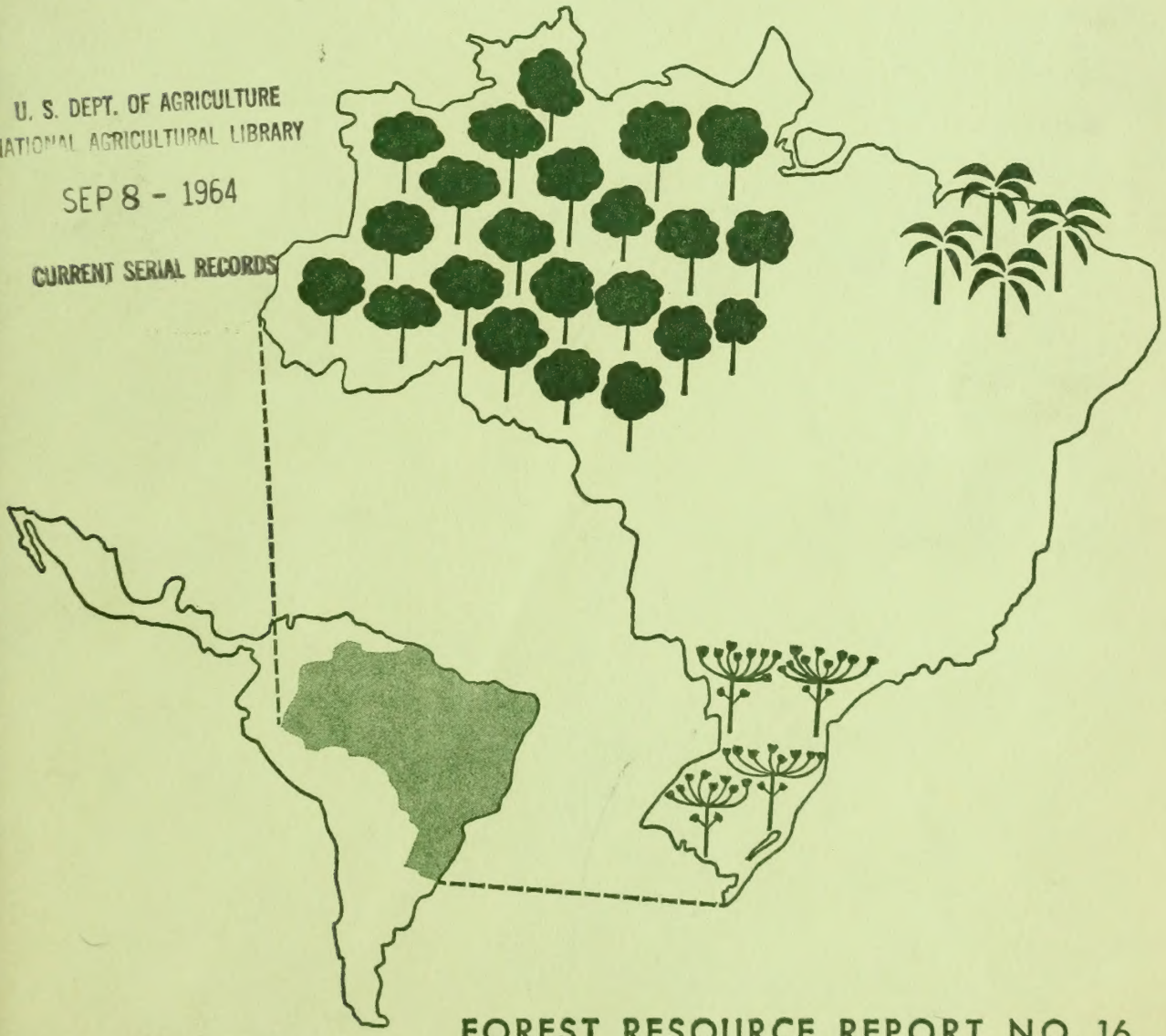
FORESTS AND FOREST INDUSTRIES OF BRAZIL



FOREST RESOURCE REPORT NO. 16

UNITED STATES DEPARTMENT OF AGRICULTURE - FOREST SERVICE

FORESTS And FOREST INDUSTRIES Of BRAZIL

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PREFACE

Heretofore the available but limited information on the forests and forest industries of Brazil has been scattered piecemeal within publications and reports on commerce, agriculture, or other more general subjects. This publication attempts to bring together the most significant of this information as an aid to a better understanding of the role of forests and forest industries in Brazil's development. It is designed to meet the needs of those interested in forest products trade between the United States and Brazil and to indicate the magnitude of the vast broadleaf, or hardwood, resources of this forest-rich country. Also, the publication aims to increase the basic knowledge of the reader, whether businessman, technician, government worker, student, or interested citizen.

All known sources of public information have been drawn upon to make this report as comprehensive and up to date as possible. Statistics were not available for some items, others were incomplete, and some were at best informed estimates. As primary sources of many of the statistics used, the authors wish to acknowledge the various issues of the Anuário Estatístico do Brasil, Estatística do Comércio Exteriór do Brasil, and the Anuário Brasileiro de Economia Florestal, reports of the U.S. Department of Commerce, and various publications of the Food and Agriculture Organization of the United Nations.

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HIGHLIGHTS

Language: Portuguese.

Population: 71 million (1960), 50 percent literate; labor force, 27 million. People concentrated along east coast and in the south; vast areas of the Amazon lowlands and the interior have almost no inhabitants.

Total area: 3¼ million square miles; 44 percent in productive forests.

Forest area: 1,454,800 square miles or 931 million acres, 15 percent being exploited, mostly in the southern States; 793 million acres not now in use, mostly in the Amazon Basin. Broadleaf species (hardwoods) occupy more than 95 percent of the total forest area.

Volume: Estimated total, 2,784 billion cubic feet in broadleaf species, 11 billion cubic feet in Paraná pine.

Timber cut: 3.8 billion cubic feet annually for industrial wood and fuelwood; one-fourth of it Paraná pine. Only one-sixth of total cut is for industrial wood, of which 60 percent is Paraná pine.

Forest products industries: A great many small establishments except in the production of pulp and paper. The forest industries account for 5 percent of the value of Brazil's industrial production.

Imports-Exports: Value of forest products exports 70 percent greater than that of forest products imports. Pulp and paper account for nearly 90 percent of the value of forest products imports. By value, 47 percent of forest products exports has been Paraná pine lumber, two-thirds of which went to Argentina, and 48 percent nonwood forest products, particularly palm waxes and Brazil nuts, the United States taking half of each, and maté.

With 20 percent of the world's tropical broadleaf (hardwood) forests, Brazil supplies less than 1 percent by volume of the tropical broadleaf logs and lumber sold on the world market.

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(Other places mentioned in the text are also shown.)

Figure 1.—Regions, States and territories, and principal cities of Brazil.

INTRODUCTION

Brazil is a vast country, covering more than 3¼ million square miles, an area approximately 10 percent greater than that of continental United States exclusive of Alaska. It is shaped roughly like a triangle, with its broad base near the Equator and its apex extending to 34 degrees south latitude. More than 90 percent lies in the tropics. From east to west it is 2,700 miles wide and from north to south 2,600 miles. Brazil is a republic, comprising 21 States, 5 territories, and a Federal district (fig. 1). Its 71 million people, 54 percent rural, are a mixture of Europeans, Africans, and American Indians, and are chiefly concentrated in the south and east fairly close to the coast. Portuguese is the official language. Fifty percent of the population is literate. The total labor force in 1962 is estimated at 27 million, with about half in agriculture and only one-eighth in service industries.

Timber, minerals, and waterpower exist in abundance in Brazil's vast interior, but these resources have barely been touched. The Amazon Basin contains the largest reserve of tropical forest in the world. The mineral resources, to a large extent undeveloped, make Brazil potentially one of the world's richest nations. Its waterpower potential is estimated at 80 million kilowatts, about 2½ times that already developed in the United States.

Only 3 percent of the land is cultivated, yet it grows half the world's coffee and substantial quantities of sugarcane, cotton, manioc, rice, corn, beans, and black pepper. Brazil produces more oranges than does any other country except the United States. Its 600 varieties of palms provide large quantities of vegetable oils, fiber, and fuel. And large numbers of livestock are marketed.

According to official Brazilian statistics, productive forests [1] cover 1,454,800 square miles or 931 million acres, 44 percent of the total land area of Brazil and more than half the forest area of South America. Only a small percentage of this forest area is being exploited, mostly in the Paraná pine forests of the south. Brazil is a net exporter of structural timber, but it still must import woodpulp and paper to take care of nearly one-third of its paper consumption. The most common use of wood from its forests is for fuel in its households and industries.

Although forest activities now provide somewhat less than 5 percent of national income, the undeveloped character of most of central Brazil and the Amazon Basin offers an almost unparalleled opportunity for well-planned, vigorous expansion.

THE LAND

In a general way, Brazil may be characterized by three broad land classifications: the lowlands of the Amazon Basin and the Paraguay-Paraná River system, the narrow coastal plains along the Atlantic Ocean, and the Brazilian Highlands occupying the roughly triangular interior of the country. The lowlands and coastal plains, generally less than 600 feet above sea level, almost encircle the Brazilian Highlands (fig. 2). The highlands embrace a vast area of rolling hills and plateaus, rising in the east to a chain of rough mountains that slope abruptly to the narrow plain along the southeastern Atlantic coast. A small part of the country along the north border lies in the Guiana Highlands.

The Amazon Lowlands

The Amazon, greatest of all rivers, drains an area as large as all of Europe and carries a volume of water estimated to be 14 times that of the Mississippi and 17 times that of the Nile. It has a remarkably low gradient from its mouth through Brazil. Although elevations have never been precisely measured, reasonable estimates put the river at less than 300 feet above sea level at a point roughly 2,000 miles upstream from the Atlantic. Oceangoing

[1] Forest land that is now producing or capable of producing usable crops of wood other than fuelwood.

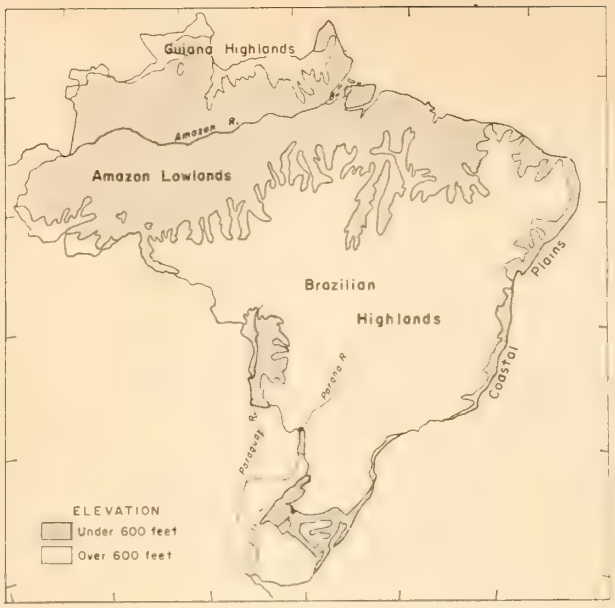

Figure 2.—Distribution of lowlands and highlands in Brazil.

vessels of less than 14-foot draft can navigate the river as far as Iquitos in eastern Peru. The Amazon tributaries can be traveled by river boats to the falls and rapids which occur where the streams drop from the low uplands to the alluvial plain. The Amazon River provides the most important means of access to a large part of the forests. More than half the area of Brazil, the Amazon lowlands and part of the Brazilian Highlands, lies in the Amazon Basin.

The Amazon lowlands, most densely forested area of the country, can be divided into four general categories in relation to the river waters: Permanently swampy (igapó), seasonally flooded (várzea), dry alluvial plain, and low uplands rising to 600 feet in elevation (fig. 3). The first three have alluvial soils while the last has residual soils derived from the volcanic and metamorphic rock formations.

The alluvial plain of the Amazon extends some 800 miles from south to north at the foot of the Andes, west of the Brazilian border. It narrows like a funnel, becoming less than 50 miles wide at its narrowest point, and again broadens on either side of the river's mouth. Of this total plain, the portion that floods annually is seldom more than 50 miles wide yet is estimated to aggregate 150,000 square miles. A large part of this lies between the median water level and the high water level or flood stage of the rivers; this area is called "várzea." The várzea drys quickly and its forests can be readily logged after the high water recedes. Fertile soils created by silt and sand deposits from annual floods have encouraged permanent settlement close to várzea lands. Accordingly, labor is more plentiful close to the streams, and these forests are the principal source of timber in the Amazon lowlands.

The poorly drained areas where flood waters stand for long periods are called igapós. These poorly drained areas support a dense growth of trees, chiefly noncommercial. These areas, old streambeds and other low flats chiefly near the confluence of streams, are scattered throughout the várzea and sometimes seriously impede the logging of timberlands of the várzea that lie behind them.

The dry alluvial plain lies between the various streams and above high water level. These dry lands, representing earlier flood plains, account for the largest area and contain the best part of the Amazon forests.

The alluvial soils of the Amazon lowlands are characteristically gray in color. They vary from silty sands occurring in relatively narrow belts of slightly higher land adjacent to present and former streambeds to clays in flat areas where water stands for long periods of time.

The low uplands rising above the alluvial plain to an elevation of about 600 feet occupy a considerable portion of the Amazon Basin. The red and yellow soils of this area are derived from the crystalline igneous rocks. In general they are friable and easy to till. They have light-colored surface layers and

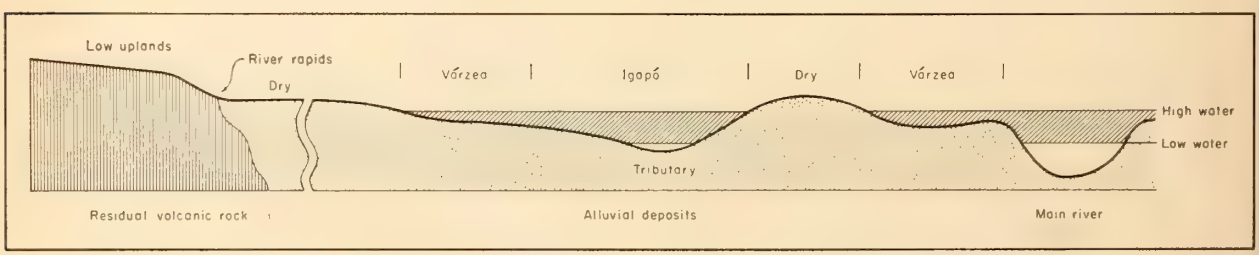

Figure 3.—Classification of Amazon lowlands in relation to stages of the river level.

reddish, somewhat heavy-textured subsoils and are penetrated readily by water and roots. Some of these soils are highly leached and low in content of plant nutrients; others are less leached and somewhat more fertile. The silty and clayey soils have good water-holding capacity and in general support tropical rain forest. Areas of sandy soils, however, often possess a hardpan layer in the subsoil which interferes with the deep penetration of water and roots and are usually covered with shrubby growth or grass.

Lowlands of the Paraguay and Paraná Rivers

The lowlands of the Paraguay-Paraná River system in Brazil are much smaller in extent than those of the Amazon. The alluvial plain of the Paraguay River in the southwestern part of the State of Mato Grosso is inundated from November to April, forming an extensive swampy area known as the "Pantanal." Because of minor differences in elevation and the low level of inundation, vegetative cover is extremely patchy, varying from areas of coarse grass to considerable areas of tropical rain forest. Like the Amazon, the Paraguay to its junction with the Paraná River and the Paraná below this junction have a low gradient, and the head of navigation for small-draft vessels is some 2,300 miles up river from its mouth at Buenos Aires. Smaller areas of alluvial lowland occur along the Paraná and Uruguay Rivers in southern Brazil. These are covered with tropical rain forest and include some prairie. The soils of these alluvial areas are, in general, similar to the grayish alluvial soils of the Amazon Basin.

Coastal Plains

The coastal plains occur as a generally narrow belt extending along the Atlantic coast from the Guiana border to the southern boundary of Brazil. East of the mouth of the Amazon River the coastal plain broadens to cover the northern half of the State of Maranhão. From the valley of the Parnaíba River east and south, the coastal plain is narrow, often less than 50 miles wide, or occasionally becoming wider where some rivers flow into the ocean. In some places the transition from the plain to plateau is gradual, but along the Atlantic coast for nearly 1,500 miles this narrow plain is bounded on the west by steep wall-like slopes known as the Great Escarpment. The parts of the coastal plain and the lower slopes of the escarpment not cleared for agriculture are covered with tropical forests; and areas of muddy saline soils usually covered at high tide contain extensive mangrove thickets. The first area to be colonized, the coastal plain has remained the most populated and intensively developed region, although it comprises only a small part of Brazil's total area.

The soils near streams and close to the coast are typically grayish, in general similar to the alluvial soils of Brazil's river systems; back on the lower slopes the soils are red and yellow, generally silts and clays. The soils in the coastal plains have been extensively used for agriculture.

Brazilian Highlands

West of the coastal plain and the Great Escarpment rise the vast Brazilian Highlands, characterized by rolling hills, mountains, and extensive plateaus. These highlands account for well over half of Brazil's total area. Generally the elevation ranges between 1,000 and 3,000 feet, but some mountain ridges reach above 5,000 feet and occasional peaks rise over 9,000 feet.

The soils of this highland area fall roughly into three general categories: Brown and red desert, red and yellow, and dark. The brown and red desert soils of the northeast, an area subject to frequent drought, support thorny brush and sparse grass. Even though their content of plant nutrients is fairly high, they have little potential for agriculture unless irrigated. Use is confined principally to grazing, but subsistence crops can be produced during years of above-average rainfall.

The red and yellow soils in central Brazil have been used most extensively for grazing; shifting agriculture for subsistence crops is secondary. Although natural fertility is generally rather low, most red and yellow soils are capable of providing satisfactory crop yields under good management and scientific agriculture. Essential practices include crop rotation, application of fertilizer, and elimination of the yearly burning of vegetation.

In southern Brazil are found two groups of dark soils superficially alike but markedly different in physical properties. West of the coastal escarpment principally in the States of Paraná and Santa Catarina, the dark silts and silty clays are derived from the noncrystalline igneous rock of Brazil's great basalt tableland on which grows much of its Paraná pine. The surface layers are black to very dark brown, thick, moderately friable, and high in content

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of organic matter. The subsoils are often reddish clay similar to those of the red and yellow soils of central Brazil.

Predominant in the State of Rio Grande do Sul are the dark clay soils that are plastic and sticky, crack markedly on drying, and expand again on wetting. They are generally found on the flatter slopes and on much of the prairie area of the far south. Although the plastic clays are difficult to manage compared with the silts and silty clays, both groups of soils have a good potential for crop production under the proper management.

CLIMATE

The variety of climates in Brazil is chiefly due to wide differences in temperature and rainfall, which are influenced by such factors as elevation, prevailing winds, and distance from the Equator. Violent storms such as typhoons or hurricanes are nonexistent. The principal climatic regions include the humid-tropical in the Amazon lowlands; tropical in the coastal plains as far south as the 23d parallel of latitude; and subtropical through much of the Brazilian Highlands except in the southernmost States of Paraná, Santa Catarina, and Rio Grande do Sul, where the climate can be temperate. The

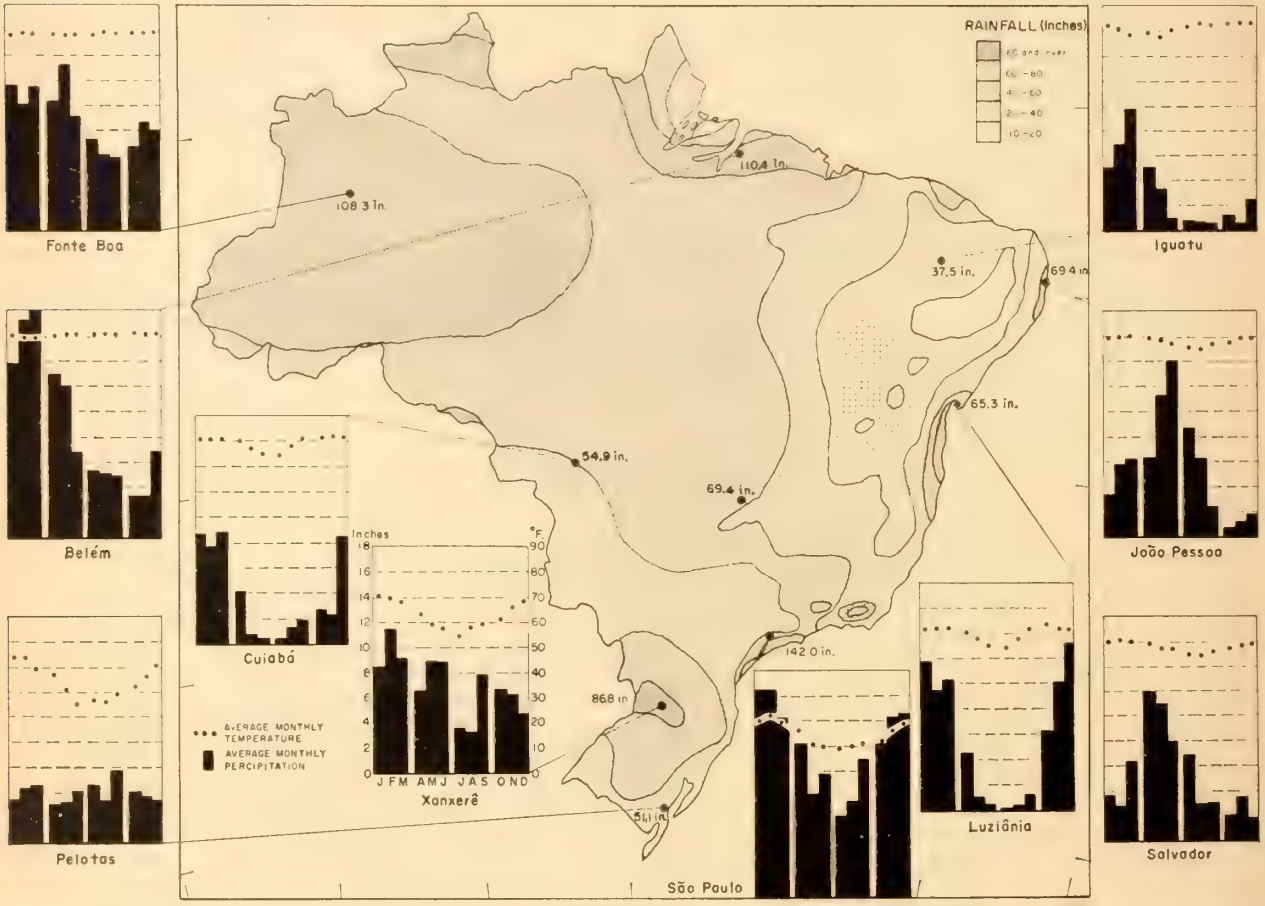

Figure 4.—Average annual precipitation. Boxes give average monthly precipitation and average monthly temperature at specified stations.

average annual temperatures in these four regions are as follows:

	°F.
Humid-tropical (Amazon lowlands)	80
Tropical (coastal plains)	74–80
Subtropical (Highlands)	64–70
Temperate (South)	62–66

Temperatures in the Amazon lowlands seldom reach above 95°, but here the high humidity contributes to discomfort. The highest absolute maximum temperature recorded in the past 36 years was 111° taken not in the Amazon lowlands but far to the south at Bagé in the State of Rio Grande do Sul.

Rainfall exceeds 80 inches a year on an average in the upper Amazon lowlands, along the north-facing coastal lowlands, and at scattered points along the east and southeast (fig. 4). Annual averages as great as 120 inches occur near the border of the Guianas and in certain areas on the Atlantic slopes of the southern highlands. Throughout much of central and southern Brazil the rainfall ranges from 40 to 80 inches annually. Inland parts of States of northeast Brazil usually have too little rainfall for normal agriculture. In this area irregularity of rainfall is the principal problem; years with adequate rainfall and occasional floods may be followed by 2 or 3 years of little or no rainfall. Average rainfall for much of this area ranges between 20 and 25 inches.

The wet season, or period of maximum rainfall, begins in southwestern Brazil about November and continues through April. Throughout the remainder of the interior and most of the Amazon lowlands and along the southeast coast, the months of maximum rainfall are December through May. Rainfall is greatest from January through June along the north coast and from February through July along the east coast. In the far north next to Venezuela, maximum rainfall comes from May through August. In the extreme south, rainfall totaling 40 to 80 inches is well distributed throughout the year. Winters are mild and light snowfall is common during July and August on the highlands of Paraná and Santa Catarina.

THE PEOPLE

Seventy-one million people, half of the population of South America, live in Brazil. Seventy percent of Brazilians live in the 10 States of the South and East. Another 22 percent are concentrated in the seven States on the northeastern bulge of the country. Thus nine-tenths of Brazil's people live on about one-third of its total land area, and 16 of the 17 States included in this area border on the Atlantic Ocean (table 1, fig. 5). Average density for the combined South, East, and Northeast is 61 persons per square mile, about the same as that for the State of Missouri.

The least populated part of Brazil is in the North where the Amazon Basin and the Guiana Highlands have an average of less than 2 people per square mile, and almost half of the people are concentrated in about 50 centers of 2,500 or more. Major parts of the States of Mato Grosso and Goiás are also very sparsely populated. The North and the Central-West, with 64 percent of the total area of the country, account for less than 8 percent of the population.

The people of Brazil have in the past been predominantly rural, but today the trend is toward urbanization. In 1950, 64 percent of the population was rural; the 1960 census showed only 54 percent rural. In 1950 the 10 largest cities accounted for nearly 13 percent of the population; in 1960 they accounted for 15 percent. Overall, the population

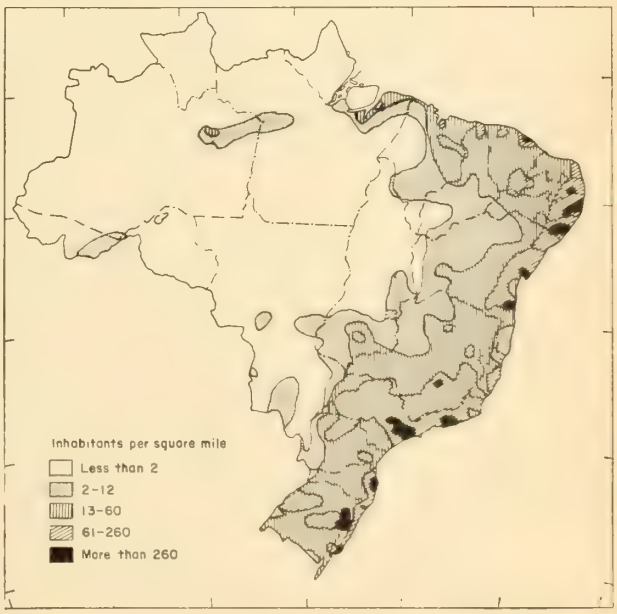

Figure 5.—Population density, 1960.

increased about 2.4 percent a year, but the rural population is growing at a rate of about 1.5 percent compared with the urban growth rate of more than 3.5 percent. Much of this difference is caused by internal migration, partly as a result of the drawing power of city pay and partly due to the push of prolonged severe drought on the people of the northeastern States.

Some two-fifths of the population is under 15 years old, and the birth rate is high—40 to 45 per 1,000 population. These dependent children while economically nonproductive are consumers, and their needs, especially those involving an outlay for education, impose a heavy burden on the adults who work. In 1960 it was estimated that 50 percent of the population could read and write. The number of students in college in 1961, however, was little more than 101,000, and the number going to primary, secondary, and technical schools was only 8⅓ million. Thus the skills necessary to man an expanding industrial economy in the modern sense are to a considerable degree lacking.

Figure 6.—Principle rail and water transportation routes.

Table 1.—Area and population of Brazil, by regions, 1960

Region (administrative division)	Area [1]		Population	
	Million acres	*Percent*	*Thousands*	*Percent*
North (Amazonas, Território do Rio Branco, Pará, Território do Amapá, Território do Acre, Território do Rondônia)	885	42	2,602	4
Northeast (Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagôas, Território de Fernando de Noronha)	239	11	15,678	22
East (Sergipe, Bahia, Minas Gerais, Espírito Santo, Rio de Janeiro, Guanabara)	311	15	24,833	35
South (São Paulo, Paraná, Santa Catarina, Rio Grande do Sul)	204	10	24,680	35
Central-West (Mato Grosso, Goiás, Distrito Federal)	464	22	3,007	4
Total	2,103	100	70,800	100

[1] Includes swamps, rivers, and lakes.

The means of transportation available to the people include 27,000 miles of navigable rivers, 4,000 miles of Atlantic coast, nearly 24,000 miles of railroad (fig. 6), and 310,000 miles of Federal, State, and municipal roads. Almost 80 percent of the railroad mileage is concentrated in the South and East. Nearly 9,000 miles of highway are paved. Rail and road mileages are only about one-tenth those of the United States. Brazil also has more than 1,100 airports.

A principal determining factor in the use of Brazil's timber resources is transportation. Most forest areas are outside of the parts of the country opened up by railroads. Transport, therefore, has been more dependent on trucks, but road conditions are not very favorable, often difficult, and in rainy weather partly impassable. In a large part of the broadleaf forests, many of the timber species have little or no present economic importance and hence cannot carry the cost of transport over long distances.

FOREST RESOURCES

At the present time Brazil's forests cover 931 million acres, about 44 percent of the area of the country. It is estimated that originally they covered about 65 percent of the total land area. Today, only the U.S.S.R. has a forest area larger than that of Brazil.

Three-fourths of Brazil's forest area is in tropical rain forest located in the Amazon lowlands; most of the remainder is in the tropical forests on the mountains and slopes of the east and south (fig. 7), the Paraná pine forests of the four southern States, and the palm forests largely in the State of Maranhão. The distribution of the forests is uneven, since they are primarily associated with rainfall that is both abundant and fairly well distributed throughout the year, as occurs in the Amazon lowlands and the mountains near the east coast. The central highlands with a dry period in the South American winter months between May and September are largely treeless (fig. 8), although dry scrub and brush with a few commercial trees grow in the northeast and patches of forest occur along the major streams.

Today only 15 percent of Brazil's forest area is being exploited (table 2). Many of the species in the Amazon forests are currently unmarketable. Accordingly, timber cutting removes only the choicest and most accessible trees of a few desirable species. The generally low percentage of forests in the eastern States is the result of destructive forest

(Photo by R. Nash, courtesy Pan American Union.)

Figure 7.—Tropical rain forest of the coastal mountains.

Table 2.—Productive forest [1] and other land use, by regions, Brazil, 1950

[Million acres]

Region	Productive forest			Cropland and pasture	Other	Total
	In use	Not in use	Total			
North	43.7	601.0	644.7	6.4	232.0	883.1
Northeast	25.0	6.9	31.9	39.0	168.8	239.7
East	25.2	35.8	61.0	88.0	162.6	311.6
South	21.0	36.8	57.8	89.2	56.9	203.9
Central-West	23.5	112.2	135.7	90.4	239.4	465.5
Total	138.4	792.7	931.1	313.0	859.7	2,103.8

[1] Forest land which is now producing or is capable of producing usable crops of wood other than fuelwood.

cutting and land clearing. Under the generally practiced system of shifting agriculture, land that is cleared of forest is utilized for crops until its fertility is exhausted and is then abandoned. This land then reverts to forest, brush, or rough pasture depending upon the extent of cultivation, the nature of the former forest, and the absence or frequency of subsequent fires.

The Paraná pine forests, though only a small part of Brazil's forests, are the principal source of raw material for the country's forest industries. Thus far, the vast timber resources of the Amazon Basin are barely being tapped, while the Paraná pine forests are threatened by serious overcutting.

Brazil is estimated to have more than 40,000 plant species, and about 7,000 of these are tree species. Those considered suitable for commercial use now number little more than 200, but only about 60 are actually exploited.[2] As more information concerning the properties and supply of individual woods becomes available, both numbers will

[2] Characteristics and uses of a number of selected trees are given in table 25, p. 43.

(Photo by K. Hueck, courtesy Instituto Forestal Latino-Americano.)

Figure 8.—Wooded savanna in western Mato Grosso.

probably increase. The forests contain a large number of trees and shrubs that produce a great variety of valuable nonwood products such as latex, gums, resins, tannins, fats, oils, waxes, edible fruits, aromatic leaves, and medicinal ingredients.

Major Forest Types

The eight major vegetative types (fig. 9) originally covered the land, according to one estimate, in about the following proportions:

	Percent
Tropical rain forest	53
Paraná pine forest	4
Palm forest	6
Littoral forest	1.5
Wooded savanna	15
Scrub and brush	8
Prairie	9.5
Swamp	3

As of 1958, the proportion of productive forest is little more than 44 percent; scrub and brush, savanna, prairie, and swamp nearly 28 percent; and cropland, land deforested by shifting agriculture or destructive cutting, and urban areas the remaining 28 percent. Only the North Region has abundant productive forests, that is, forests producing or capable of producing usable crops of wood other than fuelwood; one-third or more of the area in the Northeast, East, and Central-West is in wooded savanna, scrub and brush, and prairie (fig. 10).

Tropical Rain Forest

The tropical rain forest consists of two distinct parts: the rain forest of the Amazon lowlands and the rain forest of the coastal mountains. Each extends well into the highlands. They differ greatly in topography, accessibility, and nearness to centers of population.

Figure 9.—Generalized distribution of principal natural vegetative types.

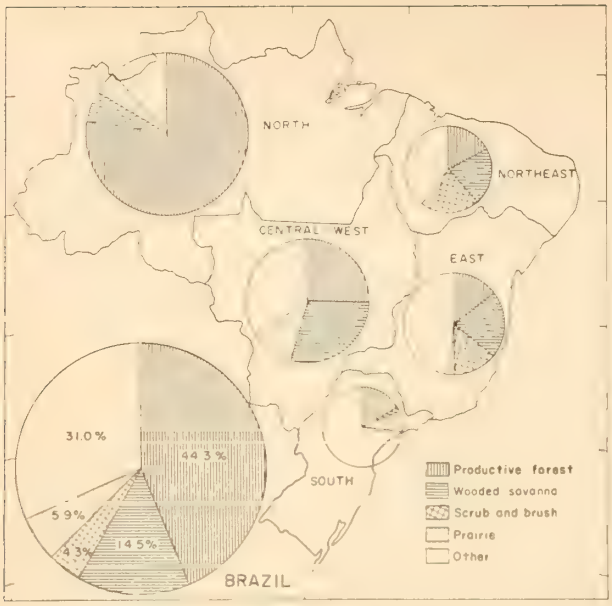

Figure 10.—Proportion of productive forest, wooded savanna, scrub and brush, prairie, and other land, by regions, 1958.

Amazon lowlands.—The Amazon lowlands take in 40 percent of the country and possess not only forest but also swamp, prairie, and savanna. The dominant feature, however, is the great forest (fig. 11.) The trees are broadleaf and evergreen and are found in great variety. On an acre of Amazon forest, scores of species may occur, but only a few individuals of each. Volume per acre of currently marketable timber is usually small. Average tree height of the larger growing species is probably not over 100 feet, though an occasional giant reaches conspicuously above the skyline. Some of the species that attain the greatest height are Brazil nut (castanheira), ceiba, maçaranduba, and sapucáia. In addition to the paucity of forest giants in large groups and the absence of pure stands of any tree species, the Amazon forest exhibits other striking characteristics: there is no seasonal leaf fall; many species develop buttresses which make felling difficult; the stands are usually two or three storied; the trees typically

(Photo courtesy Pan American Union.)

Figure 11.—Tropical rain forest along a northern tributary of the Amazon River.

(Photo by K. Hueck, courtesy IFLA.)

Figure 12.—Tropical rain forest várzea along the Madeira River.

have long clear boles; and most timbers are hard and heavy.

Average annual rainfall over much of the Amazon lowlands exceeds 80 inches; there is no cool season and no really dry season. There is, however, a pronounced wet period which occurs from December to February at about the 8th parallel and moves north into the Amazon River area about February to May and the northern border area in June and July. This shift in rainfall spreads the time of flood water over a long period; the river commences to rise in November, increases in volume until June, and falls until the end of October. The position of the land in relation to this water determines the character of the forest and its accessibility to exploitation.

Species composition is generally similar over much of the great expanse of dry alluvial plain above the level of high water. A survey, taken in 1954–57 and covering 50,000 square miles of the dry land forest south of the river offering the best logging prospects, determined that the average acre held 46 trees 10 inches d.b.h. (diameter breast high) or better with a total volume of 2,887 cubic feet in merchantable-size boles. These trees were representative of more than 300 species, some of the more important being abiurana, acapú, angelim, castanheira, itaúba, louro, maçaranduba, and quaruba. Only a third of the trees, accounting for a little more than a third of the volume and involving some 60 species, have commercial value.

The soils on the land above high water are well suited to truck and tractor logging. The forest itself is actually not a jungle; little undergrowth develops except where light reaches the ground as along streams and in clearings.

During the wet season a belt up to 50 miles wide on each side of the main streams may flood. The area of flood plain between median water level and high flood stage, known as várzea, carries a stand whose composition varies with the length of time of flooding (fig. 12). Where covered by water for several months, fast-growing trees with soft wood, such as assacú, ceiba, imbaúba, tachi, and jauary palm, are more common. On slightly higher ground flooded only a few weeks, dry land species occur more often.

The low, flat, recent alluvial lands never more than 15 feet above low water, called igapós, are wet and swampy most of the year (fig. 13). Vegetation on these lands is often dense but contains few trees of any commercial value. Wherever the igapós present a barrier to logging, the better forests behind them are usually inaccessible.

Extensive areas of excellent forest occur on the low uplands below 600 feet elevation. Commercial

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stands of mahogany are found in these areas on the upper reaches of the Juruá and Purus Rivers, and quantities of logs are floated down to Manaus for export or manufacture. Since the transport of timber from these remote areas is rather difficult and the logs have to be floated over the rapids to navigable water, mahogany is the only species valuable enough at present to take out. These forests also contain many seringueira or rubber trees which have long been exploited for rubber, especially near the rivers.

Coastal mountains.—In the east, starting in the State of Rio Grande do Norte and extending south and increasing in width to the State of São Paulo, is a large belt of tropical rain forest found on the slopes of the mountains and at the foot of the coastal ranges. This rain forest owes its existence to the abundant rain carried from the southeast by the trade winds to fall on the eastern slopes of the mountains. Rainfall over much of the area is 40 to 80 inches a year, with less at the northern end of the belt and an occasional maximum of well over 200 inches in some areas in the mountains to the south close to the Atlantic coast. The climate is generally wet, but there may be a distinct dry summer, as in the coastal north, or the mild winters may be relatively dry, as in the south behind the Great Escarpment.

The forest is similar to the Amazon rain forest and equally complex in species composition. Many species of the Amazon forest also occur in the coastal mountains or are represented by closely related species. The coastal forest differs from the Amazon forest in that dense undergrowth, lianas, and epiphytes are typical; the trees tend to be shorter and have wider crowns; and deciduous broadleaf species (hardwoods) may be fairly common in places (fig. 14). In the drier areas the forest is often called semideciduous.

Many of the cabinet woods, including considerable rosewood (jacarandá), have come from these stands. Because the population is relatively dense in many of the coastal areas and the forest has been easily accessible, the original forest area has been greatly reduced, especially in the north and the south, by land clearing, charcoal production, and destructive logging. Some tracts of virgin or nearly undisturbed forest, however, still exist in the Rio Doce valley and along the border between Minas Gerais and Bahia.

Paraná Pine Forest

On the highlands and mountains in the three southernmost States, mostly at elevations between 2,000 and 4,000 feet, occur the extensive Paraná pine (araucaria) forests (fig. 15). Precipitation in the

(Photo by K. Hueck, courtesy IFLA.)

Figure 13.—Tropical rain forest igapó along tributary of the Amazon River.

(Photo by R. Nash, courtesy Pan American Union.)

Figure 14.—Tropical rain forest of the coastal mountains; dense undergrowth, lianas, and epiphytes are typical.

(Photo courtesy International Harvester.)

Figure 15.—Paraná pine forest, Santa Catarina.

area is normally between 45 and 60 inches, with occasional snowfall, which does not remain long, in some places. Heavy frost may occur between May and August. Thirty to forty years ago Paraná pine forest covered more than 18 million acres in the State of Paraná. By 1950 the area of pine forests had been reduced by intensive exploitation and land clearing to about 6.8 million acres and by 1955 further reduced to 6.1 million acres. The 3.7 million acres in Santa Catarina and 1.2 million in Rio Grande do Sul bring the total area of Paraná pine forest available for use to 11 million acres. Some pines can also be found in São Paulo and Minas Gerais.

The predominant species in the forest is the conifer araucaria, generally called Paraná pine even though not a true pine. The most important broadleaf species generally associated with Paraná pine is imbuia, which makes up as much as 25 percent of stand volume. Two species of *Podocarpus*, the only other conifers native to Brazil, occur occasionally in large numbers. Forest vegetation includes a variety of small trees and shrubs, of which the most important is maté (*Ilex paraguariensis*). This small tree, from whose leaves a tea is made, grows in the forests all over southern Brazil and usually forms a dense understory in the Paraná pine forest.

Paraná pine attains a height of 80 to 125 feet with a long clear bole and a diameter up to 70 or 80 inches. Stands average 8,000 board feet per acre with up to 18,000 board feet on good sites. A 1950 survey estimated the volume in saw-log-size (16 inches d.b.h. or greater) trees at 42 billion board feet, with 57 percent in the State of Paraná, 33 percent in Santa Catarina, and 10 percent in Rio Grande do Sul. Only part of these stands are readily accessible at present.

Palm Forest

In northeastern Brazil, the palm forest is a transition type between the Amazon rain forest and the drier wooded savanna to the southwest and the scrub and brush to the east and southeast. Lying in northern Maranhão and Piauí at elevations of less than 600 feet, the palm stands, often occurring in dense groups of 200 to 1,400 stems per acre, are dominated by babassu (fig. 16). Subordinate in the stands are the carnauba, buriti (*Mauritia flexuosa*), and euterpe (*Euterpe oleracea*) palms. Palms are also found in small groups or scattered throughout the Northeast and the lower elevations of the Central-West wherever subsurface water is abundant during the dry season. Because babassu seed yields a commercial oil and carnauba leaves

(Photo by K. Hueck, courtesy IFLA.)

Figure 16.—Babassu palm, dominant species of the palm forest.

(Photo by K. Hueck, courtesy IFLA.)

Figure 17.—Wooded savanna of the interior highlands.

provide a valuable wax, these two palms are extensively cultivated in northeastern Brazil. These palms also furnish fiber for making hats and mats and leaves for thatching, and the trunks are used for fencing, lath, and posts.

Littoral Forest

Growing along the coast on muddy saline soils subject to daily tidal inundation are extensive thickets of small brushy trees, predominantly *Rhizophora* species (mangrove) which throw out many prop roots. Most important is the red mangrove, whose bark contains 20 to 30 percent of tannin, a product used locally and in some places as an item of commerce. The trees are sometimes of local importance as sources of charcoal and, where sufficiently large, some structural timber. Large areas of mangrove swamps occur in the Amazon estuary, but neither the bark nor the wood is utilized extensively.

Coconut palms, which in general prefer a moist soil and do not appear to suffer in ground distinctly saline, are found in a strip all along the coast above the high water mark. This strip is said to contain one-third of all coconut palms in the world.

Wooded Savanna

The vast interior highlands and a part of the Guiana Highlands in the Territory of Rio Branco, a total of more than 456 million acres according to official statistics, are occupied by wooded savanna (*cerrado*). Over most of the interior highlands rainfall totals 45 to 80 inches a year, abundant during the summer months, November to March, but scant in winter. A well-pronounced dry period occurs from May to September, with June and July the driest months.

Typically, areas of low open woody vegetation, largely of the legume family, alternate with grassland (fig. 17). Much of the grassland is the result of annual fires set to improve grazing. The general appearance of the wooded areas is usually ragged, with trees varying in height from 15 to 40 feet. Dense grass, evergreen trees and shrubs, and the absence of cacti distinguish this type from the drier scrub and brush. Closed forests 40 to 100 feet high, depending on site quality, occur along streams. Deciduous trees predominate in the upper story, but the lower story is usually composed of evergreen broadleaf trees. Vast areas of the wooded savanna are sparsely populated, and cattle raising is the base

(Photo courtesy Pan American Union.)

Figure 18.—Scrub and brush type, Ceará, northeastern Brazil.

for economic development. Frequent fires, together with destructive cutting, destroy or deteriorate woodland and are responsible for much of the grassland.

Scrub and Brush

Scrub and brush (*caatinga*), mostly deciduous, cover almost 100 million acres of northeastern Brazil (fig. 18). The climate is characterized by low rainfall, low relative humidity, rapid evaporation, and an average temperature of about 80° F. with only minor variations. In the center of this area annual rainfall decreases to less than 15 inches, with an extreme drought period from July to December. This zone, called the Polígono das Secas or drought polygon, is subject to droughts which may last entire years.

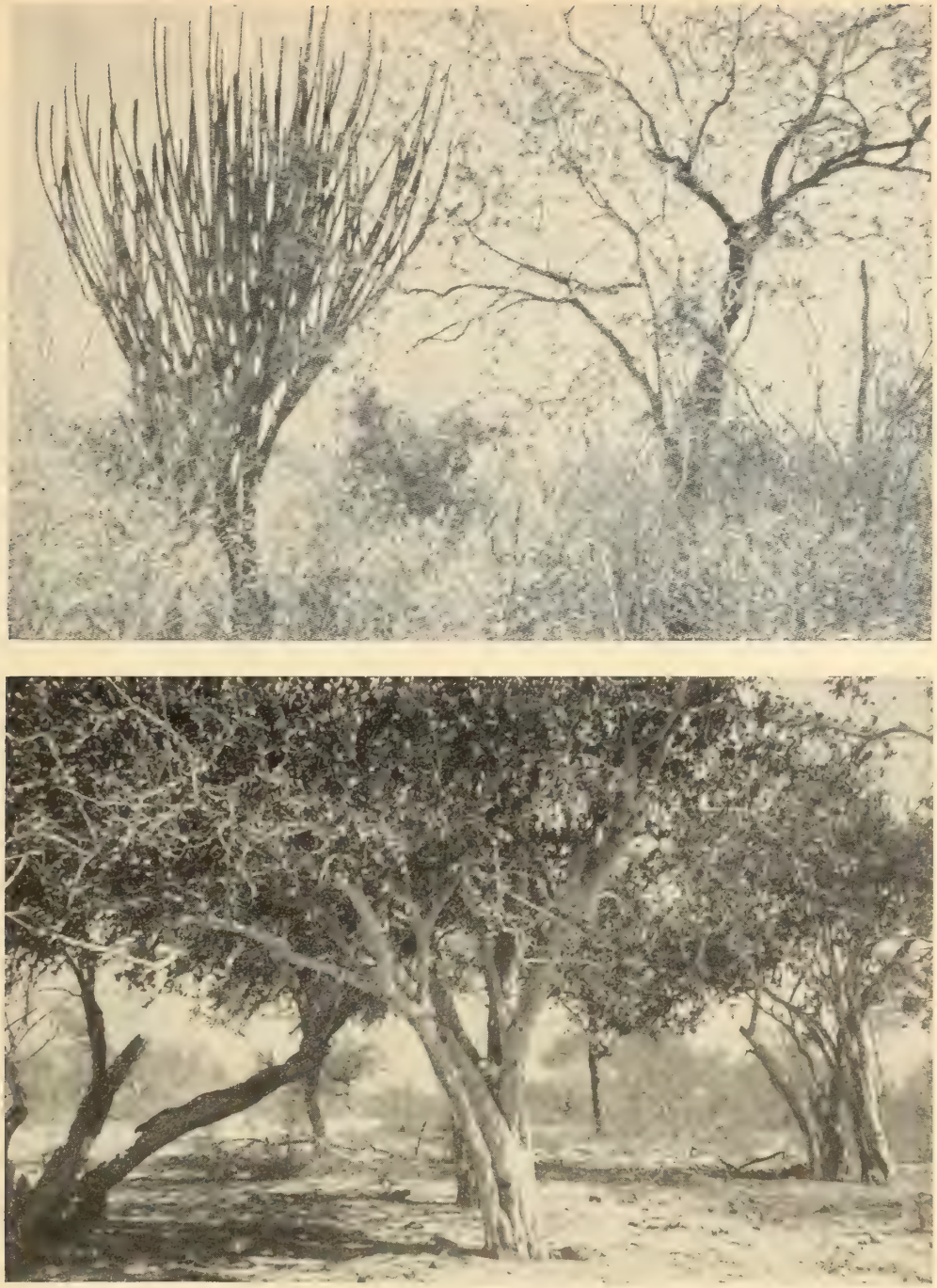
The woody vegetation ranges from scattered short trees, arborescent cacti, and palms to dense thickets of thorny shrubs and trees 7 to 10 feet high (fig. 19). Around the fringes of the dry zone, near rivers, and on the slopes of mountainous ridges where rainfall is more favorable and underground water sufficiently available, islands of better forest occur. The slow-growing trees produce a very hard wood that is excellent for fuel, and some of the better species, such as pau brasil, are a source of wood for furniture and cabinetwork. Carnauba palm grows in the more moist places in all parts of the area.

Other Types

Intermingled in the Amazon rain forest and close to low-water line, particularly on the upper Amazon and many of its southern tributaries, are many swampy areas, often dominated by cane grass and drained by marshy, sluggish, plant-choked streams. Smaller areas of swamp occur along many of the streams in other parts of Brazil.

The most extensive swamp area, and the only one shown on the vegetative type map, is the flood plain of the Paraguay River in southwestern Mato Grosso. Inundation occurs between November and April. Much of the area is covered with coarse grass, and stock raising is the chief occupation during the dry season. Throughout the area are patches or extensive stands of tropical rain forest. The small amount of timber that is cut is used locally, but some quebracho logs are sent to factories for production of tannin extract.

Large areas of prairie—grassland with patches of trees or occasional trees or no trees—occur in the far south, in parts of the southwest, and along the coast in the north. Islands of open prairie up to several thousand square miles in area are widely



(Photos by K. Hueck, courtesy IFLA.)

Figure 19.—Arborescent cactus and old trees in the scrub and brush type of northeastern Brazil.

dispersed through the Amazon Basin, especially north of the river.

In the prairie area of the far south, temperate-zone rather than tropical grasses prevail. The moderate summer temperatures, lack of excessive cold in winter, year-round precipitation, and abundant nutritious natural forage combine to make this area one of Brazil's chief livestock-producing sections.

FOREST OWNERSHIP

Almost all of the 793 million acres of forested area not now in use is in the public domain of the States, chiefly Amazonas and Pará. Ownership of the remaining 138 million acres, the forests in use, is predominantly private (table 3). More than half of this area is in holdings that total 2,500 acres or more, including cropland (table 4). The forests in use are generally part of agricultural enterprises, which often are in the form of large latifundia properties, especially near the coast. As the size of holding becomes greater, the proportion of forested land increases. A number of pulp, mining, and railroad companies own extensive tracts of forest to assure themselves of at least part of their supply of pulpwood, charcoal, and fuelwood. One pulp company, for instance, owns more than 400,000 acres of forest, much of it Paraná pine, and other land in the State of Paraná.

As in the United States, there are a large number of small ownerships of under 250 acres of all types of land, their average area in forest being less than 10 acres. More than 200,000 land units, two-thirds of them in public ownership, are occupied by squatters.

Table 3.—Area of forests in use, by type of ownership, Brazil, 1950

Type of ownership	Forest area in use			Relation to total forest area in use
	Natural	Planted and second growth	Total	
Private:	*1,000 acres*	*1,000 acres*	*1,000 acres*	*Percent*
Association	23,373	334	23,707	17.1
Company	7,468	259	7,727	5.6
Church	128	5	133	.1
Individual	94,046	2,086	96,132	69.5
Not classified	99	2	101	.1
Public	10,472	104	10,576	7.6
Total	135,586	2,790	138,376	100.0

Table 4.—Area of forests in use, by size of ownership, Brazil, 1950

Size of ownership (acres) [1]	Forests in use		Average forest area per ownership	Proportion of average ownership forested
	Area	Relation to total		
	1,000 acres	*Percent*	*Acres*	*Percent*
Less than 25	398	0.3	0.5	5
25–249	14,451	10.4	13.8	16
250–2,499	34,653	25.0	129.5	19
2,500–24,999	39,783	28.8	1,257.7	22
25,000–249,999	30,104	21.8	19,347.9	37
250,000 and over	18,987	13.7	317,523.5	64
Total or average	138,376	100.0	67.0	24

[1] Total land reported per owner, including cropland.

TIMBER VOLUME, GROWTH, AND DRAIN

Reliable estimates of the volume of standing timber cannot be made, because satisfactory data on which to base an estimate have not been obtained. One estimate, admittedly unreliable, used by FAO's Latin American Forestry Commission in its *Latin American Timber Trends and Prospects* released in 1963, gives the total volume including noncommercial species as 2,794.8 billion cubic feet, of which only 5.3 billion is in conifers. Some exploratory survey work, however, has been carried out in the Amazon Basin, and even though the area covered is extremely small in relation to the total forest area involved, the figures obtained do indicate certain possibilities. Measurements were taken between 1953 and 1958 on plots mostly on dry land in the alluvial plain and scattered from eastern Maranhão to the Madeira River fairly close to the coast or the south side of the Amazon River. Gross volume in trees 9 inches in diameter and larger ranged from a low of 485 cubic feet per acre to a high of 4,900. Average gross volume in the different areas ranged from 2,000 to 3,500 cubic feet per acre (approximately 12,500 to 21,900 board feet). The volume in species with present economic value is

low. For example, in one area near the Madeira River with an average gross volume per acre of over 2,300 cubic feet (14,375 board feet), commercial species accounted for only 17 percent of the volume. These species included andiroba, angelim, castanheira, itaúba, louro, maçaranduba, piquiá, quaruba, and sucupira.

In the Paraná pine forests of the South, stands with a volume of more than 5,600 cubic feet (35,000 board feet) per acre have been found, but the average volume is fixed roughly at 900 cubic feet (5,600 board feet). Total volume of Paraná pine is claimed to be about 11 billion cubic feet (69 billion board feet).

The growth and wood-producing capacity of Brazil's forests are unknown. In the areas of productive forest not in use, principally those in the Amazon Basin, growth is presumed to balance removal by mortality and by the Indians and squatters whose wood requirements are generally very limited. Removal from the forests in use, however, has greatly exceeded growth of trees left on cutover areas, planted on reforested areas, or restocking abandoned agricultural land.

Total drain on Brazil's forests is not known, because no estimates are available for timber destroyed by land clearing, fires, shifting cultivation, or other causes. Average annual timber cut in 1956–59 for industrial wood and fuelwood is estimated at 3.8 billion cubic feet, of which one-fourth comes from Paraná pine. Only one-sixth of the total cut is for industrial wood, the rest is removed for fuel. Volume of timber cut in 1960 (table 5) is about the same as the 1956–59 average. More than 60 percent of the industrial wood, however, is being cut from the Paraná pine forests, a situation that indicates a need for reforestation to insure the future supply for the industries using Paraná pine and a need for investigating the possibilities of expanding their supplies and obtaining better utilization.

Table 5.—Timber cut, by product and species group, Brazil, 1960

Product	Coniferous	Broadleaf	Total
Industrial wood:	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*
Saw logs, veneer logs, and logs for ties	250.7	154.3	405.0
Pulpwood and pitprops	14.1	7.1	21.2
Other	.7	.....	.7
Total	265.5	161.4	426.9
Fuelwood (including wood for charcoal)	706.2	2,471.7	3,177.9
Total	971.7	2,633.1	3,604.8

FOREST PRODUCTS INDUSTRIES

Since Brazil's discovery by Portuguese explorers in the 16th century, forests have contributed much to the country's development. The name "Brazil" is derived from the wood of the pau brasil, a tree of the rain forest of the coastal mountains. Demand for this wood became so high that its exploitation was made a monopoly of the Portuguese crown. As settlement spread slowly westward from the coast, forest exploitation was essentially primitive and destructive, its purpose to furnish land for agricultural crops while supplying the local wood needs for shelter, fuel, and tools (fig. 20). Wood is still the principal fuel and building material in rural Brazil.

Forest products industries continue to be important in the country's development. In 1958 they accounted for 5 percent of the value of Brazil's industrial production. They are characterized by a great many small establishments or enterprises, except in the production of pulp and paper which is dominated by a few large modern plants. Industrial development, especially of lumber production, is concentrated in the southern highlands, where extensive and easily accessible stands of valuable Paraná pine furnish a basis for profitable commercial exploitation (fig. 21). Collection of nonwood forest products has long been important in some areas, such as the Amazon forest where in the past the value of rubber, nuts, waxes, oils, and other nonwood products has exceeded that of the wood products. Development of the vast potential timber wealth of the Amazon forest has been impeded by the scattered occurrence of commercially valuable trees, difficulty of transport, remoteness from market, and scarcity of labor.

In 1958, of the total reported value of the output of industrial forest products, wood and wood manufactures, exclusive of furniture and fuelwood, made up 43 percent; pulp and paper, including the value

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(Photo courtesy United Nations.)

Figure 20.—Tropical rain forest being cleared for agricultural crops, Pará. Rice, often planted first, will be harvested from this land by hand.

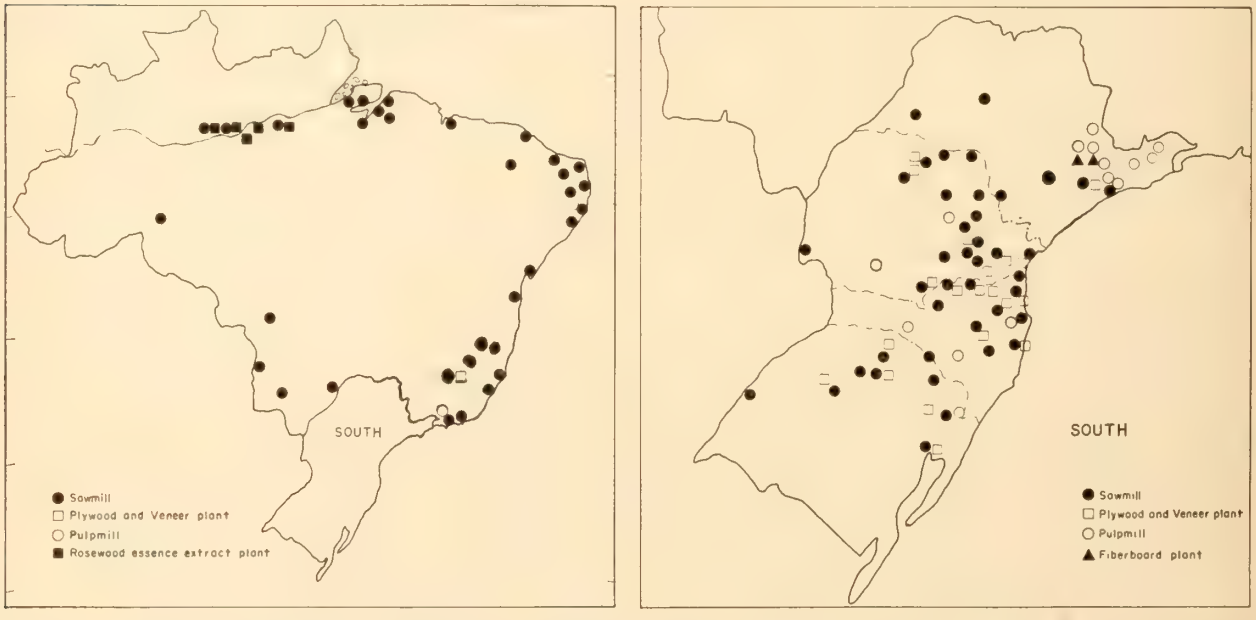

Figure 21.—Location of principal forest industry establishments, 1959. (Selection primarily according to importance in region rather than size.)

of imported woodpulp, 43 percent; and nonwood products, 14 percent (table 6). However, all fuelwood and charcoal production, as well as most of the timber used for rural construction and in small sawmills and handicraft shops, are not reflected in the industrial production statistics.

The industrial census of 1950 (covering the year 1949) recorded more than 8,000 establishments engaged in the manufacture of wood and pulp products, excluding furniture (table 7). The South, with more than three-fourths of the wood products establishments, had 4,560 producing lumber, plywood, and veneer, and 1,389 producing cooperage, cork, and wooden articles. Of the pulp products enterprises, 117 were making pulp and paper (South 97, East 18, and Northeast 2) and 324 paper and paperboard products.

More recent production statistics exist only for the four southern States where more than 11,000 wood-based plants were recorded in 1961 (table 8). Many of these plants, of which all except the 49 papermills reported by the National Association of Paper Manufacturers were registered with the National Pine Institute, are very small enterprises not considered industrial establishments in the 1950 industrial census.

The agricultural census of 1950 reported that some 125,000 establishments, 6 percent of all establishments covered, were engaged in the collection of nonwood forest products. Among the most important of these were about 70,000 collecting oil

Table 6.—Quantity and relative value of the output of forest products, Brazil, 1958

Product	Quantity	Relative value
	Million board feet	*Percent*
Rough lumber	2,405	26.0
Boxboards, siding, flooring	1,555	3.6
Crossties	59	.5
	1,000 cubic feet	
Veneer and plywood	12,040	4.8
Other wood manufacture (excluding furniture)	.....	8.2
	Metric tons	
Woodpulp [1]	5,743	1.0
Paper	416,471	41.9
Nonwood products:		
Oil seeds, waxes, gums	127,764	5.6
Rubber	29,562	3.5
Fibers, kapok	34,889	1.1
Tanning bark	23,932	.1
Brazil nuts	38,888	1.5
Cashew nuts	2,302	(2)
Maté	95,482	2.2
Total, all products	.....	100.0

[1] Excludes pulp which papermills produce for making their own products.

[2] Less than 0.05 percent.

Table 7.—Number of establishments and employees and the relative value of the 1949 output of wood-based forest industries of Brazil, by regions

Establishments

Region	Wood products	Pulp products [1]	Total
	Number	*Number*	*Number*
North	96	4	100
Northeast	260	17	277
East	1,159	139	1,298
South	5,949	281	6,230
Central-West	98	0	98
Total	7,562	441	8,003

Employees

	Number	*Number*	*Number*
North	1,937	9	1,946
Northeast	1,649	671	2,320
East	10,829	6,034	16,863
South	41,185	15,591	56,776
Central-West	444	0	444
Total	56,044	22,305	78,349

Relative value of 1949 output

	Percent	*Percent*	*Percent*
North	1.5	(2)	1.5
Northeast	1.2	0.7	1.9
East	11.1	8.9	20.0
South	48.8	27.4	76.2
Central-West	.4	0	.4
Total	63.0	37.0	100.0

[1] Includes pulp products made from bagasse and other nonwood vegetable matter.

[2] Less than 0.05 percent.

Table 8.—Number of wood-based plants in the four States of south Brazil, 1961

Type of plant	State				Total
	São Paulo	Paraná	Santa Catarina	Rio Grande do Sul	
Sawmill:					
Commercial:					
Paraná pine	8	720	1,023	382	2,133
Broadleaf	532	421	1,273	73	2,299
Mixed species	.....	102	162	20	284
Local	528	426	235	1,674	2,863
Total	1,068	1,669	2,693	2,149	7,579
Plywood and veneer plants	9	243	55	12	319
Match factories	9	0	0	0	9
Pulpmills	11	64	190	4	269
Papermills [1]	35	5	3	6	49
Other woodworking plants	241	984	620	1,109	2,954
Sassafras oil plants	0	0	145	0	145
Total	1,373	2,965	3,706	3,280	11,321

[1] Reported in 1960 by the National Association of Paper Manufacturers.

seeds and waxes from palms in the Northeast, 16,700 gathering hevea latex and other rubbers in the North, and 20,000 harvesting maté in the South. The 1950 agricultural census also reported the number of rural establishments engaged in small-scale timber production as follows:

Product:	*Establishments (thousands)*
Fuelwood	407
Charcoal	16
Logs	6
Beams	6
Crossties	6
Poles	6

Many of these enterprises may have turned out several of these products and thus were counted more than once.

While the greater part of the nonwood products are collected from wild trees, many are also produced by cultivated crops in large plantations and on small farms. Most nonwood forest products are used without further processing, processed by collectors, or processed in small or handicraft establishments.

Logging Methods

About 1,500,000 people are employed in logging. Methods of logging vary much by timber type and region, according to whether transportation is by water or land. Except for a few large mechanized operations in the Paraná pine region, timber removal methods are primitive.

In the Amazon rain forest, where practically all logs are brought out by water, logging operations are restricted to the vicinity of floatable watercourses because logs are commonly moved from stump to watercourse by manpower. Like all collection of forest products in the Amazon Basin, sawmills usually obtain their log supply through several intermediary traders and contractors, who barter for timber cutting and floating with forest workers (caboclos) living along the rivers. Some mills supplement their supply also by the capture of uprooted trees and logs from shattered rafts floating on the rivers.

Timber removal in the Amazon area is confined to scattered large specimens of a few desirable species. In general, axes are used to fell the trees and to cut the stems into 12-foot logs; the use of saws is uncommon. The men work on scaffolds to set the cut above the butt swell (fig. 22). To move the logs from the stump to floatable water, a skid road is cleared for a width of 20 feet and provided with three lines of parallel round timbers over which the logs are pushed or rolled by hand, with or without the help of levers. The skidding distance is usually short, but may exceed 1 mile in a few places. Fluted or flat-sided butt logs, too difficult to move by this method, are left in the forest, causing the loss of the most valuable wood of the tree and often the only part that furnishes figured lumber and veneer. In the larger rivers, the logs are tied into triangular rafts which are floated or towed by launch to the sawmills, sometimes over a distance up to 2,000 miles. The logs actually delivered to the sawmill seldom represent a volume of more than 250 board feet per acre.

Mahogany, the most valuable timber of the Amazon forest, grows on the volcanic uplands about 3 miles back from the main watercourses. Here logs are rolled into dry gullies (grutaos) which, after heavy rains, carry enough water for a few days to float the logs to the rivers. The failure of the timely occurrence of sufficiently strong flash floods often causes the largest and best logs to be left in the forest. Log transport from the uplands to the

(Photo courtesy Pan American Union.)

Figure 22.—Buttressed cedar (cedro) in Amazon lowlands.

lower parts of the river is further complicated by the job of untying rafts at the fall line and floating the logs singly through the rapids. This process must be executed between high and low water stages of the river, otherwise the logs would be swept over the banks or hung up on the rocks.

In the coastal rain forest, cables are used for skidding on steep mountains, and log transport from forest to mill is overland and for the few industrial operations mostly by truck.

In the Paraná pine, because of the proximity of the forests to well-settled agricultural areas, labor and transportation generally present little difficulty to timber extraction (fig. 23). Well-equipped, rational logging operations have replaced the formerly prevailing destructive cutting methods on tracts belonging to large industrial enterprises. Primitive, wasteful methods, however, still prevail with the small logging operations supplying the numerous small sawmills that change location as cutting progresses.

Lumber

Brazil's annual lumber production in recent years has been estimated at about 2.4 billion board feet. Output statistics, however, exist only for the four southern States, which account for about 70 percent of Brazil's lumber production. The lumber output of these States has decreased steadily from 2 billion board feet in 1955 to less than 1.5 billion in 1960 (table 9). In 1961, however, their production

(Photo courtesy International Harvester.)

Figure 23.—Paraná pine logs on way to mill, Santa Catarina.

Table 9.—Lumber production in the four southern States of Brazil, 1955–61

Species and kind	1955	1956	1957	1958	1959	1960	1961
	Million board feet	*Million board feet*	*Million board feet*	*Million board feet*	*Million board feet*	*Million board feet*	*Million board feet*
Paraná pine:							
Rough	1,438	1,215	1,143	1,221	1,132	936	1,358
Planed [1] [2]	272	288	239	268	218	221	226
Total	1,710	1,503	1,382	1,489	1,350	1,157	1,584
Broadleaf (hardwood):							
Rough	302	310	281	280	249	241	314
Planed [2]	46	52	46	49	39	49	47
Total	348	362	327	329	288	290	361
Grand total	2,058	1,865	1,709	1,818	1,638	1,447	1,945

[1] Includes broom handles.

[2] Includes boxboards, moldings, and staves.

jumped back up to nearly 2 billion board feet. Paraná pine, mostly from the States of Paraná and Santa Catarina, constituted about 80 percent of their lumber output (fig. 24). The rapid depletion of Paraná pine in the eastern part of these States has forced many mills to the less-developed western part of Paraná and Santa Catarina, from where lumber can be shipped to Argentina on the nearby Paraná River. The State of São Paulo produced about half of the broadleaf (hardwood) lumber in this region; imbuia, cedro, and louro were the principal species.

The majority of the southern sawmills are small installations which cut less than 2 million board feet per year. Their lumber output is generally inaccurately sawed and insufficiently seasoned in open stacks. There are also some well-equipped mills that cut more than 5 million board feet per year, and some of them operate dry kilns. Most of the lumber destined for export is trucked over 150 to 200 miles of poor roads from the highlands to ports on the coast, while lumber for the large domestic market of São Paulo is trucked over distances of up to 300 miles or shipped by rail.

Vitória and Salvador are the principal sawmill centers for timbers from the coastal rain forest, and Manaus and Belém for timbers from the Amazon rain forest. Of the 93 sawmills operating in 1953 in the North region, 60 were in Pará and 20 in Amazonas (fig. 25). Only 15 of these mills produced individually more than 500,000 board feet of lumber per year. Total lumber production of the Amazon region is estimated at 20 million board feet annually. In the metropolitan centers of Rio de Janeiro and São Paulo are several well-equipped sawmills with vertical and horizontal bandsaws for the production of high-quality broadleaf lumber for the domestic and export trade, as well as with frame saws for the common construction grades. Logs for these mills, as well as for mills in the coastal towns of the Northeast, are shipped in from the North and South.

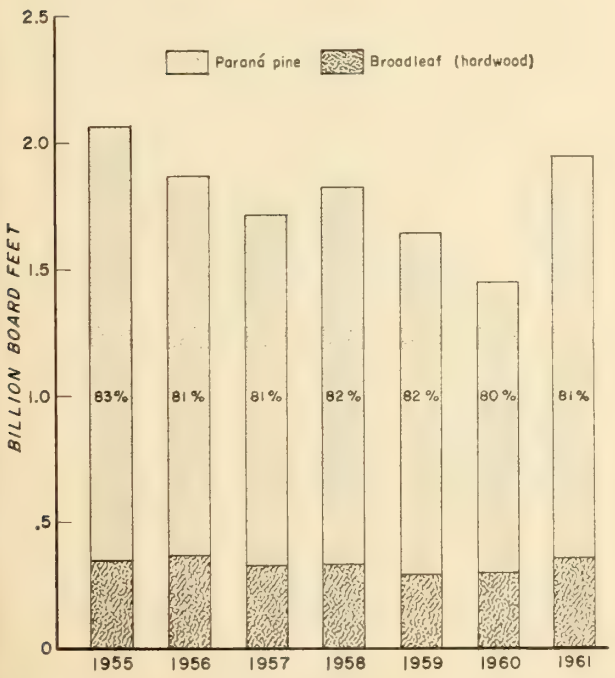

Figure 24.—Lumber production in the four southern States, Brazil.

Plywood and Veneer

In 1958 Brazil produced about 12 million cubic feet of plywood and veneer. About 45 percent of this output was of Paraná pine produced in the three southern States of Paraná, Santa Catarina, and Rio Grande do Sul for which statistics are available (table 10). The State of Paraná accounted for one-third of the total output. Plywood and veneer of Paraná pine is used mainly for crating; that of broadleaf species, principally cedro, imbuia, jequitibá, jacarandá, peroba, and sucupira, for furniture and cabinetwork.

Table 10.—Plywood and veneer output of the States of Paraná, Santa Catarina, and Rio Grande do Sul, Brazil, 1955–61

Year	Paraná pine	Broadleaf (hardwood)	Total
		Plywood	
	Thousand cubic feet	*Thousand cubic feet*	*Thousand cubic feet*
1955	2,625	791	3,416
1956	2,582	887	3,469
1957	2,317	729	3,046
1958	2,825	797	3,622
1959	2,504	783	3,287
1960	2,653	835	3,488
1961	1,709	3,272	4,981
		Veneer	
1955	4,048	1,206	5,254
1956	4,137	1,222	5,359
1957	3,463	1,152	4,615
1958	2,555	1,079	3,634
1959	2,376	907	3,283
1960	2,305	834	3,139
1961	3,082	931	4,013

(Photo courtesy United Nations.)

Figure 25.—Mill near Belém cutting hardwood logs.

Pulp and Paper

The pulp and paper industry is the most progressive branch of Brazil's forest-based industries. It is dominated by a few large modern plants, although many small and inefficient establishments still exist. In addition to 33 mills producing chemical pulp from wood and bamboo and 12 mills making pulp from bagasse and other nonwood material, there are over 200 small establishments in the southern States which make only mechanical woodpulp, mostly from Paraná pine. There were also 69 active papermills in 1960, of which 40 were integrated with pulpmills.

Total pulp production for 1961 reached nearly 500,000 metric tons, an increase of 47 percent over 1958 production (table 11). The seven largest pulpmills accounted for about half, and one mill for one-fourth of the country's pulp output.[3] Paper production in 1961 totaled 501,000 metric tons (table 12), with the 12 largest papermills furnishing

Table 11.—Pulp production, Brazil, 1958–61

Kind	1958	1959	1960	1961
	Thousand metric tons	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*
Mechanical:				
Ground wood	91.0	91.0	92.0	95.0
Defibrated	20.0	20.0	20.0	22.0
Total	111.0	111.0	112.0	117.0
Chemical:				
Sulfite bleached	26.5	30.0	53.0	58.0
Sulfite unbleached	57.0	50.0	34.4	39.5
Sulfate bleached	7.2	18.0	82.4	90.0
Sulfate unbleached	66.0	58.0	53.0	60.0
Soda	16.1	23.0	24.7	27.5
Semichemical	12.1	44.0	51.7	58.2
Dissolving	40.0	40.0	41.8	43.5
Total	224.9	263.0	341.0	376.7
Grand total	335.9	374.0	453.0	493.7

[3] Brazil's principal pulp and paper producers and their approximate output for 1960 are given in table 26, p. 48.

Table 12.—Paper production,[1] Brazil, 1955–61

Kind of paper	1955	1956	1957	1958	1959	1960	1961
	Thousand metric tons	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*
Newsprint	37.2	39.4	49.0	63.4	67.2	65.8	62.3
Other printing	29.5	65.3	61.7	73.5	72.8	85.0	97.1
Writing	44.2	46.4	45.6	51.2	53.9	59.6	64.1
Wrapping	155.2	181.8	169.9	193.1	205.3	219.9	230.3
Other	33.4	47.6	36.4	35.3	40.7	44.1	47.9
Total	299.5	380.5	362.6	416.5	439.9	474.4	501.7

[1] Excludes paperboard.

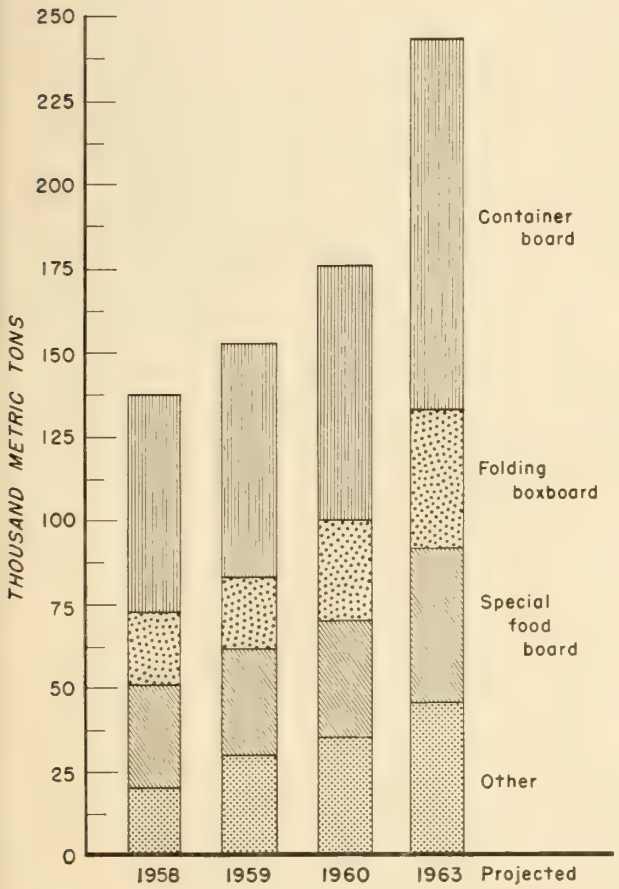

Figure 26.—Estimated paperboard production, by product, Brazil, 1958–60, and 1963 expected output based on planned expansion.

a little more than half; more than two-thirds of all paper is produced in the 2 States of São Paulo and Paraná (table 13). Paperboard production, at 175,000 metric tons in 1960, is expected to increase to 243,000 tons in 1963, with a substantial increase in container board and an expanding use of folding boxboard and special food board (fig. 26). Since 1957, expansion of the pulp and paper industry has brought some reduction in the amount of pulp and paper imports and, as the capacity of the industry increases, further reduction in such imports can be expected.

Paraná pine pulpwood and sawmill waste furnished half of the raw material for the 1960 pulp production (table 14). Practically all the mechanical pulp and four-fifths of the sulfite pulp were made from Paraná pine. Eucalyptus wood exceeded Paraná pine as the principal raw material for sulfate pulp. Soda and semichemical pulp were made from all available material suitable for the purpose. All dissolving pulp was made from cotton linters. Among other economic factors, the shift of the Paulista Railroad Co. from wood to diesel fuel, which released large quantities of wood from their extensive eucalyptus plantations for pulp manufacture, accelerated the recent expansion of the pulp industry.

Many pulp and paper companies are engaged in important expansion programs. In 1960 alone, 20 new pulp and paper companies were organized. With the completion of development now in progress, pulp output is expected to reach 660,000 metric tons in 1963.

Fiberboard and Particle Board

The two existing plants, located near São Paulo, produced about 37,000 metric tons of hard and soft fiberboard in 1960. The product is made from eucalyptus wood and sold under the trade names Eucatex and Duratex. There has been little increase in recent years.

Particle board output by two companies at São Paulo has also remained small, increasing, however,

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from 1,500 metric tons in 1955 to 3,500 in 1960. The respective products of these two companies are Fibroplan, a flat-pressed board, and Solidor, an extruded-type board.

Fuelwood and Charcoal

The average annual output of fuelwood, including wood for charcoal, as reported by the Ministry of Agriculture for 1955–59, was as follows for the regions and the five highest States:

Region:	*Million cubic feet*
North	54
Northeast	580
East	1,238
South	1,015
Central-West	135
Total	3,022
State:	
Minas Gerais	874
Santa Catarina	329
Rio Grande do Sul	272
Paraná	233
Bahia	214

Reported output steadily increased from 2,809 million cubic feet in 1955 to 3,368 million in 1959. Since a substantial amount of fuelwood cut is generally not reported, total annual production may be as much as 5 percent greater.

Wood is still the common fuel for many railroads, river boats, and industries in rural areas, in spite of recent electrification and increasing use of petroleum products. Fuel ports are located along all steamer routes of the Amazon region. One large pulp company used 18 million cubic feet of wood as fuel in its pulp and paper mills in northern Paraná in 1959, representing 0.77 cubic foot of fuelwood for each cubic foot of pulpwood used. In 1958, reported industrial fuelwood consumption was 820 million cubic feet, of which 240 million was used by the railroads. The 1950 agricultural census reported 420,000 farm enterprises engaged in fuelwood and charcoal production.

About 9 percent of the fuelwood cut is converted to charcoal. Reported charcoal production has increased steadily from 671,000 metric tons in 1950 to 1,150,000 tons in 1961. The average annual charcoal output during 1955–57 was as follows:

Region:	*Thousand metric tons*
North	8.2
Northeast	122.8
East	612.7
South	196.9
Central-West	7.3
Total	947.9

Minas Gerais, with 463.2 thousand tons, accounted for nearly half of the output of these years.

Most of the charcoal is made in primitive kilns in the forests. The metallurgical industry is the principal industrial user of charcoal. One company maintains in Minas Gerais 55,000 acres of eucalyptus plantations for its charcoal supply. It employs the most modern methods of charcoal production, including recovery of byproducts in the distillation process.

Crossties

In 1949 Brazil produced 6,464,000 crossties; current production is probably somewhat greater. The country's railroads require annually about 6 million

Table 13.—Relative output of various kinds of paper, by States, Brazil, 1960

State	Newsprint	Other printing	Writing	Wrapping	Other	Total
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
São Paulo	10.4	78.8	66.3	53.0	62.8	54.3
Paraná	80.1	1.0	0	8.1	1.5	15.1
Rio de Janeiro	3.3	14.5	20.1	5.4	28.7	10.8
Minas Gerais	.1	.6	2.9	7.9	.8	4.2
Guanabara	4.0	2.7	5.7	4.9	.5	4.1
Rio Grande do Sul	.1	.8	4.9	4.9	4.1	3.4
Other	2.0	1.6	.1	15.8	1.6	8.1
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table 14.—Estimated pulp production by type of pulp and raw material base, Brazil, 1960

Type of pulp	Paraná pine	Eucalyptus	Bamboo	Bagasse	Other nonwood vegetable matter
	Thousand metric tons	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*
Mechanical	110.0	2.0	0	0	0
Sulfite	70.9	8.5	0	8.0	0
Sulfate	33.5	80.0	0	11.1	10.8
Soda	5.1	5.7	8.8	0	5.1
Semichemical	5.8	18.0	2.5	17.0	8.4
Dissolving	0	0	0	0	41.8
Total	225.3	114.2	11.3	36.1	66.1
	Percent	*Percent*	*Percent*	*Percent*	*Percent*
Proportion of total	49.7	25.2	2.5	8.0	14.6

crossties for replacements. In 1962 the railroads experienced difficulties in procuring the 9,864,000 crossties needed for replacements and new track construction.

Most crossties are hewn in the forests, often as a part-time occupation of isolated settlers. Among the many native species well suited for crossties, itaúba, maçaranduba, ipê, sapucáia, braúna, louro, gonçalo alves, and piquiá are most commonly used. Satisfactory service of creosoted crossties of certain eucalyptus species from 20-year-old trees promises increased use of such crossties.

Tanning Extracts

Principal commercial tannin production is based on the plantations of introduced green wattle (*Acacia decurrens*), estimated at 100,000 to 125,000 acres in the States of Rio Grande do Sul and Santa Catarina. The five tannin plants in Santa Catarina have a total capacity of 47,400 metric tons of tannin, but their annual output is estimated at 30,000 tons. Two small plants in Mato Grosso make quebracho extract.

Brazil has many native tree species used locally for tannin extraction. Official statistics, however, report only the collection of the bark of angico, which increased from 13,471 metric tons in 1955 to 28,096 tons in 1961 (table 15). Angico bark, collected from several species of the leguminous genus *Piptadenia* of the scrub and brush areas and wooded savannas,

Table 15.—Output of nonwood forest products, Brazil, 1955–59 average and 1960–61, and relative value [1] in 1961

Product and source	Quantity			Relative value, 1961
	1955–59 average	1960	1961	
	Metric tons	*Metric tons*	*Metric tons*	*Percent*
Tanbark, angico	20,246	30,506	28,096	0.7
Rubbers:				
Hevea	31,047	29,846	30,955	21.5
Caucho	99	621	670	.4
Mangabeira	44	92	51	(2)
Maniçoba	236	336	689	.3
Total	31,426	30,895	32,365	22.2
Gums and resins:				
Copaíba	(3)	58	62	(2)
Balata	597	1,217	1,252	1.6
Coquirana	243	199	143	.1
Maçaranduba	779	763	773	.2
Sôrva	1,590	1,361	3,805	1.3
Total	(3)	3,598	6,035	3.2
Maté	83,609	110,678	131,648	12.9
Nuts:				
Brazil	34,969	39,382	51,713	12.9
Cashew	3,095	5,506	9,670	.6
Total	38,064	44,888	61,383	13.5

Table 15.—Output of nonwood forest products, Brazil, 1955–59 average and 1960–61, and relative value [1] in 1961—Continued

Product and source	Quantity			Relative value, 1961
	1955–59 average	1960	1961	
	Metric tons	*Metric tons*	*Metric tons*	*Percent*
Waxes:				
Carnauba	8,265	10,982	11,445	14.7
Licuri	469	212	157	.1
Total	8,734	11,194	11,602	14.8
Fibers:				
Caroá	3,830	3,267	3,895	0.6
Guaxima and malva	18,073	11,582	13,130	3.1
Piassava	13,282	15,621	17,260	3.2
Tucum	73	55	64	([2])
Total	35,258	30,525	34,349	6.9
Oil seeds:				
Babassu	85,015	100,708	117,808	20.0
Licuri	3,450	7,818	4,919	.9
Murumuru	1,302	851	1,628	([2])
Oiticica	23,611	37,934	60,019	3.4
Tucum	4,107	5,152	6,001	.5
Total	117,485	152,463	190,375	24.8
Essential oils:				
Sassafras	334	644	372	0.2
Pau rosa	388	289	221	.6
Eucalyptus	48	42	54	.1
Total	770	975	647	0.9
Kapok	341	459	548	0.1

[1] Based on a grand total of 16,778 million cruzeiros for the nonwood forest products listed.

[2] Less than 0.05 percent.

[3] Not available.

has a tannin content of 35–45 percent. Little use is made of the extensive mangrove stands for tannin production.

Rubbers

A large number of trees yielding rubber latex are native to Brazil's forest. The most and best rubber (Hevea) is produced from the seringeira or Pará rubber tree. This tree, reaching 140 feet in height in the Amazon rain forest, has been widely cultivated in many tropical countries and is now the source of almost all natural rubber. Production from wild trees reached a maximum of 85,000 metric tons in 1910 when Manaus was the rubber capital of the world, but declined thereafter under the competition of cheaper plantation rubber from Far Eastern countries. Hevea rubber output has averaged 30,860 metric tons during 1956–61 (table 15). Some Brazilian hevea rubber is now also produced from plantations, notably at Fordlândia and Belterra, but most still comes from wild trees. Latex gatherers work an average of 100 days per year, tapping a crop of 200 to 300 trees (fig. 27). Brazil's rubber policy is largely controlled by the Amazon Credit Bank and by the Executive Commission for the Defense of Rubber. Emphasis is placed on expanding small-farm planting of improved Pará rubber trees.

Minor quantities of latex, yielding elastic rubbers, are also collected in the Amazon forests from other species of *Hevea*, and caucho rubber comes from *Castillea ulei*. In the Northeast, maniçoba (*Manihot glaziowii*) furnishes the Ceará rubber, and, on the highlands of Goiás, mangabeira (*Hancornia speciosa*) is a source for elastic rubber.

Gums and Resins

Balata, serving the same uses as guttapercha for electrical insulation, particularly in the construction of submarine cables, is obtained from several species of the Amazon forest. The best grade of balata is obtained from *Manilkara bidentata*. Among inferior types are maçaranduba (*Manilkara huberi*) and coquirana (*Ecclinusa balata*). Balata tapping, unlike tapping for hevea latex, kills the trees. Sôrva gum from *Couma utilis*, a substitute for chewing gum and also a good calking material for boats, is also obtained by cutting down the trees.

Copaíba balsam is tapped from several species (*Copaifera* spp.) of small trees of Amazonas, Pará, and Mato Grosso. It is used for perfumes and medicinal purposes.

Maté

Maté, or erva maté, is a tealike beverage produced from the leaves of Paraguay tea (*Ilex paraguariensis*), a small tree of the southern States and the southern part of Mato Grosso. The tree grows best in humid depressions at elevation of 1,500 to 2,500 feet and

(Photo courtesy United Nations.

Figure 27.—Camp of rubber gatherers, Pará.

occurs commonly as dense undergrowth of the Paraná pine forest. It is also extensively cultivated. Production has increased steadily from 81,000 tons in 1949 to 131,648 in 1961 (table 15). The leaves are harvested from May to October and processed in modern plants. The National Institute of Maté organizes and assists producers, supervises grading, and promotes domestic and foreign sales.

Nuts

In the North Region, Brazil nuts (castanha do pará) rank in value next to rubber among the forest products. The nuts are gathered in the forest from January through June. Transport by boat to Manaus and Belém coincides with the high-water stage of the rivers, when even the remote tributaries are navigable.

Brazil nut trees are located mostly on high ground. The Purus basin is said to be the most densely stocked with these valuable trees. Some trees yield as much as 14 bushels of nuts. Because of the great height of the trees, the fruits containing the nuts are collected on the ground. The hard, woody outer shell of the fruit is broken to release the 15 to 20 enclosed nuts. The shell is an excellent fuel, much used for smoking crude rubber. Brazil nut collection provides occupation for rubber workers during the rainy season, when the rubber trees cannot be tapped for latex.

Almost the entire harvested crop is exported through a few firms. About 45 percent of the total

crop is hand shelled by the workers of these firms and the kernels exported in tins. The remainder of the export crop is shipped as whole nuts.

Cashew nuts come from the small tree cajú which is widely distributed over the dry sections of Brazil. The harvest from wild and cultivated trees rose from about 2,000 metric tons in 1955 to 9,670 in 1961 (table 15). Both the fleshy part of the fruit and the nut are foods, and the hard shells of the kernels are a source of cardol, an oil used largely for electrical insulation.

Waxes

The world's hardest wax is produced from the carnauba palm (fig. 28) and in lesser amounts from the licuri or ouricuri palm (*Syagrus coronata*). Both palms grow in the alternating dry and wet climate in the Northeast Region and western Bahia. From 1955 to 1961, annual output of carnauba wax increased from 5,600 to 11,445 metric tons, while that of licuri wax decreased from 510 to 157 tons (table 15). The number of carnauba palms in production is estimated at 80 million. The wax is threshed from the surface of the mature leaves. Each tree produces an average of 4½ ounces of wax per year, the yield being heaviest in extreme drought years. Licuri wax is more difficult to remove, it must be scraped from the surface of the leaves, and is therefore more expensive to collect than carnauba wax. Almost the total wax output is exported, mainly to the United States.

Fibers

Piassava palms (*Attalea funifera*) furnish a tough fiber used for brushes and brooms, and fibers of tucum, a name applied to several species of the palm

(Photo by K. Hueck, courtesy IFLA.)

Figure 28.—Carnauba palms in northeastern Brazil.

genera *Bactris* and *Astrocaryum*, are used for fishing lines and nets. Several shrubs of the Malvaceae family, notably aramina or guaxima (*Urena lobata*) and malva (*Sida* spp.), furnish tough fibers used for coffee sacks and as a substitute for jute. Ropes are made from the long tough fibers of caroá (*Neoglaziovia variegata*), a stemless bromeliad, which covers large areas of the dry Northeast. The annual production of fibers ranged between 26,000 and 35,000 metric tons in recent years, nearly all from the Northeast Region and western Bahia.

Oil Seeds

In 1961 Brazil collected 190,375 metric tons of oil seeds from forest trees, nearly all in the Northeast Region (table 15). About two-thirds of this came from babassu palms. Licuri, tucum, and murumuru (*Astrocaryum murumurum*), the last a low-growing palm of Pará, furnished lesser quantities of fruit containing palm oils used for soap and margarine. Second in importance, with 60,019 metric tons in 1961, was the fruit of oiticica (*Licania rigida*), a tall tree of the rose family. The oil produced from its fruit is similar to tung oil. Oil extraction from the seeds of ucuúba and andiroba is an important industry in northeastern Brazil.

Essential Oils

Rosewood essence is extracted from pau rosa by distillation in several plants on the lower Amazon River. In the forest, the branches and tree trunks are chopped with axes into pieces about 3 feet in length and hauled by boat or truck to the distilleries. Recovery of the essence is about 1 percent of the wood by weight. Output in 1961 totaled 221 metric tons. All but a small part came from plants in Amazonas. Sassafras oil is derived from *Ocotea pretiosa*, one of the numerous laurels of the broadleaf forests of the southern States of Brazil. The 146 sassafras oil plants, all but one in Santa Catarina, produced 372 tons of oil in 1961. The yearly output of both pau rosa and sassafras oil has fluctuated sharply during recent years. Small quantities of eucalyptus oil are also produced in a few plants in the southern States.

Kapok

Brazil produces annually between 300 and 500 metric tons of kapok, mostly in Bahia and Minas Gerais. Kapok is the flossy cottonlike fiber contained in the capsules constituting the fruit of the two closely related trees *Chorisia insignis* and *Ceiba pentandra*.

SELF-SUFFICIENCY IN FOREST PRODUCTS

Brazil is self-sufficient in wood products except for woodpulp and paper. It depends on imports for about one-third of its consumption of woodpulp and paper and for its supply of some nonwood forest products such as naval stores, cork, and certain gums and resins. Although Brazil has the resources to become the world's largest supplier of tropical broadleaf (hardwood) products, lack of roads in the interior and insufficient demand have probably been the chief factors which prevented development of broadleaf-using industries. With about 20 percent of the world's tropical broadleaf forests, Brazil supplied less than 1 percent by volume of the tropical broadleaf logs and lumber sold on the world market in 1959 and 1960. During 1959–61, broadleaf products accounted for only 5 percent of the value of Brazil's total forest products exports.

During 1954–58 apparent consumption of industrial wood averaged 413 million cubic feet annually, equivalent to about 95 percent of production (table 16). In all years since 1954 the roundwood equivalent of products exported exceeded that of products imported, but the value of imports, largely pulp and paper, tended to be slightly higher than that of exports. The expansion program of the pulp and paper industry has reduced imports somewhat since 1957; further reductions may follow as the capacity of the pulp and paper industry increases.

Although Brazilian consumption estimates are based on poor knowledge of total wood production, and consumption varies widely in different parts of the country, the per capita estimates indicate low industrial wood and high fuelwood consumption (table 17). Per capita consumption of industrial wood is one-ninth, but fuelwood consumption is five times that of the United States. Consumption rates of industrial wood products such as lumber, plywood, and paper are near the averages for South America but far below those of the United States.

Table 16.—Apparent consumption of industrial wood products (roundwood equivalent) in Brazil, 1954–60

Year	Production	Imports	Exports	Apparent consumption	
				Quantity	Proportion of production
	Million cubic feet	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Percent*
1954	435.0	48.0	48.4	434.6	99.9
1955	484.4	37.1	72.7	448.8	92.7
1956	410.3	39.6	42.4	407.5	99.3
1957	418.8	47.0	86.7	379.1	90.5
1958	426.9	37.4	69.2	395.1	92.6
1959	[1]	38.1	51.2	[1]	[1]
1960	[1]	36.0	59.5	[1]	[1]
1954–58 average	435.1	41.8	63.9	413.0	94.9

[1] Not available.

Table 17.—Estimated annual per capita consumption of wood products for Brazil, United States, and South America, 1957–59 average

Product	Brazil	United States	South America
Industrial wood [1] . . . . cubic feet . .	6.4	59.0	6.7
Fuelwood . . . . . do	49.4	9.2	34.3
Total wood . . . . . do	55.8	68.2	41.0
Lumber . . . . . board feet . .	36	212	28
Plywood . . . . . cubic feet . .	0.05	1.62	0.05
Newsprint . . . . . pounds . .	8	77	8
Other paper and paperboard do	18	326	20
Total paper . . . . . do	26	403	28
Fiberboard . . . . . do	1.3	20.1	1.3

[1] Roundwood equivalent of industrial wood products.

FOREST PRODUCTS IN FOREIGN TRADE

In recent years Brazil's total imports have been generally about 10 percent greater in value than exports. Value of forest products exports, however, has been 70 percent greater than that of forest products imports (table 18). More than two-thirds of these exports were shipped to three countries: Argentina, which took about two-thirds of the Paraná pine lumber; the United States, where half of the palm waxes and Brazil nuts went; and the United Kingdom. Paraná pine lumber, palm waxes, Brazil nuts, and maté accounted for nearly nine-tenths of the value of all forest products exports. Almost 97

Table 18.—Value[1] of Brazilian foreign trade in forest products, 1959–61

Product	Imports					Exports				
	1959	1960	1961	1959–61 average		1959	1960	1961	1959–61 average	
	Thousand dollars	*Thousand dollars*	*Thousand dollars*	*Thousand dollars*	*Percent*	*Thousand dollars*	*Thousand dollars*	*Thousand dollars*	*Thousand dollars*	*Percent*
Wood products	33	527	179	246	0.4	42,411	47,121	52,213	47,248	49.7
Woodpulp	15,168	12,869	12,398	13,478	24.2	0	37	440	159	.2
Paper and paperboard	34,726	37,703	33,673	35,367	63.4	2	154	111	89	.1
Naval stores	2,844	3,891	4,385	3,706	6.6	0	0	0	0	0
Brazil nuts and maté	0	0	0	0	0	20,799	23,685	25,376	23,287	24.5
Other nonwood products	2,827	3,405	2,785	3,006	5.4	22,419	26,076	24,230	24,252	25.5
Total	55,598	58,395	53,420	55,803	100.0	85,661	97,073	102,370	95,035	100.0
Proportion of all imports or exports	*Percent*	*Percent*	*Percent*	*Percent*		*Percent*	*Percent*	*Percent*	*Percent*	
	4.0	4.0	3.7	3.9		6.6	7.7	7.3	7.2	

[1] Value in U.S. dollars.

percent of the wood exports were shipped from the South Region. At present all exports, including forest products, must be licensed by the Bank of Brazil.

Brazil's imports of forest products are dominated in both value and volume by paper, mostly newsprint and book paper, and chemical woodpulp (table 19). During 1957–61 pulp and paper, by value, were supplied as follows:

	Pulp (*percent*)	*Paper* (*percent*)
Finland, Sweden, and Norway	86	69
Canada and United States	11	18
Other countries	3	13

Wood products consisted of small quantities of box shooks, cooperage, lumber, plywood, and veneer largely from the United States and Europe, and quebracho (*Schinopsis* spp.) logs from Paraguay.

Nonwood forest products accounted for 11 percent of imports by value. Most important of these was rosin, of which nearly half came from Greece and the remainder from other European countries, the United States, and Mexico. Other nonwood forest products imports were supplied as follows: Cork and cork products, almost all from Spain and Portugal; tanning and dyeing extracts, Argentina; turpentine and tall oil, mostly from the United States and Finland; and gums and resins from producing countries such as Sudan (gum arabic), India (lac), and Spain (tragasol) or from middleman countries, such as the United Kingdom, Federal Republic of Germany, the United States, and France, which may add value to the material by further refining.

Brazilian imports of forest products from the United States during 1957–61 averaged $22.4 million annually. Woodpulp, paper, and naval stores made up 95 percent of the value of these imports (table 20).

Table 19.—Brazilian imports of forest products, 1957–61

Product	1957	1958	1959	1960	1961	1957–61 average	
						Quantity	Proportion of total value of listed products
	Thousand metric tons	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Percent*
Wood products	1.6	0.1	0.1	5.7	12.1	4.0	0.3
Woodpulp:							
Sulfite	86.8	61.3	65.2	50.1	38.0	60.3	16.7
Other chemical	49.8	42.5	42.2	37.7	42.4	42.9	9.7
Total	136.6	103.8	107.4	87.8	80.4	103.2	26.4
Paper:							
Newsprint	173.5	140.8	144.9	164.5	148.8	154.5	46.5
Book paper	32.1	30.5	23.7	20.0	13.6	24.0	11.3
Other paper	3.7	2.6	3.2	4.9	4.7	3.8	3.6
Paperboard	.4	.3	.4	.4	.3	.4	.3
Unspecified paper and paperboard	.6	.5	.3	.5	.3	.4	.5
Total	210.3	174.7	172.5	190.3	167.7	183.1	62.2
Cork and cork products	3.4	3.7	4.5	5.5	4.5	4.3	2.6
Tanning and dyeing extracts	2.4	2.8	1.0	.6	1.4	1.6	.6
Rosin	12.8	15.7	12.3	11.5	12.1	12.9	5.3
Turpentine	.8	.7	1.0	.7	.6	.8	.1
Tall oil	.2	.1	.1	.2	.2	.2	[1]
Wood distillation products	1.2	1.2	1.4	1.8	1.3	1.4	.4
Gums and resins	1.9	.7	1.2	2.1	1.5	2.5	1.8

[1] Insignificant.

Table 20.—Brazilian imports of forest products from the United States, 1957–61

Product	1957	1958	1959	1960	1961	1957–61 average	
						Quantity	Proportion of total value of listed products
	Thousand metric tons	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Percent*
Wood products	0.2	0.1	0.1	0.8	0.4	0.3	2.1
Woodpulp	3.0	6.1	2.0	9.3	16.4	7.3	25.6
Newsprint and book paper	16.9	7.0	14.8	6.4	5.4	10.1	37.3
Other paper and paperboard	.7	.8	.6	1.5	1.8	1.1	17.1
Rosin	2.1	1.7	.6	1.9	1.7	1.6	9.7
Turpentine	.3	.3	.4	.2	.2	.3	2.1
Wood distillation tars and other distillation products	.8	.6	.7	.9	1.0	.8	3.5
Other nonwood products	.1	.1	[1]	.2	.3	.1	2.6

[1] Insignificant.

Table 21.—Brazilian exports of forest products, 1957–61

Product	1957	1958	1959	1960	1961	1957–61 average	
						Quantity	Proportion of total value of listed products
	Thousand metric tons	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Percent*
Paraná pine lumber	817.0	670.0	479.8	554.9	654.9	635.3	47.2
Broadleaf lumber	17.8	14.7	7.0	13.0	11.9	12.9	1.0
Broadleaf logs	57.9	48.5	60.1	53.1	52.7	54.5	2.5
Crossties, poles, and posts	30.2	2.4	.2	7.0	8.0	9.6	.2
Plywood	1.0	.9	1.6	2.4	1.8	1.5	.3
Veneer	2.0	1.1	3.0	4.0	7.0	3.4	.4
Wood manufactures	1.9	3.4	6.4	4.9	4.8	4.3	.4
Woodpulp and paper	[1]	[1]	[1]	.6	3.5	.8	.1
Fiberboard	.4	1.0	3.5	3.5	2.5	2.2	.2
Palm waxes	12.3	11.5	10.3	11.9	11.2	11.4	17.1
Gums and resins	4.0	2.5	3.1	3.5	8.2	4.2	2.7
Raw pharmaceuticals	.8	.6	.6	.8	1.4	.8	.9
Essential oils	.7	.6	1.0	1.2	.8	.9	1.4
Piassava	2.7	3.0	3.6	3.4	2.8	3.1	1.0
Cork and cork products	0	0	.6	.8	.3	.3	.2
Brazil nuts [2]	25.3	29.2	16.0	27.1	36.6	26.8	11.8
Other tree seed	9.3	1.9	.3	.3	.2	2.4	.8
Maté	55.0	56.6	55.3	56.1	60.9	56.8	11.8

[1] Insignificant.

[2] Includes insignificant quantity of cashew nuts.

The countries of origin of forest products imports during 1957–61, in order of percent of total value of such imports, were as follows:

	Percent
Finland	30.7
Sweden	23.6
Norway	11.7
Canada	7.9
United States	7.3
Federal Republic of Germany	4.0
Spain	2.7
Greece	2.4
Chile	2.2
All other	7.5
Total	100.0

Among forest products exports, Paraná pine lumber accounted for nearly five-tenths of the value of all such exports and palm waxes, Brazil nuts, and maté an additional four-tenths (table 21).

Paraná pine lumber exports averaged 448.6 million board feet annually during 1957–61, and the trend has been slightly upward since 1945 (fig. 29). Wide annual fluctuations reflect largely varying exports to Argentina, perennially the largest importer of Paraná pine lumber. The United Kingdom replaced Uruguay in 1950 as the second largest buyer, and in recent years the Federal Republic of Germany (25.3 million board feet annually during 1957–61) has been challenging Uruguay (27.5 million board feet) for third place. The export of pine logs is prohibited. During 1957–61 Paraná pine lumber exports were equivalent to one-third of production.

Stocks of lumber increased sharply in 1956 when exports were low, dropped in 1957, and then rose in succeeding years, as of December 31 for each year, as follows:

	Million board feet		*Million board feet*
1953	117.7	1957	172.6
1954	93.9	1958	215.3
1955	54.3	1959	271.3
1956	210.8	1960	434.1

Exports of all wood products other than Paraná pine lumber accounted for only 5 percent of the total value of wood products exports for 1957–61. Exports of broadleaf (hardwood) logs and especially broadleaf lumber show a decreasing trend since 1945, but with sharp annual fluctuations. During 1957–61 Argentina and Uruguay took about half of the log exports; most of the rest went to European countries and the United States. In the same period the Union of South Africa took no logs but two-thirds of the lumber. Cedro, mostly as logs, and imbuia, as lumber, accounted for 51 percent of

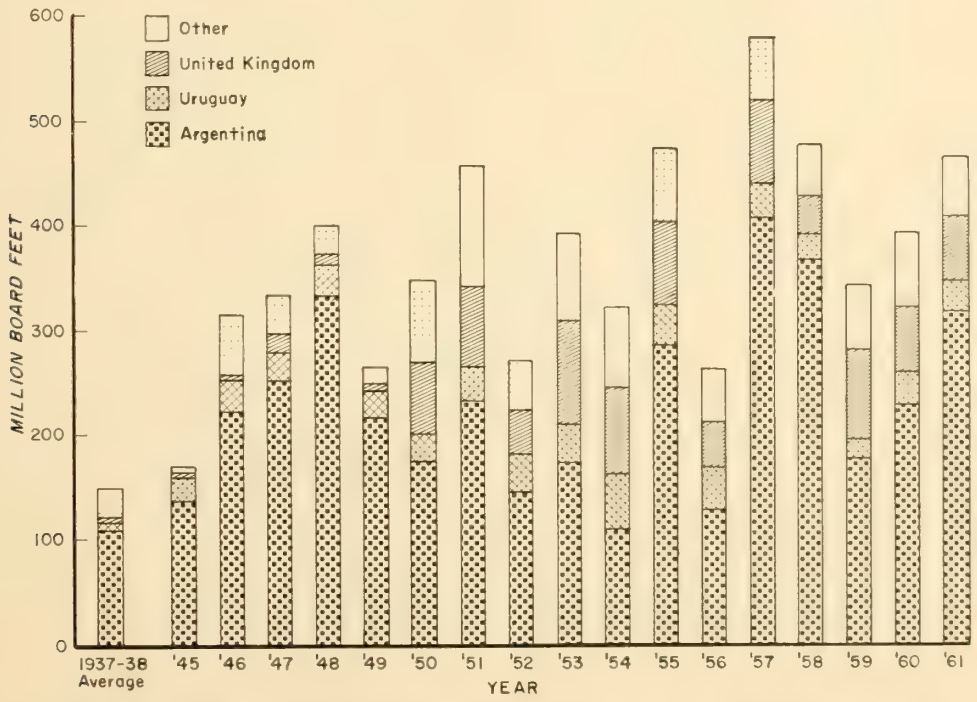

Figure 29.—Paraná pine lumber exports, by destination, 1937–38 average and 1945–61.

Table 22.—Brazil's broadleaf log and lumber exports, by species, 1957–61 average

Species	Logs	Lumber	Logs and lumber	
			Quantity	Proportion of total
	M bd. ft.	*M bd ft.*	*M bd. ft.*	*Percent*
Cedro	4,730	84	4,814	28.2
Imbuia [1]	71	3,843	3,914	23.0
Andiroba	880	198	1,078	6.3
Jacarandá	869	55	924	5.4
Sucupira	694	98	792	4.7
Peroba	273	485	758	4.5
Maçacaúba	695	21	716	4.2
Ipê	508	90	598	3.5
Mahogany	262	254	516	3.0
Louro	320	62	382	2.3
Ucuúba	336	12	348	2.1
Maçaranduba	62	265	327	1.9
Quaruba	177	7	184	1.1
Other	1,108	553	1,661	9.8
Total	10,985	6,027	17,012	100.0

[1] 335 M bd. ft. of logs exported in 1957. Since 1957 export of imbuia logs has been prohibited.

broadleaf timber exports (table 22). Some northern States, wishing to add value to their product, forbid export of raw logs. Brazil exports annually only about 1 percent of its broadleaf log production and about 0.5 percent of its broadleaf lumber production.

Small quantities of other wood products were exported as follows: Plywood, almost all Paraná pine mainly to European countries; veneer, 48 percent pine and 52 percent broadleaf on a weight basis during 1957–61, to Uruguay, European countries, and the United States; wood manufactures consisting of flooring, broom handles, cooperage, and box shooks, three-fourths by value to the United States; and fiberboard, which is all insulation board, mostly to Argentina and the United States.

Most wood products exports traveled by sea, originated in the South Region, and were made from Paraná pine (table 23). About 23 percent of wood exports by volume went to Argentina and Uruguay by river or rail. Nearly 97 percent of the exports were shipped from the South Region, and more broadleaf products came from this region than from the other regions combined. The seaports of Itajaí, Pôrto Alegre, São Francisco do Sul, and Paranaguá handled 67 percent of wood exports; the river port Foz do Iguaçu, 9 percent; and the rail ports Barra do Quaraí and Livramento, 10 percent. All these ports are in the South. Most of the broadleaf timber exports from the Amazon area are shipped from Belém, the major port in the North Region.

Nonwood forest products exports accounted for 47.7 percent of the value of all forest products exported during 1957–61, the most important being palm waxes, Brazil nuts, and maté (table 21). Palm waxes, 95 percent carnauba and 5 percent licuri (ouricuri), have a worldwide market; most of the wax exports, however, went to the United States (63 percent) and Europe. Four-fifths of the Brazil nuts were shipped to the United States and the United Kingdom. Formerly Brazil exported cull Brazil nuts and babassu kernels for oil production, but such export ceased after 1957 and 1958, respectively. All but insignificant quantities of maté went to Uruguay, Argentina, and Chile.

Other nonwood forest products were exported as follows: Nearly all the gums and resins (sôrva, 52 percent; maçaranduba, 21; balata, 20; coquirana, 6; and copaíba, 1) went to the United States, the United Kingdom, and Peru. Europe took most of the raw pharmaceuticals, mainly jaborandi leaves (80 percent), jalap roots, and ipecac rhizomes and roots. Of the essential oils sassafras from *Ocotea* spp., which is used as a substitute for true sassafras oil, made up 75 percent; pau rosa or bois de rose oil accounted for 22 percent; and eucalyptus oil, 2

Table 23.—Brazilian wood exports,[1] by region and primary mode of transport, 1957–61 average

[In percent of total volume]

Region and mode of transport	Paraná pine	Broadleaf species	Total
North, sea	0	2.7	2.7
East, sea	0	.8	.8
South:			
Sea	72.2	.9	73.1
River	10.3	1.2	11.5
Rail	10.8	1.1	11.9
Total	93.3	3.2	96.5
Brazil	93.3	6.7	100.0

[1] Includes logs, lumber, plywood, veneer, and wood manufactures.

percent. Major buyers were the United States, the United Kingdom, France, Japan, and the Netherlands. Since 1959 the other-tree-seed category of nonwood forest products exports has included only urucú (annatto) seeds and tonka beans. These and piassava went largely to Europe and the United States.

Brazilian exports of forest products to the United States during 1957–61 averaged $21.2 million annually. Palm waxes, Brazil nuts, and gums and resins accounted for almost 88 percent of this value; wood products made up less than 8 percent (table 24).

The countries of destination of forest products exports during 1957–61, in order of percent of total value of such exports, were as follows:

	Percent
Argentina	35.5
United States	20.6
United Kingdom	15.8
Uruguay	9.3
Federal Republic of Germany	6.5
Chile	3.1
All other	9.2
Total	100.0

Table 24.—Brazilian exports of forest products to the United States, 1957–61

Product	1957	1958	1959	1960	1961	1957–61 average	
						Quantity	Proportion of total value of listed products
	Thousand metric tons	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Percent*
Paraná pine lumber	10.2	10.4	10.1	9.6	8.8	9.8	4.0
Broadleaf lumber	.2	.1	.1	2.2	2.9	1.2	.4
Broadleaf logs	3.1	3.6	4.3	3.6	3.9	3.7	.9
Plywood and veneer	.1	.3	3.0	3.1	3.5	2.0	.9
Wood manufactures	(1)	2.9	5.2	3.8	4.7	3.3	1.4
Palm waxes	8.7	7.7	6.4	6.7	6.5	7.2	50.8
Gums and resins	3.6	2.1	2.8	2.9	6.1	3.5	10.8
Essential oils	.2	.4	.6	.7	.3	.4	2.5
Piassava	.3	.4	.4	.6	.3	.4	.7
Brazil nuts	10.8	10.4	6.8	10.4	13.2	10.3	26.2
Miscellaneous	1.3	1.1	2.5	2.8	.3	1.6	1.4

[1] Insignificant.

FOREST LEGISLATION

The Forest Code, put into effect by decree in 1934, recognized the common interest of all the people in the nation's forests, regardless of ownership. It placed the solution of forestry problems in the hands of a central forest service. It also provided that where Federal agents had not been appointed, the local authorities should exercise the right of guarding and conserving the forests under the provisions of the code. Its provisions are comprehensive, dealing not only with public but also with private forests, from the standpoint of classification, use, trespass, and administration; and they also apply to other vegetation beneficial to the land on which it grows. The code also provided for the establishment of a Forest Fund in the Ministry of Agriculture and the organization of a Federal Forest Council with broad advisory or consultative responsibilities.

Although the Forest Code contains provisions for the establishment and maintenance of sound forestry programs, the authorities indicate that it has had no appreciable effect in checking overexploitation or burning of forests. It has been reported that this lack of achievement up to now is due partly to the difficulty of changing public attitude and public habits and partly to insufficient funds and a lack of trained personnel.

According to the Forest Code, forests are to be classified as protective, reserve, demonstration, or productive. Protective forests are those which, due to their location, are used to protect watersheds, prevent erosion, fix dunes, aid in border defense, safeguard public health, and preserve sites of natural beauty and habitats of rare fauna. Reserve forests are those set aside as national, State, or municipio (comparable to county) parks; as special areas containing rare or valuable forest species whose conservation is considered necessary for scientific or esthetic reasons; and as public recreation areas. Demonstration forests are actually plantations of one or a limited number of forest species, native or exotic, considered suitable for extensive planting in a particular region. All other forests are classed as productive and are subject to exploitation.

The Ministry of Agriculture is charged with the responsibility of classifying the lands covered by protective and reserve forests, locating national parks, setting up demonstration forests, and carrying out a survey of the total forest area of the country. Regional and local authorities are empowered to make classifications of forests subject to revision by Federal authorities and are autonomous in the establishment of parks and demonstration forests. Forest land in private ownership may be decreed as protective forest by the Federal Government, and privately owned forest may be declared as reserve forest or expropriated for reforestation purposes as deemed necessary by Federal or local authorities, but the owner is to be paid an indemnity for any loss or damage sustained. Under this code, the forest (that is, the timber on private property) is exempt from taxation and does not increase for tax purposes the value of the land on which it stands.

The Forest Code sets up general provisions for the exploitation of productive forests, both private and public, and their protection and management. Prior license to cut or remove forest products, issued by competent authority, is required for certain specified conditions regardless of ownership, and public domain forests are opened to exploitation by means of public competitive bid.

The Forest Code provides for the establishment of a Federal forest police, outlines their powers and duties, and lists forest infractions and the penalties that may be incurred. It also states that the supervision and protection of forests can be specifically under the care of a State or municipio through an agreement with the Federal Government, and that the rights and responsibilities for guarding and conserving the forests shall be exercised by the local authorities where Federal forest agents have not been appointed.

A Forest Fund is established in the Ministry of Agriculture and consists of contributions from private corporations, institutions, and persons interested in the conservation of forests, donations, and fiscal appropriations. The resources of the fund are to be used by the competent forest authorities in accordance with the recommendations of the Forest Council.

The Federal Forest Council, composed originally of appointed individuals representing several investigational and administrative Federal agencies, performed consultative functions. Under the provisions of the Forest Code, the Council is made up of representatives of the National Museum, the Botanical Garden, the University of Rio de Janeiro, the Extension Service of Vegetal Production, the National Department of Roads, the Forest and Woods Services of the Municipios of the Federal District, and the Touring Club of Brazil; several prominent persons privately engaged in science, education, or forest industry; and the Director of the Federal Forest Service. To the consultative functions exercised by the Council, the code added the responsibility of guiding the forest authorities in the expenditures from the Forest Fund, promoting the observance of the Forest Code and making recommendations for its amendment, instituting and advancing forest extension work, promulgating forestry education, and promoting the organization of State and eventually municipio forest councils.

In the past 50 or 60 years, considerable protective and regulatory forest legislation has been enacted by the various States. Because of insufficient funds, too small a number of trained personnel, and the lack of a strong forest consciousness which the interests of Brazil require, enforcement of many of the laws passed has not yet reached the effectiveness desired. Forest legislation pertaining to the Northeast has been influenced not by the abundance but rather by the lack of forests. Most measures involve protection forests. The State legislatures of the Northeast have also tried to encourage fire prevention and reforestation. Recently several eastern and southern States, especially São Paulo, have made some progress in introducing and enforcing effective forest legislation. Most effective have been the regulations issued by the National Pine Institute restricting cutting and lumber production and encouraging reforestation.

FOREST ADMINISTRATION

The Federal Forest Service was created in 1944 in the Ministry of Agriculture, and the execution of the Forest Code placed under its jurisdiction. In 1954 the objective of the Forest Service, as set forth by official decree, was to resolve silviculture problems; to protect forests and apply the code; to study methods of soil conservation and headwaters protection; to determine conditions under which establishing forests, parks, reserves, and demonstration areas will be beneficial; and to study all aspects of the botany and technology of forest species and the economic possibilities of forest products. The decree legally constituted an elaborate organization with a director and seven sections, one of which was designated to supervise the work of regional inspectorates (fig. 30).

In 1958 the Forest Service consisted of only a skeleton technical staff of 39, of whom only 1 was a graduate of a foreign forestry school, 8 had domestic forestry training, and the others were agronomists. No substantial changes have been made since then. The regional inspectorates which have been established generally consist of only one man. Forest supervision, in practice, is delegated to State forest organizations and local political authorities.

The Federal Forest Service concentrates its activities on the promotion of reforestation. It maintains 12 forest nurseries in various parts of the country (5 of them in the Northeast) and distributes the planting stock free or at cost to public and private landowners. In 1960 the total area reforested was estimated at between 700,000 and 1 million acres. Most of this area is located in the southern and eastern States, with São Paulo far in the lead. In 1958 the northern regional office of the Federal Forest Service distributed 110,000 trees for planting, of which 38,400 were planted near Belém, and it planned to produce 10,000 mahogany trees annually for distribution in the State of Pará.

Most States maintain small forest services which are independent of the Federal Forest Service. The forest service of the State of São Paulo, established in 1896, is much larger than the Federal Forest Service, has a staff of paid forest guards, and maintains 11 forest nurseries, located generally on State forests.

Forest management has been practiced for many years by several private companies which maintain their own forestry organizations. The Paulista Railroad Co. pioneered the introduction of eucalyptus to Brazil in 1910 and has since reforested extensive areas. It also established a study area near Rio Claro in the State of São Paulo where it tested the introduction of many exotic tree species. Among other companies that have been prominent in forest management and reforestation are two in Minas Gerais, the Belgian Mining & Metallurgy Co. and the Itabira Special Steel Co.; one in Paraná, the Klabin Pulp Co.; and one in São Paulo, the São

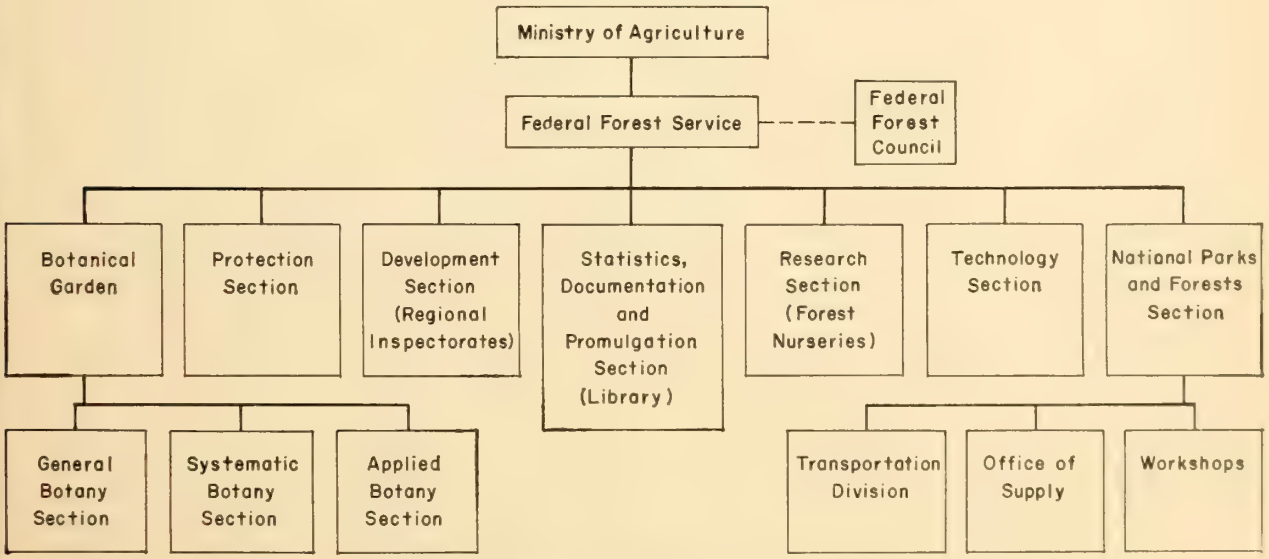

Figure 30.—Forest Service organization as constituted by law.

Paulo Development Co., which established the first industrial plantation of Paraná pine.

The National Pine Institute is Brazil's most influential forestry organization, set up to study and find a practical solution to the problems of production and commerce of pine, and other important species. This autonomous semipublic agency, established by Federal law in 1941 and strengthened in 1942, and now under the jurisdiction of the Ministry of Industry and Commerce, is governed by a board composed of an equal number of representatives of State governments and trade syndicates. Under the law the National Pine Institute has the power to regulate production and export of Paraná pine lumber; control is by quotas distributed among licensed sawmills and exporters. All Paraná pine operators must be registered with the institute. Although its activities are confined almost exclusively to the Paraná pine region, this agency levies a tax of 0.5 percent on the value of all lumber produced in the country, a situation which the producers of broadleaf lumber find unsatisfactory. The minimum cutting diameter set by the institute is 16 inches for Paraná pine. It has established grade standards for Paraná pine lumber exports, built lumber storage facilities at São Paulo, developed a lumber port at Paranaguá, and has been responsible for the reforesting of thousands of acres in the southern States. It also gives technical advice to sawmill operators and lumber dealers. A lumber coordinating committee has recently been established within the National Pine Institute to exercise general control over the forest products industry.

A nationwide forest survey was authorized by the 1934 Federal Forest Code. In 1954 an FAO mission began an inventory of part of the Amazon rain forest; reports on the six selected areas have been made to the government of Brazil. In 1959–60 a survey of more than 1.3 million acres in the Paraná pine area was made in the State of Santa Catarina.

Within its limited resources the Federal Forest Service is engaged in a movement to create a new attitude toward the forest resources of the country on the part of all ages and social classes. The State forest services, the National Pine Institute, and the National Agricultural Society are also promoting forestry through the use of various media such as exhibitions, radio, motion pictures, and publications.

FOREST EDUCATION AND RESEARCH

The National School of Forestry at Viçosa, Minas Gerais, was established in March 1960 by agreement between the Ministry of Agriculture, the Ministry of Education and Culture, and the Rural University of the State of Minas Gerais. Under a cooperative program Purdue University has provided assistance in determining the goals, functions, and methods of operation of the forestry school. Recommendations have been made for teaching positive, constructive, cooperative forestry and developing cooperative research programs. Some of the difficulties faced are lack of Brazilians trained in forestry to serve as teachers, a scarcity of technical literature, especially in Portuguese, and irregular availability of funds. In 1961 the Government of Brazil and the Food and Agriculture Organization of the United Nations signed an agreement that planned the investment of more than a million U.S. dollars on the part of the United Nations over a 5½-year period involving the forestry school at Viçosa. Only the State of São Paulo has a school for training forest guards. Near Santarem, Pará, a training center for workers in the timber industry has been in operation since August 1957.

Forest research has been concentrated largely on the introduction of exotic species for reforestation; to this has been added studies on natural and artificial regeneration of Paraná pine. Engaged in this work are the Federal Forest Service, several private companies, and especially the State of São Paulo, which maintains a research center in the State forest of Jundiaí where propagation methods and the introduction of exotic *Eucalyptus* and a number of *Pinus* and other conifer species are being tested. With the federalization of railways, the Rio Claro experiment station comes under forest administration of the State of São Paulo as a Department of Forest Research.

A small experimental planting of slash pine (*Pinus elliottii*), started in 1957 in the Forest Park of Getúlio Vargas in the State of São Paulo, was so successful—losses of less than 1 percent on relatively poor sites—that larger scale plantings are being tried.

Tropical rain forest problems are investigated by

the Botanical Garden Section of the Federal Forest Service in the southeast and by the Forest Research Center at Manaus in the north. The latter, established in 1957, has a very small staff and operates under the Superintendency of the Plan of Economic Development of Amazonia. Two organizations conduct research in wood technology: the Institute for Technological Research of the University of São Paulo and the National Institute of Technology at Rio de Janeiro.

APPENDIX

Table 25.—Characteristics and uses of selected trees, Brazil

Native and trade names	Scientific name	Specific gravity (air-dry)	Wood properties	Principal uses	Occurrence
Abiurana	*Pouteria* spp.	0. 7–1. 1	Light brown with reddish or orange tinge, hard, no clear differentiation between heartwood and sapwood, texture medium.	Heavy construction	Amazon rain forest.
Acapú	*Vouacapoua americana.*	0. 9 1. 1	Dark or reddish brown, hard, texture coarse, resistant to insects or decay.	General construction, floors, beams, furniture, crossties.	Do.
Acoita cavalo	*Luehea divaricata*	0. 5–0. 7	Generally brown, sometimes streaked, moderately hard and strong, texture medium, grain straight.	Interior trim, carpentry, common furniture, woodenware.	Coastal rain forest.
Amburana (pelo trébol).	*Amburana cearensis.*	0. 6–0. 7	Yellowish or very light brown, texture coarse, grain irregular, cuts easily, finishes very smoothly.	Fine furniture, paneling, carpentry.	Bahia, Mato Grosso, Amazonia.
Amendoim	*Pterogyne nitens*	0. 8–0. 9	Light pinkish brown to reddish brown, hard, heavy, strong, texture medium, easy to work, takes a high polish.	Furniture, carpentry, flooring, turnery.	Southern coastal rain forest.
Andiroba (crabwood, Pará mahogany).	*Carapa guianensis*	0. 6–0. 8	Reddish brown, firm and strong, texture coarse, durable. Large buttressed tree.	Furniture, cabinetwork, carpentry, turnery, plywood, boats.	Amazon várzeas and igapós.
Angelim (partridge wood).	*Andira inermis* and *Hymenolobium* spp.	0. 7–1. 0	Yellowish, reddish, or brown, hard and strong, texture coarse, durable.	Heavy construction, logging carts, turnery, veneer.	Amazon upland and coastal rain forests.
Angico (curupay)	*Piptadenia* spp.	1. 0	Dark red or reddish brown, hard, heavy, texture fine, works with difficulty but takes a smooth high polish.	Heavy and durable construction.	Do.
Araracanga	*Aspidosperma desmanthum.*	0. 7–1. 0	Orange brown, medium hard and strong, texture fine. Potential pulpwood.	Heavy and durable construction, shipbuilding.	Lower Amazon rain forest.

Table 25.—Characteristics and uses of selected trees, Brazil—Continued

Native and trade names	Scientific name	Specific gravity (air-dry)	Wood properties	Principal uses	Occurrence
Arariba (zebra wood, putumujú).	*Centrolobium* spp..	0. 7–1. 0	Yellow through orange to red, often variegated, mostly hard, heavy, and strong, texture fine, finishes smoothly.	Furniture, interior trim, flooring, general construction, crossties.	Coastal rain forest.
Assacú.....	*Hura crepitans*....	0. 3–0. 5	Creamy white to yellowish brown, soft, medium textured, woolly, similar to basswood. Large buttressed tree.	Interior construction, carpentry, boxes, crates.	Amazon várzeas.
Babassu palm.....	*Orbignya oleifera* and *O. martiana*.	(1)	(1)	Major source of palm oil, poles.	Palm forest and northern Mato Grosso.
Braúna.....	*Melanoxylon brauna*.	0. 9–1. 1	Dark brown or blackish with brown streaks, texture fine, hard, tough, and strong, durable. Bark contains tanning material and reddish-brown or black dyestuff.	Beams, sills, posts, bridge timbers, crossties, wheel spokes, flooring, fine furniture.	Coastal rain forest from Bahia to São Paulo.
Brazil nut (Castanheira).	*Bertholletia excelsa*.	(1)	Light pinkish brown, texture medium, moderately hard.	Interior work, but cutting is generally prohibited because of commercially important Brazil nuts.	Amazon rain forest.
Cabreúva.....	*Myrocarpus* spp...	0. 9–1. 1	Yellowish brown to walnut brown, hard, heavy, texture fine, not easy to work but takes a high finish.	Interior trim, cabinets, furniture, turnery, flooring, paneling.	Southern coastal rain forest.
Canjerana.....	*Cabrelea cangerana*.	0. 6–0. 9	Dull red or maroon, sapwood pinkish, texture medium to coarse, easy to work, finishes smoothly.	General construction, joinery, carved work.	Coastal rain forest.
Carnauba palm.....	*Copernicia cerifera*.	(1)	(1)	Major source of palm waxes, heavily exploited.	Palm forest, riparian in scrub and brush areas.
Cashew (cajú).....	*Anacardium occidentale*.	(1)	Wood of no known commercial value.	Cashew nuts, cardol from the fruit pericarp.	Amazon and coastal rain forests.
Caucho.....	*Castilla ulei*.....	0. 7	Whitish to yellowish brown, texture coarse, saws woolly.	Timber rarely used, secondary source of rubber.	Amazon upland rain forest.
Cedro (Spanish cedar).	*Cedrela* spp.....	0. 4–0. 7	Pinkish or reddish, characteristic figure is dark lines on red background, lustrous, good mechanical properties, attractive odor, resistant to decay and insects.	Cigarboxes, fine furniture, interior trim, carved work, general purposes.	Amazon and coastal rain forests.

See footnote at end of table.

Table 25.—Characteristics and uses of selected trees, Brazil—Continued

Native and trade names	Scientific name	Specific gravity (air-dry)	Wood properties	Principal uses	Occurrence
Ceiba	*Ceiba pentandra*	0.4	Pinkish white to ashy brown, very soft, light. Large tree.	Boxes, slack cooperage, toys, plywood cores, canoes, rafts. Seed pods source of kapok.	Amazon rain forest.
Coconut palm	*Cocos nucifera*	(1)	(1)	Used locally for food and oil.	Littoral forest.
Freijó (South American walnut, jenny wood, cordia wood).	*Cordia goeldiana*	0.4–0.7	Yellowish to brown, texture uniform and medium to coarse, soft to moderately hard, good mechanical properties.	Cabinetwork, joinery, cooperage, furniture, paneling, substitute for teak in naval construction, airplanes.	Eastern Amazon rain forest.
Gonçalo alves	*Astronium fraxinifolium.*	0.8–1.3	Cherry red to dark brownish red, hard, texture fine and uniform, durable.	Crossties, posts, piling, bridge timbers and other heavy durable construction, cabinetwork, fine furniture, veneers.	Coastal rain forest.
Imbaúba	*Cecropia* spp.	0.4–0.5	Whitish to pale brown, texture coarse, soft, comparatively strong. Quickly growing, short-lived tree.	Trunks for rafts or buoying heavy logs. Wood for match sticks, pulp, boxboards, charcoal powder, kindling. Bark for oakum and cordage. Latex for medicines.	Amazon várzeas and igapós.
Imbuia (Brazilian walnut).	*Phoebe porosa*	0.7–0.8	Yellowish or olive to chocolate brown, plain or figured, medium luster, moderately hard, fine texture, good mechanical properties, durable.	High-grade flooring, furniture, fixtures, carving, veneer, paneling, interior trim.	Paraná pine forest.
Ipé	*Tabebuia, Tecoma,* and *Paratecoma* spp.	0.7–1.2	Olive brown to blackish, hard, tough, and strong, texture fine to medium and uniform, resistant to wear, insects, and decay.	General construction, crossties, bridges, carpentry, cabinetwork, turnery, vehicles.	Coastal rain forest and wooded savanna.
Itaúba	*Mezilaurus itauba*	0.7–1.0	Brownish yellow with oily appearance, texture fine to coarse, hard, durable, similar to teak.	Boats, durable construction, furniture, shipbuilding, crossties.	Amazon rain forest.
Jacarandá	*Dalbergia nigra, D. sprucena* (rosewood), *D. cearensis* (kingwood), *D. variabilis* (tulipwood), and *Machaerium* spp.	0.8–1.2	Varicolored, figured, scented, hard, fine and uniform texture.	Furniture, carving, turnery, interior trim, veneer.	Coastal and Amazon rain forests.

See footnote at end of table.

Table 25.—Characteristics and uses of selected trees, Brazil—Continued

Native and trade names	Scientific name	Specific gravity (air-dry)	Wood properties	Principal uses	Occurrence
Jacareúba	*Calophyllum brasiliense.*	0.5–0.8	Pink to brick red, hard, texture medium and uniform, good mechanical properties.	General construction, shipbuilding, shingles, veneer, flooring, furniture.	Amazon and coastal rain forests.
Jauary palm	*Astrocaryum jauari.*	(1)	(1)	Vegetable oil	Amazon várzeas.
Jequitibá	*Cariniana legalis*	0.5–0.7	Yellowish to reddish brown, firm and tough, medium texture and luster, medium hard.	Interior construction, carpentry, plywood. Fibrous bark for cordage.	Coastal rain forest.
Louro or canela	*Ocotea* and *Nectandra* spp.	0.6–0.7	Greenish yellow to dark olive brown, soft to moderately hard, texture medium to coarse, darker specimens durable, resistant to insects.	Piling, crossties, flooring, furniture.	Amazon and coastal rain forests.
Maçacaúba	*Platymiscium* spp.	0.8–1.2	Bright red to reddish or purplish brown, hard, strong, texture fine, good mechanical properties, durable.	Heavy construction, bridge planking, crossties, joinery, furniture, musical instruments.	Do.
Maçaranduba (bulletwood).	*Manilkara* and *Mimusops* spp.	0.9–1.2	Red, extremely hard, durable. Bark yields balata latex.	Crossties, heavy durable outside construction.	Amazon and coastal rain forests.
Mahogany (aguano).	*Swietenia macrophylla.*	0.4–0.8	Reddish, luster high, soft to hard and brittle, texture fine to coarse, technical properties good.	Furniture, veneer, interior fittings and joinery, cabinetwork, boatbuilding, printers blocks.	Amazon upland.
Mangrove, red	*Rhizophora mangle.*	0.9–1.1	Red to reddish brown, hard, texture fine, resistant to decay but not to marine borers. Bark contains 20–30 percent of tannin.	Construction, posts, piling, crossties, ribs of boats, fuelwood and charcoal.	Littoral forest.
Marupá	*Simaruba amara*	0.4–0.5	White or straw colored, texture medium and uniform, taste bitter, mechanical properties good.	Boxes, general carpentry, interior construction.	Amazon rain forest.
Paraíba-wood (coixeta, pau parahyba).	*Simaruba versicolor.*	0.4–0.5	White or straw colored, texture medium and uniform, taste bitter, working properties good.	Boxes, general carpentry, interior trim.	Coastal rain forest.
Paraná pine	*Araucaria angustifolia.*	0.5–0.6	Light brown, uniform texture, good mechanical properties, resinous.	Most important timber tree in Brazil. General utility and pulp.	Paraná pine forest.
Pau amarelo (Brazilian satinwood).	*Euxylophora paraensis.*	0.8–1.1	Yellow, hard, texture medium and uniform, good mechanical properties.	Doors, tables, flooring, furniture, fancy interior trim.	Amazon rain forest.

See footnote at end of table.

Table 25.—Characteristics and uses of selected trees, Brazil—Continued

Native and trade names	Scientific name	Specific gravity (air-dry)	Wood properties	Principal uses	Occurrence
Pau brasil (Pernambuco wood).	*Guilandina echinata.*	0.9–1.3	Red with golden luster, hard and strong, texture fine and uniform, durable.	Cabinetwork, violin bows, red dye.	Northern part of coastal rain forest and scrub and brush areas.
Pau marfim	*Balfourodendron riedelianum.*	0.7–0.8	Nearly white to pale yellow brown, hard, strong, texture fine and uniform.	Furniture, turnery, tool handles, interior trim.	Southern coastal rain forest.
Pau rosa	*Aniba rosaeodora*	0.8	Lustrous yellow, aromatic.	Source of aromatic oil for perfumery, lumber for furniture.	Amazon rain forest.
Pau roxo (aramanth, purple-heart, violet wood).	*Peltogyne* spp.	0.8–1.0	Purplish, hard, fine texture, durable.	Cabinetwork, inlays, flooring, spokes for wheels.	Amazon and coastal rain forests.
Peroba	*Aspidosperma polyneuron* and *Paratecoma peroba.*	0.7–0.9	Rose red streaked with purple or brown, hard, texture fine and uniform, working properties good.	General construction, sills, framing, flooring, interior trim, sash and doors, furniture, cabinetwork.	Paraná pine and coastal rain forests.
Piquiá	*Caryocar villosum*	0.8–0.9	Yellowish or grayish, texture coarse, tough and strong.	Boat decks, joists and flooring of warehouses, hubs and felloes, cooperage. Seeds contain edible oil.	Amazon rain forest.
Quaruba (Brazilian okoume).	*Vochysia* spp.	0.5–0.7	Pinkish or salmon, medium density, strong in proportion to weight, fairly durable.	Dugout canoes, carpentry, interior construction, plywood.	Do.
Sapucáia	*Lecythis ollaria*	0.8–1.1	Brown to dark salmon, hard, compact, strong, uniform texture, difficult to work, durable.	Heavy construction, bridges, crossties, posts, carpentry, cabinetwork. Seeds are known as paradise or cream nuts, contain 40 percent edible oil.	Amazon and coastal rain forests.
Seringueira (rubber tree).	*Hevea brasiliensis*	(1)	Pale brown, light, brittle, medium coarse texture.	Wood has few uses. Principal source of rubber.	Amazon rain forest.
Sucupira	*Bowdichia virgilioides.*	1.0	Chocolate to reddish brown, hard, tough and strong, texture coarse, grain interwoven, difficult to work, durable.	Heavy durable construction, cabinetwork, veneer, furniture, crossties.	Amazon and coastal rain forests and wooded savanna.
Tachi	*Triplaris surinamensis.*	0.5–0.6	Pinkish, lustrous, soft, texture medium, similar to pine.	Interior construction, joinery, boxes.	Amazon várzeas.
Ucuúba (banak, bicuíba, virola).	*Virola surinamensis* (and *Virola* spp.).	0.6–0.8	Deep reddish brown with a purplish hue, texture medium, moderate density, good mechanical properties.	Veneer, general utility lumber. Seeds rich in oil used for candles and soap.	Amazon várzeas and igapós.

See footnote at end of table.

Table 25.—Characteristics and uses of selected trees, Brazil—Continued

Native and trade names	Scientific name	Specific gravity (air-dry)	Wood properties	Principal uses	Occurrence
Vinhático.....	*Plathymenia reticulata.*	0.5–0.6	Lustrous yellow or pale orange, texture medium, good mechanical properties, fairly durable.	Cabinetwork, furniture, interior trim, doors, flooring, shipbuilding, general construction and carpentry.	Amazon and coastal rain forests.

[1] Not available.

Table 26.—Brazil's principal pulp and paper producers and their approximate output for 1960

Company name (mill location and State)	Pulp output			Paper output					Raw material
	Mechanical	Chemical	Total	Newsprint	Writing and book	Wrapping	Other and not specified	Total	
	Thousand metric tons	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	
Aparecida, S.A., Fabrica de Papel, Nossa Senhora (Aparecida, São Paulo).	5.4	3.6	9.0	(1)	18	(1)	(1)	18	Rice straw, bamboo, eucalyptus, Paraná pine.
Celulose Cambará Ltda. (São Francisco de Paulo, Rio Grande do Sul).	0	20.0	20.0	0	0	0	0	0	Paraná pine.
Champion Celulose, S.A. (Mogi Guaçu, São Paulo).	0	45.0	45.0	0	0	0	0	0	Eucalpytus 95%, Paraná pine 5%.
Cicero Prado, Cia., Agricola e Industrial (Pindamonhangaba, São Paulo).	3.6	10.0	13.6	1	5	6	1	13	Paraná pine, eucalyptus.
Fabricadora de Papel, S.A., Cia. (Ponte Grande, São Paulo). [Klabin subsidiary.]	4.7	3.0	7.7	0	5	13	4	22	Paraná pine, eucalyptus, cotton linters.
Industra Papeis e Cartonagem, Cia. (Itacolomy, Mendes, São José, and Osasco—Rio de Janeiro).	0	5.4	5.4	0	5	1	5	11	Cotton linters, eucalyptus.
Industria Brasileiras Portela, Cia. (Jaboatão, Pernambuco).	0	10.8	10.8	0	0	13	7	20	Bagasse.
Industrias Klabin do Paraná de Celulose, S.A. (Monte Alegre, Paraná).	43.2	64.5	107.7	53	0	8	59	120	Paraná pine, eucalyptus.
Ipsa, S.A., Industria de Papel (Guarulhos, São Paulo).	0	7.2	7.2	0	0	12	(1)	12	Paraná pine, cotton linters.
Itajai Companhia Fabrica de Papel (Itajai, Bocaina, Ituporanga, Perimbo, and Canõas—Santa Catarina).	0	3.2	3.2	0	1	4	5	10	Paraná pine, eucalyptus.

Table 26.—Brazil's principal pulp and paper producers and their approximate output for 1960—Continued

Company name (mill location and State)	Pulp output			Paper output					Raw material
	Mechanical	Chemical	Total	Newsprint	Writing and book	Wrapping	Other and not specified	Total	
	Thousand metric tons	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	*Thousand metric tons*	
Matarazzo, S.A., Industrias Reunidas. (Travessa Independencia, São Caetano, Amalia, and Jaguare—São Paulo).	6.0	28.0	34.0	0	6	2	10	18	Paraná pine, eucalyptus, cotton linters, bagasse.
Melhoramentos de São Paulo, Cia, Industrias de Papel (Caiheras, São Paulo).	3.6	10.5	14.1	5	8	0	15	28	Paraná pine, eucalyptus.
Olincraft, S.A. (Canõas, Santa Catarina).	0	12.0	12.0	0	0	26	0	26	Paraná pine.
Refinadora Paulista, S.A. (Monte Alegre, São Paulo).	0	12.0	12.0	0	18	0	(1)	18	Bagasse.
Rigesa, S.A., Celulosa, Papel e Embalagens (Valinhos, São Paulo).	0	5.3	5.3	0	0	0	18	18	Do.
Santista (Companhia) de Papel (Cubatão, Sáo Paulo).	3.5	1.5	5.0	0	9	3	0	12	Paraná pine, cotton linters, wastepaper.
Simão, S.A., Industrias de Papel (Ipiranga, São Paulo).	6.0	8.0	14.0	0	8	13	0	21	Eucalyptus.
Suzano de Papel e Celulose, Cia. (Suzano, São Paulo).	0	17.0	17.0	0	15	2	4	21	Do.

[1] Less than 500 tons or unknown.

Conversion Factors

1 cubic meter lumber	=424 board feet
1 cubic meter saw logs	=221 board feet
4.53 cubic meters saw logs	=1,000 board feet
1 cubic foot saw logs	=6.25 board feet
1 cubic meter unpeeled pulpwood	=0.46 cord
1 cord (4′ x 4′ x 8′) unpeeled pulpwood	=77 cubic feet of wood volume
1 cubic meter roundwood	=0.6 metric ton (air dry) wood volume without bark
1 stere (German raummeter)	=1 cubic meter of stacked roundwood or 0.276 cord
1 cubic meter per hectare	=14.29 cubic feet per acre
0.070 cubic meter per hectare	=1 cubic foot per acre
1 cubic meter	=35.31 cubic feet
0.028 cubic meter	=1 cubic foot
1 hectare	=2.471 acres
0.4047 hectare	=1 acre
1 meter	=39.37 inches or 3.28 feet
0.348 meter	=1 foot
1 centimeter	=0.3937 inch
2.540 centimeters	=1 inch
1 kilometer	=0.621 mile
1.609 kilometers	=1 mile
1 square kilometer	=0.3861 square mile
1 square kilometer	=100 hectares
2.59 square kilometers	=1 square mile
1 kilogram	=2.2046 pounds
0.4536 kilogram	=1 pound
1 metric ton	=1.102 short tons or 2,204.6 pounds
1 liter	=1.0567 quarts
0.946 liter	=1 quart

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