AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY
BATCH #16

1. SUBJECT CLASSIFICATION
A. PRIMARY: Agriculture — AK10-0000-0000
B. SECONDARY: Forestry production

2. TITLE AND SUBTITLE
Forestry in developing countries: potentials,constraints,and opportunities

3. AUTHOR(S)
Fox,G.D.

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1972	79p.	ARC 333.75,F663

7. REFERENCE ORGANIZATION NAME AND ADDRESS
AID/TA/OST

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*
(In TA/OST 72-12)

9. ABSTRACT

10. CONTROL NUMBER	11. PRICE OF DOCUMENT
PN-RAA- 837	

12. DESCRIPTORS
Constraints
Management
Resources
Technical assistance

13. PROJECT NUMBER

14. CONTRACT NUMBER
AID/TA/OST

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

TA/OST 72-12

FORESTRY IN DEVELOPING COUNTRIES
Potentials, Constraints, and Opportunities
(Preliminary Survey)

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

OCTOBER 1972

TA/OST 72-12

FORESTRY IN DEVELOPING COUNTRIES

Potentials, Constraints, and Opportunities

(Preliminary Survey)

October 1972

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

PREFACE

This Report is intended to clarify the technical bottlenecks to more effective timber utilization in developing countries. Specifically, the analysis is addressed to the following issues:

- -- the principal factors inhibiting better management and utilization of timber resources in tropical countries;
- -- the character and significance of the technical aspects of these inhibiting factors;
- -- practical steps that might be taken by the host country or by external assistance agencies, including innovative approaches, to overcome these technical problems; and,
- -- the likely impact on timber resources and their utilization if such steps were taken.

The analysis draws in particular on experiences in Latin America that seem broadly relevant to timber utilization problems in a number of developing countries, as well as on previous analyses conducted by the FAO, U.S. Forest Service, and other interested organizations.

The Report was prepared by Gordon D. Fox, a forestry consultant, in collaboration with the staff of the Office of Science and Technology. The many individuals who contributed to the effort are identified in the Report and their assistance is gratefully acknowledged.

TABLE OF CONTENTS

INTRODUCTION

Forests cover about one-third of the land surface of the world. Over one-half of the world's forest area is found in the developing countries. For individual developing countries it will vary from less than one percent to well over 75 percent. The concern of this paper is on the use of that vast and renewable forest resource.

Emphasis is placed on economic development of the forests under rational management practices. The solution to attaining both the economic and environmental benefits from the forests is found in industrial development together with commensurate strengthening of the forestry institutions of the developing countries. The utilization of the timber resource under silvicultural management practices is an important means for increasing employment and income in the predominately rural populations. This, in turn, can reduce forest destruction caused by shifting agriculture and other practices. The tree attains value and is no longer an enemy to be destroyed.

Several important advantages which developing countries have over the developed countries, such as much higher growth rates of planted trees, are enumerated to present a balanced picture of the total forest situation. Economic benefits in terms of employment, gross national product, and export balances are estimated, as well as environmental benefits which would accrue if the developing countries are reasonably successful in overcoming the inhibiting factors and succeed in taking advantage of the forestry opportunities.

The primary inhibiting factors to increased industrialization and better management of the tropical forests are also analyzed in this study together with suggestions for actions to overcome them.

The FAO Indicative World Plan projections for forest products production, consumption, and world trade show excellent opportunities for developing countries to substantially increase exports as well as serving expanded domestic markets and in import substitution. To attain these goals, however, there are a number of inhibiting factors which developing countries will need to overcome. In the process of surmounting these

obstacles it is apparent that they will continue to need forestry help from multilateral and bilateral assistance agencies.

Forestry development is a slow process. The results are not going to be dramatic. The rate of progress in the next decade, however, needs to be greatly accelerated over the previous decade. This would result from increased tropical timber imports projected for developed countries together with the expansion of domestic use in the developing countries. While the Indicative World Plan projections do not show the developing countries becoming completely self-sufficient in the capital-intensive pulp and paper products, it is conceivable that they may do so. Import substitution in pulp and paper products would result in major savings in foreign exchange. The primary benefits to the developing countries in the long run will depend on the degree of success in obtaining control of their forest lands and application of land use plans in which they are utilized for permanent production in accordance with their soil capabilities.

More donor agencies than ever before are becoming involved in forestry development, reflected especially in an increasing interest by the international development banks. At the same time, several other agencies are reducing their assistance as a result of financial constraints. There is a trend of increased cooperation between assistance agencies. There is also greater emphasis being placed on overall country programming and sector planning. These trends suggest that a developing country with an important forest resource which desires assistance would benefit from a network analysis in which all interested technical and financial agencies participate in preparing an action plan for development. Such a development plan would specify priorities by activities, timing, costs, etc., with assignments to specific assistance agencies for such help as the host country decides is needed in its implementation. There is an encouraging trend towards this coordinated systems approach.

It is suggested that the United States forestry assistance role might be a complementary one with priority to those technological advances applicable to developing countries for which it is the sole or primary source, or where alternative sources for such

help are very limited. An example is wood property determination. It would seem logical that assistance also be given on those projects which are applicable to developing countries in special situations which are identical or very similar to those in the United States.

This paper is not intended as an in-depth study of the forestry sector. Nor does it analyze the many complicated interrelationships of forestry with the social, economic, and political situations in developing countries. Its purpose is to present a general picture of the forestry situation, its opportunities, and some of the primary problems with a few suggested measures to overcome them.

The information in this paper has been obtained from several sources including conferences or correspondence with about twenty-five persons who are experienced in foreign forestry and forest products industry. This included foresters and other specialists from the Forest Products Industry; U.S. Department of Commerce, U.S. Department of Agriculture, Forest Service; United Nations Development Programme; U.N. Food and Agriculture Organization; International Bank for Reconstruction and Development; International Finance Corporation; U.S. Agency for International Development; universities; and host countries. Their advice has been very helpful. The main source, however, has been the many publications, speeches, and conference reports by the Forestry Department of the U.N. Food and Agriculture Organization (FAO). Credit must be given to the FAO for the substantial work it has done on the various phases of the subject covered in this paper. There was close agreement between the various data sources on inhibiting factors to increased utilization and better forest management of the tropical forests and in measures proposed to overcome them.

I. FORESTRY DEVELOPMENT STAGES

Forestry in developing countries evolves along the following lines. In the initial development stage, from the standpoint of the settler, forests are an impediment. The tree to this settler has little value except for fuel; it has no market and it is an obstacle to be removed in his urgent necessity for a few acres cleared for food crops. The tree is an enemy, not a friend. The failure to control settlement, high rural unemployment and underemployment, and population pressures all result in the clearing of large areas of forest land unsuited for permanent agriculture. The trees are cut and burned in the process. The land loses its agricultural productivity within a few years and the small farmer repeats the clearing process. The FAO estimates are that from five to ten million hectares of forests are destroyed annually by migratory agriculture in Latin America alone. This uncontrolled occupancy tends to keep just ahead of road construction in opening up new areas for settlement. Destruction does not stop with the timber values of the forest but extends to the protective aspects of the forest such as soil stabilization. Unfortunately, the majority of populated forested areas of developing countries can be classed in this initial stage.

The next stage is forest utilization with a market becoming available for forest products. The tree has a value and it begins to be recognized by the small farmer. Timber is something to be used, not destroyed. It is a source of income and rural employment opportunities. The forest resource becomes an integral part of rural development along with agriculture. It is an additional source of employment and income. In this stage, timber is usually viewed as an extractive industry, not as a renewable crop for permanent production. There is likely to be only one to three of the highest-value better-known species removed in a high-grading operation which utilizes not more than five to fifteen per cent of the total volume of these tropical forests. Since domestic markets are relatively small, the greater volume of industrial timber removals are shipped as logs. The sawmilling industry with its relatively low capital requirements and mobility likewise begins its development in this period. However, further processing is largely in the primary stage, and secondary manufacture is carried out in the

developed countries. The value-added and employment opportunities, including the higher technical skills, are not attained by the developing countries. The primary exports provide a source of needed foreign exchange. Many of the developing countries with a timber resource are in this stage of development for their more accessible areas.

The next stage involves the establishment of industries including the secondary manufacturing plants and the diversification of products, often utilizing a broader range of species. This industry includes various combinations of saw timber, veneer, plywood, pulp and paper, and particle board. For the industrial development, a heavy capital investment is needed with high technical skills, and this generally requires foreign capital and technology. The integrated industry uses a much higher percentage of the heterogeneous mixture of species in the tropical forests and makes the practice of forest management feasible. Additionally, the large capital investment requirement tends to force attention on and justify the forestry measures, including reforestation where needed, to maintain and protect this investment on a sustained-yield basis. The countries in this more mature stage have forest industries with the economies of scale necessary to compete in foreign markets. These have been made possible by large domestic markets resulting from industrialization and high per capita incomes. Occasional examples of advanced forest industrial development in developing countries are exceptions to the rule.

This analysis of forestry development might be carried further to another stage which is evolving in the United States. The gradual depletion of virgin forests with steadily increasing demand raises timber stumpage values to a level which makes it economical to grow timber under more intensive practices. The tripling of average stumpage prices of timber harvested from the U.S. National Forest System in the last twenty years reflects this trend. The demands of the people (increasingly urban populations) for wilderness, wild areas, parks, or "green space" are limiting, and will likely continue to reduce the commercial land available for timber production in the United States and other developed countries. This will accelerate the timber shortages projected for this country the next few years. Although there will

be more intensive forestry practiced in the United States, the projected timber demands will require increasing imports, both softwood and hardwood. This situation creates increasingly favorable opportunities for export of forest products from the developing countries, in addition to domestic consumption and import substitution potentials.

II. FORESTRY DEVELOPMENT POTENTIALS

The discussion of stages in forestry development can be summarized by stating that the forests cannot be conserved and managed for timber production until the tree has value through known or projected uses for its particular characteristics and properties. It will not have value until there is an industry with a potential market either at home or abroad, and the industry has the size and efficiency to compete in that market at a profit. Until that time, from the standpoint of the individual farmer who frequently is outside the market economy, the tree except for fuelwood is a liability to be disposed of in the easiest and quickest manner possible.

Therefore, in an analysis of the ultimate payoff which would result from advancing the technical management of the vast tropical resources of the developing countries, it is desirable to consider both developed and developing country projected demands for forest products for the near future, and also the alternative projected sources of supply and substitute materials.

Data from the recent FAO Indicative World Plan are based on estimated per capita consumption at different income levels, timber availability for the projected production, all adjusted for several other pertinent factors. The per capita consumption of processed wood products by countries reflects the level of economic development, and this is particularly pertinent for paper products which have a high income-elasticity of demand.

Trade in forest products continues at about five per cent of total world trade, with an export value of $11.1 billion in 1968. It is a major commodity group comparable to iron and steel, and to textile and clothing. The world production value for forest products in 1969 was $48.4 billion.

The following statements highlight the world forest situation with particular reference to the tropical hardwood resources in the developing countries.

> About one-third of the land area of the world is forested, of which about two-thirds is hardwood. The softwood,

coniferous forests are largely concentrated in developed countries in the temperate zones in North America, Northern Europe, and USSR in homogenous stands. The forests of developing countries are largely hardwood in heterogeneous stands. Of the total harvest of 1.2 billion cubic meters in 1969, about three-fourths, 900 million cubic meters, was coniferous. Broad-leaved species increased from 22 per cent of the 1950 industrial wood harvest to nearly 30 per cent in 1969. The world's temperate regions, with about one-fifth of the world's hardwood resources, have been producing about 70 per cent and consuming 80 per cent of total industrial hardwood. The share for tropical regions has been increasing and will continue to increase. For veneer logs and sawn logs it is 40 per cent of the hardwoods presently used for those products. The utility tropical hardwoods are now dominant in the market over traditional precious tropical hardwoods.

In summary, the situation is clearly shifting in favor of tropical hardwoods because of tightening supplies of conifers and technological changes which make economically feasible the use of greater volumes of more species of tropical hardwoods. Unfortunately, only a few "primary" species are widely used, and hundreds of available "secondary" species are unutilized or underutilized. These species have particularly good potentials. An expression of this overall change is that exports from tropical timber regions increased from 5 million cubic meters in 1953 to 36 million cubic meters in 1969, a seven-fold increase. The tables below reflect this trend. They are taken from the FAO projections for forest products in the Indicative World Plan.

Zone A = Developed market economies--North America, Europe, and other

Zone B = Centrally planned economies--Western and Eastern

Zone C = Developing countries

TABLE 1. SAWNWOOD: PRESENT AND PROJECTED WORLD CONSUMPTION AND PRODUCTION

	Consumption			Production		
	1962	1975	1985	1962	1975	1985
	million cubic metres					
Coniferous						
Zone A	155.3	185.6	201.1	150.4	176.2	189.0
Zone B	103.9	118.3	130.6	109.8	132.1	151.6
Total A + B	259.2	303.9	331.7	260.2	308.3	340.6
Zone C						
Latin America	5.3	9.0	11.6	5.3	9.4	12.0
Africa	0.8	1.5	2.2	0.3	0.8	1.3
Near East	0.8	1.2	1.7	0.3	0.6	0.8
Asia	1.3	2.0	2.5	1.3	1.9	2.5
Total C	8.2	13.7	18.0	7.2	12.7	16.6
Total A + B + C	267.4	317.6	349.7	267.4	321.0	357.2
Broadleaved						
Zone A	37.8	49.2	56.1	35.9	45.5	50.1
Zone B	23.7	29.3	34.3	23.7	29.5	34.6
Total A + B	61.5	78.5	90.4	59.6	75.0	84.7
Zone C						
Latin America	7.4	11.2	20.0	7.5	11.8	21.2
Africa	1.4	2.8	4.5	2.0	3.6	5.6
Near East	0.5	0.7	1.0	0.2	0.3	0.4
Asia	8.0	13.0	18.9	8.4	14.1	20.4
Total C	17.3	27.7	44.4	18.1	29.8	47.6
Total A + B + C	78.8	106.2	134.8	77.4	104.8	132.3
Coniferous and Broadleaved						
Zone A + B	320.7	382.4	422.1	319.8	383.3	425.3
Zone C	25.5	41.4	62.4	25.3	42.5	64.2
World Total	346.2	423.8	484.5	345.1	425.8	489.5

Source: FAO Provisional Indicative World Plan for Agricultural Development. Vol. I. Rome, Italy, 1970.

TABLE 2. WOOD BASED PANELS: EVOLUTION OF CONSUMPTION AND PRODUCTION

	Consumption			Production		
	1962	1975	1985	1962	1975	1985
	million cubic metres					
Plywood and Veneer						
Zone A	18.0	35.2	48.8	17.1	31.8	42.7
Zone B	2.7	6.2	11.5	2.6	6.8	12.5
Total A + B	20.7	41.4	60.3	19.7	38.6	55.2
Zone C						
Latin America	0.4	0.8	1.9	0.4	1.1	2.8
Africa	0.1	0.4	0.7	0.2	1.0	1.8
Near East	0.1	0.2	0.3	0.1	0.2	0.3
Asia	0.4	1.2	2.8	0.7	2.8	5.1
Total C	1.0	2.6	5.7	1.4	5.1	10.1
Total A + B + C	21.7	44.0	66.0	21.1	43.7	65.2
	million m.t.					
Fibreboard and Particle board						
Zone A	7.5	15.4	22.4	7.3	14.7	20.8
Zone B	1.6	9.1	12.5	1.8	9.7	13.9
Total A + B	9.1	24.5	34.9	9.1	24.4	34.0
Zone C						
Latin America	0.2	0.9	3.0	0.2	1.1	3.1
Africa	-	0.1	0.2	-	0.1	0.2
Near East	-	0.1	0.2	-	-	0.1
Asia	0.1	0.5	1.4	-	0.5	1.4
Total C	0.3	1.6	4.8	0.2	1.7	4.8
Total A + B + C	9.4	26.1	39.7	9.3	26.1	38.8
	million m.t.					
All wood-based panels						
Zone A + B	21.1	49.3	71.1	20.9	47.6	67.1
Zone C	0.9	3.2	8.2	1.0	4.8	10.8
Total A + B + C	22.0	52.5	79.3	21.9	52.4	77.9

TABLE 3. PAPER AND PAPER PULP--PRESENT AND PROJECTED FUTURE CONSUMPTION AND PRODUCTION

	Consumption			Production		
	1962	1975	1985	1962	1975	1985
	million m.t.					
Paper and Paperboard						
Zone A	65.7	128.5	204.3	67.5	131.9	206.3
Zone B	9.1	20.6	41.1	9.0	20.3	40.0
Total A + B	74.8	149.1	245.4	76.5	152.2	246.3
of which Newsprint	13.9	22.3	31.5			
Printing & Writing	14.0	29.4	47.4			
Other	46.9	97.4	166.5			
Zone C						
Latin America	2.7	6.8	13.0	1.8	5.0	11.2
Africa	0.3	0.7	1.6	0.1	0.4	1.1
Near East	0.4	1.1	2.8	0.1	0.4	0.9
Asia	1.4	4.0	8.9	0.9	3.5	7.9
Total C	4.8	12.6	26.3	2.9	9.3	21.1
of which Newsprint	1.0	3.0	6.3			
Printing & Writing	1.2	3.0	6.5			
Other	2.6	6.6	13.5			
Total A + B + C	79.6	161.7	271.7	79.4	161.5	267.4
of which Newsprint	14.9	25.3	37.8			
Printing & Writing	15.2	32.4	53.9			
Other	49.5	104.0	180.0			
Paper Pulp 1/						
Zone A	56.7	111.3	179.5	57.4	113.7	183.5
Zone B	8.3	18.3	35.0	8.1	17.5	32.8
Total A + B	65.0	129.6	214.5	65.5	131.2	216.3
Zone C						
Latin America	1.4	4.0	9.4	1.1	3.6	8.0
Africa	-	0.3	1.1	0.1	0.4	1.0
Near East	0.1	0.3	0.8	-	0.2	0.4
Asia	0.8	3.1	7.2	0.9	2.9	7.0
Total C	2.3	7.7	18.5	2.1	7.1	16.4
Total A + B + C	67.3	137.3	233.0	67.6	138.3	232.7

1/ Includes mechanical, chemical, semi-chemical and other fibre pulp, excludes dissolving pulp.

Current trends and projections for the developing countries imply growth in production considerably above the world averages. For example, broadleaf sawnwood is estimated to increase 4.3 per cent per year as compared with 2.4 per cent for the world as a whole. Plywood and paper production in the developing countries is projected at 9 per cent per year, which is higher than growth in overall consumption. The exports of veneer and plywood will undoubtedly increase and the domestic sufficiency level will be substantially raised for paper products.

Estimated investment requirements in forestry and forest industries for expansion of production in the developing countries are:

	1962-1975	1975-1985
Forestry and Logging	$1,880,000,000	$2,140,000,000
Forest Industries	3,900,000,000	7,000,000,000

About three-fourths of the investment required for forest industries is estimated for the expansion of pulp and paper production.

III. PRINCIPAL FACTORS INHIBITING BETTER MANAGEMENT AND UTILIZATION OF TIMBER RESOURCES IN TROPICAL COUNTRIES

From analyses of past trends and projections of future demands for timber resources it can be stated that relative harvest and world trade in tropical timber has increased faster than total world timber production, and that this same trend is projected by FAO to 1985.

Despite this improvement, it is apparent that the contribution of the forest sector to the economies of the developing countries is substantially smaller than its potential. The improvement in forest products production and trade from the developing countries is computed from a small base; the bulk of the export is still in the form of logs or simply sawn wood so that the value added in processing accrues to the developed importing countries; and there are very few species utilized. This leaves, on the average, probably 80 per cent of the forest volume standing. This practice seriously limits opportunities for economic future operation since high value species have been removed. The most accessible areas in several of the high timber producing countries are being exhausted from this "high-grading" practice, and future production will have to come from more inaccessible areas which will require additional roads and will be a more costly operation.

Many developing countries with large untapped forest resources are net importers of forest products. The major import item is usually for the more highly processed products such as capital intensive pulp and paper.

The principal inhibiting factors are discussed in more detail in the following section of this paper. The listed items will vary in significance in different countries.

A. Institutional Factors

This category for most developing countries includes the more serious obstacles to better management and utilization of the forest resources. A basic weakness is in the capability of the forest services.

Many of the other inhibiting factors listed later in separate categories are a result of weaknesses in the items discussed in this paragraph. They are symptoms, not the cause. If a strong, capable forest service existed, it would have been correcting these factors. Many of these institutional weaknesses are not unique to the forest sector. Since the forest service in developing countries includes or should include the functions of a business with direct action responsibilities such as negotiating and administering timber sales in the management of public forests, certain operating limitations have more serious effects than is the case with the majority of governmental functions.

1. Laws and Regulations. In most tropical forested countries the laws were not conceived to encourage industrial development or timber utilization within a framework of multiple use management of the forests. They are frequently oriented toward preservation and police functions. Some of them rather than encouraging industry tend to discourage it as with the threat contained in authority to declare forest lands, public or private, as protection forests, and to prohibit cutting. There is frequently a tendency to legislate or to set by regulation the stumpage values for timber on an average uniform basis, regardless of location. As a result, the most accessible high volume areas with the highest unit values are cut first and the stands which have the higher operating costs are left. An example of a law directly affecting private enterprise is a recently enacted Honduras Forest Law. Without making a direct financial investment in the enterprise the government may obtain 51 per cent ownership of any company which starts major timber operations.

After enactment of a satisfactory forest policy into legislation with all the necessary regulations and operating procedures, there still remains a tough job of enforcement. Enforcement should be preceded by a continuing information and education job with the forest users, rural residents, and the general public at large. Both these jobs are more difficult in those forested areas which have a tradition of forest fires. A public relations and extension job is required which involves all established media in reaching the public through schools, churches, local authorities--and most importantly, the community leaders--to engender a "forestry conscience." A start

has been made, for example, by a few countries adopting a symbol in the "Smokey Bear" pattern to sell the need for forest fire protection. Others have utilized arbor day programs, established school forests, and to a limited extent broadcast radio and television programs. Both the economic values and the protection values of the forests need be stressed in such programs to convince the small farmer and the general public of the benefits to them and their children that are derived from the forest and related resources of their country. Many different skills, including sociologists, are needed, and the low educational level of the big majority of the rural population makes the job even more difficult.

2. Education and Training. Forestry is relatively a new profession. Thirty years ago, there was only one professional level forestry school in Latin America (Mexico); most countries had no foresters and there were no forest services. Therefore, forestry has had to compete for "status" with already established governmental functions. Its voice was and still is weak and not heard at the planning and policy levels, nor is there adequate general knowledge or functional competence at those levels to understand and evaluate forestry programs. With this slow start the forest services presently are not properly staffed or financed for the forest protection, management, and development job which is required.

The training orientation of developing country foresters has often been away from industry and toward the preservation aspects. Under those circumstances government and the forest products industries have not been working together for development. The absence of forest economists in over 90 per cent of developing countries reflects the development gap. The forecasting of demand involving many end uses and products, the establishment of forest plantations linked to market projections, cost-benefit analyses, transport and forest industry feasibility studies geared to the overall economic development plans of the country require participation of forest economists at various levels of government activity in this field. The same deficiency exists in the professional foresters with education majors in utilization, and who are trained in development of timber industries. There is also a lack of adequate subprofessional personnel which is accentuated by a cultural reluctance of the professional class to perform physical labor.

Forestry education has been strongly oriented toward the biological sciences. It has not filled a critical need for professional understanding of and competence in determining the potential of the forests in rural development; the social values in rural income and employment; reduction of urban migration; land-use planning, diversification of agriculture; the linkages of the variety of products from forest resources with other sectors of the economy such as supplying raw material for low cost housing; nor with the way forest industry development can be directed to fit the various stages in the country's development.

Administrative management is as equally in need of strengthening as technical competence. It is reflected in over-concentration of professional people at the national headquarters with its corollary of insufficient on-the-ground manning; inadequate delegation of authority to field personnel for effective action; lack of and failure to use scientific management for personnel placement in relation to workloads; inadequate salaries, including inequality with other professions in government services; slowness in expediting essential administrative tasks such as purchases; unresolved and unclear responsibilities between federal and provincial governments; organizational placement of forest services at a level and with responsibilities separated in a manner that hampers coordinated development, such as forest industry responsibility independent from forest protection and management and in turn separated from infrastructure development and with semi-autonomous regional units often cutting across all fields. Frequent turnover in "key" personnel must also be included in this listing of typical administrative management problems.

The foregoing sums up to a deficiency in the range of and balance between professional and other skills needed within the government unit responsible for forestry, accentuated by administrative management weaknesses.

3. Land Ownership and Concessions. In the existing stands of timber in developing countries, large investments in the forest industry are inhibited by the lack of a long-term assurance of raw material supply at a reasonable price. These limitations take different forms in different countries.

Cadastral surveys have not been made in most forested areas. Ownership has not been determined and property boundaries have not been surveyed and monumented. This leads to disputes that hinder timber utilization. There is general agreement that a majority of forested acreage is in public ownership. There are examples where large blocks of forest land presumably in public ownership and being considered for supplying industrial developments have contained up to one-third private, communal, or tribal owned lands. This may be further complicated where certain rights to use the forest are claimed. In Mexico, for example, much of the forests is held in small plots by "ejidos" as communal lands. Ejidos and Indians are prohibited by law from entering into contracts of more than one year's duration. This makes for uncertainty of industrial timber supplies. There are many other situations where custom and antiquated laws impede timber utilization. These are frequently complex situations and are not easy to change. Timber concessions are often awarded for too short a period for amortization of the capital investment needed for the type and size of plants required for permanent industries.

Many timber concession agreements with private purchasers have left much to be desired in terms of specific requirements for removal of quantities of timber by species and size classes, for rates of cutting and the plan of operation for covering the concession by cutting blocks; for forest fire and other protection requirements; for silvicultural methods to be used; for local manufacture including secondary processing; and for the controls over these operations to be exercised by the Forest Service. The result has been that the concessionaire has done about as he wished, made his own inventories and logging plans, and carried on his operations, with the major role of the Government after issuance of the concession confined only to measuring the timber cut and collecting the stumpage payments therefrom. When silvicultural practices have been prescribed, they have in many cases not been enforced due to failures in sales inspection and supervision of contracts.

The end result is "high-grading" of the most accessible forest areas without regard to future production. Many of the high-value trees have been left through lack of adequate logging plans for systematically covering the concession areas.

B. Transportation Facilities

Accessibility is a highly important factor in forestry development. The weight of unprocessed wood in relation to value is high. This relatively low value per unit of weight of raw material in logs is another factor which tends to limit the harvest to the more valuable species as transportation costs increase with distance, road conditions, and other factors reflected in costs per ton-mile. However, when the road system is established, then other marginal tree species which did not have sufficient value to pay the initial costs of roads may be logged at a profit. Road standards also affect wood transportation costs through weight limitations. Most roads in developing countries are of a low standard, and the load limitations are correspondingly low and costs per ton-mile are high.

The relationship is illustrated by the following:

Latin America with about 25 per cent of the forested area of the world presently supplies only about four per cent of the world's industrial wood. It coincidentally has only about three per cent of the world's road mileage. Clearly, lack of accessibility is one of the primary factors in the low production of industrial wood. More specifically, for the Olancho pulp and paper project in Honduras, it was estimated that $75 million would be required for main haul roads to be constructed by the Government. As this is well over one-half of the country's annual budget, the magnitude of the access problem is obvious.

Many of the roads that open up forested areas for timber operations will also give accessibility to additional agricultural lands and vice versa. It is this combination along with the social benefits which will justify the project. The total rural resources should also be considered in any evaluation. Transportation plans of developing countries are often prepared on the basis of attaining point-to-point transportation between cities and interregional connections, and the resources in rural areas are not given weight in the decisions. Part of this failure is due to a lack of sound data on these resources and their potential commercial values, for local industry and use, and export.

Together with the cost of providing access must be considered schools, services, energy sources, and other infrastructure costs which all tend to slow the rate of rural development and affect the forestry sector.

For overseas shipment the scarcity of deep water ports and of adequate port facilities has substantially added to costs in many locations. The added travel costs to reach the few ports where timber products could be exported has meant that in many areas it was an uneconomical operation or at best only the highest value species could absorb the cost, again putting pressure on these "primary" woods. The result is that export markets for tropical timbers have been handicapped. Another inhibiting factor in ocean shipments is that much of the timber products has been sent in small lots and in unstandardized lengths. The exporters as a group have been slow in adapting to banding, use of pallets, and containerization of shipments. As a result, timber cargoes have not been the favorites of ocean transport companies--either conference or non-conference carriers. This in turn has affected costs.

C. Forest Resource Information Factors: Forest Inventories; Species Identification; Wood Properties and Potential Uses

Utilization of tropical hardwoods has traditionally been built around a relatively few species such as teak, rosewood, and mahogany. The relatively slow rate of acceptance of a broad range of tropical hardwoods relates to the heterogeneous composition of those forests and ignorance of their properties. The number of identified species of trees in the tropical forests of the world has been estimated to be over ten thousand. Many are unidentified. Very few of these tree species are found in all regions. The problem is accentuated since they are often present in mixtures which may run from 50 to 100 or more per hectare. Within the three main tropical regions the Southeastern Asian community contains the largest areas of relatively more homogeneous forests, followed by Africa, and with Latin America having the forests with the greatest variety of species on a unit area basis. This greater homogeneity in tree species per unit of area in Southeast Asia is reflected in the highest production coming from that region, with the least

production from Latin America where the trees occur in greater mixtures.

Commercial use of these mixed tropical hardwoods depends on the knowledge available regarding the physical and chemical properties of each species in terms of specific gravity, workability, strength, color, silica content, etc.; the products and uses for which each wood is suitable and competitive position with species presently used for those purposes; the quantities which can be made available on a commercial basis; dependable supply and delivery; relative costs in the marketplace; and consumer acceptance. Promotion of markets, domestic and foreign, for the secondary potentially commercial species requires that these basic data be available.

Inventory data on the quantities of commercial and potentially commercial timber by locations have not been available on an adequate scale. A review of UNDP reports published by FAO shows forest inventory reports at varying stages of completeness for about twenty countries. A review of current projects listed by FAO as of July 1, 1972, shows forest inventory projects in selected areas for fourteen countries. Upon completion of UNDP/FAO inventory projects, the host countries have proceeded with the job at varying speeds. In the exceptional case of Mexico, for example, inventories are available for the larger part of the forested areas. In each UNDP/FAO project the selection of areas for inventory are those which are most accessible and in which a preliminary reconnaissance indicates they may have the necessary volume of presently known commercial species to supply an industrial operation. Inventory costs for the tropical forests are high. The intensity of sampling to determine reliable volumes by species in a mixture of many species obviously results in higher costs than for timber stands of only a few species. There are nine inventory reports listed for separate areas of the Amazon in Brazil. There has been doubt expressed as to whether the earlier inventories were sufficiently intensive to be reliable for decisions on the establishment of forest products industries.

There has also been a considerable amount of inventory work that has been carried out by private companies. Uniform methods of sampling intensity and species inventoried have not been used and much of this information is not available.

The foregoing may be summarized by stating that adequate forest inventory data are not yet available for the priority forest areas that will need to be utilized for the Indicative World Plan 1985 production projections.

There is a substantial gap in knowledge on identification of species and their wood properties. A recent inventory in Northwest Ecuador found about 15 per cent of the tree species unidentified. Testing of wood properties has not kept pace with species identification. Meanwhile the pressure continues on logging the few species having market acceptance, resulting in a more rapid depletion of supply. As another factor, the known data on species identification and wood properties are scattered in many locations. Duplication of tests is frequent. Nonstandardized methods have been used in determining wood properties.

Forestry research has also been weak in the developing countries. Research in some countries which were former colonies of advanced technology nations is farther ahead than in many of the Latin American countries with a longer history of independence. Forestry and wood utilization research projects and methodologies have often been patterned after Europe, Temperate Zone experience and have given less than adequate results in the tropics. The resultant applications to tropical conditions and species are largely a matter of chance. While there has been progress in many countries aided primarily by UNDP/FAO forestry projects, the research effort on tropical woods is really just getting under way. Forestry research requires sustained effort over a long period of time; while there will be "breakthroughs" along the way, many of the facts on the ecology of the tropical forests will not be known for many years and prudent management will be delayed.

D. Industrial Factors: Markets; Industry Size; and Practices

In addition to lack of necessary information there are other factors which influence markets. Market promotion necessary to obtain consumer acceptance of a new wood product involves considerable work and risk. The importer is inclined to stay with a species-product that he is familiar with as long as he is obtaining the supply needed. He also faces competition with plastics in the decorative woods market.

The wood products industries have never been noted for their efforts in product and consumer research. In summary, there has not been an organized large-scale effort by exporters, importers, and processors to promote the acceptance and use of many potentially commercial species.

Expansion of domestic markets in developing countries has also been slow. The relatively small size of most of the countries and low per capita incomes have kept domestic markets for forest products at a minimum. This has inhibited the establishment of efficient forest industries with the economies of scale which will enable them to compete for markets. The relatively higher prices likewise tend to hold down domestic consumption. The small producer is at a disadvantage in market promotion, either domestic or export. A trend towards encouraging greater local processing and decreased log export is exemplified by Latin America in which during the past few years three countries have prohibited log shipments altogether, two have prohibited them from public lands, and a sixth has limited shipments to certain species. This is a desirable industrialization trend.

It is a matter of judgment whether to consider deficiencies in application of acceptable grading standards, preservative practices, kiln drying, storage practices and lack of knowledge of wood properties among the principal inhibiting practices in tropical timber export and utilization. They might be considered as symptomatic of other inhibiting factors which are more fundamental such as small size of the forest product operations; unfavorable location in relation to assured sources of supply; lack of modern equipment, modern production methods, and skilled workers; and tariff protection which insures a domestic market against competition and thus does not provide incentives to improve either quality standards or production efficiency. The net result is that importers and domestic suppliers have had serious problems at times in obtaining the quantities of forest products of the grades specified; improper drying practices and preservative treatment have led to inferior products at high prices which has held down both domestic use and export trade. There is continuing progress but substantial problems remain.

The discussion of the inhibiting factors to increased timber utilization and better forest management does not present an optimistic picture. Few developing countries are likely to have the financial resources for the required restoration of their forests. The United States is still paying for the forest destruction which occurred in its development period. The developing countries still have time to profit from the United States' mistakes.

IV. TIMBER ADVANTAGES OF DEVELOPING COUNTRIES

(Reforestation Growth Rates; Land Availability; Market Position, Domestic and Export)

Without attempting to minimize the inhibiting factors that must be overcome, the opportunities and the advantages which the developing countries have over developed countries should be cited to give a balanced picture. Development strategy should capitalize on the advantages to the maximum extent. These are listed below with brief comments.

A. Perhaps the most important advantage of developing countries is in the fast growth of planted trees. Most man-made forests are of exotic species. They include both coniferous and hardwood species from different parts of the world. With much longer growing seasons, tropical growth rates are often two to four times higher than in the temperate regions. Several large industries have been established or are in the process of establishment in developing countries based entirely on reforestation.

B. Tropical timber production has been increasing more rapidly than production in developed countries. The FAO Indicative World Plan projections for 1985 are that this trend will increase at an accelerated rate. Further expansion of domestic supplies in the developed countries, including the United States, will be slower and more costly in the future. The abundant supply of virgin tropical timber should have an increasingly competitive advantage. The production and consumption projections indicate forest development opportunities for the developing countries that were not available in the early years of international assistance.

C. Technological breakthroughs in the past few years have made possible the development of a pulp and paper industry based entirely on mixed hardwoods for certain uses and with up to 80 per cent hardwoods for other types of paper. A smaller proportion of long fiber coniferous pulp is required for strength than previously. Technological advancements make it possible to use many different hardwood species without cooking them separately. This favors the developing countries with their preponderance of mixed hardwoods. Latin America, for example, with about one-quarter of

the world's forested area, has an annual negative trade balance of $250,000,000 as a result of pulp and paper imports. This can be changed to a favorable balance of trade. Technological development to date is ahead of actual practice. This trend opens the way to utilizing a greater proportion of the volume of the hardwood stands. This, in turn, improves the opportunities for practicing forestry, including reforestation of the cutover stands where conversion is desirable.

D. Recent technological change in veneer and plywood processing now permit the use of much smaller logs and higher utilization than previously. This gives an opportunity for using higher volumes from the tropical forests.

E. The increases in volume harvested per unit area as a result of technical advances in utilization decrease production costs since fixed costs for logging roads, equipment, etc., can be spread over the larger volume harvested and utilized.

F. The ready availability of forest land in developing countries either through government concessions on public lands or through long term leases or purchase of private lands at a low cost is an important advantage for the developing countries. In the developed countries generally, the value of forest land has increased and continues to increase rapidly. In the United States it is becoming unavailable to companies who wish to expand their operations, forcing them to look to the developing countries for expansion opportunities. Increasingly, forest land in the United States is being purchased in small tracts and held by owners for recreation and purposes other than timber production. This is an important factor in the investment decisions of United States firms.

G. Low cost and abundant labor is an advantage that developing countries have, even though there is a shortage of specific skills. Several forest products companies as in Brazil have been very successful in the transfer of technology to Brazilians who have replaced foreign personnel in those industries.

The advantages enumerated above should provide the opportunities for developing countries to meet or exceed the Indicative World Plan estimates for greatly increased domestic consumption including import substitution in pulp and paper products and expanded timber products exports.

V. PRACTICAL STEPS TO OVERCOME TECHNICAL PROBLEMS

The foregoing analyses have briefly covered the world timber situation in relation to the developing countries; the principal inhibiting factors to better management and utilization of the forests in the developing countries; and the advantages which these countries have over the developed countries. Development strategy should exploit the advantages to the maximum extent as well as overcome the inhibiting factors.

Fortunately, not all the obstacles to forestry development are present in all developing countries, and, more importantly, they do not carry the same weight. Forestry development opportunities likewise are not the same.

A. Forestry Assistance Interests and Trends of Development Agencies

Forestry assistance has been given to practically every developing country with a forest resource that could make a contribution to its economic development. For many of them it appears to be a continuing *modus operandi*.

An analysis of UNDP forestry projects for the past ten years (through calendar year 1971) shows 71 forestry projects of which 21 have been completed and 50 are active. The forestry projects are five per cent of total UNDP projects, and the average cost of $1,000,000 per project is slightly above the average for all projects. The average programmed duration of the forestry projects is 4.6 years. The 50 active forestry projects are in 42 countries, which is 38 per cent of the 111 countries with UNDP projects. In Latin America, 14 countries, or about two-thirds, have forestry projects. The percentage is somewhat less than one-third for developing countries in the Asian, Near East, and African regions.

The projects for which the FAO Forestry Department is the action agency were reviewed. These include UNDP small scale and large scale projects, trust funds (set up by various countries or institutions for specific purposes), and the U.N. World Food Programme. There are 81 countries with forestry related programs utilizing 430 listed employees including regional employees, part-time consultants, and volunteers.

All the Latin American countries are hosts to currently approved forestry projects for which FAO is the action agency. The following data give a more complete analysis of Latin American assistance taken as a regional sample.

A review of Technical Assistance in Forestry made in 1964 for the Latin American Science Board showed United States AID projects in 17 countries with starting dates from 1950 through July 1, 1964. There were also five regional projects during the period. The AID Forestry Advisors started with about two man years in 1951, peaked at about ten man years in 1961, dropped to about two man years of assistance in 1964, and currently there are none.

As of July 1964, FAO had 74 technical forestry assistance experts in 14 Latin American countries and its Regional Office. As of July 1, 1972, FAO listed 137 experts in 24 Latin American countries and its regional projects. This shows the trend toward increased specialization.

These data illustrate the transition, well known to all concerned, from a bilateral forestry program to increased reliance on UNDP/FAO assistance. It is generally recognized that the time has passed when a single general country advisor can make much of a contribution. Much of the forestry aid given in the past was on a "piecemeal" basis for a forestry activity which was considered most essential at the time. The trend toward an overall approach is timely. Recent emphasis in forestry assistance programs has also been on linking the institutional and other needed forestry measures with industrial development opportunities as a package.

Realistically, the demand on the limited financial resources of developing countries is such that appreciable increased budget allocations to strengthen the forest services and the other institutional elements are not likely in the absence of other incentives, unless a financial return from the sector can be obtained concurrently or in the very near future. The primary concern of a Minister of Economy is to meet a critical budget situation now. Consequently, immediate liquidation of the forest resource to satisfy urgent demands for income and employment often is practiced by the developing countries even though the future returns of sustained yield management when discounted to the present would show a favorable cost-benefit relationship.

At the present time, institutional development, particularly of Forest Services, is substantially behind industrial development. A coordinated overall approach presents the best opportunity to work toward attaining a balance.

During the past few years the interest of the multilateral World and Regional Development Banks has built up in the forestry sector. They have added forestry experts to their staffs to promote forestry development loans. FAO has been cooperating with the development banks on forestry projects, its major effort being with the World Bank.

The World Bank, the Inter-American Development Bank, and other Regional Development Banks follow the practice of sending out teams of specialists to develop investment possibilities, including forestry. They assist the host countries in preparing sector plans. The multilateral financial institutions also have programs for institutional assistance. They have recently added environmental considerations to their programs. The entry of the Development Banks into the sector is giving added impetus to forestry development. The credit incentive brings in top government levels, and commitments can often be negotiated that are not always possible in technical assistance programs.

Another organization which has entered actively into the forest products field since its recent establishment is the United Nations Industrial Development Organization (UNIDO). The Geneva Agreement of July 9, 1969, setting out Guidelines for Cooperation between FAO and UNIDO, brings UNIDO in at the advanced stages of wood products industrial conversion such as furniture, wooden prefabricated housing, paper conversion, and various secondary industries, etc. Proper functioning of this arrangement requires close coordination.

FAO has many cooperative programs with developed countries for assistance to the developing countries. The cooperative projects include several in forestry. The Scandinavian countries outnumber all others in the cooperating list. A listing of bilateral forestry programs is not available, but Germany, France, Canada, as well as others, are active in that field. The Organization of American States has forestry assistance activities. Foundations and other organizations should be included in a listing.

While the increasing number of forestry assistance organizations and projects is impressive, the forestry development job that lies ahead is even more so. Several of the assistance agencies mentioned are having budget difficulties that are resulting in program reductions.

The UNDP country programming procedure was adopted on January 1, 1972. It is another step toward an integrated approach for development planning rather than separate projects which are requested from time to time. The countries are given a planning figure to guide their UNDP program. Ongoing projects are scrutinized as part of this exercise. This trend appears logical and desirable.

In summary, there has been an increasing number of assistance agencies active in forestry; the financial position of several of them has weakened; and there is greater emphasis on national and sector planning. It appears timely for the cooperation which has been developing between assistance agencies to be further coordinated in joint forestry development programs determined for each country requesting such help.

B. Systems Approach to Forestry Development

The following describes general procedures for a systems approach to forestry development which could be fitted into national development plans.

The basic purpose of this approach is to assure that the limited financial and technical resources of developing countries that can be allocated to the forestry sector are utilized for the highest priority activities in attaining the greatest development of forest potentials as rapidly as practicable to meet its national goals. A collateral objective is to provide a coordinating mechanism in assignments to development agencies for the forestry help that the host countries consider necessary to attain forestry goals.

1. While it is understood that assistance is not given unless requested, it is important that the senior officials of a country requesting this help see the real need and have a genuine desire for it. There should be an appreciation of the value of the forest resources in the country's economic development, and it should be prepared to make specific commitments

for implementation. This may require high level discussions over a period of time using available data indicating the economic and social potential of the forests.

2. The country must be involved at all stages and make the decisions on its plan during the process. It should not be a report prepared by outside experts which is presented as a finished document.

3. All bilateral and multilateral financial and technical agencies with an interest in forestry development for the country should participate in this network analysis. The participation should be as active as practicable, recognizing that in many instances it may be limited to consultation.

4. Preparation of initial projections of domestic consumption, production, export potential, and markets on a localized basis in relation to timber supplies, growth, and drain is one of the first steps. The benefits in increased income and employment, gross national product, foreign exchange including import substitution, and from the related resources and environmental values of the forests are then determined. These data will be approximations. They provide a basis for establishing development goals.

5. The plan prepared using the critical path analysis and PERT chart techniques where helpful should detail the actions needed to overcome obstacles in reaching the goals, listing amounts, location, costs, and scheduling for tasks such as inventories; cadastral surveys; fire, insect, disease, and other protection measures; establishing and placing national forests under management; public relations; training at all levels; technical help to established industries; strengthening forestry laws and institutions including forest services, extension, and forest schools, forestry research and forest product research at an appropriate level; credit needs at different levels; infrastructure; reforestation; prefeasibility and feasibility studies, incentives, etc. The items are illustrative.

6. In addition to putting existing technical knowledge to use, the analytical procedures will likely disclose additional forest research needs.

7. The action plan by years should be within the capabilities of the country in its resource allocation to the forestry sector, together with both the financial and technical help which can be scheduled by the assistance agencies for its implementation.

8. Full commitments may not be practicable, as in the case of Development Bank financing for specific investment projects, until feasibility surveys are completed and economic viability determined. However, the assignments worked out with the cooperating agencies should be as complete as practical so there is understanding of their respective part in its implementation.

9. Five to ten different specialists in the field of full forestry development would be needed to assist the government in preparing its plan.

10. The number of experts required to carry out the plan and the period of time their expertise is needed will vary by countries, depending on the stage of development and the size and complexities of the job.

The FAO has been working toward this systems or network analysis approach. Perhaps the most complete outline for preparing an action plan on forestry development has been made by Mexico. It is presently engaged in preparing its nationwide plan with the help of foreign consultants.

C. Upgrading Forestry Programs of Developing Countries

1. Institutional

a. Laws, Regulations and Incentives

Enactment of modern forestry laws and implementing regulations should conceptually precede other measures proposed for strengthening the country's capability for industrial development and management of its forest resources so as to provide the development framework. In actual practice the recognition of need for legal reform tends to emerge much later when sufficient development and protection problems stimulate action by the government, in other words, an evolutionary educational process. FAO has done considerable work on forest laws, tailored to individual country needs.

Most of these laws include provisions which will take years before the matching institutional capacity is adequate to administer them. This has to be the case in view of existing capabilities. In general, the model laws are designed to overcome the major obstacles to development and management, but in practice most countries have exercised sovereign rights and modified the models.

The need for modernization and priority for action is largely determined by affirmative answers to two questions, namely:

(a) Do present laws hinder industrial development rather than encourage it?

(b) Do present laws give inadequate authority to the Forest Service for protecting, managing, and developing the public forests and for protecting the public interest on privately owned lands?

The latter item includes adequate authorities for prevention and control of forest fires, insect and disease epidemics, trespass, and related items.

Incentives are provided for attracting both domestic capital and foreign capital into the forestry sector where it is government policy to do so. Incentives for both are usually necessary for any significant expansion of forest industries.

Various government incentives are used at times in promoting industrial development. These include many that apply to forestry industries such as tax exemptions for specific initial periods; guaranteed tax levels for an initial period; accelerated amortization; tax waivers on machinery imports; loans at low interest rates for machinery imports; tariff reductions; and several others. Waiver of a percentage of taxes for reforestation has been effective in promoting a supply of wood to complement or augment existing supplies. It has been suggested that a subsidy be used to finance the initial costs of exports for little used or new woods. This has possibilities and might be done under the auspices of the Tropical Timber Bureau.

In theory, financial incentives for new industries are understood to be one of the last items

decided after cost and returns analyses and consideration of the other elements that attract the domestic and foreign capital required to meet industrialization objectives. They presumably are set to give the margin needed for covering the added costs and risks for establishment of the enterprise. Relative incentive advantages between countries are a selection factor in forest products companies' search for investment opportunities. There is some evidence of competition between countries on incentive offers--particularly for pulp and paper investment. In the case of tariff incentives on forest industries, once established they tend to continue and protect industries with obsolete equipment and small inefficient plants.

Which incentives to use and the extent of use will vary by countries. The one certainty is that they are needed. Incentives is a highly technical as well as a political subject.

A developing country would usually profit from expert outside assistance in developing its forest policy, laws, regulations, and forest industry incentives.

b. Forest Service Capabilities and National Forest Development

Strengthening of the Forest Service's capabilities in the developing countries is the single most important task. The professional staffing should include utilization specialists, foresteconomists, and foresters with training in sociology, land use planning, and an understanding of the role of the forests in rural and industrial development including the linkages to other related sectors of the economy. Pay levels for foresters should be at the same scale as other professional services in public service.

A majority of the forest acreage in developing countries is in public ownership. Placing these public lands under protection, management, and development as national forests provides the training ground for developing the capabilities of the Forest Service. The national forests will provide the majority of forester employment opportunities in the early stages until forest industry develops on a larger scale and becomes an additional employment source. Public forester employment also justifies support for forest

schools and training centers in the developing countries--both at professional and subprofessional levels. The national forests should be managed on a multiple-use basis. The timber, wildlife, forest recreation, including parks, forest range, and water, are all related forest resources. The foregoing is the manner in which the United States Forest Service evolved. The same evolution in forestry has occurred elsewhere. National forest management is the "spring-board" to the developing profession.

The forestry profession, like every other scientific discipline, is becoming more specialized. It is doubtful with the demands on their limited resources, that developing countries can individually support the needed specializations. These are now largely provided by assistance agencies, primarily UNDP/FAO. One possibility is staffing the more specialized forestry experts jointly financed at regional locations to serve several countries. For example, the Secretariat for the Central American Common Market might contain the scientist whose forest entomological training gives the expertise in control of the Southern Pine Beetle which has caused hundreds of millions of dollars of timber losses in the pine forests of those countries. An advisory or extension service might be provided from Regional Forestry Research Centers in different parts of the world.

The exact form of organization of a Forest Service needs to be approached on an individual country basis. Since a Forest Service functions as a business in selling and supervising timber sales from public lands, it needs more autonomy and flexibility than most government entities. It requires delegated authority to carry out transactions in its own name; administrative flexibility in the use of revolving funds; adequate authorities for headquarters and field purchases, use of imprest funds, and to act promptly to meet emergency situations. The Forest Service should operate as a decentralized organization with manning including professional staff at appropriate field locations. Staffing on the basis of workloads, program budgeting, work planning, and field inspection and controls are all administrative management tools that should be used in modernizing the organization for the job ahead. Reporting through a special commission or advisory board has been suggested as one means to give more autonomy.

Forest management and government responsibilities for forest industry development should be linked together because of their interdependency. There should be close coordination mechanisms with transportation and land-use planning, agrarian reform and colonization, and water impoundment projects. The placement of forestry specialists should go beyond the Forest Service. Forest economists are needed at the ministerial and national planning levels if programs are to receive attention. Depending on the country's form of organization, the provincial governments may require separate forest services. Forestry Research should usually be kept as a separate unit within the Forest Service.

Because of the size of the forestry information and education job, all sources should be used to reach the general public and, most importantly, the rural residents in forest areas. Short training courses in forestry given to agricultural extension agents is one way to broaden the base of assistance in this task. Advantage needs be taken of all existing communication media. Law enforcement must be strengthened to get control of illegal occupancy and timber cutting. The use of details from the armed forces has been helpful in attaining initial control in specific situations. Administrative management procedures, including short and long range program formulation, work planning and controls, need about the same degree of attention as the technical forestry sector.

The FAO has developed considerable material on forestry professional and subprofessional schools; estimated needs for foresters and technicians by countries; and on organization and management of a Forest Service. The guidelines that have been prepared for strengthening the institutional sector need modification to fit the specific situation in a country at a given time.

c. Forest Land Ownership and Timber Concessions

The problems involved in determining ownership are not simple. They involve custom and tribal possessionary rights as well as legal titles or other ownership evidence which may or may not have been registered. They will vary by countries and regions. There

is a substantial cadastral survey job in many countries. Priority should be given to forest areas which have the best possibilities for supplying timber for early industrial development. While a large majority of forest lands in developing countries are publicly owned, the private or community ownership becomes increasingly higher with population densities. Alienated ownership is generally higher in the more accessible forest areas, and these frequently have priority for timber development. The cadastral surveys for timber purposes should be part of an overall development plan for a specific investment opportunity with the other measures programmed to the feasibility study phase.

The FAO 1972 Manual on Utilization Contracts for Public Forest Lands fills a need apparent for many years. It covers contract provisions involving different classes of ownerships, size of the concessions, duration of contracts, local processing, annual timber cut, means of control and supervision, nonperformance penalties, road construction, forest management, and other key points. Sample contracts of different types are included. The conscientious use of the material in this document will greatly improve the utilization and the management of the tropical forests which are contracted for timber harvest--provided the supervision and enforcement actions are adequate. Regardless of written instructions, when a developing country is negotiating a long-term major concession involving foreign corporations and capital, it is desirable that it obtain the services of a competent and experienced advisor to assist in working out the terms. This will not only help the country to obtain a fair contract but may prevent the imposition of some terms which seriously handicap the industry. In some instances the government has been given conflicting advice by too many forester-advisors during negotiations!

Concession agreements are legal documents, and there is a tendency for them to bog down in legal reviews at the headquarters level. Small sales contracts lend themselves to standard contracts with additional clauses that can be added as necessary and which have advance legal approval. This expedites action and permits delegation of sales to field units for certain volume and value limits.

2. Transportation

Transportation is the highest single cost of delivered forest products. There is no easy answer to reducing transport costs. Forested areas are usually the most inaccessible. Existing road systems have given priority to routes between major cities. Feeder roads to agricultural areas are generally constructed to low standards and there are maintenance deficiencies. There are problems of intermittent transport in the heavy rainfall tropical forests.

Transportation planning should give consideration to all resources. This requires having sufficient knowledge available on the forest resource so it may be considered together with other factors in setting road construction priorities and standards. Providing access to forest development opportunities needs close coordination with agricultural development projects. The combination of purposes may be needed to justify a project as a part of rural area development.

Another factor often overlooked is to construct the processing plants as close to the source of supply as possible. Weight decreases and value increases with processing. Plant location in relation to timber supply and transport has often been inadequate. Feasibility surveys of the highest priority forest areas for industrial development often show a viable operation if the primary roads are constructed at public expense and the feeder and spur logging roads are financed by the concessionaire.

Assistance by development banks and other sources has been a major loan category and will continue to be needed for financing roads providing access to the timber resource. It is a long term development requirement. They will generally qualify for the "soft" long-time low interest loans. There is always a possibility that a technological breakthrough will occur and a practical alternative to road transport in developing countries becomes feasible.

Most developing countries do not have a domestic market size to support wood processing plants with the economies of scale for efficient operations. There will be increasing reliance on regional and interregional markets. The increasing export projections mean greater use of ocean transport facilities. Higher

volume shipments will gradually tend to overcome some of the present problems.

Shortage of modern port facilities, including adequate storage, has also contributed to high costs. Another factor has been the shortage of deep-water ocean ports which has required longer overland transport of wood products with consequent higher costs.

Some technical advances which will operate to reduce the cost of ocean transport, including handling costs, breakage, and pilferage follow. Shipments of lumber, plywood, and veneer are increasingly palletized, banded, and handled by fork lifts and other mechanization. Some tropical woods such as packaged plywood, packaged moldings, and veneers are perfectly suited to containers. The trend toward containers will continue. Presently there is a problem in that container ship service is not available in most of the ports in developing countries from which forest products are shipped. Storing the containers in general cargo ships is more costly and much of the cost saving is lost. Full container service will likely be available in time. The infrastructure of a container system is also needed, including shore-based cranes, paved storage areas, straddle carriers, and related facilities. The total volume of package freight available at ports nearest the timber production centers will determine the rate of attaining full advantages of containerization procedures. Attainment of the projected production increases will help overcome present low volume deterrents at many ports.

The "LASH" and "Seabee Systems" are also coming into increasing use. These systems incorporate small barges and large mother ships with different systems for lifting the loaded barges aboard and for unloading them. The shipper and importer will gain from reduced handling of the product, low cost inland transport (river transport by barge), and a safe storage vehicle to eliminate damage and provide fast delivery.

The "Mini ship" is a shallow draft, small ocean-going vessel which can serve small river ports. It is valuable except for long ocean voyages. This type of ship is being used to a greater extent.

These systems will fill a need in the transport net since water transport on inland waterways has

been and will continue to be important in timber harvesting operations.

In summary, new developments in ocean transport, together with attainment of the projections for wood production and export, will help overcome present difficulties. Construction of timber access roads is going to be a continuing need unless there is a technological "breakthrough" in transportation methods.

3. Forest Information; Inventories; Species; Wood Property Tests and Uses

Decisions on obtaining additional factual information on the forested areas of a developing country include considerations of whether the additional data are likely to result in industrial investments within a reasonable period. The data should serve more than an academic purpose. While this involves an area of judgment, it is substantially narrowed by the interest which is being shown by potential investors. Many larger forest products companies are continually searching for new investment opportunities. There are methods of arriving at preliminary estimates of economic viability for an area selected for a forest inventory. The selection of priority areas for inventory of timber volumes by species should be combined with obtaining species identification and tests of wood properties and potential commercial uses of secondary species. Inventories become outdated and a maintenance system must be provided.

There is a natural desire for a developing country to have its own wood testing laboratory. This work can best be done at a centralized regional location where modern facilities and trained personnel are available. Correlation with existing data can best be done at those locations.

In carrying out prefeasibility and feasibility surveys which follow the inventories, a considerable amount of waste effort could be saved if the company or companies which are considering an investment could to some extent participate as the surveys are made. There appears to be a very considerable amount of duplicating effort by the potential investor to recheck all the data to insure its reliability. In some circumstances, of course, participation would not be practical.

An important consideration which ties closely with both "concession" policy and selection of blocks of forest land for inventory purposes is reserving areas of a size needed to supply the raw material for large scale industry or integrated industries. These are the ones that will have the economies of scale to compete in export markets. There is often a tendency to divide the public forest lands into small concessions on a first call basis, thus missing the big opportunities.

4. Reforestation

The future for reforestation and afforestation in the developing countries needs emphasis. The rapid rate of growth of planted trees in the tropics is a major advantage. The year-round growth for many species, both conifers and hardwoods, of two to four times that of temperate zones combined with short rotations of ten to twenty-five years, and early intermediate commercial thinnings establishes a strong competitive position. Plantations overcome many of the primary inhibiting factors of the natural stands, namely: (a) they can be planted in accessible locations to cut transport costs; (b) the species planted can be selected to fill the needs of the size and type of industry for specific market products; (c) all the volume is harvestable, which reduces logging costs; and (d) species can be selected that will complement the natural stands. Conifers, for example, give the long fiber strength needed for certain kinds of paper.

There are several large pulp and paper operations in developing countries that depend on forest plantations. The plantations are providing an opportunity for intensive forestry practices to increase growth. Progress has been made in the selection of better seed sources and in genetic research in a few locations.

Tree planting can be integrated with the small farmers' subsistence agriculture. The small farmer, until he has an alternative way of making a living, is going to continue cutting and burning the timber on a few acres of the steep hillsides and grow the corn and beans for a few years until the fertility is exhausted and then repeat the process. A plan known as the "Taungya system" has been successful in several places in Asia and Africa. There are

variations, but essentially at the time the farmer plants his food crops, he is given tree seedlings of fast growing valuable species. These are planted at fairly wide spacing on the same area. By the time the agriculture capacity is gone, the planted trees are established. The next crop from this area and succeeding areas treated the same way can be a tree harvest.

The use of incentives for planting trees has given forest development a big impetus. Brazil, as an example, permits a tax deduction up to 35 per cent of ordinary income for individuals or 35 per cent of taxes for corporations if funds are applied toward establishing a plantation. The projects require approval of the Institute of Brazilian Development for Forestry, which was given Cabinet status. It is estimated that 40,000 to 60,000 new jobs have been created in the reforestation program. Chile is the first Latin American country to attain a favorable balance of trade in pulp and paper products. The industry is based on coniferous plantations.

Reforestation programs should continue to be accelerated in countries with lands which have their highest use capability for permanent forestry purposes. Plantation research should be carried out as an integral part of a reforestation program. Research is particularly important for guarding against insect and disease epidemics in the more nearly pure plantations of one or two exotic species as the natural protection of the mixed composition of tropical forests is lost.

Forest plantations have an important role in watershed protection projects. They are one of the key land treatment measures. They provide protection to soil and water resources and are a major factor in assuring high quality and sustained water supplies, and in reducing damage to agricultural lands, industrial and urban developments, and irrigation and hydroelectric water reservoirs by maintaining stable upland watersheds.

It is expected that there will be a greater awareness of environmental damage in the next decade which will lead to more attention to watershed programs. Reforestation as an integral part of upstream measures may enable harvesting of plantations so as to serve the watershed functions as well as adding to the timber harvest.

5. Markets

The primary measure for market development is the establishment of the Tropical Timber Bureau. It holds prospects for overcoming some of the main obstacles to expanding tropical timber export markets. The Bureau is in the process of establishment with temporary secretariat to be located with UNCTAD/GATT in Geneva, Switzerland. Financing for the first year's operation is scheduled from UNDP funds. Longer range financing would need be from trade associations, industry, and public entities in the exporting and importing countries which are members. A general meeting is planned for 1973, to be attended by representatives of all private and public entities interested in the project to consider the future scope and methods of operation of the Bureau.

The basic objective is to assist developing countries to maximize foreign exchange earnings from exports of tropical woods and wood products. It will be a mechanism for collecting and disseminating information on tropical timbers to producers, importers, exporters, wood using industries, and others who have an interest in the project. The proposed activities are tentatively described for four areas as follows:

An information service will identify lesser-known woods of potential interest to suppliers and users, and assemble available information about them; identify and recommend research required to develop any additional information needed to assess the market prospects of the species on the active list; promote improved market intelligence services covering the trade in tropical woods and wood products; and cooperate with the International Union of Forest Research Organizations and its designated members in the establishment of a centralized data retrieval system on tropical woods.

Market development will consist of stimulating the preparation of promotional material illustrating the actual and potential uses of tropical woods and dissemination of such material; and organizing the promotion of selected lesser-known species or groups of species and their products.

Product development will assist in raising product quality and level of product, in widening the

range of marketable products, and in improving production practices. Development of a raw material source will support with market information the identification and development of new sources of tropical wood supplies. The Tropical Timber Bureau will be under the joint direction of a coordinating committee from FAO and the International Trade Center (UNCTAD/GATT). Each participating country will be invited to set up a National Council.

The initial reaction of assistance agencies, trade associations, importers, exporters, producers, and from country representatives is favorable. The Bureau will not undertake commercial transactions. Regular commercial channels will continue. It is a mechanism designed to overcome obstacles to timber exports from tropical timber countries. It may be more feasible to start operations of the Tropical Timber Bureau at a Branch level established on a geographical basis. For example, a branch in the United States with the interested Latin American countries having common interests and timber types would provide an opportunity to "debug" the system. It could be a pilot test prior to extending operations on a wider geographic basis. The developing countries should support the Tropical Timber Bureau because of the opportunity it holds for them.

There are other active trade and market promotion mechanisms at regional and subregional levels designed to assist the developing countries. It is important that these be continued and expanded. Specific industry agreements between member countries at the subregional trade areas will give opportunities for widening markets that in turn justify modernization, plant expansion, and increased efficiency of forest product operations. Domestic market development needs special emphasis. About 80 per cent of the IWP projections of increased production for sawnwood and panel products would be required to meet the increased consumption projections for developing countries. Pulp and paper production projections are somewhat less than for consumption.

The same factors which inhibit world trade will need attention in domestic market promotion. These include the research necessary to identify new species and test wood properties and potential commercial uses for the secondary species. A dependable

source of supply at competitive prices must be assured prior to promoting industry and consumer acceptance of new woods and increased production for those presently accepted. Forest product trade associations as separate entities or as branches of overall trade associations can be very helpful in market promotion and should be encouraged.

In summary, the several measures presently established and proposed for expanding foreign trade in forest products should be helpful in providing the concerted effort needed to meet the Indicative World Plan objectives. The developing countries will need to make the same effort for expanding their domestic forest product markets.

6. Forest Industry; Size and Practices

Industrial development is in varying stages by countries and within them. The range is from initial log export and low capital, labor intensive sawmilling operations to the modern, capital intensive pulp and paper mill. The trend is for increased secondary processing within the developing countries and for larger plant capacities justified by expanding domestic markets and increased participation in regional markets.

Modernization and expansion of existing facilities will be helped by liberal credit and other financial incentives. This process could be speeded in many places by using the same approach as Mexico in obtaining foreign industrial specialists who, working with counterparts and with the industries, develop specific recommendations. It is, in effect, a critical path analysis to identify the primary industrial development obstacles and the corrective measures. Trade associations are helpful in those efforts and should be promoted.

The small sawmill operators may overcome some of their difficulties by establishing an association or cooperative wood products concentration yards to overcome several problems associated with small size. The concentration yard provides common facilities for drying, preservative treatment, sorting and grading, and as a source of marketing information and facilities, and should be encouraged. It can be a mechanism for extending training in woods operations, sawmill

practices, and grading standards to its members. It can be established as a cooperative with credit facilities to members.

The increasing use of tropical woods in particleboards holds considerable promise for greater utilization of tropical species. This use could provide panel materials for virtually all building and furniture needs and at the same time provide a use for many species of wood which are not utilized at present.

The versatility of the particleboard process will allow the production of panels or formed products from any type or mixture of clean raw material and, normally, with less expenditure of energy and cost per unit of strength than other panel processes. The product properties may be controlled during the manufacturing process by control of particle or flake size and shape, resin binder content, and panel density. Additives may be added in the manufacturing stage to provide water repellancy, insect and decay resistance, and fire resistance. In addition, a choice of resin binders may be used to provide water-resistant or waterproof bonds depending upon the economics involved and end use of the product.

The diversity of woods found in tropical species suggests several possibilities in conversion to a particleboard product. The first would be to convert the heterogeneous wood mixture as it arrives at the plant to standard types of flakes or particles and use these in a conventional process to produce homogeneous or multilayered panels. A more elaborate complex might have two manufacturing lines and direct the various species to their most logical end product. Government incentives are particularly helpful in the expansion of new industries such as particleboard.

Another suggestion is for the governments of developing countries to take the lead in requiring the proper use of wood in construction. Purchase orders by the government and approval of building permits would include a requirement for use of seasoned, dimensioned, and preservative treated lumber or other wood parts; specify the local species and furnish information so that architects and builders can follow the specifications.

The most promising solution to increased utilization and better management of tropical forests is through large integrated industrial complexes. Products in this "model" solution include sawnwood, veneer, plywood, pulp and paper, and byproducts. It uses the largest proportion of the tropical forest volume. The heavy investment ($100,000,000) requires permanent management of the raw material sources to protect that investment. It provides the technical competence on both industrial management and forest management with the best opportunities for technology transfers. It has the economies of scale to compete in the export market, the highest foreign exchange earnings, and furnishes the most sustained local employment and income. Forest product corporations as technical partners in enterprises of this magnitude have diversified market outlets. They have the trained foresters and other specialists to overcome many of the inhibiting factors cited in this report.

Forestry development towards this large integrated industry "model" is a gradual process and will take many years. There will be instances of initial foreign investments of this size being made, but for the most part they will have a stage growth. Government priorities should be given to them, including short and long range planning for allocating specific areas of the forest resources of the country.

7. Orientation of Forestry Research

Forestry research by the developing countries is a necessary adjunct to a successful forestry program. In addition to the research in forest inventories, species identification, wood properties, and markets, there are many other needs.

Because there are so many demands on developing countries' limited resources, forestry research should give priority to applied rather than basic research. There are many opportunities for testing on a selective basis the application of forest research findings from other parts of the world to specific situations in developing countries. The opportunities for quick payoffs in applied research should be taken advantage of whenever possible.

With the scarcity of trained research talent, it is preferable to concentrate certain research in regional institutes and to coordinate other ongoing research in several countries through such

institutes whenever feasible. This is especially desirable where results can be used throughout the region, where expensive equipment is needed, and to take advantage of the different skills represented in a larger group. There will be instances as in studying different silvicultural management methods where such studies will need be localized to the site conditions in specific areas.

There are larger gaps in our scientific knowledge of the ecology of tropical forests than for other land areas of the world. It is likely that the research scientists of developing countries can render some assistance on the more basic studies such as this one.

D. Areas for Innovative United States Contributions to Forestry Assistance

United States contributions to forestry assistance from all sources, including the foundations and the international agencies, should be complementary to the skills of other countries. Under that concept, the United States would, to the extent practicable, participate in filling host country requests when assignments are worked out with other assistance agencies for implementing a Development Plan. This would allocate United States resources for forestry assistance to those developing countries in which the inhibiting factors to industrialization and better forest management have been analyzed and specific actions prescribed to overcome them.

In supplying forestry assistance needs there are several activities in which United States technology in forestry and related fields is superior. United States assistance capabilities may be either unique, or alternative sources may be very limited. It would be appropriate to give priority in forestry assistance to such projects. In the application of many of these techniques to developing countries, some adaptations will likely be necessary and applied research for that purpose should be a part of the assistance project.

Another suggested category of United States forestry assistance would be for those types of projects which are applicable in developing countries because of special conditions which are identical or very similar to those in the United States. An example would be

control methods for the Southern Pine Beetle (Dendroctonous frontalis) which reaches epidemic stages in the pine stands in Southern United States and in similar pine forests in Mexico and Central America. Certain projects of the USDA's Forest Service Tropical Forest Institute at Rio Piedras, Puerto Rico, would likewise fit this category.

The foregoing categories of assistance are not exclusive. A single forestry project could fit all three categories. For illustrative purposes several examples of these types of projects follow, with brief descriptions. Sources for further information are listed in the Appendix.

1. Determination of Secondary Wood Properties

Although wood properties of primary tropical hardwoods such as teak and mahogany are well known, many secondary woods in developing countries remain unutilized or underutilized because of insufficient, unreliable, or unavailable information on their physical, chemical, and other properties. The United States is in a leadership position to determine wood properties or to guide others in such research. Identification of the species tested would be a corollary activity.

2. Reforestation by Aerial Seeding

For reforesting areas denuded by forest fires, clear cutting, shifting cultivation, or other causes, particularly in isolated areas, aerial seeding may prove effective. The technique has been developed for pine species and used successfully on over one million acres in the Southern Pine areas of the United States.

Fixed wing aircraft or helicopters can be used. Power driven seed meters and a centrifugal slinger must be used on a helicopter, while planes can operate with gravity flow of seed into a venturi-type distributor. The seed receives repellent coating. On certain sites ground preparation may be necessary.

The procedure should be directly applicable to denuded pine sites in Mexico and Central America.

It would be most applicable in sparsely populated and relatively inaccessible areas. Experimental work on other species would be needed prior to seeding in other parts of the world. It is most economical for areas over 500 acres in size. As a specific example, Honduras has thousands of acres of formerly pine forests that have been denuded by man, insects, and fire. Repeated burns have kept a mineral soil seedbed which is favorable for direct seeding. There is an abundant seed supply that could be gathered at low cost from logging operations. Care would need be taken to select areas where fire risk is at a minimum and there is organized fire control. Aerial seeding would fit developing countries which have a well trained air force that could be enlisted in a "civic action" program of this type.

3. Remote Sensing

Research is under way by the U.S. Forest Service in cooperation with both the University of California at Berkeley and NASA on use of remote sensing techniques in forest planning and inventories. This involves the Earth Resources Technology Satellite ("ERTS") and advanced airborne sensors. It includes the use of multispectral scanners, infrared, and radar techniques. The results appear more promising to date for topography, hydrologic and geologic studies than for the detail on timber types, species, size and volumes necessary for forest inventories. The rate of the thermal emission from vegetation varies, and it has not yet been possible to obtain definitive thermal stand signatures to distinguish vegetative types. The present aerial photo interpretation and field sampling procedures are superior. The studies which show the most promise for future application are referenced in the Appendix.

4. Cadastral Surveys

A procedure used in Alaska by the Department of the Interior, Bureau of Land Management, should have application to the cadastral problems in developing countries. The system is known as the Air Borne Control or ABC system. In this method, field control is established by standard methods such as triangulation, electronic traverse, doppler positioning, or stellar photography. The cadastral plan or layout is developed mathematically in the office on a map of the area, and

positions are derived for the property corners. The direction and distance between the ground control points and the property corners are then calculated.

The ABC system derives its name from the methods used to establish the corners in the field. The control points are reoccupied and a helicopter, equipped with electronic distance measuring equipment, is used to establish the land corners. The helicopter can be accurately located by simultaneously measuring the distance to two or more control points, and a corner monument is dropped from the low flying helicopter. The helicopter can hover over the dropped monument and angles measured from the control points to the helicopter are used to verify the distance measurements. Ground crews later visit the corner to set the marker. If a small offset is required, due to an error in dropping the marker, it is easily made.

Land subdivision by the ABC method is quite rapid since line clearing and ground surveying methods are not required. The technique has an additional advantage in that coordinate locations for each corner are known and can be used for many useful purposes such as electronic map drafting and reestablishing the point if it is later moved or lost.

Since it is a nonrecurrent type of project, this technical service could be contracted by the developing countries.

5. Wood for House Construction

Wood and wood-base materials can be effectively utilized in the construction of highly satisfactory and durable low-cost houses in developing countries. To insure this performance, however, the wood and wood-base materials must be used with full recognition of their inherent characteristics, and their use must be in harmony with the social mores and environmental conditions of the area.

A thorough understanding of the basic characteristics of the wood resources of the country is needed. Once these characteristics are known and the material is produced to meet specified quality and size standards, it can be properly used in construction.

The use of treated wood post foundations, single thickness floor construction, dual purpose siding and sheathing, and roof trusses can be adapted to meet local conditions with full assurance that they will provide the structural integrity and durability necessary to a good home.

The term low-cost is relative. Many of the designs will be too costly to fill the major needs for low-cost housing in developing countries. The concepts, however, can provide many useful ideas for low-cost construction. The proper use of lumber can make a substantial contribution to reducing the tremendous housing deficits. Housing can also provide a domestic use for lower lumber grades which do not have an export market but have the strength and other necessary properties for local construction.

6. Cattle Feed from Wood Residues

One innovation which should be mentioned for possible application is the progress in experiments using wood processing residues as cattle feed. Commercial trials of research findings are now under way. The project has two aspects. (a) The use of sawdust-sized particles and of ground wood fines as non-nutritive roughage in the rations of cattle and other ruminants. Such use would be limited to a wood content of from 5 to 15 per cent. Certain hardwoods have the additional capability of providing a modest contribution to the ruminant's energy intake. (b) Pulping residues hold distinct promise as an energy substitute with no need for pre-treatment. The more highly delignified materials equaled or surpassed corn in digestibility. With even moderate delignification, digestibility values that compare with hay were attained in the laboratory.

The shortages of cattle feed and forage areas in forested tropical areas suggest that additional followup on results of commercial trials be made with a view to considering possible applications.

7. Wood Preservation by the Double-Diffusion Process

The double-diffusion process for imparting resistance to biodegradation of wood was developed about 30 years ago to meet the need for a simple,

inexpensive treatment for fenceposts. Since then, use of the process has been extended to such items as poles, lumber, cooling tower slats, etc.

The method consists of soaking wood first in one chemical solution and then in a second. Several different combinations of chemical solutions may be used. Commonly, the first is copper sulfate and the second is sodium chromate and/or sodium arsenate. The water-soluble salts diffuse into the wood where they react to form a relatively insoluble, nonleachable compound, such as copper chromate, which is toxic to fungi and insects. In some cases, modifications to the basic process have proven valuable. For example, heating of the first solution, incising, and partial seasoning of the wood have improved treatment of some species to the extent that chemical penetration has exceeded that attainable by pressure treatment.

Laboratory and pilot-scale evaluation of a modified double-diffusion process with three of the commercially important softwood species and one hardwood, showed it to be markedly superior to pressure treatment in terms of preservative penetration and retention. This and other studies have established that the process may be a desirable alternative to pressure treatment even where pressure-treating facilities exist.

Since only simple equipment and relatively low-cost chemicals are needed, and the chemicals may be shipped in a dry state to the treating site where water is used as the solvent, the process would seem to deserve consideration for use in developing countries. Although the process is more effective with some species than others, the successes obtained in numerous studies with North American hardwood, and softwood posts and poles including Hawaiian and Puerto Rican posts, and Costa Rican banana props suggest a good probability of effective treatment of a diversity of species in foreign countries, once the proper combination of treatment variables has been defined.

8. Technical Research Project Examples

Two technical research projects now under study which may increase utilization of timber from developing countries if successful are:

-- The USDA Forest Service Research and Development Program for Advanced Logging Systems. Called Project "FALCON" (Forestry, Advanced Logging, and Conservation), one phase is concerned with research on machines, mechanical operations, and the total logistics of logging. Special emphasis is being given to helicopters, balloons, and aerial cable systems. The following is quoted from the project prospectus. "In addition, the results of FALCON might prove useful for those parts of the world where surface land transportation systems are presently nonexistent or limited. Much of Africa, Asia, and Latin America presently contain a large proportion of the world's untapped hardwood resource." Another phase of Project Falcon deals with forest environment research on survey techniques, logging residues, regeneration, and the effects on soils, water, fish and wildlife, and aesthetics from logging operations. Results should also be applicable to the developing countries. Research on this project is under way but not at the strength contemplated. It is too early to forecast results, but a successful balloon logging operation was recently carried out in the Mississippi Delta hardwoods.

-- The Canadian Forest Service, Forest Management Institute, has an experimental logging development program under way utilizing an air cushion vehicle (ACV) such as Hovercraft. Most of the ACV development to date has been in England and France for marine applications, but studies are now under way in Canada for heavy industrial applications. The Canadian Forest Management Institute has a test platform where applications of the ACV principle on logging operations are being studied. Air cushioned vehicles called Hovertrailers have been developed for cross-country transport of heavy and awkward loads over ground where conventional wheeled or tracked vehicles cannot move under load. These units must be pulled with conventional units but the draw-bar-pull is relatively small. The Hovercraft application, if proven feasible, might complement the helicopter and balloon systems being studied under Project Falcon.

The present state of the art and cost factors make these innovations currently inapplicable to tropical forest situations. Both of the above are advanced systems which, if and when feasible, would require substantial capital for sophisticated equipment, maintenance costs, and technology transfers in training, all

of which will present limitations to application in developing countries. However, progress on these developments should be monitored by assistance agencies.

9. Civilian Conservation Corps Programs

There may be opportunities for using combination work-study programs. For example, in an agricultural-forestry colonization project which involves road construction and other improvements in a new area, the work crews might be selected from a younger age group. They could be those individuals who might choose to make their homes in the area when colonization starts.

A portion of each day might be spent in an educational program. This could include literacy, vocational training, and the specific facts that a colonist moving to the project should know in advance, such as agriculture, forestry, and other relevant matters.

Administration of a project of this nature may need to involve the local armed forces. Where applicable, it should avoid serious adjustment problems which have arisen in some colonization projects. The experience of the United States in running Civilian Conservation Corps Camps and Centers would be valuable in advising on these types of projects.

10. Aerial Fire Detection, and Transportation of Forest Fire Fighters

The lack of access roads is a major deterrent to the success of forest fire control in developing countries. The detection of fires when small and a rapid initial attack are fundamental. There are potential applications of a system of aerial fire detection with the cooperation of the local air force during the fire season. The system requires regular flight patterns at determined intervals. Locations of fires detected are transmitted by a radio net to a Fire Central Headquarters which dispatches the attack forces.

Any available helicopters would fit particularly well into the fire suppression organization, mainly to be used for transporting fire crews. They would need a base station for maintenance but could be outposted at logical locations dependent on fire danger ratings. The use of this system or a part of it would

be applicable only in situations where there is a well trained air force and dependable cooperation can be secured. This application also could fit into "civic action" programs.

As organized forest fire protection is not needed in the humid and semi-humid tropical hardwood forests, this proposal would not always be justified for the majority of developing countries forest areas. An apparent application would be in the coniferous forests of Mexico through Central America.

11. Aerial Application of Forest Fire Retardants

This technique would be applicable to foredted areas in which (a) fire occurrence and damage justify control measures, (b) inaccessibility delays a prompt attack by ground fire-fighting crews, and (c) there is a fast rate of spread.

Speed of attack is a cardinal principle of forest fire control. The lack of roads in developing countries as in the pine forests of Central America might make feasible the use of flame inhibiting chemicals such as ammonium phosphate, commonly available as commercial grade agricultural fertilizer in solid form or liquid concentrations. Its availability at a reasonable cost would be an important factor in a decision on this application.

The retardants serve to slow the rates of fire spread until ground crews can reach them. It would only be feasible where there is a well trained air force that could be assigned the job during the fire season.

Fixed wing aircraft of a bomber configuration are best for retardant dropping. Cargoes will run from 600 gallons in a torpedo bomber to 3,000 gallons in a P2V type. Helicopters can carry buckets from 50 to 1,000 gallon capacity.

The use of retardants is a more sophisticated measure that might be considered after experience with aircraft has been gained in other phases of fire control.

A feasibility study and considerable training would be necessary before initiating this project.

12. Prescribed Burning

This technique was developed in the southern pine forests of the United States by the U.S. Forest Service. It is used on the National Forests in the South where privately owned cattle are grazed under permit. It is the planned use of fire under controlled conditions. The burn is prescribed during periods of low fire hazard when it will be a creeping ground fire. It is a periodic prescription which permits small seedlings to reach a size that they will not be damaged by low intensity fire. It prevents an accumulation of organic matter to the extent that a forest fire during a hazardous period will generate sufficient heat to destroy the standing timber. Under certain conditions, the prescribed burning will have certain sanitation benefits and serve as a means of destroying the "rough" which has built up, and thus improve forage volume and increase nutritional values. It is also helpful in reducing the occurrence of incendiary fires set by the cattle owners.

There are many places in the developing countries where there is dual use of forests for grazing. The system should be most applicable to the coniferous forests of Mexico and Central America. Its application requires a strong informational and educational campaign with the forest residents.

13. Air Freight Terminals

Air freight complexes have had some very preliminary studies in relation to their potential application to developing countries. Airports are presently located and built for passenger traffic--not for freight. This suggestion would call for an air terminal for air freight in a developing country. A Central American country with proximity to the United States might serve as an example. The industries would be built around an airfield which would thus become part of the industrial complex. Normally, there would be more than one industry represented. The United States sister terminal might be in Florida, where some exploratory work has already been done relative to this idea. Some of the light industries might be for assembly, with components flown in and

the assembled products flown out. Air transportation to the new industrial site within the country, utilizing helicopter or fixed wing aircraft, might also be part of this network. The proposal would complement ocean transport as an integrated transportation system. While costs of ocean and land transportation have been rising, air freight costs have decreased with the technological improvements in aircraft.

The products csrried by air freight obviously would have to be those whose value is high in relation to weight and volume. This limits forest product applications. Wood products in the initial stages have low value in relation to weight. Each processing operation decreases weight and increases product values. If an air freight complex proved to be viable, wood products such as handicraft articles could fit that category. Bowls, tea-tables, bookends, lamps, figure carvings, etc., have a greater market in this country than has been supplied to date. Inhibiting factors have been the usual ones of unreliable quality, too small a production, and an undependable supply. The opportunity to build new industries on a large scale around an air freight terminal might be one of the answers.

In summary, the present surface transportation of trucks to railroads, ports, and ocean steamers in the exporting country and to ports, railroads, and trucks in the importing country with several handling costs, pilferage, breakage, and time factors involved may be improved by new especially designed air freight complexes for certain uses and products.

14. Other Aspects

The thirteen examples described are not all-inclusive. They illustrate a range of research and development projects and other activities in which there is unique competence in the United States and which should have application in developing countries. They include those on which development work is completed and others for which research is still under way. About one-half of the forestry research in the world is conducted in the United States. The one Canadian project is included to indicate that other countries with special capabilities on certain innovations might follow the same principle in their assistance priorities.

The potentials for application of the types of projects described and the frequent innovations and ideas from new research findings suggest that an assistance agency such as AID might consider setting up a system with the U. S. Forest Service for preparation and periodic revision of a project listing for its possible use.

The International Executive Service Corps and the United Nations Volunteers program offer opportunities for transferring United States forestry and industry technology to developing countries. Publicity in the Journal of Forestry and trade magazines to reach public forester retirees would likely result in a more than adequate list of competent volunteers. Prior to this action a review--and possibly some promotional effort--should be made of opportunities for their services.

VI. CONCLUSIONS

Time is important in attaining adequate developing country forestry programs to reach the objectives for industrial development and protection and management of the forests. The estimated 5.2 billion acres in forests of those countries--approximately one-sixth of the earth's land surface--is under increasing population pressures with accelerating destruction from shifting agriculture, uncontrolled exploitation, and other destructive causes. If these countries are to attain their development goals--and avoid a tremendous future obligation to restore the forests and watersheds--application of the primary measures discussed in this paper should be stepped up! Priority needs are strengthening the local Forest Service and related institutional development.

When the FAO Provisional Indicative World Plan production and trade projections for 1985 are reached, it is estimated that 30 to 40 million additional employment opportunities will be created. Importantly, most of the industry creating this employment should be located in rural areas. It will make a major contribution to providing rural employment and reducing urban migration.

The value of forest products exports is estimated to add over $600 million annually to foreign exchange earnings of the developing countries in 1975 relative to 1962 and another $600 million annually between 1975 and 1985 to reach a total of $1,820 million.

The value added attributed to timber is illustrated by 1958 data for the United States.

Forest management and harvesting	$2.5 billion
Primary manufacturing	3.9 "
Secondary manufacturing	5.4 "
Construction	7.6 "
Transportation and markets of timber products	5.3 "
Total	$24.7 billion

Employment increases about eight times between the harvesting and final stage with the product value increasing about ten times.

While the ratios will vary considerably between developing countries and in comparison with the United States, the data indicate the substantial gain by increasing local processing and domestic use in construction. The foregoing data are some of the key indicators of the economic results from development of the forest resources.

While it has been touched upon in various places in this paper, the picture would not be complete without further emphasis on the environmental benefits attainable from adequate forestry programs. It has been stated that the welfare of man is inextricably interwoven with how he uses, manages, and conserves the natural resources of the world. In the humid tropic ecosystem of the developing countries, the maintenance of soil fertility after removal of the high forest cover is a major problem. Leaching of soluble salts and plant nutrients from the exposed soil is so acute that crop yields decline rapidly in a short period. Destroy the forest and the oxidizing power of the tropical sun and the washing, leaching effect of tropical rain soon destroy the fertility. The adverse effects of destructive forest practices in soil erosion, siltation of streams and reservoirs, on quality, quantity, and timing of water flows, and to recreation and wildlife resources are well known. The perspective of history is likely to judge the environmental forestry benefits to have been of greater importance than the economic aspects.

The basic need is institutional. How do the developing countries get planned, concerted, and sustained action to make the right things happen in time in the management, protection, and development of this vast timber resource? It is always much easier to prescribe what ought to be done than to do it. The poor developing country struggling with all the demands on its limited resources needs the economic benefits from its forests. It is going to use them unwisely for its short run benefits or wisely for its long time permanent development. The practical result will be somewhere between those two alternatives.

The major thrust of this paper is a commonly accepted view that both timber utilization and institutional development must proceed together. The latter is the key to better forest management which is made possible by utilization. The objective is to develop

both as rapidly as feasible. Speeding up the process means that outside forestry assistance will be required; and if past experience is any guide, assistance will be requested by the developing countries, looking particularly toward the United States.

As mentioned earlier, the United States conducts about one-half of the world's forestry research. The results of this research could provide a continuing opportunity for technology transfers to developing countries. While the International Union of Forestry Research Organizations (IUFRO) provides a forum for forestry research discussions, something more is needed. A liaison system between USDA's Forest Service and an assistance agency such as AID would help fill that need. It would consist of a listing, brief description, and periodic revision of research findings having potential applications in developing countries, widely disseminated to developing countries and donor agencies. In addition, United States support of regional tropical forestry research institutes would motivate and guide local initiative to provide the research needed to resolve common problems. Priority in United States forestry assistance could be given to innovative technological developments of this nature as well as to projects in situations which are very similar to United States conditions.

APPENDIX

A. COUNTRIES WITH USAID MISSIONS WHERE UNDP/FAO FORESTRY ASSISTANCE IS APPROVED, OPERATIONAL, OR RECENTLY CONCLUDED

Latin America	Africa	Near East
Argentina	Botswana	Afghanistan
Bolivia	Cameroon	Bangladesh
Brazil	Chad	Burma
Colombia	Ivory Coast	Morocco
Chile	Kenya	Nepal
Dominican Republic	Liberia	Pakistan
Ecuador	Nigeria	Tunisia
El Salvador	Senegal	Turkey
Guatemala	Swaziland	
Guyana	Tanzania	
Haiti	Uganda	
Honduras	Upper Volta	Asia Pacific
Jamaica	Zaire	
Mexico	Zambia	Indonesia
Nicaragua		Korea
Panama		Laos
Paraguay		Philippines
Peru		Thailand
Uruguay		
Venezuela		

References:

1. FAO Misc/72/14/1 July 1972

2. Foreign Service List, U. S. Department of State, June 1972

APPENDIX

B. The following persons contributed many suggestions and ideas used in the preparation of this paper;

Bazan, Flavio, Office of Regional Development
Organization of American States
Washington, D. C.
(Formerly Director, Forest Service,
Peru, S. A.)

Becker, Maxwell E., Technical Administrator
Office of International Programs
Colorado State University
Fort Collins, Colorado

Bushman, Robert R., President
The Mann and Parker Lumber Company
New Freedom, Pennsylvania

Dewar, Robert J., Deputy Division Chief
General Agriculture
International Bank for Reconstruction
and Development
Washington, D. C.

Dickerman, M. B., Associate Deputy Chief for Research
USDA, Forest Service
Washington, D. C.

Gregersen, Hans M., Assistant Professor
School of Forestry
University of Minnesota
St. Paul, Minnesota

Hair, Dwight, Special Studies
Division of Forest Economics and
Marketing Research
USDA, Forest Service
Washington, D. C.

Haynes, W. N., Manager, Woodlands Division
Union Camp Corporation
Savannah, Georgia

Holscher, Clark E., Director
Division of International Forestry
USDA, Forest Service
Washington, D. C.

Horner, David, Office of Foreign Investments
Department of Commerce
Washington, D. C.

Howlett, Myles R., Director, Division of Engineering
USDA, Forest Service
Washington, D. C.

Huberman, M. A., Chief, S.E. Asia Projects
United Nations Development Programme
New York, N. Y.

Hutchinson, S. Blair, Division of Forest Economics
and Marketing Research
USDA, Forest Service
Washington, D. C.

Johnson, David B., Wood Chemistry and Fiber Products
Division of Forest Products and
Engineering Research
USDA, Forest Service
Washington, D. C.

Koenig, Paul, Forest Industry Specialist
Business and Defense Services Admin.
Department of Commerce
Washington, D. C.

Kotok, Edward S., Structural and Forest Systems Eng.
Division of Forest Products and
Engineering Research
USDA, Forest Service
Washington, D. C.

Lamb, F. Bruce, Technical Director, Forest Resources
Champion International
New York, N. Y.

Mashler, William T., Chief, Section for Global and
Inter-regional Projects
United Nations Development Programme
New York, N. Y.

McSwain, George A., Process and Product Engineering
Division of Forest Products and
Engineering Research
USDA, Forest Service
Washington, D. C.

Nelson, John A., Southern Kraft Division
Woodlands Department
International Paper Company
Mobile, Alabama

Oberdorfer, M. R., Pulp and Paper Specialist
International Finance Corporation
Washington, D. C.

Oedekoven, K. H., Director
FAO Forestry Research Project
FAO Country Office
Rua Jardin, Botanico 1008
Rio de Janeiro, Brazil

Potter, Robert V., Staff Assistant
Division of International Forestry
USDA, Forest Service
Washington, D. C.

Rowe, Raymond D., Forestry Specialist
Agricultural Projects
International Bank for Reconstruction
and Development
Washington, D. C.

Schubert, Thomas H., International Tree Seed Exchange
Division of Timber Management Research
USDA, Forest Service
Washington, D. C.

Wadsworth, Frank H., Director
Institute of Tropical Forestry
USDA, Forest Service
Rio Piedras, Puerto Rico

Walker, Laurence C., Dean, School of Forestry
Stephen F. Austin State University
Nacogdoches, Texas

Yavorsky, John M., Dean, Public Service,
Continuing Education
State University College of Forestry
Syracuse, N. Y.

Zerbe, John I., Division of Forest Products and
Engineering Research
USDA, Forest Service
Washington, D. C.

APPENDIX

C. BIBLIOGRAPHY

1. Agricultural Development Council Workshop. Research on Forestry Development in Developing Countries. Papers delivered and discussion summary. Washington, D. C., March 27-28, 1972.

2. Baechler, R. H. and Roth, H. G., The Double Diffusion Method of Treating Wood: A Review of Studies. Forest Products Laboratory, Forest Service, U. S. Department of Agriculture, Madison, Wisconsin. 1964.

3. Chudnoff, Martin. Void Volume Wood, Whole Tree Use Concept. U. S. Department of Agriculture, Forest Service, Institute of Tropical Forestry. Rio Piedras, Puerto Rico.

4. Derr, Harold J. and Mann, William F., Jr. Direct-Seeding Pines in the South. U. S. Department of Agriculture, Forest Service. Agriculture Handbook No. 391.

5. Economic Commission for Asia and the Far East: Asian Industrial Council. Report of the Fact-Finding Team on Forest-Based Industries in the Region. Bangkok, Thailand. 1968.

6. FAO Advisory Committee on Pulp and Paper. Second Consultation on World Pulp and Paper Demand Supply and Trade. 1971. Outlook for Pulp and Paper Consumption and Trade to 1985. Rome, Italy. 1972.

7. FAO Agricultural Commodity Projections 1970 - 1980. Forest Products. Rome, Italy. 1971.

8. FAO Forestry Department. List of UNDP Reports, 1 January 1972. Rome, Italy.

9. FAO Forestry Technical Reports sent to Governments - Listing by Titles. December, 1971 through June, 1972.

10. FAO/Government Cooperative Programme. List of Projects. 1 August 1972. Rome, Italy.

11. FAO Informe del Seminario Sobre Desarrollo Forestal, Reforma Agraria y Colonizacion Para Paises de America Latina. Brasilia, Brasil. 1968.

12. FAO et al. Proceedings. World-wide Consultation on Use of Wood in Housing. Vancouver, British Columbia. 1971.

13. FAO, The State of Food and Agriculture, Chapter IV, Modernizing Institutions to Promote Forestry Development. Rome, Italy. 1969.

14. FAO, Westeby, Director. Programme Coordination and Operations. Forestry Dept., Rome, Italy. (Correspondence with Holscher re subject of this paper. August 1, 1972.)

15. FAO, Wood: World Trends and Prospects. Basic Study No. 16. Rome, Italy. 1967.

16. FAO (a) World Consultation on Forestry Education and Training; (b) Fifth Session of the FAO Advisory Committee on Forestry Education. Two reports. Stockholm, Sweden. 1971.

17. FAO, Yearbook of Forest Products. 1969-70. Rome, Italy.

18. FAO, Forestry Education and Training in Latin America. Shirley, Hardy L. and Llaurado, Javier Prats, Provisional Test. 1969.

19. Gregersen, Hans M. The Latin American Contribution to United States Forest Products Imports. Problems and Potentials for the Exporter. Paper presented at Annual Meeting of the Forest Products Research Society. Miami Beach, Florida, 1970.

20. Hair, Dwight. The Economic Importance of Timber in the United States. U. S. Department of Agriculture, Forest Service. Miscellaneous Publication 941. 1963.

21. Hughes, Bennett O. Technical Assistance in Forestry in Latin America. Latin American Science Board. 1964.

22. International Trade Center UNCTAD/GATT Proceedings. Seminar on the Promotion of Tropical Timber in Europe and the United States of America. 1971.

23. Lamb, F. Bruce. World Forest Resource Tributary to the North American Sphere of Development. Paper given at Yale Forest School Seminar. New Haven, Conn.

24. Liska, J. A. The Effective Use of Wood in House Construction. Presented at Seminar on Design and Construction of Low-Cost Housing for the Caribbean Countries. San Juan, Puerto Rico. 20 April 1972. U. S. Department of Agriculture, Forest Service. Forest Products Laboratory, Madison, Wisconsin.

25. Mexico--Terms of Reference for the Elaboration of a Plan for Forestry Development. (Estudio de Gran Vision.) As presented to the Inter-American Development Bank for Review.

26. Millett, M. A., Baker, A. J., and Satter, L. D. Cattle Feed from Wood Residues? U. S. Department of Agriculture, Forest Service. Forest Products Laboratory, in cooperation with the University of Wisconsin, Madison, Wisconsin.

27. National Aeronautics and Space Administration. ERTS Program. Listing Studies under way and Departments Involved. July 20, 1972.

28. Payne, Burnett H., and Nordwall, David S. A Review of Certain Aspects of the Forestry Program and Organization in Indonesia. FEDS Field Report 10. Foreign Economic Development Service, U. S. Department of Agriculture, cooperating with U. S. Agency for International Development.

29. Silversides, C. R., Chairman, Associate Committee on ACV, Technology. (Correspondence with Holscher re Canadian Forest Management experiments with air cushion vehicles.) Forest Management Institute. Ottawa, Canada.

30. State University, College of Forestry Proceedings. Conference on Transportation of Tropical Wood Products. Syracuse, N. Y. 1971.

31. State University, College of Forestry Proceedings. Conference on Tropical Hardwoods. Syracuse, N. Y. 1969.

32. UNDP United Nations Development Programme - Status of Approved Projects in the Special Fund Component, as of 30 November 1971. New York, N. Y.

33. USDA Forest Service. Aerial Fire Detection; Use of Fire Retardants; and Prescribed Burning. Forest Service Manuals and Handbooks. Washington, D. C.

34. USDA Forest Service. Low-Cost Homes for Rural America. Agricultural Handbook No. 364. 1969. Washington, D. C.

35. Wellwood, R. W. Report to the Government of Nigeria on Forest Industries. FAO. Rome. 1966.