	--
Ongoing	1,412	13,660	4,328	27,618	717	20,558	16,166	4,834	5,727	2,074	1,941	--
Proposed	--	--	--	35,158	--	25,387	7,200	--	--	--	153	--

Table 6.--ASIA AND PACIFIC. Summary of donor agency expenditures by country, forestry activity, and project status (in $1,000 U.S.)--con.

Forestry activity	Nepal	Pakistan	Papua New Guinea	Philippines	Solomon Islands	Sri Lanka	Thailand	Vietnam	West Samoa	Regional	Total
Industrial:											
Completed	--	--	--	--	--	--	--	--	494	252	937
Ongoing	--	793	--	--	--	1,275	--	330,000	1,332	487	392,964
Proposed	300	--	--	--	30	--	--	2,500	--	--	38,033
Conservation:											
Completed	65	--	1	--	--	--	--	--	--	--	417
Ongoing	2,056	--	--	--	--	--	2,478	--	15	--	12,931
Proposed	--	--	--	--	--	--	--	--	--	--	--
Education:											
Completed	--	--	--	--	--	--	--	--	--	--	880
Ongoing	--	--	--	6,985	--	--	--	--	148	--	15,976
Proposed	103	2,903	--	--	--	--	--	5,467	--	--	15,760
Research:											
Completed	--	--	--	886	--	--	106	--	--	--	972
Ongoing	--	1,925	--	2,750	--	--	53	--	--	--	12,763
Proposed	--	--	--	--	--	--	--	--	--	--	158
Reforestation/ afforestation:											
Completed	--	--	--	--	--	--	--	--	--	--	--
Ongoing	--	100	--	18,150	--	3,600	--	8,712	--	--	33,562
Proposed	--	--	--	2,300	--	--	1,013	--	--	--	24,463
Integrated development:											
Completed	--	--	--	--	--	--	--	--	--	--	--
Ongoing	18,546	5,300	--	--	--	--	400	--	--	--	35,129
Proposed	73,875	--	--	--	--	--	2,250	--	--	--	80,025
Technical/ administrative/											
Completed	--	--	--	570	--	--	2,650	35	--	37	3,634
Ongoing	--	--	--	550	--	--	--	--	--	--	1,365
Proposed	--	--	--	--	--	--	--	--	--	--	200
Total:											
Completed	65	--	1	1,436	--	--	2,756	35	494	289	6,840
Ongoing	20,602	8,118	--	28,435	--	4,875	2,931	338,712	1,495	487	504,690
Proposed	74,278	2,903	--	2,300	30	--	3,263	7,967	--	--	158,639

APPENDIX 5

Summary of Donor Agency Activities

Table 7 summarizes the information contained in tables 1 to 6 and reflects regional differences among project categories. This provides an overall view of the types of ongoing and proposed forestry activities, and was made to identify any obvious gaps between perceived needs and what is actually taking place.

The table shows a clear dominance of industrial activity, both in terms of ongoing and proposed projects. The large figures in the industrial category represent heavily capitalized pulp mills or sawmill complexes, rather than on-the-ground establishment and management of forest stands. This heavy emphasis on industrial activity is of great concern because creation of additional pulping and sawmilling capacity will certainly exert greater pressure on existing forest reserves and contribute to the overall deforestation problem.

The second most dominant activity is reforestation/afforestation. Spears' (1978) World Bank summary of overall world needs in wood biomass, particularly for energy, points to the severity of the deforestation problem. Even when considering technological advancement and increased utilization of alternative energy sources, such as solar, wind, etc., projected wood biomass required by the year 2000 will exceed that which will actually be produced at current rates of planting by a factor of four.

In response the World Bank, and numerous other worldwide donors, have substantially increased their commitment to forestry (see appendix I and summary tables in chapter 2). Yet the situation is likely to get worse before the trend is reversed. This happens when people are turning to alternative energy sources without regard for, or understanding of, the consequences of changing the energy source. As fuelwood becomes increasingly scarce, and people switch to the alternatives, food production will be foregone because of losses in nutrients and soil productivity. This quickly becomes a vicious circle which is difficult to alter.

The reforestation/afforestation category is an obvious gap in donor-sponsored forestry activities in developing countries in view of the World Bank estimates of wood biomass requirements by the year 2000 (1978). A.I.D. is well advised to concentrate its activities in this area.

Table 8 is a ranking of donor project involvement in terms of total cost in the seven defined forestry activities.

In terms of total forestry assistance for ongoing projects, Sweden ranks first followed by IBRD, FAO/UNDP, and USA. Sweden's contribution, however, is attributable largely to a single large-scale, heavily capitalized pulpmill project in North Vietnam. The IBRD projects are also heavily on the industrial side whereas the FAO/UNDP and U.S. activities are spread out over all categories. In proposed activities

IBRD ranks first, based largely on industrial activities, followed by USA, Germany, and WFP.

Fewer donors are involved in forestry conservation activities than in most of the other categories. A probable reason is that conservation projects tend not to be economically feasible and are often implemented in high-failure probability areas such as several of the arid Sahelian countries. USA ranks first in ongoing, but only fourth in planned categories.

Education projects seem to have a dismal future since ongoing activities outweigh those proposed by nearly a factor of three (see table 8). This is indeed another gap in overall forestry assistance since the developing world is faced with a critical shortage of forestry expertise. A U.S. proposal for a $9 million Africa-wide education program is in an embryonic stage. A clear need exists to strengthen forestry educational institutions in terms of physical facilities and curricula development in many developing countries. The United States is addressing the educational problems more than other donors.

USA is also the largest donor in research projects, both in terms of ongoing and proposed activities. Again, ongoing projects far outweigh those planned (see table 8). The general consensus among donors as well as recipient country governments is that research and further studies of the forestry problems would, at this stage, be of a cosmetic nature. What is needed are action-oriented activities, if we are to effectively stem the alarming rate of deforestation.

In the reforestation/afforestation category, proposed activities are 51 percent greater than those of the ongoing activities. This is a desirable trend to be sure, albeit far from adequately addressing the magnitudes of the deforestation problems. Much more is needed. The IBRD ranks first in both ongoing and proposed activities, with USA a distant second.

Integrated development projects are those containing several components, including forestry, which are implemented in a balanced approach to development. These are the projects that could not comfortably be placed in any of the other defined forestry categories. The IBRD ranks first in ongoing activities, followed by FAO/UNDP and Germany.

Finally, Technical Assistance, the least influential category in terms of total forestry assistance is used more by FAO/UNDP than the other donors. This category consists of short- to medium-term direct consulting services to developing countries, addressing specific problem areas.

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Table 7.--Ongoing and proposed forestry activities by region and project category (in $1,000 U.S.)

Region	Industrial		Conservation		Education		Research		Reforestation/ afforestation		Integrated development		Technical assistance	
	Ongoing	Proposed	Ongoing	Proposed	Ongoing	Proposed	Ongoing	Proposed	Ongoing	Proposed	Ongoing	Proposed	Ongoing	Proposed
Sahel	180	1/6,083	36,908	2/13,033	6,669	3/600	369	4/2,500	30,573	5/31,982	1,920	21,941	--	--
Other West Africa	13,544	53,100	874	--	1,020	1,680	5,279	--	901	54,700	--	16,715	1,643	2,659
East Africa	56,849	906,000	22,285	3,194	1,335	399	662	250	18,373	47,083	32,730	61,300	2,278	451
North Africa and Middle East	10,509	24,000	--	--	2,351	250	1,470	--	588	100	90,433	--	150	79
Africa-wide	--	--	--	--	--	9,000	--	--	--	8,300	--	--	--	--
Latin America and Caribbean	50,631	30,000	22,946	2,440	33,005	--	8,207	1,000	3,912	16,150	6,129	4,700	2,639	4,535
Asia and Pacific	392,963	38,033	12,931	--	15,977	15,760	12,763	158	33,562	24,463	35,129	80,025	1,365	200
Total	524,676	1,057,216	95,944	18,667	60,357	27,689	28,750	3,908	87,909	182,778	166,341	184,681	8,075	7,924

Grand Total:
Ongoing 972,052
Proposed 1,482,863

1/ Additional projects totaling $1,228,000 have been proposed, but no donors designated.
2/ Additional projects totaling $32,398,000 have been proposed, but no donors designated.
3/ Additional projects totaling $4,762,000 have been proposed, but no donors designated.
4/ Additional projects totaling $1,774,000 have been proposed, but no donors designated.
5/ Additional projects totaling $1,211,000 have been proposed, but no donors designated.

Table 8.--Forestry related projects--current (1979) and proposed ($1,000 U.S.)[1/]

Donor	Industrial		Conservation		Education		Research		Reforestation/ afforestation		Integrated Development		Technical Assistance		Total				Overall	
	Current	Planned	Current	Planned	Current	Planned	Current	Planned	Current	Planned	Current	Planned	Current	Planned	Current	Rank of current	Planned	Rank of planned	Total	Rank
IBRD	18,665	833,500	2,613	--	--	--	4,700	--	30,493	125,230	122,276	28,465	--	--	178,747	2	987,195	1	1,165,942	1
Sweden	369,400	36,000	--	--	5,441	--	--	--	--	--	4,900	--	--	--	379,741	1	36,000	6	415,741	2
USA	--	--	30,626	2,094	14,453	9,250	2,538	500	11,210	29,228	3,637	75,647	150	6,500	62,614	4	123,219	2	185,833	3
Germany	19,600	43,183	6,481	8,133	6,642	--	1,723	--	5,454	3,550	11,816	10,100	--	--	51,716	5	64,966	3	116,682	4
UNDP/FAO	23,861	233	17,038	2,440	10,720	10,736	3,878	658	1,905	2,938	1,805	18,669	5,070	1,224	64,277	3	36,898	5	101,175	5
Norway	35,239	36,000	--	--	--	--	--	--	--	--	--	--	--	--	35,239	6	36,000	6	71,239	6
World Food Program	--	--	20,426	--	--	--	--	--	9,104	--	122	37,300	--	--	29,652	8	37,300	4	66,952	7
Kuwait Fund	--	36,000	--	--	--	--	--	--	--	--	--	--	--	--	--	27	36,000	6	36,000	8
Nordic Investment Bank	--	36,000	--	--	--	--	--	--	--	--	--	--	--	--	--	27	36,000	6	36,000	8
OPEC	--	36,000	--	--	--	--	--	--	--	--	--	--	--	--	--	27	36,000	6	36,000	8
Asian Development Bank	25,100	--	--	--	--	--	--	--	--	--	6,500	--	74	--	31,674	7	--	21	31,674	9
Japan	--	--	--	--	18,500	7,000	1,000	1,000	750	--	--	--	--	--	20,250	9	8,000	12	28,250	10
Switzerland	--	--	1,170	6,000	2,072	300	544	250	1,029	209	4,422	9,500	2,261	--	11,498	14	16,259	10	27,757	11
Great Britain	16,000	--	160	--	--	--	1,344	--	--	--	--	5,000	72	--	17,576	10	5,000	13	22,576	12
France	--	--	5,702	--	267	--	3,740	500	6,335	2,880	646	--	--	--	16,690	11	3,380	14	20,070	13
Canada	4,090	--	5,283	--	1,554	--	4,209	500	--	2,218	--	--	30	200	15,166	12	2,918	15	18,084	14
IDB	--	--	--	--	--	--	--	--	--	14,500	667	--	--	--	667	25	14,500	11	15,167	15
European Development Fund	10,389	--	1,373	--	--	--	--	--	1,038	1,925	--	--	--	--	12,800	13	1,925	16	14,725	16
Australia	1,332	300	--	--	--	103	619	--	--	--	8,720	--	418	--	11,089	15	403	18	11,492	17
Philippine Development Bank	--	--	--	--	--	--	--	--	8,200	--	--	--	--	--	8,200	16	--	21	8,200	18
Netherlands	--	--	220	--	--	300	1,232	--	5,102	--	--	--	--	--	6,554	17	300	19	6,854	19
Lutheran World Service	--	--	--	--	--	--	--	--	6,129	--	--	--	--	--	6,129	18	--	21	6,129	20
Belgium	--	--	518	--	708	--	700	500	915	--	830	--	--	--	3,671	19	500	17	4,171	21
African Development Bank	--	--	2,613	--	--	--	--	--	--	--	--	--	--	--	2,613	20	--	21	2,613	22
IUCN/WWF	--	--	1,721	--	--	--	--	--	--	--	--	--	--	--	1,721	21	--	21	1,721	23
UNESCO	--	--	--	--	--	--	1,700	--	--	--	--	--	--	--	1,700	22	--	21	1,700	24
Finland	1,000	--	--	--	--	--	--	--	--	100	--	--	--	--	1,000	23	100	20	1,100	25
Denmark	--	--	--	--	--	--	823	--	--	--	--	--	--	--	823	24	--	21	823	26
Church World Service	--	--	--	--	--	--	--	--	245	--	--	--	--	--	245	26	--	21	245	27
Total	524,676	972,052	95,944	18,667	60,357	27,689	28,750	3,908	87,909	182,778	166,341	184,681	8,075	7,924	972,052		1,482,863		2,454,915	

1/ For projects with multiple donors, an average was calculated from the total contributions and their average was allocated to each donor.

APPENDIX 6

[Environmental Action, March 1980]

Eco-Crime On The Equator

(By Janet Marinelli)

Kalimantan, better known to the English speaking world as Borneo, is the third largest island in the world, one of Indonesia's long string of islands that stretches 3,000 miles between the Indian and Pacific Oceans. Indonesia is the third largest country in Asia, a lush tropical archipelago and one of the world's treasure chests of natural wealth—timber, petroleum, fish and a variety of minerals. The Indonesian forests, it's estimated, not only contain some 4,000 types of trees and 30,000 kinds of flowering plants, but a remarkable variety of animals, including the legendary "wild man of Borneo"—the orangutan.

Up until about 10 years ago Kalimantan, fed by rainfalls averaging over 98 inches a year, was covered with nothing but dense rainforest. The island's rough terrain and lack of roads and ports kept most outsiders away. The Dayak and Kutai people, traditional river people of Kalimantan, built their huts and longhouses along the many streams and lived mainly by fishing and hunting.

But rugged new settlements are now being carved out of Kalimantan's steaming equatorial jungle. Most of Indonesia, not only Kalimantan but other islands like Sumatra and Irian Jay, the western half of the island of New Guinea, is sparsely populated rainforest. Of the country's 140 million people, though, nearly 82 million, or 63 percent, are jammed onto the island of Java. Unlike many tropical areas, Java is an island with rich volcanic soils, but the vast majority of the people there are still desperately poor. Another three million cram the tiny island of Bali. The government hopes to move many of these people to the once deserted Indonesian islands. Thousands have already arrived.

And in the past several years, thousands more have been lured to Kalimantan by the prospect of jobs in the booming oil and timber industries. For many, however, this dream just hasn't materialized, and along with the other new arrivals they've fanned out along the network of logging roads that spread deep into the island's interior. There they do what farmers in the tropics have been doing for centuries—slash and burn the rainforest and plant subsistence crops like bananas and rice.

When carried out by small bands of semi nomadic people in very large tracts of forests, slash and burn agriculture is virtually harmless. Tiny clearings are cut and a diverse mixture of crops are planted for two or three years. The farmers may not return for another 50 to 100 years and by then the forest will have healed. But done by masses of landless peasants on poor tropical soils, slash and burn can only spell disaster. Every few hundred yards, swatches of land are stripped, the earth scorched, and only a few spindly trees remain standing.

Like over half the people of Indonesia, Kalimantan's slash and burn cultivators live beneath poverty levels; two-thirds cannot afford a basic, minimum diet. Disease is rampant, infant mortality is high and life expectancy is short.

But business is booming.

In 1950, the country was freed from Dutch rule, led by the fiercely nationalistic and leftist Sukarno. By the late 50s the Indonesian army, some say with support from the CIA, began to figure more prominently in national politics, and in 1966 Sukarno was overthrown and the army took control. Several months later, the new government opened its doors wide to foreign investment. The 1966 Investors Incentive Act offered long "tax holidays" for foreign investors and exempted them from import duties on equipment and supplies. Since then it's been the military government's strategy to wipe out Indonesia's massive debt to affluent world banks by auctioning off its precious natural resources. Offshore that means oil. On Kalimantan and other islands, it means timber.

With 300 million acres of rainforest, Indonesia has the largest timber resources in Southeast Asia, and multinational corporations like Weyerhaeuser, Mitsubishi and Mitsui didn't waste a minute before plunging into the Indonesian timber sweepstakes. By early 1978 commercial loggers had taken advantage of over 600 forest concession agreements amounting to practically all the accessible lowland forests in the country, plus some upland forests that were supposedly protected. Almost 25 percent of this forestland is controlled by 40 companies.

The past decade of growth in the timber business, though, has not improved the lot of the average Indonesian. In most of Kalimantan, logging corporations have created temporary boomtowns, displacing or disrupting the traditional cultures. Because the same stretch of forest is rarely logged twice, few bother to build permanent facilities, and even temporary logging operations employ few native people.

What's happening in Indonesia is happening elsewhere in Southeast Asia, in Latin America, in Africa and throughout what was once a broad green belt extending from the Tropic of Capricorn to the Tropic of Cancer. All over Southeast Asia timber companies and a small affluent minority are reaping a quick profit from the rainforests; in Latin America cattle ranchers are the major culprit. Meanwhile, the poor in these areas are getting even poorer. And together the ironic combination of multinationals and slash and burn subsistence farmers is causing what some say could be the biggest environmental disaster of the century, a disaster ecologist Erik Eckholm describes as "a threat to human well-being far more insidious and intractable than the industrial pollution of our air and water."

The tropical forests are by far the richest biological regions on earth. Especially rich are the moist forests, which cover about half the tropics. Three major moist forests encircle the planet—in Southeast Asia, in the Amazon Basin and in the Congo Basin. In these areas, even during the dry season, cloudbursts can unleash an inch of rain in half an hour, up to 40 times more water than the average shower in the Northeast United States.

The vegetation of the tropical forests is dominated by three main levels of storeys. The hardwood trees of the two highest storeys form the forest canopy and soar as high as 328 feet. Tree crowns are often covered with webs of spectacular flowers belonging to vines that wrap their way up the tree trunks in search of sunlight. The forest canopy cushions the impact of torrential rains and protects the tropical soil from erosion. It also protects the rest of the forest from the strong equatorial sunlight that would otherwise make the soil in many areas incapable of supporting almost any life. Palms, airplants and orchids flourish in the dark, misty realm beneath the forest canopy.

Tropical forests are not only lush but efficient. Dead and dying matter is quickly recycled by fungi, bacteria and insects. As biologist Anne LaBastille put it, it's not the rainforest's soil, but its foliage that's fertile.

Less is known about tropical forests than any other region on earth. But one thing's for sure: rainforests are disappearing at an alarming rate.

Worldwide, 50 acres of tropical rainforest are destroyed every 60 seconds, totalling 27 million acres a year. Latin America has lost about 37 percent of its original rainforests, southeast Asia 38 percent and Africa almost 52 percent. The wettest and richest of Southeast Asia's forests are located mostly in Indonesia, Malaysia and the Philippines; in the Philippines, one-fifth of the entire land mass is deforested, lying idle and unproductive and causing severe ecological problems. At the current rate, all accessible lowland forest in the Philippines and Malaysia, which have been plundered for commercial timber for the past 25 years, will be flattened before 1990. Indonesia's forests may not last longer than the turn of the century. Large chunks of virgin Amazonian forest in eastern Brazil appear doomed. And major portions of forest will probably be wiped out in West Africa. The destruction there will be partly the work of commercial loggers—in Nigeria and Ghana, for example, virtually all remaining forest has been divided into timber concessions—and at least an equal amount will be caused by slash and burn cultivation.

There's still some hope for central Africa, especially Zaire, the Congo and Gabon, where an abundance of mineral resources could keep the forests from being converted into cold cash, and also for vast expanses of Amazonian forest in remote western Brazil.

But in essence tropical forests, even though they're potentially a renewable resource, may be depleted even faster than major nonrenewable resources like oil. The countries that are most in need of conserving their resources to assure a

sound base for economic development are bound to suffer the most. And this, scientists say, will not only have economic repercussions as serious as the oil crisis, but also severe environmental impacts.

Most of the destruction has been in tropical zones, but by no means all. Roughly half of the earth's forests have disappeared since 1950. According to a forthcoming government report, we're headed "from a period of global forest wealth to a period of global forest poverty."

The loss of nutrients leached from tropical vegetation and carried out to sea by vast river systems like the Amazon and the Congo could seriously impair fishing industries around the world and as far north as, for example, the East Coast of the United States.

Even the Iowa corn complex may be vulnerable. Carbon released from burning forests could increase carbon dioxide levels, already aggravated by fossil fuel burning. According to this hypothesis, changes in global patterns of rainfall and precipitation could result, including a drier climate and, according to one study, "an irreversible process of desertification * * * in the grainbelts of North America and other countries."

As more and more rainforest—which contains between two and five of the earth's 10 million species—disappears, huge numbers of species will be wiped out. Norman Meyers, author of *The Sinking Ark*, says the problem of disappearing species is "one of the great sleeper issues of all time."

The stock of genetic material on earth would be severely diminished, an irreversible loss not only to science but to our ability to satisfy basic human needs like food and medicine.

But even more urgent than all these "global effect" arguments are the problems that tropical people themselves face as their forest shrink:

Large numbers of rainforest dwelling tribes are heading for oblivion, and with them a priceless body of knowledge about the tropics. In 1900 there reportedly were 230 tribes, totalling one million people, just in Brazil's Amazon region. Now 87 tribes are gone, and only 50,000 individuals have survived. On humanitarian grounds alone, these people should be allowed to adapt to the modern world at their own pace.

Extensive deforestation has already taken its toll on the local climate. Some 50 percent of the rainfall is recycled directly through tropical forests. When trees are cut, floods increase, there's less rainfall all around and in time an irreversible drying trend can begin. According to a CIA study, erosion, siltation, flooding and other problems associated with forest loss are likely to become a severe constraint on food production in South and Southeast Asia by the year 2000. And Robert Goodland, author of *Amazon Jungle: Green Hell to Red Desert*, warns that desertification of the Amazon is only decades away.

Michael Benge of the U.S. Agency for International Development sees deforestation as a development problem. The ecological problems resulting from loss of forests in developing countries, he says, cannot be separated from the larger problems of hunger, population growth and rural development. On the island of Java, for example, without trees to help absorb the water, rain washes down the mountains, floods ricefields and fills irrigation canals with silt. One storm can sweep 75 tons of topsoil from a single acre, and that can translate into as much as 80 million tons a year. All over the tropics vast areas of previously forested watersheds are being denuded by landless people—there are millions of slash and burn peasants with nowhere to sink a hoe except in a virgin rainforest—resulting in devastating floods that destroy millions of tons of food crops yearly, and in accelerated erosion that reduces the productivity of the land for all time.

And as Erik Eckholm has pointed out, for more than a third of the world's people, the real energy crisis is not the shortage of Persian Gulf crude but rather the daily scramble for firewood. "The most widely overlooked impact of the increase in oil prices," says Eckholm, an impact drowned out by all the bellyaching by the oil importing countries, "is the fact that what had been the most feasible substitute for firewood, kerosene, has now been pulled even farther out of reach of the world's poor. * * *"

Nine-tenths of the people in most poor countries depend on firewood as their chief source of fuel, adding pressure on already receding forests. In parts of Latin America and West Africa, poor urban families spend about a quarter of their income on wood or charcoal for cooking. "Even if we produce enough food to feed the world's population," Eckholm says, "there won't be enough firewood to cook it."

In addition, a shortage of paper, already causing severe setbacks in education in many developing countries, will only get worse. Despite their sizable resources, these countries import virtually all their paper supplies from the affluent world at a huge cost. People of the affluent world each consume over 330 pounds of paper a year—in this country, it's more like 740 pounds—while the poor world citizen is unlikely to use more than 11 pounds a year, and often little more than two pounds—or about half of one issue of the Sunday New York Times.

Americans and Europeans also use as much fertilizer on their gardens, golf courses and cemeteries as is used by all the shifting cultivators of tropical lands. The high price of fertilizer, in fact, is one thing that drives these people farther into the rainforest and prevents them from pursuing more intensive agricultural practices.

We consummate consumers of the world's temperate zones comprise about one-fifth of the world's population but account for four-fifths of the raw materials traded on the international market. Many of these materials come from the tropics. No wonder poor Third World people are hard pressed to understand why environmentalists in affluent countries scream about parks and preserves or even papermill pollution. Obviously, the survival of tropical forests depends on a lot more than the passage of strong national conservation laws or the ratification of international wildlife treaties. The problems of the rainforest can only be understood in the framework of political and economic relationships both within rich and poor countries and among them.

Along the mangrove lined banks of an inlet near Balikpapan, Kalimantan, timbermen are getting through another day's work splitting hardwood logs. Huge stackers effortlessly lift the fat South Sea logs, as Southeast Asian hardwoods are called, from the beds of battered timber rigs. The machines then add the timber to high piles of hardwood ready for export.

Throughout the Indonesian archipelago, more than 600 concession holders tow their logs in huge river rafts down to over 100 separate loading terminals. From these and their counterparts in Malaysia and the Philippines the logs are shipped, mostly to Japan, South Korea and Taiwan. Japan alone accounts for around two-thirds of the world's hardwood imports, and per capita, the Japanese consume more wood than any other people on earth.

At some later date the wood processing countries, as these nations are known, will ship the wood again, this time in finished form, to the United States, to Europe and, increasingly, to the Middle East.

Most of the woods cut in Southeast Asian forests belong to the family of trees called dipterocarps, which includes some 500 species, all high quality timber that's exceptionally light and well suited for plywood and veneer.

Seventy percent of all exported tropical hardwoods come from Southeast Asia. Just about all the rest, including valuable woods like African mahogany, ebony and padauk, originates in Africa and ends up in the hands of European consumers.

According to Keister Evans of the Imported Hardwood Products Association, American companies got heavily involved in tropical woods about 25 years ago. Prized American hardwoods like walnut had been badly overcut, and there just wasn't enough of the domestic stuff to go around. At the same time, new technology made the hardwood plywood business attractive and, says Evans, it was generally believed that "tropical species would make a good grade for that."

The American tropical hardwood trade developed in two directions. The biggest companies like Weyerhaeuser, Georgia-Pacific and Kimberly Clark rushed to Southeast Asia to invest in lucrative timber concessions. Today, the list of more than 30 U.S. based multinationals with timber operations in tropical forests reads like a Who's Who of the American forest products industry. Boise Cascade has subsidiaries in the Philippines, in Singapore and in Central America. The Scott Paper Co. does business in both Central America and Southeast Asia. Crown Zellerbach, the Container Corp. of America, Dixie Wax Paper, Olinkraft, Potlatch and West Virginia Pulp and Paper Co. all operate in Latin America.

In addition, a number of small companies, known in the business as prefinishers, buy tropical wood and manufacture goods as varied as decorative wall paneling, unfinished hardwood plywood, orange crates and popsicle sticks.

A whopping 82 percent of all American hardwood imports come from the tropics (most of the rest comes from Canada). And this country's dependence on tropical woods has been increasing by more than 7 percent annually over the past 10 years.

That's largely because, for the past 20 or so years, American consumers have had a keen interest in tropical lumber. During the 50s, they ditched the metal kitchen cabinet and switched to wood. These days rough, rich browns instead of painted reds are chic, and tropical hardwoods, available in every conceivable pattern and color, are an interior designer's dream.

Timber prospectors have already scoured the tropics for the most sought after species. Consider Brazilian rosewood, which takes 200 years to mature in the wild. According to Robert Koeppen of the Forest Service's Forest Products Lab, this tree, used to fashion everything from fine wall paneling to guitars and billiard cue butts, will be commercially extinct within 20 years. And Oriental teak, which is transformed into classy items like sailboats, bookshelves and strip, plank and parquet floors, now survives virtually only on plantations. Even the lesser known names, Indonesian meranti, for example, which go into the making of more mundane objects like drawer pulls, are becoming scarce. Carl BeZeeuw of the Tropical Products Information Center in Syracuse, N.Y. says meranti is "reduced to the point where there's only one region left to get it. The stuff we've got now in Borneo is about all we've got." Still another analyst claims that even lowly plywood is quickly becoming a product only the rich can afford.

But the developing world is paying an even higher price for the teak salad bowls in Bloomingdale's and the rosewood tables in corporate boardrooms.

In Kalimantan, workers recently finished uncrating and assembling pieces of a $6 million saw mill owned by P.T. International Timber Corp. of Indonesia (ITCI). The mill is part of the projected new look for the country's timber industry. Dissatisfied with its position as predominantly an exporter of raw logs, Indonesia is trying to industrialize its timber business. The government is pushing new investment in domestic processing and discouraging log exports through heavier taxes and other measures. But critics charge the strategy is simply too little too late.

The ITCI operation is owned jointly by Weyerhaeuser and Tri Usaha Bhakti, a private, army controlled holding company. Weyerhaeuser, the world's largest timber corporation, is by far the largest foreign investor in Indonesia's timber business.

The company began exploring possible investments in Southeast Asia in 1971. Of course, there are always risks involved in investing in such a politically explosive area, but relatively low labor costs and nations hungry for foreign exchange assured a high rate of return. The company believed that Southeast Asia would someday be generating vast quantities of pulp, lumber and other products through timber plantations. It wanted a piece of the action.

In 1971 Weyerhaeuser bought a 65 percent interest in ITCI's 20 year concession license. The Indonesian army's 35 percent equity, charges a report by the public interest Pacific Studies Center, is essentially fiction, a legal way to channel profits into the hands of army generals. The Indonesian partners reportedly have contributed nothing to the project but the license, while Weyerhaeuser has furnished all the capital and expertise, including the construction of Kenangan, a small logging town on the Balikpapan estuary.

ITCI began production in 1971, exporting over 600,000 cubic feet of South Sea logs. Today, output is more than five times that. But the new saw mill, contrary to government rhetoric, will not be able to handle more than 7.5 percent of ITCI's output. Millions of raw logs will continue to be shipped out of the country and processed in the more affluent industralized nations.

ITCI has shortchanged the Indonesian people in other ways. The Pacific Studies Center estimates that in 1976 Weyerhaeuser got a 33 percent return on its ITCI investment (overall, during the same year, the company got a 10 percent return on invested capital). "The magnitude of Weyerhaeuser's profits in Indonesia," claims the PSC report, "drastically reduces the country's foreign exchange earnings from the ITCI development. * * * Nearly all equipment is purchased outside of Indonesia, and nearly two-thirds of the profit does not stay in Indonesia long. The generals spend much of the valuable foreign exchange on imported luxury goods."

Meanwhile, in Kalimantan and all over Southeast Asia, the rainforest may have suffered irreparable damage. Regulations on domestic processing, as well as regulations concerning so called selective logging, replanting and supply quotas, have been ignored by both national and multinational companies, reports The Far Eastern Economic Review, Indonesia's forest service consists of less than one forester per concession. ("You just don't meet foresters in these woods," laments one Indonesian environmentalist.)

In theory, only the largest trees in the rainforest are supposed to be harvested, while seedlings are nurtured and the all important forest canopy is preserved. But critics charge that even when only a few trees are logged, the forest canopy is broken and many of the remaining trees are damaged beyond recovery. As Weyerhaeuser's Bill Gladstone told EA, "We don't yet know the downstream results of tropical logging. We just can't answer definitely about whether a dipterocarp forest can be successfully regenerated." Nevertheless, the cutting continues.

And Weyerhaeuser is not doing nearly enough to find out, says Wayne King, a noted expert on tropical ecology. As early as 1972 King, then a scientist with the N.Y. Zoological Society, met with representatives of Weyerhaeuser and Georgia-Pacific to try to convince them to approve research projects at their Indonesian concessions. "They paid very nice lip service to the idea," says King. "They even said they would provide food, bunkspace and perhaps even a little money. But it never happened."

Weyerhaeuser officials point proudly to the fact that they are doing their own research in Indonesia, mostly to determine whether sustainable tree plantations can turn a profit in tropical lands. And, indeed, they probably represent the only multinational corporation operating in Southeast Asia's forests that is bothering to do any research at all. But ecologists aren't happy about the fact that Weyerhaeuser is only experimenting with foreign softwoods like pine, not native hardwoods that are in short supply and disappearing fast.

There's some evidence that Weyerhaeuser is anxious to sell its share of ITCI. The company complains that timber poachers are an expensive nuisance. And, it says, so are shifting cultivators who are continually moving into the forest concession. Willem Maijer, a botanist who lived and worked in Indonesia for a number of years, isn't very surprised. Weyerhaeuser, he claims, helped displace some 30,000 natives when it bought into ITCI. Native timber entrepreneurs also resent the encroachment on their lands, claiming their often undercapitalized operations are being squeezed out of the market.

In any case, with Southeast Asian timber supplies shrinking rapidly, the timber corporations won't be around too much longer. In fact, there are already indications that they are looking elsewhere.

A recent issue of Import/Export Wood Purchasing News reports that growth in worldwide demand for wood, in addition to the "impending exhaustion of all the most traditional sources of supply—Africa and Southeast Asia"—has led to "a veritable race of importing countries to Latin America and in particular to the Amazon Valley—present holder of the last vast reserve of earth's tropical wood."

At the moment, however, it's not timber cutters but an equally powerful and destructive cash crop economy that's decimating Latin America's forests.

The banana and oil companies of an earlier day have recently been joined by corporations and individuals interested in stripping the land for cattle. The resulting grasslands monoculture, experts say, could put Central American economies at the mercy of the international market in much the same way that crops like bananas and coffee have in the past.

According to Douglas Shane, who recently completed a report on the subject for the State Department, cattle ranching accounts for 38 percent of Latin America's forest loss. "Cattle ranching," Shane says, "is probably the single largest cause of deforestation in Latin America and to a large degree in Africa."

So far Latin America has lost one-third of its original tropical forest; Central America alone some two-thirds. And the problems are getting worse. In tiny Costa Rica, beef production has doubled since 1960. In parts of southern Mexico, the increase is even sharper. Brazil recently opened one million acres of the Amazon, an area roughly the size of California, to foreigners, promising that individuals and corporations will be able to write off 50 percent of their income tax if they invest in the country's booming cattle business. Cattle raising is generally considered the most destructive of all tropical activities.

Along the 1,000 mile long route BR 010, which cuts through Brazil's eastern Amazon region from the capital, Brasilia, north to the bustling Amazon port of Belem, almost all the forest is already gone. Thousands of squatters practice slash and burn along the highway's flanks. And five million cattle graze on the manmade rangeland that's replaced the rainforest there—especially where the road crosses through a corner of Para, the state that's now home to many of Brazil's corporate cattle ranchers.

Much of Latin America's most productive land is already under cultivation, and as a result, whenever new roads are blazed through the rainforest, landless

rural and urban poor follow, in Shane's words, "to hack homesteads out of the wilderness." Government colonization programs bring thousands more. After two or three harvests of subsistence crops like corn, manioc and beans, weeds have invaded, swarms of insects have arrived, the soil is spent and the farmers are forced to move on. The depleted land is often snatched up by rich cattle ranchers.

Throughout Latin American, though, it's becoming increasingly common for the ranchers to simply carve their spread out of the rainforest. Often, peasants are employed to clear the land; sometimes heavy machinery is used. Vast areas are even doused with dangerous herbicides like Agent Orange, then burned.

But no matter which way the ground is being broken, the outcome is often the same. Three to five years later, soil fertility declines, grasses become less nutritious, poisonous weeds start poking up and the entire pasture is abandoned. The cycle is repeated at a new forest site.

Most tropical cattle ranchers appear to be native Latin Americans, but the number of foreigners—including Americans—is increasing fast.

Hundreds of individual cattlemen from Montana to Texas have invested in South and Central American cattle ranches. These expatriot ranchers, always on the lookout for a new frontier, are lured by the vast quantities of dirt cheap land and the big bucks that come when they sell their beef back home. "There's land there," says one St. Louis cattle consultant. You put a fence around it and a cow on it and you are in business."

The list of American based multinationals engaged in the Latin American cattle trade includes King Ranch and the Swift-Armour Meat Packing Co., which, along with a consortium of Brazilian interests, operates a 200,000 acre ranch in Para, just off the Belem-Brasilia Highway. Del Monte, Sifco Industries, Standard Brands and Standard Fruit, a subsidiary of Castle & Cooke, the American food processing giant, have also cashed in on the cattle craze. According to Shane, so has United Brands, which now owns a ranch in Honduras. "United Brands," says Shane, "had some problems with banana blight so they diversified with cattle."

Gulf & Western, the huge conglomerate that owns everything from oilfields to Manhattan publishers—and that has long dominated the Dominican Republic's sugar industry—recently rounded up 150,000 acres for a cattle ranch in Paraguay. Goodyear, Heublein, Borden and Caterpillar are all making a killing in tropical cattle. But the largest ranch of all, 840 square miles of Brazil's eastern Amazon, belongs to Volkswagen.

What's a German car maker doing with a ranch? A U.N. Food and Agriculture Organization study says that worldwide demand for meat is expected to rise more rapidly than any other food except fish over the next 10 years. In 1979 about 20 percent of American beef imports came from Latin America, accounting for almost 9 percent of that area's exports, and the amount has climbed steadily for the past 12 years. U.S. imports of Costa Rica beef alone have doubled since 1970; total 1978 imports equaled some 63 million pounds. Meanwhile, for every million and a half pounds of beef exported, it's estimated that up to 75,000 acres of rainforest are cleared.

American consumers, it seems, just can't break the hamburger habit. So scores of American meat companies and brokerage firms are getting fat buying imported beef and selling it to fast food franchises, food processors and supermarkets across the country.

Up until the mid 50s, the United States was virtually self sufficient in livestock. But around that time Americans began gobbling up billions of dollars worth of Big Macs, Whoppers and roast beef fixins. The nation's bill for fast food now reportedly tops $21 billion a year.

Roy Rogers, Big Boys, Hot Shoppes—all owned by the Mariott Corp.—use imported beef, including Central American beef, in their burgers. Hardees, Jack in the Box and Burger King also offer the imported fare. Wendy's and McDonald's claim they never touch the stuff; however, at least one spokesperson for the fast food business swears that "any chain saying they don't use imported beef is handing you a crock." Shane discovered, in fact, that many hamburger vendors may simply not know where their beef comes from. That's because when imported beef is approved by inspectors and enters this country, it's usually "cut" with domestic cattle trimmings since the imported, grass fed version is simply too lean for American tastes. The resulting international mixture is then sold as "American grade" meat.

Inexpensive steak houses are another big buyer of imported beef. And 13 percent of American beef imports from tropical Latin America come in canned,

pickled, cured or preserved form. The rest comes "fresh frozen," but a great deal of that ends up in the hands of American processors of products as ubiquitous as canned or corned beef, chili, soups, sausages, luncheon meats, TV dinners and beef pot pies—food processors like Del Monte, Castle & Cook and Campbell's, which sells 90 percent of all soups in the United States, and its subsidiaries, Franco-American and Swanson's.

American fast food firms are involved in the Latin American beef business in still another way. McDonald's, for example, may claim it uses no imported beef, but it is exporting the all American concept of fast food to (and repatriating the profits from) countries like Panama, Nicaragua, Guatemala, El Salvador, Costa Rica and Brazil. The hamburgers fried up at these franchises of the far South are obviously "100 percent pure" Central American cattle.

But McDonald's could hardly claim to be feeding the Latin American masses. A government sponsored study in Costa Rica found that per capita protein consumption in rural areas has actually declined 25 percent during the past 20 years. Guatemalan beef consumption dropped a staggering 50 percent during the same decade that exports rose from zero to 30 million pounds per year. To make matters worse, ranching provides few jobs for Latin America's massive labor force.

There is one attraction, though. "The country gets more foreign exchange to buy cheap Japanese cars," says Joseph Tosi of the Tropical Science Center in Costa Rica, "and the tiny cattle oligarchy is further enriched."

As the 1960s approached, the United Nations and other international agencies proclaimed, amid much fanfare, that during the next decade the world's poor nations were going to climb up the economic ladder. But the Decade of Development, as it was called, despite dramatic economic growth in a few poor countries, turned out to be a flop.

Development planners assumed that poor countries could develop their economies the same way the rich countries do—by industrializing as much and as rapidly as possible. The argument went something like this: simply by tapping their often vast natural wealth—land or timber in the tropics, say—borrowing enough money and stimulating the right kinds of investment, the economies of poor nations would be pumped up to the point where they'd achieve a momentum of their own. For the countries of the third world, that has usually meant courting multinational corporations and big bankers from abroad.

Under this scenario, of course, the last thing you want to do is scare away investors. And that's meant bankers and corporate executives have wielded the kind of political muscle over the third world that even the richest and stablest governments find hard to resist. At a recent U.N. hearing on multinationals, a Nigerian delegate put it like this: "A poor country, starved for foreign exchange, overburdened with foreign debt and struggling to implement a modest development program will, in the absence of alternatives, readily enter into various agreements with multinational corporations on unequal terms, reflecting its weak bargaining position and its desperate pursuit of a modest rate of investment."

Fine, some might say, as long as it achieves the right results. But study after study has shown that this model of development has actually widened the gap between the world's rich and poor and has made 40 to 60 percent of the earth's poor even poorer.

"The whole assumption that development is based on foreign exchange is erroneous," says Lenny Siegel of the Pacific Studies Center. It leads to a kind of "dualistic development," in which a small urban elite, tied into the international industrial economy, can invest its newfound wealth in baubles from abroad while the rural masses suffer.

This has been the case even in the "economic miracle" countries like Brazil. Brazil's poor—the overwhelming majority of the country's 120 million people—have been completely excluded from an unfair and ineffective development process.

Like ambitious businessmen everywhere, Brazilians borrowed heavily, invited foreign investment, recycled their earnings, skimped on wages and social programs and watched as profits soared—and as they went ever deeper into debt. Like a dragging anchor, Brazil's fast growing debt—at $52 billion already the biggest any developing country has ever amassed—is threatening to stall its drive to enter the ranks of the industrial powers. Although Paulo Noguiera Neto, Brazil's environmental minister claims that all tax incentives to develop the

Amazon will be stopped, most analysts say Brazil's military government, backed into a corner by its enormous foreign debt, has no choice but to transform its two million square miles of Amazonian rainforest into a source of quick cash.

In Brazil and elsewhere the multinationals, say Richard Barnet and Ronald Muller, authors of Global Reach, often use scarce local capital for their operations, capital that otherwise could be available to local entrepreneurs or government development projects. During one three year period, U.S. manufacturing subsidiaries financed some 78 percent of their Latin American investment locally; that means only about 22 percent represented a transfer of capital from the rich world to the poor. Nevertheless, during those same years, out of every dollar of net profit the same companies made, 52 cents left the country.

Another claim is that investment and trade by multinationals can create jobs. But there's substantial evidence that foreign investment, along with unenlightened government policies, does just the opposite. The women of Java, for instance, used to hull their rice by hand until, in the early 70s, mechanical hullers were imported from Japan. The landless women of the island lost 133 million work days and $50 million in income a year. Yet today Indonesian tariffs still favor the import of capital over the employment of labor.

"That the developing countries cannot do without a modern sector," writes E. F. Schumacher, "particularly where they are in direct contact with the rich countries, is hardly open to doubt." What's needed, he goes on to say, are development policies in which access to the international economy is clearly secondary to satisfying domestic needs.

Finally, after two and a half "decades of development," there's an emerging consensus that poverty needs to be attacked directly. More than 600 million rural people around the world—including 85 percent of the households in Java and 70 percent in Brazil—are either completely landless or lack secure access to land. In Latin America, 7 percent of the landowners owned 93 percent of the arable land as of 1975, producing cash crops like sugar, bananas, tobacco and tea, largely for export to the affluent world. This system exists for one purpose—to bring the greatest profits to the largest landowners. Land reform and millions of new rural jobs in small scale industries are the only answers, ones that rich countries via the multinational corporation with its expensive, labor saving technologies cannot possibly provide.

Neither, apparently, can our international aid agencies. The World Bank, various agencies of the United Nations, the regional banks like the Inter American Bank and the Asian Development Bank, the U.S. Agency for International Development—they've all funded many counterproductive projects in the past. The World Bank, for one, has lavished money on industrial, export oriented forest projects, at the expense of the kind of rural forest management—village woodlots, labor intensive tree plantations, saw milling, furniture manufacture, small scale paper mills—that's so sorely needed in tropical regions. The Agency for International Development, for another, has funded enterprises like the Latin American Agribusiness Development Corporation (LAAD), made up of the Bank of America, Dow, Monsanto, Caterpillar, Borden, Standard Brands and others. LAAD, among other things, is engaged in joint ventures with local companies involved in tropical cattle production.

There are some signs, though, that at least a couple of these agencies are starting to turn around. On paper, if nothing else, they're beginning to show a belated commitment to the world's rural poor.

What citizens of the affluent world should do to stop the destruction of tropical forests is make sure the traditional kind of financial and technical "aid" stops. It would also help if developed nations could learn to control their own corporations, to make them consider the consequences of their actions both at home and abroad. Extra environmental safeguards on tropical forest concessions would help, even if guitars and tennis rackets were to cost more as a result. It would also be desirable, of course, for Americans to start consuming less: eating less beef, recycling and using less wood, among other things, could take some pressure off the tropics.

When you get right down to it, though, all the consumer boycotts in the world wouldn't save the third world's forests. According to Erik Eckholm, only a widely shared development process will. "In the end," says Eckholm, "everything depends on the abilities and intentions in the third world itself."

A first priority for developing countries is the setting aside of key areas of rainforest. Fortunately, scientists have already discovered a number of so called

"Pleistocene refuges" across the tropics, areas which are especially rich biologically. Funds gathered in well to do countries could help subsidize any such conservation scheme.

Light logging on larger tracts of rainforest, says Eckholm, could complement the preserve system. Other areas, however, have to be managed much more intensively—as hardwood and pulp plantations, for instance—to meet the world's demands for paper and wood.

In other economic spheres, the kind of development that fosters self sufficiency, energy efficiency and appropriate technology should be tackled—better stoves, charcoal kilns and other wood burning technologies, for example, or better yet solar or other renewable energy technologies that don't consume wood at all. And one way to get around the tropical soils problem is agroforestry, a system in which trees and foods are intercropped, producing food and restoring forest cover at the same time.

But any socially, economically and ecologically acceptable development process must also involve land reform. That, says Eckholm, "is the stickiest political problem and in the long run the most critical to saving the tropical forests." Small scale agriculture is very labor intensive, and replacing the export oriented cash crop system would both help abolish hunger by leading to increased domestic food production on the tropics' most fertile lands, and also end the need for dubious government colonization schemes frequently undertaken just to avoid confronting the need for land reform on established farmlands. And if the United States were to encourage such efforts, it would put us on the right side of political struggles in countries like Indonesia, Guatemala and Brazil, considered among the world's most repressive regimes.

"If post war experience has proved anything," says Eckholm, "it is that 'development' is not a simple sanitary process of investing capital or introducing new technologies into a country. It is a messy, conflict ridden business." The conflicts have already started in many third world countries—El Salvador, Guatemala, the Philippines.

Violent conflicts or not, anyone truly serious about eliminating hunger, unemployment and poverty—and about saving the world's tropical forests—has no choice but to back efforts that would put control of natural resources in the hands of the largest number of people for the greatest ecological good.

APPENDIX 7

[National Geographic, May 1980]

JARI: A BILLION DOLLAR GAMBLE

(By Loren McIntyre)

FOR JOÃO MELO, the leviathan appeared without warning.

A Brazilian boy about 10 or 11, João was fishing from his dugout canoe in the Rio Jari one April day in 1978 when it happened.

The Jari is a dark tributary that splashes down from the remote Guiana Highlands over many waterfalls, grows wide and deep, and merges into the north channel of the Amazon before that mightiest of rivers reaches the sea. This is a land of primeval forest, rife from root to canopy with fecund plants and rapacious creatures.

At daybreak the air trembles with birdsongs like cellos and chimes played deep in a well. After midday heat has silenced the birds, cicadas assail the eardrums with an unwavering high-pitched buzz. Toward evening awesome thunderstorms shred leaves and limbs and uproot aging trunks.

As he had canoed on and bathed in the river all his life, I suppose João had an almost fetal awareness of the currents of the Jari. He sensed that day a pulsing of air and water perhaps long before you or I—riding in his canoe—would have felt the low-frequency throb of a massive propeller driven by a 22,000-horsepower marine diesel.

The boy looked up. Beyond an island in the river a silvery cluster of towers loomed above the forest crown and drew toward him. It was spooky, he later said to me.

Trailing his fishline, João paddled furiously for home—a stilt-legged hut on the shore. Big eyed and breathless, he told his mother, "A city is coming up the river!"

In truth, nothing so immense had ever entered the mouth of the Amazon, realm of legendary monsters. The hulk that startled João weighed 66 million pounds and was drawn by one of the world's most powerful seagoing tugs. From a plane it looked less like a city in tow than a titan's tool chest: a steel box two and a half football fields in length, open at the top, with equipment standing twenty stories high.

It was destined to recover some of the sun's energy fallen on the Amazon Basin in years gone by. The monster would consume 2,000 tons of wood every day and render it into 55 megawatts of electricity—enough to supply a paper-pulp mill and the now and future cities to arise along the Jari.

The river bisects the 5,600-square-mile property of Jari Florestal e Agropecuária Ltda., a private company applying high technology to extract food and fiber from the Amazon Basin. One of Jari's bold experiments is using aircraft and advanced methods to convert floodplains into huge rice fields, growing food for Brazil and the world. More daring—and far more contro-

versial—is the cutting down of luxuriant native forests to plant two or three species of fast-growing trees to be harvested for paper-pulp manufacture. With 250,000 acres already under cultivation, Jari is the world's largest tropical tree farm.

Critics contend that the Jari pulpwood plantations typify a mindless drive to destroy Brazil's great forests primeval, with worldwide repercussions. Erosion will clog streams, they say, and countless plants, animals, and Indians will die.

Some years ago a prominent Brazilian scientist predicted that the *hylaea*—the equatorial-rain-forest ecosystem of the Amazon Basin—would be mostly destroyed by A.D. 2000 at the present rate. Some scientists believe that about 50 percent of the heavy rain in Amazonia is generated by the release of moisture from the foliage of the forest itself, and that the loss of the jungle would cause shattering changes of climate.

Others maintain that the greenhouse effect of increasing atmospheric carbon dioxide from burning forests and fossil fuels will raise temperatures, melt polar ice, and the oceans then will inundate major cities.

For ten years, with such dire predictions in mind, I have been watching the Jari experiment and discussing it with ecologists. The arrival of Jari's fabulous factory was a high point of my experience.

Six days later came another. Flying above the Atlantic Ocean, a pilot and I sighted a small silver rectangle drawn by a tug with a brown Amazon tide in its teeth. It was another 66-million-pound treasure chest—this one containing the pulp mill.

At a cost of 269 million dollars, these two massive industrial complexes—power plant and pulp mill—had been assembled in Japan and towed for three months across the Philippine Sea and the Indian Ocean, around Africa, and across the Atlantic to South America (map, page 688).

They entered a basin at the jungle's edge. There machine shops, warehouses, chemical plants, and a sawmill stood waiting at the terminus of a railroad and 2,800 miles of roads leading into Jari forests. The basin was diked and more water was pumped in to lift both vessels above the river. Then they were aligned on top of 3,700 rot-resistant wooden pilings, lowered into place, and coupled with catwalks and tubing. When all the water had been drained, the hulls were cut open and connected by conveyor belts and piping to the shore installations.

In 1979 the biggest factory ever to cross the sea, now fully land based, fired its boilers, and all the myriad pieces throughout Jari began to move together.

Enterprise Provides for 30,000

Today the mill produces almost 750 tons of bleached kraft pulp from plantation forests every 24 hours. "At dockside," said Jack Trescot, then manager at Jari, "that's worth more than $300,000 a day—enough to cover the cost of felling native forest, planting pulp trees, and providing for the 30,000 people who already live off this operation."

Half these people—staffers, technicians, service personnel, and families—live in new company towns. All but sixty are Brazilians. The foreigners are a United Nations—Canadians, Japanese, Finns, Peruvians, Indonesians, Americans, and Argentinians, to name a few. Largest town is the headquarters, Monte Dourado, thirty miles upriver from João's shoreside hut. Lumbermen, railroaders, scientists, and management people work in and out of hastily built offices dusty with the traffic of 700 vehicles.

The pulp factory lies about 15 miles downstream at the industrial site named Munguba, which didn't exist when I first visited Jari a decade ago. Neither did Beiradão (Big Place Alongside), a typical boomtown sprouting on stilts along the shore across the river from Monte Dourado (page 708). Beiradão is not supervised by the company but by the Amapá territorial government.

Few people—except hordes of children—think of Beiradão as home. But several thousand boat migrants drink, dance, work, pray, buy, sell, and catch a wink there. Some Jari technicians, with an itch to drink *cachaça* (Brazilian firewater) and do what they please of an evening, live in Beiradão. One explained, "I'm from Rio; I can't stand the soda-pop surroundings of Monte Dourado. It's too antiseptic . . . except when you're sick, and then of course you're glad that health care comes with the job."

Beiradão has no automobiles or roads; it is tied to Monte Dourado by 24-hour umbilical traffic of motorboats and canoes.

Three or four thousand Jari inhabitants live in jungle camps, sleeping in hammocks. Laborers recruited from riverbanks and arid lands in northeastern Brazil, they clear underbrush with machetes, and are taught to fell trees with chain saws (page 705) and even to operate heavy machinery.

"My contract is for three months," said one with a gesture to show how he'd signed with a thumbprint. "When I get paid off [perhaps $300], I'll rejoin my family in Maranhão State." He used to make a living there hunting wildfowl by canoe.

"Few ship over," said Don Hoppe, a Jari forester. "Labor is scarce because other projects south of the Amazon—railroads, iron mines, dams—draw workers away. The turnover rate of 200 percent a year for contract labor is horrendously costly."

Don and his wife, Heidi, both former members of the Peace Corps, help me find my way around a Jari profoundly changed from visit to visit.

On each visit I have met the latest director; I know eight of the more than twenty who have headed this project since its beginning 13 years ago. I quoted one in a NATIONAL GEOGRAPHIC article on the Amazon River. "This project," he said, "may cost 100 million dollars before it turns a nickel." Five years later I reported that 500 million dollars had been sunk into Jari (see issues of October 1972 and November 1977). Now the total approaches a billion dollars—but at least some nickels are being turned.

A Man in Tune With A.D. 2000

By now Jari may be the biggest one-man private-development project on earth. And one of the least understood.

Stories appear in the U. S. and Brazilian press about Jari's private army (there is none), enslaving Indians (there are no tribes or slaves on the property), and U. S. plans to populate Jari with "excess Negroes." I think such flights of imagination spring from Jari's inaccessibility to reporters, both Brazilian and foreign, and frustrated fascination with Jari's sole owner and operator, a private person who avoids interviews.

Daniel Keith Ludwig—D. K. to his intimates—was born June 24, 1897, in South Haven, Michigan (page 701). Slim, with an alert eye and a full head of hair, he swims an hour a day to alleviate an old back ailment caused by a shipboard explosion. (Jogging is stupid, he says; it jars the spine.) He is technologically oriented toward the year 2000, and I think he expects to get there, so long range are his interests.

Ludwig bought Jari when he was 70 for three million dollars, and has enjoyed Brazilian federal government support from the beginning. The fact that he has spent an average of $180,000 a day on the project for the past 13 years gives some idea of his wealth and the immensity of his commitment to Jari. Since Ludwig has no children, he plans to bequeath Jari's eventual profits to cancer research.

Ludwig started a shipping business at age 9 by salvaging a sunken boat. Forty years later he was pioneering supertankers and advancing supertanker technology. "Besides shipping," said Elmer Hann, onetime head of Ludwig's supertanker shipyard in Japan and later a director of Jari, "he's into mining, ranching, housing . . . oh, all sorts of investments in 15 countries. He got there by thinking twenty years ahead."

"I believe you must have luck in the world," the man known to be one of the richest in the world told me. He was chatting over lunch in his Beverly Hills home about his good fortune in the choice of a power plant for Jari.

"After several attempts we came up with a wood-burning plant that's a lulu! We save eight or ten million dollars a year by burning a resource that's replenished every day by solar energy. Brazil is short on fossil fuels; we could never get enough oil there to keep going. Pulp and paper use lots of energy; few industries in the U.S.A. use more."

Ludwig said he never rolls dice but that Jari is an exciting crap game, biggest in his career. "Back in the fifties I thought of floating a factory on a barge to an undeveloped region—such as a desalinization plant to make fresh water for an Arabian seaport. And I figured the world-communications explosion would cause a paper shortage by the 1980s. So twenty years ago I sent experts to search out fast-growing pulpwood trees. We hit on melina [*Gmelina arborca*], an Asian tree. It grew like crazy in Nigeria and Panama."

To put all of these ideas together and

become a major producer of food and fiber by the 1980s, Ludwig needed a piece of tropical forest and a floodplain, with access to the sea. He found Jari.

Only a few mixed-blood descendants of Indians, Portuguese colonists, and Negro slaves lived along this stretch of the Jari in those days. For centuries they had extracted Brazil nuts and rubber from the native jungle, ruled by a succession of petty dictators. The last of these, Col. José Júlio de Andrade, sold out in 1948 to Jari Commerce and Navigation Company, a small Portuguese trading firm that harvested Brazil nuts and raised some cattle and water buffalo. In 1967 Jari was acquired by Universe Tankships Inc., a Ludwig company.

Persistence Pays Off

I wondered at Ludwig's audacity years ago when I first met Clayton Posey, the knowledgeable forester who has supervised Jari's plantations from the beginning. Posey radiated confidence then, but seemed to have little idea whether, when, where, or how his melina groves, first planted in 1969, would be processed into paper. Henry Ford attempted to raise rubber trees in the Amazon Basin. Starting in 1927, Ford sank millions into developing plantations almost as big as Jari. He gave up in 1945.

Not Ludwig. When melina languished on sandy soil, he switched to Caribbean pine on a third of Jari's plantations.

A constant threat is damage from leaf-cutting ants and other plagues that might touch only a species here and there in the heterogeneous native forest but conceivably could wipe out his entire monoculture.

"Caterpillars did eat up a few acres of leaves one year," Posey told me, "but a virus—a natural disease—luckily destroyed them in turn. In addition, our experiments in cloning, pruning, fertilizing, and pest control are now paying off."

Ron Woessner, in charge of forestry research at Jari, showed me a seed of *Eucalyptus deglupta* as thin as a hair. "Would you believe it will grow to 18 feet high and 3 inches in diameter in 12 months? This eucalyptus may feed the power plant when we no longer cut native forest."

How do ecologists feel about converting jungle into tree farms?

"Frustrated," answered one of the Amazon's leading plant taxonomists, Dr. João Murça Pires, a Brazilian. In his laboratory at the famous Goeldi Museum in Belém—the skyscraper city at the mouth of the Amazon—he expressed a major concern of most tropical-forest specialists I consulted.

"We don't even know what we are destroying," he said. "We've identified less than half the species of the hylaea, an incredibly complex ecosystem that took millions of years to evolve. Perhaps some medical or nutritional keys to man's survival are hidden in that still mysterious gene pool, which is being obliterated bit by bit. I wish Amazon development might be slowed until we understand the ecology well enough to plan wisely."

As to Jari's own jungle, Manager of Forestry Operations Johan Zweede advised me that more than half of Ludwig's three and a half million acres will be kept virginal. As of mid-1980, he said, only 6 percent of Jari's native forest will have been cleared and replanted. "We expect to clear 10,000 acres a year," he went on, "until 500,000 acres are under tree cultivation."

I asked Clayton Posey whether melina forests produce as much of the oxygen we breathe as the original jungle. "Definitely more," he replied. "Young forests render more oxygen than they absorb. Old forests are essentially steady state. Decomposition on the forest floor uses up almost as much oxygen as the lofty biomass releases. I doubt that the Amazon forest supplies much atmospheric oxygen. Science now tends to credit the oceans as the main supply."

Ludwig presses hard for full use of native forest. Johan Zweede told me: "First we fell and extract good lumber trees. We utilize more than forty species at Jari for buildings and manufacture. But less than a dozen hardwoods are accepted abroad. If we can induce foreign buyers to order other Amazon hardwoods, all Brazil might profit."

Fuel is one of Amazonia's main forest resources, for wood will burn regardless of color, hardness, or size. "Many Jari species are useful only to fuel our power plant."

I interviewed the government official responsible for forest utilization at Jari. Dr. Clara Pandolfo, a widely respected authority on Amazon

development, is director general of the Department of Natural Resources for the all-powerful SUDAM: Superintendency for Development of Amazonia. A cheerful, articulate Brazilian, Dr. Pandolfo received me in her spacious offices in Belém.

"We follow Jari's wood-fuel experiment closely," she began, "considering that Brazil already has wasted billions of dollars' worth of wood and trillions of Btu's by indiscriminate burning, while the cost of oil imports is ruining our economy."

I asked Dr. Pandolfo's opinion on the value of Ludwig's pine, melina, and eucalyptus plantations.

"I have few qualms about transforming jungle into monoculture tree crops. Jari involves only a fraction of one percent of the region under my supervision. And it is the most innovative of all current projects—some of which are frightful.

"It won't be tried on a larger scale until it proves viable. I hope Jari leads to the planting of trees on millions of acres of savanna in central Brazil."

A leading Amazon ecologist, Dr. Robert J. A. Goodland, agrees. Co-author of *Amazon Jungle: Green Hell to Red Desert?*, Dr. Goodland points out that to check leaching of nutrients from the soil, it is important to maintain the forest canopy. He believes melina does that better than annual crops. Dr. Goodland also rates tree plantations well above the ubiquitous cow pastures of Amazonia, which he believes are possibly the worst economic and biological trade-off for the original forest.

Shipboard Logs Sprout Leaves

Most Amazon forest nutrients are held in the biomass of leaf, limb, and roots, Johan Zweede told me. "These may be returned to otherwise deficient soil by oxidation, either by burning or by rotting, which is a longer process. The ashes are fertilizer worth about $275 an acre. When warm rains come early in the year, we plant seedlings in the ash-covered soil."

In 1976, before the pulp mill was built, Ludwig shipped 13,000 tons of Jari melina to Finland to make into pulp, then paper, as a test of its quality.

"Crossing the Equator," Johan said, "the deckload of tree trunks sprouted leaves. Hundreds of Finns came down to the docks to see the Amazon ship decked with greenery. Longshoremen refused to unload it until the cargo was inspected for snakes. Finally, papers made of melina were tried all over Europe and found good."

By that time, D. K. Ludwig had set up a worldwide systems approach for his Amazon project. The Japanese redesigned a pulp mill to tuck into a hull built as carefully as a ship. They filled it with machinery from Europe, Asia, and the U. S. Components were manufactured in 20 different Japanese shops, and transported to Kure, where cranes capable of lifting 1,200 tons dropped them into place.

The power plant and pulp mill were assembled in less than a year. Had they been built from scratch in the Amazon jungle, time and cost would have soared beyond the limits of practical planning. The implications are significant for other remote and developing areas, which could order intricate, high-cost plants and have them transported in, both on time and within their budgets.

I had supposed that cramming acres of pulp mill and 55 megawatts of power plant into steel hulls would create a bedlam of heat and noise. Cecil MacDonald, general manager, took me on an all-day walk through Munguba, site of the complex.

"As you see, it's cooler inside than out," he said. "It's clean, the noise level is normal, and there's lots of free space, as in a well designed kitchen. The plant observes the latest U. S. specifications for pollution control. You'll find dolphins sporting near the effluvium output in the river."

Few technicians were on duty. Most of the plant operates automatically, monitored from air-conditioned control centers.

The discovery of high-grade kaolin, a fine white clay used to coat paper with the gloss necessary in color printing, as well as for ceramics, cosmetics, and medicines, was another of Ludwig's lucky breaks. A kaolin mill alongside the pulp plant at Munguba already produces 190,000 tons a year from reserves underlying Jari property, both for export and for Brazilian markets. Now, expansion planning includes a possibility of a paper plant towed from Japan.

The tract also includes half a million acres of treeless Amazon floodplain suitable for

66-326 O - 81 - 24

growing rice (pages 710-11). At Jari one day Ludwig told me: "By the mid-eighties I expect to help provide Brazil with rice enough to export."

Marvin Ragland, the Louisianian in charge of Jari's rice program, outlined the project. "We doctored up the *várzea*—floodplain—with canals and dikes and pumps," he said. "We sow by plane and harvest by machine, netting two crops a year, four tons an acre, high by world standards."

Ragland's assistant, my old friend Han Steenmeijer, a Dutchman from Indonesia, showed me the 10,000 acres now under cultivation—a vast extension of the single experimental paddy we had photographed from the air in 1972. Today's goal is 35,000 acres, producing 140,000 tons of rice a year.

Cristovão Lins, a young Brazilian in charge of livestock for Jari consumption, breeds cattle that graze in the upland pine plantations. "Jari is short of woodsmen for cutting back second-growth jungle that chokes out the pine," he said. "My cattle trample the weeds and feed on grasses sown among the pines."

Cristovão led me along Jari's swampy Amazon shore, where cowboys in canoes herd nearly 6,000 water buffalo. Milkers know cows by name, and buffalo respond individually when called. Cristovão said, "Few bugs bother them. They eat almost anything green, grow bigger and faster than cattle, and their milk yields 9 percent butterfat." It tasted delicious.

Environmentalists Assail Project

Controversy about Amazon development continues to flame. Three Brazilian congressional groups investigated Jari in 1979, the "International Year of the Amazon" declared by the government. The slogan "Save the Amazon, Save the World" caught on. In July, 5,000 scientists convened in northeastern Brazil to debate "dilemmas of scientific production in Brazil." They shouted down the Jari spokesman.

Daniel Keith Ludwig says he is somewhat puzzled by charges that he is wrecking the environment. As a man born in the 19th century, who has been a leader in America's technological revolution in the 20th, and who foresees a world of hunger and want in the 21st, he says that "only numbskulls would censure our use of .03 percent of the Amazon Basin to provide food and fiber for the future."

Ludwig disputes the phrase "surprisingly fragile ecosystem," which is frequently applied to descriptions of the Amazon jungle. He has always believed (along, perhaps, with many inhabitants of the region) the old saw that goes: "While you're clearing the jungle from your door, it's coming in the windows." "Hell's bells," he says, "I spend five million dollars a year just to whack down the wild growth that springs up among our planted trees!"

That great spectacle by the river, the Jari power plant, may lose some of its appetite for wood before it consumes even an infinitesimal fraction of the Amazon forest. Why?

"The Brazilian Government has just verbally approved a thousand-megawatt dam on the Jari," D. K. Ludwig confided to me. "When it is in operation, it will produce clean energy for us . . . hydroelectric . . . cheapest thing in the world once the steep building costs are paid off." Once again, I thought, that Ludwig luck!

The dam will rise upstream from Jari's Santo Antônio waterfall and will not submerge that natural park. Nowhere in the Amazon Basin have I discovered a lovelier place to photograph flowers, to shower under cascades springing out of black cliffs, to dive into waters pure enough to drink.

Tree Crop Replaces Jungle

Recently in a splendid pine plantation on a hill not far from Monte Dourado, I walked through even ranks of trees and paused to rest on a mossy log. It was the charred and rotting trunk of a fallen giant of the "natural forest," as the jungle thereabouts is sometimes called. By implication, then, the pine forest is "unnatural." And indeed this forest seemed to be, for no snakes lurked beneath the log, no birds sang in the branches, and no insects buzzed in the still air.

The rite of death and renewal of life of the rain forest here—after millions of years—had burned into oblivion. A thick carpet of long brown needles covered the sandy soil and inhibited emergence of all but the most persistent of the vanquished vegetation.

I was sitting amid Ludwig's orderly trees, a crop spreading row on row. Soon woods-

men would lop them down, burn the brush, and return in the rain to stick into the sand and ashes whatever superseedling had just been cloned at the Jari nursery. I felt free of the apprehension one sometimes feels in the oppressive tropical rain forest, yet I missed the savagery.

I had to recognize, though, that harvests of pulp trees like these make possible the publication of the words I write and you read. Blame Johann Gutenberg and his printing press, if you must. The disappearance of broad belts of the age-old Jari jungle and the hurried life cycle of the new pulp forest are consequences of the information explosion, of today's world demand for paper, and of one man's scheme for meeting that demand on into the 21st century.

By then perhaps we'll know the winners—and losers—of D. K. Ludwig's biggest gamble, and the continuing debate it has inspired.

APPENDIX 8

[Los Angeles Times, May 4, 1980]

ONCE-LUSH HAITI CLOSE TO DISASTER—AGRICULTURALLY BASED ECONOMY IS CRUMBLING

(By Leonard Greenwood)

PORT-AU-PRINCE, Haiti—Along the road leading north to Gonaives, old women stoop beside sacks of charcoal, waiting for buyers.

The road crosses a flat, sun-baked plain. Stark mountains rise miles away to the east.

What used to be a lush Caribbean country has been stripped of its foliage. The Haitians are literally burning their future. Forests have been felled for charcoal, and now not much remains for that use.

The hills around Gonaives are bare of all but thorn bushes, the topsoil long ago having been carried away by erosion that foliage once held in check.

And thorn bushes make poor charcoal.

An old woman in a faded red cotton dress watched anxiously as a visitor examines her charcoal, snapping the thin twigs.

"I'm sorry, sir," she said, struggling with seldon-used French words (she usually speaks Creole), "but that is all that is left in this region."

All over Haiti, once known as the "Pearl of the Antilles," destruction of the land is going on at an ever-accelerating pace.

Before the slave uprising that freed this land from its French masters in 1804, Haiti accounted for 40 percent of France's foreign trade. A small country the size of Maryland, it had great plantations that produced sugar cane and a wealth of fruits.

Today the plantations are gone, broken up by successive generations into plots of diminishing size until today the average farm consists of just two acres and supports four or five people.

The ruins of the plantation houses are surrounded by rocky, worn-out holdings where listless peasants struggle to raise enough food to keep their hungry children alive.

There is less land under irrigation now than there was two centuries ago.

And the last of the forests are being devoured.

Only 10 years ago, 12 percent of Haiti was still covered by trees. Since then, a third of those trees have been destroyed, the wood used for fuel and the land, suitable or not, planted in crops in a desperate attempt to relieve the pressures caused by growing numbers of starving people.

Charcoal provides 85 percent of Haiti's energy needs, and while the trees last, hundreds of thousands of peasants will augment their meager incomes by making charcoal.

"As the population has boomed, people have moved farther and farther up the hillsides, cutting the forests and denuding the land," Al Furman, director of the U.S. aid program here, told a recent visitor.

"The result is widespread erosion. Erosion is literally washing away the agricultural base in Haiti."

The state of the land is a symbol of what has happened to Haiti politically and economically in the last 175 years. Generations of tyrants have exploited the country and its people, repressing them and robbing them.

Haiti, whose people remember with pride that their country was the second nation in the Western Hemisphere to win independence by fighting for it, today finds itself in the humiliating position of being the poorest country in the hemisphere and one of the poorest on earth.

Since independence, the population has increased tenfold. In this country there has been a steady decline in rural living standards and today nearly four out of five rural Haitians live below the poverty line.

In a country that is expected to remain heavily rural for at least the remainder of this century, the outlook is bleak.

A recent report by the U.S. Agency for International Development says the main cause of Haiti's poverty is low agricultural production.

"Haitian agriculture is increasingly unable to feed its growing population and the government has been forced to import more and more food to prevent widespread suffering," the report says.

An examination of Haiti's agriculture reveals a picture of disintegration:

Coffee is the most important crop, the major source of income for 1.5 million people, or a quarter of the population. Booming world coffee prices have helped to keep the economy from sinking, but exports are declining.

Haiti used to export huge quantities of sugar and bananas. Today it does not send a single banana abroad and sugar has to be imported in greater quantities each year.

Sisal producers are losing markets to Mexico, Brazil and East Africa.

Rice is a staple food in Haiti but the country is far from self-sufficient.

"In 1978, African swine fever hit the country, causing $20 million to $30 million in losses. It struck hardest at the rural poor, who traditionally use pigs as a form of mobile savings.

Haiti has almost no mineral resources. There is a bauxite mine near Port-au-Prince, the capital, but it is close to being mined out.

"Even the sea has been fished out," an observer said.

The country is regularly beset by drought, floods and hurricanes, and the Haitian peasant, undernourished, sick and illiterate, reels under the blows.

As drought followed last year's Hurricane David, the peasants of the worst-afflicted areas migrated to Port-au-Prince and other towns.

Those who could scrape together the money joined the "boat people" in what has become Haiti's most famous export—human beings.

Emigration is an old safety valve for Haiti, a way out during economic disasters or political repression. For generations, Haitians have left in waves. There are probably 100,000 Haitians in Cuba and thousands more in the Dominican Republic, which shares the island of Hispaniola with Haiti.

And there are large and growing exile colonies in Miami, New York, Mexico, Paris, Montreal, the Bahamas and Caracas, Venezuela. Great numbers left during the 15 years under the tyrant Francois (Papa Doc) Duvalier, who brought death, torture, repression and economic stagnation to Haiti.

Some experts calculate that during his reign 40,000 people disappeared. When Duvalier died in 1972, almost nothing had been done for the country for 15 years.

A black man, he had broken up the old administration of mixed-race Haitians, eliminating from government service the people who had run the country for generations. Even the few roads, built by U.S. Marines who occupied Haiti from 1915 to 1934, were falling apart.

During the worst years of Duvalier's regime, Western nations that had been providing financing and technical aid withdrew. After his death, they returned.

Today $75 million a year is being poured into Haiti in aid from all over the world, including the United States, the World Bank, the Inter-American Development Bank, France, West Germany, Canada and Belgium.

U.S. aid this year will amount to $25 million in commodities, equipment and services. It is the third largest aid program in the Western Hemisphere.

The U.S. program is aimed basically at agricultural developments—conservation and upgrading the land—and public health and nutrition in rural areas.

Together, the aid-giving countries have formed a commission with the Haitian government to administer the development programs but, according to foreign experts who take part in it, the old ways die hard, and the government is often passive. The donor nations have had to make it clear regularly that Haiti has to make a stronger commitment to development if the aid programs are to be continued and expanded.

Today Haiti is run by Jean-Claude Duvalier, 28, the son of Francois Duvalier. Known as Baby Doc, young Duvalier was proclaimed president for life the day after his father died.

Since then he has ruled in what some people here describe as an "African tribal" manner, holding personal consultations with many of his people. There is a Cabinet and there is a legislature, but Duvalier is clearly in charge. He has the support of the army and the police and he treats them well to keep them loyal.

Political repression has eased under young Duvalier. There are reported to be only a handful of political prisoners in jail. There are still reports of some torture, but it is not systematic, as it was in the 1960s.

By last year, two political parties had been formed. For the national elections in February more than 300 candidates registered for 58 seats.

But then came a crackdown. By coercion and corruption, the government whittled down the number of candidates to the point where almost all of them were pro-Duvalier. As a consequence, the legislature that was elected is extremely docile.

"For a time after Jean-Claude took power things improved, but there has been a deterioration since last year," said Gregoire Eugene, leader of the Social Christian Party. "There has been a very tense mood since August, when opposition leader Sylvio Claude was arrested. People who were powerful under Papa Doc are coming back into office."

Eugene admits that the opposition parties have few members, but, he said, they include most of the country's intellectuals and teachers.

Last November, Gerard Gourges, head of Haiti's Human Rights Commission, scheduled a lecture on human rights. It drew an enormous crowd and 60 thugs armed with batons moved in to break it up. Gourges and his wife were among those who were beaten. Haiti apologized to four countries, including the United States, whose diplomats were also beaten.

Many people believe that the thugs acted with government approval.

"It was like an action of the Gestapo," Gourges said.

A new press law was introduced last year, prohibiting a long list of activities including "speaking ill of the dead." This was seen as a move to stop criticism of the late president. The law has been liberalized, but it still requires newspapers to submit articles to the government 72 hours before publication.

"Generally, the government did not repeat the brutality of the Papa Doc years, but it has not institutionalized changes that will provide any guarantee that those days cannot come back," a foreign diplomat said.

"Haiti still has a president for life. It still has a rubber-stamp legislature. And when the legislature adjourns each year from September to April constitutional guarantees are suspended and complete power is left officially in the hands of the president."

Although Haiti has a long way to go before it looks even remotely democratic, the improvements have brought private investment back to Haiti. In the last five or six years labor-intensive light industries have created 40,000 new jobs, mainly in Port-au-Prince. They turn out a wide range of goods, from 98 percent of the world's baseballs to electrical components.

It is only a drop in the bucket in terms of the number of jobs needed in Haiti, where roughly 250,000 youngsters come into the work force every year.

The investors say they are delighted with the Haitians, who work hard to keep low-paying jobs. Most of the new industries are owned by Haitians, but there are many U.S. firms among them.

Many people, Haitian and foreign, see such industries as the long-term solution for Haiti, together with agricultural self-sufficiency.

"Haiti is always on a razor's edge," U.S. Ambassador William B. Jones said recently. "If there is any hope it is in the development of private enterprise.

"This hope, no matter how slight or difficult to realize, must be pursued."

APPENDIX 9

Statement on the Human Consequences of Development Policies in the Brazilian Amazon, Submitted by Robin M. Wright and Dr. Shelton H. Davis of the Anthropology Resource Center, Boston, Mass.

We would like to thank the Chairman and Members of the House Subcommittee on International Organizations for the opportunity to present a statement as part of these historic hearings on the scope and consequences of deforestation in tropical areas of the world.

For several years, the Anthropology Resource Center (ARC, Inc.) has been monitoring the social and environmental consequences of development policies in the Amazon region of South America. In 1976, ARC published a 106-page report that documented the impact of recent petroleum and mineral explorations on the Indian tribes of the Amazon basin (Davis and Mathews, 1976). In 1977, Dr. Shelton H. Davis, the ARC director, published a book entitled Victims of the Miracle: Development and the Indians of Brazil on the history of Brazilian Indian policies (Davis, 1977). In 1978, ARC presented testimony before a special briefing of the Subcommittee on International Development, Committee on International Relations of the U.S. House of Representatives, on the impact of Brazil's "economic miracle" on Amazonian Indians (U.S. Congress, 1978).

In recent months, ARC has devoted a great deal of attention to the situation of the Yanomami Indian Nation in Brazil. The Yanomami are the largest unacculturated Indian tribe in South America and live in scores of villages along the border of Venezuela and Brazil. Since the early 1970's, the physical and cultural integrity of the Yanomami have been threatened by new highway, mining and agricultural projects. Because of the delicate life-and-death situation of the Yanomami, a campaign is now underway to convince the Brazilian government to create a 16-million acre Indian Park for the Yanomami tribe (A.Ramos and K.I. Taylor, 1979; Holden, 1979).

As anthropologists, we are particularly concerned about the fate of the Yanomami and other indigenous peoples in light of recent development and deforestation activities. Whereas the science of tropical forest biology offers one type of perspective on the problems of deforestation, the humanistic and holistic approach of Anthropology provides insights into the role that human populations have had in the tropical forest environment. It is impossible to formulate a rational and humane policy for tropical forest areas without recognizing the fact that people have lived in and successfully adapted to the rain forest for millenia. No policy for the preservation or development of these areas will succeed without considering the modes of adaptation of indigenous tribes.

The Brazilian government has recently taken positive steps to prevent the destruction of the Amazon rain forest. Currently, the Brazilian President is considering a new land-use plan for the Amazon which will protect Indian lands, impose strict regulations on the agents of tropical deforestation, and ensure that environmental impact studies are conducted before any mining

or hydroelectric projects are authorized (Eisner, 1980). The significance of this new plan cannot be underestimated. If implemented, it would potentially reverse, or at least halt, the destruction that has been unleashed on the peoples and environment of the Amazon from early colonial times until the present day.

Before the arrival of the Europeans, more than five million native peoples lived in the Amazon Valley. Along the floodplain of the Amazon River, large and relatively complex societies existed that produced economic surpluses and had a rich ceremonial and ritual life. In the interior forest regions, there were scores of smaller societies who subsisted on hunting, fishing and gathering activities. These peoples utilized the resources of the Amazon Valley efficiently, produced a large variety of foodstuffs, and maintained a wide-ranging network of trading alliances. Most importantly, they did not destroy the rain forest, although they lived and wandered all over it for over 20,000 years (Meggers, 1971; Sweet, 1974).

When the first Europeans arrived in the Amazon Valley in the 17th Century, they viewed the region as an immense resource bank from which wealth could be extracted and used for the purposes of self-enrichment. Thousands of Amazonian Indians were enslaved by Jesuit missionaries and slave-traders and put to work on plantations and estates. Indians were used to extract wild forest products, such as cacao, vanilla, and salsaparilla, which were destined for export to European markets. In less than half a century, the European markets for these products had been flooded, and the tropical forest and its peoples had been destroyed (Hemming, 1978; Sweet, 1974, n.d.).

The history of the Amazon Valley contains countless examples of unsuccessful development schemes based on the model of quick extraction for profit in foreign markets. During the rubber boom of the late 19th and early 20th Centuries, the entire Amazon Valley was oriented to supplying natural rubber for European and American markets. Thousands of immigrants from the Northeast of Brazil were forcibly relocated to the Amazon, invading areas occupied by the last remaining Indian tribes. More than 30,000 Indians of the Putumayo River region in the Northwest Amazon were enslaved or decimated by disease during these terrible years. When the rubber boom collapsed previous to World War I, the Brazilian Amazon and its population were left impoverished, ruined and disillusioned (Sweet, n.d.).

So many of these schemes have remarkable parallels to the present experience in the Amazon. In 1970, the Brazilian government began a massive program to open up and develop the resources of the Amazon basin. Without any prior environmental or social-impact studies, the government constructed five highways across the region. Huge tracts of land were given to peasant colonists, cattle ranchers, and timber, mining and agribusiness firms. More than a billion dollars, much of it coming from international banks and development agencies, poured into Brazil for new highway, port, hydroelectric and resettlement schemes (Cardoso and Muller, 1977).

From the beginning of this program, scientists warned the Brazilian government about the potentially disastrous effects that such a massive development effort would have on the delicate ecology and population

of the Amazon region. Unfortunately, the predictions of these scientists came true. Beginning in 1970, a brutal process of physical and cultural extermination was again unleashed on Brazil's remaining Indian tribes. Native peoples were not the only victims of the Brazilian government's program to open up and exploit the resources of the Amazon. In the states of Mato Grosso, Rondônia and Pará, thousands of peasants were uprooted by cattle ranches and became impoverished pariahs in the backlands of Brazil. A massive process of deforestation also took place, which robbed the rain forest of its natural fertility and turned huge areas of once-productive forests into a worthless landscape barren of trees (Davis, 1977; Goodland and Irwin, 1975).

Today, the whole world is watching the three-million acre Jari Forestry and Ranching project established by shipping tycoon Daniel Keith Ludwig in Brazil. What is particularly disturbing about this project is the massive amount of ecological destruction which took place without any previous assessment of its social and environmental consequences. Ludwig's "billion-dollar gamble", as it has been termed in a recent National Geographic article (McIntyre, 1980), was undertaken without prior consultation with Brazilian scientists. Many of these scientists still remain sceptical about the long-term effects of Ludwig's project on the ecosystems of the Amazon (Faleiros, Pires and Maia, 1979).

The Amazon Valley provides a test-case for judging the success or failure of modern forms of development. Corporate models of development, based on huge transfers of alien capital and technology, and oriented to production for international markets, have by and large failed when applied to the delicate ecology of the rain forest. Yet these kinds of projects still form an integral part of private and governmental notions of how to develop the forest resources of the Amazon (Goodland and Irwin, 1978).

On close inspection, the reasons for the failure of so many of these projects in the Amazon Valley have to do with the fact that the people who make the decisions about development are outsiders. As Dr. Warwick Kerr, the former Director of the National Institute for Amazon Research (INPA) in Manaus, stated in a recent interview:

> "We can do a great deal to manage our resources in a sound way. But we can't control the ecological exploitation and damage by multinational companies... Sixty percent of development is being done by outsiders, thirty percent by Southern Brazilian firms, and only ten percent by Amazonians. You can be sure that most multinationals will not offset the deficit cost to the environment with any of their profits from the projects. Nor will they help out the poor caboclos / peasants / who depend on fish for food and trees for firewood. I call that 'ecological imperialism!'" (LaBastille, 1979)

The political and economic elites who make decisions about development are incapable of turning to Amazonian Indians or peasants for the answers to key questions. Typically, they think of Indians as "hostile tribes"

standing in the way of progress and development. Small immigrant farmers and peasants, who struggle directly with the environment and with development projects devised by planners, are even blamed for the failure of these projects to produce their desired results (Woods and Schmink, In Moran, 1979).

Stereotypes of Amazonian Indians and small farmers also persist in the scientific literature and in popular journalistic accounts. Small-scale forest farmers are said to be the principal agents in the destruction of the tropical forest. Seldom do these accounts analyze the historical, social and economic factors that have contributed to the problems of the forest farmers or the real reasons for the failures of development schemes (See, for example, Salisbury, 1980).

During the past two decades, many anthropological studies have been conducted on the adaptations of Amazonian Indian peoples to the tropical forest environment. Systematic studies have also been pursued on the adaptations of peasant farmers particularly along the Trans-Amazon Highway (See especially E. Moran, 1979, and other studies listed in the accompanying bibliography). These studies indicate that Amazonian Indians and peasants utilize a sophisticated agrarian technology that is efficient and successfully integrated with the tropical forest ecology and that "does not require capital investment or subsidies in the form of energy or petrochemicals from outside the region." (Moran, 1979, p.114)

Indigenous systems of adaptation are based on an incredibly rich knowledge of environmental resources, ecological cycles and a diverse inventory of harvestable plants. Recent studies have shown this to be true for hunting and fishing, as well as for horticultural activities (Hames, 1980). The Yanomami Indians, for example, practice a type of policulture that is considered to be one of the most environmentally benign forms of land use in tropical rain forest conditions. Not only do the Yanomami practice soil conservation, but they also conserve the flora, fauna, and all other elements of the ecosystem. In terms of their economy, society and technology, the Yanomami have been documented to be extremely well-adapted to the tropical forest (Meggers, 1971; Smole, 1976; Lizot, 1971).

There are many other instances which can be given of efficient environmental and economic utilization on the part of Amazonian Indians and peasants. A survey of the existing anthropological literature on this subject could provide scientists and planners with an important source of information for making decisions concerning tropical forest development. Furthermore, Amazonian peoples, who work and struggle with the environment daily, should participate in all decision-making about regional development. As Dr. Robert Goodland of the Environmental Affairs Section of the World Bank has stated:

> "Only the Amerindian possesses the knowledge to survive in the forest; we only know how to destroy the forest without even making an attempt to maintain it. The sustainable exploitation of the forest is likely to require or be based on Amerindian knowledge." (Goodland, NYT, 1975)

The National Research Council has recently published two reports on the problem of tropical deforestation, both of which provide extensive analyses of the destruction that has occurred in the Amazon region (National Research Council reports, 1980). James Talbot, a National Academy of Sciences staff officer, has independently offered a set of recommendations for responding to this problem (Talbot, 1980). His article and the National Research Council reports recommend that (1) rational management techniques should be taught to countries that are experiencing deforestation problems, (2) more research should be done on tropical ecosystems and aquatic systems, and (3) monitoring should be undertaken of forest conversion trends, and (4) multidisciplinary projects should be undertaken to study "selected aboriginal peoples" and their adaptations to the environment.

While these recommendations might ultimately increase our understanding of tropical forest ecosystems and their current problems, we believe that there are several other areas where the U.S. Congress might appropriately bring its influence to bear on the rational use of tropical forest regions. Specifically, we would suggest that the following areas are in need of immediate attention:

1.) The U.S. Congress should promote, through the appropriate scientific agencies, a systematic survey of the historical and anthropological literature on the traditional economic systems, technologies and environmental adaptations of Amazonian Indian and peasant populations. Once this literature survey has been completed, field studies should be promoted to increase our knowledge of the human populations of the Amazon region. The findings of these studies should be incorporated into all development and tropical forest policy planning and should be communicated to the appropriate governmental and international agencies.

2.) The U.S. Congress, through appropriate national and international organizations, should attempt to persuade the governments of Brazil and other South American countries to recognize and respect the land rights of indigenous peoples. Many Amazonian tribes are faced with the threat of extinction. The case of the Yanomami is one among many instances where tribal groups are being uprooted by new highway, mining, and cattle-ranching projects. It is ironic that international pressure has succeeded in persuading the Brazilian government to set aside large tracts of land for forest and biological reserves, but that nearly one hundred Indian tribes still do not have their lands demarcated. The U.S. Congress should give full support to the national and international effort now being waged on behalf of the human and cultural rights of indigenous peoples and tribes.

3.) The U.S. Congress should begin to monitor and regulate the negative social and environmental consequences that are often associated with the practices of U.S. companies in countries such as Brazil. The tendency of U.S. government agencies abroad has been to promote American business interests, rather than to ensure that U.S. corporations do not carry out activities that would be judged to be unlawful in our own country. In many instances, the practices of U.S. corporations and other foreign companies

go against the stated policy of the U.S. Congress to promote the interests of the "poorest of the poor" in developing countries. A broad area exists for U.S. Congressional concern with the practices of multinational companies, the transfer of appropriate technology, unfair labor practices, the protection of the global environment, and human rights violations in several areas of the world.

By way of conclusion, we believe that it is imperative for the U.S. Congress to view any future policy for tropical forests as part of a larger effort on behalf of the peoples in developing countries. All too frequently in the past, the foreign policies of our government have been seen as serving narrow national interests. Two ways in which we can reverse this trend are by increasing our sensitivity to global environmental issues and by furthering our understanding of the aspirations of the poor and dispossessed peoples of the world.

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APPENDIX 10

LETTER TO HON. DON BONKER, FROM S. DILLON RIPLEY, SECRETARY, SMITHSONIAN INSTITUTION

SMITHSONIAN INSTITUTION,
Washington, D.C., May 16, 1980.

Hon. DON L. BONKER,
House of Representatives,
Washington, D.C.

DEAR MR. BONKER: I am pleased to offer comments from the Smithsonian Institution in regard to the hearings on tropical deforestation which you are undertaking this spring and summer. The role of tropical forests is quite at the center of many activities of Smithsonian scientists, who have been engaged in biological inventory and ecosystem studies in many of these areas. We share the concerns of the Tropical Forest Non-Governmental Working Group and the U.S. Interagency Task Force that a sensible U.S. policy to insure the protection of these unique resources will be developed from the recommendations in their forthcoming report. The National Research Council's report on research priorities in tropical biology explains the scientific basis of need for retention of tropical forests, and we are pleased to have participated in the Task Force and National Research Council efforts to bring this significant subject to a wider audience.

Specifically, we believe that increasing resources from the Federal Government should go into research, management/protection, and improvement of basic forestry practices in the tropics. We believe that increasing scrutiny should be placed on the role of AID in carrying out its developmental assistance programs with an eye to improving in-country capability to protect environmentally sensitive natural resources, as well as providing U.S. expertise in resource management and protection of tropical areas.

Since the United States is heavily dependent for certain forestry products from areas in the tropics, annually importing hundreds of millions of dollars worth of Asian wood alone, we do believe that our relation to this trade and its impact on the forests is an area of great urgency for U.S. policymakers. More importantly, the whole role of the tropics as the cradle of life, not only in terms of its flora and fauna, but in terms of its potential for new food, medicine, and energy sources makes it even more urgent that we move rapidly forward on this issue.

The rapid rate of destruction of tropical forests is unparalleled in the history of our planet. As a major force in world decisionmaking we must, by means of a sound policy, guarantee these natural treasures as our duty to generations yet unborn, and strive to educate the public on the values of conserving and judiciously utilizing them. I urge you and your colleagues to examine closely and support the work of the Interagency Task Force, as well as the important role of the Non-Government Working Group, in terms of enhancing our efforts with our colleagues in the third world to prevent the rapid loss of this most important resource.

Sincerly yours,

S. DILLON RIPLEY, *Secretary.*

APPENDIX 11

Letter to Hon. Don Bonker, From Thomas L. Kimball, Executive Vice President, National Wildlife Federation

National Wildlife Federation,
Washington, D.C., May 7, 1980.

Representative Don Bonker,
Chairman, Subcommittee on International Organizations, Committee on Foreign Affairs, Rayburn House Office Building, Washington, D.C.

Dear Mr. Chairman: We are pleased that your Subcommittee is conducting hearings on the tropical deforestation problem, and request that this letter be made a part of the record.

The National Wildlife Federation encourages and supports a vigorous program to protect and wisely manage tropical forests. We believe the United States has an opportunity and obligation to help other countries, particularly the developing nations, with this alarming problem. Our basic policy is outlined in a resolution adopted during our annual meeting held in 1979 (copy attached).

For a number of years now, it has been my privilege to serve as a member of the National Committee for "Man and the Biosphere", a program within the purvue of the U.S. National Commission for UNESCO. The "Man and the Biosphere" program is an international effort sponsored by UNESCO, with a secretariat in Paris. Coordinated by the U.S. Department of State, the MAB program in this country has 14 project areas. The first of these is tropical forests, indicating the importance and gravity of the problem.

The Subcommittee will hear testimony of many highly qualified witnesses before these hearings are concluded, and I should like to merely highlight a few points:

First, rising costs have priced many people in developing countries out of oil products and they are looking to forests as sources of fuel. This situation is being aggravated by increasing numbers of people, who are clearing lands for agriculture and other purposes often unsuited for the areas involved.

Second, the rapid depletion of tropical forest areas usually results in soil erosion, losses of nutrients, impairment or elimination of opportunities to discover and develop new drugs and foods and industrial products, and may cause climatic difficulties by a building of CO_2 in the atmosphere.

Third, we are pleased that the U.S. Forest Service is working with the Institute of Tropical Forests in Puerto Rico and the Institute of Pacific Islands in Hawaii on research in this important area. We are equally pleased that the U.S. Agency for International Development (AID) is working on the problem. However, we think we can do more.

To conclude, we feel that the U.S. Government, segments of the timber industry, and private conservation/environmental groups can make many contributions to the wise management of tropical forests. We are hopeful that an Interagency Task Force report, soon to be released, will attract deservedly-important attention to what we consider as a major global problem.

The National Wildlife Federation laid stress on the problem in the first of our "Fragile Earth" series of articles. This appeared in the July–August, 1976, issue of International Wildlife Magazine, a copy which is attached for your information.

Thank you for the opportunity of sharing these views.

Sincerely,

Thomas L. Kimball,
Executive Vice President.

Attachments.

RESOLUTION No. 3

CONSERVATION OF TROPICAL FORESTS

Whereas, tropical forests consist of and support tremendous numbers of plants and animal species, renewable resources with scientific, medicinal, genetic, cultural, aesthetic, nutritional, commercial and ecological values of global importance; and

Whereas, realization of these values is dependent on sound resource management specifically designed for tropical forest ecosystems, in particular the adoption of scientific forestry and agricultural practices; and

Whereas, increasing demands are being placed on tropical forests to produce food, fiber, and energy to meet the short-term needs of the people in developing countries in which these forests are found, and these demands are resulting in a rapid and accelerating clearing of forest lands; and

Whereas, a continuation of current land use practices and policies will result in the conversion of large areas of forest lands to other less appropriate and valuable uses by the end of the century, some of which threaten the capacity of the land to produce renewable resources; and

Whereas, neither scientists nor management agencies are currently able to predict the long-range ecological, climatic, sociological, or economic consequences of such vast changes in vegetation; and

Whereas, both the benefits associated with sound resources management and the costs of possible losses of renewable resources and adverse climatic changes resulting from deforestation will affect both developing and developed nations; and

Whereas, no program to change existing land use practices in tropical forests can succeed without the cooperation of the local government and financial and technical support from developed countries; and

Whereas, the U.S. Government, has established an Interagency Task Force on Tropical Forests, to address the deforestation problem: Now, therefore, be it

Resolved, That the National Wildlife Federation in annual meeting assembled March 22–25, 1979, in Toronto, Ontario, hereby urges the U.S. Government, through its Interagency Task Force on Tropical Forests, to develop, as a matter of highest priority, a national policy, strategy, and program statement on tropical forests; and

Be it further resolved, That the National Wildlife Federation supports the efforts of international organizations such as IUCN, UNEP, and UNESCO to aggressively pursue programs such as UNESCO's Man and the Biosphere (MAB) Program which can contribute significantly to the resolution of the tropical deforestation problem, and

Be it further resolved, That the National Wildlife Federation urges the U.S. Government to increase its support, financial and otherwise, to both research and operational programs (such as MAB) of international organizations which possess the greatest potential for resolving the tropical deforestation problem. Priorities for these programs should include:

(1) establishment and implementation of deforestation monitoring and assessment systems at the global, regional, national and local levels,

(2) identification and quantification of the economic, social, and environmental costs associated with deforestation and the benefits received from proper forest management, including the economic importance of pharmaceutical drugs, genetic materials, and wildlife,

(3) improvement of scientific understanding of basic physical, chemical, biological, and ecological processes, especially in tropical rainforests, to assist in predicting the impact of large-scale clearing of vegetation and in making sound land use decisions, and

(4) development of alternatives to the present use of forests as well as improved reforestation and afforestation techniques; and

Be it further resolved, That the National Wildlife Federation urges the U.S. Government to review AID, Peace Corps, and other federally supported domestic and international programs to ensure that U.S. efforts, especially in the Panama Canal Zone, Hawaiian Islands, and American Samoa are directed towards sound management of tropical forest resources.

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Doomed Jungles?

(By Peter Gwynne)

In the tropical island chain of Indonesia, stretching 3,000 miles across the western Pacific, the amount of timber felled for export by American and Japanese logging companies boomed more than twentyfold between 1966 and 1970. Since then, mechanized cutting operations have been chewing up the archipelago's rain forests at an even faster clip.

In the jungle of Rwanda, at the heart of the African continent, overpopulation has vastly intensified local slash-and-burn agriculture. Thousands of acres of forest have become wasteland and the inexorable onslaught of more and more farmers, plundering one area after another, has put the mountain gorilla on the brink of extinction.

In Brazil, the military government is pushing ahead with an ambitious plan aimed at developing the huge, steamy "green hell" of the Amazon basin, peopling it with 18 million farmers and industrial workers, converting entire regions into grassland for cattle ranching or otherwise destroying forest areas in what is known as one of the most inaccessible regions on earth.

In southern India and Malaysia, extensive clearing of the tropical forest seems to have altered patterns of rainfall, with heavier bouts of precipitation at longer intervals than normal—and ominous indications that the annual rainfall is decreasing.

These activities are symptoms of one of the most significant, longlasting and irreversible changes that the face of the earth has ever undergone—the pell-mell devastation of the planet's tropical rain forests. Just a quarter of a century ago, a composite satellite photograph of the earth would have revealed a broad belt of greenery around the equator that was broken only by the oceans—a belt that had remained essentially unchanged for some 50 million years.

Today, the picture is strikingly different. Photographs from space now show that the girdle of green is broken in many places, and reduced in area throughout its width. Pressures from industry, farming and man's soaring numbers are tearing into its very fabric. "The tropical rain forest is by far the world's most threatened ecosystem," warns Tom Kimball, executive vice president of the National Wildlife Federation. "The consequences of all the destructions now taking place may be far more costly to man over the long run than any short-term economic gains could possibly justify."

All indications are, however, that the rate at which the pristine jungle is disappearing is on the increase. "If unguided commercial and agricultural exploitation are permitted to continue at the present accelerating pace," asserts Thomas Lovejoy, staff scientist and program director of the U.S. World Wildlife Fund, "almost all these virgin rain forests will be eliminated in only 25 years."

The major concern of conservationists is the near certainty of losing most fauna and flora living in the jungles. According to Duncan Poore, senior ecologist of the International Union for the Conservation of Nature and Natural Resources (IUCN), "the tropical rain forest is the richest expression of life that has evolved on this planet." The seven to nine million square kilometers of tropical rain forests around the world are cradles of evolutionary diversity—gene pools whose continued health is vital to the productivity, climate, and quite possibly even the very survival of the earth as a whole. "Destruction of the rain forests," warns Lovejoy, "would mean the loss of an enormous wealth of genetic material, permanently altering the future of evolutionary options."

Many scientists caution that the current worldwide massacre of rain forests could have far more immediate consequences, as well. Chief among these is the dramatic alteration of climatic conditions that will almost certainly result from the transformation of immense areas of jungle into deserts.

To conserve the rain forests, however, scientists must understand their ecology far better than they do now. Experts know that the forests extend in a band of varying width from the equator toward the tropics of Cancer and Capricorn and that the predominant fact of life inside them is rain. Few tropical forest areas receive less than 100 inches of rain per year, while the nearly 400 inches of annual rainfall that deluges the Choco forest of Colombia is enough to make the damp northwestern U.S. appear as dry as a desert in comparison. It is this rainfall that facilitates many of the ecological relationships in the tropical forests—relationships that are often too complex to be understood on more than a superficial level.

Ecologists recognize that the popular picture of the rain forests as steamy regions of impenetrable undergrowth underlain by masses of rotting vegetation, from which fabulous creatures of every imaginable type and hue might emerge at any moment, is quite wrong. Close to the ground, the forests' vegetation is actually quite sparse. As a result of the jungles' extraordinarily efficient recycling of all their material—most nutrients are cycled locally within the vegetation and surface layers of the soil—the amount of dead leaves underfoot is less than that found in a normal temperate forest.

The first impression of the tropical rain is generally one of monotony rather than diversity. The trees all seem very much alike and few animals hove into view, apart from an occasional bird, butterfly or lizard and numerous ant flies and ticks. Only rarely is there a glimpse of the forests' splendor, in the form of a startling red land crab, an anteater curled up asleep in a hollow tree, an elephant or leopard viewed at a distance, or a tall, pink-flowered wadara tree surrounded by a swarm of hummingbirds.

More thorough studies, from the tops of trees and from specially mounted 100-foot towers, reveal the true extent of the jungles' riches. In fact, no other ecosystem in the world has such a diversity of plants and animals. A hectare (2½ acres) of rain forest in Malaysia, for example, contains between 100 and 150 different kinds of trees exceeding a foot in girth and 65 feet in height. More often than not, the adjacent hectare contains up to 60 more types of trees. An 11-acre section of the Mocambo Forest close to Brazil's 450-year-old Amazonian port of Belém features the astonishing total of 295 separate tree species. By contrast, any naturalist would be hard put to find just ten tree species in a hectare woodland plot in New England or Europe. Even the coves of the southern Appalachians, the richest forests in North America, rarely contain more than a couple of dozen distinct types of trees.

The diversity of birds in the tropical rain forests is equally astonishing. In a single Andean valley in Peru, naturalists have discovered more than 600 individual species of resident birds, while the tiny Barro Colorado island in the Panama Canal boasts 208 species in its 6½ square miles. By contrast, a typical 100,000-square-mile tract in North America contains between 120 and 140 avian varieties.

Trees and birds represent only a fraction of the fauna and flora in the tropical rain forests. The jungles contain large numbers of orchids, ferns, bromeliads (relatives of the pineapple) and other herbaceous plants, most of which grow on the trunks and branches of trees and not on the ground. The forests also hold literally hundreds of different species of vines, mosses, liverworts, lichen, fungi and microorganism too small to be visible to the naked eye.

The animal life of the tropical forests ranges from the largest mammals, such as elephants and hippopotamuses, downwards in size through the big cats—leopards, jaguars and others—to snakes, lizards and frogs. But the numbers of these vertebrate species are far exceeded by those of the insects. Experts estimate that in some tropical forests the total biomass of all the ants alone is greater than that of all vertebrates put together.

Much of the animal life, however, is in middle and upper forest levels where it cannot be sampled easily. Census methods are so inexact—they normally consist of nothing more sophisticated than sweeping a butterfly net through the forest undergrowth and identifying the creatures captured—that no scientist worth his salt is prepared to say just how many species of animals make their homes in a single acre of any tropical forest. Experts are content to assure us that the numbers are very large, and almost certainly exceed those to be found in similarly-sized areas in nontropical regions.

Just as impressive as the ecological diversity within individual jungles is the variation between tropical forests in different parts of the world. In the Kibale Forest of Uganda, the 5,000-foot elevation gives a definite chill to the morning air—a remarkable contrast to the normal pattern of heat and humidity morning, noon and night. Nearly half of the roughly 25,000 species of plants that grow in the rain forests of southeast Asia are found nowhere else in the world. Toucans, for instance, are restricted to the jungles of the Americas, while their distant cousins, the hornbills, are found in all jungles except those in the Americas.

The unusual environmental conditions that exist in the tropical rain forests have given rise to a number of remarkable relationships between plants, soil and animals. None is more strange than the pollination of flowers by bats, a situation typified by the durian tree of Malaysia. Bats collect nectar on the wing, in

the same fashion as hummingbirds, and are attracted to the flowers by very specific colors or odors. The fruit of the durian is in a class of its own for odor, but if one can somehow manage to mask its stench enough to bite into the fruit, its flesh turns out to be delicious. The costly fruit is a traditional offering for Buddhist monks of Southeast Asia.

The major reason for the rather monotonous first impression of the tropical forest is that the leaves of most of the trees are superficially very similar in size, shape and texture. But beneath the monotony is a forest structure of complicated layers. While the tallest trees of the forest climb to heights of 130 to 160 feet, standing out above the rest of the forest like giganic cauliflowers, the densest regions of vegetation in the jungles occur between altitudes of 45 and 90 feet. This closely-packed region produces a natural barrier between the airy, well-lighted region above often known as the canopy, and the gloomy, unchanging undergrowth below, which is illuminated only by passing sunflecks.

Another layer vital to the smooth functioning of the forests is the one below the ground. German researchers who have investigated the Amazon forest have estimated that fully half of the total mass of animals supported by that jungle live in the soil. The subterranean creatures include not only insects but also such reptiles as blind lizards and burrowing snakes that never make even a token appearance above the ground.

The wealth of exotic creatures is not, however, the most astounding aspect of the tropical forests. That distinction must go to the speed at which the forests use their basic resources of heat, water, minerals and organic material. The jungles are really huge recycling centers that put their scarce resources to use the instant they become available. Most of the forest plants have tiny roots near to the surface of the soil, ready to take in nutrients as soon as they reach the soil, and even the tallest trees put most of their roots within three or four feet of the surface. As a result of this rapid turnover, the tropical rain forests normally accumulate negligible amounts of leaf litter and produce scarcely any topsoil.

What is the use of these jungles to man? Many species of trees in the rain forests produce valuable timber, nuts, gums, fibers and the tough, pliable stems of climbing palms (rattans) that are used in making furniture. The forests also contain the wild ancestors of some of the world's most useful crop plants, among them cacao, coffee, rubber and oil palm. Some of the forest animals are in demand for zoos and laboratories and others, among them the blue Morpho butterflies, are used in ornaments. Medical research has already benefitted from the Mexican dioscorea, the source of the corticosteroids used in making the contraceptive pill, and the Mucuna vines whose seeds are rich in the l-dopa that provides major relief for victims of Parkinson's disease.

Beyond these current uses, experts are confident that the jungles will yield more compounds that will benefit mankind. The trees, vines and herbs of the tropical forests contain a huge number of chemicals that appear to protect them against the ravages of insects and other enemies; if the mechanisms of these compounds can be understood, it should be but a short step to adapt at least some of them to the role of protecting crops, domestic animals and even humans.

But these bright hopes are already being dimmed by the headlong rush—sparked by the powerful tools of modern technology—to exploit the forests' other resources. Whereas in years past a gang of men with axes and machetes would take several weeks to clear an acre of forest, a small team equipped with chain saws and bulldozers can now fell the same amount in a single hour. Nor are the modern lumbermen selective in their exploits. For while only the choicer tropical hardwoods can be used to make furniture and veneers, almost every tree in the forest provides timber of a quality sufficient to produce fiber boards and paper. Two factories, at Gogol in New Guinea and in the Choco rain forest, are now converting all the forest's trees, regardless of their timber value, into wood chips that will be exported for paper-making; other tropical nations presently have plans on the drawing board for similar facilities.

The search for mineral reserves is also turning up finds that threaten to uproot more of the jungles. Tin mining in the Malaysian peninsula has been making inroads into the rain forest for years, while newly developed methods of surveying for minerals from airplanes and orbiting satellites have shown signs of iron ore and other resources in Amazonia that will inevitably be mined in the near future. Large scale agriculture is also contributing to the devastation of the forests, as

entrepreneurs and state agencies invest in "monocultural" projects of oil palms, rubber trees and tropical pines.

Modern technology has planted another nail in the coffin of the jungles by making even the most remote tropical areas accessible to twentieth century man. Amazonia, for example, remained an outpost of inaccessibility in the past because its soil was too infertile to justify the expense of building roads and railroads. But in the past decade, air transport and modern methods of road construction have opened up almost all the vast region to the depredations of industrial man. Land-hungry settlers by the thousands have made their way along the highways that link Belém with Brasilia, 1,200 miles to the south, and the Atlantic port of Recife with Perimetro Norte, 2,500 miles distant and just a few hundred miles from the Pacific Ocean. And while their efforts to grow crops and raise cattle have been uniformly disappointing to date, the Brazilian government still seems unshaken in its belief that, somehow, some day, modern agricultural technology will make the Amazon region productive.

It is not only modern agriculture that threatens the rain forests. Throughout the equatorial regions of the world, small farmers are using their axes to clear acre-sized or even larger patches on which they can plant a crop or two of rice, manioc, sweet potatoes or corn, before moving on to adjacent plots after the soil becomes too weakened to support even those poor harvests. Slash-and-burn agriculture of this type is hardly a phenomenon of the twentieth century, and in the past it has provided primitive, nomadic tribes with successful, if sparse, diets. Now, however, the human population of the tropical rain forests is increasing at such a rate that the primitive farmers are forced to return to forest plots before the soil has fully recovered. The result is that vast areas of jungle are cut down to produce insignificant quantities of food.

In fact, just about every type of conventional use of the tropical forests is self-defeating. In contrast to the temperate northern forests, which grow back to be used again, forest removal in the tropics can wipe out the possibiiity for renewal. Intensive agricultural development, for instance, the intense heat of the sun, which bakes it as hard as concrete, and to the torrential rain, which washes away whatever nutrients are left in the soil. Usually, the soil is so denuded that it can support only two or three harvests of crops without the use of fertilizers; and with fertilizers in increasingly short supply, few agricultural experts are likely to advocate their use in chronically infertile areas. The monocultures of rubber plants, cocoa and oil palms also suffer depredations unknown in the natural forests. For while the jungles are so well balanced ecologically that species of birds, insects or fungi rarely multiply unchecked, pests seem to be all but inevitable in the monocultures. The leafcutting ants that cuts pieces out of leaves to grow for food in their underground "fungus gardens" do little damage in the rain forests of South and Central America because they spread their attacks over several species of plants. But when their activities concentrate on the citrus and cocoa trees of West Indian plantations, the ants become major scourges. In similar fashion, tropical timber trees are often difficult to grow as pure stands because they fall foul of diseases that cause little apparent harm to the trees in their natural settings. Sometimes a lack of pollinators, which depend for their survival on plant diversity, will also spell doom for a single-species crop.

The destruction of the rain forests also threatens indirect harm to rivers and streams and the life they contain. In an undisturbed forest, of the type that still exists in parts of Amazonia, many rivers are relatively free of large amounts of soil run-off. They usually receive little silt or other materials from the streams that feed them because the forests' ultra-efficient recycling system leaves hardly any waste to be collected by drainage water. But when large clearings are cut in the forests, the situation changes completely. Surface erosion carries away large quantities of soil and its nutrient-rich organic material into the rivers, which become clogged with silt. The resut is impoverishment of the soil, destruction of fish, which die in large numbers from lack of food, elimination of other forms of river life and frequent flash floods.

The effect of over-exploitation of the tropical rain forests is not restricted to the ten percent of the earth's land area that they now occupy. If the forests are destroyed, as now seems likely, biologists believe that virtually all the plant and animal life that inhabits them will be doomed—including more than half of the earth's bird species and three-fourths of all the world's tree species. Such carnage would inevitably reduce the earth's natural genetic diversity to a dangerously

low level, and destroy the vast potential of the tropical forests to contribute to the good of mankind. "New and valuable uses of organisms are constantly being discovered in medicine, pest control and in the breeding of economic plants and animals, and it would be blind and irresponsible to detsroy the source of so much potentially valuable material," explains IUCN's Duncan Poore.

The forests are vital to mankind in another, more fundamental way. The fact that an enormous diversity of plants and animals live together in ecological harmony in the tropical rain forests indicates that there must be some kind of natural biological balance within them. If we could fully understand this balance, we might be able to learn lessons that are important for our own survival on this planet. But unless the felling of the forests is halted soon, the jungles will join the dinosaur and the dodo, and the great potential that they contain will disappear like the nutrients that are swept away from forest soil once its tree cover is removed.

(In researching this article, author Peter Gwynne—who is science editor of Newsweek magazine—relied heavily on the work of rain forest expert P. W. Richards of the University College of North Wales in Bangor, Wales.)

APPENDIX 12

Letter to Hon. Don Bonker From Warren B. King, Chairman, International Council for Bird Preservation, United States Section, Inc.

INTERNATIONAL COUNCIL FOR BIRD PRESERVATION
UNITED STATES SECTION, INC.

WARREN B. KING, *Chairman*
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Honorable Don Bonker
Chairman, House of Representatives
Subcommittee on International Organizations
House Foreign Affairs Committee
U.S. House of Representatives
Washington, D.C. 20515

9 May 1980

Dear Congressman Bonker:

I would like to congratulate the House Foreign Affairs Subcommittee on International Organizations for initiating a series of hearings on tropical deforestation. The ICBP views tropical deforestation as the single most serious threat to the future of the greater part of the world's wildlife, including its bird life. This threat will manifest itself both in the loss of whole species with local distributions and in the drastic decline of species more widely distributed. Among the latter are a great many birds which we think of as U.S. species but which are equally dependent on the tropical forests of our Latin American neighbors for several months of each year. Two hundred twenty-five species of birds that breed in the United States utilize tropical forest in the northern winter.

Since 1600 only 11 species of birds (12% of all extinct bird species) have become extinct on continental areas, whereas 81 from oceanic islands have become extinct. Looking at the distribution of today's endangered species as an indication of where tomorrow's extinctions will take place, of 268 endangered species of birds currently listed in the volume on birds of the Red Data Book series, compiled by myself for the International Union for the Conservation of Nature and the International Council for Bird Preservation, 126 or 47% are continental species whereas 142 or 53% are island species.

Thus, it is clear that a shift has already taken place from the historical situation of bird extinctions occurring mainly on islands to an increasing number and percentage likely to occur on continental areas. Fully two-thirds of these continental endangered

birds are dependent on forests. In general, the number of species of organisms, including birds, is highest in tropical continental forests; for example, Colombia with 12% of the land area of the United States has 2100 species of birds compared with 700 in the United States. Oceanic islands have relatively very few species. The significance of this is that the focus of extinction processes is now shifting away from species-poor areas and onto precisely those areas of the earth's surface richest in numbers of species. The inescapable result of tropical deforestation will be an unprecedented accelleration of the rate of extinction of birds, a phenomenon that will undoubtedly be repeated in each of the other classes of living organisms.

The second predictable result of tropical deforestation will be the decline of widespread bird species, including many that breed in the United States. Recent research in tropical forests in Latin America shows that many North American migrants establish territories on their wintering grounds. This territoriality implies an upper limit to the number of birds that a given tract of tropical forest can support. When a tract is cut the birds that relied on it are eliminated; contrary to popular conception they cannot search out an unoccupied tract and begin again, for evidence shows that all suitable forest is already occupied by birds who will defend, almost always successfully, their territories against newcomers. While territory size is somewhat elastic, depending on a number of factors, it cannot be compressed beyond a certain limit.

For these reasons we view with alarm the increasing rate of tropical deforestation and welcome your initiative toward finding institutional solutions to the problem. We would like to encourage congressional support of the Federal Interagency Task Force, for we believe their initiatives are in our own and the world's best interests.

Sincerely yours,

Warren B. King

Warren B. King
Chairman

APPENDIX 13

Deforestation and CO_2

(By A. D. Hinckley)

INTERNATIONAL RESEARCH AND TECHNOLOGY CORPORATION

Abstract

Some of the variables that must be considered in analyzing the CO_2-biomass relationship include the kinds of vegetation coverage, rates of conversion from one to another kind, rates of plant growth, thresholds of CO_2 growth stimulation, and rates of CO_2 release from vegetation, wetlands, tundra and soil. Up until recently, it had been assumed that the world's biota served as a sink for CO_2 released by combustion of fossil fuels. However, it now appears that deforestation exceeds re-growth worldwide and CO_2 from the biota is contributing to the observed increase in the atmospheric concentration of CO_2. Mid-range estimates of tropical deforestation are around 12 million ha/year. This is equivalent to a rate of 0.5% per year. The amount of CO_2 released from the dead vegetation and exposed humus in the tropical clearings is approximately 3.0×10^9 metric tons (10^{15} grams) per year. However, uptake by regrowth in tropical and temperate ecosystems may remove as much as 1.5×10^9 tons, leaving a net contribution to the atmosphere and hydrosphere of approximately 1.5×10^9, in contrast to the 5×10^9 tons released by combustion of fossil fuels. A shift to bio-energy will reduce the rate of CO_2 increase only if the fuel crops are managed for sustained yield.

Full Text

There are many unanswered questions about CO_2:

- what effects will increased concentrations have on climatic patterns:
- are there homeostatic mechanisms (increased cloud cover, more rapid plant growth, etc.) interacting with atmospheric CO_2 concentrations?

- how much CO_2 is captured by the ocean surface and how rapidly is it transported to sediments or carbonate deposits?
- how much CO_2 is released from biomass and soils when a forest is cleared?
- how much is fixed photosynthetically by new growth in forests and fields?

Today I will deal only with the last two questions and my answers will be quite tentative. Table 1 shows some recent estimates of annual carbon release from the biosphere. As you can see, there is considerable variation in estimates made in each paper (low to high factors of 4, 10, 3, 5 and 9, skipping Chan's simulation). The overall range is even greater, with a 45-fold difference between Bolin and Adams' lowest and Woodwell's highest. Intuitively, you might take a median value as your best estimate but Woodwell's high value skews the median upward. An average of mid-range values is 2.0×10^9 tons but hardly a statistic in which you would place great confidence.

A better approach is to reexamine the assumptions used by the authors in making their estimates. If these assumptions are not well founded, then the estimates can be discounted or modified. It is especially important to understand why Woodwell's estimates are conspicuously high. In his Science article (co-authored with Whittaker, Reiners, Likens, Delwiche and Botkin) he states:

"If a rate of clearing of 1 to 2 percent per year were applied to the forests of the earth, which we take to have a total plant mass of 743×10^{15} g of carbon ... and if two-thirds of the biomass were released as CO_2 with the remainder stored, the amount of carbon released annually would be 5 to 10×10^{15} g - one to two times the amount currently released from fossil fuels." (p. 143)

From this statement and from Table 2 in his paper (see Table 2 herewith) it is apparent that he considers all major biomes as net exporters of CO_2. To be sure, he does emphasize the role of the tropical forests, stating:

"If we consider only the tropical forests, the amount released would be about 3 to 6×10^{15} g of carbon annually" (assuming annual clearing of 1 to 2 percent) (p. 143) and "we judge that the range of 0.5 to 1.0 percent per year includes the correct current rate of clearing of tropical forests and that the most probably range from the biota annually is 4 to 8×10^{15} g of carbon". (p. 145) Following his Table 2, a pro rating of the detritus and humus release would attribute more than half of all net release to tropical forest ecosystems.

Table 1. Release of Carbon from the Biosphere

Author	Annual Release 10^9 ton C	Comments
Bolin (1977)	0.4-1.6	Net transfer
Adams (1977 et al	0.4-4.0	Based on wood consumption
Hampicke (1979)	1.5-4.5	Mostly in the tropics
Chan (1979) et al	2.6-2.9	Computer model simulation
Freyer (1979)	3 ± 2	1850-1979; based on $^{13}C/^{12}C$
Woodwell (1978) et al	7.8 (2-18)	Net transfer; mostly in the tropics

(adapted from T.V. Armentano (ed.) (1979), The Role of Organic Soils in the World Carbon Cycle - Problem Definition and Research Needs. TIE-DOE/EV/10040-2)

Table 2. Estimates of current releases of carbon from major terrestrial plant communities. Column 5 gives what were considered to be the most probable limits based on a maximum of twice the net release and a lower limit of one-third the net release.

Plant Community	Carbon released (X 10^9 metric tons)			
	Forest clearing and harvest	Increased NEP	Net Release	Range
Tropical forests	4.4	0.9	3.5	1-7
Temperate zone forests	1.7	0.3	1.4	0.5-3
Boreal forest	1.0	0.2	0.8	0-2
Other vegetation (including agriculture)	0.3*	0.1	0.2	0-1
Total land vegetation	7.4	1.5	5.9	1.5-13
Detritus and humus			2.0+	0.5-5.0
Land total			7.9	2-18

*The major contributions to a release are from woodlands and savannas that are cleared for agriculture or grazing. We have assumed a clearing rate of 0.6 percent of these lands, with about one-third of that restored as increased NEP.

+Major releases from organic detritus and humus are probably in the clearing of forest for agriculture or for grazing, although there are substantial releases associated with harvests or timber.

(Based on Woodwell et al, (1978), The Biota and the World Carbon Budget. Science. 199: p. 149)

In his Scientific American article, Woodwell makes similar statements.

"The best assumptions available to me suggest that the rate of clearing of tropical forests for all purposes is probably in the range of .5 to 1.5 percent of the existing area annually. If the rate is 1 percent and if most of the clearing is through the expansion of agriculture and grazing lands into areas that were formerly forested, the release of carbon from forests alone would be about 4.5×10^{15} grams per year. By applying such estimates to the entire terrestrial biota, allowing for additional storage through regrowth, my colleagues and I have recently estimated that the net release of carbon dioxide to the atmosphere from the biota is 6×10^{15} grams of carbon annually. The magnitude of an additional release through the decay of soil humus is hard to calculate but we have estimated the loss at 2×10^{15} grams per year. The total estimated release is therefore about 8×10^{15} grams." (p. 42)

Woodwell and his colleagues were taken to task by Ralston (1979) in a letter to Science. He used FAO estimates for world forest removal and concluded that Woodwell's estimates of carbon release should be reduced by a factor of 10. He also suggested that U.S. forests are serving as a sink for CO_2 and will continue to do so until 1995. The latter theme was emphasized at a recent workshop sponsored by the Department of Energy and conducted by the Institute of Ecology (Armentano and Hett, 1979). They estimated (p. 26) that the net increase in the carbon pool of temperate forests is 0.87 to 1.02×10^9 tons per year in commercial forests and an additional 0.1 to 0.2×10^9 tons per year in uninventoried stands. They conclude that "temperate forests may be absorbing carbon equal to nearly 50% of the approximately 2.3×10^9 tons added to the atmosphere" annually.

This raises the question - what is the global carbon budget if tropical forest ecosystems are net exporters of CO_2 and temperate forests net importers? First, we have to pick a number for tropical deforestation, then convert that to carbon release from dead plant material and exposed soil. Annual deforestation in the tropics has been estimated at levels from 8 to 20 million hectares/year. If 12 million is taken as a mid-range value, and Woodwell's areal total of 2450 million hectares for tropical rain forest and tropical seasonal forest is correct, the rate of annual deforestation is approximately 0.5%. Using Woodwell's total of 461×10^9 tons tropical biomass, this is equivalent to 2.3×10^9 tons. Another 0.7×10^9 tons may be released as a result of soil disturbance and exposure associated with the tropical deforestation, although this would imply large contributions from montane forests, (see Schlesinger, 1979) or 50% release during the first year after deforestation.

Estimates of uptake in tropical and temperate forests must also be couched in caveats. The 1.0×10^9 tons carbon storage in inventoried stands, mostly European and North American, seems reasonable. However, forest fires and other problems in the People's Republic of China make it unlikely that reforestation is proceeding according to plan, and annual increments of 2.4 million hectares (Eckholm, 1979) are improbable, although the target is 3.0 million hectares per year between now and 2000. Similar problems beset forestry programs in many other countries. Therefore, a total net annual increase of 0.5×10^9 tons carbon in uninventoried tropical and temperate forests would seem to be a fair guess. It should be noted that in Woodwell's Table 2, increased NEP (net ecosystem production) totaling 1.5×10^9 tons carbon is estimated for "total land vegetation" but 60% was attributed to the tropics.

To recapitulate, deforestation in the tropics may be releasing annually 2.3×10^9 tons carbon from burnt and rotten vegetation plus another 0.7×10^9 tons from oxidation or organic material in the soil. In the temperate and tropical regions, however, uptake through reforestation and regrowth may be 1.0×10^9 tons carbon in inventoried (commercial) forests and 0.5×10^9 tons carbon in forests less closely monitored and measured. This can be construed as a net export to atmosphere and hydrosphere from the forested biosphere of 1.5×10^9 tons carbon in contrast to 5.0×10^9 tons carbon released by combustion of fossil fuels.

Since the annual increment in the atmosphere is 2.3×10^9 tons and oceans purportedly absorb only 2.7×10^9 tons per year, there is still an annoying discrepancy of 1.5×10^9 tons carbon. That is a lot of carbon to misplace, but it is possible that the world's forests are closer to equilibrium than would be apparent from these rough calculations. It is also possible that the oceanic uptake rate should be recalculated. This puzzle has inspired much of the interdisciplinary activity sponsored by the Department of Energy's Carbon Dioxide and Climate Research Program. There is also a great need for improved measurements of forest clearing, replanting and regrowth. Remote sensing imagery, well interpreted, can provide some of the answers but ground surveys are also vital. Finally, it should be recognized that any shift to biomass as a source of energy will reduce the rate of CO_2 increase only if the trees and other crops used for alcohol or direct combustion are managed for perpetual balance between rates of harvest and regrowth.

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APPENDIX 14

Letter to Hon. Don Bonker From Dr. Peter H. Raven, Director, Missouri Botanical Garden

May 12, 1980

The Honorable Don Bonker, Chairman
Subcommittee on International Organizations
House of Representatives
Washington, D.C. 20515

Dear Congressman Bonker:

It was a real pleasure to have had the opportunity to appear before the Foreign Affairs Subcommittee on International Organizations last week. I hope you will let me know how I may help you in your notable initiative in this area over the coming months.

It is of extreme importance that you realize that the development of the forest in tropical regions does not lead to the creation of agricultural systems that are productive over the long run. The soils of the tropics are simply degraded so rapidly when the forest has been removed that even the application of fertilizer will not help; their structure is, in most cases, entirely gone. Therefore, it is highly misleading to imagine that what is going on in the tropics is analogous to what happened in the United States and other temperate regions in the past. Our agricultural system simply cannot be exported.

Also, reforestation in the tropics, while possible, is exceedingly difficult. Simplified forests in which only a few species predominate are attacked by pests to a degree that is simply unknown in temperate regions. Furthermore, our lack of knowledge is so profound that we just do not know how to operate in most instances, as Dean Bethel brought out in response to your questions.

In short, the United States should not simply be standing by and assuming that the development of the forests is in the interests of the countries concerned. In fact, given the knowledge base that we actually possess, the "development" of the forests in most tropical regions is leading straight to ecological disaster. It is creating an unstable system on a world scale and one in which the United States and all other developed, temperate countries will be only numerically minor participants within just a couple of decades. It is, therefore, a matter of self-interest in the cause of national security that should motivate us to contribute whatever intellectual resources we have to the creation of stable systems in these countries while there is still time.

Equally, it is a genuine mistake to assume that the knowledge is available which will allow us, provided we go about it in the right way, to set up things in the tropics on an indefinitely productive basis. It is not available; we need much more; and we need to acquire it in such a way that the results of our investigations will be applied directly to development.

I certainly enjoyed working with your staff to some extent on this question and, as I mentioned above, I will be delighted to do what I can in the future.

With all good wishes, I am

Sincerely,

Peter Raven

Peter H. Raven
Director

PHR:jh

APPENDIX 15

LETTER TO HON. DON BONKER, FROM DEAN BETHEL, COLLEGE OF FOREST RESOURCES, UNIVERSITY OF WASHINGTON

UNIVERSITY OF WASHINGTON
SEATTLE, WASHINGTON 98195

James S. Bethel, Dean
College of Forest Resources
AR-10

May 20, 1980

Congressman Don Bonker, Chairman
Subcommittee on International
Organizations, Committee on
Foreign Affairs
House of Representatives
Washington, D.C. 20515

Dear Congressman Bonker:

Thank you for asking me to participate in the overview hearings on "Tropical Deforestation". I am glad that the Congress is interested in the role of tropical forests in the world. The lands occupied by forests in the tropics are important primarily because they constitute a critical portion of the resource base of many developing countries that find it difficult to adequately house, feed and clothe all of their people. A much more secondary role of these forests is to supply materials to the international markets though this may be a locally important source of foreign exchange.

Some of us in the University community were concerned about these problems twenty years ago when we set in motion the activities that resulted in the formation of the Organization for Tropical Studies (OTS), a consortium of more than twenty U.S. and Latin American universities that are interested in tropical biology. Still later six universities organized the consortium "Universities for International Forestry (UNIFOR)" for the purpose of pooling their resources to provide for education, research and service in the area of tropical forest resources. The University of Washington, College of Forest Resources was instrumental in organizing both of these university groups and has been an active member of both of them since their beginnings.

Over the years many of us have been frustrated by the indifference of such large federal departments as State and Agriculture to the problems posed by tropical forests. It is refreshing to see that President Carter's expressions of interest in investment in this activity has sparked some efforts on the part of these large departments.

The one federal agency that has maintained a continuous interest in developing an understanding of tropical forests has been the National Science Foundation. While it's resources have not been great it has dedicated a share of those resources to research and education in the sciences and technologies related to tropical forests. The fact that there is today a small but experienced group of tropical biologists and

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tropical foresters is attributable for the most part to the commitment of N.S.F. to these fields when other federal agencies were busy with other things. I hope that Congress will not fail to take advantage of this long established agency expertise. While I have a long track record of advocating investment by the federal government in the solution of problems related to forestry in the tropics I hasten to note that I believe that it is much more important that the investments be wise then that they be large and spectacular.

Just as a footnote may I point out that the concern that I expressed in my testimony for adequate definitions was not academic nit-picking. If we are going to devote resources to the solution of problems in the domain of tropical forests we need first to be certain that we are dealing with the real problems. To quote the man for whom the hearing site was named "If it aint broke, don't fix it". Some of the rhetoric surrounding deforestation in the tropics is in this category. For example the 1979 annual report of the Council on Environmental Quality cites Honduras as a horrible example of tropical deforestation. It states that 30 to 40 percent of Honduras' forests have been deforested since 1960. This is a blatant misrepresentation of the status of forestry in Honduras. It is one of the most completely forested of all Central American countries. It has the most effective forestry program in Central America. It has the largest group of professional foresters in Central America south of Mexico and they were essentially all educated in U.S. universities. About two years ago when FAO wanted to make a new appointment of an assistant director general to head it's forestry division it selected Marco Flores Rhodas, Chief of forestry for Honduras at the time, as the first such appointee from the western hemisphere and the second from a developing country. Incidentally, Marco is a University of Washington doctoral alumnus. Our state has provided significant help to Honduras in the development of its forestry program. Don Hopkins, retired assistant supervisor of the State Department of Natural Resources is now engaged in his second tour of duty as an advisor on forestry to Honduras. Our college has helped develop a forestry research program for Honduras, conducted three in service training courses for the professional foresters in Honduras and conducted forestry research for Honduras all fully paid for by Honduras. Our federal government has provided no assistance to the recently developed Honduran forestry program even though it's professionals are essentially all U.S. educated. Canada has provided the majority of bi-lateral forestry aid with the UK and West Germany providing small quantities. FAO and the Inter-American Development Bank have provided assistance from the multi-lateral sector. Substantial U.S. funds are involved here of course.

The second district of Washington is from a forestry standpoint one of the most productive districts in the United States--perhaps the most productive. Using some of the criteria currently in vogue most of the high

site land in your district would be classified as deforested. I find these classification systems misleading and singularly lacking in utility. This was my reason for proposing a different system.

I am sending you copies of some of the reports of our research into tropical forestry utilization problems funded by the National Science Foundation.

I hope that we can continue to maintain a dialogue on this subject from time to time at your convenience. If I can be of service to you, please call upon me.

Sincerely,

James S. Bethel

James S. Bethel, Dean
College of Forest Resources

JSB:ad
Enclosures

APPENDIX 16

U.S. Possibilities for Plant Conservation Internationally

B. MacBryde
U.S. Department of the Interior, U.S. Fish and Wildlife Service, Washington, D.C., U.S.A.

Reprint from: Systematic Botany, Plant Utilization and Biosphere Conservation. I. Hedberg (ed.) 1979. Almqvist & Wiksell International. Stockholm.

When the University of Uppsala was founded by Jakob Ulfsson in 1477, the Inca Empire under Tupac-Yupanqui had only recently begun its expansion into Ecuador. With that culture came a conservative and adaptive pattern of land use dependent upon nature in a harsh landscape. A staple of that Andean people which was described by Linnaeus, the potato (*Solanum tuberosum* L.) has become a main food crop for humankind.

Yet by the time of Carl Linnaeus (1707–1778), the Incan way of life was largely destroyed, and portions of the Ecuadorian land and biota were undergoing new pressures based on imported techniques which had been developed for foreign conditions, and on the exploitive demands of foreign cultures. However, most of the area was still wild, and some regions remained free of colonial influence, especially in the tropical lowlands (Engel 1976).

Today, five centuries after the founding of this university, and only two centuries after Linnaeus flourished, the wilderness is largely gone in two-thirds of the country, and the remaining natural area is undergoing extensive change—which has intensified in this decade (Putney 1976). Economic demands on the land and nature continue to have a strong international component (Sick 1963), and the potential loss to Ecuador and humankind of useful plant lore continues by abrupt acculturation of Indian peoples (Whitten 1976; Harner 1972).

This pattern of pervasive and intensive modification of natural ecosystems is everywhere the usual heritage of today's generations. Taxonomists have benefited from the expansion of technological civilization, from the impetus it gave Linnaeus to produce a classification system which could keep pace with the accelerating discovery of species, to the recent collection of new species as remote areas become accessible and frequently are then destroyed (Schauenberg 1970; Lynch and Duellman 1973; MacBryde 1972). Yet saying this is our heritage, and documenting the destruction in numerous examples, has only begun to change the trend in only a few respects. How can more jeopardized natural areas and rare species be conserved? At this stage, a crucial share of the responsibility must fall on today's botanists, especially taxonomists, for we are among the few professionals in society trained to recognize natural diversity (Lovejoy 1977).

To use our knowledge for conservation of plants in their ecosystems, botanists must change the traditional use of their time, change their research emphasis, expand their professional contacts, expand their techniques and equipment, and extend their means of communication (both in where they read and where they publish, and otherwise). In effect, we are establishing a new discipline of *plant conservation* analogous to the field of wildlife management or wildlife conservation. Indeed many helpful ideas and approaches can be gleaned by examining the organizations, agencies, publications and methods used in the conservation of animals. Approaches to consider in developing such participation are provided by Cairns (1977), who also points out the benefits that should result for systematists. If you think the situation does not require so much of your involvement, ask yourself who *is* ensuring the conservation of the species and areas you study—and are you confident of their survival? Here, where Linnaeus met the needs of his time with the discipline of systematics, is a fitting place to recognize the needs of our time—with a commitment to plant conservation.

One piece of "equipment" for conservation of a limited number of plants is the Convention on International Trade in Endangered Species of Wild Fauna and Flora, which includes Sweden, Ecuador, and the U.S.A. among the 47 countries that are parties to it. This treaty regulates potentially harmful trade in vulnerable species by means of export and import controls through governmental permits.

In effect, it provides international sanction of each exporting country's responsibility for its natural resources and control of its species in trade. Enforcement responsibilities are shared to a limited extent, since export documents must be confirmed upon importation (cf. Lucas 1976, MacBryde 1977).

The first conference of parties to the convention was held in Berne, Switzerland in November 1976, at which time several hundred species of plants (especially tree ferns) were added. Only four botanists and a forester (representing Ecuador, Papua, New Guinea, United Kingdom and U.S.A.) were among the specialists who attended, and plant proposals only from Madagascar and United Kingdom were discussed. A portion of the Berne conference was filmed for a documentary (mostly on the animal trade) televised in the United States, and shows strikingly the possible impact of this treaty (Gullahorn-Holecek 1977; Nadel 1977).

In the United States, regulations to implement the convention were published on February 22, 1977 (U.S. Fish and Wildlife Service 1977b). The management and scientific authorities required by the convention have been established (U.S. Fish and Wildlife Service 1976; Endangered Species Scientific Authority 1977a). The scientific authority has stated its criteria for evaluating permit applications and its policy for importing Appendix I species (Endangered Species Scientific Authority 1977a, 1977b). Both authorities have provided details regarding regulation of export of at least one native plant (*Panax quinquefolius* L.) (U.S. Fish and Wildlife Service and Endangered Species Scientific Authority 1977; Endangered Species Scientific Authority 1977c, 1977d); such efforts are urgently needed for native cacti.

A technical meeting relating to the convention and not limited to party countries has been planned for October 1977 in Geneva, Switzerland. The United States has been active in investigating issues to be resolved at the meeting (U.S. Fish and Wildlife Service 1977a, 1977c). The location of the second conference of parties to the convention, first planned for Ecuador and now Costa Rica in March, 1979, emphasizes the relevance of the treaty to exporting nations. The botanical community should take an active part in developing information for this conference and future sessions.

In the United States, the enforcement of import and export regulations for terrestrial plants is the responsibility of the Department of Agriculture, Animal and Plant Health Inspection Service. Thus far no regulations implementing enforcement have been published, efforts to carry out this responsibility have been limited, and few illegal actions have been detected. Strong concern was expressed during development of the permit regulations that they would impede legitimate activities with red tape (Peterson 1976; Bleck and Bleck 1976; Madison and Wiehler 1977). For the issuance of permits and indeed the convention to be meaningful, vigorous enforcement must be expected.

As enforcement increases and some plants are confiscated, botanical gardens and arboreta will be likely to play increasing roles as rescue centers; the American Association of Botanical Gardens and Arboreta has been interested in providing such support. Horticulture is the last alternative for survival of species ecologically extinct or unable to be returned to the wild for other reasons, although the effectiveness of such a costly approach must be repeatedly examined (Simmons et al. 1976; Walters 1977). There are interested botanical gardens reasonably near most U.S. ports, so rapid development of an official network of rescue centers by the management authority is feasible.

Another item of "equipment" for the plant conservationist, also administered by the Animal and Plant Health Inspection Service, is the U.S. Federal Noxious Weed Act of 1974 (Public Law 93–629). This law provides for the control and eradication in the U.S. of injurious plants of foreign origin, including those harmful to useful plants and wildlife resources (section 3 may need amendment to apply to any endangered or threatened plant). Regulations and the first weeds under the law were published in November 1976 (Animal and Plant Health Inspection Service 1976). The president of the United States reinforced this authority by Executive Order 11987 on May 24, 1977, which restricts introduction of any exotic species which may have an adverse effect on natural ecosystems. The order is also of international value since it restricts export of native U.S. species that may adversely effect natural ecosystems elsewhere (U.S. President 1977b).

In the Americas, a comprehensive treaty to which 17 nations are now party is becoming active. The Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere was developed in 1940, and provides for strong habitat preservation as well as conservation of endangered species (MacBryde 1977). Resolutions supporting

the convention were passed at meetings of the Organization of American States (depository for the treaty) in Santiago, Chile in 1976 and Montevideo, Uruguay in 1977 (Orejas-Miranda 1976).

In his environmental message of May 1977, the U.S. president proposed that the countries of the Americas, through the offices of the Organization of American States, implement the convention now (U.S. President 1977a). Technical meetings are planned for 1977 through 1979, and a full conference is suggested for 1980. A recent example of the diplomatic value of the Pan American Convention is the protection of Barro Colorado Island under its terms during canal negotiations of the U.S.A. and Panamá (Leeper 1977). Botanists and others whose research involves the Americas, for example those in Sweden, Denmark, and U.S.A. working on the *Flora of Ecuador*, have a particular responsibility to help the treaty be the intergovernmental framework for vigorous nature conservation in the hemisphere.

Two major items of "equipment" in U.S. plant conservation are beginning to have international value. The U.S. National Environmental Policy Act of 1969 directs federal agencies to support programs of international cooperation to maintain the quality of the environment, and requires the U.S. government to act with ecological responsibility. Recently, the contribution of the U.S. to construction of the Pan-American highway through the Darien in Panamá has been reexamined under this law because of the road's environmental consequences (Sierra Club 1976). The U.S. Endangered Species Act of 1973 has explicit provisions for international cooperation, and also requires environmental restraint. Under this law, staff has been provided to aid the Survival Service Commission of the IUCN in Morges, Switzerland. Also, U.S. foreign currency funds are being used to develop a conservation program in Egypt, and similar efforts are planned for India and Pakistan (BioScience 1977); botanists may be more familiar with the *Flora of Ceylon* project's use of such funds.

The May 1977 environmental message of the U.S. president also brought environmental considerations into the economic assistance programs of the United States with other nations. The environmental soundness of development projects with possible U.S. support are to be reviewed, and the U.S. Agency for International Development will make assistance in natural resources management available to developing countries (U.S. President 1977a).

Clearly, the U.S. has the legislative authority and directives to be ecologically responsible abroad, and has made some progress since my report on international aspects in Prance and Elias (Mac Bryde 1977). More extensive changes for the land will require greater financial support, and alert botanists to inform administrators of the technical ecological problems concerning plants. Myers (1977) emphasizes the necessity to extend the land ethic to multinational and privat corporations, and suggests some methods for compensation from governments.

By now the deterioration of the natural environment, including extinction of many species, is sufficiently documented. Botanists and other natural scientists have so far failed to convince humankind of the dire consequences to human survival. Economic and cultural incentives for conservation must intensify. The surest trend is to maintain natural diversity within cultural diversity, as advocated by Dasmann (1976), Appell (1975), and Cowan (1976). The disruption from inappropriate technology and unwise acculturation must be controlled, and replaced with sound, restained development building on the best in indigenous patterns (Schumacher 1973; Berry 1972, Eckholm 1978).

Humankind is domesticating the earth to its short-range needs. While nature is too complex and large for total control, an increasing management burden is being assumed. As the evolutionary potential of the planet diminishes, responsible people must incorporate natural values into local concerns. This is most effectively accomplished by developing a spectrum of approaches demonstrating the significance of nature, and the components of nature such as plants, to the welfare of each person.

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APPENDIX 17

Letter to Hon. Don Bonker From Hugh H. Iltis, University of Wisconsin-Madison

University of Wisconsin-Madison,
Department of Botany,
Madison, Wis., May 12, 1980.

Hon. Don Bonker,
Chairman, Subcommittee on International Organizations,
Committee on Foreign Affairs, Washington, D.C.

Dear Mr. Chairman: The destruction of tropical rain forests in the world today is so extensive and so devastating that humanity soon will lose its richest and most diverse biotic resource.

For us, in Wisconsin especially, it will mean that the migratory birds we love to see in the summer will have no place to survive in their Latin American winter. Already in the Ohio Valley, Warblers are getting rarer, birds on which orchard owners and farmers depend to a considerable degree for insect control. I cannot tell you with what feeling of horrors, hopelessness and anger I saw the destruction of hundred thousand (!) hectare plots of virgin tropical thorn forests in the coastal plain of southwestern Mexico (near Puerto Vallarta), land that is essentially useless for agriculture but will now grow one or two miserable crops of 10–12 inch high sorghum for cattle feed. A lot of this type of tropical destruction is done on the advice of U.S. specialists and U.S. financed "development" programs.

While many other people will testify to the details of this destruction, I wish to call your attention to a little known fact regarding tropical ecology, which is explained in the enclosed paper by Professor Chang of the University of Hawaii; namely, the basically low productivity of the tropics as compared to temperate grass climates. This is due to the long and warm tropical nights, when respiration burns up whatever surplus carbohydrate is produced during the day. In the Dakotas, in contrast, the day may be 16 hours long and the cold night only 8, allowing bumper crops of wheat. American companies and advisers have been misled by the tropical luxuriance of vegetation to think, "here lies the answer to hunger,"—a most dangerous and destructive assumption. Your committee would do well to examine this problem in detail.

The main reason for writing you is to call your attention to the deliberate "bamboozling" of the American public by magazine articles and TV shows, especially regarding one of the very worst ecological atrocities, Mr. Ludwig's "empire" on the Jari River in Brazil, a prime example of American ecological ignorance, economic imperialism, and personal greed in action. Both a recent National Geographic story and the NOVA TV show referred to in the enclosed letter are misleading, and will cause the American public to be ill-informed on one of the world's most imminent and urgent issues.

I would be grateful if you would include both the letter as well as the letter to the Boston TV station in the official record of these hearings. I hope that your committee will help to stop this destruction by enacting laws preventing American-type development in the tropics whether due to the lumberman's greed or the humanitarian's vain wish to alleviate hunger.

With all good wishes, I remain

Cordially yours,

Hugh H. Iltis,
Director of the Herbarium, Professor of Botany.

Attachment.

UNIVERSITY OF WISCONSIN-MADISON

DEPARTMENT OF BOTANY

139 Birge Hall
430 Lincoln Drive
Madison, Wisconsin 53706
Telephone: 608/262-1057

March 27, 1980

Director of TV Programs
NOVA
P. O. Box 1000
Cathedral Station
Boston, Massachusetts 02118

Dear Gentlemen and Ladies:

I had the opportunity yesterday to view the NOVA program on Mr. Ludwig and his Green Empire and wish to protest your one-sided and incomplete presentation of what is surely one of the biologically most dangerous and destructive events of this century.

The Amazon forest, 3 million acres of which Mr. Ludwig bought for $1 per acre and is now bulldozing to produce cardboard, toilet paper, and newsprint, is the richest biological ecosystem on the face of the Earth. True, this fact is alluded to in the early part of the program, in a calm and most cavalier way. Nowhere in this presentation, however, is the point made that of the fully 50,000 species of flowering plants and 6,000 species of trees native to Amazonas, a very large percentage are rare and often highly local endemics (i.e., plants having a very local range). The same can be said of most of the 1 or 2 million species of animals. What needed to be stressed by NOVA is known to every biologist worth his salt: namely that, by destroying this land, Mr. Ludwig is exterminating a very large number of species of plants and an innumberable number of species of animals. And once extinct, a species is extinct forever! Yet NOVA, in its innocence, did not have time for a single word about extinction in the whole of this one-hour program! To all who care about a decent world, this omission is outrageous and dangerous.

Considering that other companies or people as compulsively greedy as Mr. Ludwig may soon jump on the "Conquer the Amazon" bandwagon, as the NOVA program so cheerfully suggests at the end, and that there are as yet hardly any permanent Amazonian national parks which would insure protection, either for animals and plants or, for that matter, for the local and marvellously adapted Indians, this is an omission that should never have happened in a program supported by the U. S. National Science Foundation.

The urgent, crucial and immediate problems of tropical extinction have now (1979) been recognized by the U. S. Department of State as well as the Agency of International Development, and need to be held up again and again to

the American public at large, especially since in the past as well as now the United States has had a disproportionate large share in tropical forest destruction. NOVA owes its viewing audience an apology for this neglect, as well as for evidently having "been had" by Mr. Ludwig's public relations agents. (One of my students asked whether Mr. Ludwig helped finance this program? We would like to know!)

There are other subjects which appear to have been distorted. On the human side, nothing was said about the often deliberate extinction of Indian tribes in the Amazon basin. What, pray, happened to the Indians that once lived in the territory acquired by Mr. Ludwig? There are some ugly rumors floating around, hence the question should have been asked and answered. Similarly, concerns have been voiced about the prison camp atmosphere reputed to exist in Jari, where Mr. Ludwig's men exercise complete control.

One special problem concerns Amazonian limnology. NOVA showed pictures of the gigantic paper mill with a good deal of admiration, but not a word was said about the fate of the river and its living ecosystems. There are over 2,000 species of endemic fish in the Amazon River drainage, fully 10 times as many as in the Mississippi River drainage; in fact it is the richest fish fauna of the world. Like the flora, this fauna is only poorly known, and is being destroyed before it is understood. A paper mill such as this is a terrible pollutant (being from Wisconsin, I ought know), and there is no doubt that this one will do immense damage to the aquatic ecosystem down river from it. The settling ponds seem hardly sufficient and appear to be cosmetic, being much too small for such a gigantic mill. You should have pointed out that there are no pollution laws in Jari, nor an EPA!

Many thoughtful people have worried about these problems. For NOVA to simply and blindly ignore most all of them will result in an irresponsible and inexcusable brainwashing of the American public. It is true that Mr. Ludwig has been called by Time Magazine "the most creative of the billionaires" but, as I wrote in 1972, "The enormity of [Ludwig's ecological] crimes against humanity speaks for itself. Where is the International Environmental Crimes Tribunal that will convict a man who controls three billion dollars? Where is the ecologically responsible government that will restrain such men for the good of man?" (Am. Biol. Teacher, Vol. 34).

The pollution of the Amazonas and the destruction of Amazonian biota are desparately serious matters. For NOVA to nonchalantly present a movie favorable to all this destruction, a movie apparently filmed largely by Mr. Ludwig's men themselves, and which incidentally are seen mouthing what could charitably be called "slanted" information throughout, a movie which does not include the voice of a single critical scientist such as H. Sioli, Howard Irwin, or G. Prance, and which thus seduces the public into believing it to be a fair-minded appraisal of the situation, makes one wonder whether public television is all that much less influenced by big business than regular television.

May I suggest that you now plan to make another movie about the destruction of the Amazon region, one based on Irwin and Goodland's book, Green Hell to Red Desert, and one that would use the great expertise available in this country and in Brazil, to present to the American public the true dimensions of this irreparable and insidious tragedy.

Sincerely,

Hugh H. Iltis
Professor of Botany and
Director of the Herbarium

P.S. I would like to suggest to WHA that they ask Drs. Beals (Zoology Dept.), Denevan (Geography), Denslow (Zoology) and other to put together a panel in which both this movie and the whole tropical rain forest problem will be discussed. As a long-time supporter of public broadcasting, and of WHA, I feel that WHA owes this to its audience.

HHI:lk
cc: Director
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APPENDIX 18

LETTER TO HON. DON. BONKER FROM REXFORD A. RESLER, EXECUTIVE VICE PRESIDENT, AMERICAN FORESTRY ASSOCIATION

Founded 1875 1319 Eighteenth Street NW Washington DC 20036 telephone (202) 467-5810

September 4, 1980

Honorable Don L. Bonker
Chairman
Subcommittee on International Organizations
Committee on Foreign Affairs
703 Annex 1
Washington, D.C. 20515

Dear Mr. Chairman:

We appreciate the opportunity to submit this statement for the hearing record on the subject of U.S. policy regarding American forest products companies operating in tropical forest areas of the world.

The American Forestry Association is a citizen conservation organization dedicated to the wise management, protection and use of forest resources. Although our primary emphasis is on forests and forestry in the U.S., we are also concerned about the problems of tropical deforestation: first, because the adverse impacts are global in nature and could in the long run be detrimental to our own national interests; and secondly, because we recognize the value of trees, forests and forest products to people wherever they may be. For the sake of both the forests and the people, it is important that the tropical forests be managed in a way that will make an optimum contribution to the lives of the people in those countries.

The decade of the 1980's will be a critical time for forest development, management and conservation throughout the developing countries of the tropical forest regions. Within this time, decisions will be made and action taken that could well mean the difference between forest growth and productivity or forest decline for years to come. The consequences will affect not only the social, economic and environmental future of the countries themselves, but could even produce global impacts of little understood but potentially far-reaching consequences for all of mankind.

In the main, these decisions will have to do with the allocation of land to various uses; urban and industrial growth, agricultural expansion, and various categories of forest land uses. Non-forestry land-use allocations will often come at the expense of existing forest land, while the increasing need to accommodate a wider range of forest-related activities will cause an expansion and adjustment of priorities on areas which remain as forests.

Many of these decisions will be legislative ones, as governments seek to achieve increasing social and economic advancement for their people and at the same time maintain an adequate area of forest lands to meet social and environmental as well as economic goals. Most of the tropical forest countries are in a period of transition from a policy of maximizing timber utilization and revenues to one of establishing permanent forest reserves for long-term sustained productivity.

Some of the countries have already enacted new legislation for forestry, and are working to develop the necessary institutions to implement the new laws.

Others are still in the process of developing legislation, while at the same time seeking to strengthen their forestry institutions.

The political, social and economic constraints these efforts face are substantial. Timber is a source of important revenue to most of the countries. Growing populations exert continued pressure for more agricultural land. The problem of controlling destructive shifting cultivation practices continues to defy solution, and improved forest management and development programs require trained and experienced personnel, of which there is a severe shortage.

Therefore, to put the relationship between U.S. government policy and the activities of U.S. corporations in perspective, several points are important.

First, commercial timber operations are not the primary or even the secondary cause of tropical forest alteration overall. Shifting agriculture, fuelwood gathering, and planned conversion of forest lands for agriculture all rank ahead of commercial logging as a major cause of deforestation. These issues deserve priority attention.

Secondly, U.S. interests are a relatively small part of the logging industry in the tropical countries. Domestic companies and other multi-national corporations substantially outnumber American corporations.

Thirdly, in most cases the forests that are cut for commercial timber purposes are government-owned forests, offered for sale by the government at a time and place of the government's choosing and under rules and regulations established by the government. The land use and management decisions are not made by the timber concessionaires.

The key decision is the land-use decision. Which areas are to be converted to food crops? which are to be converted to grazing lands? which will become wood fiber or fuelwood plantations? which will be managed natural forests? and which will be left untouched as watershed protection or for scenic and scientific purposes?

The timber company usually comes into the picture after this basic land-use decision has been made.

If the land is slated for conversion to agricultural crops, the logging will simply be a land-clearing operation, with commercially valuable trees being sold and the rest being disposed of to make way for crops.

If the land is to be replanted as a commercial forest plantation, the initial logging is again mainly one of land clearing, except that the new crop will be trees planted for fuelwood, lumber, or pulp and paper.

If the natural forest is to be logged selectively and managed on a long term basis for native timber species, more care is required in the timber harvesting and subsequent management of the stand.

Where the land is to be devoted to fiber production, either as a managed natural stand or as a commercial forest plantation, long-term investments are required. These investments either must be made by the landowner (which in most developing countries is the government) or by the timber concessionaire.

However, there is some question to what extent natural stands in the tropical forests can be managed economically. One authority has recently written that foresters have been trying for almost 100 years to develop successful sustained yield forestry practices in native tropical forests, and have just about concluded that this type of commercial forest management in the tropics is uneconomical, and should be replaced by plantation forestry where commercial timber is the goal.

This would suggest that where fiber production is the goal, for local wood needs, fuelwood, pulp and paper production, and timber export, more emphasis will need to be placed on forest management techniques not aimed at managing the natural forest. Such projects as commercial plantations of exotic species, community forests for local wood needs, fuelwood plantations, and agro-forestry will be the production forestry of the future.

By meeting wood production needs from these intensively managed man-made "forests," pressure can be reduced on the vital areas of natural forest that should be left relatively untouched for watershed protection, natural area preservation and scenic and scientific purposes.

Most of these countries lack the expertise, funds, research capability and technical ability to keep pace with the conversion of the forest and the establishment of long-term forestry programs.

Given these circumstances, what should we expect the U.S. timber companies to do?

First, we should expect them to use the best practices available in the harvesting operation, doing minimum damage to the soils, and to trees which are to be for future production, if that is the plan for the land.

We should expect them to use their technical expertise to the extent it is applicable in the tropical forestry situation, to improve or maintain the productivity of the areas in which they work.

If given the responsibility of managing the land over the longer term, we should expect them to do what they can, consistent with principles of sound investments, to seek new answers to the problems of wood production in these tropical forests.

Beyond that, we could encourage them to cooperate with the national and state forestry agencies in programs of training for native workers, experiment with fuelwood plantations, agroforestry and community forestry programs, and assist where possible in programs of technical training for native forestry personnel.

The U.S. companies which are operating in the tropical forest countries are more than just loggers. Most have staffs of trained forest managers and research programs relating to forest production. We believe they can make significant contribution if encouraged to find solutions to the problems of people, fuelwood and shifting agriculture which beset the tropical forest countries.

To the extent that U.S. companies are guilty of logging practices which are detrimental to the long-term forest resources of the areas in which they operate, stricter enforcement of regulations is desirable.

But there is not a great deal that the U.S. government can do in this regard. The setting of the forest policies and practices are up to the governments of the tropical countries, not the U.S.

A more positive role can be played by the U.S. government if it will seek ways to work with U.S. companies to encourage them to apply their expertise and investment capital to helping solve some of the wood production problems facing the developing countries, rather than looking for ways to regulate logging practices.

Encouraging and assisting U.S. investment in forestry research, plantation management, and related areas would have positive effects of increasing wood production from designated production forests and taking pressure off the protection forests — pressure stemming largely from domestic wood needs.

U.S. industry has a potential for benefit that far outweighs the potential for destruction. U.S. government policy should seek to expand the benefits as the best way of reducing the adverse impacts of tropical forestry activities.

Sincerely,

Rexford A. Resler
Executive Vice President

APPENDIX 19

[From the New York Times, Oct. 16, 1980]

LUDWIG MAY CUT BRAZIL PROJECT

(By Warren Hoge)

RIO DE JANEIRO, Oct. 15.—Daniel K. Ludwig, the shipping executive who is reputedly the richest man in the United States, has threatened to "paralyze" operations at his $700 million development project in the Amazon region if the Brazilian Government does not give him financial relief and resolve persistent bureaucratic problems.

The challenge has angered some Government officials and stimulated certain sectors of the Brazilian population that have always viewed the Ludwig land holdings, which are roughly the size of Connecticut, as a threat to the country's sovereignty.

But despite assertions like that of Camilo Penna, the Minister of Industry and Commerce, that "the Government does not respond to this kind of pressure," Brasília appears to be doing just that.

The project, known as Jari, includes 3,000 miles of roads, a 26-mile railroad, bauxite and kaolin mines, rice fields, cattle ranching, 250,000 acres of tree plantations spread throughout the 6,175 square miles of jungle property, and a 17-story high cellulose mill.

National leaders are eager to keep the project functioning, because its economic contribution helps ease the country's balance-of-trade difficulties, helps feed its growing internal markets and provides lessons in rain forest development at somebody else's expense.

LETTER TO MILITARY LEADER

Mr. Ludwig's challenge was issued in a 17-page letter from the 83-year-old entrepreneur to Gen. Golbery do Couto e Silva, architect of the 16-year-old military management of the country. The correspondence was dated Aug. 5, but was recently made public by the Rio de Janeiro daily O Globo.

"If the Government cannot satisfy our legitimate pleas for assistance," Mr. Ludwig wrote, "our situation is hopeless, even if we reduce expenses to their lowest possible point. I am seriously considering either paralyzing our operations or selling our paper mill to any third parties, including the Government, who would be interested in continuing operations."

Mr. Ludwig's two principal demands are that the Government start paying for the $5.5 million annual "infrastructure" costs of providing essential services for the more than 30,000 people who live on the property (residents get health care, education, light, water, sewage and sanitation free) and that land claims in dispute be settled promptly so that the project can get on with expanding its forest plantations. He said that losses would amount to $50 million in the next five years under the present procedures.

Attacking 11 different federal bodies, the letter reviewed episodes that Mr. Ludwig argued had prevented Jari from making enough progress to make ends meet. In one transaction, for instance, Mr. Ludwig said that the Government had ordered him to build a newsprint paper mill using only Brazilian resources but that the only plant capable of doing such a sizable job in this country would not do it for fear of not being able to accommodate its Government contracts. By the time the Government relented and granted him the right to have the mill built in Japan and shipped here, the letter said, costs had become prohibitively high and the project was abandoned.

As a result, Mr. Ludwig argued, he only can produce half the 1,500 tons a day of cellulose that the original agreement called for and he is now saddled with an "infrastructure" twice as big as he needed.

"By the end of 1979," Mr. Ludwig wrote, "my investment was $625 million, of which $75 million were for infrastructures, all this investment came out of my resources and my resources alone."

To underline his threat to discontinue development, Mr. Ludwig described the process by which he would dismantle Jari. "I will begin by stopping the forestry operations and the cellulose mill," he wrote, "while I try to continue with the activities dealing with kaolin, bauxite and the sawmill. Naturally, this will be a last resort because it will mean leaving extremely valuable equipment and facilities unprotected and making them no longer productive. However, it is absolutely clear to me that this is the only path I can follow."

However, Mr. Penna, the Minister of Industry and Commerce, said that Jari's problems stemmed more from its managers' tendency to change their minds than from bureaucratic impediments. It would be "folly," he said, to meet Mr. Ludwig's demands.

As a result of the controversy, once-familiar wall-side slogans have reappeared telling Mr. Ludwig to "get out" and proclaiming "the Amazon is ours." In addition, Modesto da Silveira, an opposition party congressman from Rio who has long been a critic of Jari, traveled to Switzerland and reported that the Swiss cancer research institute to whom the heirless Mr. Ludwig intends to leave Jari was really "a front for strange secret business deals."

And an official of the Ministry of Industry and Commerce leaked word that Mr. Ludwig was senile and that he had shocked participants in a meeting at the agency headquarters by pulling a banana from his briefcase and eating it.

DISPUTE OVER LAND CLAIMS

Paulo Yokota, head of the Government land colonizing office, said that Mr. Ludwig's land claims were "crazy" and that one in particular would include a part of the Atlantic Ocean. Jari has claimed some nine million acres as its own under the purchase agreement in 1967. The state of Para says the right number is only 875,000 acres, while Mr. Yokota's agency is prepared to "legitimize" 1.4 million acres.

Still the project has its supporters. "The time has come," said Antonio Delfim Netto, the Planning Minister, "when Ludwig should stop being treated like a foreign body in this country. We will give him the support he needs to guarantee the project."

A special National Security Council has just returned from Jari with recommendations for drastically increasing Government presence on the site. It is a proposal that pleases both sides since it assuages critics' fears that Jari is, in effect, expropriating Brazilian territory for foreign interests and it promises Mr. Ludwig some relief in the administrative costs of running the project.

To solve the territorial disputes, several Government leaders have suggested renting Mr. Ludwig the land he says he needs. Francisco Andrade, president of the holding company that formally owns Jari, declined repeated requests to discuss the matter, but there was evidence that the Jari directors could agree to the rental idea.

Mr. Ludwig sent a telex from his New York base to workers at Jari reaffirming his hope that the project would have a secure future.

Still, the Rio daily Jornal do Brasil warned that Brazilian taxpayers were already bent under the weight of supporting giant state companies. "The Brazilian political system hasn't yet invented a way by which society can refuse to fund these megalomanias," it said in an article. "But the Brazilian political system should have no difficulty, acting through Congress and aided by a free press, in barring the federal Government from bailing Mr. Ludwig out of his own business collapses."

66-326 O - 81 - 27

APPENDIX 20

Letter to Hon. Don Bonker, From Lewis A. Engman, President, Pharmaceutical Manufacturers Association

PHARMACEUTICAL MANUFACTURERS *Association*

1155 FIFTEENTH STREET, N.W.
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LEWIS A. ENGMAN
PRESIDENT

September 25, 1980

The Honorable Don Bonker
Chairman, Subcommittee on International
Organizations
Committee on Foreign Affairs
U. S. House of Representatives
Washington, D. C. 20515

Dear Mr. Bonker:

In your August 26 letter concerning the Subcommittee's third hearing on tropical deforestation, you requested that PMA submit a statement on the importance of tropical forest resources to the American pharmaceutical industry.

The importance of tropical forest resources to the American pharmaceutical industry is primarily as an initial source of a limited number of new chemical entities rather than an ongoing source of supply, except in those cases where synthesis is technically or commercially unfeasible. It is not possible to quantify how many new pharmaceutically active entities may remain to be discovered from these resources. Nor do we have data on the dollar value of pharmaceutical products manufactured from tropical plants and animals.

Two important distinctions must be made. First is the difference between importance of forest resources as an initial source of new natural products and their importance as a source of ongoing supply. Second is the considerable difference in scale and type of operation between the large pharmaceutical companies operating on a global scale and the smaller indigenous companies operating on a local scale in various tropical countries.

Most new pharmaceutical products today are developed from synthetic materials. However, a significant number of products can trace their origins to tropical plants and animals. For example:

Digitalis glycosides
Opium alkaloids
Rauwolfia alkaloids
Steroids rerived from Mexican yams (also derived from other sources)
d-Tubocaoarine (now replaced with synthetic derivatives)

Belladonna alkaloids (some now made synthetically)
Acacia (used in formulations)
Quinidine and Quinidine Salts, (Cinchona alkaloids)
Physostizmide (now replaced with synthetic prostizmide) *

However, with only infrequent exceptions, once a promising chemical entity is identified and isolated in a plant, research and development efforts are undertaken to manufacture it synthetically. Synthesis is preferred for the following reasons:

- to insure the consistent purity and potency necessary to meet quality control (QC) and good manufacturing practice (GMP) requirements;

- to insure stability of supply sources;

- for convenience and safety in shipping the chemical rather than the plant from which it was previously obtained.

I appreciate the opportunity to submit this statement for the record on such an important issue. Should you have further questions on the importance of the tropical resources to the pharmaceutical industry, I would be more than happy to be of assistance.

Sincerely,

Lewis A. Engman

*Subcommittee Footnote: These derivatives are used in the manufacture of pharmaceutical products for the treatment of heart disease, ulcers, intestinal disorders, hypertension, diarrhea, glaucoma; steroids derived from Mexican yams are used in the manufacture of contraceptive products.

APPENDIX 21

Statement of Roger A. Sedjo, Director, Forest Economics and Policy Program, Resources for the Future

One of the most exciting features of contemporary forestry is the increasing role that industrial plantation forests--forests planned, managed, and harvested for their industrial wood values--are playing in meeting the world's growing wood requirements. Historically, man met his needs for wood by utilizing the natural forest in a manner akin to the hunting and foraging mode employed by early man to meet his food and fiber needs. The initial endowments of forest resources were far in excess of early man's wood requirements, and made concern about the resource unwarranted. As with hunting and foraging resources, stumpage resources were largely treated as a common property resource with the significant expense of wood products being related to harvest, transport, and processing costs. Through time, of course, hunting and foraging have been almost entirely replaced by livestock raising and agriculture. Similarly, the world is currently experiencing a transition from reliance upon natural unmanaged forests to an increasing reliance upon managed plantation forests to provide an increasing share of the world's wood needs.

The transition from natural to plantation forests has, thus far, been very gradual. Typically, plantations have been established to replace the harvested natural forest. This is particularly true in regions such as Europe and much of North America, where the process of natural regeneration is increasingly being displaced by artificial regeneration.

In the tropics and the Southern Hemisphere, the introduction of industrial forest plantations also proceeded slowly. True, before World War II New Zealand and Chile both developed rather large plantations of pinus radiata; industrial plantations were established in South Africa and parts of Asia and Africa, and Brazil utilized fast-growing eucalyptus plantations as fuel for its railroad systems around the turn of the century. But, on a global scale these activities were quite modest indeed.

However, after World War II, and particularly beginning in the 1960s, the tempo of forest plantation development increased dramatically in regions of the tropics and the Southern Hemisphere.

The preliminary successes of many of these plantations, the rapid biological growth rates often achieved, and the vast land areas potentially available suggest the long-term possibility for meeting much of the world's increasing wood and wood fiber requirement with increased production from the forest plantations of the tropics and the Southern Hemisphere.

Plantation Types

Three types of major plantation types can be characterized as occurring currently across the world. First, in temperate regions that traditionally produced the majority of the world's industrial wood--Northern Europe and North America--plantations utilizing indigenous species have typically replaced cutover natural forests. Second, other temperate regions that have not been traditionally major industrial wood producers are commonly introducing in their plantations exotic temperate climate species (largely North America) that exhibit rapid growth and desired merchantibility. Third, certain tropical regions are introducing exotic species (tropical pines, eucalyptus, gmelina) from other tropical regions which exhibit desirable growth and merchantibility characteristics. While experience with exotic plantations in the tropics is limited, results thus far are so dramatic that some knowledgeable observers maintain that tropical regions will eventually become dominant wood suppliers.

Although plantations are a small fraction of the world's total forested area, the current land areas involved belie their true potential. Industrial potential is the result of not only more land being converted into forest plantations, but also of the volume of output per land unit. These volumes are likely to be large for plantations since the location is usually determined, at least partially, by considerations of high biological growth and also because management practices usually associated with plantations increase usable growth. Thus fast growing forest plantations offer the potential of meeting a major share of the world's timber supply requirements from relatively small areas of forest plantation.

Examples of Recent Plantation Experience

Outside of Europe and North America, only a few regions have developed large industrial plantation forests. New Zealand currently has about one million hectares in plantation forests, most of it in exotic conifer from North America. New Zealand is adding to these forests at a rate of some 50,000 hectares per year, and has become a factor in Pacific Basin markets. Australia has also introduced exotic plantations, particularly conifers, on a large scale, to provide for her domestic long fiber requirements. Industrial plantation forestry of various types is underway in Japan, the Philippines, Indonesia and Malaysia, and India. Numerous parts of Africa have been involved in various forestry schemes. Industrial plantations have been created in Kenya and Tanzania in East Africa, utilizing a variety of tropical conifer species. South Africa has undertaken large plantations of various species. West Africa has been involved in plantation schemes utilizing eucalyptus, gmelina and tropical pines.

Of all the nontraditional producing areas of the globe, however, industrial forest plantations appear to have the greatest potential in South America. Plantations have been in place in Chile for about seventy-five years. In recent years the planting activity in Chile has increased substantially to almost 80,000 hectares per year and Chile has begun to active-

ly enter world markets within the past five years. Significant plantation activity is also underway in Colombia and Argentina. In Venezuela, serious interest in large industrial plantations has developed only within the past decade or less. However, the level of activity is substantial involving hundreds of thousands of hectares and appears to have great potential, due to the availability of large areas of land with few alternative uses and a location astride a major navigable artery which provides access to the sea. The country of greatest potential, however, is probably Brazil. Brazil's potential is large because biological growth rates in Brazil are very rapid compared with those experienced in North America. The land areas of Brazil that are available for forest plantations are vast and in many cases the opportunity costs of the land are quite small, and the location of Brazil vis-a-vis major world markets is quite favorable. Since the mid-1960s Brazil has established over 3 million hectares of fast-growing industrial forest plantations.

Global Trends in Forest Plantations

A recent FAO study (FAO, 1978) provides some perspective on the global extent of forest plantations. As table 1.1 shows, all areas regenerated by artificial means totaled about 90 million hectares in the mid-1970s. These plantations were, for the most part, located in the traditional producing temperate climate regions of Europe, North America and the USSR. Also, China had some 30 to 40 million hectares of plantation forest and South Korea added about 4 million hectares. Of course, not all of the world's 90 million hectares are industrial plantations. Many of the forests, e.g., South Korea's are designed primarily for protection and/or fuelwood with only limited attention given to industrial potential.

Data on the extent and status of plantations are extremely sketchy because of definitional problems, questions of survival, and so forth. In the mid-1970s, however, manmade forests were estimated at approximately 222 million acres distributed as show below:

Table 1.1

Economic class and region	Million acres
Developed	
North America	27
Western Europe	32
Oceania	2
Other	25
Total	86
Developing	
Africa	6
Latin America	8
Asia	6
Total	20
Centrally planned	
Europe and the Soviet Union	42
Asia	74
Total	116
Total World	222

Sources: Food and Agriculture Organization of the United Nations. Development and investment in the forestry sector. FO:COFO-78/2. 21. p. Rome, 1978.

Manmade forests compose roughly 3 percent of the closed forest area and include all areas regenerated by artifical means including conventional afforestation and reforestation techniques. Conifers are generally the preferred species although large areas of eucalyptus and gmelina have been established in Latin America, particularly in Brazil.

While the majority of forest plantations are situated in the Northern Hemisphere temperate climate regions, in recent years increased attention has been given to plantation activities in the tropics and subtropics, and in the Southern Hemisphere temperate climate regions. Table 1.2 summarizes a study of forest plantations in the tropics by Lanly and Clement (Lanly and Clement 1979). They estimated that the tropic and subtropic regions of Central and South America, Africa and Asia had about 11.8 million hectares of plantation forest in the mid-1970s. Of this, about 6.7 million hectares were industrial forest plantations. By 1980, a period of only five years later, the industrial forest plantations were projected by FAO to increase by 36 percent to 9.1 million hectares and projections for the year 2000 indicated the industrial plantations in that region would reach over 21 million hectares. Although these figures include slow-growing specialty woods such as teak, the majority of the present and projected tropic and subtropical industrial plantations consist of fast-growing conifers and hardwoods designated for ordinary solid wood and fiber production.

Potential Impact of Plantations Upon World Production and Trade

The long-term supply of forest resources has been a topic of concern for some years. In the United States the concern has been expressed in terms of the adequacy of domestic supply. Internationally, the FAO has expressed concern over the long-run adequacy of world supply. Recently, the recognition has been growing that the tropical regions have substantial potential to supplement worldwide production of industrial wood.

Table 1.2. Industrial Plantations--Tropical and Subtropical America, Africa and Asia

	1975	Projected 1980	Projected 2000
Cental and South America	2,786	4,123	10,705
Africa south of Sahara[a]	997	1,248	2,180
Developing Asia[b] and the Far East	2,892	6,520	8,265
Total	6,675	9,095	21,150

Source: J.P. Lanly and J. Clement. 1979. "Present and Futural Natural Forest and Plantation Areas in the Tropics." Unasylva vol. 31, no. 123. pp. 12-20.

[a]Excluding South Africa.

[b]From Pakistan east excluding the Peoples Republic of China, Mongolia and Japan.

The potential of tropical and substropical forest plantations for increasing the world's wood supplies is clearly substantial. Not only is the biological potential available, but recent research undertaken at Resources for the Future suggests that the economics of forest plantations are also favorable.

Forest plantations offer the opportunity of providing a vehicle for supplying the increases in the world's wood that will be required through time. They also provide an alternative to further commercial logging of the native tropical forest. To the extent that forest plantations can provide wood and wood fiber at attractive costs, the pressures for further exploitation of natural tropical forests to meet the world's wood needs will be reduced.

APPENDIX 22

Statement of Survival International (USA)

On the occasion of the first series of hearings on world wide deforestation, Survival International (USA) is honored to be asked to present this testimony to the Subcommittee on International Organizations of the Committee on Foreign Affairs. Our testimony concerns the effects of deforestation on the peoples who are indigenous to the forest.

Survival International (USA) would like to pose a question to the members of all multi-national corporations involved in deforestation: How do you account for the people who are living in the area which you designate for deforesting? By its mere definition, deforestation brings about the destruction of whole ecosystems - and with it the destruction of the people who have lived within their bounds.

In this age of world wide corporate activity, it is no longer possible that people living in a lifestyle of non-Western tradition can continue to be unaffected by Western culture. The kind of affect which Western corporations have on an indigenous society is what is now in question. The speed, extent, and methods used by industry abroad - specifically the forest products industry - are factors of a project which are within the corporation's control and responsibility.

Depleting the forest on which a people depend for food and shelter should be recognized as a drastic - cataclysmic - change in their lives, and should be dealt with by timber companies as such. Recognizing the basic rights of the people indigenous to the forest should be a primary factor in evaluating the potential worth of a deforestation project, and a primary concern of the project once

it is underway.

Human beings, like all other animals, adapt to a certain environment - learn how to use the resources within that environment so that they can survive. To take away those resources is to ensure their death. Most people would shrink from the idea of directly murdering people who inhabit the forest. Yet the record shows that to take away the necessities of food and shelter, as well as the established order, is to kill the people as surely as shooting or poisoning them - the only difference being that the process is slower and more difficult to recognize.

The first step in planning a project which considers the indigenous people is to find out information about specifically where the people are living, and their basic way of life - their general practices for obtaining food and living in their environment. An excellent source of information on an indigenous population is an anthroplogist who has worked with the people. Another question which Survival International (USA) would like to ask of the members of multi-national corporations involved in deforestation is: Do you employ anthropologists or use anthropological knowledge in the planning of your deforestation projects, and if so, to what extent? Many deaths of indigenous people might have been avoided if the corporation cutting the forest in a particular area had been better informed of the people's curcumstances.

Before we begin, it is important to note two things. One is that a promise of reforestation does not solve the initial problems of deforestation. If an ecosystem is destroyed, the things in it are destroyed, whether or not they are replaced with similar things

in the future. To the people who once have lived in and depended on the forest, it is of little consolation that the forest in thirty-five years will be filled with an abundance of resources and again be inhabitable - they will not be able to live long enough to enjoy this regeneration.

The other point is that one can not remove trees without destroying the forest. To leave half the trees of a forest is not to have destroyed only half a forest - the forest is a complete system, and that complete system is destroyed.

Deforestation brings about the disruption of many of the established technological and social systems of an indigenous society. One such system which is disrupted by deforestation is the agricultural system, the obvious result being an insufficient continuing food supply. Any agricultural system requires a certain amount of land and resources, and when these are limited, the system becomes inoperable.

The type of agriculture used by most indigenous peoples is the slash and burn method. Dr. George N. Appell of Brandeis University describes it as such:

> Slash and burn agriculture, or as it is known technically, swidden agriculture, involves cutting the forest or bush, firing it, and then planting crops. The firing provides ash for fertilizer and kills weeds. After one or sometimes several years, when the crops have all been removed, the area is left to revert to forest or bush. At some later point, usually seven or eight or more years, the area is used again for agriculture.

It is important to note that the system of slash and burn agriculture utilizes natural resources without consuming them. According to Appell:

66-326 O - 81 - 28

> When the indigenous system remains undisturbed, there is no degradation of forest resources. Indigenous peoples recognize that the success of their crops depends on the generation of adequate fertilizer from burning forest or bush. Therefore, they conserve this resource. Furthermore, the forest provides many of the required raw materials for housing, mats, baskets, etc. In the region which I am familiar with, the indigenous peoples actively conserved areas of their primary forest that were randomly distributed throughout their territory. This provided a source of reseeding the areas cut and burned for agricultural purposes and preserved the genetic diversity of the forest in their area.

This agricultural system, if uninterrupted, can continue virtually for an indefinite period of time. But, according to Appell, "When an indigenous population is interfered with, conservation methods become inoperative, and even further deforestation can result. It may appear that indigenous peoples are responsible for deforestation, as has been suggested to Survival International (USA) by forest product company representatives. If indigenous peoples do begin consuming resources, it is only because using their normal system of conserving the resources is no longer possible.

The actual process of clearing the forest may have an impact on the indigenous population long before the trees have actually disappeared. Workers entering the forest bring with them illnesses which may be common to them , but which to the indigenous population prove to be fatal epidemics. The common cold and measles have been as disastrous as the Plague was in Europe in Medieval times. Thousands of people have died - huge percentages of many populations. No thought has been given to innoculating people, or otherwise protecting them from new diesases, although I am sure that the corporation surely innoculates its employees prior to their entering a tropical area.

Certain methods used in clearing a forest have also proved to be of great danger to the indigenous populations - particularly in the case of chemical defoliants such as Agent Orange. William Ballée of Columbia University reports that,

> In the early 1960's, the Brazilian minister of the interior ceded 9000 hectares of the adjacent Tembe reservation to the Swift-Armour company for beef production and timber export. In the mid-1960's, Swift-Armour sprayed the defoliant Agent Orange throughout the region. According to some Kaäpor Indians who live nearby, "The plane passed overhead, spraying poison over the jungle. The wood of the trees began to dry out; fish, alligators, everything began to float dead in the water." Afterwards, many Indians suffered a fever, and today 2 percent of the Kaäpor population are deaf. In the absence of a medical investigation, it is impossible to know whether or not the spraying of defoliants is responsible for this; nevertheless, in the 1950's no visitor to the Kaäpor reported the presence of deaf persons. (from ARC Newsletter, December 1979)

The long term effects of Agent Orange are yet unknown, but it may be that even greater harm to the Kaäpor will become manifest.

The change which is suddenly imposed on an indigenous population can scarcely be perceived by we who live in the United States. In the U.S., one may change residences, jobs, or where one shops, but rarely if ever would one change one's entire way of life. The only thing comparable in our society would be if all food stores, industries, and even money, were suddenly abolished, and every person in Washington, D.C. were told to get food by fishing and farming. Who, starting tomorrow, could provide for his own needs, and the needs of his family?

One aspect of the drastic change which deforestation brings which is the least easily recognized is the disruption created in the social order, and the consequent physical effect this has on an indigenous population. Disrupting a social order does much more than merely cause inconveniences for the people - it causes stress

which actually brings about health threats to the people in the society - causing death. Vinson Sutlive of the College of William and Mary states that stress is "the threat of loss of a significant part of one's environment. The Iban [a Southeast Asian tribe] and scores of other peoples are threatened from many sources and at virtually every level of their lives, with the loss of land, forests, water, employment, and traditional values. The stresses originate both locally, within the region of Southeast Asia, and from external sources, and the potential losses are beyond comprehension."

The reason for stress is that one social system is undone, and another suddenly imposed. As Sutlive further states, "Our economic systems are tied to growth, greater productivity, and consumption, and our standards of living have become the goals and dreams of developing peoples. So that we have exported and others have accepted all-too-uncritically our architacture, amenities, systems of transportation, and creature comforts, marketing our technological superiority out of our ethnocentricity, our interest in 'making them in our image," and our general ignorance of the vulnerability of the natural and social systems we were 'developing.'"

Stress has its physical effects on the human body - a lesser ability to cope with one's surroundings. The sudden changes which deforestation brings about not only offer a new environment to which the people must adapt, but lowers their ability to adapt. Appell writes that "The adaptation load of social change produces psychosocial stress; and psychosocial stress can depress the response of the body's immune system." (Appell, "The Health Consequences of Social Change")

The probability of disease - and death - increases tremendously as the resistances of each person's body decreases. The new pathogens and bacteria present in the new environment most likely will have an even greater impact because the body resistances are lower.

One of the basic problems of all deforestation projects is that the gap between managers of a corporation and indigenous peoples is tremendous. Neither group can begin to comprehend the other.

Anthropologists who are familiar with the way of life of the indigenous population of the area where lumbering projects are soon to take place can be of tremendous help in making this gap smaller. Through finding out exactly where indigenous settlements are located, and coming to understand better the mode of subsistence of the inhabitants, the medical practices, and the system of values, perhaps many deaths of indigenous peoples could be avoided. Rights of indigenous people which are violated due to ignorance on the part of the corporation might be avoided.

The United States has always prided itself on its stands on human rights issues - in fact many feel that these rights are "self-evident." The U.S. has ratified United Nations declarations on genocide and ethnocide in the policy of its aid programs. Yet when corporations cut down a forest these precepts have been ignored. The effects of forcing change through deforestation on an indigenous population may not be as easily apparent as the torturing of a political prisoner or the murder of a person who practices an unaccepted religion. But the final result is the same - deforestation directly causes the death of thousands of people. Unless measures are taken quickly which can ensure the safety of the people who have traditionally inhabited the tropical forest areas, the problems may be solved in quite a different way - the people indigenous to the forests will all be gone.

APPENDIX 23

Tropical Reforestation

A Statement by the Imported Hardwood Products Association

The Imported Hardwood Products Association (IHPA) is an international trade association headquartered in Alexandria, Virginia. Members of the Association are involved in processing, shipping, manufacturing and sales of tropical hardwoods. Membership is comprised of U.S. buying companies, offshore supplying firms, overseas export trade associations, and allied industries such as steamship companies, port authorities, international banks and law firms.

The Imported Hardwood Products Association is devoutly interested in the preservation of tropical forests, and the Association has for many years been involved in activities related to proper utilization of these forests. IHPA was an active participant in the U.S. Strategy Conference on Tropical Deforestation sponsored by the U.S. Department of State in June, 1978. The Association has also been involved in offshore conferences on this subject with forest industry and government officials in Thailand, Indonesia and the Philippines. IHPA also served with other forest industry associations in an advisory capacity to agencies of the U.S. Government concerned with the development of a U.S. Policy Strategy and Program Statement on Tropical Forests.

While our industry is aware and concerned with the rapid decline of tropical forests throughout the world, we feel it is important to recognize that commercial forestry is not the major threat to these important natural resources. Rather, the primary factor in the destruction of tropical forest ecosystems is the unchecked growth of human populations, which is now proceeding much more rapidly in tropical zones than elsewhere.

Millions of people are involved in removing the forests in order to clear land to grow subsistence crops. Slash and burn agricultural clearing is quite popular and leaves the land bare. In many impoverished regions, valuable tropical timber species are used for fuel and energy.

The regions suffering the most widespread destruction of tropical lands are in Latin America, particularly the Amazon Region of Brazil, where

agricultural clearing goes on at a rapid rate. Conversely, the developing countries of Southeast Asia, which are much more prominent in the tropical timber industry, are making progress in forest preservation and reforestation. The Government of the Philippines now requires replanting for each tree harvested, and has imposed an export ban on logs to further restrict uncontrolled timber harvesting. In Indonesia, where the major supply of Asian tropical timber is located, large corporations are developing productive reforestation programs. Both the Georgia-Pacific Corporation and Weyerhaeuser have active programs designed to replace the forests with rapid growing species.

It is the position of the Imported Hardwood Products Association that care must be taken to restore the forests as they are harvested. We are opposed to destruction of tropical forests from poor forestry practices, but we also oppose tropical forest stagnation, leaving forests idle. Rather, we favor proper utilization of the great growth potential of tropical rain forests. Good utilization is in the mutual best interest of the forest owners and potential users.

APPENDIX 24

Statement by David L. Skole, Entitled United States Foreign Assistance and Tropical Deforestation

Because of the current problems and issues associated with tropical deforestation, we urge that careful consideration be given to the renewal of funding for the Foriegn Assistance Act, and especially incorporate a specific mandate for the International Development Cooperation Agency and the Agency for International Development. The impoverishment of the tropical forest biome is one of the most serious problems facing the world today; and U.S. government policies and programs can aid in its resolution. The recently released State Department Interagency Task Force strategy paper on Tropical Forests demonstrates an excellent focus for federal-level involvement in this area.

Our own research efforts at the Complex Systems Research Center have directly interfaced with this issue. Our work with the Ecosystems Center at the Marine Biological Laboratory attempting to model the influence of terrestrial biota on the global carbon cycle has required the use of data on the rate and nature of land clearing in the tropics. In recent computer simulations the paucity and ambiguity of such data and information has been strikingly apparent. The assessed magintude and dynamics of carbon dioxide release to the atmosphere due to deforestation differs depending on the particular data-base used in the analysis.

We feel that deforestation leads toward overall biotic impoverishment, which lowers the quality of human life. Current research indicates that carbon dioxide release is directly correlated to deforestation and the clearing of land for agriculture and forestry. Thus, atmospheric accumulation of carbon from the terrestrial biota may be indicative of biotic impoverishment. In light of this, as well as current concern over the effects of possible global warming due to carbon dioxide accumulation in the atmosphere, the establishment of a solid base of information and the formulation of policy with regard to tropical deforestation is paramount.

Concurrent with our modeling research, we have attempted to survey the nature and extent of tropical deforestation. For your reference we have attached this survey. From this survey, it is clear to us that the issues surrounding tropical deforestation-- from the role of traditional shifting cultivators to the involvement of U.S. multinational corporations--are complicated and not well understood. The analysis, understanding and resolution of questions about tropical deforestation are problems that are both ecological and scientific in nature and that require consideration of the elements of human behavior and culture. Such problems are not well suited to linear cause-and-effect analysis. Not only do these questions demand a systems approach, but they require analysis of cultural, human and

social aspects. Such systems which have the human element as a major component are termed complex systems. Any resolution of such complex problems requires the study of both biological and social factors.

As John S. Spears, forestry advisor to the World Bank, stated in his address before the General Meeting of the Commonwealth Forestry Association, 10 April 1979, "One of the problems we face in trying to analyze the future fate of the tropical forest is that soil scientists, land use planners, botanists, agronomists, meteorologists, sociologists, hydrologists, ecologists, environmentalists and even foresters, all tend to look at this issue from a parochial viewpoint. The volume of specialized literature which has grown up around the subject would fill St. Paul's Cathedral, whereas the number of papers which tackle this issue in an 'holistic' way would probably fit into my briefcase."

Because the problems presented by tropical deforestation are coupled with problems of third-world development goals and directives, we feel strongly that the Agency for International Development should continue and expand their aproach to developing a U.S. policy on tropical deforestation.

Toward resolution of these questions we propose the following recommendations to the Agency for International Development:

1. TECHNOLOGY TRANSFER

Many tropical countries are also less developed nations. Governmental interests of the countries occupying the tropical forest biome mesh smoothy with the world demand for lumber, pulpwood, agricultural land, and grazing land. The result is exploitation of the forests as convenient resources offering relief to the burdens of burgeoning populations and dwindling supplies of capital.

Yet undisturbed tropical forests offer important baseline information which can be useful for a basic understanding of biological proccesses and also supply species which are economically valuable for use in agicultural breeding, medicines and pharmaceuticals. Finally, and more importantly, these forests may not always be renewable resources. Current research suggests that under present development plans and land use practices the tropical forests may not be able to sustain regeneration due to the loss of primary forest cover.

AID can implement management practices which incorporate tropical ecological theory into its own activities, but more important, it can support the development of local ecological expertise (which is presently lacking) through training programs. This would encourage sound environmental and ecological planning through local awareness of the specific response of these ecosystems to various perturbations. Further, the technological capabilities of remote sensing (LANDSAT) and data processing for monitoring tropical biotic change should be incorporated into development planning and made

available to tropical governments. The support given to the Philippines and Thailand by AID for such programs is a good example of the application and transrer of remote sensing capabilities.

2. THE NATIONAL ENVIRONMENTAL POLICY ACT

The NEPA requirement of writing environmental impact statements for all federal-level projects which have potential environmental impact should be encouraged, if not required. In keeping with the spirit of NEPA, this approach would encourage consideration of sound environmental management practices during initial planning. The world-wide environmental concern expressed in section 102(E) should be the main emphasis. Also, AID should encourage the implementation of Executive Order 12114 when applicable.

In cooperation with the Council on Environmental Quality, impact assessment and impact statement guidelines should be reviewed and modified where needed to allow proper consideration of forest values and impacts.

3. LEGISLATIVE MANDATE

Since the 1960's AID has been involved in tropical forestry projects; an involvement in resource conservation and management should accompany this mandate. Under the Foreign Assistance Act of 1972, AID was given a specific mandate to provide and encourage sound forestry management practices such as small woodlots, agroforestry, reforestation, and watershed management. We believe that this direction in foreign assistance should continue and be expanded. Much of this requires the allocation of funds, expertise, and material.

4. RESEARCH

Sound decision-making requires a solid foundation of data and theory. We suggest that with the current lack of complete and reliable data, sound decisions and management alternatives can be made only with expanded basic and applied research. Government consultation with a broad range of experts in the fields of development, agriculture, ecology, anthropology, and environmental management should be a key tool for the transmittal of information from academe and the private sector to the public sector.

Finally, in any research effort the interrelationship of economic, sociocultural, and ecological analyses cannot be overemphasized.

5. PARKS AND PRESERVES

Many authorities insist that complete protection of the tropical forest biome cannot occur without the establishment of national parks and forest preserves. Moreover, because of the particular ecology of tropical systems, a few large parks will not suffice to maintain genetic diversity. The US should encourage the preservation of areas of forest in selected localities covering distinct ecosystems.

In light of capital and alternative resource scarcities in many tropical nations, this recommendation may have many constraints. At the very least the US should provide seed money, technology, and expertise to facilitate the reconnaissance of unique or select ecosystems for their preservation.

We understand that many of these recommendations may be constrained by the foriegn image of our way of life in the United States. How can we discuss deforestation in the tropics as a source of C02 when we burn large amounts of fossil fuels? How can we discuss deforestation in the tropics when the US demand for foreign wood in continually increasing? We rest our recommendations on the premise that impoverishment of the tropical forests, like no other ecosystem on earth, will inhibit the development of tropical nations themselves, and will result in the impoverishment of the quality of life in the tropics and the rest of the biosphere.

In closing, we would like to reiterate that the policy and stategy report to the President from the Interagency Task Force on Tropical Forests parallels our own thoughts and recommendations. We urge further support for this approach and similar programs through appropriate funding and legislation in Congress.

David L. Skole
Research Scientist
Complex Systems Research Center

APPENDIX 25

Statement of Dr. Clayton E. Posey on Jari Florestal

I am Clayton E. Posey and am providing this written statement about Jari Florestal e Agropecuaria. Ltd. of Belem, Brazil through the auspices of the Tropical Forestry Subcommittee of the National Forest Products Association. I have twenty years experience in forestry including eleven years in tropical forestry. Recent positions held have been Executive Director of Jari and Vice President of the parent company.

Jari now has the following operations:

High-yield forestry with 100,000 hectares of melina, Caribbean pine, and Eucalyputs plantations established.

Sawn-timber production - 30,000 m^3/yr.

Bleached kraft pulp production - 260,000 tons/yr.

Kaolin mining and processing - 220,000 tons/yr.

High - yield rice cultivation - 5,000 hectares.

Jari Florestal e Agropecuaria is a Brazilian company. A decision was made in the mid 50s, in anticipation of a projected world fiber shortage in the mid 80s, to establish a large forest plantation to help meet the need. After several years of observation, it was decided to concentrate on melina (Gmelina arborea L.) as a fast growing species with a good general purpose wood and a history of successful establishment over a wide geographic range.

An extended search was made for a location with (1) an apparently stable government which was interested in investment by a foreign organization, (2) a large uninterrupted block of land, (3) a moist or wet tropical climate, and (4) a deepwater port.

The area finally selected was approximately 1 million hectares on both sides on the Rio Jari, the last major tributary on the north side of the Rio Amazonas, latitude 0^{9} 50' south and longitude 53^{9} west.

The original policy, as implied above, was to produce wood fiber on a commercial basis.

This was quickly expanded to include production of commercially viable forest products. From the beginning this has included wood from the native forest to satisfy our own needs, currently 30 species or species groups, for lumber and crossties. We have begun to develop internal and export markets for some of the more promising species, with results that are adequate for this stage in our development.

We have also harvested some native forest crops, notably Brazil nuts.

Power generation for our first pulpmill is by woodfueled steam turbines. Practically all of the native species can be utilized in the boilers.

A number of other policies more or less emerged as development proceeded.

Today's objectives:

(1) Produce commercially viable forest products.

(2) Comply with the laws of Brazil.

(3) Use Brazilian personnel, materials, and equipment except for specialized needs not currently available within the country.

(4) Keep in the forefront in social services and real wages, without unrealistic leapfrogging outside the local culture.

(5) Develop personnel; don't pirate them from elsewhere.

(6) Use labor intensively, mechanizing only the jobs for which labor (a) is simply not available or (b) productivity is too low to justify a living wage.

(7) Do not unnecessarily damage or destroy our soils or water.

(8) As a corollary to (7), establish bench marks for monitoring environmental change.

A. Site Selection

In selecting sites for future plantations, the first step is to eliminate, by aerial photo interpretation, very rough and broken terrain, marshes, and swamps.

A crew then enters an apparently usable area; lays out a grid of survey lines; makes an extensive inventory of native species and soils by texture then recommends whether the area shall be converted and what species to plant.

Logging crews then remove wood for company needs.

B. Land Clearing

After logging for our needs, the forest is left for one to three years to re-establish a complete vegetative cover.

Originally landclearing was done using heavy machinery. This had three major disadvantages: (1) disturbance of the already skimpy topsoil, (2) compaction of soil, and (3) high costs.

Therefore, heavy equipment was replaced by laborers with axes and chainsaws. This eliminated the first two problems and alleviated the third. This system continues to date.

C. Silviculture

Species. Although the original decision was to plant melina, it quickly became obvious much of our land is not suitable for melina, and in 1973 Caribbean pine Pinus cariaea var. hondurensis Eucalyptus deglupta was adopted for sandy clay soils. A substantial number of other species and varie-

ties are under trial, but none are yet demonstrably superior to melina, P. Caribaea, or Eucalyptus.

D. Planting. Planting is begun as soon as the ground is soaked at the beginning of the rainy season. All planting is manual.

Normal spacing of pine is 4 m between rows and 2.25 m between trees in a row (1111 trees/ha).

E. Cleaning. Competing weeds and brush are controlled as necessary and possible.

We are still in our first rotation on all sites, but predicted clearcut ages are 6 years for pulpwood melina and Eucalyptus and 12 years for pulpwood pine.

F. Multiple Cropping.

1. Since 1975 we have been sowing bunch grasses in our pine plantations, which is why rows are 4 m apart. As soon as possible after planting the pine, we sow grass seed in a double row down the middle, 1.5 m from the nearest pine. Cattle are put on the grass, at 1 steer/2 ha, after 6-7 months. At about 12-15 months, cattle numbers can be doubled to 1 steer/ha.

No grazing is done in melina plantations.

2. Indian corn (Zea mays L.) and manioc (Manihot utilissima Pohl.) are grown annually in new plantings of either species, but principally melina. Most production goes to company swine.

3. Small food plots, mostly watermelon, squash, and papaya are planted every year by individual workers, but the gross area is small because new clearings are remote from permanent population concentrations.

G. Plantation Management.

The total plantation area is divided into 20,000 ha blocks, with a graduate forester in charge of each.

A Forestry village is being built in each block to house about 750 workers with their families, about 3500-4000 people. Besides housing, the village includes a school, infirmary, general store, water system, power plant, and light vehicle maintenance shop. A doctor, nurses, schoolteachers, and other service personnel, besides those in forest management and harvesting, live in the village where they work.

Housing is provided by the company at nominal expense.

There have been many articles written about Jari. The two most recent and most complete are:

"Jari": A massive technology transplant takes root in the Amazon Jungle by Loren McIntyre in the May, 1980, issue of National Geographic,

and

"Jari": by John Kalish, in the January, 1979 issue of Pulp and Paper International.

A copy of the report by Mr. Kalish is included as a part of this statement.

Jari appreciates the opportunity to present this information on behalf of NFPA's Tropical Forestry Subcommittee.

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[From Pulp and Paper International, January 1979]

JARI

(By John Kalish)

The Jari Project in Brazil has been called bold, imaginative, ambitious, historic, ingenious and mind-boggling. It is perhaps all of these. Jari is also the largest and grandest forest industry and agricultural development project ever undertaken by private enterprise, and it is thus all the more remarkable that this venture springs, not from a giant corporation, but from one man—the American industrialist Daniel K. Ludwig.

Jari Florestal e Agropecuaria Ltda. (Jari Forestry and Agricultural Enterprises) is the official name of Daniel Ludwig's project to develop a 15,000 square kilometer tract in the Amazon Basin of Brazil, which he bought about 11 years ago for a reported $3 million.

The two conceptual cornerstones of Jari's development have been operational integration and self-sufficiency, and it is hard to imagine any other development scheme—including those undertaken by state authorities—where these two concepts are so rigorously pursued.

Today Jari's commercial operations comprise:

- High-yield forestry – 90,000 hectares of gmelina and pine
- Sawn timber production – 30,000 m^3/yr
- Bleached kraft pulp production—260,000 tons/yr
- Kaolin mining and processing—220,000 tons/yr
- High-yield rice cultivation—60,000 tons/yr

The biggest innovation, of course, is the pulp mill–built in Japan on floating platforms and towed across the oceans to Jari. It will begin start-up operations on 1 February.

There is already a modern town, the Jari capital of Monte Dourado, with a growing population of some 8,000 people plus two satellite forestry villages. There are 10,000 people on the payroll. Close to 450 kilometers of roads have been built, plus another 3,000 km of plantation roads, plus a railroad. And there are numerous major self-sufficiency operations such as cattle and poultry raising, vegetable and fruit cultivation.

The degree of integration between all these operations and between them and the growing Jari community is impressive. Cattle are fattened by grazing in young pine plantations; forest residues and mill wastes will be burned at the pulp mill to provide electrical power for the kaolin plant, the sawmill and Monte Dourado. Rice is a main staple food at Jari, plus being an export commodity.

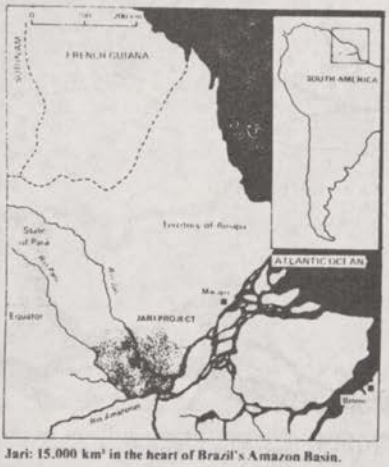
And all this is just *Phase 1* of Jari. The potentials of *Phase 2* and whatever may follow are substantial to say the least. Jari could become one of the world's major forest products operations centers within a decade. Even using fairly conservative figures, one may estimate the annual yield from Jari's forests at 5-6 million solid m³ by about 1985. (A promotion brochure put out by Price & Pierce, which markets Jari's pulp, claims that by 1984 the forests will produce "12,000 tons of marketable wood per day.")

Here are a few of the immediate plans and potentials:

- Another 100,000 hectares of forests are already mapped out—again both pine and gmelina, giving both softwood and hardwood product potentials.
- It is no real secret that Jari is actively studying paper production. It could be newsprint or even coated papers, as kaolin is right next door. Paper production will almost certainly materialize within five years, and it will be large scale. Most likely the plant would again be built on platforms and floated to Jari.
- The potential for expanding sawmilling and adding related forest products operations such as plywood and particleboard is enormous.
- There is hydro-electric potential in the Rio Jari. It could be utilized to produce thermomechanical pulp.
- Rice farming is being quadrupled, and kaolin production doubled.

Though Daniel Ludwig is said to dislike organization charts, and any Jari executive will tell you that all lines of responsibility end ultimately at one desk, there is an official organizational structure. Jari Florestal e Agropecuaria Ltda, a Brazilian company, headquartered at Monte Dourado, handles the day-to-day operations of the Jari project. Jari Forest Products Inc., headquartered in Greenwich, Connecticut, USA, is the top management organisation.

President of Jari Forest Products Inc. is Tom Willers, former chairman of Champion International. His vice presidents include Stuart Lang (production), Clayton Posey (forestry), Stafford Hopwood (administration/marketing), William D. Morrison (planning and development), Gordon C. Douglas (solid wood), and Peter J. Gutschow (finance).



Jari: 15,000 km² in the heart of Brazil's Amazon Basin.

The current head of Jari Florestal, which means immediate responsibility for everything that sits or moves at Jari, is Elmer Hann, who formerly managed Daniel Ludwig's shipyard in Kure, Japan.

Jari managers and executives underline the dependence of this project on the personal inspiration and leadership of Daniel Ludwig. They point out his mastery of details in planning and operations, his frequent visits to the site, his personal drive to make Jari succeed as a viable self-sustaining enterprise and community. While Jari represents the hard and inspired work of thousands, there is no doubt that the ideas and concepts at the roof of it are Daniel Ludwig's.

Why, you ask, is a man of 81—however wealthy and successful—involved in such a vast undertaking to invest hundreds of millions and enormous energy on a project so clearly conceived as very long term? It has been argued that no commonly acceptable return on this investment can be realized for another 10-15 years, thus there must be idealistic motives involved. Daniel Ludwig will probably never answer the question—quite likely he would consider it a waste of time to do so—though were he to speak he might just say that he was, in fact, only 70 when he started the job.

Elmer Hann, who is now 76, recounts how Daniel Ludwig persuaded him last year to move from Japan to take over the top post at Monte Dourado. "I told him, 'I've been working a long time, Mr. Ludwig, and I was thinking I might like to take it easy one of these days.' And he asked me: 'How old are you, Elmer?' I told him I was 75, and he said: 'I'm 80, Elmer. You're still a young man.' "

This visitor's impression is that Jari is all business. There is no visible trace of philanthropy. What has been done and is being planned meets every sensible technical criterion for good, long-term operations. And that makes some sense, for Daniel Ludwig is not only one of the world's most successful businessmen, he has also been one of the best long-term performers, and forest products, agriculture and mining are all pretty solid long-term prospects.

As with other well-run operations, the accent at Jari is on getting things done, the more and the faster the better. Tom Connor, the construction manager for the pulp mill site, relates how Daniel Ludwig, while visiting Jari in mid-June, drove down to Munguba to see for the first time the $200-million pulp mill, safely landed after its 90-day ocean voyage. Tom Connor offered to show him around the inside of the mill. "You ought to see it, Mr. Ludwig. It's really a beautiful job." Daniel Ludwig replied that while he would like to tour the mill, he didn't have the time; he was busy working on what to do next at Jari. "I see you've put it in the right place, Tom," he said, "and that's what's important."

If Jari is successful—and it appears off to a good start—it will be more than just another successful project or a boost for Brazil's goal of developing the Amazon region. The achievements and the innovations—such as the pulp mill construction—could have important consequences for many parts of the world.

Gmelina and modern forestry in the Amazon

The story of Jari is closely tied to the story of *Gmelina arborea*, a previously little known hardwood species which someday may become as common a household word as eucalyptus.

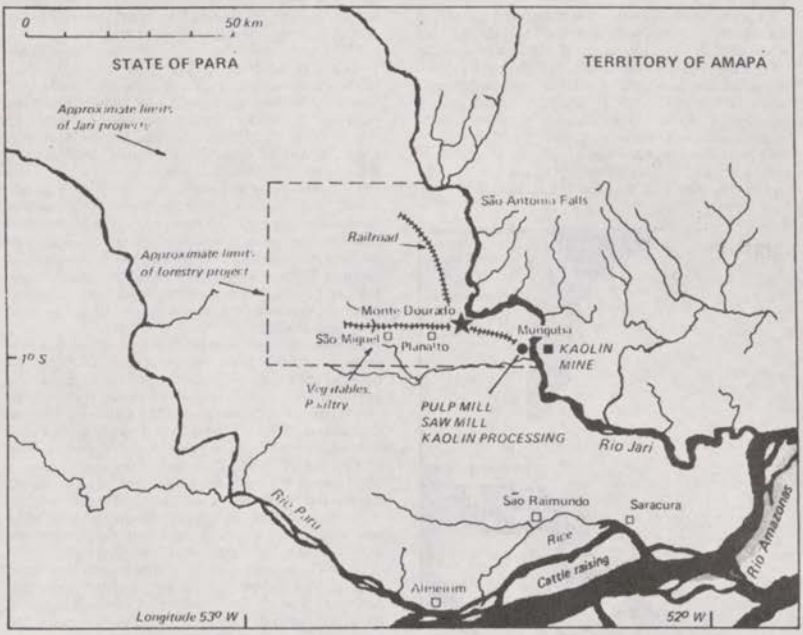
Back in the 1950s, Daniel Ludwig had a feeling—and it is doubtful it could have been more than a feeling at the time—that there would be a world fiber shortage in the mid-1980s. He gave a project to one of his assistants to find a tree which would, simply stated, give more fiber. Wanted was a tree which would produce good fiber quickly, be resistant to disease and pests, and further, produce a fiber suitable not only for pulp but also for solid wood products—timber, veneer, plywood and particleboard. In short: a perfect tree.

The tree was found in Southeast Asia - *Gmelina arborea*, native to Burma and India. Not surprising to a forester, gmelina is not a particularly strong species in its native region; it occurs sparsely due to competition from other local species, and it exhibits few of the attributes for which it is acclaimed today. Gmelina was test planted in Honduras and gave the desired results. Daniel Ludwig then began looking for an appropriate piece of land to sustain a major forestry operation based on this tree. Several sites were examined, including Nigeria. Gmelina had already been planted in Nigeria years ago by the British Colonial forest service to supply pit props for mining operations. It had also been planted in other African countries—Zambia, Sierra Leone, Uganda, Gabon and the Ivory Coast—and in British Honduras. The original seed stock for Jari was drawn from these countries.

"The initial concept," explains Clayton Posey, vice president, forestry, of Jari Forest Products Inc., USA, "was an integrated forest products complex. Before Jari was purchased, gmelina was tested and found good for veneer peeling, sawing and for pulp." To prove the point, samples of sawn goods, joinery products, and particleboard, all made of gmelina, are displayed and Johan Zweede, head of Jari's forestry operations, points to the office door—it too is made of gmelina.

The Jari property was purchased in 1967 from a consortium of Brazilian owners. It totals some 1.5 million hectares, or 15,000 km², of which about two-thirds lies west of the Rio Jari in the State of Pará and one-third east of the River in the Federal Territory of Amapá.

At the time of purchase, little was known of the



Jari's operations today; headquartered at Monte Dourado. Industrial operations are centered at Munguba, rice farming and cattle breeding in the south, vegetable and poultry farming at Sao Miguel. The forestry project covers only about 15% of the property

property. It had not been surveyed and it was virtually uninhabited—the estimated population of the whole area at the time was 2-3,000 people, all living on a subsistence level collecting Brazil nuts or fishing. There was one small village, Jarilandia, which served as headquarters for the Brazil nut gathering operations.

Surveys after purchase revealed the nature of the Jari tract, and some few pleasant surprises. The northern part of the property belongs geologically to the Guiana highlands, in which the Rio Jari has its source, and is characterized by reasonably rich, clay soils. About halfway south through the property a sharp geological fault runs roughly east-west. South of this line are the sandy, alluvial soils typical of the Amazon basin. (Sao Antonio Falls, shown on the map of Jari, occur on this fault line. The division in soil types along this fault is very sharp, no more than a few meters wide.)

"Jari is in a unique position," explains Clayton Posey. "To the north we have soils well suited for gmelina, to the south the sandy soils best for pine. Very few other areas are good for both." He admits it was a stroke of luck to find both soil types, and he adds that it would be difficult to find another property with the same combination. So immediately, Jari had a softwood as well as a hardwood potential.

Other pleasant surprises included the low-lying area at the confluence of the Jari and the Amazon, which was quickly found suitable for rice cultivation, and—as is well known—the major deposit high-quality kaolin discovered across the river from Munguba.

Forestry operations began in 1968 and by 1970 plantation establishment was in high gear (see table). The initial plans called for 200,000 hectares of plantations, half of it to be completed by 1978, the rest by the middle of the 1980s.

Though initially conceived as a gmelina-based operation, the discovery of the two distinct soil types made it evident that pine should and would be planted as well. The foresters believed in this approach, feeling that both long and short fiber would sustain an even better integrated complex. Daniel Ludwig did not disagree, but, explains Clayton Posey, "he felt that during the early stages we did not want to dilute our effort away from gmelina." "Anyone can plant pine, anytime," Daniel Ludwig told his foresters, and so the initial efforts were concentrated on gmelina.

Pine was first planted on a major scale in 1973, after some years of experimentation. The species chosen was *Pinus caribaea, v. hondurensis,* but not, observes Clayton Posey, until "we had tried every species which had ever been successful in the tropics." There are 16 different origins of the species planted today at Jari.

Despite the two distinct soil types, both species are in fact planted in all areas; it is just the proportions which vary. Pine predominates in the southern sector (sandy soils), while gmelina is planted much more in the north.

The marketing options available through having pine as well as gmelina are obvious, for pulp and paper as well as for solid wood products. This has been recognized in the increased planting of pine, which exceeded that of gmelina for the first time in 1978. Though Phase 1 is still dominated by gmelina by more than 2 to 1, this imbalance will be corrected towards a 50:50 ratio in the next generation of plantings on Phase 1 land. Pine will be substituted for gmelina in certain blocks in the southern sector.

Phase 2 plantings will aim for a 50:50 ratio between the two species. The goal is a balanced softwood and hardwood supply for a whole range for integrated forest products operations.

Plantations in the Amazon, the integrated approach

Though the virgin rain forest contains hundreds of hardwood species, contrary to popular belief there are few good trees—fully grown, free from defects or pests, and, in short, usable for something.

Jari's foresters first combed the virgin jungle for any good, usable trees. What is today Jari—Monte Dourado, the industrial site at Munguba, the plantation villages, even the railroad—has been built to a large extent with trees pulled out of the virgin forest. Massaranduba logs by the thousands became the pilings for the pulp mill foundations, others were sawn into railroad ties. Other species went to the Monte Dourado sawmill, which for years has produced sawn timber plus furniture for all the housing construction at Jari.

And the same procedure is followed today when clearing virgin jungle. There is only a slight difference: with the commercial sawmill starting soon at Munguba, some of the selected hardwood logs may end up as marketable timber in other parts of Brazil or abroad, not just as cabinets and tables in Jari households.

At the very beginning, heavy machinery was used to clear the jungle—after removal of the good trees. This method was quickly abandoned: it disturbed and compacted the thin topsoil, and it was expensive. The method used to date has been to fell the forest with chain saws and burn it *in situ*. This method is, however, now changing slightly. With the pulp mill in operation—with its two wood-fired power boilers—all remaining transportable wood will be taken out and shipped to Munguba and there chipped for boiler fuel. The residue from clearing about 4,000 hectares of virgin forest will be needed annually to feed these boilers, which in turn provide the electric power for the mills and community.

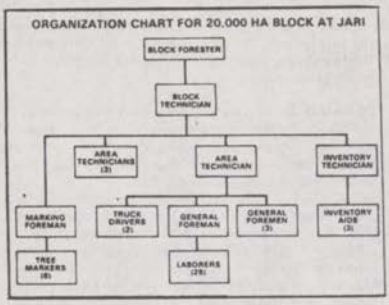
The tops and branches, however, will be left in the forest and burned. "Burning releases nutrients to the soil," explains Charles Briscoe, head of forestry management, "and the ash also acts as an herbicide to keep down the undergrowth." Briscoe says burning—even just the tops and branches—is worth roughly $170/ha as fertilizer and herbicide equivalent.

Burning is done in the "dry season," which runs roughly from July to December, and which means only that it may not rain for up to 10 days at a given spot. Timing has to be good, says Briscoe: "Usually we wait for at least three days after the last rain, and then we'll get a good, clean burn."

The main planting season starts in January; a site is planted as soon as possible after the first good rain following burning. Planting is done by hand: a 3.5 by 3.5 m spacing (816 trees/ha) is used for gmelina, while pine planting is denser at 4 by 2.5 m (1,111 trees/ha).

Jari has one central nursery producing all the seedlings. Gmelina seedlings are grown in beds 2-3 months; the tops are pruned back to 40 cm high several days before removal. After removal the roots are pruned and the stem is pruned to 2-4 cm; after which the stumps are put in a burlap bag filled with moist sawdust. They must be planted within 72 hours.

Pine seedlings are grown about six months in a



10 YEARS OF TREE PLANTING AT JARI

Planting data 1968-1978; Hectares

Year	Area of Gmelina	Area of pine	Fire breaks	Experimental	Total area
1968		—		113	113
1969	403	—		3	406
1970	5,488	62			5,551
1971	7,100	49		13	7,163
1972	9,954	—		59	10,014
1973	6,289	4,978	681	92	12,040
1974	7,918	4,545	152	110	12,724
1975	7,844	5,452	206	239	13,740
1976	6,060	2,828	27	120	9,034
1977	5,600	2,922	—	32	8,553
1978	4,341	5,130	—	—	9,471
Totals	**61,000**	**25,966**	**1,066**	**779**	**88,810**

container and trimmed back to 17 cm before planting.

At the end of the rainy season—usually in June or July—the young plantations must be cleaned of undergrowth. This is a manual job, done by crews of workers with machetes, and this must be repeated generally once each year until the trees are tall enough to cut off the undergrowth by themselves. For gmelina stands, cleaning must be done for about three years, for pine usually five years.

One way of clearing the young pine plantations is to let cattle graze in them. This concept of multiple land use has been discussed many times, but Jari may be the first forestry operation to try it on a serious, if still experimental and rather limited, scale. The pine has to be over a year old, and special grass is seeded in the stands. The cattle seem to enjoy the meal, and it saves a lot of annual clearing with machetes. The only problem is that the stands in question have to be enclosed.

About 75% of the plantation area is managed for pulpwood, the rest of solid wood. For gmelina this means clear-cutting for pulpwood at 6-7 years, or at 10 years for sawlogs. The average gmelina tree at 6-7 years is about 22 m tall; at 10 years it is close to 30 m high.

Like eucalyptus, gmelina re-grows from the stump. Charles Briscoe thinks that three re-grows will become the practice here.

Thinning is done 3, 5 (and 7) years in gmelina stands. The first thinning yields only pulpwood, the second gives some solid wood, while the third (in those stands on a 10-year cycle) gives mostly solid wood. In the best stands, both pine and gmelina are also pruned to increase production of clear wood. The first pruning is to 3 m clear length when top height reaches 6 m, the second is to 5.5 m when top height reaches 11 m.

Pine will be thinned at 6, 9 and 12 years, with the first two thinnings yielding pulpwood, the last thinning yielding some solid wood and the clear cut for solid wood at 16 years.

The exact growth rate was not disclosed by Jari foresters, but it is believed to be in the range of 25-35 solid m^3/ha/yr for gmelina and slightly lower for pine.

Harvesting gets underway with a railroad

Harvesting is just getting underway at Jari on a major scale. Techniques will vary considerably from site to site, say the foresters, depending on terrain and nature of operation—thinning or clear-cutting. Initially, most of the felling and delimbing will be manual with chain saws. Eventually mechanized equipment will be introduced, with the timing dependent to some extent on the availability of skilled labor, now being trained at Jari.

A key to the harvesting program in Jari's railroad, which runs twin track from Munguba to Monte Dourado and then splits into two single track branches extending about 75 km into the plantation blocks.

Why a railroad with its enormous capital investment? The answer is the long-term future of Jari, and the volumes of wood which are going to be processed at Munguba. With the present Munguba facilities running at capacity, an estimated 1.5-1.8 million m^3 of wood must be transported to the mills annually. When Jari adds more forest products operations—and this is quite likely within the next five years—the transport volume could easily double. Handling these volumes with road transport would pose two problems: excessive loading of the main roads with heavy trucks and consequent high road maintenance; and, of course, high fuel consumption. (Jari is far from refineries.) The diesel-powered railroad not only solves the problems for the immediate future, but, even more important, the railroad is a key to realizing Jari's real potential as a major forest products complex.

Complete village for each plantation block

Forestry operations are broken down into five 20,000 ha blocks, with a professional forester (university degree) responsible for each. He in turn has six technically trained assistants, mainly serving as foremen.

The 25-man labor contingent shown on the organization chart for the plantation blocks, is, in fact, the only permanently assigned labor force. Temporary labor requirements, particularly while establishing plantations, are obviously much higher. With the high degree of manual work, some 2-3,000 forestry workers are needed during peak seasons—during clearing/burning, planting and cleaning of undergrowth in the young stands. Up until now most of this labor force has consisted of contract workers supplied to Jari through nine labor contractors. One of these, Sasi, is a Jari-owned operation; the other eight are independent.

But contract forest labor is not part of Jari's long-term objective. The aim is to establish a permanent, self-sustaining community. "To develop our program," explains Clayton Posey, "we must have

trainable people living here. As we progress, we need a higher percentage of skilled people, and to get them from regions in Brazil where they exist today would be prohibitive. Thus we decided quite early to establish plantation villages . . . we call them Silva Villas."

The goal is straightforward: "When people are fixed on the land in permanent communities with their families," Posey continues, "they are happier and work better, and we can afford to invest more in training them for skilled jobs." The young children growing up today in the Jari Silva Villas will provide the skilled labor force for future operations, which will certainly be more mechanized and sophisticated.

The first Silva Villa was completed several years ago on the Plan Alto (altitude 200 meters) near the airport, about 10 km from Monte Dourado. The second village, at São Miguel, was finished during 1978. Three more villages are planned, and should all be completed within the next 3-4 years, giving one village for each administrative forestry block.

Each Silva Villa is designed as a permanent rural community for 750 families, complete with schools, medical clinics and stores. A full-time, professional social worker is assigned to each village to aid in developing educational programs and other aspects of community life. Village schools provide education up to the eighth school year for children, and they are used extensively for adult education—mainly literacy—in the evenings. The clinics handle routine medical services; more sophisticated medical care, such as major surgery, is done at the Monte Dourado hospital.

It is estimated that it costs roughly $1,000 per year for each person on the payroll to subsidize, or create, this social infrastructure, including the initial capital investment and continued staffing of the various social services.

Today, barely 10 years after the first "explorers" arrived at Jari, about 20% of the total forestry labor force is permanently settled in the two Silva Villas. The immediate target is to settle 50% within five years. "Then we'll see what happens," says Posey, adding that ultimately—in 20-30 years—the entire labor force should be permanently part of Jari.

The job is a major enterprise. Most of the laborers brought in by the contractors have never had a steady job, nor seen a school or a doctor. They come mainly from the northeast of Brazil, the poorest part of the country, virtually devoid of major industry and with chronic high unemployment.

The basic labor contract is for a three-month-minimum engagement, with an option to renew. The contract workers are without families for the most part and most return home after a contract period. But more than 70% "recycle" and return to Jari for another contract. As housing becomes available in the Silva Villas, workers are offered permanent residence with their families. Often, these are workers who have "recycled" several times, and who are regarded as trainable.

If all goes according to plan—and there is little reason to doubt that it will—the Jari forestry community will total some 3,700 families by about 1985 in five villages. In other words, somewhere between 15 and 20,000 people.

The tale of a well-traveled pulp mill

In the early 1950s, Daniel Ludwig had an idea for a floating pulp mill. The design was developed by the Kure shipyard in Japan, owned at that time by Daniel Ludwig, and called for a 500-ton/day processing plant on a floating platform sized to pass through the Panama Canal. The destination was Honduras. The mill's recovery system was to be permanently shore-based, but the actual mill platform would float offshore.

This project was eventually shelved in 1957. But the work was not entirely unfruitful. Some of the men who worked on the concept—which centered on efficient use of forest resources far from world markets—ended up designing the first woodchip carriers.

The idea was reactivated in February 1975. By this time Jari's forestry work was well advanced; trees were growing quickly and the first plantings would reach cutting age in several years. Daniel Ludwig wanted to get a pulp mill operating as quickly as possible at Jari. The remoteness of the Jari site and the lack of infrastructure made the prospect of conventional construction rather unattractive in terms of time, logistics, and skilled manpower.

An initial feasibility study—for a 750-ton/day mill—was finished by May 1975. This time, though, the plant would be permanently grounded; it would float only from its point of construction to final destination.

In June 1975 the first meetings were held with Ishikawajima-Harima Heavy Industries (now owner of the Kure shipyard), National Bulk Carriers (Daniel Ludwig's flagship company) and Crown Zellerbach, which at the time was interested in participating in the project. In six months the three created a design sufficient for the contract specifications. CZ later dropped out, and the Vancouver-based consulting firm H. A. Simons Ltd. joined the team.

The contract was signed on 18 February 1976 with IHI. The price: ¥60,000 million (about $200 million at the time) including spares.

The keel of the first platform was laid on 25 November 1976 and the launching took place in September 1977. The official delivery of both platforms—essentially a fully completed plant—took place on 31 January 1978, less than two years after contract signing. Undoubtedly a record for such a facility.

Two years saved in construction schedule

The mill was delivered "ready to go," both as a production plant and as two very seaworthy vessels. All the pipes, valves, and instruments were not only already in place, but were pre-tested as well. Jari's pulp mill manager, Ney Montiera da Silva, was quick to point out, several months before start-up, that the fully completed control rooms greatly aided operator training at Munguba. "There is no need to train our people on simulated panels; we have the actual control system hooked up. We show a man a controller, then he can go into the plant and see the valve working."

The platforms were built as ships. No concessions were made, even though they were built for only one

voyage. IHI had to design the platforms to navigate at sea, and for 25,000 kilometers . . . no mean feat! Some 4,000 tons of steel re-inforcing was welded in place to secure the machinery. All the stresses were calculated for rough sea conditions (15° roll and 5° pitch). Anyone contemplating putting, say, a 50-meter-high recovery boiler or a 200-ton lime kiln, to say nothing of a four-drinier pulp dryer section, through this kind of motion would probably shudder at the thought. IHI, with its shipbuilding experience, remained undaunted. The recovery boiler alone was secured with some 2,000 tons of reinforcing steel. All the instruments were carefully wrapped in humidity-proof plastic covers with a bag of dessicant in each. The platforms were each built with three watertight hull compartments, designed so that even with holes in two of the sections the platforms would still float, (After all, one does want $200 million of machinery to stay afloat!) And, as a final security measure, each platform carried two giant anchors and plenty of anchor cable to be used in case of a break in the towline near shore.

The construction technique itself is revolutionary for this industry, though admittedly not for the shipbuilding industry. Sub-contractors and IHI's various subsidiaries pre-assembled the major process elements—boilers, lime kiln, fourdrinier, air-float dryer, bleach towers, power turbine—and simply dropped them into place. There was little actual assembly work carried out on the platforms. Hence the record construction time.

Actually, the job could have been done even faster. IHI reportedly worked only one shift. Had Jari's shore-based facilities been ready at Munguba, delivery could have been made in late 1977, according to Jari executives.

Carefully containerized and packed in every available space on the platforms were 4,000 tons of spare parts. And next to the baling line, neatly stowed, were 30 pulp bales — ready to test out the bale presses and conveyors.

The result, sitting comfortably at Munguba today, represents a saving of about two years in construction time, according to Stuart Lang, Jari's vice president for production. Lang, an American but a 15-year veteran of the Brazilian paper industry, suggests that one has only to multiply these two years saved by the cash flow from a 260,000-ton/yr bleached pulp mill to get some idea of how much this gamble was worth.

One other advantage, admittedly local, is that the whole plant, including spare parts, arrived under one import license and one set of documents. Anyone who has faced shipping and clearing through customs hundreds, if not thousands, of machinery parts for a mill in some remote location will probably understand just what is meant by "one set of documents."

The best weather forecast in history

It is one thing to build a pulp mill in a shipyard; it is quite another to tow it more than half-way around the earth. That the job was accomplished so successfully—on time and with no damage whatsoever to the platforms or machinery—is a fair commentary on the whole project. "They arrived in perfect shape," says Lang, "and we didn't have a single insurance claim." Almost unbelievable, but true.

The platforms are not small. Each measures about 230 m long by 45 meters wide and weighs 30,000 tons, the equivalent in size of a 150,000-DWT tanker. Larger objects have been towed, but this certainly ranks as the longest (25,000 kilometers) big towing job.

The planning of the sea voyage was critical. National Bulk Carriers and IHI collected historical weather data from all over the world and computer-analyzed it to select the most favorable route for weather conditions. The shortest route via the Panama Canal had been ruled out during the initial design stages; restricting the platform width to Panama Canal limits (33 m) would have meant three or possibly four platforms to house the pulp mill. The route was finally selected (see map) together with a time schedule to coincide with best possible seasonal weather conditions. An example: the convoy was planned to pass the Cape of Good Hope during a slim two-week period in March when the chances were best that the heavy prevailing westerly winds would be absent. They were.

This may go down as history's best weather prediction: in over 80 days on some of the most treacherous seas, no major storms were encountered.

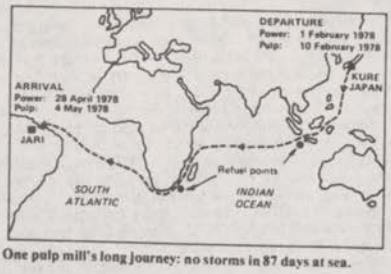
This is substantiated by precise measurements made during the voyage. In cooperation with IHI, Yokahama University installed a complete instrument package (valued at over $1 million) on each platform to monitor continuously everything from stress and movement of individual machine elements to wind force, wave height and platform motion. The official report indicates a maximum roll of 8.2° and a 2.2° maximum pitch during the voyage. The entire instrument container with all its recordings has gone back to Japan; the valuable data will certainly be used for the design of future platform-mounted plants.

The towing job went to the Dutch firm Smits on a competitive bid. There are, in fact, only a handful of firms in the world capable of handling such a tow. Smits assigned its 26,000-horsepower tug, *New York*, to pull the pulp platform, and a 20,000-hp tug for the power platform. The tow was accomplished without any major problems at an average speed of about 6.5 knots.

Towering over the forest, the power platform appeared around the last bend in the Rio Jari on 28 April to the enthusiastic cheers of the construction workers at Munguba. The pulp platform arrived six days later, similarly unmarked by a voyage more than halfway around the globe.

Preparing a permanent home for a traveling mill

Just as impressive as the platforms is the site preparation work at Munguba, not only the construction of conventional shore-based auxiliary systems—wood handling, chemicals, fresh water and effluent treatment units—but also the careful preparation of the final rest-



One pulp mill's long journey: no storms in 87 days at sea.

ing place for the platforms.

"This is one of the world's biggest wood pile-driving jobs ever," says Frank Joyce, senior vice president of Universe Tankships Delaware (a Ludwig group company).

The alluvial soil and the high water table made a piling job necessary to support the weight of the platforms with absolute stability. The New York consulting firm of Madigan & Praeger did a computer study of the load distribution of the platforms, and together with IHI designed a precise grid pattern of pilings—closely spaced at high load points, further apart at lighter points. Over a surface area of some 21,000 m² the cut-off height specifications for the 3,900 individual piles was ±6 mm.

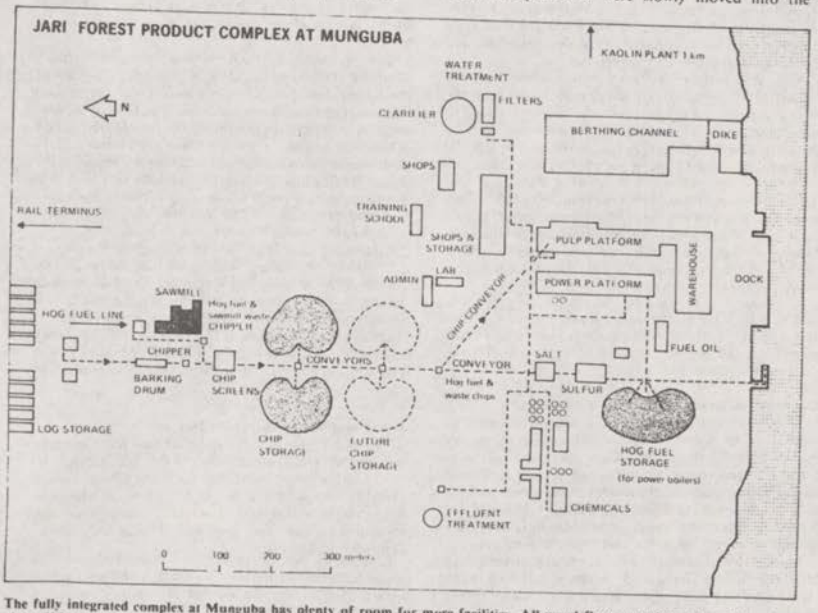
The Jari forests provided the pilings: an Amazon hardwood species called massaranduba (*M. huberi Standl*), extremely hard and resistant to moisture almost indefinitely. About 2,000 hectares of jungle were scoured to find some 10,000 massaranduba trees; there are usually only half a dozen or so per hectare.

Most of the auxiliary sub-systems also arrived at Munguba in complete, pre-assembled units. Plants for sulfuric acid, chlor-alkali and chlorine, all manufactured by Hooker Chemical and shipped from Houston, Texas, were unloaded across the Munguba dock and dragged to their prepared concrete foundations with the aid of another bit of Jari ingenuity. A huge sled was built of massaranduba—this alone weighed 45 tons—and the "modules," as Tom Connor calls them, were lifted from the ship onto the sled, then dragged by big Caterpillar tractors to their locations.

"Just put them right here, please"

The last part of the platforms' long journey was a few hundred meters from river bank to final grounding—a berthing job with the 30,000-ton vessels which ended happily with millimeter precision.

First, the platforms were slowly moved into the



The fully integrated complex at Munguba has plenty of room for more facilities. All wood flows, starting at the rail terminus about 500 m to left of this drawing, are parallel into the sawmill, the pulp mill and the power generation (hog fuel) line. Electricity generation on the power platform (55 MW) supplies all facilities at Munguba plus the kaolin plant and Monte Dourado.

berthing channel, pushed from behind by tugs and pulled from the land side by cables. Three people manned each operating station, Tom Connor recounts, as commands were translated between Japanese, English and Portuguese. With the platforms floating in the channel and well secured, earthmovers pushed thousands of cubic meters of fill into place to form the dike to cut off the channel from the river.

Jari's own dredge was then used as a pump to fill up the berthing channel and flood the area surrounding the pilings, retained by a temporary earth dike. It took four days of pumping with the 20-inch dredge to raise the water level—and the platforms.

In place only a few centimeters above the pilings, the platforms were then ballasted—water was let into the hulls, just like any other vessel—to settle them gently onto the pilings.

Tom Connor was asked how precisely the platforms had been berthed. He mopped his brow—he was outside in the noonday sun—and replied: "When they were berthed, we got a crane and dropped the first bridge (joining the platforms) into place. All the bolts lined up with holes."

Pulping trials and operating know-how from Finland

In 1976, as the pulp mill design was being finalized in Japan, some 12,000 tons of gmelina logs were shipped from Munguba to Finland for full pulping trials. Far from the equator, at the bleached kraft mill of Oulu Oy on the Gulf of Bothnia, about 1,500 tons of fully bleached pulp were produced. Trial lots were then sold to various European paper companies.

According to Price & Pierce, which is handling the marketing of *Jaripulp* worldwide, the results of the trials "exceeded all expectations. *Jaripulp* was found to contribute the bulk and opacity of eucalyptus pulp in the early stages of beating, while in the later stages the strength characteristics were comparable with birch."

Towards the end of 1977 another full-scale trial (1,600 tons) was run at the Kaukas mill in Finland. This time the objective was not only to make pulp, but to train some of Jari's pulp mill operators and technicians. Twenty-six Jari production men spent the winter of 1977-78 in Finland, most of them enjoying a northern winter for the first time.

A technical and operating assistance contract was signed with Kaukas and Kymi Kymmene of Finland, and a team of about 40 Finnish engineers and technicians arrived at Jari late last year to supervise the start-up and initial operations.

Conventional processing, compactly arranged

"For your next pulp mill, find a good shipyard to build it." That's one visitor's initial reaction. Contrary to expectations, the inside of the Jari pulp mill platforms is as generously laid out as any modern land-built mill. The precision and cleanliness of the layout and the actual facilities are faultless. Undoubtedly, much of this is because everything was pre-assembled in factory conditions in Japan, and the construction was done to "marine" specifications, with a certain attention to detail one finds in ships. And, certainly, IHI took many extra pains with this project since it is a "model" plant which will be studied very closely for years.

The processing itself is fairly conventional, but at the same time up-to-date in all respects. Cooking is done in a single line of eight batch digesters (207 m^3 each), with a total nominal capacity of 850 air-dry m tons/day. Chip feeding is automated, via a conveyor to the digester house and chutes into the digesters.

Initially Jari will produce only gmelina pulp, but eventually it will produce bleached pine pulp as well. The current target for pine pulp is 1983, though some quantities may be made before then. As the mill is single-line, the two pulps will be run alternately.

Based on trials in Finland, cooking for gmelina will be to a Kappa No. of 20-22. Similarly, the tests indicated a bleached yield of about 50%.

Volatile gases from the digesters are bled off and collected in a spherical collector/condensor (which looks much like a radar dome used for navigation) and burned in the lime kiln. After the blow tank, the pulp passes two stages of knotters, and then through three Impco brown stock washers (12 m long × 4 m diameter). Two high-density storage tanks (1,200 m^3 each) are provided for brown stock due to the need for switching between pulp grades (pine and gmelina).

Following screening and three-stage cleaning, the pulp is bleached in a conventional C/D-E-D-E-D system, nominally rated at 750 tons/day. The end of this line is a single 1,200 m^3 high-density tower, which then feeds a four-stage screening/cleaning line terminated by another 1,200 m^3 high-density tank ahead of the pulp dryer and designed to reach a brightness of 90°GE.

The fourdrinier pulp drying machine (Black Clawson/IHI) trims at 7.2 m, and is said to be one of the widest ever built. The reason for the exceptional width—as one may guess—was the need to keep the unit short to fit it onto the platform. The fourdrinier section is followed by three presses, a sheet cooler and a Flakt air-borne dryer. After the cutter layboy at the end of the dryer, the finishing splits into two lines which feed twin Washington bale presses, automated folding and tying units and bale stackers. The twin lines then merge ahead of an 8-bale unitizer.

Connected directly to the end of the pulp platform is a 12,000-m^3 warehouse which can hold about 30,000 tons of finished pulp. The warehouse itself opens onto the apron of the loading dock on the Rio Jari, and, as is obvious, all shipping from Munguba is via the river. Deapsea vessels up to about 11-m draught (30,000-DWT class) can dock at Munguba. (Though Munguba is at least 400 km by river from the ocean, there is a 1.5-m tide.)

Wood supplies the energy for Jari

The power platform of the pulp mill plays a major role in the overall integration of the Jari project. Its power rating far exceeds the needs of the pulp mill itself: it will provide electrical power for the whole Munguba infrastructure—commercial sawmill, kaolin plant and community—plus for the Jari capital of Monte Dourado, 17 km away.

To achieve this, there are two large high-pressure power boilers (140 tons/hr of steam at 60 kp), which drive a 55-MW Toshiba double extraction-condensing turbine and generator set.

Though the generating capacity is large by pulp mill standards, what is unique is that the two power boilers are designed to operate mainly with wood. All the conventional wood wastes from the sawmill and pulp line *plus* all the noncommercial wood generated in the clearing of virgin forest for future plantings will power the Jari complex. Nothing is to be wasted. (The boilers can burn oil also, and will be started with this fuel, then gradually changed to all wood waste.)

The two power boilers should consume about 20-30,000 dry tons of local wood fuel per month, which translates into roughly 3-4,000 hectares per year of clearings from virgin forests. So, as one Jari forester put it: "With Phase 2 of our forestry program we can power these boilers for about 25 years."

Jari may thus be cited as one of the first examples of direct wood-to-energy applications on a major industrial scale.

In addition to the power boilers and generator, the power platform houses the entire recovery system, including a recausticizing plant.

The evaporation system is a Swenson 6-effect non-contact unit designed to reach 63% solids in the liquor for firing. In addition—though tests in Finland indicated they would not be necessary—there are three black-liquor concentrators. The recovery boiler—a Babcock/Hitachi unit—is rated at 1,360 tons/day of dry solids, generating 207 tons/hr of steam at 60 kp nominal pressure. There were no compromises with the recovery broiler: it is equipped with dust collectors and electrostatic precipitators, just as any land-built facility today.

Though the Rio Jari appears rather brown, Ney Montiera da Silva says its water is of rather high quality and relatively low turbidity. Fresh water preparation is thus rather simple: sedimentation and passage through sand filters. Effluent treatment is straightforward in a single stage: clarification, with the sludge dewatered for firing the power boilers.

Jari: a big exercise in self-sufficiency

Luis Oliviera, an outgoing, 40-year-old native of Sao Paulo, carries the rather unassuming title of associate executive director of Jari. The job, he says, covers administration, logistics and maintenance. Hidden behind that common-place description is a task which calls for the combined qualities of a field marshall and a civil governor.

Today there are slightly over 10,000 people on the payroll at Jari (including several thousand forestry laborers hired through contractors). Add on families, which tend to be large, and the immediate Jari community is 17-18,000 people. It's Luis Oliviera's job, from his headquarters in Monte Dourado, to keep them supplied with everything from fresh eggs to rice harvesters; to make sure the schools and hospitals function well; to assure the supply of bathtubs for the new houses continually being constructed at Monte Dourado and at other locations on the project.

He is not alone in this effort. The administration of the Jari project keeps some 1,100 people busy at Monte Dourado alone. This includes the staffing of all social and support functions—schools, clinics, restaurants, clubs, supermarket and stores, and general purchasing. Another 300 people work in logistics which includes managing a fleet of some 38 river vessels used to link Jari with the outside world, and 800 more handle maintenance of everything from construction and forestry machinery to automobiles to the DC-3 aircraft which make several daily flights to and from Belem bringing passengers, mail and freight.

"We buy around 85,000 separate items today," says Luis Oliviera. "It will be about 100,000 items when the pulp mill starts operating. Everything from airplanes to sewing needles." Jari, in fact, has just bought another plane—a 45-seat Fokker F-27—to upgrade its passenger service to Monte Dourado.

Just what does it take to keep the Jari community well fed and well stocked? "Each month we bring in about 10,000 cases of beer, 1,000 head of live cattle and 75,000 chickens, 70 tons of frozen fish . . ." Oliviera ticks off the figures. The list goes on with sugar, canned vegetables, beans, fresh eggs, milk, fruits, butter, down to pots and pans.

Prices of all consumer goods—food to refrigerators—are strictly controlled at Jari on a cost-plus basis. "We cover costs, but make no profit. It's a support service," says Oliviera.

The main purchasing office is in Belem, where some 60 people organize and administrate purchasing and shipment by river vessel or plane into Jari. The shipping fleet includes two passenger/cargo ferries, one of which can carry some 300 people on the 30-hour trip to Monte Dourado (about 500 km by river).

"What we can't get in Belem," continues Oliviera, "we get in Sao Paulo or Rio . . . most is then trucked to Belem and put onto barges there. The cattle, about 250 head per week, come up from Goias State, to Belem, where we put them on a special barge."

But the goal of Jari is self-sufficiency. "Today we supply about 20% of the meat we consume from our own cattle operations. We raise water-buffalo on an island in the Amazon—the herd is about 4,500 head today—and we have 6,500 head of cattle." Cattle raising is centered at Saracura on the Amazon and employs about 85 people. Like almost everything else at Jari, cattle breeding is the object of intense experimentation and will be expanded. The cattle being bred now are a cross with local strains and cattle from India.

Virtually all the meat consumed on the Jari Project is processed at the Monte Dourado slaughterhouse, a tidy operation which handles cattle and pigs at the rate of 50 per day.

In the back of the slaughterhouse is another of Jari's self-sufficiency experiments: a pig-breeding farm. Clean, concrete-surfaced yards and neat stalls house several hundred pigs today and experience has shown better survival rates than with cattle. Plans are to increase the scale of this operation and make it a major

meat supplier for Jari.

Down near São Miguel, 25 kilometers from Monte Dourado, vegetable farming and poultry raising are getting into high gear. After several years of only limited success, six Japanese-Brazilian specialists were brought in last year from the south of the country. (In Brazil, vegetables and poultry are a virtual monopoly of Japanese immigrants in the south of the country.)

"In a few years we'll have a million chickens in our own chicken farm," says Luis Oliviera, "enough to supply all our needs. And in five years we expect that vegetables and fruit will be substantially self-produced here at Jari."

Rice, the main staple food, is already completely supplied by Jari's own large rice farming operations around São Raimundo.

Monte Dourado, future Amazon metropolis

Rome was not built in a day, nor was Monte Dourado, headquarters and capital city of the Jari project. But Monte Dourado has been built quickly. Ten years ago there was nothing here. Today Monte Dourado's official permanent population is around 8,000, and growing every day.

Even if it is not yet the biggest town north of the Amazon River, Monte Dourado is already the most modern and can boast the highest standard of living.

Here are a few facets of Monte Dourado today:

- The school has some 1,800 students—about 1,000 children and some 800 adults who study at night. The school operates about 18 hours per day.
- The modern 99-bed clinic is permanently staffed by 18 doctors, and is equipped to handle major surgery.
- Housing is in three categories: single-unit houses for staff with families; smaller single-unit houses for skilled tradesmen and office workers, and semi-detached, single-storey four-unit buildings for workers. In addition, there are several apartment buildings for unmarried staff. Construction is mainly concrete.
- There are private cars, but no registration plates: Jari is private property.
- The supermarket, which opened in early 1978, sells everything from food to washing machines.
- Monte Dourado is not an outpost of expatriate Americans or Europeans. At last count, the total non-Brazilian population was around 150, including some 40 Finnish technicians (with families) working on the pulp mill start-up.

Signs of affluence across the river

Jari began to attract "outsiders." People from all over the eastern Amazon basin came here on the rivers and started settling across the Rio Jari from Monte Dourado and Munguba, drawn by the lure of money being earned by thousands at Jari. Today, the two river settlements qualify as towns in their own right: the one across from Monte Dourado has an estimated population of some 6,000 people — it has been officially recognized by the territorial government of Amapá and has its own mayor and police force. About 2,000 live across from Munguba.

They are both typical one-street river settlements, built entirely on rough wooden pilings on the edge of the river, with two rows of houses separated by a wooden-plank main street. And, by river-town standards, they are prosperous: across from Monte Dourado the town stretches almost two kilometers along the river, complete with two-storey dwellings, a department store, food markets, and large motor launches tied up alongside unloading goods. A fleet of some 50 shiny aluminum boats with outboard motors provides around-the-clock taxi service across the river. (The taxi fare is controlled.)

And what are all these people doing here? The economic base of the towns is selling goods to people across the river—from pots and pans to clothes to fresh fruit, whatever may be momentarily in short supply on the project. And many of the project's contract workers settle their families across the river while waiting for permanent housing in Jari.

In any event the two river towns provide rather concrete proof of the economic meaning of Jari: In addition to the roughly 17,000 "official" Jari residents, the economic multiplier supports another 8,000 across the river. It's not hard to believe Jari veterans when they say that in 10 years there may be well over 50,000 people living in the area, supported directly or indirectly by Jari's industrial and agricultural operations.

Kaolin business at Jari

The Felipe kaolin deposit was discovered on the eastern bank of the Rio Jari just across from Munguba (see map) shortly after forestry operations began. In fact kaolin was the first major export product and cash earner for Jari. Clay exports started about two years ago—to Europe, and Japan principally—and are expected to continue growing.

The resources here are vast and reportedly of exceptional purity. The current processing capacity of 220,000 m tons/yr will be doubled within about a year, but even this volume is far from the ultimate potential.

The presence of this kaolin opens the possibility for making paper at Jari using the clay as filler or for coating. Kaolin is certain to figure in Jari's long-term paper production plans, in addition to remaining a steady export product.

According to geologists, the Felipe deposit is sedimentary and belongs to the "Barreiras Series of the pliocene age." In practical terms, the bulk of Jari's kaolin lies between 18 and 55 meters below the surface, and the mineral is very fine, porous and partially hardened. It is mined by open strip operations.

The kaolin operations are organized under a separate company, Caulim da Amazonia Ltda.—Cadim for short—which employs a total of about 200 people at the mine and in the processing plant.

After extraction, the kaolin is first dispersed in water and separated from sandy grit in clarifiers. The cleaned slurry is then pumped via a 6-km-long pipeline under the Rio Jari to the main processing plant at Munguba—only one kilometer upriver from the pulp mill.

For the technician, *Amazon 88's* key properties are very fine particle size, high brightness and high purity. Initially its main application has been as a coating clay.

Growing rice on the Amazon

Along the banks of the Amazon the land is flat, there is no lack of water and the sun shines all year long. These three conditions have been successfully transformed into a major rice producing operation. It not only provides a basic staple food to the rapidly growing Jari community, but is a major cash commodity on both domestic and export markets.

After almost 10 years of work, led by experts with experience in Southeast Asia, there are 5,000 hectares under cultivation today. Year-round sunshine and abundant water make two crops per year possible. With fully mechanized seeding and harvesting, aerial fertilization and crop spraying, and use of advanced hi-bred rice strains, the yields have been exceptionally high—said to be among the highest in the world at 10-12 tons/ha/yr.

The venture is so successful that it is being rapidly expanded: plans call for increasing operations to 15,000 hectares in five years.

A rice mill is now being built at the operation center at São Raimundo. It will start in the spring and permit Jari to sell milled rice. Until now the raw rice—called paddy rice—has had to be shipped to Belem for milling. The new rice mill will double cash income from the operations since milled rice brings roughly twice the price of paddy rice.

For those not in the business, the rice growing sequence at Jari is roughly: plant on dry land, fertilize, flood the land and keep it under water until the plants grow, drain the land when the plants mature, let the rice ripen and harvest the dried fields.

It isn't all that simple, however. First you need hundreds of kilometers of canals and dikes to encircle and criss-cross the fields.

Jari built its own floating canal excavators by mounting a conventional hydraulic back-hoe on a fabricated pontoon structure. Starting from the river or from an existing canal, they dig ahead, advancing on the canal they have just dug. They are far more efficient than land-type excavators as they are independent of soil conditions. They operate around the clock; fuel and crews are brought out to them.

Jari already has sold major quantities of rice on export markets. Currently, with shortages in Brazil due to weather problems affecting other rice growing areas of the country, Jari is selling most of its output to southern Brazil. But rice will be a big export product from Jari in the long-term. Even after the expansion to 15,000 hectares—which translates into 160,000 tons/yr of rice—there is plenty of good rice land for further expansion, including nearly 20,000 hectares already diked.

One last Jari-ism: Rather than build a big warehouse to store the milled rice, Jari plans to bring in an old bulk carrier and anchor it in the Amazon. Rice will be brought out and stored in the ship, then other ships will tie up to the warehouse ship to load rice for transport. Perhaps even the rice business benefits from having a parent company called National Bulk Carriers.

Myths of the Amazon

Amazon: the world's longest and largest river, the largest continuous rain forest, an enormous, virtually unsettled and barely charted region. The word Amazon conjures up images: impenetrable jungles, snakes, alligators unbearable heat, perpetual rain . . . a vast region uninhabitable for man.

The Amazon, river and region, may indeed be many things, but most of all—so learns a visitor from the Northern Hemisphere in June—it is a misconception shared equally by all who have never been there, by Brazilians from the south of the country, as well as by Europeans and North Americans.

"I had no intention of coming to the Amazon," says Clayton Posey, Jari's vice president forestry, and a native of Oklahoma. "I had the same idea as everyone else of living here—swarming with alligators!"

"It's the same with anyone from the south of Brazil," echoes Ney Montiera da Silva, the Jari pulp mill manager who comes from Sao Paulo. "Everyone coming up here from the south is quite surprised."

Some interesting facts: In 10 years, the highest temperature recorded on the Jari property—which lies virtually on the Equator—has been 37°C. The lowest temperature was 17°C.

Yes, there is plenty of rain, about 2,500 mm per year. But, believe it or not, there is a dry season. From July to December it might not rain for up to several days at a given place. It is during this season that burning is done to clear areas for planting. The foresters explain that evaporation exceeds precipitation for five months each year.

Most of the Jari land is not flat. There are elevations as high as 600 m in the north, and in general the land would be called hilly in most places. The town of Monte Dourado is on a bluff some 70 meters above the river. The airport is 202 m above sea level.

Destruction or development? But what about the devastation of the Amazon? The destruction of the virgin tropical forest and its delicate soil? The depletion of the world's oxygen supply resulting from reducing the size of the virgin rain forest?

Legitimate concern on these issues has been expressed with increasing frequency over the past 10 years, in scientific conferences as well as in popular mass-circulation magazines and television commentary. Most recently, allegations along these lines have been raised in the media in connection with the Jari Project itself. The popular arguments—which, as is often the case, are inaccurately based—generally run along two lines:

- The Amazon soil is delicate and poor in quality. If one tampers with it (i.e. agricultural/forestry operations), it depletes rapidly; in a few years one is out of business, and the resulting poorer soil is eroded and washed out to sea by the heavy rains. Result: a potential desert area.
- As most of the world's oxygen comes from the tropical rain forests, anyone who clears these forests for whatever purpose is by consequence guilty of robbing humanity of its oxygen supply.

There is a third concern, discussed mostly in scientific and industry circles: the problems of forest monocultures—what happens when a heterogenous mixture of plant life is replaced with a homogenous growth of a single species.

The general description of the soil in the Amazon basin is alluvial: a well-washed, rather sandy soil. The topsoil layer is relatively thin, and since the soil is sandy, it will tend to lose nutrients by leaching. However, the soil itself is good. If well-managed, the soil improves in nutrient content. This has been demonstrated at Jari.

"Take our tree nursery," says Johan Zweede, general manager of forestry operations, and a resident here since 1971. "We have planted on that soil for eight years, and it is better now than when we started."

Charles Briscoe explains it scientifically: "When we first opened up the jungle, we got a big influx of native legumes due to the increase in sunlight" (the forest floor had previously been shielded by the tree cover) "and these have improved the soil by building a thicker organic 'cap.'

"Under a young stand of gmelina or pine up to about 3 years growth," continues Briscoe, "there is a heavier layer of organic material—or 'cap'—than in the natural forest. This cap holds the water—keeps it from washing through the soil. The retained water, in turn, does two things: it supports the development of micro-organisms, which keep the soil loose; and it increases the amount of available calcium and magnesium. The pH of the soil thus goes up, and the amount of aluminum and iron in free form goes down."

The result, a richer and more stable soil. This visitor saw no signs of erosion in the forests during a six-hour inspection including aerial overflight and driving 50-60 kilometers through a variety of gmelina and pine stands. And the trees are doing fine.

Oxygen depletion? Virgin tropical forests, say Jari experts, produce little excess oxygen. Most of the oxygen produced in the virgin rain forest is consumed on the forest floor where organic material is decaying at roughly the rate it is growing up above. "One must remember," says Clayton Posey, "that the old natural forest operates in a steady state condition. It is dying at the same rate as it is growing. Due to the high temperatures and humidity on the forest floor, decay is rapid, and oxygen consumption is high.

"Young plantations of rapidly growing trees do, in fact, produce excess oxygen. Old, mature natural forests don't. Any vigorously growing plant life produces plenty of excess oxygen."

In fact, the foresters observe, much of the world's available oxygen is generated by the plankton in the oceans.

The question of monocultures is more germane to modern forestry. Monocultures, say the critics, have inherent weaknesses. For one, a pest or disease could devastate a vast region of a monoculture forest. In a naturally mixed forest, the argument goes, only some trees would be affected.

The word monoculture has been attached closely to man's efforts, when, in fact, remarks Clayton Pose: "Some of the purest monocultures in the world are the natural forests near and north of the Arctic Circle."

"Here, we plant and manage one species on a given site, but nature plants hundreds of others. Our trees," says Charles Briscoe, "represent only a small percent of the total vegetation in a given area."

"When you have a complicated bio-system," explains Johan Zweede, "the chances are good that you will find a natural regulation of the disease or pest. The gmelina have not had diseases yet, but we have had a native moth pest. Its larvae defoliated about 120 hectares. But the second generation of larvae were quickly attacked by four natural parasites and the situation was under natural control."