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TIMBER PRODUCTION AND MARKETING IN THE BRAZILIAN AMAZON

By

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ABSTRACT

TIMBER PRODUCTION AND MARKETING IN THE BRAZILIAN AMAZON

By

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This study summarizes the results of a 1979 field investigation of the economic characteristics of the lumber, plywood and veneer industries in the Amazon region and the efficiency of marketing procedures in these industries. Detailed interviews were held with a large sample of mill operators, using a formal interview schedule. Additional interviews were conducted with market agents and with Federal and state agencies.

The sawmill industry is described in considerable detail--number of sawmills and output, geographic dispersion of mills, ease of entry into sawmilling, availability of raw material, level of technology, tree species used, seasonality in log receipts, transportation of sawlogs, sawlog procurement methods, price determination, lumber grading and seasoning, kinds of product, product inventories, lumber sales procedures and lumber production problems. Similar subject coverage is also presented, but in less detail, for the plywood and veneer industries.

Inefficiencies in production and marketing are numerous, particularly among the small- and medium-size sawmills. However, the

penalties for inefficiencies are not readily apparent. Timber production is expanding rapidly, and there is a market for all that can be produced. Product prices are relatively high; stumpage is available free or at nominal cost; labor costs are generally low; and profits are high.

Mills typically operate at well below their installed capacity. The obstacles to full production include equipment failures and delays in obtaining spare parts, inefficient mill layout, unstable labor force and energy shortages. Most critically, the major limitation to full production in the sawmill industry is in the failure to accumulate sufficient inventory of logs during the wet season to carry production through the dry season when log deliveries fall off or cease. In the plywood industry, the chief limitation to production is in the inadequate ratio of dryers to production lines.

Most Amazon sawmills are too small to gain important advantages in marketing products that would become possible with larger size. Lack of vertical integration as well as the geographic dispersal of the timber-products industries leads to inefficient use of wood raw material. Innovation and adaptation of new techniques and products are not common. Poor quality of product is commonplace in the sawmill industry. The quality of products is identified through the use of international grading rules in the plywood industry and in lumber exports, but the major part of the lumber industry, which produces lumber for local and national markets, is not governed by generally accepted written lumber-grading rules.

The timber industries have expanded rapidly to a 1978 output of 4.0 million cubic meters of lumber, 205,000 cubic meters of plywood and 70,000 cubic meters of veneer. The combined total output represents only 0.7 of 1 percent of the estimated commercial timber volume in the Amazon region. However, the marketable species are relatively few and only a very small portion of the forest is economically accessible to forest industry. In a number of localities where mills have tended to congregate, the preferred kinds of timber within ready access have been exhausted.

To: Ignacio, Carmela and Teresa.

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CHAPTER I

INTRODUCTION

Brazil's Amazon Basin is a vast, underdeveloped region. With an area of some 3.6 million square kilometers, more than 40 percent of the national territory, population reached only 4.8 million in 1978 or less than 5 percent of the total population. Most of the population is scattered through the Basin along the Amazon River. There are few urban centers other than Manaus and Belém.

With the exception of the industrial centers of Manaus and Belém, the economy is minimal. Per capita income is only about US $360 (IBGE, 1977). There are some important mining establishments, but little agriculture. Attempts at agriculture on Amazonian soils have been largely unsuccessful. Forest industries are tied mainly to extracting products from the forest and the manufacturing of timber products such as lumber, veneer and plywood. But despite a considerable degree of dependence on forests locally, the forests have been tapped only in restricted areas. The Amazon forest, estimated to contain 45.7 billion cubic meters of timber (Pandolfo, 1978), is by far the greatest concentration of undeveloped tropical forest in the world.

Timber industry has been developing gradually. Most production has been aimed at local markets and the adjacent Northeast

region of Brazil. Increasingly, however, production has moved into the export market, particularly the United States, some European nations, Venezuela and to the South and Southeast regions of Brazil.

South and Southeast Brazil are the important market regions of Brazil. They are also the major locations of timber manufacturing, but the raw material base has been largely exhausted. Part of the problem has been addressed by an impressive program of reforestation, stimulated by tax incentives, but the reforestation program will be insufficient to supply major timber needs, particularly in sawlogs. The production of lumber from Paraná pine, the mainstay of the sawmill industry in the South and Southeast regions, has been declining very fast both in absolute quantities as well as in its relative share of total production. It is estimated that the Paraná pine forest will disappear in less than 10 years at present exploitation rates (Sudesul, 1977).

Also, it is very likely that the approximately 2.9 million hectares of Eucalyptus spp. and Pinus spp. established in the South, mainly by strong pulp and paper interests, will supply raw material principally to the pulp and paper industry. A large supply deficit can be predicted in sawnwood, plywood and veneer. This situation offers a great opportunity for development of the Amazon region's vast forest resources.

Advantages of Timber-Industrial Development

To the owners and investors, the primary goal of the timber-based industries is to return a profit; aiding in economic and industrial development is entirely secondary. However, from a social viewpoint, timber-sector development can be especially helpful to regions such as the Amazon Basin which have experienced little economic development. Some of these advantageous features are discussed below.

1. Investment Alternatives. As Westoby (1962) states, forest industries range from small sawmill enterprises requiring little investment to complex pulp and paper enterprises requiring very large investments. The alternatives are many, but the choices made at any stage of development can be adapted to the availability of capital and the technological skills available.

2. Import-Saving Effect. Timber-industrial development of the Amazon Basin, where the standing timber inventory approaches 50 billion cubic meters of wood, holds out the possibility of substantial exports, thereby contributing favorably to Brazil's balance of trade.

3. Location. Raw timber is heavy and bulky. Because processing eliminates much of the bulk and weight, forest industries tend to locate close to their raw material source. The location of forest industries in the hinterland leads to the development of infrastructure and other dispersed industries. Such developments are attractive in an era when societies tend toward excessive urbanization in a limited number of locations.

4. Technological Advantage. The skills required in logging and in the small timber-manufacturing enterprises are acquired easily. Once acquired, these skills can be transferred to the more complex timber-manufacturing enterprises and to other industries. Timber industries are an excellent means of introducing industrial skills into regions where unskilled labor predominates.

5. Linkages. The forestry sector is well recognized for its strong forward and backward linkages to other economic activities. Strong backward linkages are created for supplies and service industries and forward linkages to secondary wood manufacturers.

Objectives of the Study

This study attempts to describe the economic characteristics of the primary-processing forest industries and to provide an analytical framework for investigating the efficiency of sawmill, plywood and veneer markets. More specifically, the objectives are:

1. To describe timber production and the marketing system in the Brazilian Amazon.
2. To identify and describe the elements of market structure which have influence on market performance.
3. To describe how effectively the functions of timber marketing are fulfilled.
4. To identify possible changes in market structures and practices which might raise market performance.

Study Area

The study area, termed the Amazon region, is defined as the states of Pará, Amazonas and Acre and the Federal territories of Roraima and Rondônia (Figure 1). For purposes of this study, the territory of Amapá was considered part of the state of Pará.

Procedure

The basic procedure of this study was to conduct detailed interviews, using a formal interview schedule (Appendix A), with primary timber manufacturers throughout the Amazon region. Interviews covered details of log acquisition, timber-product manufacture and timber-product marketing. Additional interviews were conducted with market agents functioning between timber producers and timber-products manufacturers and between manufacturers and timber-products consumers. Background material needed for this study was sought through direct contact with Federal and state agencies in Rio de Janeiro, Brasilia, Belém, Macapá, Santarém, Manaus, Boa Vista, Pôrto Velho and Rio Branco.

Field Sample

Timber-products manufacturing of interest to this study included sawmills, veneer mills and plywood mills. The Ludwig pulp-mill, a unique case of timber manufacture in the Amazon Basin,[1] was excluded from this study.

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[1] As of June 1978, the Ludwig complex included 98,000 hectares of tree plantation--58 percent of Gmelina arborea and 42 percent of tropical pines. The industrial part of the complex includes a large-scale pulp mill (750 tons/day).

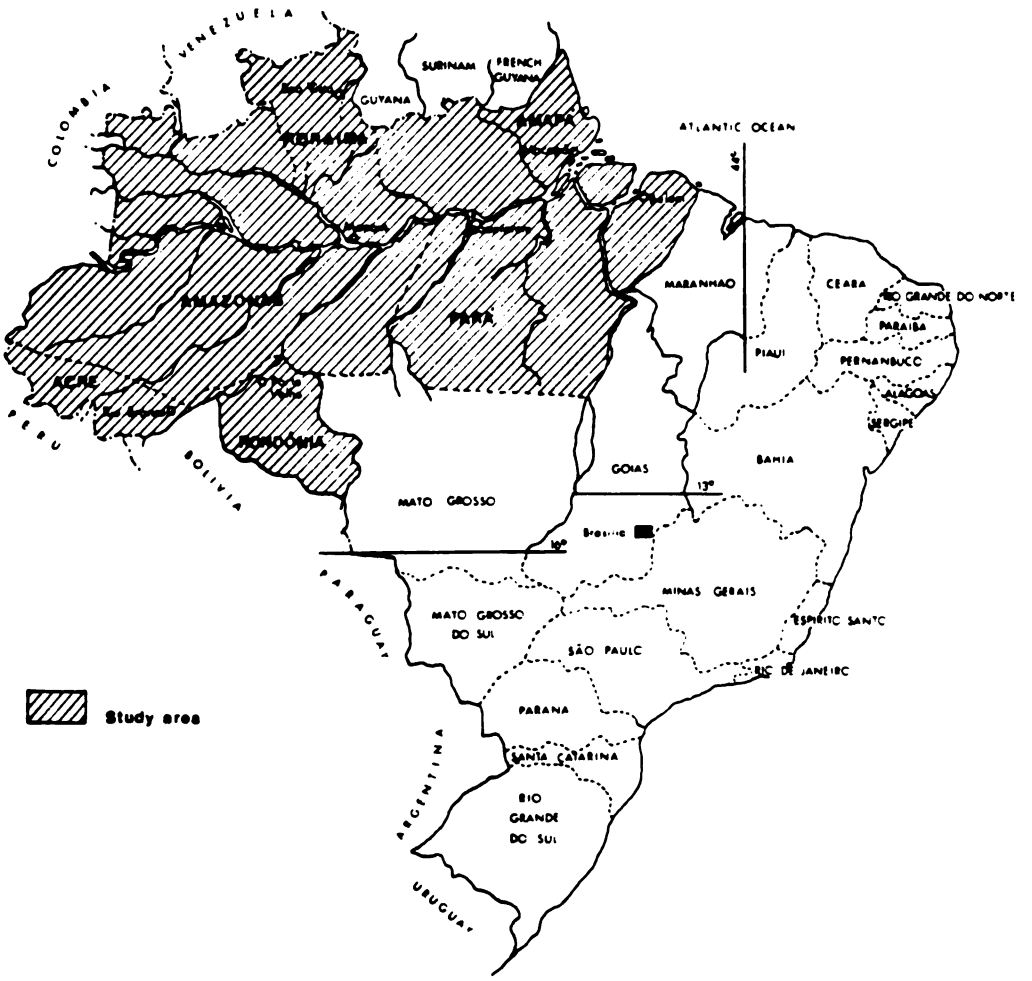


Figure 1.--Location of the study area in the Amazon region.

Without prior knowledge of the total population of mills or their locations, it was difficult to establish an adequate sampling procedure. The total sample of interviews aimed at was about 100, distributed geographically over the entire Amazon. An effort was made to sample much more heavily among the larger mills.

An approximation of the population of mills can be made by tallying the mills registered with various IBDF offices in the region, although it must be recognized that an unknown number of small mills in remote locations are not registered. The registration tally in the spring of 1979 indicates that there are 9 veneer mills, 8 plywood mills and 793 sawmills in the region. Interviews were conducted at 5 veneer mills, 8 plywood mills and 101 sawmills. Sawmills were classified into three size classes:

Small mills--Producing up to 5,000 cubic meters of lumber per year.

Medium mills--Producing from 5,001 to 10,000 cubic meters of lumber per year.

Large mills--Producing over 10,000 cubic meters of lumber per year.

Small sawmills are estimated to number 514. A sample of 30 widely scattered mills in this class was selected randomly for interviews. In the medium sawmill class, numbering an estimated 223 mills, 28 were selected for interviews. In the large sawmill class, numbering 56 mills, interviews were conducted at 43 mills.

Production and marketing data obtained in interviews were extrapolated to apply to the total population of mills.

CHAPTER II

REVIEW OF LITERATURE

A number of authors have reported on various aspects of timber production and marketing in the Brazilian Amazon, but none of the reports deal comprehensively with the subject. The first report, by Knowles (1966), described production and marketing in the region. Although this report is very detailed and descriptive, the data presented were limited to official statistics. Knowles (1971) also described opportunities for investment within the region. Soares (1972) reported on some aspects of timber-products marketing in selected areas of the Brazilian Amazon. Bruce (1976) presented a quantitative overview of wood production and wood flows within the region. Using Bruce's data, Hägerby (1976) provided econometric projections of wood production. Rivoli (1978) discussed some aspects of lumber production and marketing in the Amazon region. In a companion report, Rivoli (1978) outlined common marketing practices.

IBDF (1975) produced a general report on forestry in the Amazon. SUDAM (1973) described forest products technology in the Amazon as well as regional forest legislation. Rivoli (1978) offered grading rules for species from the Marajó region presently marketable in export markets.

Several reports have dealt with production and marketing on a national basis. Some of these are helpful indirectly in providing a perspective on potentials in the Amazon region. SUDAM (1975) reported on international wood markets for Brazilian timber production. Shand et al. (1978) described, in two reports, systems for internal and export marketing of wood products. Prado (1977) emphasized the economic importance of the forestry sector to Brazil's foreign exchange balance. Muthoo (1977) offered considerable statistical data on Brazil's forestry sector. Potma (1976) projected the national demand for sawnwood products to the year 2000. Rivoli et al. (1978) discussed trends and prospects for the utilization of wood in housing.

Some literature which does not deal with timber production and marketing is, nevertheless, helpful to understanding conditions in the Amazon region. Santo (1974) described the region and its resources. Mahar (1978) traced, historically, the economic development of the region. Tavares, Considera and Silva (1972) described colonization programs in the region. Cardoso and Muller (1978) described colonization of the Amazon region, emphasizing social conditions. Neto (1979) analyzed the evolution of the regional economy, fiscal incentive programs and some aspects of agricultural marketing.

Other literature of a more general nature in forestry, marketing or economics has been helpful in the formulation of concepts useful in this dissertation. Duerr (1960) indicated the position of marketing within the scope of forest economics. Worrell (1959) described the field of marketing in forestry. Rich (1970) stressed

the importance of consumer orientation rather than product orientation of firms. He discussed marketing functions as well as their practices. Gregory (1957) suggested more emphasis on consumer-oriented research. Gregory (1972) also identified the special characteristics of production and marketing in forest products. Lamb (1966) analyzed the disparity between the resources in a tropical forest and its commercial development. Tromp and Schmithusen (1966) discussed wood-selling techniques and their problems.

CHAPTER III

THE AMAZON REGION

As defined in this study, the Amazon region is that part of the Amazon River Basin within Brazil's boundaries in the states of Pará, Amazonas and Acre and the federal territories of Roraima, Rondônia and Amapá. This is a huge area of almost 3.6 million square kilometers (Pires, 1974), 42 percent of the total land area of Brazil. Headwater areas in surrounding countries--Bolivia, Perú, Ecuador, Colombia, Venezuela, Guyana, Surinam and French Guiana--are excluded from the Amazon region which is the subject of this study. Also excluded are the 1.3 million square kilometers within Brazil in Goias, Mato Grosso and Maranhão which constitute, together with the Amazon region, what is defined within Brazil as "Amazônia Legal" (Table 1 and Figure 2).

The Amazon region is dominated by unbroken tropical forests. Much of the region is unoccupied by people. The total 1978 population of 4.8 million people represents an average density of only 1.33 persons per square kilometer (IBGE, 1977).

The Amazon Forest

Many factors have a direct effect on the formation of the forest as well as logging operations. Among these factors are:

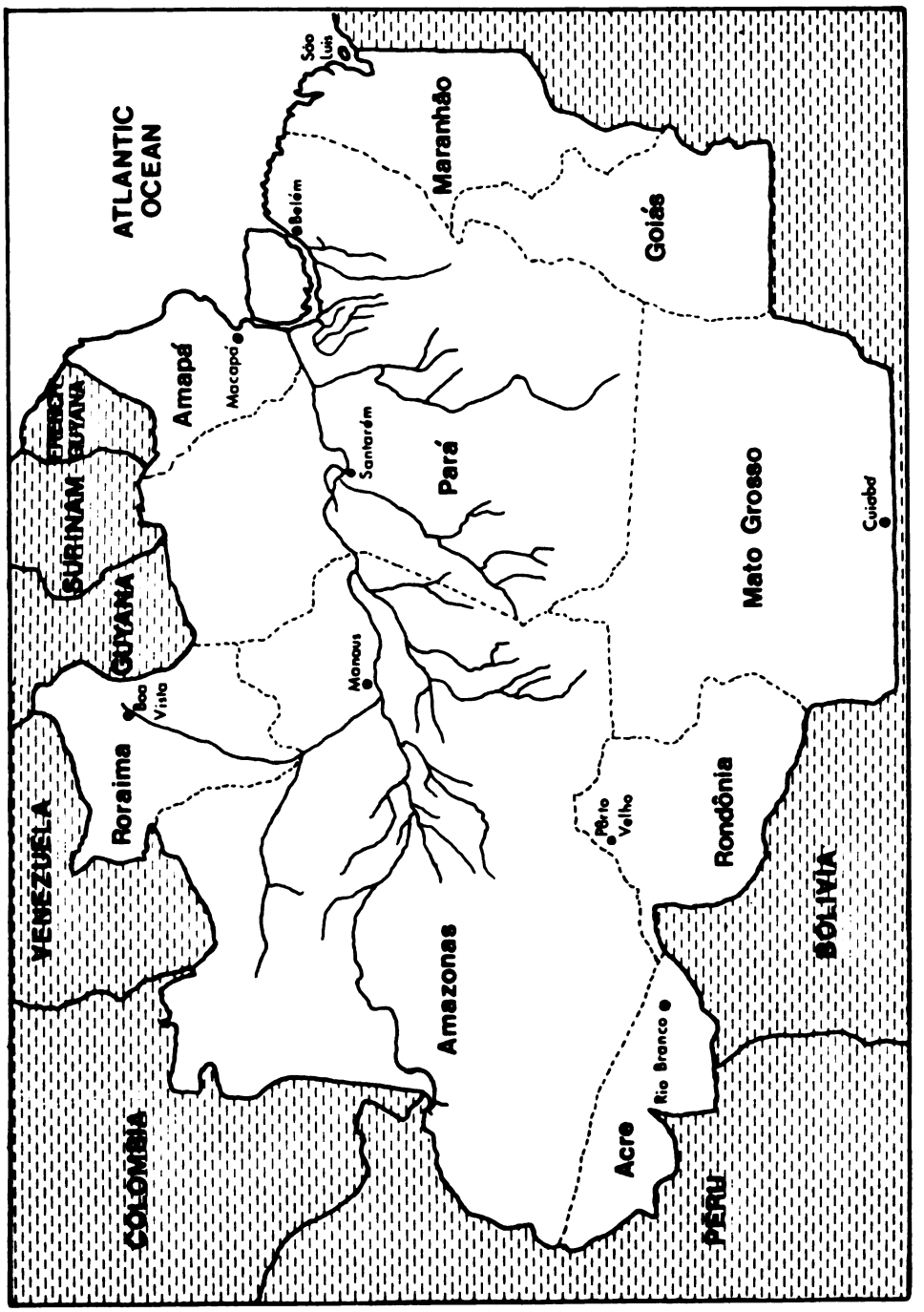


Figure 2.--Map of Legal Amazônia.

differences in rainfall throughout the region, the extent of annual flooding by the rivers, local site conditions and other factors.

Table 1.--Area in the Brazilian Amazon, by subregion.

Subregion	Area (1000 km^2)
Rondônia	243.0
Acre	152.6
Amazonas	1567.1
Roraima	230.1
Pará	1248.0
Amapá	140.3
Amazon Region	3581.1
Goias (Above Parallel 13)	285.8
Mato Grosso (Above Parallel 16)	776.9
Maranhão (West of Meridian 44)	257.5
Legal Amazônia	4901.3

Source: Instituto Brasileiro de Geografia e Estatística 1977, Anuario Estatistico do Brasil, Rio de Janeiro.

Climatic Conditions

The Amazon is a tropical region. Rainfall varies from less than 1200 millimeters per year to more than 4000 millimeters in some places. The average precipitation is about 2200 millimeters per year. There is no typical dry season. However, some areas are subjected to a severe dry season of up to 4 to 5 months per year during the period October-February (IBDF, 1975).

Forest Types

Forest types are delineated on a map of the Amazon region (Figure 3).

Upland forest. This is forest on the nonflooded higher ground which covers 90 percent of the Amazon (Goodland & Irwin, 1975). It appears to be a uniform forest, but there is much variation in species composition from area to area (Table 2 and Figure 3). The principal subdivisions are:

(a) High dense forest or semi-humid forest. Potential volume for immediate exploration is around 60 cubic meters per hectare. The distribution of trees through diameter classes shows a crowding of small and medium diameter trees.

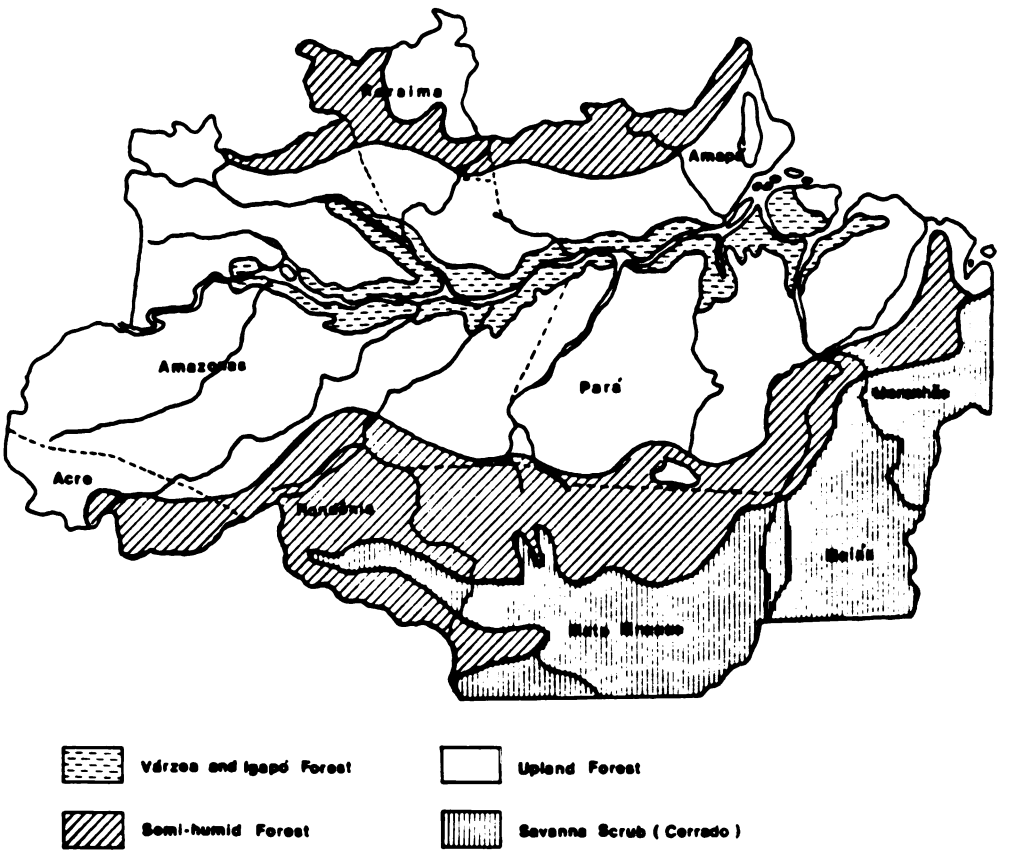
(b) High forest of open structure. Expected commercial fellings are of the same order as in the high dense forest. There is a higher concentration of volume in the upper diameter classes.

(c) Low forest with emergents. Trees of 45 cm DBH and more are sparse. The understory of these forests is very dense due to the presence of great numbers of small diameter trees.

(d) Low forest with vines and climbers. Commercial timber volume per hectare is low. Penetrability is difficult because of the densely crowded small trees and shrubs and the abundance of vines and lianas.

Among the most important species[1] in the upland forest are: abiurana (various species), two types of mogno, angelim (various

[1] A list of scientific names is in Appendix E.



Source: Clara Pandolfo, 1978. A Floresta Amazônica Brasileira: Enfoque Econômico-Ecológico, SUDAM, Belém.

Figure 3.--Forest types in the Amazon region.

Table 2.--Timber volume in the Amazon region, by forest type.

Forest Type	Forest Area (Million ha)	Volume in All Species		Volume in Currently Marketable Species	
		Per Hectare (m^3)	Total (Billion m^3)	Per Hectare (m^3)	Total (Billion m^3)
Upland Forest	253.5	170	45.1	60	15.2
Várzea	6.5	90	.6	30	.2
Total	260.0		45.7		15.4

Source: Clara Pandolfo, 1978. A Floresta Amazônica Brasileira: Enfogue Econômico-Ecológico, SUDAM, Belém.

species), bicuiba cheirosa, cedro and cedro branco, copaiba, faveira (various species), freijó, louro (various species), marupá, matá-matá, morototó, muiracatiara, muiratinga verdadeira and pau amarelo.

Várzea forest. This is forest on periodically flooded ground (Figure 3). The number of months of flooding varies with the height above river level. Várzea forests are much less heterogeneous than most upland forests. The volume cut and logged out, on the average, ranges from 5 to 10 m^3/ha (IBDF, 1975). Although the area of várzea forest comprises only 2.5 percent of the total forest area, it is responsible for more than 65 percent of total Amazon wood exports and 80 percent of the raw material utilized in Pará and Amazonas (Filho, 1978).

The most important commercial species are: açacu, açacurana, ananí, andiroba, cedro branco, cedrorana, macacauba, macacauba de várzea and preta, sucupira, sumauma, tachi preto de várzea and virola.

"Igapó" forest. This is forest on regularly flooded ground, with stagnant water for at least part of the year. The vegetation is highly specialized and exhibits less species diversity than the várzea forest.

Physical Timber Supply

The forest resource is the most important factor influencing the structure and conduct of the timber industry. The species, size, quality, location, density, access and other characteristics of the forest cover determine, to a considerable extent, the size and location of wood-using industry, the costs of logging, hauling and milling and the species and quality of lumber produced.

The timber resource of the Amazon is characterized by a huge contiguous stand that contains thousands of species and a wide spectrum of quality classes. Although the region contains 260 million hectares of forest, only 15 percent of the area can be considered readily accessible.

Timber volume estimates are highly speculative. A SUDAM report estimates the total timber volume at 45.7 billion cubic meters and the volume in currently marketable species at 15.4 billion cubic meters (Table 2). Species utilization has broadened rapidly during the past decade. The total number of species utilized in 1966 was 64 (Knowles, 1966); by 1978, the number increased to 228 (Pandolfo, 1978).

Forest Utilization

The Amazon region produces about 15 percent of Brazil's industrial wood. Most of Brazil's industrial wood is still produced in the southern part of the country.

The most heavily utilized forest land in the Amazon is concentrated in narrow strips along waterways, several hundred meters wide, with removals ranging from 5 to 10 cubic meters per hectare. Logging in the upland forests is restricted to the few areas accessible to roads.

Landownership

Table 3 shows the extent of private land ownership in the Amazon region. At the most, less than 9 percent of the land is

privately claimed. Even this figure is uncertain since nearly half of the total is classed as "latifundios"[1] (IBDF, 1975) with property title often questionable.

Table 3.--Private landownership in the Amazon region, by size of holding, 1960 and 1970.

Size of Holding in Hectares	1960 Ownership		1970 Ownership	
	Number of Holdings (1000)	Area (1000 ha)	Number of Holdings (1000)	Area (1000 ha)
Less than 10	67	258	107	395
10- 99	58	1,622	107	3,500
100- 999	8	2,250	39	8,160
1000-9999	2	4,620	3	5,725
10000 or more	3	14,700	5	5,400
Total	138	23,450	261	23,180

Source: Dennis J. Mahar, 1978. Desenvolvimento Econômico da Amazônia, IPEA, Rio de Janeiro.

Some 91 percent of the forest is in public ownership. The vacant lands (Terras "Devolutas") are vacant in the sense that they have not been allocated to any specified use. Many people have entered vacant lands along the main rivers and roads, usually practicing shifting cultivation. Some public lands have been set aside

[1] "Latifundios" are defined as "properties left unproductive or characterized by production standards clearly insufficient in terms of their physical and economic potential as well as the social role that they normally should fulfill."

as national security zones along the frontiers, forest reserves, protection reserves and national parks.

Forest Land Tenure and Selling Practices

Land tenure before 1964 was chaotic and the major portion of the public lands had not been given any clear or effective definition in regard to immediate or potential use.

Large sections of all accessible lands, public and private, were occupied by trespassers who lived by fishing, hunting and shifting cultivation. In late 1964, the government issued a new law establishing present policies on land tenure: (1) to promote the progressive extinction of unproductive large estates; (2) to sponsor the creation of private agricultural properties; and (3) to implement colonization programs, agrarian reforms and to grant rightful possession to untitled small farmers of proven merits (IBDF, 1975). In regard to private rural properties, the government has established the principle of noninterference except in areas of high social tension and "latifundios."

Land tenure rights along federal highways must be obtained through the National Institute of Colonization and Agrarian Reform (INCRA). INCRA's jurisdiction extends 200 kilometers in depth from federal highways. Small properties up to 3,000 hectares in size may be obtained by direct purchase from INCRA or by settlement and definitive establishment of an agricultural unit. Larger properties, both within and without INCRA's jurisdiction, can only be obtained by action of the federal Senate.

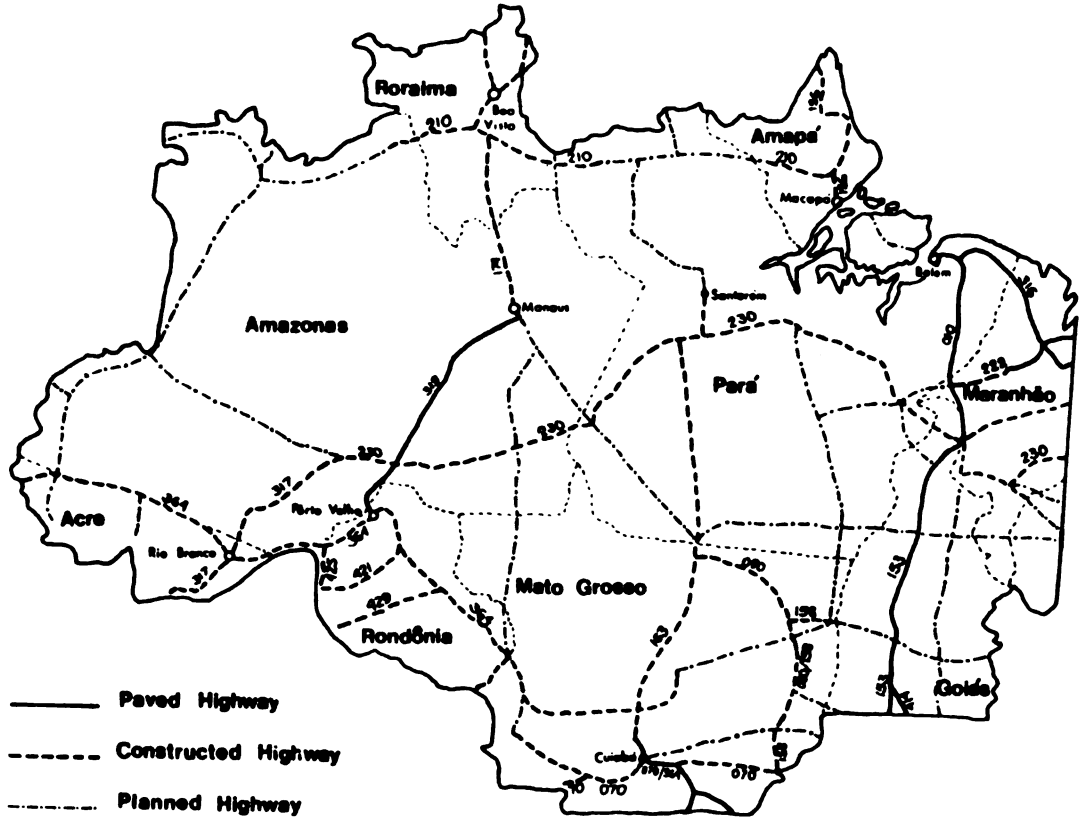
Forest land can be purchased at prices which have been rising but which are still cheap when compared to prices in southern and central Brazil. Land prices depend on location, particularly on proximity to the Manaus and Belém urban centers, and on accessibility by road and river. Standing timber has almost no influence on the cost of land (IBDF, 1975). This can be explained by the fact that sawtimber for the forest industries can usually be obtained "free" or at nominal cost.

Highway Network

In October 1970, the Brazilian government began construction of a number of new highways across the Amazon Basin. Previous to this date, there were only two major highways in the region--BR-010 and BR-364 (Figure 4). Since 1970, additional road construction has been undertaken, and as Figure 4 illustrates, a network of roads is planned.

River Network

About 15 percent of the region is easily accessible by river. It is estimated that more than 8,000 kilometers of the Amazon River and its tributaries are accessible to ocean-going vessels during most of the year (IBGE, 1977). Many thousands of additional kilometers are available to smaller boat, barge or raft traffic (Figure 5).



Source: Abril Editora, 1979. Guia Quatro Rodas Brasil, Abril S.A. Cultural e Industrial, São Paulo.

Figure 4.--Actual and planned highway network in the Amazon region.

Source: Instituto Brasileiro de Geografia e Estatística, 1977. Geografia do Brasil Região Norte, Rio de Janeiro.

Figure 5.--River network of the Amazon Basin.

CHAPTER IV

PUBLIC FORESTRY POLICIES

Fiscal Incentives

In recent years Brazil has used fiscal incentives to promote economic and social development of regions or economic sectors of the country. Substantial tax incentives have been offered to promote such activities as reforestation, fisheries and tourism. Initially, with passage of Law 5106 in 1966, fiscal incentives were offered for reforestation permitting individuals and corporations to reduce income taxes as much as 50 percent to subsidize investments in reforestation. Since 1970, effective tax credits for reforestation have been reduced in stages. The effective tax credit for reforestation is now 17.5 percent except in the Amazon region and the Northeast where it remains 25 percent (Berger, 1979).

The effect of fiscal incentives on reforestation has been substantial. It has resulted in several million hectares of forest plantations in the southern portions of Brazil where natural forests have been largely eliminated. Berger (1979) has shown that projected timber yields from existing plantations will probably be insufficient to sustain even current levels of timber demand.

Fiscal incentives for reforestation have promoted forest establishment in southern Brazil, but they have had virtually no effect on the Amazon region. The Amazon is a region of great natural

forests, and the pertinent public policies here are those that affect the management and utilization of these natural forests. Only those fiscal incentive programs which affect forestry developments in the Amazon region are described here.

Superintendency for the Development of the Amazon (SUDAM)

SUDAM, a government agency created in 1953 under the earlier designation of Superintendency of Planning for Economic Valorization of the Amazon (SPVEA), was intended to stimulate economic development of Legal Amazônia through the device of fiscal incentives.

Corporations can divert up to 50 percent of their income taxes due into funds deposited in the Bank of the Amazon which are subject to SUDAM's jurisdiction. Access to these funds can be gained by submitting proposals for development projects to SUDAM and obtaining SUDAM's approval. Qualifying projects for the forestry sector are specifically covered by investment funds deposited in the Special Fund for Investment in the Amazon (FINAM) which is administered by SUDAM. SUDAM must approve the use of FINAM's funds for projects to establish wood-manufacturing enterprises--lumber, plywood, veneer, particleboard, fiberboard and manufactured wood products. The evaluation of projects favors projects which provide for high employment, mechanized operations, higher-value products, export products and which link forest management activities to industrial activities (thus assuring sustained raw-material supply). Appendix C is a digest of project-evaluation criteria used by SUDAM.

National Integration Program (PIN)

In 1970, the national government created PIN to strengthen and accelerate the development of northern Brazil. PIN has financed the building of basic infrastructure such as the Transamazônia and the Cuiabá-Santarém highways, colonization programs, basic research and surveys (including forest inventories). PIN's funds are obtained by a mandatory deduction of 30 percent of the funds set aside for SUDAM and other regional development programs.

Program of Land Distribution and Agrarian Reform (PROTERRA)

PROTERRA is aimed at agrarian reform. It buys or expropriates land and redistributes it. It also finances rural projects for up to 12 years, with a 3 years' grace period, at 7 percent interest without correction for inflation (actually, negative interest). PROTERRA's funds are obtained by a mandatory deduction of 20 percent of the funds set aside for SUDAM and other regional development programs.

Special Incentives

Free Zone of Manaus (SUFRAMA). SUFRAMA's objective is to develop the city of Manaus, capital of the state of Amazonas. Incentives for the establishment of manufacturing plants are numerous. At the federal level, manufacturing plants are exempt from the industrialized products tax; they are also exempt from the restrictions which apply elsewhere in the country governing the importation of component parts. At the state level, manufacturers are exempt from

95 percent of the commodities movement tax. At the local level, firms and individuals are exempt from taxes for municipal services.

Exports. Firms in the SUDAM area of jurisdiction have special incentives for exporting products. Total remission of income taxes for a period of years is possible for firms exporting all of their product. In some cases, financing for exports is available from the Bank of Brazil at 8 percent per year (Central Bank Resolution No. 71). Exporting firms are not only exempt from the federal sales tax; a premium equivalent to the tax which would be paid for domestic sales is credited to the exporting firms.

Polamazônia Program

This program, under the Minister of Interior, is intended to implement the economic growth of 15 selected centers for priority development. Mining, highway construction, cattle raising and agricultural projects are included, but 4 of the selected centers include specifically forestry-sector projects. These are aimed at producing sustained-yield, wood-based industrial enterprises. The total investment planned for the 1975-79 period was 7 billion cruzeiros (Ministerio do Interior, 1976).

Forest Reservation Policy

Brazilian programs to exploit and occupy the Amazon region have been criticized by increasing numbers of scientists. Criticisms have ranged from the concern that the entire Amazon rain forest would disappear to alarm that the earth's vital oxygen-carbon dioxide balance would be upset. A well-known work by Gomez-Pompa, Vasquez-Yanes

and Guerra (1972) theorizes that the Amazon's tropical rain forests are incapable of regeneration under present land-use practices. Another work (Goodland & Irwin, 1975) disputes the economic and ecological viability of the agricultural colonization program proposed along the Trans-Amazonian Highway by the Institute for Colonization and Agrarian Reform.

However viable some of the concerns about deforestation in the Amazon region may be, forestry operations have been a minor cause of the deforestation that has occurred (Table 4). Official figures show that cattle-raising, peasant colonization and highway construction accounted for 96 percent of the 11.5 million hectares deforested between 1966 and 1975. Berutti (1979) states that one million hectares per year have been cleared for agriculture and cattle-raising during the past four years.

Table 4.--Area of land deforested in the Amazon region, 1966-75.

Cause for Deforestation	Area Deforested	
	(1000 ha)	(Percent)
Cattle-raising	4,375	38
Colonization	3,519	31
Highways	3,075	27
Forestry	500	4
Total	11,469	100

Source: IBDF, cited in Shelton Davis, Victims of the Miracle: Development and the Indians of Brazil. 1977. Cambridge University Press, Cambridge, Mass.

Public policy toward the Amazon region has been directed toward development. In regard to the vast forest resources, planning has focused on exploitation. This is not surprising in view of the vastness of the resources, the meager development that has occurred and the need to find developmental alternatives for the large population in the impoverished Northeast region. Now that development programs are active in the Amazon region, some attention is being directed toward use and maintenance of forest resources.

A high official of SUDAM's Natural Resources Department has proposed the establishment of 12 regional production forests in the Amazon covering some 50 million hectares of land. New aerial-photographic surveys have facilitated the locations of areas that might best serve the purpose of sustained-yield forests. SUDAM has suggested that government should place these 12 commercial forest reserves in public ownership and create a mixed private-public corporation to develop and manage the reserves.

Projected land-use patterns, still highly tentative, are summarized in Table 5. It is proposed that some 134 million hectares be cleared for agriculture, grazing and other cleared-land purposes, but that 126 million hectares be retained for Indian reservations, national parks, sustained-yield forests and biological and ecological reserves.

Little has been done to date to create forest reserves. Four national parks, including 2.3 million hectares of land, were established between 1959 and 1961 in the transition zone between the Amazonian moist forests and the dryer cerrado forests. The first

national forest, Tapajós, was established in 1973 in Pará. Extending over one million hectares, the Tapajós National Forest is viewed as a pilot model for management systems to be developed for use on other national forests yet to be established. Nine other forest reserves have been declared in the Amazon region, including 10 million hectares of land, but these reserves have not yet been protected effectively (Wetterberg & Padua, 1978).

Table 5.--Projected land uses in the Amazon region.

Land Use	Land Area	
	(Million Hectares)	(Percent)
Agriculture	40	15
Grazing	15	6
Other cleared-land uses	79	30
Floodplains and swamps	9	4
Indian reservations	20	8
National parks and biological reserves	43	16
Sustained-yield forests	54	21
Total	260	100

Source: S. A. Serete, cited in Clara Pandolfo, "Estudos Basicos para o Establecimento de uma Politica de Desenvolvimento dos Recursos Florestais e de uso Racional das Terras na Amazônia." 1974. SUDAM, Belém. (Mimeographed.)

CHAPTER V

THE LUMBER INDUSTRY

Primitive sawmilling operations have existed in the Amazon region for more than 200 years, but substantial development of the lumber industry has occurred only in the past 10 to 15 years.

Number and Size of Sawmills

There are 793 sawmills in the region (as of June 1978). In the small mill class (producing up to 5,000 cubic meters per year), there are 514 mills, 64 percent of the total sawmill population (Table 6). Medium-size mills, producing 5,001 to 10,000 cubic meters per year, number 223. Only 56 mills can be classed large, producing more than 10,000 cubic meters annually. Even this classification is generous since it is questionable whether any mill producing less than 20,000 cubic meters should be termed large. Actually, only 14 sawmills in the Amazon region produce more than 20,000 cubic meters annually.

The population of sawmill firms is not much smaller than the population of sawmills. Eleven firms own more than one mill and, in one instance, a single firm owns 8 mills. In every case of multi-mill ownership, the mills are all small. Multi-mill ownership, however, is not common. In the typical situation, an individual proprietor owns a single sawmill.

Table 6.--Number of sawmills and lumber output, by size class of mill, 1978.

Annual Production Size Class (Cubic Meters)	Number of Mills	Lumber Output (1000 cu. m.)
Up to 5,000	514	1,152
5,001-10,000	223	1,690
Over 10,000	56	1,179
Total	793	4,021

Source: Appendix Tables B1 and B2.

The number of full-time employees is one indication of the size of sawmill establishments, but there is considerable variation in employment levels even among sawmills with similar volume outputs. The variation is heavily influenced by the quality of product produced and the extent to which manufacture is carried forward. Sawmills that produce flooring, e.g., may have from 3 to 11 times as many employees as similar-size mills producing rough lumber. In general, nearly all small mills employ fewer than 25 full-time employees. Large mills usually have more than 100 employees. Only 3 mills have 200 or more employees.

Location of Sawmills

Distribution of sawmills by states and territories is shown in Table 7. Sixty-five percent of the mills, accounting for 67 percent of the lumber output, are located in the state of Pará. Most of the production is concentrated in the eastern part of Pará--on

Marajó Island, along the Belém-Brasilia Highway and, to some extent, along the Transamazonian Highway.

Table 7.--Number of sawmills and lumber output, 1978.

State or Territory	Number of Mills	Lumber Output (1,000 cu. m.)
Pará	510	2,680
Amazonas	89	494
Roraima	18	44
Rondônia	141	643
Acre	35	160
Total	793	4,021

Source: Appendix Tables B1 and B2.

Concentrations of mills on Marajó Island and at Santarém and Manaus have been aided by the existence of an infrastructure--functioning municipalities, manpower supply, and water and road access to timber and markets--as well as the existence of timber supply. Even in the absence of infrastructure, the building of new roads has stimulated sawmill establishment. In Rondônia and Acre, e.g., there were 32 sawmills in 1973 (Bruce, 1976), but the number increased to 176 in five years following the completion of the Pôrto Velho-Vilhena Road (BR-364) and the Pôrto Velho-Guarajá-Mirim Road (BR-319).

Amazonian sawmills are stationary (i.e., none of the mills visited have moved location within the past five years), but the

industry has a great deal of locational flexibility. New labor supply can be obtained if necessary, since unskilled workers can be trained in a few days for most sawmilling jobs. Only the head sawyer requires extensive training.[1] Logger mobility permits mills to reach out farther for raw material as the more accessible stands are depleted. When timber supply becomes inadequate, sawmillers know that they can move their mills to new locations with access to stands of uncut timber.

Ease of Entry Into Sawmilling

Conditions for entry into a market are said to be "easy" when potential entrants are able to buy and sell in a new market without incurring substantially higher per unit costs or lower profits than firms already in the market. This is the situation in the Amazon region's lumber industry.

One obvious indication of ease of entry into sawmilling is the rapidly growing population of sawmills. The number of mills increased steadily from 89 in 1952 to 793 in 1978 (Figure 6).

A number of explanations can be offered to explain the comparative ease of entry into sawmilling: (1) initial investment, (2) lack of product differentiation, (3) availability of raw material and (4) level of technology.

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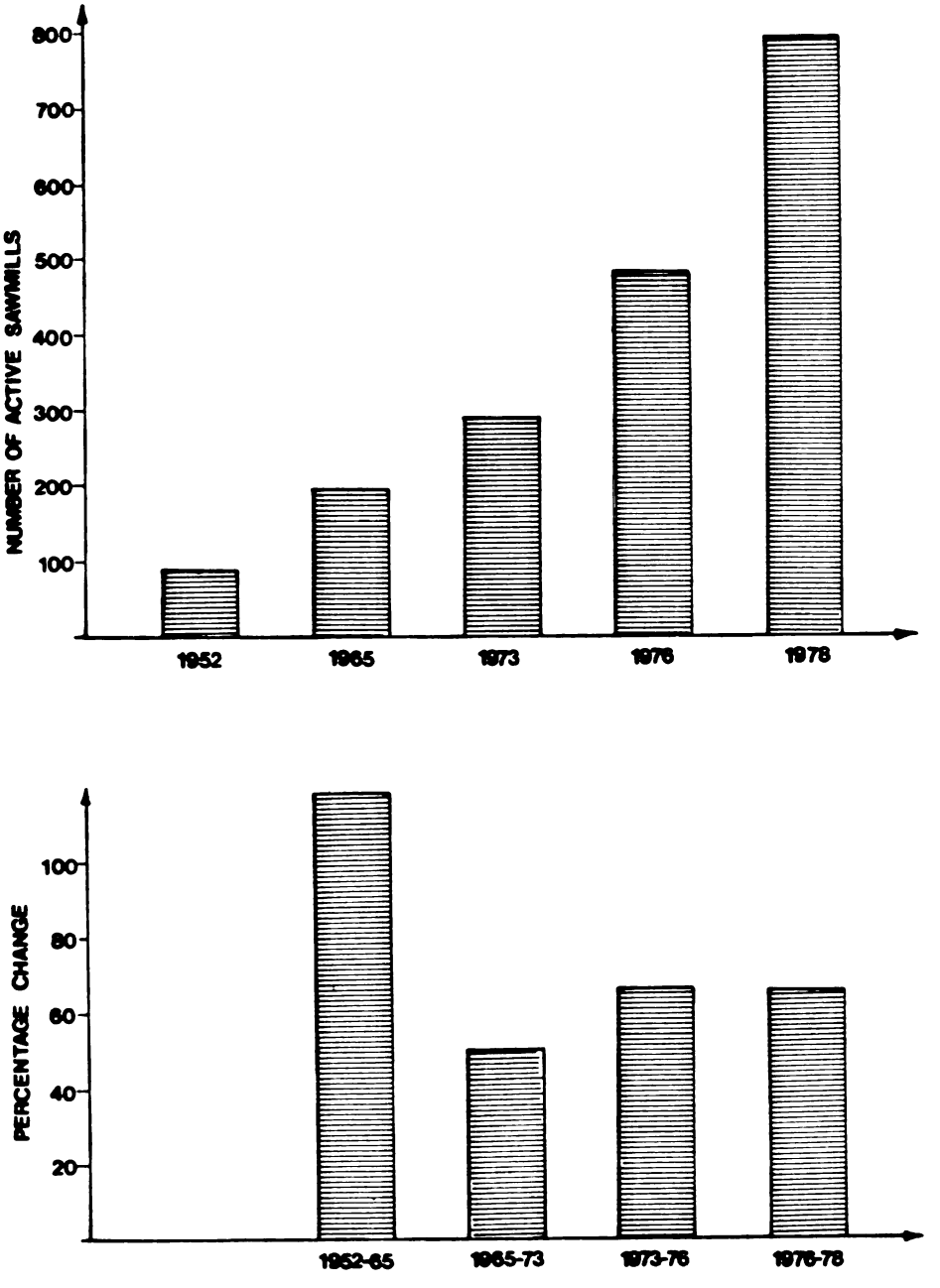
[1] SUDAM has a technical school for head sawyers at Santarém.



Source: Knowles, 1966; Soares, 1972; Bruce, 1976; Hägerby, 1976.

Figure 6.--Number of sawmills operating in the Amazon region, 1952-78.

Initial Investment

Small sawmills (which comprise 64 percent of the total population of sawmills) could be replaced with new mills at a 1978 cost of less than US $40,000. Larger mills would require larger investments, but a mill of medium size would cost from $60,000 to $80,000, and a very large mill for the Amazon region capable of producing 54,000 cubic meters per year was estimated to cost in 1976 no more than $153,000 (Rogers, 1976).

New sawmill costs cannot be considered a serious barrier to entry into the industry, but not all of the firms moving into the Amazon region find it necessary to invest in new mills. Many previously idle mills have been reactivated, often by new firms. Many second-hand mills have been moved into the region, particularly from Paraná state where the exhaustion of timber supply continues to idle sawmills in that previously important lumber-producing region.

Lack of Product Differentiation

Lumber mills entering the Amazon region to supply regional and national markets join an industry producing similar dimensions and grades from a group of traditionally accepted species. Basically, there is no product differentiation between the new firms and the long-established firms. New firms can expect to receive the same prices as the established firms for similar lumber products. Since new firms have no apparent effect on lumber price levels and current markets have been taking all the lumber that is produced, established sawmilling firms have not resisted the appearance of new firms in the industry.

Availability of Raw Material

Availability of raw material can be a barrier to sawmill entry, but the barrier cannot be considered serious except in a few locations. Only 2 percent of the forest land is owned by forest industry; the remainder is in public ownership, virtually all of it available for commercial timber exploitation. The Amazon has vast forest resources, but the areas tapped are only those close to river or road access. Loggers and log-traders are mobile but they have had to move logs long distances at times to supply sawmills. The depletion of marketable timber tributary to some mills might serve as a barrier to the entry of new mills which would be dependent on the same forest resources. This would be particularly true when a large new mill becomes established and requires sufficient timber volume to affect the log-price structure in an area. Some large mills pay from US $2 to $4 more per cubic meter than prevailing log prices to guarantee their log supply.

Typically, however, sawmills can be located in newly opened areas of the Amazon region where the timber resource has not previously been tapped. Broadly speaking, there is no problem of limited timber supply. The chief problem in raw material supply is a seasonal one caused by flooding of the rivers. New firms need to be financially strong enough to afford log stockpiling for the dry-period season when logs cannot be delivered.

Level of Technology

Entry into the sawmill industry is facilitated by the low level of technology with which sawmill firms can operate. Except for the head sawyer, who needs to be skilled, sawmill workers do not require extensive training. Unskilled workers can be trained in a few days for most sawmilling jobs. Skilled head sawyers are becoming more numerous as graduates of the technical school at Santarém enter the industry.

Age of Sawmills

The recent influx of sawmills into the Amazon region is well illustrated by Table 8. The figures apply only to the 563 mills registered with IBDF, and although the total is less than the population of 793 mills estimated in this study, the age distribution of mills shown should reflect the actual situation reasonably well.

Only 6 percent of the mills operating in 1978 were established prior to 1971. Five percent were established in 1971-72; 16 percent in 1973-74; 36 percent in 1975-76; and 37 percent in 1977-78. The industry is obviously a dynamically expanding industry. Older mills occur only in Pará and Amazonas, but recent additions to the industry are occurring in all states and territories.

Sawlog Receipts

The sawlog volume utilized by the lumber industry to produce 4.0 million cubic meters of lumber in 1978 is estimated at 6.3 million cubic meters. Although there are some differences in efficiency of log utilization by areas, it can be assumed that sawlog volume

Table 8.--Years in which registered sawmills operating in 1978 were established, by subregion.

Years	Amazon Region	Pará	Amazonas	Roraima	Rondônia	Acre
	(Number of Mills)					
1900-70	35	29	6	-	-	-
1971-72	31	15	15	-	1	-
1973-74	90	47	19	1	18	5
1975-76	200	126	17	8	34	15
1977-78	207	89	21	4	78	15
Total	563	306	78	13	131	35

Source: IBDF Offices.

consumption by states and territories is roughly proportional to lumber outputs. (Lumber output by geographic units was presented in Table 7.)

The annual sawlog volume currently removed from the Amazon region by the lumber and other timber-products industries probably represents no more than 1 cubic meter per 5,000 cubic meters of standing tree inventory. However, recognition of this superficially inconsequential impact of logging must be tempered by recognition of the very limited area that is immediately accessible to logging and the limited number of tree species that are utilized.

Species

Tree species are extremely numerous, perhaps as many as 1,000. Some are avoided because of undesirable characteristics such as extreme weight and hardness, lack of durability or lack of strength characteristics. Many other species are avoided because their characteristics are not well understood, or they are simply unknown in established markets.

Fewer than 100 species were utilized by the lumber industry in 1978. A majority of these species have limited local outlets only. National markets accept fewer than 30 species, and export markets accept only a fraction of these species.

Virola is the most likely accepted species, representing 18 percent of the volume of Amazon lumber used in local markets, 22 percent of the volume distributed to national markets and 64 percent of the lumber exported. Other important species are açacu, andiroba,

sumauma, muiracatiara, maçaranduba, cedro, sucupira, mogno, pau d'arco and pau amarelo.

Seasonality in Receipts

Sawmilling, even under ideal logging conditions, faces seasonal activity in construction and, therefore, seasonal activity in sawlog demand. Some adjustments to these market swings can be made in lumber industry operations because of the relative durability of wood which permits storage for some time for both logs[1] and lumber.

However, the Amazon region is peculiar in that seasonal variation in lumber output is so largely controlled by the seasonal pattern of logging. During the dry season (October to February). lumber output declines as much as 30 percent because of the shortage of sawlogs.

Water transport is the chief means of moving logs to sawmills. In the várzea forests, which supply nearly half of the sawlog volume, transportation is exclusively by water. Tree felling, a largely manual operation, is restricted to narrow stretches of forest of not more than 500 meters on either side of rivers and waterways. During the wet season, when watercourses rise, logs are floated and moved to sawmills. Dependence on water transport for log movement to sawmills causes log supply to diminish sharply during the dry season. Log receipts at sawmills build up steadily from a low point in

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[1]Virola sawlogs, e.g., can be floated in rafts 4 to 6 months or stored under water more than 2 years without any significant loss in the quality of the product that can be produced.

December to a peak in September; thereafter, receipts decline rapidly to their lowest level in December.

Sawmills adapt their sawmills operations to the seasonal pattern in log deliveries. Large, financially stronger firms stockpile logs during the wet season sufficient for sustained lumber production throughout the year. But smaller, financially weaker firms (the majority in the region) do not stockpile adequate quantities of sawlogs for sustained lumber production throughout the dry season when log receipts are difficult to obtain. The result is that lumber production at many mills falls off, becomes intermittent or ceases altogether. The capital needed for the stockpiling of logs is substantial since log costs may represent 50 to 70 percent of a mill's total production costs. These sawlog investment costs frequently represent a greater financial burden to mill operators than the costs involved in shutting down sawmilling operations during a portion of the year.

There are instances of limitations to log stockpiling other than investment costs. In a few cases (3 of the mills sampled), yard storage space is the limiting factor in log storage. Most sawmill operators express concern about insect and disease damage to logs stored more than a few months, but this is probably not a critical limitation on log inventory except for mills operating in upland areas. Location on water, which is true of nearly all mills in Pará and Amazonas, permits the storage of logs in lagoons which the operators build or in small river channels.

Transportation of Sawlogs

Sawlogs are moved to mills by water or truck. For the region as a whole, 68 percent of the log volume is moved in rafts, 5 percent by tugboat and barge and 27 percent by truck (Table 9). In Roraima, Rondônia and Acre, where road access to upland forests has been developing, logs move almost entirely by truck. In Pará and Amazonas, the major lumber-producing areas, water transport is, by far, the predominant means of moving logs.

Table 9.--Methods of transportation used to transport sawlogs to mills, 1978.

State or Territory	All Transportation	Raft	Tugboat and Barge	Truck
	(Percent of Volume)			
Pará	100	80	5	15
Amazonas	100	89	10	1
Roraima	100	-	-	100
Rondônia	100	5	-	95
Acre	100	-	-	100
Amazon Region	100	68	5	27

Water transportation is the means of access to the várzea forests bordering the waterways. The extensive network of navigable waterways reaches throughout the Amazon region. Perhaps as much as 15 percent of the forest area is accessible to the river network.

At waterside, logs are usually built into rafts. Smaller rafts are usually moved to gathering points where larger rafts are

constructed before towing to mills. Rafts may contain nonfloating logs, but they are buoyed up by floating logs. If the water journey is long, however, floating logs absorb water through their exposed ends and begin to sink. Losses are common and, in extreme cases, as much as 60 percent of the original volume of a log raft may be lost before delivery. Rafting may be slow and subject to substantial losses of logs, but it remains a preferred means of transporting logs because it is relatively cheap.

Log transport by tugboat and barge is much more efficient than rafting, but the highest costs involved limit this method of transportation to the large and more financially able firms.

Because of the restricted pattern of forest exploitation--harvesting in narrow bands along the waterways or the few existing roads and the removal of relatively few species--logging distances tend to be long and are becoming longer. Even in the subregions almost entirely dependent on truck transport, substantial volumes are moved more than 200 kilometers (Table 10). In Pará and Amazonas, dependent on water transportation, distances extend considerably farther. In Amazonas, as much as 28 percent of the log volume is moved in excess of 1,000 kilometers. Some sawmills report obtaining sawlogs from distances of as much as 2,000 kilometers.

Sawlog Procurement Methods

Many sawmill firms have their own logging crews to supply at least a portion of their wood requirements, but most of the lumber industry's sawlog supply is obtained by direct purchase from

Table 10.--Distance of log transportation to sawmills, by state and territory, 1978.

Distance (Kilometers)	Amazon Region	Pará	Amazonas	Roraima	Rondônia	Acre
	(Percent of Volume)					
1- 100	34	28	9	72	67	68
101- 200	24	32	14	14	20	16
201- 300	11	10	9	14	13	16
301- 600	7	6	18	-	-	-
601-1000	12	14	22	-	-	-
Over 1000	12	10	28	-	-	-
Total	100	100	100	100	100	100

log-traders (intermediaries between loggers and sawmills). Log-traders, in turn, contact loggers and landowners to obtain sawlog supplies. All purchase arrangements are based on personal contact and negotiations between individuals.

Sawmillers are constantly seeking sources of sawlogs. Small mill operators usually do their own prospecting, traveling through their wood procurement areas to locate sources of sawlog supply. Large mills and some medium mills employ log buyers who spend all of their time seeking out sources of wood supply. The sawlog marketing system is totally unorganized; it is dependent on direct contacts made by individual suppliers and buyers. Large sawmill firms may attempt to line up sawlog purchases from log-traders as much as two years in advance, but in general, sawlog purchases are short-term arrangements concerned with the exchange of particular lots of sawlogs. Small and medium sawmills purchased from an average of 6 log-traders in 1978; for large mills, the average number of contracts was 30.

Sawlog Price Determination

Sawmillers inspect log rafts or barge loads of sawlogs before making a firm offer to purchase. The first inspection may not be detailed, but the price offer allows for a margin of error. If a log-trader is dissatisfied with the price offer, the sawmiller will make a careful inspection of the sawlogs before negotiations proceed further.

There is little question that sawmillers have the superior bargaining position when negotiating with log-traders. Sawmillers

have a better grasp of lumber values and the likely grade yields of sawlogs. They also have an advantage in that volume is determined by sawmillers, and at least five different Francon log rules are in common use in the region. Log-traders are not likely to be able to determine the value of a lot of logs as accurately as a sawmiller can. Log-traders are also aware of the fact that many sawmill firms employ their own logging areas and, if the prices log-traders insist on appear excessive, lumbermen will expand their own logging operations.

Data collected in this study suggest the dominant position of sawmillers in establishing sawlog prices, at least during the wet season when logs are relatively abundant. Sawmillers indicated that sawlog purchase prices in 1978 were established as follows:

	Percentage of Sawlog Sales
Sawmillers' first price offer	53
Log-traders' required price	17
Negotiated compromise price	20
Sawmillers' price offer modified by negotiation	10

Log-traders acquire a dominant position in price determination only during the dry season when log supply is inadequate and sawmills must compete vigorously for the available supply.

Purchase Contracts

Sawlog purchase contracts may be oral or written. Written contracts apply to about 60 percent of the sawlog volume exchanged;

they are used most frequently by the larger mills. The most common elements of contracts are the following:

Species. Tree species to be exchanged are always stipulated in a contract.

Size of timber. The large majority of contracts stipulate minimum log diameters and length.

Quality of timber. Quality is nearly always referred to in contracts in terms of the sawmill operator's grading standards.

Quantity. About 90 percent of the contracts specify quantity in terms of a minimum number of logs rather than volume. The contract states, or implies, that all marketable timber will be purchased.

Price. The price to be paid is stated, but it is sometimes understood to be subject to change, depending on prevailing prices at the time logs are exchanged. Payments are always in cash.

Time of payment. Payments are usually made at the time of log delivery, or 3 or 4 days later. In some instances, partial or total payment in advance of delivery is specified.

Place of log scaling. Nearly all contracts specify where logs are to be scaled. Usually, measurement is done at the mill.

Period of delivery. A majority of contracts state the time interval for delivery of sawlogs. Thirty percent of the contracts allow a 1- to 2-year period; 20 percent, 6 months to 1 year. Some contracts extend beyond 2 years. Rarely does a contract stipulate a period less than 6 months.

Other provisions. Contracts may stipulate who is responsible for transporting logs, who is responsible for log losses occurring during transportation and who will pay sales taxes.

Lumber Grading and Seasoning

One of the big obstacles to development of markets for Amazon lumber outside of local areas is the absence of standardized grading rules. Some attempts at standardization have been made,[1] and export mills conform to the rules applying to foreign markets, but most sawmills operate without written rules. Common practice refers to three grades of lumber: First class--free of defects; Second class--small defects on both faces, or large defects on one face only; and Third class--large defects on both faces. In Roraima, only two grades are usually recognized: First class--free of defects; and Second class--defects present. Some sawmill operators in the region do not do any grading.

Related to the problem of standardized grading is the variability in seasoning lumber. Air-drying is the prevailing method of seasoning lumber, but the methods and techniques have not been developed to recognized standards. Some export mills are shipping lumber with as much as 40 percent moisture content. Fewer than 5 percent of the mills have mechanical equipment to regulate and standardize the drying procedure.

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[1] SUDAM has developed grading rules based on allowable defects which it uses for instruction at the industry training center in Santarém. The rules have been adapted from the National Hardwood Lumber Association rules of the United States.

Sawnwood Output

Due to the heterogeneity of species and the size and quality variations in sawlogs, most sawmills produce several sawn products. Five categories of sawn products account for the total output--construction lumber, grade lumber, flooring stock, paneling and ungraded lumber. In the following tabulation, sawmills are classified on the basis of the principal product group produced:

Product Group	Percentage of Mills
Construction lumber	46
Grade lumber	16
Flooring stock	10
Paneling	22
Ungraded lumber	6
Total	100

Nearly three-fourths of the sawmills produce two to three product groups. Only 12 percent of the mills limit production to one product. A majority of mills focus on one or two products, but sawlog heterogeneity leads to some production of products of secondary interest. Mills that concentrate on grade lumber, for example, cannot avoid producing construction lumber and ungraded lumber as well. Only the mills that specialize in flooring or paneling restrict much of their output to one product group. These mills are more specialized in their equipment; the flow of materials through them is continuous and follows a fixed pattern, which would make the switching of products relatively expensive.

Although some product diversification is typical of Amazon sawmills, it represents largely an attempt to achieve the highest value of output from the available raw material rather than a means of reducing the risks associated with fluctuations in the demand for different sawmill products. The policy is essentially passive, a reaction to the variability in the species and quality of sawlog supply. Few sawmill firms attempt to create new product lines.

Seasonal Production

Seasonal fluctuations in sawmill output follow seasonal fluctuations in sawlog deliveries. For most of the region, dependent on sawlog deliveries by water, sawlog deliveries peak during the wet season and diminish or cease during the dry season. Lumber output also peaks during the wet season and drops off or ceases during the dry season dependent on the availability of logs.

In areas where truck transport of logs predominates--Rondônia, Roraima, Acre and Santarém in Pará--the dry season is the most active period of sawlog delivery, and sawmills produce lumber most heavily in this period. Lumber output diminishes here during the wet season when log deliveries diminish and become more erratic.

Lumber Inventories

No more than 1 firm in 20 attempts to maintain a fixed ratio of product inventory to sawlog receipts or product sales. About 70 percent of the sawmill operators state that they try to completely eliminate their lumber inventories at all times. Lumber inventories

on hand in 1978 averaged 50 cubic meters for small mills, 120 cubic meters for medium mills and 180 cubic meters for large mills.

Although five mills are limited in lumber storage by yard capacity, and many mill operators suggest that lumber storage is limited by the probabilities of insect and disease damage, it is obvious that the chief limitation to lumber storage is a financial one. Mill operators are anxious to cash in their lumber inventories as quickly as possible.

Production Capacity

Most sawmill firms report that they can sell all the lumber they can produce, but their production is below capacity, greatly influenced by the irregular pattern of log supply. For the Amazon region as a whole, 1978 lumber production represented 60 percent of installed sawmill capacity. The percentages varied by subregion as follows: Pará, 60 percent; Amazonas, 70 percent; Roraima, 80 percent; Rondônia, 60 percent; and Acre, 50 percent.

Lumber Sales Procedures

Market knowledge is acquired by mill operators by personal contacts and personal awareness of the market transactions taking place. Little can be learned through formal sources of information. Only two limited sources of published lumber market information exist in Brazil. Brasil Madeira contains some generalized information with news about available sawmilling equipment. Informe de Oportunidades Comerciais reports on opportunities for lumber exports.

Nearly all sales are made at the mill, usually handled by the mill operator who acts as both production manager and sales manager. Very few mills operate a separate retail yard, wholesale yard or sales office apart from the mill.

Most firms make sales at frequent intervals to small local builders and the do-it-yourself trade. Contacts with commercial buyers occur less frequently--perhaps one to three times a month for smaller firms, and weekly or oftener for larger firms. In general, the commercial buyer takes the initiative, contacting the sawmill firm by telephone, by visiting the mill or by use of Telex.[1] Only the very large firms have sales departments or distribute price lists.

Sawmills usually produce lumber (about 85 percent of the sales) to fill prior orders. The purchase orders are usually of 1- or 2-months duration. Prices are usually fixed for the duration of the contract. From the mill operator's viewpoint, the minimum acceptable price is one that covers the cost of production and yields a margin for profit. Under the most unfavorable market conditions, the price must cover more than the variable costs; otherwise, the mill operator will not produce lumber.

Mills that sell lumber from inventory are in a different pricing situation. All costs incurred in production are sunk costs, and sawmillers base their price decisions on their understanding of current market prices. This understanding is often limited.

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[1]Most large mills operate Telex as a sales and communications tool for domestic as well as overseas contacts.

Infrequently, the best information available may be the mill's last sales transaction. On the more fortunate side, lumber prices have been moving up fairly consistently, reflecting sustained demand for Amazon lumber. Price increases have occurred up to eight times a year. Under the market conditions prevailing in 1978, a majority of the lumber sales were made at the prices specified by sellers.

Production Problems

Asked about their production problems, sawmillers cited a number of problem areas which interfered with efficient lumber production (Table 11). Continuity in sawlog supply is a basic problem which was discussed separately. Table 11 refers to internal problems in mill operations.

For the region as a whole, the lack of skilled labor is cited most frequently as a problem area. Other important problem areas cited are: lack of capital, obsolete equipment, difficulty in obtaining spare parts, inefficient mill layout, unstable labor force and energy shortage. Some of the problems are interrelated. For example, what is perceived as a lack of capital could be related to the problems of obsolete equipment and inefficient mill layout. Problems also vary by subregion. Again as an example, obtaining and holding an adequate labor force is a frequently cited problem in Amazonas, particularly in the rapidly developing Manaus area where competition for labor is intense. In Pará, in contrast, general unemployment is high and sawmill operators rate labor problems far less important than other problems.

Table 11.--Production problems cited by sawmillers, by subregion, 1978.

Problems	Amazon Region	Pará	Amazonas	Roraima	Rondônia	Acre
	(Percent of Sawmillers)					
Lack of skilled labor	60	20	58	30	63	50
Lack of capital	40	56	51	7	20	20
Obsolete equipment	35	30	40	22	33	42
Difficulty in obtaining spare parts	30	38	37	5	51	40
Inefficient mill layout	29	25	70	3	58	80
Unstable labor force	22	15	39	-	10	-
Energy shortage	10	15	3	-	40	6

Lumber quality is frequently poor, particularly the output of the small sawmills. Dimensions are inaccurate and thicknesses are variable. Lack of precision in sawing is acceptable in low-grade local markets, but it is not acceptable in national or foreign markets. Much of the poor-quality production stems from poor mill layout, worn-out equipment and the lack of adequate equipment maintenance. Well-designed, modern sawmills are relatively few.

CHAPTER VI

OTHER WOOD-USING INDUSTRIES

Plywood Industry

There were 8 plywood mills in the Amazon region in 1978, twice as many as in 1972. Three of the mills are in Pará; 5 are in Amazonas. The industry's production, which was 99,000 cubic meters in 1975, increased rapidly to 205,000 cubic meters in 1978. Some 5,170 workers were employed by the industry in 1978.

Relatively few Amazon species are used in plywood manufacture. Virola accounts for 49 percent of the log input; muiratinga, 21 percent; sumauma, 10 percent; breu sucuruba, 10 percent; all other species, about 10 percent (Appendix Table B5).

Wood-procurement procedures parallel those of the sawmill industry, but the plywood industry is financially stronger and is, therefore, better able to obtain logs. Plywood mills can offer more for logs than sawmills usually can, and virtually all plywood mills use tugboats to bring in log supply from as far away as 2,000 kilometers. However, there are problems in obtaining continuous log supply because of dependence on a few species, especially virola, obtained from the seasonally flooded várzea. Any broadening of species utilization which may occur will greatly improve the industry's ability to obtain a dependable log supply.

All plywood mills accumulate logs during the wet season to insure at least several months of log supply during the dry season. To prevent decay, logs are stored in water. Often, they are bundled to keep as many logs as possible below the surface of the water. One company uses a sprinkling system to keep exposed parts of logs wet at all times. In manufacture, insecticides are mixed in the glue, and finished plywood is sprayed with a fungicide before shipment.

In comparison with the sawmill industry, plywood mills are more efficient and much more conscious of quality control. Machinery, imported from the United States, Italy and Japan, is modern and maintained to high standards. However, mill operators do have a problem in obtaining needed machine parts. Most spare parts are ordered from São Paulo or from abroad. In the latter case, customs clearance adds to the problem since months may be consumed in the process.

Mill operators also complain of difficulties in obtaining trained workers and keeping them. Despite worker-training programs and competitive wages, worker turnover is high. This problem is most acute in the Manaus area.

The demand for plywood is high. Normally, most mills operate two 8-hour shifts per day. The bottleneck in production is the drier which usually operates 24 hours per day, 6 days per week. In other respects the industry operates at about 70 percent of full capacity.

Veneer Industry

Historically, valuable logs were shipped from the Amazon region to southern Brazil or abroad for slicing into decorative veneers. Only lately has an indigenous veneer industry become established. Both sliced and rotary processes are used. Nine mills were in operation in 1978--2 in Pará, 2 in Amazonas and 5 in Rondônia. Four of the five mills in Rondônia have only a rotary lathe and wet clipper. Veneers are dried in the open air under a small canopy.

Veneer production of 70,000 cubic meters in 1978 represents about 75 percent of the capacity of the existing mills. When asked about the limitations on production, mill operators most frequently mentioned lack of demand, transportation problems or fluctuations in the consumption markets (mainly the furniture industry).

Veneer mills rely on high-quality hardwoods for their raw material. Virola and muiratinga are the major species for rotary veneer. Sliced veneer is produced from mogno, cerejeira, cedro, jacareuba, sucupira and louro preto.

Sliced veneer is, potentially, the most valuable product. Logs are specially selected, quartered and aligned to produce maximum decorative qualities. Customers are in position to dictate their species requirements. Sometimes, in fact, they provide their own logs for slicing. Veneer slices are usually 0.6 mm in thickness.

Species used for sliced veneer are usually obtained from dry land areas. Log supply can be a problem, mainly because of the poor development of dry land logging. Competition with the lumber

industry for logs cannot be considered a serious problem since log value is higher for sliced veneer than for lumber.

Raw material supply is more of a problem to rotary veneer mills since these mills must compete directly with the plywood industry. Virola and muiratinga are the major species used by both industries. This problem can be eased only if other species can be determined to have good peeling properties and acceptability in national and export markets.

Pulp and Paper Industry

A pulp and paper mill established in Belém in 1963 was based on utilization of 12 tropical hardwood species. After 10 years of operation, however, this mill was transformed entirely to a paper recycling process. It produces about 125 tons per month of wrapping paper, kraft and special paper products.

A large pulp mill, part of a substantial industrial and agricultural complex, began operations on the north side and near the mouth of the Amazon River in 1978. Wood raw material for this mill is obtained from extensive tree plantations of Gmelina arborea and Pinus caribaea var. hondurensis established on 90,000 hectares of land. The pulp mill (imported fully assembled from Japan) has a capacity of 750 tons per day. It operated at 30 percent of capacity in 1978, but was expected to reach full capacity by the middle of 1979. Worldwide marketing of the pulp is anticipated. The complex which includes the pulp mill is also exporting some 70,000 tons of sawtimber per year (Carvalho, 1979).

Minor Wood-Using Industry

Production of blockboard has recently been introduced in the Amazon region. Two existing plywood mills have added blockboard production to their regular lines of output. In one mill, blockboard is prepared manually and cured in the plywood presses. In the second mill, a separate mechanized production line for blockboard has been installed. Blockboard production in 1978, based entirely on virola, is estimated at 20,000 cubic meters.

A match factory has been in operation for several years at Belém. Raw material is no problem since the species used--pará-pará, marupá and morototó--are not in demand by the lumber or plywood industries.

CHAPTER VII

MARKETING AND MARKETS

Sawmill Products

Because of the wide geographic dispersion of sawmills and the great distances between lumber producing and consuming areas, the distribution of lumber and lumber products requires a diversity of marketing channels. Five types of market outlets were recognized in this study--manufacturers, industrial users, wholesalers and brokers, retailers and noncommercial users.

Manufacturers are firms which remanufacture lumber into other products such as furniture, furniture parts and flooring. Industrial users are commercial consumers such as building contractors who use lumber without substantially changing its form. Noncommercial users are the do-it-yourself consumers. Wholesalers are market intermediaries who buy lumber from sawmill firms and resell to other commercial users of sawmill products. Brokers are market intermediaries who arrange lumber sales on a commission basis; they do not take title to lumber as wholesalers do. Retailers operate lumber yards and sell both to commercial and noncommercial users. Wholesalers and retailers sometimes carry out such finishing operations as seasoning, trimming and surfacing, but they do not substantially change the form of lumber.

There is some relationship between types of lumber buyers and size of sawmills (Table 12). Small mills market their product primarily through retailers and noncommercial users. Large mills are heavily dependent on wholesalers and brokers and manufacturers. Medium mills are in an intermediate category, relying on all types of buyers for the sale of their product.

Table 12.--Distribution of lumber to different types of buyers, by size class of sawmill, 1978.

Type of Buyer	All Mills	Small Mills	Medium Mills	Large Mills
	(Percent of Volume)			
Manufacturers	18	10	16	25
Industrial Users	24	20	32	8
Wholesalers and Brokers[a]	23	-	25	55
Retailers	15	40	17	7
Noncommercial Users	20	30	10	5
Total	100	100	100	100

[a]Includes exporters.

Distribution of lumber in different product groups to types of buyers is summarized in Table 13. Nearly all lumber product groups are distributed widely to all buyer groups, but a few of the distribution channels are noteworthy. Forty-five percent of the construction lumber moves directly to industrial users; 45 percent of the flooring stock moves to wholesalers and brokers; and 40 percent of the paneling moves to industrial users.

Table 13.--Distribution of lumber to different types of buyers, by sawmill product group, 1978.

Type of Buyer	All Lumber Products	Construction Lumber	Grade Lumber	Flooring Stock	Paneling	Ungraded Lumber
	(Percent of Volume)					
Manufacturers	18	10	33	-	5	18
Industrial Users	24	45	25	15	40	24
Wholesalers and Brokers	23	10	25	45	30	30
Retailers	15	20	10	30	20	12
Noncommercial Users	20	15	7	10	5	16
Total	100	100	100	100	100	100

Fewer than one out of five sawmills rely only on a single market outlet. On the average, small sawmills deal with 5 commercial outlets; medium sawmills, 10 commercial outlets; and large sawmills, 14 commercial outlets. Most sawmills, in all size classes, also make numerous sales to noncommercial users.

Geographic Location of Markets

One-third of the lumber output in the Amazon region is marketed within the region. A much larger share of the output--55 percent--is shipped to other regions of Brazil, and 12 percent of the total output is exported (Table 14). The picture varies by subregions. Mills in Pará and Rondônia are oriented mainly to national markets. More than half of Roraima's output goes into export markets, and Amazonas points mainly to local markets.

The location of sawmills has considerable influence on the location of markets. There is also some correlation between size of sawmills and markets and sawmill product groups and markets. Small sawmills are oriented to local markets; medium and large mills move more of their output to national and export markets. Similarly, lower-value product groups such as construction lumber and ungraded lumber are sold mainly in local markets; higher-value products usually move into national or export markets.

Local Markets

Local markets accept lower grades of lumber than do the national or export markets, although some higher grades of lumber are also used in the urban centers of the Amazon region. The

existence of such local markets is important, not only for the small mills whose product may be consistently of lower grades, but also for the larger mills which can market only higher grade lumber in the national and export markets and which need some outlet for lower-value lumber. The existence of local markets also permits the utilization of a broader species mix. Ten species predominate in the utilization patterns of the Amazon region, but a total of 228 species is used (Pandolfo, 1978).

Table 14.--Principal lumber market areas for sawmills in the Amazon region, by subregion, 1978.

Subregion	All Markets[a]	Local Markets[b]	National Markets[c]	Export Markets
	(1000 m^3)			
Pará	2,680	750	1,662	268
Amazonas	494	380	24	90
Roraima	44	21	-	23
Rondônia	643	96	495	52
Acre	160	79	35	46
Amazon Region	4,022	1,327	2,216	479

[a]Totals may not add due to rounding.

[b]Some local sales may actually be destined for national or export markets.

[c]Some sales to national markets may include logs as well as lumber.

Most local sales are made at the sawmill, although some mills operate distribution centers in nearby cities. Depending on the volume of a sale, credit may be offered for 30, 60 or 90 days. However, credit sales include an interest charge of some 4 percent per month.

National Markets

Lumber destined for national markets has its origin principally in Pará and Rondônia. Pará, in fact, accounts for 75 percent of all the Amazon's lumber moving into national markets. The species mix suitable for national markets is smaller than the mix acceptable in local markets but larger than the mix acceptable in export markets.

Some 2.2 million cubic meters of lumber is distributed in national markets as follows: Northeast, 43 percent; Southeast, 40 percent; Center-West, 14 percent; and South, 3 percent.

Wholesalers and brokers are the principal means by which sawmillers gain access to national markets. The brokers, who maintain offices in the markets they serve, are particularly important. As Shand (1979) points out, there are two types of brokers: (1) sem del credere--brokers who arrange sales and receive a 5 percent commission for services; and (2) del credere--brokers who arrange sales and collect payment for the seller and receive from a 6 to 10 percent commission for services. Close contact with brokers provides sawmillers with a wider range of market outlets as well as a means of gaining knowledge about market conditions.

Export Markets

The principal foreign markets are the United States, Venezuela, Canada and Great Britain. Sixty percent of the lumber exports are taken by the United States. Venezuela is increasing its share of the foreign market most rapidly following its recent policy of forbidding logging in some heavily forested regions of Venezuela.

As many as 34 species are exported, but five--virola, mogno, andiroba, sucupira and freijó--account for more than 90 percent of the lumber exports.

There are five general procedural methods of exporting lumber. These are listed below with an indication of how much volume moves by each method:

Method	Percent of Volume
1. Direct sales to foreign importers	85
2. Sales to foreign importers represented by purchasing agents in Belém or Manaus	8
3. Sales to foreign importers through overseas sales agents	3
4. Consignment sales through lumber exporters	2
5. Sales to exporting sawmills	2
	100

The most important method of effecting lumber exports is through direct sales to foreign importers. Contacts between sawmill firms engaged in exports and foreign importers are numerous; most of these sawmill firms had at least 5 to 10 inquiries per month in 1978

from foreign importers. The second method is facilitated by the presence of purchasing agents in Belém or Manaus who can easily contact sawmillers to invite price quotations and check their acceptability. These agents can also supervise production, grade products and supervise delivery. The third method, which eliminates intermediaries, is used only by very strong sawmill firms--those that are well managed, that are knowledgeable about foreign markets and that are familiar with foreign preferences in lumber products. The fourth and fifth methods are used mainly by smaller mills which would have no other access to export markets.

Plywood Products

Plywood production in the Amazon region, focused in 8 mills located entirely within the states of Pará and Amazonas, totaled 205,000 cubic meters[1] in 1978. This output was distributed to broad market areas as follows: local markets, 9 percent; national markets, 71 percent; and export markets, 20 percent.

Plywood destined for local markets is used mainly in the construction industry. It is marketed through commission agents who receive a 2 to 4 percent commission for their services.

National markets served are principally the Southeast (mainly São Paulo and Rio de Janeiro), the Northeast (mainly Pernambuco, Bahia and Ceará) and the Center-West region (mainly Brasilia).

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[1] Official statistics show a larger plywood output, but one plywood mill produces rotary-cut veneer as well as plywood. For purposes of this study, its veneer output has been added to the output of the veneer industry.

Sales for national markets are made through branch sales offices located in major cities. A very small portion of the plywood moving into national markets is sold through commission agents.

Foreign markets are principally Great Britain (55 percent of the volume exported in 1978) and the Netherlands (24 percent of the volume). Other important countries are Canada, France, Venezuela, Belgium and West Germany. Exported plywood is used in construction and furniture manufacture. It is marketed through commission agents in the importing countries who represent the plywood mills. Four species--virola, sumauma, muiratinga and andiroba--account for nearly 95 percent of the exported plywood.

Veneer Products

Rotary veneer, used in the manufacture of such items as wall panels, door panels and cabinets, is produced at one veneer mill and one plywood mill which produces veneer as well as plywood. Most of the output--62,500 cubic meters--is exported. The principal markets are the United States (72 percent of the volume) and Europe. The mills producing rotary veneer are subsidiaries of foreign corporations which handle the marketing of Amazon-produced veneer within the parent company marketing structures. The species used are muiratinga, sumauma, breu sucuruba and virola.

Sliced veneer is a higher-value product used in the manufacture of furniture and such items as radio and television cabinets. The 8 mills producing sliced veneer had an output of 7,500 cubic meters in 1978. Fifty-six percent of this output is exported,

mainly to Spain, Great Britain and Venezuela. The rest of the output--44 percent--is sold in national markets. One exporting mill has two commission agents representing it in Europe; these agents receive a 5 percent commission for services. Most sliced veneer, however, is sold directly without the services of intermediate agents. The most common method of sale is a direct sale to buyers who inspect the veneer at the factory before purchase.

CHAPTER VIII

MARKET PERFORMANCE

The data available in this study of production and marketing of timber in the Amazon region are not sufficient for a detailed analysis of market performance in the timber industries, but they do permit deductive inferences about some aspects of market performance. The aspects that are considered for discussion here are production efficiency, progressiveness in production, product performance, participant rationality and conservation. Other aspects of market performance such as the amount and quality of sales promotion, the level of earnings of producers, exchange efficiency, labor relations and unethical practices do not lend themselves to reliable deductions from the data available. In respect to unethical practices, for example, it can be pointed out that variable approaches in the use of the Francon log scale in measuring log volumes enables log buyers to deceive log producers, but the degree to which such deception exists is unknown.

Production Efficiency

Evidence of inefficiencies in timber production and marketing is readily apparent, but the penalty for such inefficiencies is not apparent. Timber production in the Amazon region is expanding rapidly. There is a market for all that can be produced. Product

prices are relatively high; stumpage is available free or at nominal cost; labor costs are still generally low; and profits are high. Under such circumstances, one cannot expect to find much concern with matters of efficiency. Many mill operators have had little education or managerial training. Few operators keep records of costs and returns, yet such casualness in operations has not prevented them from obtaining high returns on investment. Obviously, the favorable environment for production could change, and when it does, production inefficiencies will be penalized.

Most sawmills and plywood mills have unused capacity even in this period when there is an apparent demand for all that can be produced. Sawmills characteristically operate one 8-hour shift, but on an annual basis they operate at 60 percent of installed capacity. The obstacles to full production are varied, including equipment failures, labor turnover and, especially, discontinuity in log supply. Operating as they do, sawmills have an unnecessarily high fixed cost of investment in relation to lumber products output. Most plywood mills also underutilize their capacity despite operating with two 8-hour shifts; on the average, they operate at 70 percent of installed capacity. The bottleneck in plywood manufacture is in the drying process. Dryers cannot accommodate the full production that is possible simply because the mills characteristically have two production lines and one dryer or three production lines and two dryers. Failure to install the number of dryers needed limits full use of other equipment and diminishes the output that would otherwise be possible.

Optimum sawmill size is uncertain. It would undoubtedly vary depending on forest characteristics, including stand densities and accessibility, on the kinds of products manufactured and the degree of vertical and horizontal integration. However, developments in other countries suggest that some economies of scale do exist at least into the medium mill size class (Gregory, 1972). Most Amazon sawmills are too small to gain important advantages that would become possible with larger size: the ability to attract greater numbers of buyers and geographically more widely dispersed buyers for greater stability in markets; the feasibility of sorting out species grades and types of product for different markets; the ability to hire more managerial skills; and the ability to attract financing more easily and cheaply.

The general lack of vertical integration as well as the geographic dispersal of the timber-products industry lead to inefficient use of wood raw material. Wood-production residues are abundant and, usually, they are given away or burned. This is true of both the lumber and plywood industries. There is little evidence of interest in using wood residues at manufacturing plants for other products such as particleboard.

Probably the most critical element in production efficiency is log supply. Characteristically, log supply is accumulated during the season of river flooding. Log deliveries fall off during the dry season, and only the larger and more financially able firms accumulate sufficient logs during the wet season to sustain production throughout the year. Many of the small and medium mills simply

shut down operations when the log supply disappears. The solution of this problem is twofold: (1) Sufficient financing to permit mill operators to accumulate inventories of logs during the wet season to guarantee mill operations throughout the year; and (2) contractual agreements among log producers, log-traders and mill operators that would offer more security in log deliveries than can be obtained from the usual oral, short-term and unenforceable contracts that are characteristic of the timber-products industries.

Progressiveness in Production

A progressive industry can be expected to seek to improve its production techniques with the aim of lowering its costs and improving its products. Progressiveness in production can be measured by the amount of resources devoted to research--discovery, innovation and adaptation of new techniques and products.

The plywood industry evidences some degree of progressiveness since most firms engage in some research, particularly in the area of adhesives. But it is not clear that this industry does much research and development to utilize a wider range of Amazon tree species in plywood manufacture and to gain market acceptance for these species. As for the lumber industry, progressiveness in production is virtually nonexistent. The problem is not simply a lack of research effort; more importantly, the problem is a lack of adaptation to new techniques and products developed at public research centers. Forest products research is carried on at the National Wood Laboratory in Brasilia and at a number of universities, but all such research work is unknown to nearly all sawmill firms.

Product Performance

Whether the Amazon lumber industry performs well in the quality of its products is doubtful. To some extent the quality of lumber products depends on inherent characteristics of the tree species used, but even in this respect, the sawmiller can control the amount and character of defects to be included in the lumber output. Other important ingredients of lumber quality are the standardization of dimensions and the proper seasoning of wood. On both counts, the lumber industry performs poorly. Poor equipment and machine maintenance are commonplace among the small and medium mills. Frequently, tracks and bearings are worn, saws shake and saw teeth are misaligned. Inevitably, the result is inaccurate dimensions of the lumber product. Improper seasoning of lumber is also a common fault in the industry. Dry kilns are virtually nonexistent, and the air-drying methods used are performed poorly.

Participant Rationality

Rational decisions by market participants require that the product which is the subject of negotiation be recognized in similar terms by buyer and seller. The product should be similarly identified on both sides in regard to species, dimensions, volume and grades.

Decorative veneer offers no serious problems to market participants despite the absence of grading rules. Decorative veneer is purchased after inspection at the mill by the buyer. Both buyer and seller know the specific product under negotiation.

Plywood also permits rational decisions by the market participants. The plywood industry follows international rules in describing its products, and this permits distant buyers to negotiate rationally with plywood firms on plywood purchases.

The situation is different in the lumber industry. Export lumber is controlled by international grading rules, but the major part of the market which is in Brazil is not governed by generally accepted written rules. Written rules adapted from those of the National Hardwood Lumber Association in the United States have been developed by the SUDAM forest industry training center at Santarém, but these rules have not gained common usage. Most sawmill operators are not even aware of them. At the present stage of development, many sawmill operators would be incapable of applying grade standards.

The absence of grading standards in the domestic lumber industry makes rational decisions between lumber buyers and sellers difficult. In a similar way, lack of standardization obstructs rational decisions between sawlog buyers and sellers. The Francon log rule is the only log rule used, but at least five different approaches are used in applying the rule. Rational decisions are not possible if the seller of logs is unaware of the specific measurement application used by the sawmill firm buyer. For example, one sawlog buyer may deduct 5 centimeters for bark thickness in determining log circumference while another sawlog buyer deducts 10 percent from mid-log circumference outside bark.

Conservation Performance

Forest industry is exploitive in its approach to timber utilization in the Amazon region. A concern for conservation of the forest resource--full utilization of the timber harvested and management of the forest resources to insure sustained production in perpetuity--is virtually nonexistent.

The exploitive attitude is easily understood. The Amazon region is a vast region containing an estimated 46 billion cubic meters of timber. The volume presently marketable may exceed 15 billion cubic meters. Annual log removal of less than 10 million cubic meters represents less than .07 of 1 percent of the presently marketable timber. Not only is the amount of timber superficially limitless, but it is available for the taking. Over 90 percent of the forest is in public ownership, but government exercises little control over forest exploitation. Standing timber is available to forest industries at no cost or at nominal cost. The predominant attitude is simply that when usable timber is removed from an area, logging can be shifted to other areas.

Nevertheless, it is obvious that there are some problems in sustained timber production for the long run. Forest industry is widely dispersed, but there are concentrations of mills which have exhausted the preferred kinds of timber within ready access. This is obvious from the fact that some mills reach out along the waterways as much as 2,000 kilometers for log supply. Water access, in fact, is crucial to timber supply for most forest industry. Eighty percent of the timber utilized in Pará and Amazonas (including

65 percent of the wood exports) comes from várzea areas which comprise, in total, no more than 2.5 percent of the Amazon region. The timber resource may appear to be inexhaustible on an overall basis, but in the practical sense of what is accessible to timber industry, there are many signs of depleted resources.

Some efforts at conservation are overdue. Forest industry cannot be expected to do much in this regard so long as the situation is simply a matter of competition among firms to capture timber that appears to be a free gift of nature. Forest industry has no incentive to be concerned with growing timber, sustained-yield management of forests or full utilization of the timber that is harvested. If conservation efforts are to be encouraged, they will have to stem initially from efforts by government to exercise management control of the publicly owned forest resource.

CHAPTER IX

SUMMARY AND CONCLUSIONS

The Amazon region of Brazil is largely undeveloped. A region of some 3.6 million square kilometers, with a population of 4.8 million people, and little agricultural development or potential, its most conspicuous and promising resource is the greatest concentration of tropical forest in the world.

The huge Amazon forest, containing an estimated 46 billion cubic meters of standing timber, is potentially important in providing raw material for forest industrial development within the region, to supply timber products to the important market regions of Brazil which face increasing future timber supply deficits and to provide timber products for exports.

Forest industrial development is proceeding at a rapid pace. Lumber production, which reached 1.2 million cubic meters in 1972, expanded to 4.0 million cubic meters in 1978. Plywood production reached 205,000 cubic meters; and veneer, 70,000 cubic meters.

The Lumber Industry

The 793 sawmills in the region are predominantly small (514 mills produce less than 5,000 cubic meters per year). Only 56 mills are classed large, producing more than 10,000 cubic meters annually. Typically, an individual proprietor owns a single sawmill.

Initial investment for entry into the lumber industry is relatively small. The typical small sawmill could be replaced new at a 1978 cost of less than US $40,000. Many entrants into the industry have simply reactivated previously idle mills or obtained second-hand mills which have been moved into the region from South or Southeast Brazil.

Availability of raw material can be a barrier to entry in some areas, but this cannot be considered serious except in some specific localities. Most of the vast forest is in public ownership, much of it available at no cost for timber exploitation. The chief problem in log supply is a seasonal one caused by flooding of the rivers. Sawmills need to stockpile logs during the wet season for processing during the dry season when log deliveries taper off or cease. Stockpiling of logs requires an investment which many small and medium mills find difficult to make. The result is that many mills close down for several months during the dry season.

There may be as many as 1,000 tree species in the Amazon forest, but fewer than 100 are utilized to any degree and most of these have limited local markets only. National markets accept fewer than 30 species, and export markets accept only a fraction of these species.

Sawlogs are moved to mills by water or truck. Some 68 percent of the log volume is moved in rafts, 5 percent by tugboat and barge and 27 percent by truck. Road access to timber supply is less common than water access. Most sawlogs are obtained by direct purchase from log-traders who, in turn, contact loggers and landowners

to obtain sawlog supplies. All purchase arrangements are based on personal contact and negotiations between individuals.

Sawmillers have the superior bargaining position when negotiating with log-traders. They have a better grasp of lumber values and the likely grade yields of sawlogs. They also have the advantage in that they make volume determinations by use of Francon log rules which are applied in at least five different ways. The prices that apply are usually the sawmillers' offered prices.

Log purchase contracts are oral or written. Written contracts are used most frequently by the larger mills. Items covered usually include species, minimum log size, quality, quantity, price, time of payment, place of log scaling and period of delivery.

Recognized product groups are construction lumber, grade lumber, flooring stock, paneling and ungraded lumber. Only 12 percent of the mills limit production to one product. Nearly three-fourths of the sawmills produce two to three product groups.

Few mill operators attempt to maintain a fixed ratio of product inventory to sawlog receipts or product sales. Most, in fact, state that they try to completely eliminate their lumber inventories at all times. Lumber inventories on hand in 1978 averaged 50 cubic meters for small mills, 120 cubic meters for medium mills and 180 cubic meters for large mills.

Market knowledge is acquired by mill operators through personal contacts and personal awareness of the market transactions taking place. Little can be learned through formal sources of information. Nearly all sales are made at the mill, usually handled by

the mill operator who acts as both production manager and sales manager. Contacts with commercial buyers occur perhaps one to three times a month for smaller firms, and weekly or oftener for larger firms. In general, the commercial buyer takes the initiative.

Sawmills usually produce lumber to fill prior orders. Purchase orders are usually of 1- or 2-months duration, and prices are usually fixed for the duration of the contract. Mills selling from inventory face a more uncertain situation, but under prevailing market conditions, lumber prices have been moving up fairly consistently, reflecting sustained demand for Amazon lumber. Price increases have occurred up to eight times a year.

Sawmillers cite a number of problem areas which interfere with efficient lumber production. Continuity in sawlog supply is a basic problem. Lack of skilled labor is cited frequently as a problem area. Other important problem areas cited are: lack of capital, obsolete equipment, difficulty in obtaining spare parts, inefficient mill layout, unstable labor force and energy shortage.

Lumber quality is frequently poor, particularly the output of the small sawmills. Dimensions are inaccurate and the thicknesses are variable. Lack of precision in sawing is acceptable in low-grade local markets, but it is not acceptable in national or foreign markets. Much of the poor-quality production stems from poor mill layout, worn-out equipment and the lack of adequate equipment maintenance. Well-designed, modern sawmills are relatively few.

The Plywood Industry

Eight plywood mills in 1978 produced 205,000 cubic meters of plywood. Four tree species, especially virola, accounted for 90 percent of the output. Demand for plywood is strong. Normally, most mills operate two 8-hour shifts per day.

Wood procurement procedures parallel those of the sawmill industry, but the plywood industry is financially stronger and is, therefore, better able to obtain logs. Logs are stockpiled during the wet season to insure continuous operation during the dry season. However, dependence on a few species from the seasonally flooded várzea, particularly virola, does offer problems in obtaining continuous log supply. Any broadening of species utilization which will occur will greatly improve the industry's ability to obtain a dependable log supply.

In comparison with the sawmill industry, plywood mills are more efficient and exert more quality control. Machinery is modern and maintained to high standards, although there is a problem in obtaining machine parts when needed.

The Veneer Industry

The veneer industry is new, but there were 9 mills in operation in 1978 producing 70,000 cubic meters of veneer products.

Sliced and rotary veneers are produced, both products requiring a few select high-quality hardwoods for raw material. Sliced veneer is, potentially, the more valuable product. Customers dictate their species requirements. Sometimes, they provide their own

logs for slicing. Logs for sliced veneer are obtained from upland areas. This can present a problem in supply because of the poor development of dry land logging, but the high value of logs minimizes any competition offered by the lumber industry for logs.

Raw material supply is more of a problem to rotary veneer mills since these mills must compete directly with the plywood industry. But in the case of both sliced and rotary veneer, the supply problem is caused mainly by the limitation of species in market demand.

Marketing and Markets

Sawmill Products

The distribution of lumber products requires a variety of marketing channels--manufacturers, industrial users, wholesalers and brokers, retailers and noncommercial users. Small mills market their product primarily through retailers and noncommercial users. Large mills are heavily dependent on wholesalers and brokers and manufacturers. Medium mills rely on all types of buyers for the sale of their product.

One-third of the lumber output is marketed within the region. A larger share--55 percent--is shipped to other regions of Brazil, and 12 percent of the total is exported. The location of sawmills has some influence on the location of markets. The primary geographic orientation for sawmills in Pará and Rondônia is to national markets; in Roraima, to export markets; in Amazonas, to local markets.

There is also some correlation between size of sawmills and markets and sawmill product groups and markets. Small sawmills are oriented to local markets; medium and large mills move more of their output to national and export markets. Similarly, lower-value products such as construction lumber and ungraded lumber are sold mainly in local markets; higher-value products usually move into national or export markets.

Most local sales are made at the sawmill. Local markets accept lower grades of lumber and broader species mixes than do the national or export markets. The existence of local markets is important, not only for the small mills whose product may be consistently in lower grades, but also for the larger mills which can ship only higher grades of lumber to national and export markets and which need some outlet for lower-value lumber.

Lumber destined for national markets has its origin principally in Pará and Rondônia. The species mix suitable for national markets is smaller than the mix acceptable in local markets but larger than the mix acceptable in export markets. Wholesalers, and especially brokers who maintain offices in the markets they serve, are the principal means of access to national markets. Close contact with brokers provides sawmillers with a wider range of market outlets as well as a means of gaining knowledge about market conditions.

Ninety percent of the lumber exported is accounted for by five species--virola, mogno, andiroba, sucupira and freijó. The United States takes the largest share of the exports. Methods of contact between sawmills and foreign markets are variable, but the

dominant method (85 percent of the sales volume) is in direct sales to foreign importers. Foreign importers maintain frequent contacts with exporting sawmills.

Plywood Products

Plywood is distributed to broad market areas as follows: local markets, 9 percent; national markets, 71 percent; and export markets, 20 percent.

Plywood destined for local markets is used mainly in the construction industry and is marketed through commission agents. Sales for national markets are made through branch sales offices located in major cities; only a very small portion is sold through commission agents. Foreign markets, principally Great Britain and the Netherlands, are reached through commission agents in the importing countries who represent the plywood mills.

Veneer Products

Almost all of the rotary veneer is exported to the United States and Great Britain. Since the mills producing rotary veneer are subsidiaries of foreign corporations, marketing is handled within the parent-company marketing structures.

Sliced veneer is exported (56 percent) to Spain, Great Britain and Venezuela; the remaining 44 percent is sold in national markets. Most sliced veneer is sold directly without the services of intermediate agents. Buyers commonly inspect the veneer at the factory before purchase.

Market Performance

Inefficiencies in production and marketing are numerous, but the penalties are not readily apparent. Timber production is expanding rapidly, and there is a market for all that can be produced. Product prices are relatively high; stumpage is available free or at nominal cost; labor costs are generally low; and profits are high.

Despite the high level of demand for timber products from the Amazon region, mills typically operate at well below their installed capacity. Sawmills operate at an average of 60 percent of capacity; plywood mills, 70 percent; veneer mills, 75 percent. The obstacles to full production include equipment failures and delays in obtaining spare parts, inefficient mill layout, unstable labor force and energy shortages. More specifically, the major limitation to full production in the sawmill industry is in the failure to accumulate log inventories; and in the plywood industry, the chief limitation is in the ratio of dryers to production lines.

Nearly three-fourths of the log supply in the sawmill industry is dependent on water transportation to mills. Characteristically, log inventory is accumulated during the season of river flooding, but only the larger and financially stronger firms accumulate sufficient inventory to carry them through the dry season when deliveries fall off or cease. Many small and medium mills simply shut down when the log supply disappears. This could become a critical problem when lumber market conditions become less favorable.

Plywood mills operate with two 8-hour labor shifts, yet production does not approach the capacity that is theoretically possible.

The problem is in the ratio of dryers to production lines. Characteristically, plywood mills with two production lines have one dryer; and mills with three production lines, two dryers. In either case, an additional dryer is needed. Currently, dryers are the bottleneck in production despite the fact that dryers operate 24 hours a day, six days per week.

Economies of Scale

It is not at all clear from forestry literature that economies of scale are important in the sawmill, plywood and veneer industries. In view of the problems of raw material supply, the scale of operations in plywood and veneer may be adequate; it does not appear that return on investment would be increased with investments in larger mills. The same reservation applies to the large sawmills and some of the medium sawmills. But most Amazon sawmills are too small to gain important advantages that would become possible with larger size: the ability to attract greater numbers of buyers and geographically more widely dispersed buyers for greater stability in markets; the feasibility of sorting out species, grades and types of product for different markets; the ability to have more managerial skills; and the ability to attract financing more easily and cheaply.

Vertical Integration

The lack of vertical integration as well as the geographic dispersal of the timber-products industry lead to inefficient use of wood raw material. Wood production residues are abundant and, usually, they are given away or burned. This occurs in all

timber-products industries. There is little evidence of interest in using wood residues at manufacturing plants for other products such as particleboard.

Innovation

Innovation and adaptation of new techniques and products are not common among the forest-products firms of the Amazon region. The plywood industry displays some efforts in adhesives research, but it is not clear that this industry does much research and development to utilize a wide range of Amazon tree species in plywood manufacture and to gain market acceptance for these species. As for the lumber industry, not only is research effort lacking, but there is a lack of adaptation to new techniques and products developed at public research centers. Most sawmill firms are unaware of the research work carried out at the National Wood Laboratory in Brasilia and at a number of universities.

Quality of Product

Poor quality of product is commonplace in the sawmill industry. This is an inevitable consequence of poor equipment and machine maintenance among the small and medium mills where worn tracks and bearings, shaking saws and misaligned saw teeth result in inaccurate dimensions of sawlog products. Improper seasoning of lumber is also a common fault in the industry. Air-drying is the prevailing method of seasoning lumber, but the methods and techniques used have not been developed to recognized standards.

The identification of quality through grading rules would at least permit buyers and sellers to negotiate on a rational basis. The plywood industry follows international rules in describing its products and export lumber is controlled by international grading rules, but the major part of lumber market (all of Brazil) is not governed by generally accepted written grading rules. Written lumber grading rules have been developed by SUDAM, but these rules have not gained common usage; most sawmill operators are not even aware that these rules exist.

Timber Supply

The timber resource appears limitless. The Amazon forest contains an estimated 46 billion cubic meters of timber, and annual timber removal for all products is well under 10 million cubic meters. However, the marketable species are relatively few and only a very small part of the forest is economically accessible to forest industry. In a number of areas where mills have tended to congregate, the preferred kinds of timber within ready access have been exhausted.

Timber supply will become an increasing problem which can be met through two basic approaches: (1) Increase species utilization, which requires more knowledge about the wood characteristics and utilities of a great number of species and marketing efforts to gain acceptance in consumer markets for these species; and (2) Gain wider access to the forests through an expanded road network. This need may be partially met by the government's current and planned

programs to increase settlement and economic development in the Amazon region.

In the long run, it will not be sufficient to broaden the species mix in utilization and to gain greater access to the Amazon forest. The present system of logging constitutes a mining operation. Forest management for sustained production is essential, but such management is almost totally absent. The bulk of the forest is in public ownership, but government exercises little control over forest exploitation. Standing timber is available to forest industries at no cost or at nominal cost. The predominant attitude is simply that when usable timber is removed from an area, logging can be shifted to other areas.

Forest management efforts are needed. Forest industry cannot be expected to do much in this regard so long as the situation is simply a matter of competition among firms to capture timber that appears to be a free gift of nature. Forest industry has no immediate incentive to be concerned with growing timber, sustained-yield management of forests or full utilization of the timber that is harvested. If conservation efforts are to be encouraged, they will have to stem initially from efforts by government to exercise management control of the publicly owned forest resource.

APPENDICES

APPENDIX A

PRIMARY PROCESSING INTERVIEW SCHEDULE

APPENDIX A

PRIMARY PROCESSING INTERVIEW SCHEDULE

Name of firm

Address

A. 1. Is your sawmill portable or stationary?

Portable _____ Stationary _____

2. How many years has your firm been operating at this location?

Years _____

3. Does your firm operate other wood-using mills? Yes___ No___

If yes, how many? _____ Where? _____

4. What were the principal final products of your firm at this location in 1978?

a. _____ d. _____

b. _____ e. _____

c. _____ f. _____

5. How many full-time employees did you have at this location in 1978? _____

6. How many seasonal employees did you have at this location in 1978? _____

7. Were any of your wood receipts in 1978 (saw logs) resold in the same form in which they were received? Yes___ No___

If yes, what species, and amounts? _____

_____

_____

_____

_____

If yes, why was this wood not processed at your mill?

B. Quantities of sawlog receipts (volume by _____ log rule)

1. What was the total volume of sawlog receipts at your mill in 1978? (List volume by species.)

_____

_____

_____

_____

_____

2. What was the seasonal pattern in volume of sawlog receipts at your mill in 1978?

a. Peak-use months and amounts (average) _____

b. Lowest-use months and amounts (") _____

c. Other months and amounts (") _____

3. Is the above a typical pattern? Yes ____ No ____

If not, why not? _____

_____

_____

_____

_____

4. How do you explain the seasonal variations in the typical pattern of sawlog receipts at your mill? _____

_____

_____

_____

5. What percentage change in the annual volume of your sawlog receipts has taken place in the last five years (1973-1978)?

No change _____

Increase _____%

Decrease _____%

6. What is the average distance of the source of the raw materials in 1978?

_____km maximum _____km minimum _____km

7. The logs were transported by

   River _____%

   Truck _____%

   Other _____%

C. Inventories of Sawlogs

1. What was the seasonal pattern in sawlog inventories on hand at your mill in 1978?

   a. Peak-inventory months and amounts (average) _____

   b. Lowest-inventory months and amounts (") _____

   c. Other months and amounts (") _____

2. Do you consider the seasonal pattern in sawlog inventories at your mill in 1978 to be a typical pattern? Yes___ No___

   If no, why not? _____

   _____

   _____

3. Is there a limit to the volume of sawlog inventories that can be stored in yard economically? Yes____ No____

   If yes, what is the nature of this limitation? _____

   _____

   _____

   If yes, what is the maximum volume? _____

4. Is there a physical and time limit to the volume of sawlog inventories that can be stored in yard because of insects, fungi, etc.? Yes____ No____

   If yes, what is the nature of the limitation? _____

   _____

   If yes, what is the maximum volume? _____

D. Sources of Sawlog Receipts

1. What was the 1978 sawlog supply area for your mill?

   a. States _____

   b. Radium of operations _____(maximum in km.)

   _____(average in km.)

2. Have there been any significant changes in the sawlog supply area for your mill in the last five years? Yes____ No____

   If yes, what were the changes? _____

   _____

   _____

   _____

3. What is the ownership of the forest land from which the 1978 sawlog supply was obtained (estimate volume of wood or percentage of total volume obtained from each source)?

	Volume
a. Own land	_____%
b. Farmer	_____%
c. Other Private	_____%
d. National Forest	_____%
e. Other Public	_____% ("Devolutas")
f. Don't know	_____%

4. Have there been any significant changes in the sawlog supply obtained from different forest ownership sources in the last five years? Yes____ No____

   If yes, what were the changes? _____

   _____

   _____

   _____

   If yes, what explanations can you give for these changes?

   _____

   _____

   _____

5. From which agent sources was your 1978 wood supply obtained?

	Volume	%
a. Own employees	_____	
b. Wood producer	_____	
c. Agent (specify)	_____	

E. Sawlog Procurement Methods and Policies

1. What percentages of your firm's 1978 sawlog purchases were obtained under the following types of agreements?

   a. Written contract _____%

   b. Oral contract _____%

   c. No prior agreement _____%

2. What percentages of your sawlog purchases (when first initiated) were obtained through negotiations initiated by your firm or initiated by the sellers?

	Sawlogs (%)	Sawlog Stumpage (%)
a. Mill		
b. Sellers		
c. Indefinite		

3. When your firm takes the initiative in negotiating sawlog purchases, what are the methods you use in contacting potential suppliers? _____

   _____

   _____

   _____

4. When your firm takes the initiative in negotiating stumpage purchases, what are the methods you use in contacting potential suppliers? _____

   _____

   _____

   _____

5. What quantities of your 1978 sawlog receipts were purchased on the stump, riverside and delivered?

	Quantity	%
On the stump		
Roadside		
Riverside		
Delivered to the mill		

6. To what degree does your firm perform the following functions in regard to sawlog procurement?

   a. Logging? _____

   _____

   b. Hauling? _____

   _____

7. From how many different persons was your 1978 wood supply purchased?

	No.
a. Landowner	_____
b. Producer	_____
c. Other agents	_____

8. What are the details of oral contracts for cut wood purchases? (Check the following items which are included in agreements; then describe as much as possible.)

   a. _____ Kind of wood _____
   b. _____ Amount of wood _____
   c. _____ Size of wood _____
   d. _____ Quality of wood _____
   e. _____ Time or period of delivery _____
   f. _____ Method of payment _____
   g. _____ Time of payment _____

9. What are the details of written contracts for cut wood purchases? (Check the following items which are included in agreements; then describe as much as possible.)

   a. _____ Kind of wood _____
   b. _____ Amount of wood _____
   c. _____ Size of wood _____
   d. _____ Quality of wood _____
   e. _____ Time or period of delivery _____
   f. _____ Method of payment _____
   g. _____ Time of payment _____

F. Prices

1. Are there any differences in prices paid for delivered wood on basis of distance of haul? Yes____ No____

   If yes, what are the differences? _____

   _____

   _____

   _____

2. Are the prices you pay for sawlogs most often the result of:

   a. _____ your offered price?
   b. _____ the seller price?
   c. _____ negotiation?
   d. _____ other

3. Are the prices you pay for stumpage most often the result of:

   a. _____ your offered price?
   b. _____ the seller price?
   c. _____ negotiation?
   d. _____ other

4. Are the prices received for your principal products sold most often the result of:

   a. _____ your price?
   b. _____ the buyer price?
   c. _____ negotiation?
   d. _____ other

5. Have the prices you paid for sawlog changed frequently during the 5-year period 1978-78? Yes____ No____

   If yes, in what percentage have the prices changed? _____%

6. Have the prices received for the principal products sold by your firm changed frequently during the 5-year period 1978-78?

   Yes____ No____

   If yes, what percentage change occurred over the 5-year period? _____%

G. Transportation

1. What percentage of the volume of your sawlog receipts in 1978 were delivered to your mill by different methods of transportation?

	%
a. Truck	
b. Boat	
c. River	
d. Other (specify)	

2. What were the hauling distances to your mill in 1978 in direct-to-mill hauls?

	km
a. Average distance	
b. Minimum "	
c. Maximum "	

3. What changes in the distances of haul for truck deliveries of sawlogs to your mill have occurred in the past five years?

_____

_____

_____

H. Sales of Processed Products

1. What was the total volume of production at your mill in 1978? (List by products.) _____

_____

_____

2. What percentage of mill capacity did your 1978 production represent? _____%

3. What was the seasonal pattern of production at your mill in 1978 (in terms of volume)?

a. Peak-production months and amounts (average) _____

b. Lowest production months and amounts (") _____

c. Other months and amounts (") _____

4. Do you consider the seasonal pattern of production at your mill in 1978 to be a typical pattern? Yes____ No____

   If no, why not? _____

   _____

   _____

5. What was the seasonal pattern in processed product inventories on hand at your mill in 1978?

   a. Peak inventory months and amounts (average) _____

   b. Lowest inventory months and amounts (") _____

   c. Other months and amounts (") _____

6. Do you consider the seasonal pattern in processed product inventories at your mill in 1978 to be a typical pattern?
   Yes____ No____

   If no, why not? _____

   _____

   _____

7. Is there a limit to the volume of processed product inventories that can be stored in yard economically? Yes____ No____

   If yes, what is the nature of the limitation? _____

   _____

   _____

   _____

   If yes, what is the maximum volume? _____

   _____

   _____

8. Is there a physical and time limit to the volume of processed product inventories that can be stored in yard because of insects, fungi, etc.? Yes____ No____

   If yes, what is the nature of the limitation? _____

   _____

   _____

   If yes, what is the maximum volume? _____

   _____

9. What percentages of the volume of your principal products in 1978 were produced to fill previously obtained orders?

	Product	%
a.	_____	_____
b.	_____	_____
c.	_____	_____
d.	_____	_____

10. What area did your sales territory cover in 1978? (List by principal products. List cities, states: state maximum distances.) _____

_____

_____

_____

_____

11. Have there been any significant changes in the product market areas for your firm in the past five years? Yes____ No____

If yes, what are the changes? _____

_____

_____

_____

12. To which types of buyers did sales of your principal products in 1978 go? (Estimate, by products, the volume or percentage of total volume.)

	Volume	%
a. Manufacturer	_____	_____
b. Wholesaler	_____	_____
c. Retailer	_____	_____
d. Industrial user	_____	_____
e. Other (specify)	_____	_____

_____

_____

_____

13. Have there been any significant changes in the volumes of products going to different types of buyers of your principal products in the past four years? Yes____ No____

If yes, what were the changes? _____

_____

_____

If yes, what explanations can you give for these changes?

_____

_____

14. How many different buyers of your products did you sell to in 1978?

	No.		No.
a. Manufacturer	_____	d. Industrial user	_____
b. Wholesaler	_____	e. Other (specify)	_____
c. Retailer	_____	_____	

15. Have there been any significant changes in the numbers of buyers of your principal products in the past four years?
Yes____ No____

If yes, what were the changes? _____

_____

_____

If yes, what explanations can you give for these changes?

_____

_____

16. What is the typical time interval between receipt of an order from a buyer and the filling of that order?

_____

_____

_____

17. If your buyers are known to be intermediate agents, can you identify the real markets? List cities, states, countries (state maximum distances).

_____

_____

_____

APPENDIX B

STATISTICAL TABLES

Table B1.--Distribution of sawmills in the Amazon region, by subregion, 1978.

Total Production (m^3/Year)	Amazon Region		Pará		Amazonas		Roraima		Rondônia		Acre	
	No. Mills	Per-cent	No. Mills	Per-cent	No. Mills	Per-cent	No. Mills	Per-cent	No. Mills	Per-cent	No. Mills	Per-cent
1- 1,000	78	10	51	10	12	14	10	55	2	1	3	9
1,001- 2,000	202	25	128	25	21	25	2	11	45	32	6	17
2,001- 3,000	76	9	51	10	8	9	1	6	12	9	4	11
3,001- 4,000	79	10	51	10	8	9	-	-	15	11	5	14
4,001- 5,000	79	10	46	9	8	9	3	16	17	12	5	14
5,001- 6,000	23	3	10	2	12	14	-	-	-	-	1	3
6,001- 7,000	52	7	31	6	4	4	-	-	15	11	2	6
7,001- 8,000	23	3	15	3	4	4	-	-	2	1	2	6
8,001- 9,000	88	11	72	14	-	-	1	6	13	9	2	6
9,001-10,000	37	5	20	4	-	-	-	-	13	9	4	11
10,001-15,000	24	3	15	3	4	4	1	6	3	2	1	3
15,001-20,000	18	2	10	2	4	4	-	-	4	3	-	-
Over 20,000	14	2	10	2	4	4	-	-	-	-	-	-
Total	793	100	510	100	89	100	18	100	141	100	35	100

Table B2.--Lumber production in Brazil's Amazon region by production class of sawmill, by subregion, 1978.

Annual Lumber Production (m^3)	Amazon Region	Pará	Amazonas	Roraima	Rondônia	Acre
			($1000\ m^3$)			
1- 1,000	53.6	34.5	9.8	6.0	.9	2.4
1,001- 2,000	274.4	177.8	30.9	2.1	55.8	7.7
2,001- 3,000	192.8	133.0	18.8	3.1	28.6	9.3
3,001- 4,000	279.2	183.6	27.6	4.2	46.7	17.1
4,001- 5,000	351.9	209.3	37.0	9.0	74.8	21.8
5,001- 6,000	129.3	55.3	68.5	--	--	5.5
6,001- 7,000	339.6	199.4	26.2	--	100.6	13.4
7,001- 8,000	164.9	109.5	28.8	--	14.8	14.8
8,001- 9,000	704.5	583.4	--	8.3	96.7	16.1
9,001-10,000	348.5	189.3	--	--	121.9	37.3
10,001-15,000	295.9	185.4	45.6	11.2	39.0	14.7
15,001-20,000	331.6	184.1	84.0	--	63.5	--
Over 20,000	552.5	435.7	116.8	--	--	--
Total	4,021.7	2,680.4	494.0	43.9	643.3	160.1

Table B3.--Growth of sawmill population in Brazil's Amazon region, by subregion, 1952-78.

Subregion	1952	1965[a]	1973	1976	1978
Pará	61		201	327	510
Amazonas	20		) 54	) 75	89
Roraima	2		)	)	18
Rondônia	4		) 32	) 78	141
Acre	2		)	)	35
Total	89	194	287	480	793

Source: Knowles, 1966; Soares, 1972; Bruce, 1976; Hägerby, 1976.

[a]Breakdown by subregions not available.

Table B4.--Species mix utilized by sawmill industry in the Amazon region, 1978.

Common Name	Sawlog Volume (1000 m^3)	Percent of Volume
Virola	2,245.2	36.0
Mogno	559.8	9.0
Cerejeira	514.7	8.3
Andiroba	418.3	6.7
Louro Inhamui	411.7	6.6
Cedro	296.0	4.7
Maçaranduba	276.7	4.4
Sucupira	160.7	2.6
Açacu	128.7	2.1
Pau Amarelo	115.9	1.9
Angelim	96.5	1.6
Freijó	77.2	1.2
Pau D'arco	63.4	1.0
Jatobá	51.5	0.8
Cedrorana	45.0	0.7
Quaruba	45.0	0.7
Copaiba	32.1	0.5
Others	696.3	11.2
Total	6,234.7	100.0

Table B5.--Species mix utilized by the plywood industry in the Amazon region, 1978.

Common Name	Log Volume (m^3)	Percent of Volume
Virola	258,196	49.1
Muiratinga	109,410	20.8
Sumauma	50,900	9.7
Breu Sucuruba	50,900	9.7
Caucho	14,876	2.8
Copaiba	14,876	2.8
Esponja	5,400	1.0
Paricarana	3,850	0.7
Jacareuba	3,850	0.7
Açacu	3,850	0.7
Pau Marfin	1,296	0.3
Ceiba	1,296	0.3
Others	7,500	1.4
Total	526,200	100.0

Table B6.--Sawnwood production in the Amazon region, by subregion, 1972, 1976 and 1978.

Subregion	1972	1976	1978
		(1000 m^3)	
Pará	824.8	1,475.8	2,680.4
Amazonas	323.3	493.9	494.0
Roraima			43.9
Rondônia	85.6	229.6	643.3
Acre			160.1
Amazon Region	1,233.7	2,199.3	4,021.7

Source: Bruce, 1976; Hägerby, 1976.

APPENDIX C

FINAM INVESTMENT REGULATIONS AND INCENTIVES

APPENDIX C

FINAM INVESTMENT REGULATIONS AND INCENTIVES

The following are extracts from pp. 22-47 of the booklet issued by SUDAM (1976), considered relevant to forestry and forest industries.

Article 22--The use of special equipment for control of pollution from any industrial source will be compulsory, and in line with the present laws on this subject and the recommendations of the specific controlling agencies, the inclusion in the project of detailed proposals concerning the installation of environmental pollution control, equipment is required and must be signed by the expert responsible for designing it. The industries will have to adopt measures that prevent air or water pollution, erosion of lands and the silting of rivers and streams in their areas of influence.

Article 25--Wood projects must foresee the integration of the productive process through a direct link of the industrial activities with the forestry operations, so as to assure raw material supply in conditions of rational exploitation. To this end, they must show that they have the necessary forest area available to them, either under their ownership or belonging to others, and located at distance considered economic in relation to plant locations.

Sole paragraph--For the purpose of this article, it is up to SUDAM to establish the maximum distance allowed for logging and transportation, taking into account the geographical location of the forest areas, in relation to industry, the areas of influence of the processing units operating in the region, and the technology used in the forestry operations.

Article 26--As an integral and essential part of the industrial project, a forestry management or reforestation program shall be included with at least 50% local species used. The plan will be designed under the supervision of the company or individual qualified according to the law, according to the instructions of Decree nº 68.565 April 29, 1971, and the regulations of the Brazilian Institute for Forestry Development.

Sole paragraph--The integration of industrial activities and forestry operations in order to assure the industries' raw material supply under conditions of rational exploitation will include operations of forestry management for mechanical conversion industries and operations of reforestation for transformation industries.

Article 27--The forest inventory will have to accompany the management project of the wood supply area, to assure that the area has the ability to satisfy the industry's needs, within the production plan foreseen in the project.

Article 28--The project will include, in the part referring to forestry operations, the planning of wood harvesting through the use of mechanical saws, as well as the utilization of adequate boats or appropriate trucks and tractors, depending on the locale, capable of assuring wood transportation in good condition and in a reduced period of time.

Article 29--The wood industries which use a restricted number of forestry species in their productive process (selective exploitation) should compulsorily conduct the reforestation project (to whose execution they are obliged by Clause 20 of the Forestry Code) by the method of guided natural regeneration, through adequate silvicultural treatments, in order to reach a gradual and progressive enrichment of the exploited areas with species used in the processing industries.

The management of the supplying forestry area should be planned in order for it to provide at least 30% of the raw material supply necessary to the industrial operations of the enterprise, from the first year of its activity, so that this supply can increase gradually in the next years.

The conduction of the natural regeneration process and enrichment in the forestry area exploited should be a minimum of one hectare, treated for each 50 m^3 of wood harvested.

Article 30--The purchase of forestry condominium shares will only be allowed for the purpose of compulsory restocking by the small enterprises, here understood as the ones which have production capacity equal or inferior to 15,000 m^3/year.

Sole paragraph--According to the replacement based on artificial plantations, which is the concern of the present clause of 50% from commercial native species is required.

Article 31--In the projects converting heterogeneous forests into homogeneous ones (Clause 19--from the Forestry Code) it will be required to maintain at least 20% of the primitive forest canopy, distributed into protective strips of land, inserted between large planting fields, which cannot exceed, in a continuous area, 1000 ha each.

Sole Paragraph--Besides the constant requirement of this clause, the increased stocking of the commercial wood harvested in the area will be compulsory under any circumstances.

Article 38--The participation of management resources of SUDAM in the financial support of the total investments in each project cannot exceed 75% of the difference among the total investments referred and the financing granted to the project by other sources of credit, to be complemented with the own resources of the beneficiary.

Sole paragraph--The resources deriving from the program of Land Redistribution and Incentives to agro-industry of the North and North-East--PROTERRA, with the purpose of project financing, will be part of the correspondent quota of resources managed by SUDAM.

Article 46--For the purpose of participation in the resources managed by SUDAM, the wood projects will be classified under four priority areas, distinguished by the letters A, B, C and D, in the limits which follow, according to the amount of points achieved.

Areas	Participation of the Resources Managed by SUDAM	Amount of Points
A	Up to 75 per cent	Equal to or higher than 85
B	Up to 60 per cent	Equal to or higher than 65 and lower than 85
C	Up to 50 per cent	Equal to or higher than 45 and lower than 65
D	Up to 30 per cent	Lower than 45

Article 47--The classification of the priority areas, which is the concern of the previous clause, will be made observing the number of points achieved according to the criteria mentioned below:

I. Level of participation of the resources managed by SUDAM

Resources Managed by SUDAM, National Treasury Indexed Bonds (O.R.T.N.)		Points
Up to	178,200	10
178,200	356,400	8
356,400	712,700	6
712,700	1,603,600	4
1,603,600	1,870,800	2
Above	1,870,800	1

II. Location

1. Projects located on national boundary areas in the states of Acre and Amazon and in territories of Amapá, Rodônia and Roraima . . . . . 20 points

2. Projects located on areas technically adequate or on areas of special programmes established by the Federal Government for the region . . . . . 15 points

3. Projects that do not fit in numbers 1 and 2, which have their supplying area located in a sphere of action considered economic, by SUDAM's criterion, and which use modern methods of transportation . . . . . 10 points

III. Technology Grade in the activities of forestry exploitation

1. Employment of technology type I . . . . . 20 points

2. Employment of technology type II . . . . . 10 points

3. Employment of technology type III . . . . . 5 points

IV. Grade of sectorial integration

1. Manufacturing of plywood particleboard, fiberboard, moulding production, panels, wood forms and similar furniture manufacturing, fluvial boat manufacturing, house construction and other types of complementary industries, which can provide the vertical integration as well as the horizontal, from the existing ones, furnishing a final product of higher grade of processing; forestry activities of mechanized harvesting, pulp and paper industries . . . . . 20 points

2. Veneer production (peeled or sliced) and parquets . . . . . 10 points

3. Sawnwood manufacturing, as long as it has another parallel product line whose production volume represents at least 30 percent of the sawnwood production volume . . . . . 5 points

V. Market

1. Projects which sell more than 50 percent of their production on the international market, or which provide the substitution of imports proceeding from the international market . . . . . 20 points

2. Projects which sell more than 50 percent of their production on the domestic market, when the region is the source of products, in face of the comparative advantages which it presents in relation to other regions of the country, or which provide the substitution of imports proceeding from those regions . . . . . 15 points

3. Projects whose production is sent to national or regional markets . . . . . 10 points

VI. Employment Opportunity

1. 500 or more jobs . . . . . 30 points

2. from 300 to 499 jobs . . . . . 25 points

3. from 190 to 299 jobs . . . . . 20 points

4. from 50 to 99 jobs . . . . . 15 points

5. from 20 to 49 jobs . . . . . 10 points

Sole paragraph--for the purpose of what is stated in item III of this article it is considered:

a) technology type I--one in which all forest exploitation activities are mechanized (logging and transportation);

b) technology type II--one in which more than one forest exploitation activity is mechanized;

c) technology type III--one in which only one forest exploitation activity is mechanized.

Article 51--The participation of the resources (of SUDAM) cannot exceed, in each project, the maximum limit of Cr. $430,345.24 (1976).

Sole paragraph--Exceptionally, through the approval of the deliverative body, this limit can be exceeded in favourable conditions of resources availability, and keeping in mind the high interest of the project for the development of the Amazon.

Article 53--In the beneficiary enterprises whose shareholders' control belongs directly or indirectly to individuals or enterprises.

SECTION II

Reduction and Exemption of Import Duties and Taxes on Manufactured Products

Article 71--SUDAM can grant a reduction of 50 percent on import duties and taxes on manufactured products, including machines, equipment, devices, spare parts and hardware, with no national substitutes and in normal amounts, necessary to the execution of the approved industrialization projects, considered of interest to the Amazon region and which fit into project categories approved by the Development Industrial Council.

Sole paragraph--It is understood by "normal amount" as that, at project level, which is considered by the Executive office of SUDAM as necessary to the formation of minimum stocks assigned to the initial phase of the project.

Article 72--The fiscal benefit mentioned in the previous clause can be increased to 80 percent, when destined for projects that fit in the following sectors:

a) machine and equipment production and their components;

b) manufacture of machines, agricultural and transporting equipment, and forest resources exploitation equipment;

c) components production for the electric, electronic and mechanical industry;

d) production of railway material;

e) production of motor vehicles destined for public transportation;

f) naval and aeronautic construction;

g) primary steel and nonferrous metallurgy;

h) production of cement and refractory materials;

i) pulp and paper production;

j) production of fertilizers and agricultural derivatives and their raw materials;

k) production of basic chemicals;

l) petroleum and by-products industry;

m) mining industries;

n) industries and activities related to national security, defined by the National Security Council.

APPENDIX D

PRINCIPAL FOREIGN MARKETS FOR SELECTED TREE SPECIES FROM THE AMAZON REGION, 1978

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PRINCIPAL FOREIGN MARKETS FOR SELECTED TREE SPECIES FROM THE AMAZON REGION, 1978

Açacu	United States, West Germany
Amapá	United States
Andiroba	Netherlands, United States, United Kingdom, West Germany, Portugal, Spain, Barbados, Belgium, France
Angelim pedra	Norway, Portugal
Angelim vermelho	Norway
Cafearana	Venezuela
Casca grossa	Venezuela
Cedro	United States, West Germany, Spain, Ireland, Puerto Rico, United Kingdom, Portugal, Italy, Barbados
Cedrorana	Venezuela, West Germany, France
Copaiba	France
Cumarú	West Germany, Venezuela, Portugal, Belgium
Cupiuba	Portugal, Italy
Freijó	United Kingdom, Venezuela, West Germany, United States, Portugal
Jacaranda do Pará	Portugal, West Germany
Jacareuba	France
Jatobá	West Germany, Spain, Belgium, Netherlands, Portugal, Venezuela
Louro preto	Venezuela
Louro vermelho	West Germany, Ireland, Portugal, Italy

Mandioqueira	United Kingdom
Marupá	West Germany, United States
Maçaranduba	United Kingdom, United States, Italy, Portugal
Mogno	United States, West Germany, Netherlands, United Kingdom, Ireland, Puerto Rico, France, Spain, Norway, Barbados, Jamaica, Venezuela, South Africa
Muiracatiara	Italy, West Germany, United States
Muiratinga	United States
Pau amarelo	West Germany, Portugal
Pau d'arco	Italy, West Germany, Netherlands, Venezuela, Portugal
Pau roxo	Portugal
Piquiá	Portugal
Quaruba	West Germany, Venezuela, Ireland, United States, Netherlands, Portugal
Sucupira	United States, West Germany, Venezuela, Italy, Portugal, Norway, Netherlands, France
Sumauma	United States, Ireland
Tatajuba	United Kingdom, United States, Ireland, France, Spain, West Germany, Netherlands, Portugal
Virola	United States, Sweden, West Germany, United Kingdom, Belgium, Ireland, Canada, Netherlands, Puerto Rico, Italy, Spain, Haiti, Barbados, Norway

APPENDIX E

SCIENTIFIC NAMES OF TREE SPECIES

APPENDIX E

SCIENTIFIC NAMES OF TREE SPECIES

Abiurana	*Pouteria* spp.
Açacu or Assacu	*Hura creptans*
Açacurana	*Erytrina glauca*
Acapu	*Vouacapoua* spp.
Agoano or Mogno	*Swietenia macrophylla*
Amapá	*Parahancornia amapa*
Ananí	*Simphonia globulifera*
Andiroba	*Carapa guianensis*
Angelim amargoso	*Vatairea* spp.
Angelim grande	*Hymenolobium elatum*
Angelim pedra	*Dinizea excelsa*
Angelim pedra	*Hymenolobium excelsum*
Angelim rajado	*Pithecolobium vacemosum*
Angelim vermelho	
Bicuiba cheirosa	*Virola theiodora*
Breu sucuruba	*Trattinickia durserifolia*
Cafearana	
Caucho	*Brosimum* spp.
Casca grossa	
Cedro	*Cedrela odorata*
Cedro branco	*Poupartia amazônica*
Cedro branco	*Cedrela luberi*

Cedrorana	Cedrelimba catansefornia
Ceiba	Ceiba pentandra
Cerejeira do Pará	Malpighia punicifoli
Copaiba	Copaifera multijuga
Cumarú	Coumarona odorata
Cupiuba	Goupia glabra
Esponja	
Faveira	Parkia spp.
Faveira bolacha	Vatairea spp.
Faveira paricá	Piptadenia spp.
Freijó	Cordia spp.
Jacaranda do Pará	Dalbergia spruceana
Jacareuba	Calophyllum brasiliense
Jatobá	Hymenaea courbaril
Louro	Nectandra pichurim
Louro amarelo	Aniba spp.
Louro branco	Ocotea spp.
Louro inhamui	Ocotea barcelensis
Louro preto	Nectandra mollis
Louro vermelho	Ocotea rubra
Macacauba	Platymiscium spp.
Mandioqueira	Qualea paraensis
Marupá	Simaruba amara
Maçaranduba	Manilkara huberi
Matá-matá	Eschweilera spp.

Morototó	Didymopanox morototoni
Muiracatiara	Astronium lecointei
Muiratinga verdadeira	Olmedia maxima
Pau amarelo	Euxylophora paraensis
Pará-pará	Jacaranda copaia
Paricarana	Pityrocarpa pteroclada
Pau d'arco (Ipê)	Tabebuia serratifolia
Pau marfim	Agonandra brasiliensis
Pau roxo	Peltogyne altissima
Piquiá	Caryocar villosum
Quaruba	Vochysia spp.
Sucupira	Diplotropis purpurea
Sucupira amarela	Poucheria schomburgkii
Sumauma	Ceiba pentandra
Tachi preto de várzea	Triplaris surinamensis
Tatajuba	Bagassa guianensis
Virola or Ucuuba	Virola spp.
Virola da várzea or Ucuuba	Virola surinamensis

LITERATURE CITED

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Abril, Editora. 1979. Guia Quatro Rodas, Brasil. Abril S.A. Cultural e Industrial. São Paulo.

Berger, Ricardo. 1979. "The Brazilian Fiscal Incentive Act's Influence on Reforestation Activity in São Paulo State." Unpublished Ph.D. thesis. Michigan State University, East Lansing.

Berutti, Paulo. 1979. "Ex-Presidente do IBDF nega contrato de risco e defende a exploração das Florestas." Journal do Brasil, 6-13-1979. Rio de Janeiro.

Brasil, Madeira. Diretriz Emprendimentos. Monthly. Curitiba.

Bruce, Richard W. 1976. Production and Distribution of Amazon Timber. Field Document No. 21. FO: DP/BRA/71/545. UNDP/FAO/IBDF. Brasilia.

Cardoso, Fernando H. and G. Muller. 1978. Amazônia: Expansão do Capitalismo. 2ª Edição. Editora Brasiliense. São Paulo.

Carvalho, Ronald. 1979. "Jari um Bilhão de Dolares na Floresta." Journal do Brasil, 4-2-1979. Rio de Janeiro.

Davis, Shelton H. 1979. Victims of the Miracle: Development and the Indians of Brazil. Cambridge University Press. Cambridge, Mass.

Duerr, William A. 1960. Fundamentos da Economia Florestal. Fundação Calouste Gulbenkian. Lisbon, Portugal.

Filho, Perminio C. P. 1978. Exploração mecanizada em matas de várzea. Série Técnica No. 14. PRODEPEF. Brasilia.

Gomes, Pompa A., C. Vasquez-Yanes, and S. Guevara. 1972. "The Tropical Rain Forest: A Non-renewable Resource." Science, 177: 762-765.

Goodland, R. J. A. and H. S. Irwin. 1975. Amazon Jungle: Green Hell to Red Desert? Elsevier Scientific Publishing Co. New York.

Gregory, Robinson G. 1957. "A Re-orientation of Forest Marketing Research." Journal of Forestry 55(6): 454-458.

_____. 1972. Forest Resource Economics. The Ronald Press Company. New York.

Hägerby, L. 1976. "Forest Industry in the Amazon: Capacity and Production." Research Note N:11 rev. 1. Project BRA 171/545 rev. 1. Brasilia. (Mimeographed.)

IBDF. 1975. Amazonian Forestry: Present Situation and Perspectives for Its Development. Informative document of the Government of Brazil Submitted to the Technical Conference on the Tropical Moist Forests. PRODEPEF. Rio de Janeiro.

_____. Informe de Oportunidades Comerciais. INFOC. COPLAN Semi-Monthly. Brasilia.

IBGE. 1977. Anuario Estatístico do Brasil. Rio de Janeiro.

_____. 1977. Geografia do Brasil. Região Norte. Rio de Janeiro.

Knowles, H. O. 1966. Relatorio ao Governo do Brasil sobre Produção e Mercado de Madeira na Amazônia. Projeto do Fundo Especial No. 52. FAO-SUDAM. Belém.

_____. 1971. Perspectiva das Oportunidades de Investimentos no Desenvolvimento da Industria Florestal da Amazônia Brasileira. Projeto do Fundo Especial No. 52. FAO-SUDAM. Belém.

Lamb, F. B. 1966. "Marketing and Utilization of Tropical Forest Products." Proceedings of the Sixth World Forestry Congress. Madrid, Spain. pp. 3098-3104.

Mahar, Dennis J. 1978. Desenvolvimento Econômico da Amazônia. IPEA. Rio de Janeiro.

Ministerio do Interior. 1976. Programa de Polos Agropecuarios e Agrominerais da Amazônia. Secretaria de Planejamento e Operações. Brasilia.

Muthoo, Maharaj K. 1977. Perspectivas e Tendencias do Setor Florestal Brasileiro 1975-2000. Vol. I and II. COPLAN-IBDF Série Técnica No. 8. Brasilia.

Neto, Miranda. 1979. O Dilema da Amazônia. Editora Vozes Ltda. Petropolis. R.J.

Pandolfo, Clara. 1974. "Estudos Basicos para O Estabelecimento de uma Politica de Desenvolvimento dos Recursos Florestais e de uso Racional das Terras na Amazônia." Sudam. Belém. (Mimeographed.)

_____. 1978. A Floresta Amazônica Brasileira: Enfogue Econômico-Ecológico. SUDAM. Belém.

Pires, João M. 1974. "Tipos de Vegetação da Amazônia." Brasil Florestal, Ano 5, No. 17: 48-58.

Potma, L. H. 1977. Projeções de Demanda de Madeira Serrada no Brasil 1975-2000. COPLAN-IBDF. Série Técnica No. 3. Brasilia.

Prado, Carlos Antonio do. 1977. Contribuição do Setor Florestal ao Comercio Exterior do Brasil 1959-1974. COPLAN-IBDF. Série Técnica No. 5. Brasilia.

Rich, Stuart U. 1970. Marketing of Forest Products: Text and Cases. McGraw-Hill Book Company. New York.

Rivoli, Gianni. 1978. Produção e Comercialização de Madeira Serrada na Amazônia. COPLAN-IBDF. Série Técnica No. 7. Informe No. 2. Brasilia. pp. 35-55.

_____. 1978. Madeiras, Produtos, Mercados. Brasilia. pp. 61-99.

_____. 1978. Exigencia de Mercado e a Resposta Amazônica. COPLAN-IBDF. Série Técnica No. 7. Informe No. 4. Brasilia. pp. 109-122.

_____. 1978. Padronização de Medidas e Qualidades da Madeira Serrada no Polo Marajó Destinado a Exportação. COPLAN-IBDF. Série Técnica No. 6. Brasilia.

Rivoli, Giani, Kalko Koljonen, Paulo R. Nascimento, and Roberto Samanez Mercado. 1978. A Aplicação da Madeira e seus Derivados na Construção Habitacional. COPLAN-IBDF. Série Técnica No. 9. Brasilia.

Rogers, J. W. 1976. "Forest Industries. The Scope of the Amazon Wood Industry." PRODEPEF. Belém. (Mimeographed.)

Santo, Antonio E. 1974. O Vale Amazônico no Futuro do Mundo. 3º. Edição. São Paulo.

Shand, Eden A. 1979. "Marketing of Forest Products." FO: BRA/76/027-IBDF Technical Report. Brasilia. (Mimeographed.)

Shand, Eden A., Raimundo N. Bezerra, and Paulo R. Nascimento. 1978. Diagnostico do Mercado de Madeira e Derivados. Volume II. Analise do Sistema de Comercialização Interna de Madeira e Derivados. COPLAN-IBDF. Brasilia.

Soares, Francisco de A. J. 1972. Aspectos da Comercialização das Madeiras da Amazônia. SUDAM. Belém.

SUDAM. 1973. Tecnologia de Produtos Florestais na Amazônia. Belém.

_____. 1975. Mercado Internacional da Madeira. Belém.

_____. 1976. Incentivos Financeiros e Fiscais. Regulamentação FINAM. Belém.

SUDESUL. 1977. Estudo das Alternativas Técnicas Econômicas e Sociais para o Setor Florestal do Paraná. Sub-Programa. Mercado. Curitiba.

Tavares, Vanio P., Claudio M. Considera, and Maria Thereza de C. Silva. 1972. Colonização dirigida no Brasil, suas possibilidades na regiao Amazônica. INPEA/INPES. Relatorio de Pesquisa No. 8. Rio de Janeiro.

Tromp, H. and F. Schmithusen. 1966. "The Introduction of More Effective Wood-Selling Techniques." Proceedings of the Sixth World Forestry Congress. Madrid, Spain. pp. 539-550.

Westoby, J. D. 1962. "Forest Industries in the Attack on Economic Underdevelopment." Unasylva 16(4): 168-202.

Wetterberg, G. B. and Maria Tereza J. Padua. 1978. Preservação da Natureza na Amazônia Brasileira. PRODEPEF. Série Técnica No. 13. Brasilia.

Worrel, Albert C. 1959. Economics of American Forestry. John Wiley and Sons, Inc. New York.