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THE BRAZILIAN FISCAL INCENTIVE ACT'S INFLUENCE
ON REFORESTATION ACTIVITY IN SÃO PAULO STATE

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Ricardo Berger

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THE BRAZILIAN FISCAL INCENTIVE ACT'S INFLUENCE
ON REFORESTATION ACTIVITY IN SÃO PAULO STATE

By

Ricardo Berger

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ABSTRACT

THE BRAZILIAN FISCAL INCENTIVE ACT'S INFLUENCE ON REFORESTATION ACTIVITY IN SÃO PAULO STATE

By

Ricardo Berger

This analysis of Brazil's reforestation program focused on the state of São Paulo, one of the most highly developed states in Brazil in terms of industry, commerce, and agriculture. São Paulo is a logical study area, because it typifies the central forestry problem of Brazil. Its natural forests have been largely depleted, it is a center of timber-products manufacturing, and it is a major timber-products market area. Forest plantations must be relied upon, almost exclusively, for timber raw material.

Reforestation was under way before the Brazilian government launched the fiscal incentives program in 1966, but the Fiscal Incentives Law offered tax incentives to individuals and corporations which greatly accelerated the establishment of forest plantations. Some 910,000 hectares in São Paulo have been reforested. The area is almost sufficient to balance projected yields with current levels of timber consumption in the period 1980-84, but it is insufficient for the period 1985-90. The total projected supply deficit in small timber products for the period 1980-90 is 10 million cubic meters.



Fiscal incentives have been highly profitable to investors. Analysis of plantation investments under varying assumptions about land costs indicated high internal rates of return to investors under all assumptions about land costs. Returns have been higher for eucalyptus plantations than for pine, and investors who have planted eucalyptus more extensively than pine have recognized this.

If actual government costs are added to investors' costs, the investments appear much less attractive, but the returns are positive. A smaller government subsidy would have permitted private investors to realize adequate returns on reforestation investments, but it is not clear that reduced government subsidies would have produced nearly as much reforestation as has occurred.

The reforestation program will produce a projected yield of 166 million cubic meters of small roundwood products and 42 million cubic meters of sawlogs during the period 1980-90, with a stumpage value of more than CR \$24 billion. An estimated 148,000 man-years of employment were provided between 1967 and 1978, and wages during that period amounted to CR \$600 million. Reforestation has permitted rapid growth in timber industries using small timber products, particularly the pulp and paper industry, and, through multiplier effects, has contributed in other ways to the regional economy.

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CHAPTER I

INTRODUCTION

Brazil has an area of some 8,511,965 square kilometers. In extreme dimensions, it extends 4,296 kilometers from north to south and 4,302 kilometers from east to west. Brazil has a land frontier of about 16,000 kilometers and an Atlantic coastline of 8,000 kilometers (Figure 1).

The country's population, in excess of 100 million people, is distributed unevenly among five regions--North, Northeast, Central-West, South, and Southeast (Figure 2). The population is concentrated in the South and Southeast and in coastal portions of the Northeast. There are great pockets of uninhabited areas in the North and Central-West regions (Figure 3).

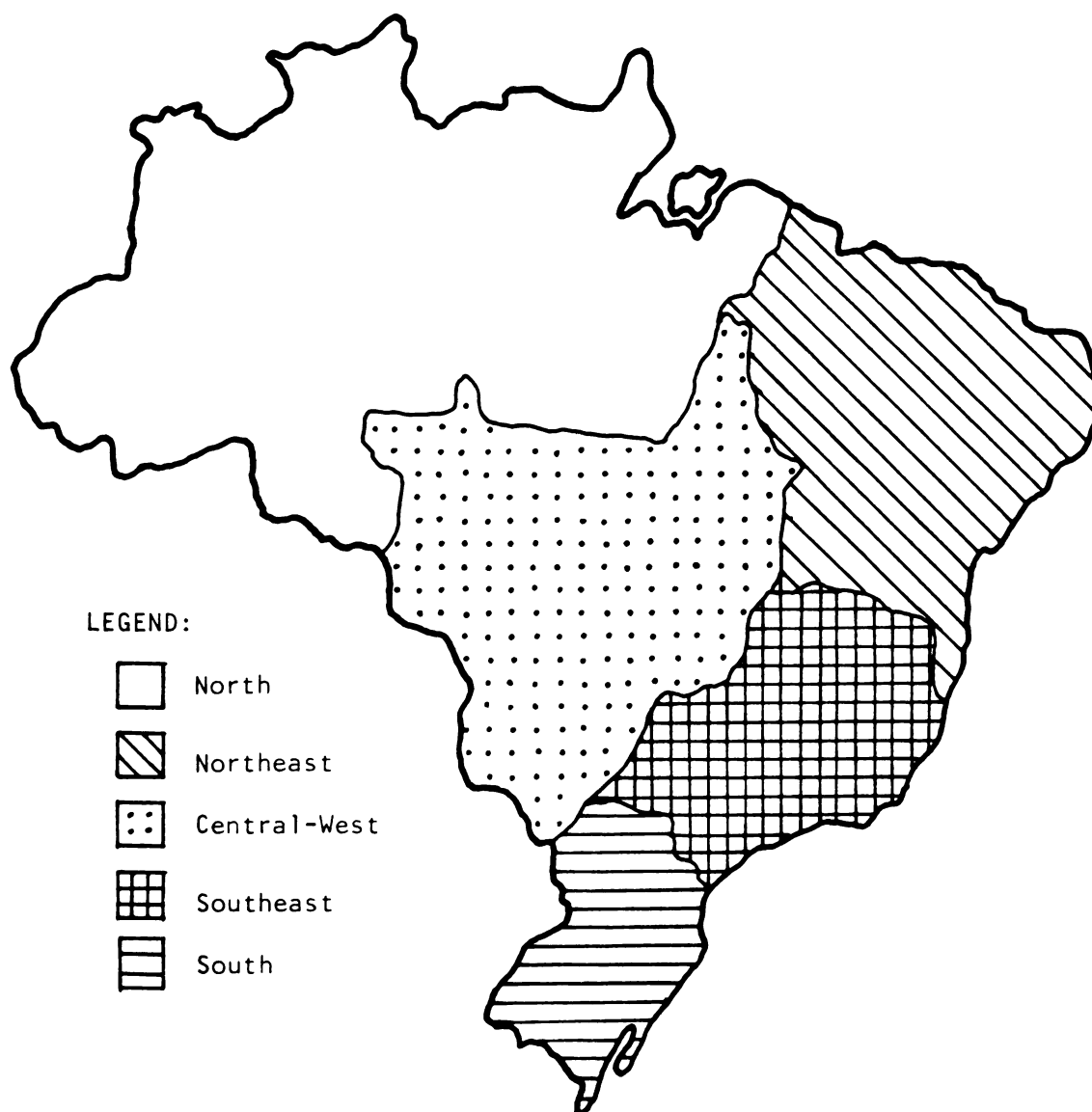
Brazil's Forests and Forest Industrial Development

Despite the vast forest lands remaining (some 846 million hectares, constituting 41 percent of Brazil's land area), natural forests have largely been eliminated from the more heavily populated and developed regions of Brazil (Table 1).

Industrial timber production aggregated more than 45 million cubic meters of roundwood in 1973--21 million in mechanical wood industries, 20 million in charcoal production, and nearly 5 million in the pulp and paper industry (30). Production is still centered in the more populous regions, but the forest base has been shrinking

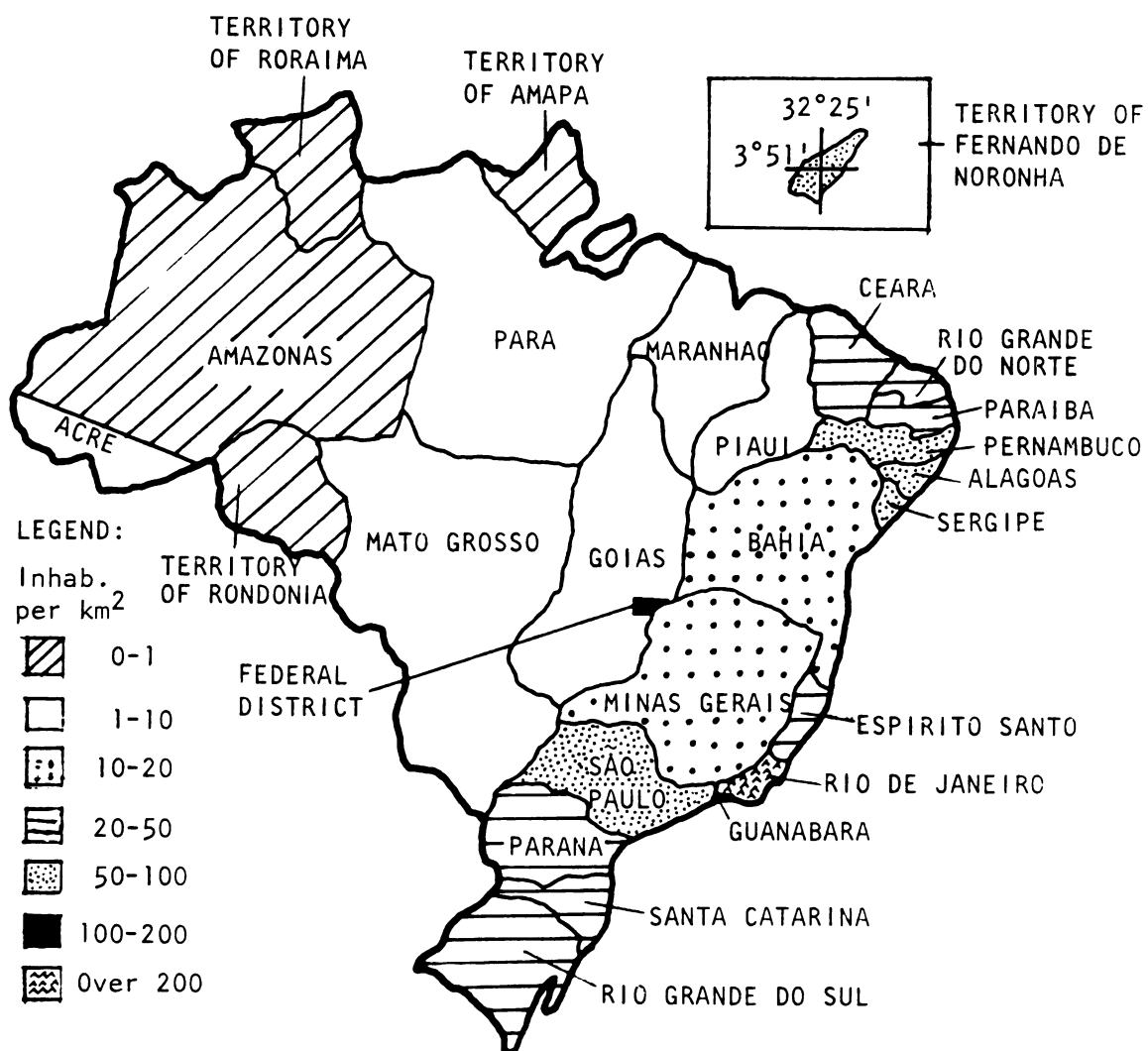


Figure 1.--Map of South America.



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

Figure 2.--The five geographical regions of Brazil.



Source: Instituto Brasileiro de Geografia e Estatística, Anuário Estatístico do Brasil (Rio de Janeiro, 1977).

Figure 3.--Population density of Brazilian states.

rapidly in these areas. The superb original forests of Paraná pine (*Araucaria angustifolia*), the historical mainstay of the lumber industry in the South and Southeast regions, will disappear in less than 10 years at present exploitation rates (38).

Table 1.--Distribution of natural forests in Brazil, by region (in million hectares).

Region	Land Area	Natural Forest Area	Forest as Percent of Land
North	355.4	286.3	81
Northeast	154.2	13.5	9
Central-West	187.9	32.2	17
Southeast	91.9	8.6	9
South	56.2	6.5	12
Total	845.6	347.1	41

Source: M. K. Muthoo et al., *Situação Florestal Brasileira*, IBDF-COPLAN Série Técnica no. 4 (Brasília, 1977).

Increasing use is being made of the Amazonian and interior forests to supply the more populous and developed regions with timber, but there are formidable obstacles to development of the more remote forests: scarcity of capital, limited current species marketability, inadequate access to the forests, and long distances to the developed timber industries and markets.

Brazil has been largely self-sufficient in timber products (Table 2), but continued self-sufficiency has become increasingly problematical. For a number of years it has been apparent to national

planners that laissez-faire policies would lead to a deteriorating timber supply situation. To correct this situation (to meet timber products export goals as well as to maintain national self-sufficiency), Brazil launched its reforestation programs.

Table 2.--Brazil's trade balances in timber products, 1959-74 (in million \$ U.S.).

Year	Exports	Imports	Net Exports
1959	42.5	50.0	- 7.5
1964	60.2	23.6	36.6
1968	98.5	57.4	41.1
1969	115.9	48.8	67.1
1970	115.3	60.9	54.4
1971	128.0	82.7	45.3
1972	145.0	109.3	35.7
1973	237.4	142.0	95.4
1974	255.9	329.4	-73.5

Source: Antonio C. Prado, Contribuição do Setor Florestal ao Comércio Exterior do Brasil, IBDF-COPLAN Série Técnica no. 5 (Brasília, 1977).

A major program of reforestation was initiated in 1966 with enactment of the Fiscal Incentive Law. This law permitted individuals or firms to reduce their income-tax payments to cover allowed expenditures for reforestation.¹ A related program announced in 1974, the National Program for Paper and Cellulose, sought to increase production

¹In Chapter IV the specific provisions of the Fiscal Incentive Law are discussed.

of paper and cellulose products, primarily from the establishment and management of tree plantations.

Objectives of the Study

This study is an examination of the operation of the Fiscal Incentive Law and its effects in the state of São Paulo. São Paulo typifies the central forestry problem of Brazil. Its natural forests have been largely depleted, it is a center of timber-products manufacturing, and it is a major timber-products market area.

Focusing on São Paulo, the specific objectives of this study were:

1. To describe the extent and location of reforestation activity, both before and following enactment of the Fiscal Incentive Law.
2. To project timber production from tree plantations and to compare it with projected timber demands.
3. To analyze the profitability of plantation establishment and management under the Fiscal Incentive Law.

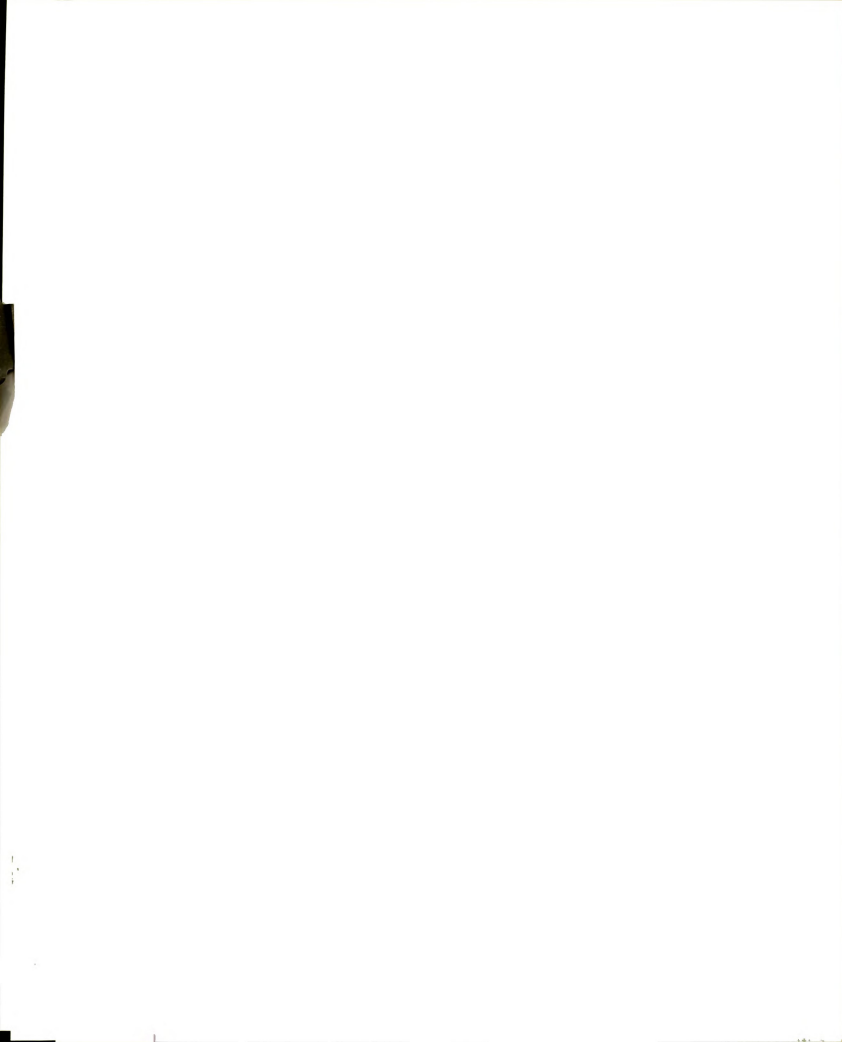
Procedures

Published material appropriate for use in this study is limited, but publications were used as extensively as possible. These publications have been cited wherever used.

A considerable amount of information was obtained through direct visits to government agencies in São Paulo State--through interviews with officials and use of records compiled by the agencies. The researcher visited the regional offices of the Brazilian Institute

of Forestry Development (IBDF), the State Forestry Institute, and the State Department of Agriculture. Data needed from the primary timber industry were obtained through interviews with officials of four firms (a random sample drawn from a population of 11 major primary timber manufacturers). Interviews were also conducted with 25 reforestation companies (a random sample drawn from the population of 150 reforestation companies registered with IBDF).

Sources of much of the information presented were mixed; e.g., data on the area, location, ownership, and years in which plantations were established were drawn from a number of publications as well as unpublished data in the files of IBDF. Again, in calculating internal rates of return for plantations, the researcher used cost and returns data from a variety of sources: government agencies, primary timber industry, and reforestation companies. The specific procedure used in each phase of this study is described in the appropriate section of the dissertation.



CHAPTER II

BACKGROUND ON SÃO PAULO STATE

The state of São Paulo has an area of 24.8 million hectares, 2.9 percent of Brazil's total land area (Figure 4). In 1970, the population of São Paulo State reached 17.7 million, 19.4 percent of the total national population (20).

Per capita income is U.S. \$1,700, in sharp contrast with an average of U.S. \$834 for the country as a whole (22). São Paulo's domestic product (60 billion cruzeiros in 1970) represents 36 percent of the national total. The state accounts for 18 percent of the national domestic product in the agricultural sector, 44 percent in the industrial sector, and 34 percent in service industries (Table 3).

Table 3.--Value of domestic product in São Paulo State and in Brazil, by sector, 1970 (values in billion cruzeiros).

Sector	Brazil	São Paulo	
	Value	Value	Percent of Brazilian Total
Agriculture	17	3	18
Industry	61	27	44
Services	89	30	34
Total	167	60	36

Source: Governo do Estado de São Paulo, Secretaria de Economia e Planejamento, Coordenadoria de Análise de Dados, "Central de Dados e Referências: Setor de Economia Ref. T 21/22" (São Paulo, 1977). (Mimeographed.)

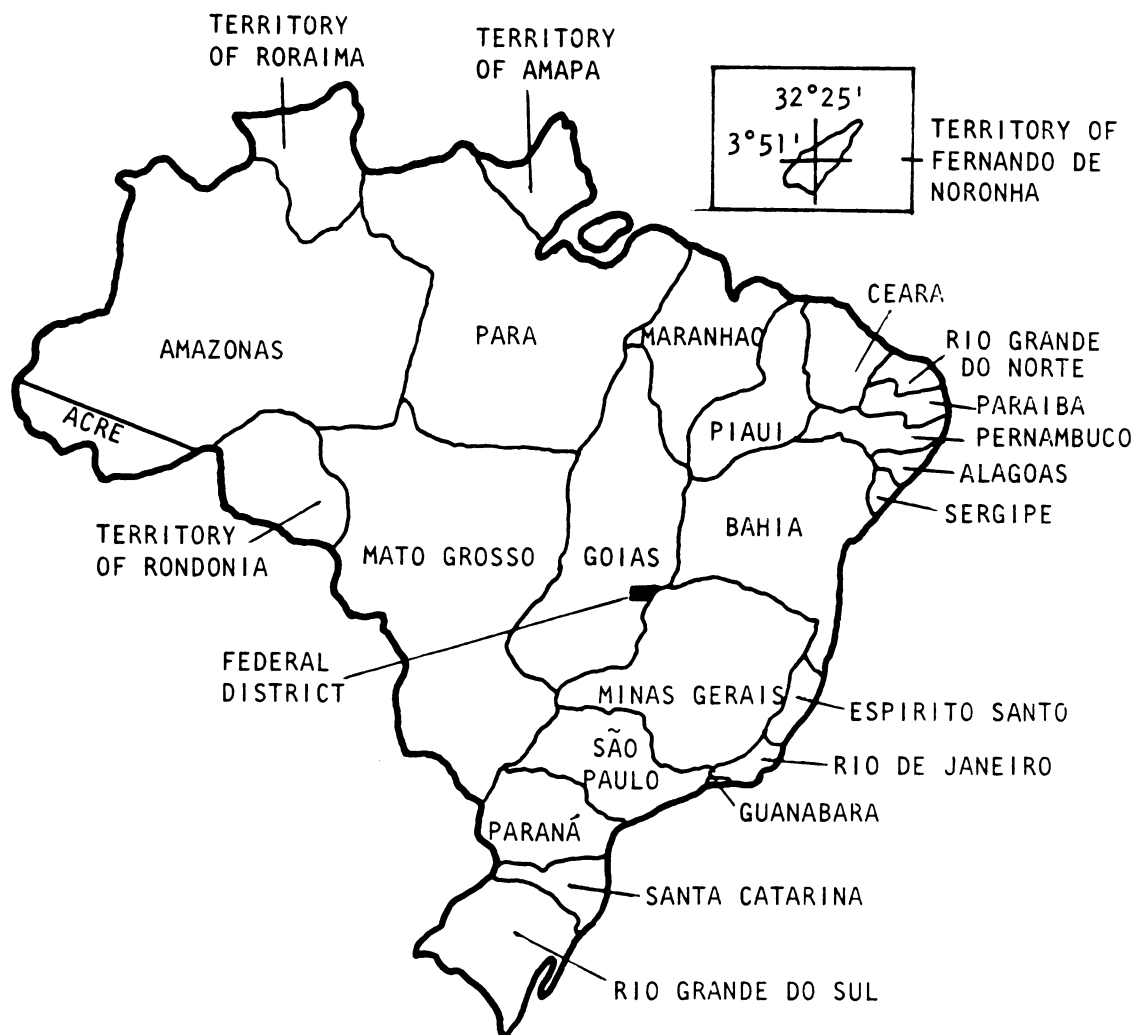


Figure 4.--States of Brazil.

Active agriculture occupies 15.5 million hectares (63 percent of São Paulo State's land area). Thirty-one percent of the agricultural land is in crops; 65 percent is in pasture. Leading farm products, by value, are beef, sugar, coffee, rice, cotton, corn, and milk (22, p. 88).

The railway network totals some 5,000 kilometers. All neighboring states can be reached by rail from the city of São Paulo. Paved roads, including federal and state highways, total in excess of 20,000 kilometers (27).

The highly industrialized city of São Paulo, like most great industrial cities, faces increasing problems of environmental pollution. One consequence is that public policy is attempting to establish new industries in other parts of the state. New industries are being established in other cities, such as Campinas, Jundiaí, Sorocaba, Limeira, and São José dos Campos.

Primary Timber Industries

Pulp and paper production dominates the timber industry of São Paulo State. There are presently 11 pulp mills, clustered in the eastern part of the state (Figure 5). This industry, producing 740,000 tons of wood pulp in 1977 (nearly all short-fibered pulp), accounted for 49 percent of Brazil's entire output of wood pulp (Table 4). More than 32,000 people were directly employed in the industry in 1977; wages and salaries totaled 3,036 million cruzeiros (3). Three additional pulp and paper mills are in the planning stages.

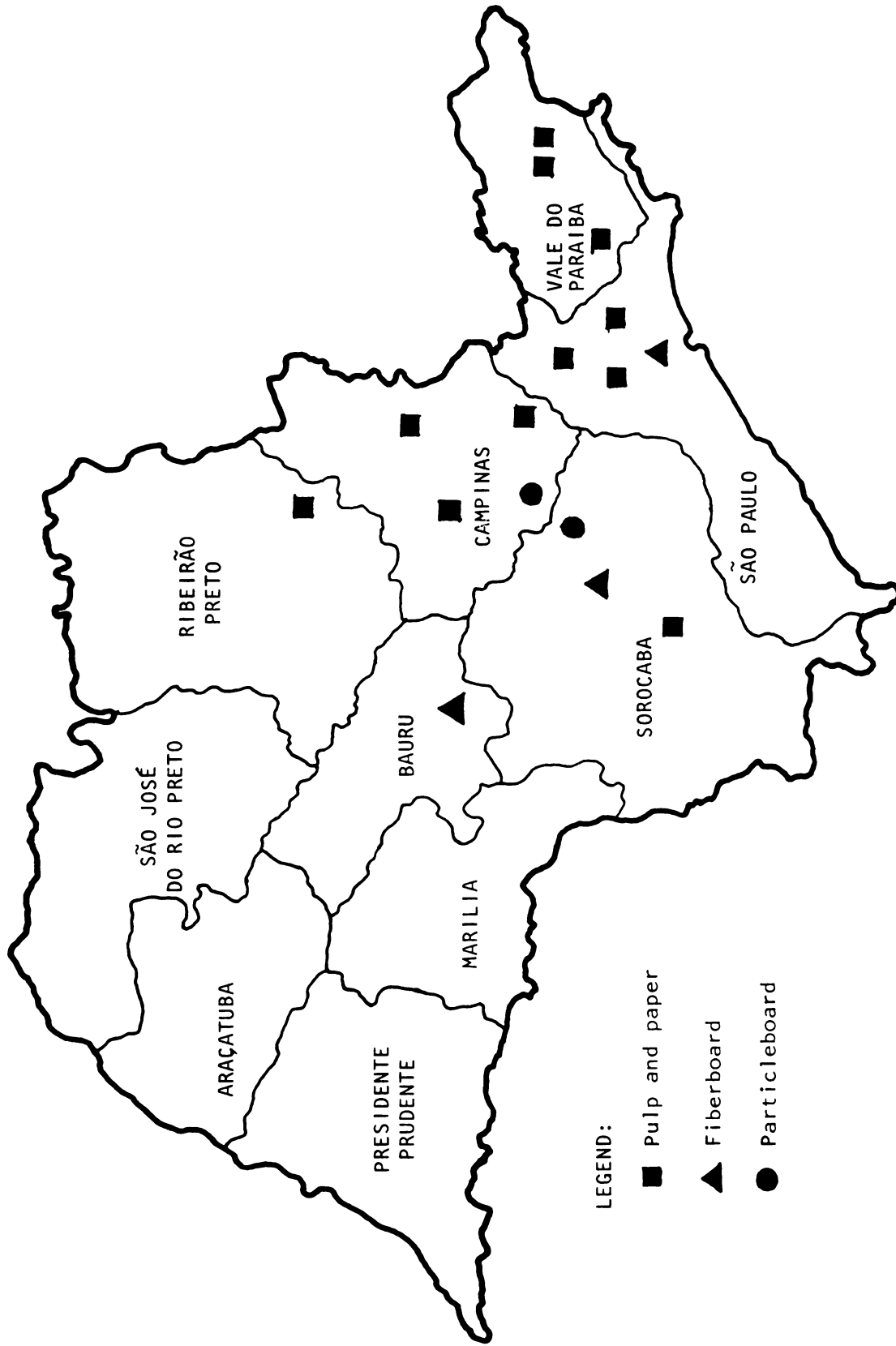


Figure 5.--Distribution of primary timber industries in São Paulo State, by agricultural region.

Table 4.--Wood pulp production in Brazil, by state, 1976 and 1977
(in thousand tons).

State	1977	1976
São Paulo	740	613
Santa Catarina	264	253
Paraná	189	153
Rio Grande do Sul	181	164
Minas Gerais	50	14
Pernambuco	46	37
Bahia	14	10
Paraíba	9	2
Rio de Janeiro	6	5
Rio Grande do Norte	3	2
Ceará	Negl.	Negl.
Total	1,502	1,254

Source: Associação Paulista dos Fabricantes de Papel e Celulose, Relatório Estatístico 1977 (São Paulo, 1978).

Fiberboard production ranks second among São Paulo's primary timber industries (Figure 5). There are only two mills, but their output (280,000 tons in 1973) is sufficient to meet demand within the state and to permit export of half their output. São Paulo provides virtually all of Brazil's fiberboard output.

Three particleboard mills are in production in São Paulo State (Figure 5). Their 1973 output, 55,000 cubic meters, represented 20 percent of national production (30).

The lumber industry is not as well developed in São Paulo as in neighboring Paraná, but 675 sawmills in São Paulo are registered at the IBDF regional office (17). These sawmills, distributed throughout the entire state, are mostly small, ranging in lumber output from 2 cubic meters to 64 cubic meters per day. Most of the

lumber marketed in São Paulo is imported from other regions, particularly the state of Paraná. Paraná alone exports to São Paulo 5.9 million cubic meters of Paraná pine and 3.8 million cubic meters of other species (37, p. 184). (Some unknown portion of this import is in the form of logs rather than lumber.)

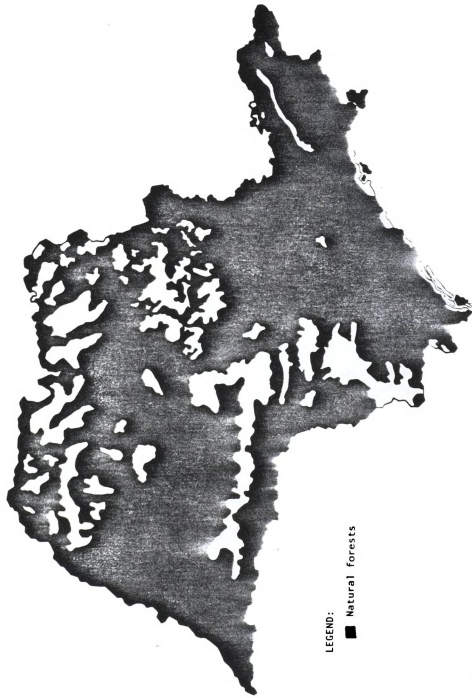
Wood is also an energy source in São Paulo. The total amount used is unknown, but the ceramic and baking industries alone used 4.6 million cubic meters in 1977 and 4.1 million cubic meters in 1978 (18, 19).

Forest Resources

Natural Forests

The original forests of São Paulo State were very extensive. At the beginning of the nineteenth century, it was estimated that these forests covered 20.5 million hectares, or 82 percent of the total land area (Figure 6). Forest types ranged from tropical rain forest to woodland savanna (cerrado) in the northeast and southeast portions of the state. Araucaria forests were prominent in the south and southwest portions.

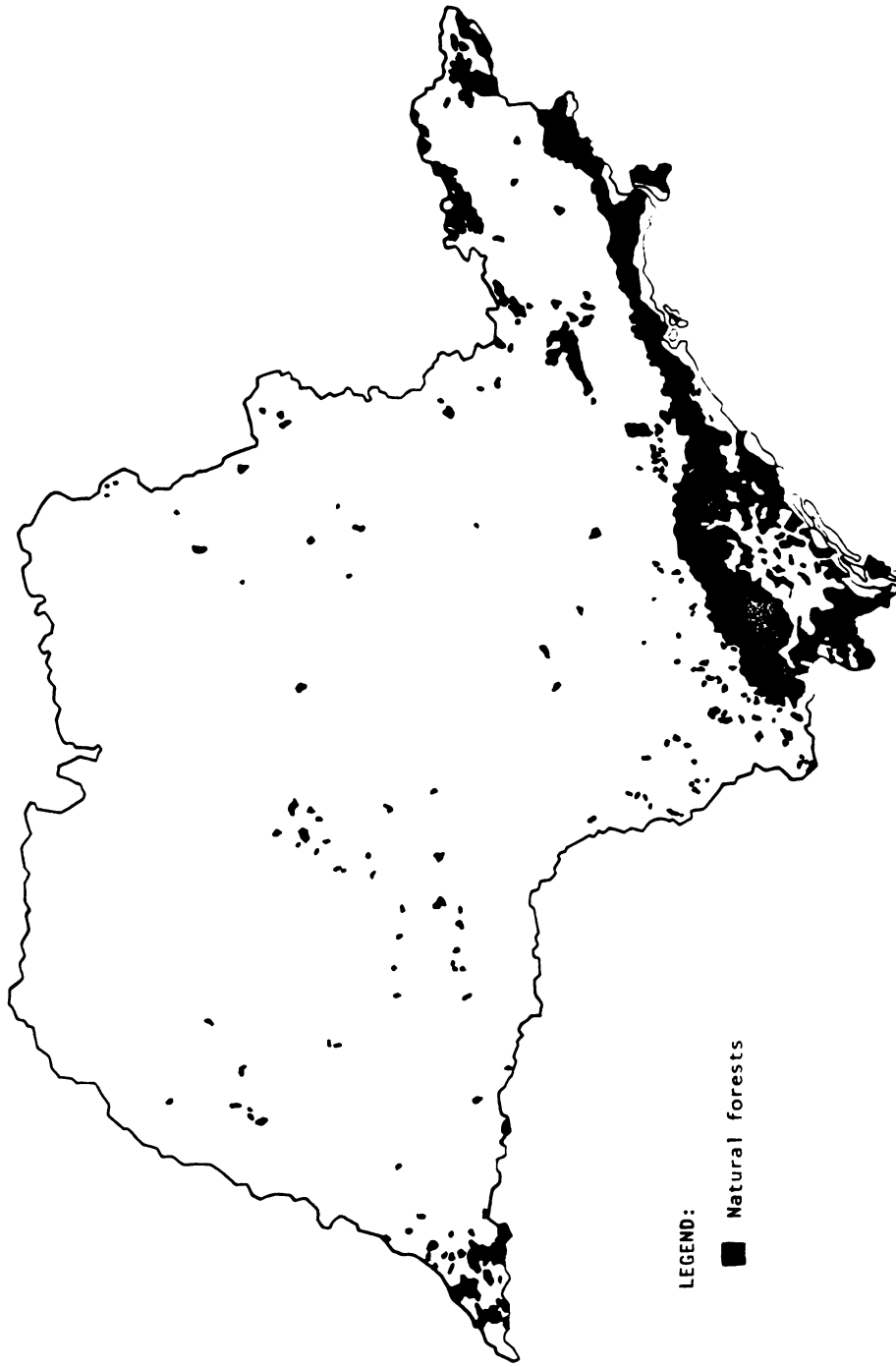
Forest lands were cleared for agriculture--first coffee production, then cotton and grazing. Forest area had been reduced to 14.5 million hectares by 1907, 3.4 million hectares by 1962, and 2.1 million hectares by 1973 (42). The little natural forest that remains is concentrated in the southeastern mountains, where accessibility is limited (Figure 7). About one-third of the remaining natural forest is in public ownership, under the jurisdiction of the Instituto Florestal. Some of the remaining forest will be protected,



Source: Mauro A. M. Victor, A Devastação Florestal (São Paulo: Sociedade Brasileira de Silvicultura, 1977).

Figure 6.--Map showing location of original natural forests in São Paulo State.





Source: Mauro A. M. Victor, A Devastação Florestal (São Paulo: Sociedade Brasileira de Silvicultura, 1977).

Figure 7.--Map showing location of remaining natural forests in São Paulo State, 1973.

but, in all likelihood, further erosion of the natural forest base will occur. For practical purposes, the remaining natural forests cannot be considered a significant future source of timber raw material in São Paulo.

Forest Plantations

As natural forest sources of fuelwood, charcoal, and other needed timber products became scarcer, railroad companies established forest plantations. The railroad companies introduced these plantations into São Paulo State. Native species were used initially, but relatively poor results led to investigation of exotic species.

Beginning in 1904, the Companhia Paulista de Estradas de Ferro (Paulista Railroad Company) adopted eucalyptus species for its plantations. The success of these plantings led other companies and individuals to establish similar plantations. After 1911, plantation establishment was given a further boost by the State Forest Service's program of distributing eucalyptus seed and seedlings to rural landowners. Railroad companies also distributed eucalyptus seed and seedlings (41).

As railroads made increasing use of oil and electricity, their need for wood fuel supplies diminished and a surplus of eucalyptus plantations developed. The surplus was short-lived as pulp and paper and fiberboard industries were established.

Pine plantations were introduced by the State Forest Service in 1948 for the purpose of providing sawlogs as well as long-fiber pulp. The first species introduced, Pinus radiata, failed as a result

of attack by the fungus Diplodia pinea. Subsequently, in 1957-58, the State Forest Service tried pines again, this time using Pinus elliottii (slash pine) and Pinus taeda (loblolly pine). These plantations were very successful (7). In more recent years, other pines--including P. oocarpa, P. kesiya, and P. caribaea, var. *caribaea*, var. *hondurensis*, and var. *bahamensis*--have also been successfully established.

Forest plantations in São Paulo now cover an area of 910,000 hectares. These plantations constitute the domestic raw material base for São Paulo's timber industries.

Plantation Management and Yields

Tree plantations have been established in São Paulo, as elsewhere in Brazil, specifically for timber production. Other possible objectives, such as recreational and environmental concerns, have had little applicability to plantation programs (34).

Eucalyptus

The eucalyptus species planted in São Paulo are most commonly E. grandis, E. saligna, E. alba, and E. propinqua. Complete site preparation is normal. The land is cleared, plowed, and harrowed before seedlings are planted. Seedlings are four to six months of age when planted and are spaced 3 x 1.5 meters or 3 x 2 meters. Weed control is applied during the first few years of plantation life. If fertilization is used, it is applied at the time of planting. Fertilization is a recent technique increasingly adopted mainly as the result of Mello's work (25). No further silvicultural treatment is

applied until the first harvest occurs, at seven to eight years from planting.

Harvest at seven to eight years assumes that mean annual increment peaks at this point. Clearcutting is the method of harvest, and reproduction occurs through stump sprouting. At about eight to ten months of age, stump sprouts in each clump are reduced manually to the two or three best stems. No further work other than protection and road maintenance is required until the second harvest takes place, in six to seven years. The process is repeated a third time, so that three crops are obtained with a single planting in an 18-to-21-year period. The system is predicated on a maximum fiber production for pulpwood, charcoal, particleboard, and other small-timber uses. Sawlog production from eucalyptus species has been avoided for a number of reasons: uncertainty about the species' suitability for lumber, sawtimber management, seasoning problems, and markets (14).

Some extraordinary yields have been obtained from eucalyptus plantations. One researcher pointed out:

In well managed plantations, even without the benefit of improved seed and planting stock, yields averaging more than 40 cubic meters per hectare per year are common. On good sites and with improved seed and planting stock, yields up to 62 cubic meters have been obtained on 7 and 8 year rotations (34, p. 785).

However, average yields need to include the full range of plantations, recognizing site differences, seed and species selections, and management intensities. An IBDF report stated:

Fifty percent of our reforestation shows excellent field work which will result in production of 30 to 35 cubic meters per hectare per year. Thirty percent can be classed between fair

and good but can be improved. Twenty percent of the reforestation shows very little productivity. . . (23, p. 105).

Victor et al. (41) assumed yields of 191 cubic meters per hectare at age 7, 96 cubic meters at age 13, and 81 cubic meters at age 18. Berger and Engler (6) calculated similar yields--190 cubic meters at age 7, 100 cubic meters at age 13, and 80 cubic meters at age 19. Another report (39) projected the following yields: 153 cubic meters at age 7, 65 cubic meters at age 12, and 52 cubic meters at age 17.

There is room for some conjecture about average eucalyptus yields. For purposes of subsequent analysis in this study, the following yields were selected:

<u>Years at Harvest</u>	<u>Yield in Cubic Meters per Hectare</u>
7	170
13	100
18	80

Pines

Management of pine plantations is not as well defined as for eucalyptus. Pines have not been planted as extensively, and the oldest pine plantations are no more than 20 years old.

Complete site preparation is required, as in the case of eucalyptus. Management techniques include fertilization, weed control during the first few years after stand establishment, pruning, and periodic thinnings. Initial spacing varies between 2 x 2.5 meters and 3 x 1.5 meters. The first thinning is made at seven or eight years of age and is used for pulpwood or other small-timber products.

Subsequent thinnings are repeated at two-to-four-year intervals. Final harvest for sawlogs and other large timber products is estimated to occur at 25 to 30 years of age. As Rudolph et al. (34) stated: "Optimum rotations and combinations of products are still to be determined for Brazilian growth and utilization conditions." Thinnings have well-developed markets, but there is some uncertainty about the development of currently minor pine sawlog markets.

Pine plantation yields are tentative. Beattie and Ferreira (5) assumed a rotation age of 26 years, with a total yield of 168 cubic meters of small timber and 172 cubic meters of sawtimber. Victor et al. (41) assumed a rotation of 25 years, with a total yield of 182 cubic meters of small timber and 230 cubic meters of sawtimber. Other researchers (29, 30, 39) have made similar assumptions about pine yields.

For purposes of subsequent analysis in this study, the following yields from pine plantations were selected for four thinning treatments and a final harvest at age 25:

<u>Year of Cutting Treatment</u>	<u>Yield in Cubic Meters per Hectare</u>	
	<u>Small Timber</u>	<u>Sawtimber</u>
7 (thinning)	22	--
11 (thinning)	30	6
15 (thinning)	36	15
19 (thinning)	34	46
25 (harvest)	35	154
	<u>157</u>	<u>221</u>

CHAPTER III

REVIEW OF LITERATURE

Brazil's fiscal incentive system and reforestation programs have been extensively discussed in popular literature, but few formal studies have been reported in technical publications.

The most thorough analysis of fiscal incentives and reforestation activity to date was done by Beattie and Ferreira (5). Examining Brazil as a whole, Beattie and Ferreira made detailed financial analyses, using social and market values for costs and revenues. They also examined and quantified some socioeconomic effects of reforestation. The authors concluded that reforestation is a financially sound economic activity.

Callahan's work (8), based on Beattie and Ferreira's study, drew similar conclusions but noted some negative aspects. Callahan suggested that: (a) the incentive program has provided unnecessary subsidies to reforestation activity; (b) economic inefficiencies are manifested by high planting costs, the planting of trees on agricultural land, and subsidization of the removal of natural forests; (c) the program has been biased toward favoring landowners and corporations, thus furthering the inequitable distribution of wealth in Brazil; and (d) the program has contributed to Brazil's high inflation rate through the large expenditures made in a program that appears to

have wasted financial resources through inefficient administrative and management practices.

Beattie (4), using a benefit-cost analysis framework, concluded that from the program participant's point of view, fiscal incentives are substantial inducements to reforestation. The participant contributes little to total costs but receives all of the direct revenues. Beattie also pointed out that the program has some secondary national benefits, such as the potential for import savings, capital formation, and employment generation in rural areas.

None of the publications cited said much about the fiscal incentive program for reforestation as a means of insuring raw material supply for timber industries.

In São Paulo State, the focus of this dissertation, there has been no previous analysis of the physical and economic results of the fiscal incentive program for reforestation. A few studies (6, 13, 16, 31, 39, 40, 41, 42) have described various aspects of reforestation activity. Most helpful are the studies by Victor et al. (40), Chiarini et al. (9), and Negreiros et al. (31), which analyzed the evolution of reforestation activity in São Paulo before enactment of the Fiscal Incentive Law.

CHAPTER IV

THE FISCAL INCENTIVE SYSTEM

In recent years Brazil has been actively using fiscal incentives to promote economic and social development of regions or economic sectors of the country. Incentives offered distinguish between individuals and corporations. Incentives to individuals are in the form of income-tax reductions, but corporations are granted tax credits (8). The distinction is biased in favor of corporate investors, as illustrated in Table 5. The illustration shows a 50 percent reduction in the tax bill for both the individual investor and the corporation, but the individual's investment in an approved project is \$5,000 as compared to the corporation's investment of \$500. Effectively, the individual receives a 10 percent incentive (a \$500 reduction in taxes for a \$5,000 investment), whereas the corporation receives a 100 percent incentive (a \$500 reduction in taxes for a \$500 investment) (8).

Fiscal Incentive Programs

Fiscal incentives are offered for programs of regional development (Superintendency for the Development of the Northeast, and Superintendency for Amazon Development) and for the development of economic sectors such as reforestation, fisheries industry, and tourism.

Table 5.--Comparative fiscal incentive tax benefits to individual and corporate investors in Brazil.

Item	Individual Investor	Corporate Investor
Gross income	\$10,000	\$10,000
Income tax due before investment in incentive program (10%)	1,000	1,000
Maximum investment allowed in incentive program	5,000 (deductible from gross income)	500 (tax credit)
Taxable income after investment in incentive program	5,000	10,000
Tax due after investment	500	500
Tax savings	500	500
Ratio of tax savings to investment	10%	100%

Source: William D. Beattie, "An Economic Analysis of the Brazilian Fiscal Incentives for Reforestation (Ph.D. dissertation, Purdue University, 1975).

Superintendency for the Development of the Northeast (SUDENE)

The first incentive program for regional development was instituted in 1959 for the purpose of developing the impoverished Northeast region (28). The agency in charge, SUDENE, is a federal agency in the Ministry of the Interior. Geographically, SUDENE's responsibility applies to the states of Bahia, Sergipe, Alagoas, Pernambuco, Paraíba, Rio Grande do Norte, Ceará, Piauí, Maranhão, and about one-fifth of Minas Gerais.

Projects that qualify for fiscal-incentive application include agriculture, industry, and tourism. In fact, any enterprise that



promises to contribute to regional development may qualify. The allowable tax credit has a maximum limit of 50 percent of the tax due.

Superintendency for Amazon Development (SUDAM)

SUDAM, created in 1966, functions in parallel fashion to SUDENE. SUDAM's area of jurisdiction is "legal Amazonia"--the states of Pará, Mato Grosso, Amazonas, Maranhão, Goiás, and Acre, and the territories of Amapá and Rondonia. Legal Amazonia represents 57 percent of Brazil's total land area.

As of the beginning of 1978, SUDAM had approved 551 projects representing total investments of more than 23 billion cruzeiros (1).

Reforestation

This program of sectorial development is administered by the Brazilian Institute for Forestry Development (IBDF). Any individual or corporation may apply for tax benefits pertaining to reforestation projects established anywhere in Brazil. Currently, the maximum effective tax credit allowed for corporations is 25 percent of the tax due; individuals may claim a maximum 20 percent reduction in gross income. Outside SUDENE's and SUDAM's areas of geographic jurisdiction, the maximum effective tax credit has been reduced further to 17.5 percent.

Fisheries Industry

The Superintendency for the Development of the Fisheries Industry (SUDEPE) administers fiscal incentives for fisheries

industrialization and packing. The maximum tax credit allowed is 25 percent of the tax due.

Tourism

EMBRATUR administers fiscal-incentive applications for hotel construction and other investments related to tourism. The maximum tax credit allowable is 12 percent of the tax due.

Mandatory Development Programs

The federal government has designed special mandatory development programs to aid economic sectors that cannot attract private investment because of the risks involved and the levels of investment required. Examples of such investments are the Transamazonica Highway and the Northeast Irrigation Plan. Most of the funds for mandatory development programs--National Integration Plan (PIN) and the Program of Land Redistribution and Stimulus to Agriculture (PROTERRA)--represent subtractions from the incentives previously offered under the regional and sectorial fiscal incentive programs.

Reforestation Program

Fiscal incentives have had a great effect on reforestation efforts in Brazil. Between 1967 and 1977, 2.9 million hectares of plantation were established (Appendix Table A11) at a cost in excess of 20 billion cruzeiros. Fiscal incentives for reforestation began in 1966 with passage of Law 5106.

Law 5106 provided that the cost of reforestation could be deducted from the income tax due from corporations or from the gross

taxable income of individuals, as long as it did not exceed 50 percent of corporate tax due or 50 percent of the gross income of private citizens. The law specified that only the first four years of reforestation activity in a project could qualify--one year of plantation establishment costs and three years of maintenance costs.

Law 5106 stipulated that a reforestation project be undertaken before a list of the expenses incurred could be submitted to IBDF for approval. After IBDF approved the project and expenses, the taxpayer could then deduct the previous year's expenses from the current year's income tax bill. This posed problems for investors in predicting the subsequent tax bill that would establish the reimbursable limits to current reforestation investment. Participants' complaints about the year-long lag between planting expenditures and tax relief, plus the risk of establishing a plantation and having the project rejected by IBDF, resulted in some relief in November 1970 with enactment of Decree Law 1134.

Decree Law 1134 applied only to corporations.¹ It allowed corporations to deposit their tax credits with the Bank of Brazil in frozen accounts and to draw on these funds as they proceeded with approved planting projects. The law also permitted corporate taxpayers to turn their deposited funds over to third-party reforestation companies for the preparation and execution of reforestation projects.

¹Individual participants are not permitted to use the benefits of Decree Law 1134. On the other hand, after Decree Law 1503 was passed in December 1975, corporations lost the right to use the benefits of Law 5106 when applying in reforestation projects.



Third-party reforestation companies have become important links between investors and IBDF. These companies help investors prepare reforestation projects and gain approval by IBDF. They customarily establish plantations and maintain them. Often they also provide the land on which plantations are established.¹

Beginning in 1970, the original allowance for corporate tax deductions in reforestation projects was reduced to 35 percent to provide extra funds allocation to the mandatory National Integration Plan. In 1971, another reduction of 10 percent in tax deductions was adopted to provide monetary resources to PROTERRA. The net effect of these two mandatory programs on tax-paying investors was to reduce the original 50 percent allowance for tax deductions in reforestation projects to 25 percent.

Two additional decrees further modified corporate tax deductions for reforestation in areas outside of SUDAM's and SUDENE's geographic jurisdictions. Decree Law 1307, enacted in 1974, provided that the effective tax credit for reforestation would be gradually reduced from 25 to 12.5 percent of the tax due. Decree Law 1478, enacted in August of 1976, stopped the phased reductions in tax incentives specified in Decree Law 1307 at 17.5 percent. In SUDAM's and SUDENE's geographic jurisdictions, corporate tax credits for reforestation projects remain unchanged at 25 percent.

¹Theoretically, the taxpayer should have property rights to the land used in fiscal-incentive projects, but this is not interpreted to mean ownership of land. Many plantation investors arrange with reforestation companies to have their plantations established on reforestation company lands.



Decree Law 1338 (June 23, 1974) regulates the fiscal incentives for investments made by individuals. The original allowance of 50 percent deduction from the gross income tax for monies invested in reforestation projects was reduced to a maximum of 20 percent.

Decree Law 1376, enacted in 1976, did not affect tax deductions for reforestation projects, but it did change the system of handling tax credits. Under the 1970 Decree Law 1134, corporations were permitted to deposit their tax credits with the Bank of Brazil and to draw on these funds as they proceeded with approved planting projects. Decree Law 1376 pooled the funds from sectorial incentive programs--reforestation, fisheries, and tourism--into one Sectorial Investment Fund (FISSET), from which investors could buy quotas as desired. Presumed advantages were: (1) correct imbalances between the supply and demand for money, which sometimes developed in individual sectorial incentive programs; (2) eliminate delays in the execution of approved projects because of capital shortages; and (3) eliminate commissions previously paid to brokers who acted as go-betweens for investors and reforestation companies.



CHAPTER V

FOREST PLANTATION ESTABLISHMENT IN SÃO PAULO

Data on plantation establishment were obtained from miscellaneous sources, primarily records of IBDF. There were some weaknesses in the records available, but the compilations should serve as reasonably accurate indicators of relative differences in areas planted with different species, forest locations, and the time periods of plantation establishment.

Table 6 is an overall summary of plantation establishment over time. The total area planted since 1956 is estimated at 910,000 hectares. Seventy-two percent of the area planted is in eucalyptus species, 28 percent in pines. The preference for eucalyptus is obvious, but a slight trend toward greater pine representation can be noted in the most recent time period. Planting since 1967, following enactment of the Fiscal Incentive Law in 1966, has proceeded at a much more rapid rate than it did in earlier years.

Appendix Tables A1 and A2 detail the record of plantation establishment by agricultural regions. More than 68 percent of the eucalyptus plantations are in Sorocaba, Campinas, and Ribeirão Preto; 82 percent of the pine plantations are in Sorocaba, São Paulo, and Bauru. Most plantations are still accessible to the primary timber industries, which are located in the Campinas, São Paulo, and



Vale do Paraíba agricultural regions, but more recent plantation establishment is occurring farther from the industrial centers.

Table 6.--Area reforested in São Paulo, by species and selected time periods (in thousand hectares).

Period of Years	All Species	Eucalyptus	Pines
1956-60	93	87	6
1961-62	51	42	9
1963-66	129	87	42
1967-78	594	398	196
Dates uncertain ^a	43	37	6
Total	910	651	259

Source: Appendix Tables A1 and A2.

^aTime periods could not be identified for 37,000 hectares of eucalyptus and 6,000 hectares of pines planted by the timber industries.

Before 1966, Campinas was the primary location of eucalyptus plantations. Sorocaba is now the principal location of new plantations, both eucalyptus and pine. In fact, Sorocaba contains some 38 percent of all forest plantations in the state of São Paulo. Since Sorocaba is one of the less-well-developed regions of the state, it can be concluded that Sorocaba has some present comparative advantages for planting establishment. Among these advantages are the availability of land and the presence of an ample supply of labor.

Government agencies, principally Ferrovias Paulista Sociedade Anonima and Instituto Florestal, were active in plantation establishment



before 1966 (accounting for more than 15 percent of the forest planted in the state), but since 1966 these agencies have planted no more than 2 percent of the total reforested area.

Reforestation Under Fiscal Incentives

Table 7 shows the variation in average annual rates of forest establishment in São Paulo by time periods. Plantation establishment rates increased successively through the time periods shown, but the increase from 1963-66 to 1967-78 was an impressive 50 percent, suggesting the strong influence of fiscal-incentive legislation.

Table 7.--Average annual rates of forest establishment in São Paulo, by time periods, 1956-78 (in thousand hectares).

Period of Years	All Species	Eucalyptus	Pines
1956-60	18	17	1
1961-62	25	21	4
1963-66	32	22	10
1967-78	48 ^a	32 ^a	16 ^a

^aLimited planting by government agencies not included.

The effect of fiscal incentives on reforestation in São Paulo is more readily seen by breaking down the overall time period since enactment of fiscal-incentive legislation, 1967-78, into smaller time segments corresponding with changes in the incentives offered. (The changes in legislation are discussed in some detail in Chapter IV.) Four time periods can be recognized--1967-70, 1971-73, 1974-75, and

1976-78. The first period reflects the influence of the initial law enacted in September 1966. The second period, ushered in by Decree Law 1134 which was enacted in November 1970, liberalized procedures from the investor's standpoint, but countered this advantage by introducing mandatory allocations of fiscal incentive funds to national development programs. The third period was introduced by legislation providing for annual reductions in fiscal incentives. The fourth period was introduced by legislation that froze annual reductions in fiscal incentives at 17.5 percent of taxes due.

Table 8 does not reflect a perfect correlation between changes in fiscal-incentive legislation and annual rates of forest establishment. Such a correlation could not be expected because there are other important influences on the rate of forest establishment. Nevertheless, it can be observed that the annual rate of planting increased sharply with the inception of fiscal incentive legislation. The momentum of reforestation appears to reflect an increase in planting in 1971-73, despite some lessening of the tax advantage offered; but thereafter, with further lessening of the tax advantage offered, the rate of planting decreased rapidly.

Figure 8 is a refinement of the correlation between the rate of forest establishment and changes in fiscal-incentive legislation. Area planted increased rapidly and consistently throughout the period 1967-71. Annual planting peaked in 1971, then plunged downward as the successive changes that decreased taxpayer benefits occurred. The last legislative change (August 1976), which arrested the decline

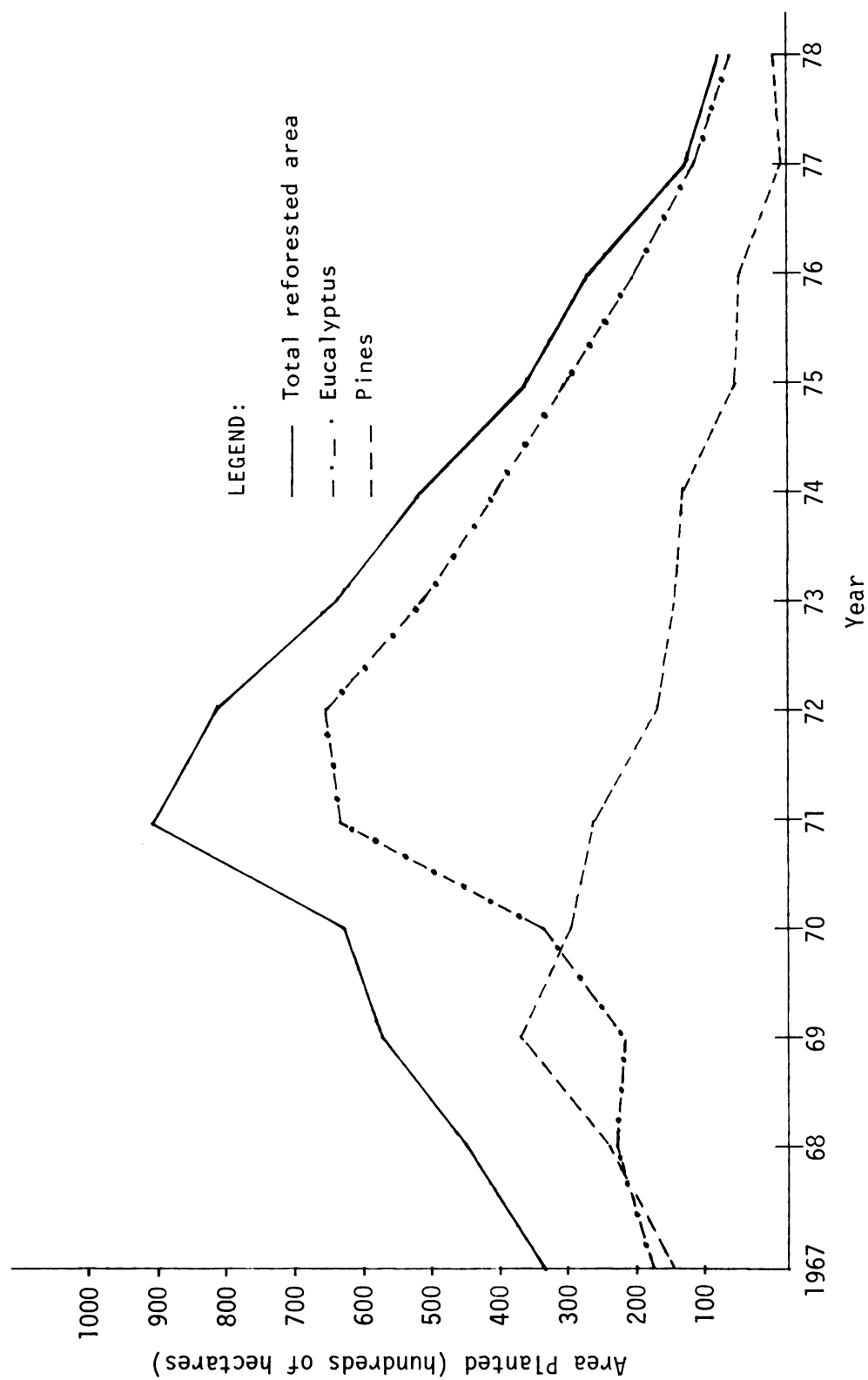


Figure 8.--Area reforested annually in São Paulo under the fiscal incentive program, 1967-78.



in incentive payments at the effective rate of 17.5 percent, slowed the rate of decline in reforestation but did not arrest the decline completely.

Table 8.--Average annual rates of forest establishment in São Paulo since fiscal incentive legislation, by legislative time periods, 1967-78 (in thousand hectares).

Period of Years	All Species	Eucalyptus	Pines
1967-70	59	24	26
1971-73	79	60	19
1974-75	46	36	10
1976-78	17	14	3
All years	48	32	16

Land Prices Under Fiscal Incentive Program

Plantation establishment increased rapidly after the inception of fiscal incentive legislation in 1966 and decreased rapidly after 1971 as legislation was modified to decrease benefits to taxpayers. Cause and effect are suggested, but not all of the decline in area planted after 1971 can be ascribed to changes in fiscal incentives. Land prices are also assumed to be an important factor in the decline in area planted after 1971, and this assumption is supported by land-price data.

Land prices are summarized by years in Table 9. The prices shown are averages for land in São Paulo judged suitable for reforestation. From 1969, land prices rose consistently until 1972 and



rapidly thereafter. Deflated prices exhibit a less-regular curve, but the basic pattern is the same. Real land prices increased rapidly until 1973, made a spectacular increase in 1974, and essentially held firm for the next few years. Real land prices increased more than 400 percent from 1969 to 1976.

Table 9.--Average price per hectare for land judged suitable for reforestation in São Paulo, 1969-76 (in thousand cruzeiros).

Year	Current Price	Deflated Price ^a
1969	.52	2.10
1970	.73	2.46
1971	1.05	2.97
1972	1.40	3.30
1973	2.40	4.74
1974	5.80	10.12
1975	7.69	9.81
1976	11.20	10.76

Source: Governo do Estado de São Paulo, Secretaria de Economia e Planejamento, Coordenadoria de Análise de Dados, "Central de Dados e Referências: Setor Agricultura Ref. T 6/27" (São Paulo, 1977). (Mimeographed.)

^aPrice in terms of value of cruzeiros as of January 1976.

The sharp increase in land prices has been noted elsewhere:

Lands which at the time of official surveys for elaboration of the São Paulo Forestry Program were sold for CR \$200 per hectare today are valued at CR \$1,000, an increase of 400 percent in 30 months. Additional figures indicate that in the region of Avaré, São Paulo, plots which three years ago were worth CR \$500 to CR \$1,000 per alqueire have been bought for fiscal incentive application for up to CR \$8,000. And these are relatively poor soil lands (4, p. 298).



It is a reasonable assumption that the sharp rises in land prices have discouraged some investors from investing in forest plantation establishment. Whether land is purchased outright or leased, land cost is a cost to the investor. Under the fiscal-incentive program, land cost is not deductible from income tax payments.

The reforestation program itself has probably been a factor in rising land prices, although some observers have pointed to more fundamental explanations:

It appears that buying land has become the best use of capital. --There is nothing monetary about this land rush unleashed in search of negotiable plots in São Paulo on the part of medium and large size business and businessmen with little and in many cases no connection or immediate interest in productive agricultural enterprises. This probably results from the new philosophy today, well understood by the larger money holders of the state: the "theory" that the surface area of the richest region in Brazil (São Paulo) is not elastic, and the very rich, within a few years, will be the person who owns a piece of this surface area (4, p. 298).

Ownership of Reforested Areas

Determining the pattern of ownership of forest plantations in São Paulo from available data is extremely difficult. The approach taken in this study was to interview government officials and check verbal estimates against a miscellany of government records. The results are highly tentative (Table 10), but they are probably reasonable indications of the relative roles of different ownership classes in forest establishment.



Table 10.--Area reforested in São Paulo by class of ownership, 1956-78
(in thousand hectares).

Ownership Class	All Species	Eucalyptus	Pines
Primary timber industry	200	162	38
Other private	654	456	198
State government	53	33	20
Federal government	3	..	3
All ownership	910	651	259

Ninety-four percent of the forest plantations are in private ownership. Timber industries hold 22 percent of the total; other private ownership accounts for 72 percent of the total. IBDF records, which are most complete in relation to fiscal-incentive projects, provide some clue to the breakdown of the "other private" ownership class. A sample of the records provided the following distribution of reforested areas among "other private landowners":

<u>Ownership</u>	<u>Area Planted (thousand hectares)</u>
Owners under fiscal incentives	
Corporations	283
Individuals	80
Joint (corporations and individuals)	60
Owners not under fiscal incentives	231
Total "other private"	654

Private ownership not recorded under fiscal incentives cannot be identified further, but reforestation projects registered under fiscal incentives clearly show that corporations are the dominant group among "other private owners."



CHAPTER VI

PROJECTED TIMBER YIELDS FROM PLANTATIONS

Timber yields have been projected separately for eucalyptus and pine species on the basis of areas planted by years and average per-hectare yields anticipated (discussed in the section on Plantation Management and Yields). Yields have been projected, by years, from 1980 to 1990.

Eucalyptus Plantations

Projected yields from eucalyptus plantations are summarized in Table 11. Yields for the period 1980-85 will depend on existing plantations. After 1985, yields will depend on plantations yet to be established. Here it was assumed that the 1978 rate of planting will continue unchanged for at least the next five years. This assumption underlies eucalyptus timber yield projections for the years 1986-90.

Although the trend in projected yields is somewhat confused by annual fluctuations, the trend is slightly downward. Most of the anticipated output is from plantations established under fiscal incentives (nearly 90 percent of the total).



Table 11.--Projected timber yields from eucalyptus plantations, 1980-90 (in million cubic meters).

Year ^a	All Plantings	Plantings Under Fiscal Incentives
1980	12.3	10.5
1981	11.4	9.1
1982	9.4	7.4
1983	7.6	6.9
1984	11.2	8.6
1985	9.8	9.3
1986	8.7	8.2
1987	7.6	7.1
1988	7.6	7.1
1989	9.1	8.5
1990	8.4	7.8
Total	103.1	90.5

Source: Appendix Table A5.

^aContinuation of the 1978 rate of planting into the early 1980s underlies projected yields in years 1986-1990.

Pine Plantations

Projected yields from pine plantations are summarized in Table 12. Pine management is based on the assumption that several thinnings for small round products (such as pulpwood and fiberboard) will be made before the final harvest at rotation age for sawlog products. Since most pine plantations are young, projected yields in the early 1980s will largely be a result of thinnings for small round products. Sawlog yields will not overshadow yields from thinnings until the latter part of the 1980s.

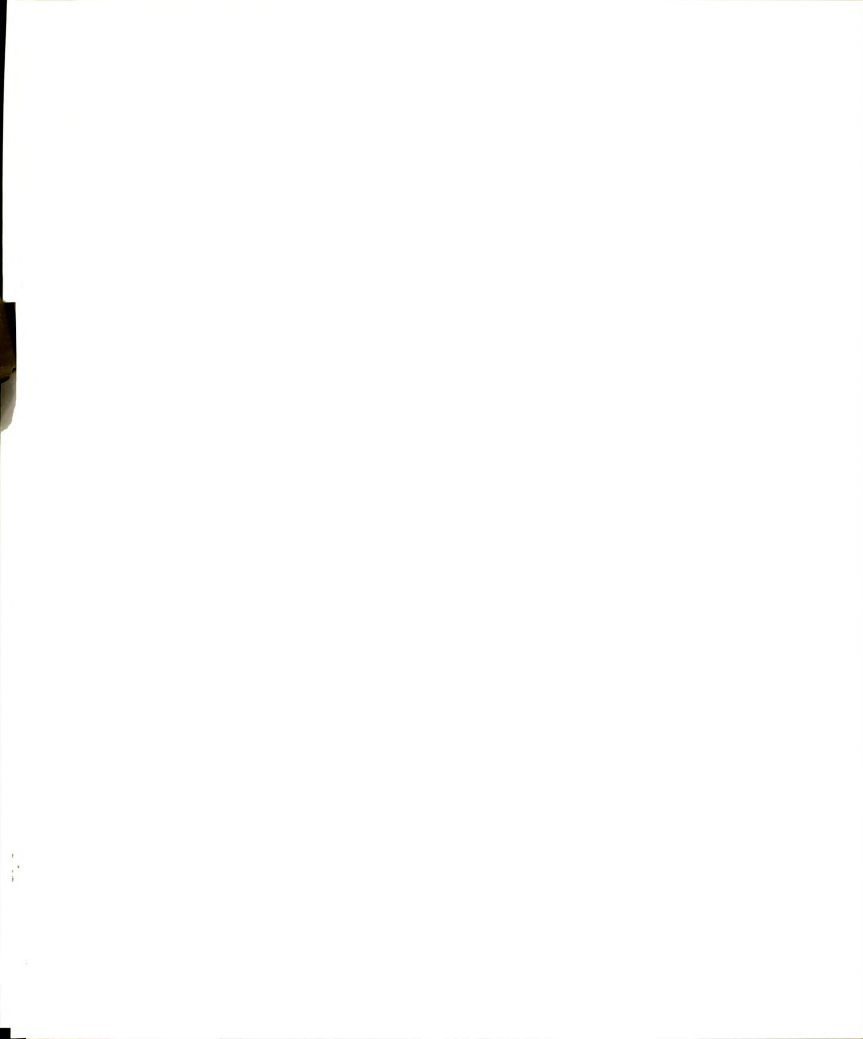


Table 12.--Projected timber yields from pine plantations, 1980-90
(in million cubic meters).

Year ^a	Small Timber Products		Sawlog Products	
	All Plantings	Plantings Under Fiscal Incentives	All Plantings	Plantings Under Fiscal Incentives
1980	1.9	1.4	.5	.2
1981	1.6	1.2	.7	.2
1982	2.1	1.5	1.2	.4
1983	2.1	1.5	1.3	.4
1984	2.1	1.7	1.2	.6
1985	1.8	1.5	1.0	.5
1986	1.9	1.7	1.9	1.1
1987	1.8	1.6	2.1	1.4
1988	2.3	1.8	4.0	1.9
1989	2.1	1.5	3.7	1.6
1990	1.6	1.2	2.6	1.3
Total	21.3	16.6	20.2	9.6

Source: Appendix Tables A6 and A7.

^aContinuation of the 1978 rate of planting into the early 1980s underlies projected yields in years 1986-90.

Similar to the situation in eucalyptus plantations, pine yields for the period 1980-85 will depend on existing plantations. Yields after 1985 will be influenced by plantations yet to be established, and it was assumed that the 1978 rate of pine planting will continue unchanged for the next five years. Thinnings from these latter plantings will appear in the projected yields of the period 1986-90.

Projected yields for pine small timber products reflect a fairly flat trend line. Sawlog yields project upward until 1988,

after which a downturn in yield is apparent. However, since few pine plantations were established before 1966, sawlogs will not become generally available from São Paulo plantations until after 1990. Fiscal-incentive plantings have a lesser role in projected yields than is the case for eucalyptus.

Comparison of Projected Yields of Small Timber
Products With Consumption Levels

Projected small timber yields from all plantations are compared with current consumption levels in São Paulo State in Table 13. This is the most favorable scenario to devise, since the 1980 level of consumption is held constant through the period 1980-90. Even on this basis, substantial deficits are apparent from 1985 to 1990. Deficits are most apparent in the important consuming regions--Vale do Paraíba, Campinas, and São Paulo.

The actual situation that will develop will probably be much more unfavorable than that illustrated. The estimate of the 1980 consumption level of 12.2 million cubic meters is based on an industry and government agency consensus that pulpwood and particleboard consumption will be 8.1 million cubic meters (up slightly from 1978) and that fuelwood consumption will hold at 4.1 million cubic meters (19). It would be much more realistic to assume that small timber consumption will expand throughout the period 1980-90. Pulpwood and particleboard consumption can be expected to increase as new plants are established or the capacity of existing plants is expanded. The shortage of alternate fuels in Brazil also suggests increasing pressure to expand fuelwood consumption.



Table 13.--Projected yields of small timber products from plantations of all species, 1980-90, compared with current consumption (in million cubic meters).

Year	Projected Yields	Consumption ^a	Net Balance
1980	14.2	12.2	2.0
1981	13.0	12.2	.8
1982	11.5	12.2	- .7
1983	9.7	12.2	-2.5
1984	13.3	12.2	1.1
1985	11.6	12.2	- .6
1986	10.6	12.2	-1.6
1987	9.5	12.2	-2.7
1988	9.9	12.2	-2.3
1989	11.1	12.2	-1.1
1990	10.0	12.2	-2.2
Total	124.4		-9.8

^a1980 consumption held constant through 1980-90.

No attempt was made to project pine sawlog yields with consumption, since the formal market for pine sawlogs in São Paulo State is not significant. Sawlogs of many species are currently imported from such states as Bahia, Espírito Santo, Goiás, Mato Grosso, and Paraná (10). As pine sawlog output from São Paulo's plantations increases, it can be surmised that the local sawmill industry will take the opportunity to produce softwood lumber from locally produced stumpage.



CHAPTER VII

FINANCIAL ANALYSIS OF PLANTATION INVESTMENTS

Since 1967, the federal government has subsidized reforestation in São Paulo through fiscal incentives in the amount of 1.9 billion cruzeiros. (See Appendix Tables A9 and A10 for details.)

The timber output that will result from fiscal-incentive plantations will aggregate 166 million cubic meters of small roundwood products and 42 million cubic meters of sawlogs. Stumpage value of this yield, calculated at 1978 prices, is more than 24 billion cruzeiros.¹

Procedure

Many economic parameters have been suggested and used to analyze long-term investment profitability (24, 26, 35). This researcher selected internal rate of return (IRR)² as the measure of investment profitability in reforestation investments.

The analysis was focused on direct costs and revenues. Average costs per hectare were calculated for each planting year. (See

¹ Stumpage prices were assumed as follows: eucalyptus, CR \$60 per cubic meter; pines from three successive thinnings, CR \$125, CR \$200, and CR \$275 per cubic meter; pine sawlogs at final harvest, CR \$380 per cubic meter.

² Internal rate of return was defined as that rate of interest or discounting the future that equates the sums of all costs and returns from a particular investment.



Appendix Tables A12 and A13 for details.) Average revenues per hectare were calculated for each year of anticipated revenues. All costs and prices were adjusted to 1978 values to eliminate the effect of inflation. A computer program was used to calculate IRR's.

Three cases were delineated for analysis. Case 1 assumes no cost for land. Case 2 considers land cost on the basis of a conservative rental value (6 percent of market price was assumed). Case 3 considers the opportunity cost of land to be equal to the rate earned by the forestry enterprise.

For each case, three other alternative assumptions about costs were made: Alternative 1 considers all costs borne by both government and private investors; Alternative 2 considers only the costs borne by private investors; Alternative 3 is similar to Alternative 1 except that the government costs (limited to the first four years of each planting project) were reduced 50 percent.

Alternative 1 is intended to evaluate the financial performance of all monetary resources invested in reforestation in São Paulo. Alternative 2 evaluates financial performance solely from the investors' viewpoint. Alternative 3 is an examination of profitability under the assumption that government limited its incentives to the minimum level needed to achieve the planting results obtained.

Several studies (4, 12) have called attention to the presumption that reforestation costs paid by government exceed actual planting costs. One of these researchers stated:

It is possible to double the area planted annually with the same amount of money from the fiscal incentive system. In doing this, we are maximizing the realized investments with



public funds, and, at the same time doubling the social benefits of this activity (11, p. 29).

This conclusion was reinforced by the cost data obtained in this study from reforestation companies and primary timber industries, which indicated that investors with projects approved by IBDF in 1978 had actual costs 46 percent lower than those allowed by IBDF.

Results

Table 14 summarizes the internal rates of return obtained from the three alternative assumptions under each of the three cases analyzed.

Table 14.--Internal rates of return from plantations established under incentives in São Paulo State.

Cases and Alternatives ^a	Eucalyptus Plantations	Pine Plantations	All Plantations
<u>Case 1</u>			
Alternative 1	2.8	8.8	7.4
Alternative 2	663.1	104.4	405.2
Alternative 3	12.4	12.6	12.6
<u>Case 2</u>			
Alternative 1	1.1	8.2	6.6
Alternative 2	71.1	30.6	54.8
Alternative 3	10.1	11.8	11.4
<u>Case 3</u>			
Alternative 1	2.2	8.1	6.6
Alternative 2	27.1	18.9	22.1
Alternative 3	8.7	11.1	10.4

^aAssumptions underlying each of the three cases and the three alternatives under each case are explained in the text.



To judge the adequacy of different internal rates of return on reforestation investments, Beattie and Ferreira (5) suggested the following: An IRR greater than 15 percent is excellent; an IRR between 8 and 15 percent is good; an IRR of less than 8 percent is unacceptable. These appear to be reasonable assumptions.

Case 1, in which land costs are ignored, predictably results in the highest rates of return. Under Alternative 2 in Case 1, which examines only the private investors' costs, IRR is astoundingly high. Under Alternative 3, which includes all private investors' costs but reduces government costs to a level assumed to be sufficient to accomplish the extent of reforestation achieved, IRR is above 12 percent for both eucalyptus and pine projects. Alternative 1, which recognizes all costs to government and private investors, shows lower returns.

Case 2, which considers land cost to be 6 percent of land market price, and Case 3, which puts land cost at the IRR earned by the forestry enterprise, show mixed results depending on which alternative cost assumptions and tree species are examined.

If the focus is placed on alternatives, Alternative 2 (which considers only private investors' costs) shows excellent results regardless of case assumptions about land costs. IRR can be judged excellent regardless of tree species, but eucalyptus is seen to be the more profitable species. Apparently, investors have recognized this because they have reforested a much larger area with eucalyptus than with pine.



Alternative 1 (which includes actual government costs as well as investors' costs) does not indicate a high degree of profitability in pine plantations, and offers a clearly unacceptable rate of return in eucalyptus plantations. The results are influenced very little by different assumptions about land costs. The federal government may have invested far more than it needed to in order to achieve the degree of reforestation attained. This is suggested by Alternative 3, which indicates good internal rates of return under all land-cost assumptions for both eucalyptus and pine plantations.



CHAPTER VIII

SECONDARY BENEFITS OF FISCAL INCENTIVES
FOR REFORESTATION

Aside from the direct effect of fiscal incentives in augmenting the timber resource of São Paulo, a number of major social effects deserve discussion.

Employment Opportunities and Income Distribution

The reforestation program has provided employment and additional income in rural areas with limited employment opportunities. IBDF files indicated that plantation establishment and maintenance for the first four years of the plantation rotation required 0.25 man-years of labor per hectare. (Labor requirements are detailed in Appendix Table A14.) The labor requirement in subsequent years of the rotation averaged 0.002 man-years per hectare per year (8). In total, fiscal-incentive plantations provided 148,000 man-years of employment between 1967 and 1978 (Table 15).

Reforestation provided some CR \$600 million in wages during the 1967-78 period. As Alvarenga (2) pointed out, "the capital applied in reforestation has come from economic sectors other than agriculture." A condition of employment under fiscal incentives has been the requirement of minimum wages and the inclusion of some social benefits. These are important provisions for employment in



the low-income areas in which reforestation projects have been concentrated (2).

Table 15.--Man-years of employment and wages generated by the reforestation program in São Paulo, 1967-78 (man-years in thousands; wages in millions of cruzeiros).

Year	Man-Years of Employment	Wages Generated
1967	8.2	11.1
1968	12.0	18.3
1969	15.3	32.1
1970	16.5	51.8
1971	23.3	78.8
1972	21.1	83.4
1973	16.5	72.1
1974	13.1	65.9
1975	9.7	62.3
1976	7.2	62.3
1977	3.4	39.5
1978	2.3	31.4
Total	148.6	609.0

Source: Appendix Tables A1, A2, and A14.

Reforestation has provided a job market for professional foresters throughout Brazil as well as in São Paulo. In 1965, there were only 25 persons working as foresters in Brazil (4); that population is now about 1,000 (33), with some 400 located in São Paulo. The majority of foresters in São Paulo are employed by primary timber industry and reforestation companies.



Regional Development

Forestry and related processing industries contribute to a regional economy in a number of ways. People are employed, local materials and services are purchased, taxes are paid, infrastructure is developed, and products are provided (21). Several researchers have noted the role of fiscal incentives in promoting regional development (21, 23, 36). A specific reference to reforestation in São Paulo stated:

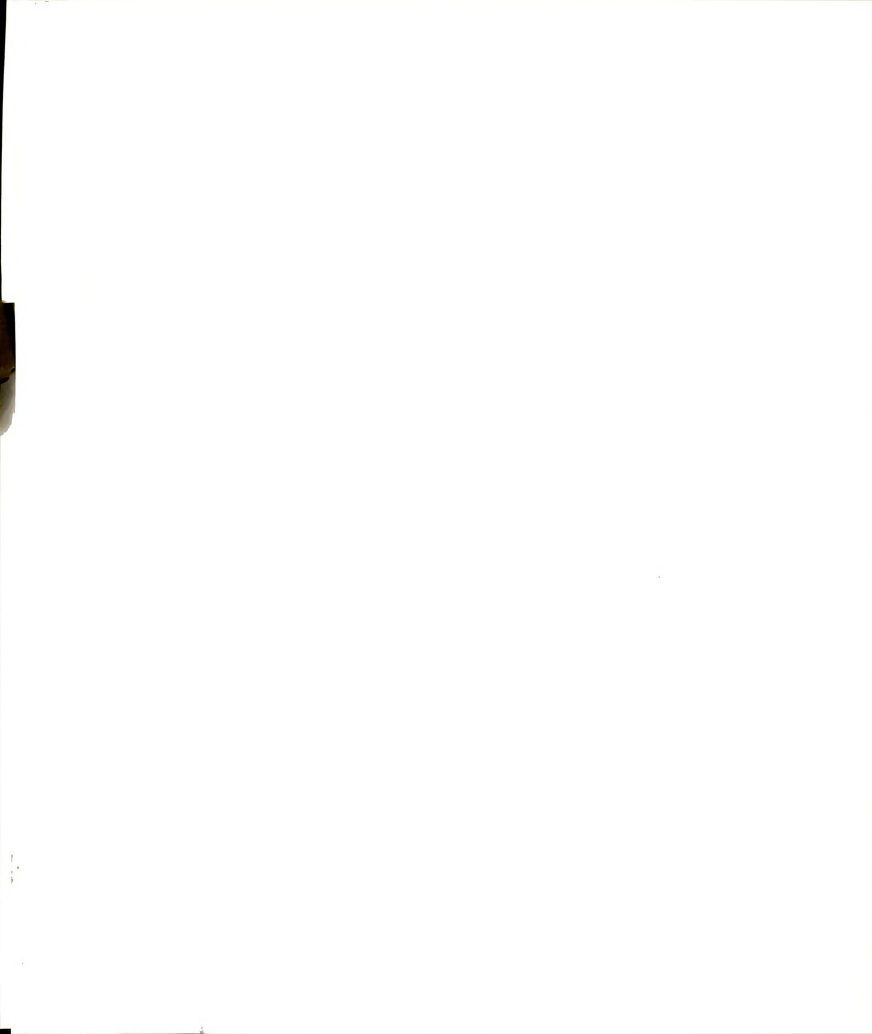
In the southern part of the state, municipalities like Buri developed due to the reforestation program. Abandoned agricultural lands were occupied again and rural families have improved their social conditions of living, food and welfare. The same process has occurred in other municipalities like Jacupiranga and Boituva (36, p. 13).

Industrial growth has also been favorably affected by reforestation. The increase in the pulp and paper sector (16 percent per year between 1967 and 1977) cannot be attributed entirely to reforestation, but it is clear that the establishment of tree plantations has been a great incentive to the expansion of the pulp and paper industry. The sawmill industry has not yet been significantly affected, but there is a strong likelihood that this industry will expand markedly when plantations can produce large volumes of sawlog-size logs.

Foreign Trade and Earnings

Reforestation has the potential of generating significant amounts of combined foreign exchange savings and earnings (4, 5, 8).

The wood products originated from reforestation can be used to satisfy domestic demand or they can be exported. In the first case, it can be assumed that they (wood products) will



substitute for imported forest products, and they can be evaluated in terms of foreign trade savings based on CIF prices. In the second case, FOB prices can be used to estimate potential earnings if the production is exported (5, p. 84).

If all small roundwood timber from São Paulo's plantations is used for pulpwood production, earnings from existing plantations will aggregate about U.S. \$6.6 billion.¹ This amount represents 28 times the value of all Brazilian forest product exports in 1977 and 59 percent of all Brazilian exports in the same year.

¹Based on the assumption that five cubic meters of small roundwood will produce one ton of pulp valued at an FOB price of U.S. \$200 per ton.



CHAPTER IX

SUMMARY AND CONCLUSION

This analysis of Brazil's reforestation program focused on the state of São Paulo. São Paulo is a logical study area because it typifies the central forestry problem of Brazil. Its natural forests have been largely depleted, it is a center of timber-products manufacturing, and it is a major timber-products market area.

São Paulo has a land area of 24.8 million hectares and a 1970 population of 17.7 million (19 percent of the national total); the state accounts for 18 percent of the national domestic product in the agricultural sector, 44 percent in the industrial sector, and 34 percent in service industries.

Timber industries are important in São Paulo. Eleven pulp mills account for about half of Brazil's pulp production. Two fiberboard mills account for nearly all of Brazil's fiberboard production, and three particleboard mills represent 20 percent of national production. Although the lumber industry is represented by 675 sawmills, many of these mills have limited output; most lumber marketed in São Paulo is imported from other regions.

Natural forests in São Paulo have largely disappeared, a process that has also occurred throughout the more highly developed states of Brazil in the South and Southeast regions. The problem



presented--how to sustain or expand timber industries in the principal timber market areas in the face of shrinking timber resources--was selected by the government of Brazil as one of the major national problems to be addressed by the fiscal incentive program adopted in 1966.

Fiscal Incentives and Reforestation

Reforestation was under way in São Paulo before fiscal incentives became available in 1966. However, in the 11 years preceding 1967, only 273,000 hectares were planted; in the 12 years following 1966, some 594,000 hectares were planted. The rate of planting doubled, suggesting the strong influence of fiscal incentive legislation.

The influence of fiscal incentives is seen more readily in the record of annual plantings. Area planted increased rapidly and consistently throughout the period 1967-71, when tax incentives were greatest. After 1971, annual planting plunged downward as the successive changes that decreased taxpayer benefits occurred. The last legislative change (August 1976), which stopped the decline in incentive payments at the effective rate of 17.5 percent, slowed the rate of decline in reforestation but did not arrest the decline completely.

Not all of the decline in area planted after 1971 can be ascribed to changes in fiscal incentives. Other factors, especially land prices, are undoubtedly involved. Real land prices, probably affected in part by the boom in reforestation, increased more than



400 percent from 1969 to 1976. It is reasonable to assume that the sharp rises in land prices have discouraged some investors from investing in forest plantations. Whether land is purchased outright or leased, land cost is a cost to the investor. Under the fiscal incentives program, land cost is not deductible from income tax payments.

The Fiscal Incentive Law for reforestation, adopted in 1966, offered tax incentives to individuals or corporations that would establish forest plantations. Reductions in tax bills were offered, to cover plantation establishment and maintenance costs for three subsequent years. Corporations could deduct plantation costs from income taxes due, up to 50 percent of the taxes due. Individuals could reduce their gross incomes on which taxes were based, up to 50 percent of the gross income. Subsequent changes in the law reduced the effective tax incentives by introducing mandatory allocations of fiscal incentive funds to national development programs and by scaling down the percentages allowed. In São Paulo, current tax incentives for reforestation permit corporations to reduce income taxes due, up to 17.5 percent of the taxes due; individuals can reduce gross incomes on their tax returns by up to 20 percent of gross income.

Location and Ownership of Plantations

Most plantations are still accessible to the primary timber industries located in the agricultural regions of Campinas, São Paulo, and Vale do Paraíba, but more recent plantation establishment is occurring farther from the industrial centers. Sorocaba has emerged



as the principal location of new plantations, both eucalyptus and pine. It now contains 38 percent of all forest plantations. Since Sorocaba is one of the less-developed agricultural regions of the state, where land costs are comparatively low and there is an abundant supply of unskilled labor, it can be surmised that plantation establishment is moving to areas that can offer lower land and labor costs.

Ownership of forest plantations reflects the influence of fiscal incentives. Some 423,000 hectares of plantations under fiscal incentives are held by a miscellany of private owners (not including the roughly 200,000 hectares held by the primary timber industry). A breakdown of the private ownership indicates that 67 percent of the area is held by corporations and another 14 percent is held jointly by corporations and individuals. The fact that corporate ownership is dominant is not surprising because fiscal incentives have been biased to favor corporations over individuals.

Projected Timber Yields From Plantations

Plantation yields in timber products were projected, by years, through the period 1980-90. Projected yields for the period 1980-85 will depend on existing plantations. Yields after 1985 will depend on plantations yet to be established; for this calculation, it was assumed that the 1978 rate of planting would continue unchanged for at least the next five years.

The projection for eucalyptus plantations indicates a total yield of 103 million cubic meters, with annual yields following a

slightly declining trend line. Eighty-eight percent of the total yield will come from plantations under fiscal incentives. The pine projection indicates a total yield of 21 million cubic meters in small timber products, with annual yields following a flat trend line, and 20 million cubic meters in sawlog products, with annual yields projecting upward until 1988, after which a downturn occurs. The large increase in pine sawlog yields will occur sometime after 1990. Fiscal incentives play a lesser role in projections of pine yields than for eucalyptus. Seventy-eight percent of the total pine yield in small products and 48 percent in sawlog products will come from plantations under fiscal incentives.

Although fiscal incentives have played a considerable role in expanding the extent of reforestation, it would be highly conjectural to indicate the extent of reforestation (and the projections of timber yields) that would have occurred in the absence of fiscal incentives. Projected yields without fiscal incentives might have been less than half of the projected yields under the fiscal incentive program. This supposition and similar ones reflect a critically important role of fiscal incentives in stimulating wood production in São Paulo--an important market area with timber-manufacturing industry and an inadequate timber raw-material base.

If the projected timber yields from São Paulo plantations are compared with current timber consumption levels, a deficit of some 10 million cubic meters in small timber products during the period 1980-90 becomes apparent. An annual balance between projected yield and consumption holds roughly until 1984, after which a



negative annual deficit of two million cubic meters will occur.

If a timber supply were available in São Paulo, it would be reasonable to expect that roundwood consumption would increase beyond present levels during 1980-90. Government hopes for self-sufficiency in timber products have not been achieved in São Paulo, but without fiscal incentives the outlook would be much more unfavorable than it is.

Financial Analysis of Plantation Investments

Financial incentives have been highly profitable to investors. Analysis of plantation investments indicates high internal rates of return to investors under the three assumptions of land costs considered. Even under the most costly assumption about land, where the opportunity cost of land is considered to be equal to the rate earned by the forestry enterprise, internal rates of return to investors have averaged 22 percent. The return has been higher for eucalyptus than for pine plantations. Investors have recognized this since they have reforested a much larger area with eucalyptus than with pine.

If total costs are considered under fiscal incentives (actual costs to government plus investors' costs), internal rate of return is at least 8 percent in pine plantations but is unacceptably low in eucalyptus plantations. The results are influenced only slightly by different assumptions about land costs.

An alternative assumption about costs, which includes all private investors' costs but reduces government costs to 50 percent



of actual government costs, indicates that internal rate of return would be satisfactory for both pine and eucalyptus plantations and for all three assumptions about land costs. Even under the most costly assumption about land (where the opportunity cost of land is considered to be equal to the rate earned by the forestry enterprise), the internal rate of return is calculated at 11.1 percent in pine plantations and 8.7 percent in eucalyptus plantations. This suggests that the federal government may have invested far more than it needed to in order to achieve the degree of reforestation attained. However, the latter conclusion needs to be tempered by recognizing the fact that the rate of reforestation has declined as fiscal incentives have been decreased.

Benefits of the Reforestation Program

The fiscal incentives program in São Paulo has provided lucrative investment opportunities to many investors. The resultant reforestation will contribute substantially to the anticipated yield of 166 million cubic meters of small roundwood products and 42 million cubic meters of sawlogs during the period 1980-90. The projected yield, when compared with current levels of timber consumption, indicates that a shortfall in supply will occur after 1984. It is evident that fiscal incentives have met a critical need to augment timber resources in São Paulo.

The reforestation program under fiscal incentives has provided employment and additional income in rural areas with limited employment opportunities. An estimated 148,000 man-years of employment



were provided between 1967 and 1978. Wages amounted to CR \$600 million during that period.

Reforestation has provided a job market for professional foresters throughout Brazil. In 1965 there were only 25 "foresters" in Brazil; the population is now about 1,000, with some 400 located in São Paulo. The creation of a substantial professional group to deal with forestry development may offer opportunities to the country that go well beyond the reforestation program.

Reforestation has not only resulted in direct employment and wages, but through multiplier effects it has contributed to the regional economy. Forestry industrial growth has also been favorably affected. Growth in the pulp and paper sector--16 percent per year between 1967 and 1968--is linked to the reforestation program. The sawmill industry has not yet been significantly affected, but there is a strong likelihood that this industry will expand markedly when plantations reach the stage where they can produce large volumes of sawlog-size logs.

Reforestation has the potential of generating significant amounts of combined foreign exchange savings and earnings. If all small roundwood from São Paulo's plantations is used for pulpwood production, the value of the pulpwood alone will aggregate about U.S. \$6.6 billion. This is 28 times the value of all Brazilian forest products exports in 1977.



APPENDIX



Table A1.--Estimated area of eucalyptus plantations established in São Paulo, by agricultural region, 1956-78
(in thousand hectares).

Year	Araçatuba	Bauru	Campinas	Marília	Presidente Prudente	Ribeirão Preto	São José do Rio Preto	São Paulo	Sorocaba	Vale do Paraíba	Total ^b
1956	a	.8	5.4	.8	.1	1.9	.5	3.9	3.2	.7	17.4
1957	a	.8	5.4	.8	.1	1.9	.5	3.9	3.2	.7	17.4
1958	a	.8	5.4	.8	.1	1.9	.5	3.9	3.2	.7	17.4
1959	a	.8	5.4	.8	.1	1.9	.5	3.9	3.2	.7	17.4
1960	a	.8	5.4	.8	.1	1.9	.5	3.9	3.2	.7	17.4
1961	.1	.9	6.5	.9	.1	2.4	.6	4.6	3.9	.8	20.8
1962	.1	.9	6.5	.9	.1	2.4	.6	4.6	3.9	.8	20.8
1963	.3	.3	8.8	.3	.3	3.6	.8	6.3	5.5	1.4	27.6
1964	.2	.2	7.3	.2	.2	3.0	.7	5.3	4.6	1.1	22.9
1965	a	a	2.7	a	a	1.1	.2	1.9	1.7	.4	8.4
1966	.3	.3	9.1	.3	.3	3.7	.9	6.6	5.7	1.4	28.6
1967	.5	.5	3.1	a	.5	.6	.5	3.8	9.5	1.2	18.8
1968	a	1.2	3.9	.1	.1	1.6	.5	2.5	11.0	1.8	22.4
1969	.5	2.3	4.2	.2	.5	3.8	.3	2.1	7.3	2.5	22.8
1970	a	3.5	3.7	a	.5	5.3	.5	.7	15.8	4.5	33.7
1971	.5	15.3	7.5	.1	a	9.3	.5	2.0	25.7	5.0	65.1
1972	.5	8.8	6.9	.1	2.3	16.2	.5	1.8	22.1	7.6	65.9
1973	.4	4.1	6.4	.5	.5	14.8	.5	.9	21.3	3.2	51.8
1974	.5	.7	5.7	a	.5	8.4	.5	2.0	17.2	6.4	40.7
1975	a	5.5	3.3	.7	.5	5.2	.5	4.0	10.3	2.2	31.4
1976	.5	2.8	1.3	.2	.5	6.0	.5	.2	7.6	3.1	21.2
1977	.5	4.2	a	.5	.5	4.6	.5	.5	4.1	1.1	14.1
1978	.5	.4	1.0	.5	.5	2.6	.5	.5	6.2	.5	10.3
Total ^b	2.1	56.3	114.9	8.9	4.2	104.3	6.5	68.9	199.7	48.5	614.3

Source: Derived from a number of published sources (9, 12, 15, 31, 32, 40) and IBDF files.

^aLess than 100 hectares.

^bTotals may not add due to rounding.



Table A2.--Estimated area of pine plantations established in São Paulo, by agricultural region, 1956-78 (in thousand hectares).

Year	Araçatuba	Bauru	Campinas	Marília	Presidente Prudente	Ribeirão Preto	São José do Rio Preto	São Paulo	Sorocaba	Vale do Paraíba	Total ^b
1956	a	a	.4	a	a	.1	a	.3	.2	a	1.2
1957	a	a	.4	a	a	.1	a	.3	.2	a	1.2
1958	a	a	.4	a	a	.1	a	.3	.2	a	1.2
1959	a	a	.4	a	a	.1	a	.3	.2	a	1.2
1960	a	a	.4	a	a	.1	a	.3	.2	a	1.2
1961	a	.2	1.4	.2	a	.5	.1	1.0	.8	.2	4.4
1962	a	.2	1.4	.2	a	.5	.1	1.0	.8	.2	4.4
1963	a	.2	1.9	1.3	a	1.2	.4	2.9	4.7	.5	13.3
1964	a	.2	2.0	1.4	a	1.2	.4	3.1	4.9	.6	14.0
1965	a	.1	1.2	.8	a	.7	.2	1.8	2.9	.3	8.2
1966	a	.1	1.0	.7	a	.5	.2	1.5	2.3	.3	6.7
1967	..	1.0	1.0	a	.2	1.0	..	.9	12.3	.2	16.8
1968	..	5.8	.7	a	..	.8	..	2.5	14.1	.1	24.1
1969	.1	4.3	.3	.7	3.9	2.3	a	9.0	16.3	.6	37.6
1970	.7	4.1	.1	.4	.2	.4	..	6.5	17.5	.3	30.2
1971	..	3.5	.1	.6	.4	a	..	3.2	18.5	.4	26.8
1972	..	1.8	a	a	1.8	a	..	3.2	9.9	.2	17.0
1973	..	3.7	..	.2	..	.1	..	2.0	7.0	.5	13.6
1974	..	1.2	a	.6	..	.3	..	2.3	8.2	a	12.6
1975	..	.2	a	a	..	a	..	.1	6.9	.1	7.6
1976	..	a	a	a	..	.1	..	..	7.1	..	7.4
1977	..	..	..	..	..	..	..	..	.3	..	.3
1978	..	..	..	..	..	..	..	..	1.5	..	1.5
Total ^b	1.2	27.1	13.2	7.6	6.9	10.7	1.6	42.4	137.2	4.8	252.7

Source: Derived from a number of published sources (9, 12, 15, 31, 32, 40) and IBDF files.

^aLess than 100 hectares.^bTotals may not add due to rounding.



Table A3.--Estimated area of eucalyptus plantations established in São Paulo by state government agencies, before 1967 and 1967-78 (in thousand hectares).

Year	Bauru	Campinas	Marília	Ribeirão Preto	Sorocaba	Total ^b
Before 1967	5.6	5.8	.9	8.5	3.9	24.7
1967	a	.2	a	.2	.1	.7
1968	a	a	.1	a	a	.3
1969	a	.1	a	.8	a	1.0
1970	..	..	..	a	a	a
1971	..	a	a	.8	a	.9
1972	..	a	a	.2	a	.3
1973	..	a	a	.3	..	.3
1974	..	..	a	.4	..	.4
1975	..	a	a	.3	..	.4
1976	..	a	a	a	..	a
1977	..	..	..	1.0	..	1.0
1978	..	..	..	1.6	1.0	2.6
Total ^b	5.7	6.5	1.2	14.3	5.1	33.0

Source: Derived from several published sources (12, 15, 32).

^aLess than 100 hectares.

^bTotals may not add due to rounding.

Table A4.--Estimated area of pine plantations established in
São Paulo by federal and state government agencies,
before 1967 and 1967-76 (in thousand hectares).

Year	Bauru	Campinas	Marilia	Ribeirão Preto	Sorocaba	Total ^b
Before 1967	.4	3.7	2.5	2.2	8.9	17.7
1967	a	a	a	.4	.6	1.3
1968	a	.1	a	a	.6	.8
1969	a	.2	a	.2	.5	1.0
1970	..	a	a	a	.2	.4
1971	a	a	..	a	.4	.5
1972	..	..	..	a	.1	.1
1973	..	..	a	a	a	.1
1974	..	a	a	a	.1	.1
1975	a	a	a	a	a	.2
1976	a	a	..	a	a	.1
Total ^b	.7	4.4	2.8	3.1	11.6	22.6

Source: Derived from published sources (12, 15, 32) and IBDF files.

^aLess than 100 hectares.

^bTotals may not add due to rounding.



Table A5.--Projected eucalyptus timber production in São Paulo, by agricultural region, 1980-90 (in thousand cubic meters).

Year	Aracatuba	Bauru	Campinas	Marília	Presidente Prudente	Ribeirão Preto	São José do Rio Preto	São Paulo	Sorocaba	Vale do Paraíba	Total ^a
1980	83.1	831.6	1,914.4	170.5	10.5	2,761.9	45.0	913.3	4,875.8	743.1	12,349.3
1981	23.7	276.8	2,071.2	50.2	41.9	1,867.7	66.2	1,108.3	4,476.4	1,388.8	11,371.1
1982	25.5	1,196.1	1,567.3	158.8	18.3	1,498.5	91.2	1,317.9	2,856.3	724.1	9,453.9
1983	12.7	838.6	801.1	51.3	6.7	1,631.9	20.2	257.9	3,007.8	1,020.4	7,648.6
1984	22.9	2,273.7	1,487.5	37.0	23.7	2,007.9	68.6	724.7	3,731.8	806.6	11,184.4
1985	..	1,003.8	1,106.8	22.1	228.7	2,121.0	..	479.9	4,017.7	859.3	9,839.3
1986	45.2	590.0	1,116.2	62.2	15.8	2,055.9	..	298.1	4,059.8	471.2	8,714.5
1987	..	344.0	1,080.0	24.0	..	1,589.9	29.0	374.8	3,359.3	843.8	7,644.8
1988	9.0	917.0	797.5	74.4	..	1,391.5	..	460.6	3,343.5	586.6	7,580.1
1989	..	1,586.6	894.9	35.4	.6	1,796.1	..	176.8	3,866.1	718.4	9,074.8
1990	..	1,207.0	723.4	12.2	183.0	2,204.2	..	141.8	3,231.4	718.1	8,421.1
Total ^a	222.1	11,065.2	13,560.2	698.1	529.2	20,926.5	320.2	6,254.2	40,825.9	8,880.4	103,281.9

^aTotal is may not add due to rounding.



Table A6.--Projected pine production in São Paulo for pulpwood and fuelwood, by agricultural region, 1980-90 (in thousand cubic meters).

Year	Araçatuba	Bauru	Campinas	Marília	Presidente Prudente	Ribeirão Preto	São José do Rio Preto	São Paulo	Sorocaba	Vale do Paraíba	Total ^a
1980	6.9	222.4	99.2	61.9	119.3	113.4	13.9	414.0	773.7	46.5	1,871.3
1981	23.8	162.6	98.6	56.7	8.8	60.0	11.7	341.6	824.8	27.0	1,615.6
1982	2.6	155.7	120.3	69.3	25.5	87.5	13.4	239.8	1,315.5	41.1	2,070.8
1983	2.7	275.7	110.6	50.9	57.4	82.2	14.0	299.7	1,136.7	32.4	2,062.3
1984	7.2	273.0	65.4	61.5	141.8	114.3	11.0	456.8	909.6	49.0	2,089.7
1985	27.3	190.0	51.1	55.7	9.0	46.3	7.3	362.9	996.2	22.3	1,768.2
1986	.8	174.3	90.6	33.0	25.4	61.3	4.2	182.5	1,352.8	30.6	1,955.6
1987	.8	273.6	77.4	8.8	65.8	54.9	4.2	232.8	1,112.4	18.6	1,849.2
1988	7.7	289.4	82.9	78.3	135.0	125.6	14.7	483.1	1,012.9	56.7	2,286.3
1989	27.1	192.6	80.2	82.8	10.0	69.1	13.3	413.0	1,140.1	30.7	2,058.8
1990	1.5	131.4	53.9	50.8	16.5	34.2	7.8	176.8	1,055.9	30.6	1,559.5
Total ^a	108.5	2,341.0	930.2	609.8	614.5	848.7	115.5	3,603.0	11,630.7	385.5	21,187.3

^aTotals may not add due to rounding.

Table A7.---Projected pine production in São Paulo for sawlogs, by agricultural region, 1980-90 (in thousand cubic meters).

Year	Aracatuba	Bauru	Campinas	Marília	Presidente Prudente	Ribeirão Preto	São José do Rio Preto	São Paulo	Sorocaba	Vale do Paraíba	Total ^a
1980	2.6	36.8	82.6	25.3	25.4	47.3	9.2	126.4	178.5	16.7	550.8
1981	6.8	43.6	135.5	29.3	4.4	54.8	13.3	147.3	212.0	21.6	668.7
1982	4.1	54.7	161.9	74.1	11.7	91.1	21.6	209.4	544.2	37.1	1,210.0
1983	4.3	116.9	161.8	72.6	16.2	90.2	22.5	240.6	531.2	37.0	1,293.3
1984	5.2	101.2	117.2	57.5	61.9	88.6	16.2	272.4	452.9	34.5	1,207.6
1985	13.3	82.4	104.1	48.0	6.2	54.9	13.4	220.7	453.7	24.7	1,021.5
1986	3.5	131.8	257.3	44.0	22.8	128.6	18.3	239.4	1,010.9	41.7	1,898.5
1987	3.5	325.8	243.4	31.0	31.3	117.8	18.3	312.3	967.2	37.3	2,087.7
1988	17.9	287.1	312.9	239.2	191.7	284.6	58.3	900.6	1,573.9	117.3	3,983.6
1989	44.5	243.1	319.0	240.8	23.1	208.6	58.4	812.1	1,691.1	101.6	3,742.3
1990	6.6	182.9	192.3	153.6	28.0	115.3	34.2	429.6	1,405.5	71.7	2,619.7
Total ^a	112.6	1,606.1	2,088.7	1,014.8	422.6	1,281.7	283.8	3,910.7	9,021.2	541.3	20,283.7

^aTotals may not add due to rounding.

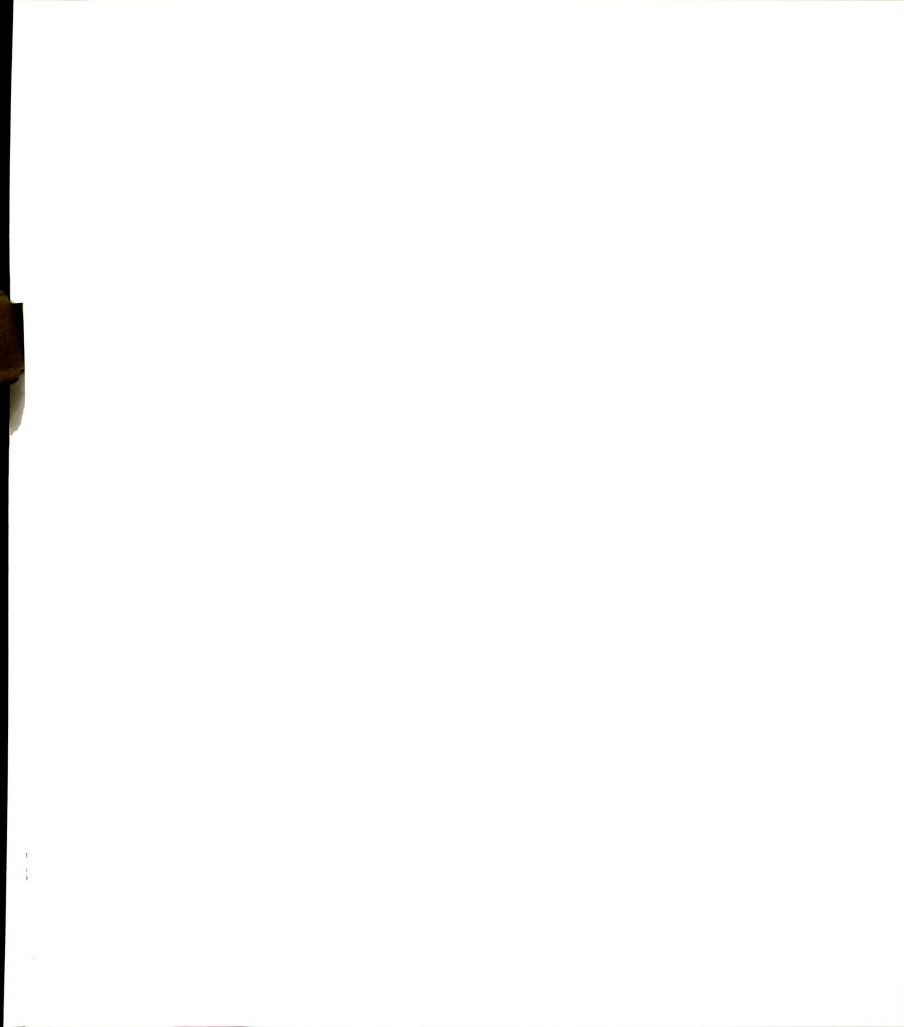


Table A8.--Net balance between projected small-timber production from plantations and current industrial consumption level^a in São Paulo, by agricultural region, 1980-90 (in thousand cubic meters).

Year	Araçatuba	Bauru	Campinas	Marília	Presidente Prudente	Ribeirão Preto	São José do Rio Preto	São Paulo	Sorocaba	Vale do Paraíba	Total ^a
1980	90	814	13	232	130	2,545	59	- 1,257	4,190	- 700	6,116
1981	47	199	170	107	51	1,598	78	- 1,134	3,841	- 74	4,883
1982	28	1,112	- 312	228	44	1,256	104	- 1,026	2,712	- 725	3,421
1983	15	874	-1,088	102	64	1,384	34	- 2,026	2,684	- 437	1,606
1984	30	2,307	- 447	98	165	1,792	30	- 1,402	3,181	- 634	5,170
1985	27	954	- 842	78	238	1,837	7	- 1,741	3,554	- 608	3,504
1986	46	524	- 793	95	41	1,787	4	- 2,103	3,953	- 988	2,566
1987	^b	378	- 843	33	66	1,315	33	- 1,976	3,012	- 628	1,390
1988	17	966	-1,120	153	135	1,187	15	- 1,640	2,896	- 847	1,762
1989	27	1,539	-1,025	118	11	1,535	13	- 1,994	3,546	- 741	3,029
1990	1	1,098	-1,223	63	199	1,908	8	- 2,265	2,827	- 741	1,875
Total	328	10,765	-7,510	1,307	1,144	18,144	435	-18,564	36,396	-7,123	35,322

^aCurrent industrial consumption of 8.1 million cubic meters considered constant through 1990.

^bLess than 1,000 cubic meters.

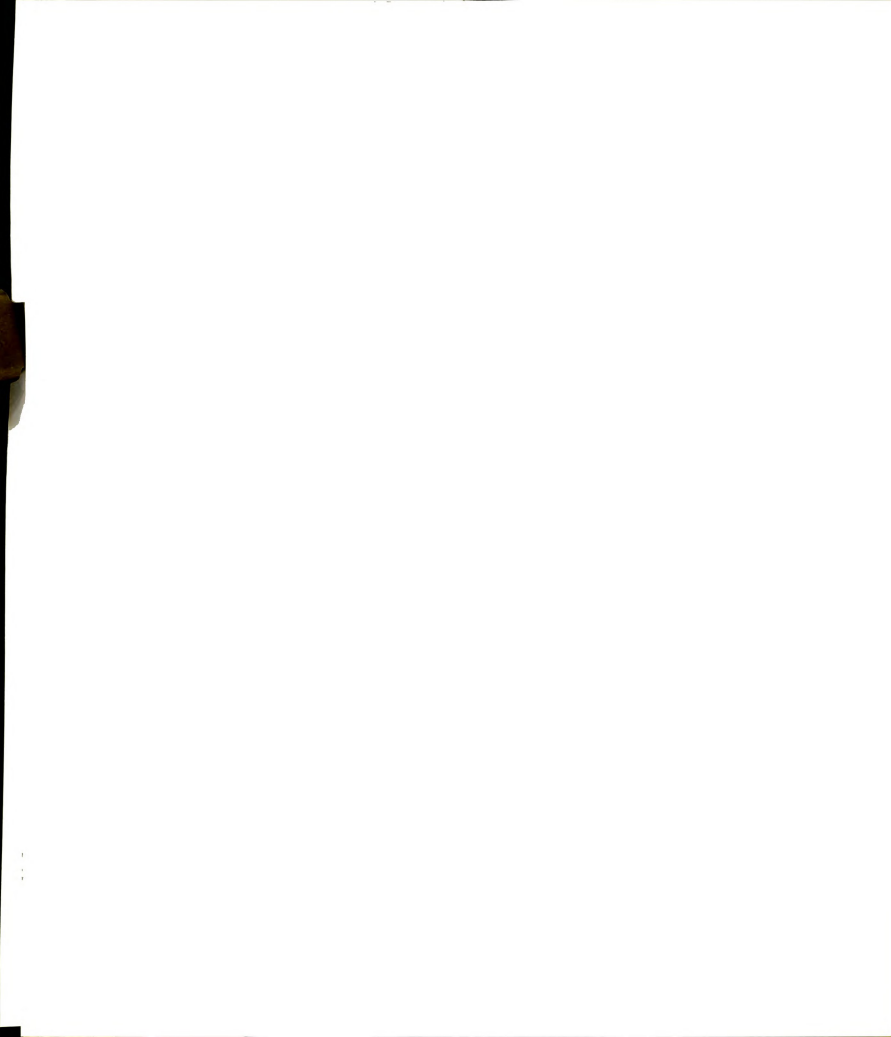


Table A9.--Investments in eucalyptus plantations in São Paulo, by private investors participating in the Fiscal Incentive Law, by agricultural region, 1967-78 (in million cruzeiros).

Year	Aracatuba	Bauru	Campinas	Marília	Presidente Prudente	Ribeirão Preto	São José do Rio Preto	São Paulo	Sorocaba	Vale do Paraíba	Total ^b
1967	..	.5	2.5	..	..	.2	..	3.1	6.1	1.0	13.4
1968	a	1.3	4.6	a	.2	1.7	..	3.0	11.0	2.0	23.9
1969	..	3.7	6.0	.2	..	4.4	.6	2.9	10.6	3.4	31.8
1970	a	6.6	6.4	a	..	9.5	..	1.4	29.0	8.2	61.4
1971	..	33.3	15.4	.3	a	16.5	..	4.2	52.7	10.7	133.1
1972	..	20.4	16.2	.3	5.8	87.1	..	4.2	51.9	18.7	204.8
1973	1.3	12.7	18.0	1.6	..	42.0	..	2.8	57.6	8.9	144.9
1974	..	3.3	26.2	.2	..	40.9	..	9.7	70.3	28.4	179.2
1975	.3	38.3	18.8	4.1	..	31.0	..	26.6	62.3	11.9	193.3
1976	..	24.2	10.0	1.6	..	51.4	..	1.4	54.8	23.7	167.1
1977	..	44.7	.4	..	..	39.8	..	..	38.7	13.4	137.0
1978	..	6.4	14.5	..	..	31.3	..	..	98.6	..	150.8
Total ^b	1.7	195.3	139.3	8.4	6.1	356.1	.6	59.2	543.6	130.5	1,440.8

Source: IBDF files.

^aLess than 100,000 cruzeiros.

^bTotals may not add due to rounding.



Table A10.--Investments in pine plantations in São Paulo, by private investors participating in the Fiscal Incentive Law, by agricultural region, 1967-78 (in million cruzeiros).

Year	Araçatuba	Bauru	Campinas	Marília	Presidente Prudente	Ribeirão Preto	São José do Rio Preto	São Paulo	Sorocaba	Vale do Paraíba	Total ^b
1967	..	1.0	.9	..	.3	.5	..	.9	13.3	.1	17.0
1968	..	6.8	.6	..	..	1.1	..	3.0	16.6	.2	28.3
1969	.2	7.0	.2	.9	6.2	3.0	.1	18.2	23.7	.9	60.3
1970	1.2	7.9	a	.5	.3	.5	..	13.0	29.0	.5	53.0
1971	..	7.6	.3	1.2	.8	a	..	6.6	38.2	.8	56.0
1972	..	4.4	.1	a	4.4	.1	..	7.9	23.7	.5	41.2
1973	..	10.3	..	.6	..	.2	..	5.4	18.9	1.4	36.8
1974	..	4.6	.1	2.2	..	1.0	..	9.0	31.6	a	48.6
1975	..	.5	..	.2	..	..	..	.7	37.9	.8	40.2
1976	..	.4	..	.2	..	.5	..	..	50.6	..	51.7
1977	..	..	..	..	..	..	..	..	3.5	..	3.5
1978	..	..	..	..	..	..	..	..	19.1	..	19.1
Total ^b	1.4	50.5	2.3	5.9	12.1	7.0	.1	64.7	306.2	5.3	455.5

Source: IBDF files.

^aLess than 100,000 cruzeiros

^bTotals may not add due to rounding.

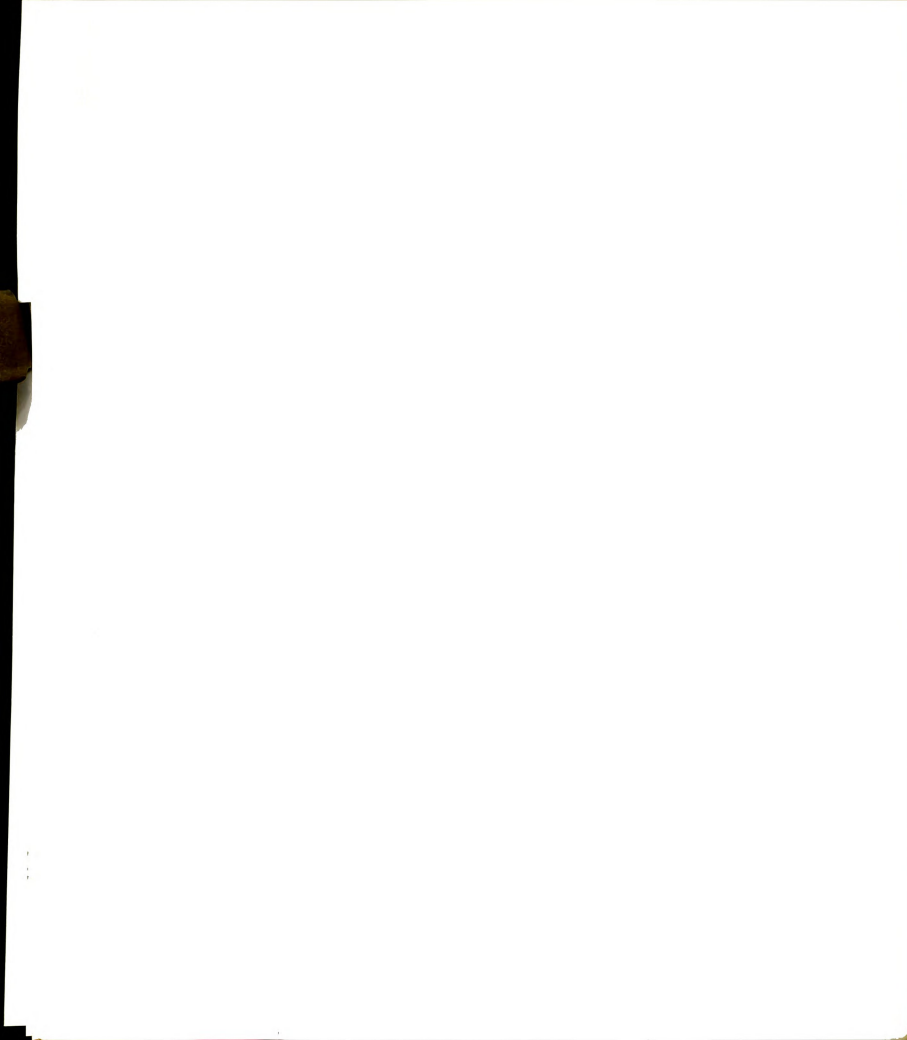


Table A11.--Tree planting in Brazil under the fiscal incentive program, by species, 1967-77
(in thousand hectares).

Year	Pines	Eucalyptus	Araucaria	Native Trees	Fruit Trees	Palms	Other Species	All Species
1967	18	14	1	a	a	..	..	34
1968	61	30	7	2	2	..	a	101
1969	97	54	8	3	1	..	a	163
1970	120	84	12	4	2	a	a	222
1971	98	129	8	4	2	3	4	248
1972	101	172	8	3	9	3	7	304
1973	86	161	7	7	7	22	4	294
1974	83	188	7	4	9	28	4	324
1975	94	223	7	6	7	58	3	398
1976	107	262	5	4	11	73	6	469
1977	99	194	a	a	30	20	a	346
Total ^b	964	1,511	72	38	81	208	29	2,904

Source: IBDF files.

^aLess than 1,000 hectares.

^bTotals may not add due to rounding.

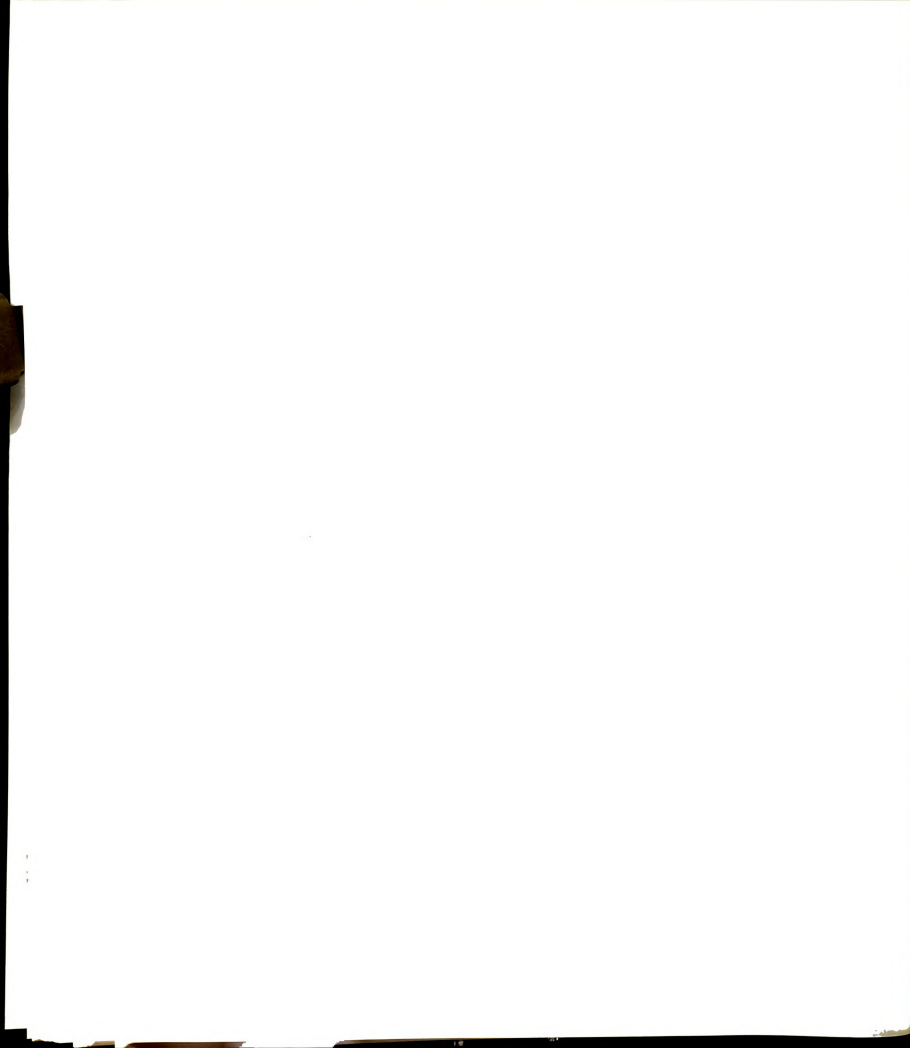


Table A12.--Average costs per hectare for planting and management of eucalyptus plantations established through the fiscal incentive program in São Paulo, 1967-78 (in cruzeiros).

Rotation Year	Year of Plantation Establishment											
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
1	415	596	816	1,315	1,555	2,185	2,027	3,243	4,805	6,002	7,178	14,252
2	178	314	365	275	269	468	394	577	749	948	1,584	2,771
3	89	97	190	146	166	343	282	444	562	711	1,372	1,980
4	59	76	87	91	83	125	113	178	125	237	422	792
Subtotal ^a	741	1,083	1,458	1,827	2,073	3,121	2,816	4,442	6,241	7,898	10,556	19,795
5	22	32	43	54	61	92	83	132	185	234	313	586
6	22	32	43	54	61	92	83	132	185	234	313	586
7	22	32	43	54	61	92	83	132	185	234	313	586
8	68	99	134	168	192	288	260	404	570	723	964	1,813
9	22	32	43	54	61	92	83	132	185	234	313	586
10	22	32	43	54	61	92	83	132	185	234	313	586
11	22	32	43	54	61	92	83	132	185	234	313	586
12	22	32	43	54	61	92	83	132	185	234	313	586
13	22	32	43	54	61	92	83	132	185	234	313	586
14	68	99	134	168	192	288	260	404	570	723	964	1,813
15	22	32	43	54	61	92	83	132	185	234	313	586
16	22	32	43	54	61	92	83	132	185	234	313	586
17	22	32	43	54	61	92	83	132	185	234	313	586
18	22	32	43	54	61	92	83	132	185	234	313	586
Subtotal ^b	400	582	784	984	1,116	1,680	1,516	2,392	3,360	4,254	5,684	10,658
Total	1,141	1,665	2,242	2,811	3,189	4,801	4,332	6,834	9,601	12,152	16,240	30,453

Source: Derived from IBDF files and data furnished by timber industries and reforestation companies.

^aCosts paid by federal government.

^bCosts paid by reforestation program participants.



Table A13.--Average costs per hectare for planting and management of pine plantations established through the fiscal incentive program in São Paulo, 1967-78 (in cruzeiros).

Rotation Year	Year of Plantation Establishment											
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
1	616	669	925	1,283	1,584	1,707	1,971	2,841	4,199	5,405	6,576	9,064
2	264	353	413	267	275	366	383	506	654	854	1,450	1,762
3	132	109	215	143	169	268	274	389	491	640	1,257	1,259
4	88	85	99	89	84	98	109	156	109	213	387	504
Subtotal ^a	1,100	1,216	1,652	1,782	2,112	2,439	2,737	3,892	5,453	7,112	9,670	12,589
Year 5-25 ^b	672	735	1,008	1,092	1,281	1,491	1,680	2,394	3,339	4,368	5,922	7,707
Total	1,772	1,951	2,660	2,874	3,393	3,930	4,417	6,286	8,792	11,480	15,592	20,296

Source: Derived from IBDF files and data furnished by timber industries and reforestation companies.

^aCosts paid by federal government.

^bCosts paid by reforestation program participants.

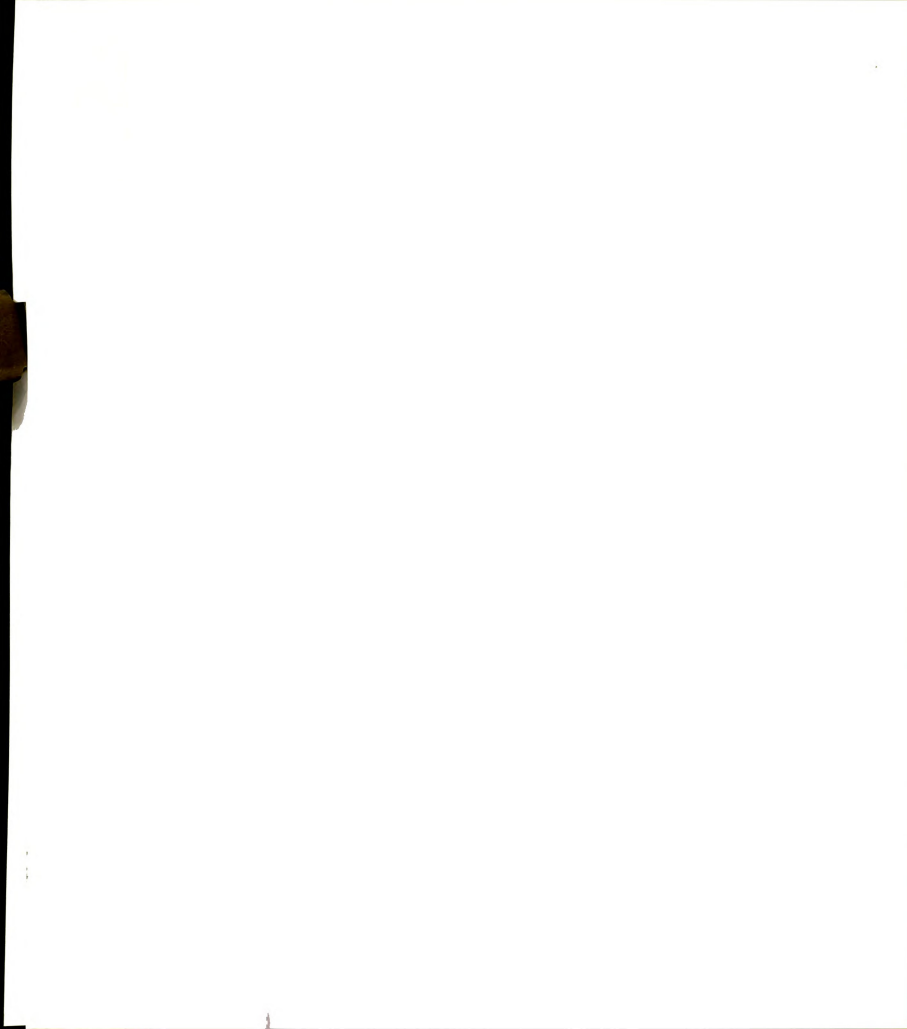


Table A14.--Estimated man-hours of labor per hectare in plantation management under the fiscal incentive program in São Paulo and average hourly wages, 1967-73.

Year	Man-Hours				Average Hourly Wage ^b
	Planting Year	Maintenance Years			
		First	Second	Third	
1967	357	176	99	75	.54
1968	381	184	113	80	.61
1969	351	200	122	94	.84
1970	302	127	62	21	1.26
1971	210	90	57	37	1.35
1972	225	116	99	69	1.58
1973	290	150	111	90	1.75
Average employment per hectare ^a	0.12	0.06	0.04	0.03	

Source: Sample of IBDF approved projects for reforestation.

^aAssumes 2,500 hours of work per year (50 work hours per week and 50 work weeks per year).

^bBecause of change in project format, average wages paid after 1973 are those applying to the agricultural sector (CR\$ 1.98/hour in 1974, CR\$ 2.58 in 1975, CR\$ 3.48 in 1976, CR\$ 4.70 in 1977, and CR\$ 5.46 in 1978).

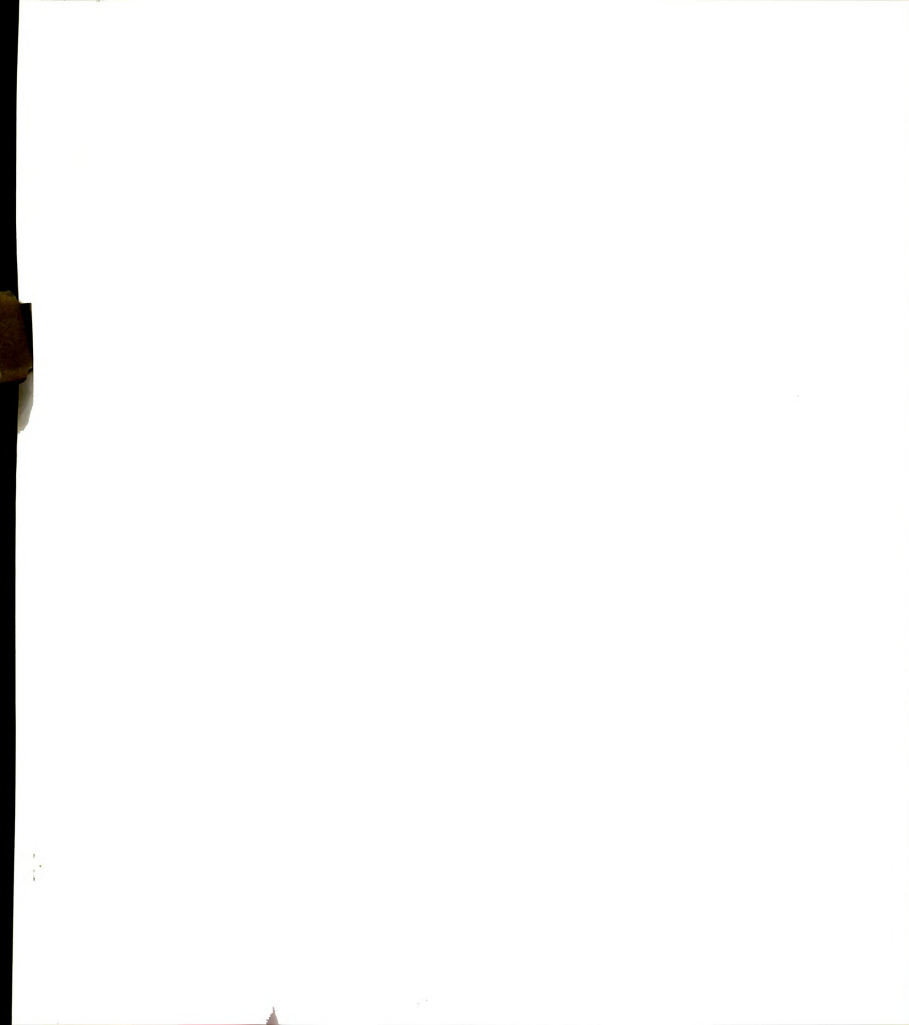
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