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MAN-MADE FORESTS AND PULP/PAPER INDUSTRY IN BRAZIL

by

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CHAPTER I

INTRODUCTION

Statement of Problem

Brazil is a country whose economy has been growing at a high rate for the last five years. Emphasis is being placed upon a more intensive use of national resources with the goal of reaching self-sufficiency for most intermediate and consumer goods. Entering the international export market in order to earn foreign exchange is also an important goal.

The most significant contribution from the forestry sector to the national economy during the last decades has come mainly from the sawmilling industry, which is heavily concentrated in the South, the region of the Parana pine, *Araucaria angustifolia*.

More recently, pulp and paper production has been growing rapidly. Importing pulp from overseas and the use of waste paper has become unfeasible in view of the national goals. As a result, the pulp industry has begun seeking available fiber raw material inside the country. Parana pine, *Eucalyptus spp*. from plantations, and to a certain extent sugar cane bagasse, have been the main raw materials. More recently, pines (*Pinus spp*.) from plantations promise to replace Parana pine,

which is vanishing under intensive exploitation.

Paper production grew from 0.253 million metric tons in 1950 to 1.446 million metric tons in 1972. Per capita consumption of paper was 6.2 kg/year in 1950 and 17.2 kg/year in 1972. The Brazilian economy is growing at a high rate, with 11.3 percent real growth in 1971 and 10.5 percent in 1972. This high growth is expected to continue at rates higher than nine percent per year through the 1970's. As part of economic growth, industries are growing, volume of business transaction is increasing, the education program is being expanded and improved, foreign trade is being intensified, and the national pulp and paper industry is expected to provide most of the paper needed in the economy.

The Brazilian Institute for Forestry Development (IBDF)*, as the national forestry agency, has been aware of the important responsibilities of providing forestry resources to support the demands of the forest industries and the consumers, but has not acted to meet them fully.

In 1966, a law was passed (Law 5106) creating a fiscal incentive program for taxpayers that makes available part of the income tax due (25 percent presently) for use in covering expenditures of establishing forest stands. As a result of this fiscal incentive program in the forestry sector, a large area of forests has been planted both with Eucalyptus spp. and Pinus spp.

*IBDF - Instituto Brasileiro de Desenvolvimento Florestal

In the short-run the man-made forests are primarily resources for the pulp industry, and most are being established with this purpose in mind. However, until now no exact information has been published as to where the forest stands are located, the area planted in the different locations, and their potential wood production. The new forests are scattered in Minas Gerais and in the southern States, particularly in Sao Paulo, Parana, Santa Catarina, Rio Grande do Sul, and also in Espirito Santo.

Considering that consumption of paper is expected to rise continuously, it is deemed necessary to conduct a study of future consumption of pulp and paper and the future production of wood, in order to determine, in terms of volume and economic accessibility, the extent to which existing man-made forests could fulfill the raw material needs of the pulp and paper industry.

Objectives of Study

The main objectives of the present study are:

1. Estimate the future trend of both production and consumption of pulpwood for the next twelve years.
2. Suggest criteria to guide the formulation of a forest policy which IBDF could follow to provide the raw material needs of the pulp industry for this period. This is done under the assumption that the country aims to be self-sufficient in terms of production of pulp and most kinds of paper.

The intermediate results in this study will have some value by themselves because they will provide a basis for further studies and rational planning. The other objectives are the following:

3. Estimate the future trend of paper consumption and pulp production.
4. Ascertain the quantity of raw material that the pulp industry can expect from the man-made forests already planted and from those that can be planted in the 1970's.

Scope of Study

For the evaluation of the physical supply of wood the study includes the following States: Sao Paulo, Parana, Santa Catarina, Rio Grande do Sul, Minas Gerais, and Espirito Santo. In the other States only small plantations have been established; therefore they are not of major importance as a source of raw material from man-made forests.

For the projections of pulp and paper consumption the study considers the whole country as a market unit.

Research Background

The subject of study is chosen in view of the writer's background, interests and research resources. The writer's background consists of his participation as an analyst in the economic study of forest plantations in the Southern States of Sao Paulo, Santa Catarina and Rio Grande do Sul (1), and of visits to pulp/paper mill operations in

(1) Programa Florestal de Sao Paulo, 1969; Zoneamento Economico Florestal do Estado de Santa Catarina, 1970; Zoneamento Economico Florestal do Estado do Rio Grande do Sul, 1971.

Brazil, Chile, USA, Norway, and Sweden, as well as graduate studies in forestry economics. The writer's interest is to work in forestry economics as applied to the pulp and paper industry.

Plan of Work

Figure 1.1 shows the variables of the study and their relationships (simplified).

Procedure

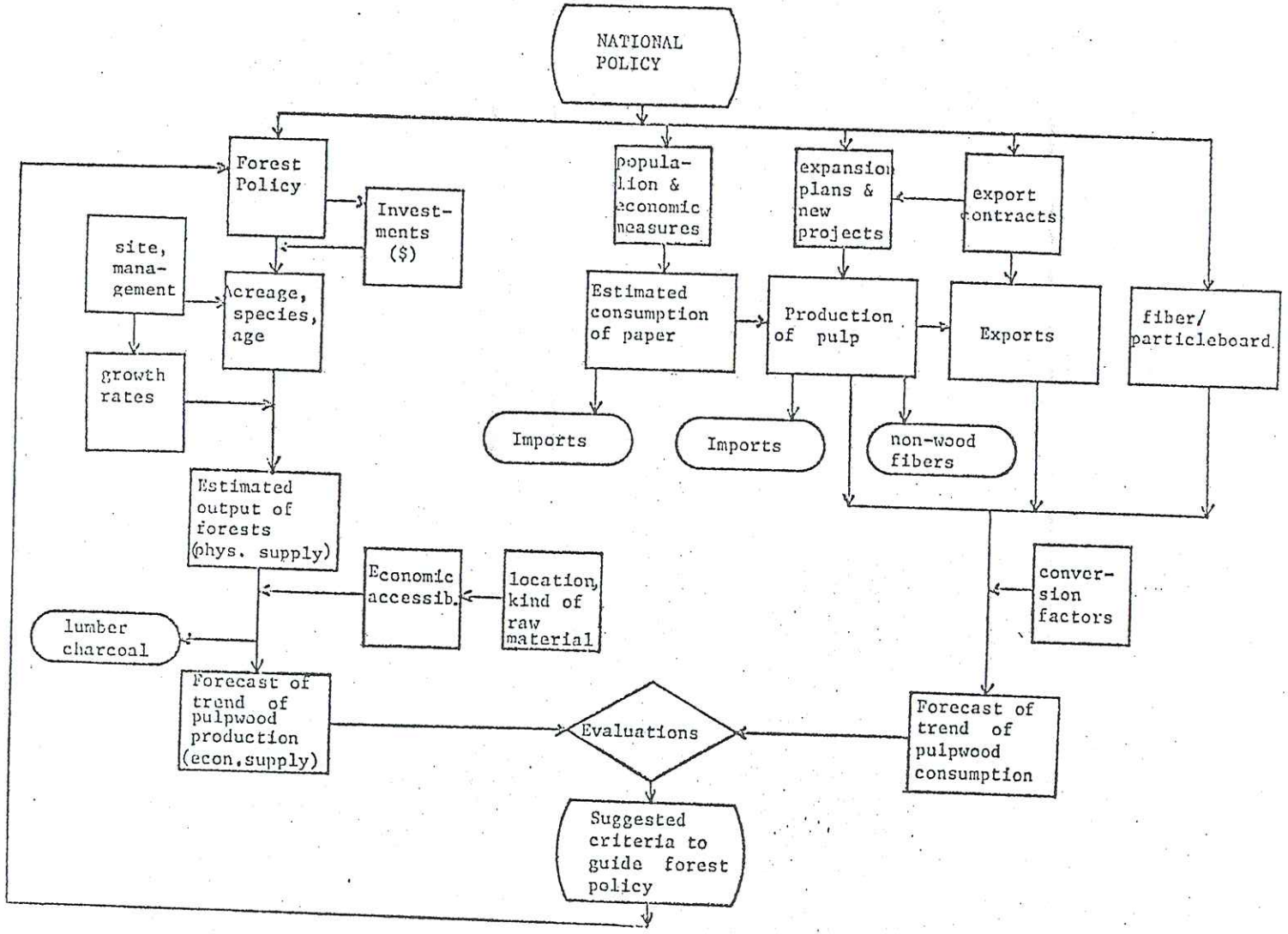
From April 30 to August 5, 1973, field research was carried out in Brazil consisting of data collection from economic, development, planning, statistical, and forestry institutions as well as from the pulp and paper association and individual companies.

The data have been compiled and computed in Syracuse using a CDC-3200 and an IBM-370/155 computer for the calculations through two statistical programs, BMD02R and BMD05R, plus two FORTRAN programs written for this study.

Stepwise and multiple regression were used in the projections of paper consumption. Data on population, gross domestic product (GDP), per capita GDP, and industrial production were used as selected independent variables in order to build the models.

This study is based on the actual economic planning of the country, which anticipates a growth rate of nine percent per year for

Figure 1.1. PLAN OF STUDY



GDP, as expressed in the National Plan for Development (PND)*. For the sake of comparison, projections for paper consumption were also derived for economic growth of seven percent per year.

Information on forest plantations including area, species, growth rates, location of stands, and length of rotation was the basis for forecasting the future physical supply of wood through simulation models.

Pulpwood balances were elaborated by comparing projections of consumption and production of both long and short fiber pulpwood.

Limitations of the Study

Work with the future is work with the unknown. For this reason many limitations are imposed on this study.

1. The projections of paper consumption are based on the projections of certain demographic and economic variables. The economic measures projected are based on the National Plan for Development, which expects the economy to grow at nine percent per year until 1980. It is also assumed, for the purpose of this study, that the same growth will continue through 1985. Deviations from the economic and demographic growth projections would affect the projections of paper consumption obtained in this study.

2. Effects emerging from the present energy crisis have not been included in the present study. The major possible effect could be a slower rate of economic growth. For the sake of comparison, projections

*PND - Plano Nacional de Desenvolvimento 1972/74

of paper consumption have been made for a lower level economic growth of seven percent per year.

3. For the last fifteen years the Brazilian pulp and paper industry has been developing its own technology for pulping Eucalyptus* and for the use of this pulp in the production of different types of paper. This short fiber woodpulp has been replacing the conventional long fiber woodpulp in many products. The projections of long and short fiber pulp requirements carried out in this study are based on present knowledge of the use of such fibers. Consequently, an unexpected change in such uses would affect the findings of the study.

4. The projections herein developed are based on relatively few variables. The Government efforts for improving education, the success of entering the international export market, the increasing use of computers and photo-copying (or reproducing) machines, and increased construction, as well as income distribution and price, are all independent variables whose effects on paper consumption are not individually analysed in this study.

5. Price is not included in the analysis of trends because of the lack of time series information. For the purpose of this study, it is assumed that relative prices will remain constant throughout the period of study.

6. The great deficiency of forestry statistics constitutes a major limitation for any study, especially one with as wide a scope

*In this study, Eucalyptus spp. are referred to as Eucalyptus, Pinus spp., simply as Pinus, and Araucaria angustifolia, as Araucaria or Parana pine; individual species are presented in Chapter II.

as the present one. Tree-planting projects approved by IBDF do not necessarily mean trees planted. However, as justified later, it was assumed for the purpose of this study that from the statistics on IBDF-approved forest plantations 80 percent can be considered as planted.

7. For the evaluation of the future physical supply of wood, States were taken as homogeneous units of study. However, the growth of Pinus and Eucalyptus varies considerably within each State. For example, in Minas Gerais yield per hectare per year for Eucalyptus ranges from 15 to 35 steres(2). A precise study would only be possible if each State were divided into micro-regions of homogeneous growth rates for each particular species.

8. The physical properties of wood vary from species to species, within both the Pinus and the Eucalyptus genera. The variation can be in specific gravity, resin content, lignin content, fiber length, and pulp yield. The variations can affect the conversion factor from pulp production to pulpwood consumption. However, for the purpose of this study, an average conversion factor for Pinus and one for Eucalyptus have been adopted.

9. Each forest owner is interested in managing his stands in a way that meets his highest satisfaction. Therefore, rotation length will vary from stand to stand. For the purpose of this study it has been assumed that Pinus will be subjected to a rotation length of

(2) One 'stere' corresponds to 1 x 1 x 1 meter of stacked wood. The measure has been used throughout this study.

25 years and Eucalyptus, 18 years. According to collected information these rotation lengths are the most common ones to go into practice.

10. This study has not considered the forest resources of the Amazon region although it is recognized they represent a potential resource for the pulp and paper industry.

CHAPTER II

THE EXISTING SITUATION

National Development Policy Goals

Brazil, a developing country, has experienced economic 'ups' and 'downs' throughout history. From a stagnation of economic growth in 1963-65, the rate of growth increased to 9.3 percent in 1968. Since then, the yearly growth rate has ranged from 9.0 to 11.3 percent.

In the National Plan for Development (PND) the Government goal is to double the per capita income from 1969 to 1980. In order to reach this goal, assuming a 2.8 to 2.9 percent per year population growth, the PND established growth rates ranging from eight to ten percent per year for GDP, with an industrial expansion of ten to twelve percent per year(1,2).

The high economic growth rates obtained in the last five years (see Table 2-1) show that the established goals are feasible goals. Since no change is anticipated in the structure of Government, it is assumed that the economy will continue under the present orientation toward the stated goals of economic development and growth.

The present Government has been giving a political and economic

(1) Brazil, "Sintese; Metas e Bases para Acao do Governo", September 1970, pp. 19-20.

(2) Brazil, "Primeiro Plano Nacional de Desenvolvimento(PND)-1972/74", Law no. 5727, November 4, 1971, pp. 13-16.

Table 2-1. --TIME SERIES DATA: POPULATION AND ECONOMIC INDEXES

Year	Population (millions) (a)	Index of real production (GDP) (1949=100) total (b)	annual growth (%)	per capita (b)	annual growth (%)	Index of industrial production (1949=100) total (b)	annual growth (%)
1950	51.97	106.5	6.5	104.0	4.0	111.3	11.4
1951	53.52	112.8	5.9	107.0	2.8	118.4	6.0
1952	55.12	122.6	8.7	112.9	5.6	124.2	5.0
1953	56.77	125.7	2.5	112.4	-0.5	135.1	9.0
1954	58.47	138.4	10.1	120.1	7.0	146.8	9.0
1955	60.22	147.9	6.9	124.6	3.7	162.4	11.0
1956	62.02	152.6	3.2	124.9	0.2	173.6	7.0
1957	63.88	164.9	8.1	131.0	4.9	183.5	5.7
1958	65.79	177.6	7.7	137.0	4.6	213.2	16.2
1959	67.81	187.5	5.6	140.4	2.4	238.5	11.9
1960	70.26	205.7	9.7	149.6	6.6	261.4	9.6
1961	72.29	226.9	10.3	160.4	7.2	289.2	10.6
1962	74.37	238.8	5.2	164.1	2.3	311.8	7.8
1963	76.52	242.5	1.5	161.9	-1.3	312.4	0.2
1964	78.73	249.6	2.9	162.0	0.0	328.5	5.2
1965	81.00	256.4	2.7	161.7	-0.1	313.0	-4.7
1966	83.34	269.5	5.1	165.2	2.2	349.6	11.7
1967	85.74	282.4	4.8	168.3	1.8	360.0	3.0
1968	88.22	308.7	9.3	178.8	6.3	415.8	15.5
1969*	90.76	336.5	9.0	189.4	5.9	460.5	10.8
1970*	93.38	368.5	9.5	201.6	6.4	511.8	11.1
1971*	96.08	410.1	11.3	218.3	8.2	569.1	11.2
1972*	98.85	452.7	10.4	234.0	7.2	647.5	13.8

*preliminary figures

Sources: (a) Fundaçao IBGE, Boletin Demografico CBED, vol.2, no.4, Abril/Junho 1972, by J.Lyra Madeira and C.C.Simoes
Obs.- population as of July 1st of each year.
(b) Centro de Contas Nacionais - DCS-IBRE-Fundaçao Getulio Vargas.

stability to the country that allows industries confidence in planning for the future.

Forest Fiscal Incentive Program

The fiscal incentive program for forest plantations was created by law in 1966, enabling firms to use up to 50 percent of corporate tax owed the federal Government for investments in tree-planting projects. Later on the percentage was set at 35 percent, and is presently at 25 percent for corporations. Individuals may deduct from their gross income the amount applied in forestation or reforestation projects, provided the abatement does not exceed 50 percent of gross revenue.

The Brazilian Institute for Forestry Development (IBDF) is the public agency in charge of this program. In order to make use of the fiscal incentive program the taxpayer must submit the tree-planting project to IBDF. Depending on the feasibility of the project IBDF may or may not approve the investment. However, most of the projects are approved as long as the selected species to be planted are suitable for the area. Climate, soil, rainfall, land ownership, cost per hectare, and planned future use of the wood are considered for the approval of the investment.

The original form of the forest incentive program was modified in 1970(Decree-Law 1134) when it allowed two or more taxpayers to unite to invest in the same tree-planting project. From the forest

development point of view this decree-law provided large benefits that made the concentration of various investments in single and larger plantations possible.

The Federal Government felt that such a program was needed in order to reverse the process of deforestation taking place in the country. However, this was not the only reason for federal Government enactment of this forest program. It was also concerned with(3):

1. Making forestry a new and enduring economic activity.

2. Formation of new forests to supply the volumes of wood as raw material demanded by the growing forest industries, and to pursue the sustained yield of forests.

3. To obtain environmental protection, particularly soil and watershed protection.

The Decree-Law 1134 of 1970 injected a greater dynamism into the program so that by the end of 1972 tree-planting projects represented an investment of US $375 million (current value) for a reforested area of more than one million hectares. The figures made public by IBDF on forest investments as of December 1972 are given in Table 2-2. The figures for total and per hectare investments have been developed and adjusted to 1972 cruzeiro and US dollar value.

As for the future availability of fiscal incentives for tree-planting projects, no clear information was available at the time of the survey. Nevertheless, the program is expected to continue up to

(3) Joaquim F. de Carvalho, personal communication (IBDF President, Rio de Janeiro, July 1973)

Table 2-2. -- TOTAL AREA AND INVESTMENTS UNDER THE FOREST FISCAL INCENTIVE PROGRAM, 1967-1972 (All States)

Year	Area (ha)	Investment		Investement, 1972 values			
		CR$	US$	Cr$	US$	Cr$/ha	US$/ha
		⊢ MILLIONS ⊣		⊢ MILLIONS ⊣			
1967	38,388	30.09	10.52	77.33	13.10	2,014	341.2
1968	165,051	157.27	43.96	325.39	55.16	1,971	334.2
1969	107,076	117.63	29.03	201.50	34.15	1,881	318.9
1970	225,932	365.67	80.12	514.13	87.15	2,275	385.7
1971	267,392	496.57	94.53	583.47	98.90	2,182	369.8
1972	292,875	693.89	117.62	693.89	117.62	2,369	401.6
Total	1,096,714	1,861.12	375.78	2,395.71	406.08	2,184	370.2

Source: IBDF, Department of Economics, January 1973.

Note: General price index and Cr$/US$ ratios from Conjuntura Economica, Fundacao Getulio Vargas, vol. 27, June 1973, p. 174 and p. 142.

a point in time when the main goals will have been partially or totally achieved and the forest development program will be irreversible in terms of continuation by other financial means. Since it is impossible to determine the future rate of reforestation, the present study is assuming that the plantation program will continue until 1980 at the 1972 rates of reforestation.

Forest Plantations

As shown in Table 2-2, 1.09 million hectares have been approved by IBDF to be planted under the fiscal incentive program. However, given the size of the program with stands scattered all over southern

Brazil, the small staff of foresters controlling the projects of IBDF, and the absence of planned management in some plantations as well as the non-implementation of some projects, it is believed that only 80 percent of the total area can be considered as planted and managed for regular production of wood. This 20 percent reduction seems to be quite realistic and is based on information obtained in interviews. In cases of both Pinus and Eucalyptus even the various IBDF regional representatives were unanimous in their agreement that this reduction is necessary to bring the wood supply projections to a more realistic level.

Species

Besides Araucaria angustifolia and Acacia spp., the following main species of Pinus and Eucalyptus account for most of the plantations: P.elliottii, P.taeda, P.caribaea, P.oocarpa, E.saligna, E.grandis, E.tereticornis, E.urophylla (also known as E.alba), E.citriodora, E.propinqua, E.robusta, E.viminalis. Other species being planted under the fiscal incentive program, such as native species and fruit trees, are insignificant in terms of area planted and are not relevant for the purpose of the present study.

Eucalyptus has been planted mostly in the States of Sao Paulo, Minas Gerais, Rio Grande do Sul, and Espirito Santo with smaller plantations in the State of Parana.

Pinus has been planted mostly in the States of Sao Paulo, Parana, and Santa Catarina, with smaller plantations in the States of Rio Grande

do Sul and Minas Gerais.

According to the survey carried out through interviews and the collection of available information, the existing plantations established after 1955 are given in Table 2-3. No significant plantation of Pinus existed before 1956. The plantations of Eucalyptus established earlier than 1956 are excluded because if they were managed with an 18 year rotation, they would already have been subjected to the third and last cut and would be out of production. This theoretical assumption will be discussed later.

Table 2-3. -- AREA OF EXISTING MAN-MADE FORESTS BY STATE AND SPECIES, 1956-1972

(thousand hectares)

State	Pinus	Eucalyptus	Total
Sao Paulo	180	336	516
Parana	176*	13	189
Minas Gerais	27	260	286
Santa Catarina	97	-	97
Rio Grande do Sul	30	17	47
Espirito Santo	-	45	45
Total	510	671	1,181

*20,000 ha Araucaria not included

Source: IBDF, Department of Forest Economics and Regional Offices; Instituto Florestal de Sao Paulo

IBDF also reported that projects for 24,000 ha of Eucalyptus plantations have been approved for Mato Grosso State.

The yearly area of tree-planting projects approved by IBDF

under the fiscal incentive program is presented in Table 2-4, by State.

Table 2-4. -- AREA OF PLANTATIONS APPROVED UNDER THE FISCAL INCENTIVE PROGRAM BY STATE, SPECIES, AND YEAR (thousand hectares)

State/species	Year 1967	1968	1969	1970	1971	1972	Total
Sao Paulo[a]							
Pinus	20	23	24	20	23	20*	130
Eucalyptus	10	22	17	21	54	50*	174
							304
Parana[b]							
Pinus	4	16	25	38	45*	45*	173
Eucalyptus	.7	.5	1	1.4	4*	4*	11.6
							184.6
Minas Gerais[c]							
Pinus	.5	1.3	1.7	6.7	8	8.7	26.9
Eucalyptus	10	12	24	38	42	54	180
							206.9
Santa Catarina[d]							
Pinus	5	13	16	18	20	20*	92
Rio Grande do Sul[e]							
Pinus	2.1	4.2	6.5	6.2	4.7	6.3	30
Eucalyptus		1.2	2.3	4.1	4.4	5.0	17
Acacia					3.8	4.0	7.8
							54.8
Espirito Santo[f]							
Eucalyptus	1	3	5	8	10	18	45

*Preliminary figures

Sources: [a]Instituto Florestal de Sao Paulo
[b]IBDF, Dept. of Forest Economics and Regional Office
[c]IBDF/Comissao de Zoneamento Economico Florestal
[d]IBDF
[e]IBDF Regional Office
[f]IBDF

Sao Paulo State

Sao Paulo is the State with the most reliable forestry data. A comprehensive study of the Eucalyptus and Pinus plantations was published in 1972(4) describing their spatial distribution, production, and consumption of wood. The first experiences in the country regarding man-made forests were obtained in this State, with the introduction of Eucalyptus at the beginning of the century and with introduction of successful plantations of Pinus in the late 1950's. Sao Paulo is also the leader in area planted under the fiscal incentive program. Most of the species of Eucalyptus mentioned previously in this study grow in Sao Paulo. The species of Pinus that have found an ecological habitat are P.elliottii and P.taeda (for temperate climate) and P.caribaea and P.oocarpa (for tropical climate).

According to the study made by the Forest Institute of Sao Paulo(5), by the middle of 1972 there were 580,000 ha planted with Eucalyptus, plus 378.5 million pine trees. This is equivalent to an area of 150,000 to 180,000 ha. As far as Eucalyptus is concerned, the productive stage of plantations, especially of those established in the 1950's and earlier, is very controversial. The plantations established before 1956, with a rotation length of 18 years and under a coppice silvicultural system, should have been subjected to the third and last cut. This, however, is not necessarily true since the last cut could have been delayed. For the purpose of this study, only

(4) M. A. Victor et al., "Evoluçao, Estagio Atual e Perspectivas das Plantaçoes Exoticas em Sao Paulo", Instituto Florestal de Sao Paulo, Boletim no. 1, Sao Paulo, 1972.

(5) ibid.

plantations established after 1955 amounting to 336 thousand hectares are taken into account since it was impossible to gather information referring to previous plantations and their productive stage.

Apart from production of pulp, Eucalyptus has been used for many other purposes: charcoal, utility and fence poles, fuelwood, etc. Only a detailed survey could tell the real area of productive plantations and the end-uses for which they are managed.

Pinus plantations are scattered throughout the State with a dense concentration in the southern region of the State. Many of the plantations located outside this region did not find the proper ecological conditions for regular development; consequently they experience a lower growth rate and must be carefully considered or discounted as far as wood production is concerned. According to a survey carried out by the IBDF regional office(6), by December of 1972 in the southern region of the State the total area planted with Pinus (mainly P.elliottii and P.taeda) was 97,000 ha (see Figure 2-1), with an average growth of 26 steres/ha/year.

Kajiya(7) carried out a forest inventory of 1,400 ha in the Capao Bonito area and found an average growth of 23.7 m3(33.9 steres), bark included, in seven year old plantations of P.elliottii. Bark content accounted for 14.3 percent of the volume of standing trees, resulting in an average increment of 20.3 m3(bark excluded) per hectare per year.

(6) Delegacia IBDF/SP, unpublished statistics of survey on Pinus plantations within a radius of 150 km around Capao Bonito and 100 km around Cerqueira Cesar towns.

(7) Shiguenori Kajiya, Forest inventory of P.elliottii plantations in Capao Bonito, Instituto de Pesquisas Tecnologicas, unpublished, 1972.

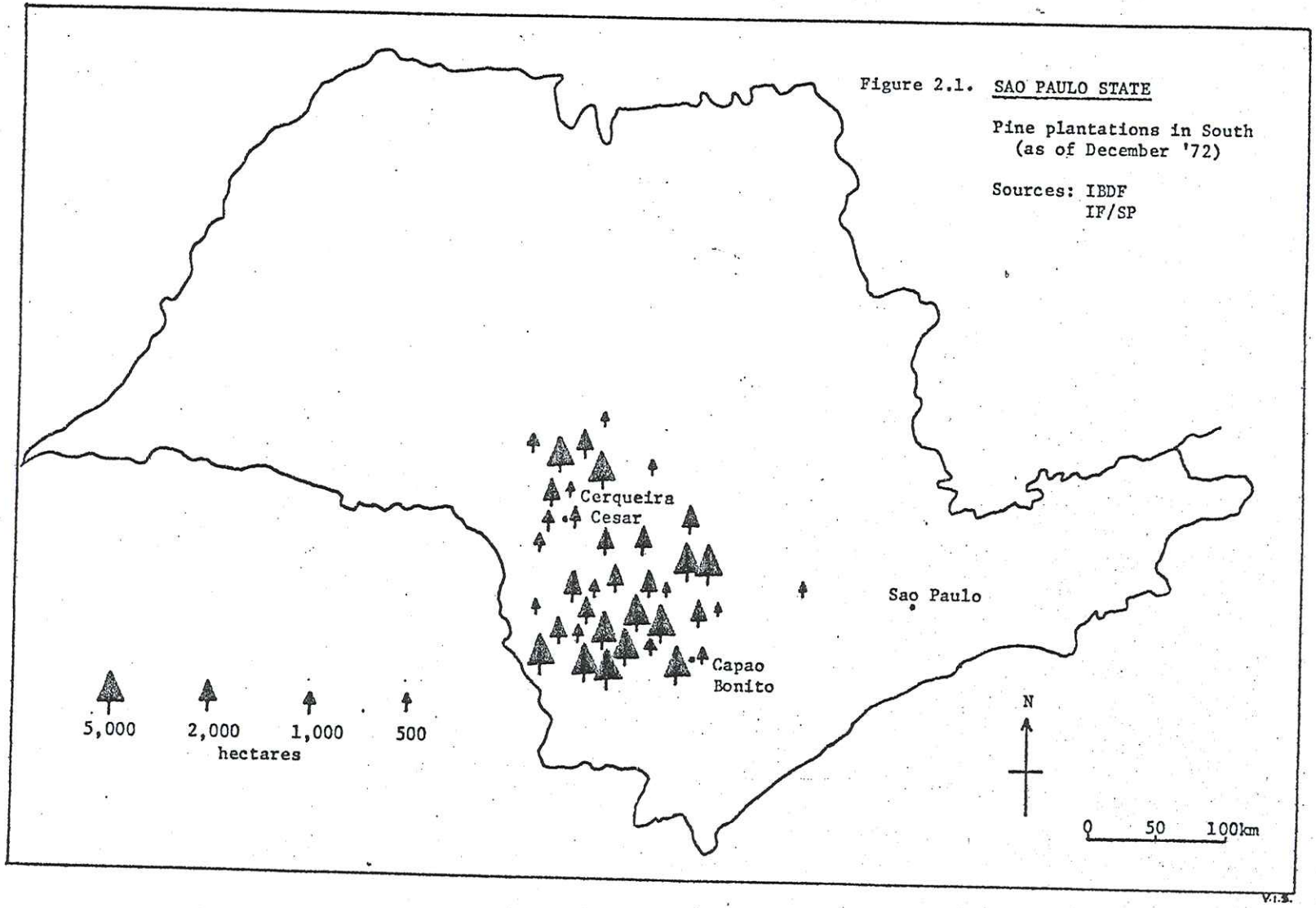


Figure 2.1. SAO PAULO STATE

Pine plantations in South
(as of December '72)

Sources: IBDF
IF/SP

Minas Gerais State

Minas Gerais is the State in which the steel and iron industries are located and are consuming, besides coal, a considerable volume of charcoal, part of which is produced from Eucalyptus.

The area planted with Eucalyptus as of mid-June 1972 has been estimated at 270,000 ha(8). For the purposes of this study, using various sources of information including those prepared by the Commission for Economic Forest Zoning(9), the total area under Eucalyptus plantations as of December 1972 is estimated at 260,000 ha. No information, however, was available on the classification of these plantations in regard to yield per hectare. It was learned(10)that most of the plantations located in the Belo Horizonte area have very low growth (15 steres/ha/year) when compared with the East, South, and South-West part of the State (32 steres/ha/year).

Pinus was introduced in Minas Gerais in 1967 with a total area of 27,000 ha as of December 1972 of which 25,000 ha were located in the South-Western part of the State, the triangulo Mineiro region. The species planted are mainly tropical pines (P.oocarpa and P.caribaea) with an average growth of 28 steres/ha/year(11).

The spatial distribution of Pinus and Eucalyptus plantations in Minas Gerais is shown in Figure 2-2.

Parana and Santa Catarina States

These States, including the Northern part of Rio Grande do Sul

(8) V. A. Matt, "Analysis of Timber Supply: Minas Gerais, Brazil", Study presented as Ph.D. Dissertation in the SUNY College of Environmental Science and Forestry, Syracuse, New York, July 1973.

(9) A. G. Bastos, data on forest plantations in Minas Gerais, IBDF/Comissao de Zoneamento Economico Florestal, 1973, mimmiogr.

(10)Cia Florestal Santa Barbara (Belgo Mineira), unpublished data on clear-cutting of 35,000 ha of Eucalyptus plantations.

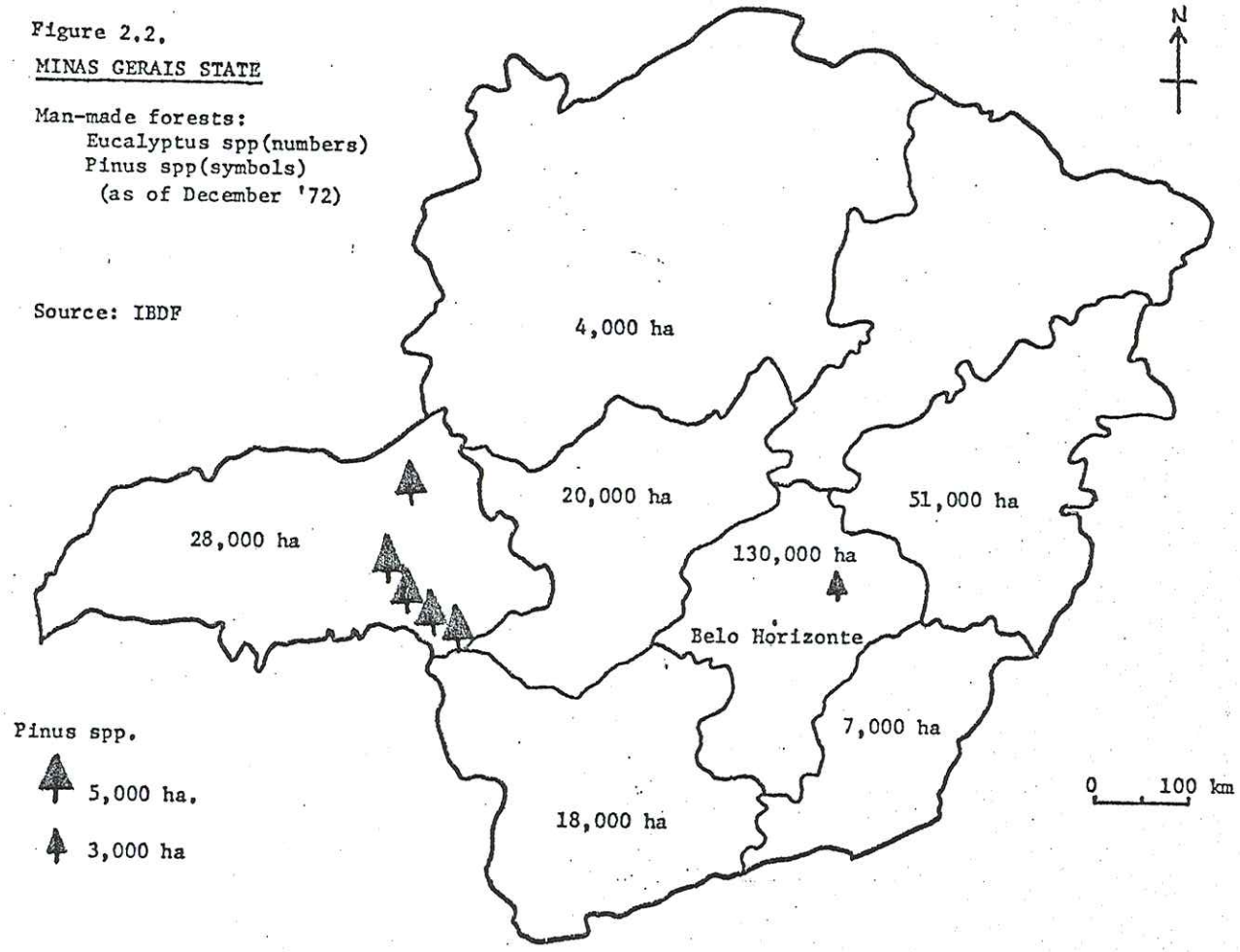
(11)L. Golfari, personal communication (Belo Horizonte, 1973)

Figure 2.2.

MINAS GERAIS STATE

Man-made forests:
Eucalyptus spp(numbers)
Pinus spp(symbols)
(as of December '72)

Source: IBDF



State, are the native region of Parana pine. This native pine has been exploited for sawmilling and pulping at a high rate without control, and the reserves are expected to vanish in the present decade if the actual rate of cutting continues. At present, IBDF is carrying out a forest inventory in order to locate and evaluate the remaining reserves.

As of December 1972 an area of 20,000 ha was planted with Parana pine in Parana State, while P.elliottii and P.taeda accounted for 176,000 ha, and Eucalyptus for 13,000 ha(12). Almost all these plantations were established under the fiscal incentive program. In Santa Catarina State the Pinus plantations accounted for 97,000 ha. In 1970 it was reported that 12,000 ha had been planted with Eucalyptus in Lauro Muller in the South-Eastern part of the State, to produce pitprops(13).

The spatial distribution of Pinus and Eucalyptus plantations in Parana State is shown in Figure 2-3.

Rio Grande do Sul State

The tree-planting projects under the fiscal incentive program, up to December of 1972, have resulted in 30,000 ha with Pinus, 17,000 ha with Eucalyptus and 10,000 ha with Acacia. The location and spatial distribution of plantations are shown in Figure 2-4. However, this map does not include all the plantations existing in the State. The existence of 40,000 ha of Eucalyptus and 45,000 ha of Acacia plantations,

(12) IBDF/PR (Equipe de Analise) Forest plantations in the State of Parana, mimmiogr., 1973.

(13) IBDF, "Zoneamento Economico Florestal de Santa Catarina", 1970, p. 11.

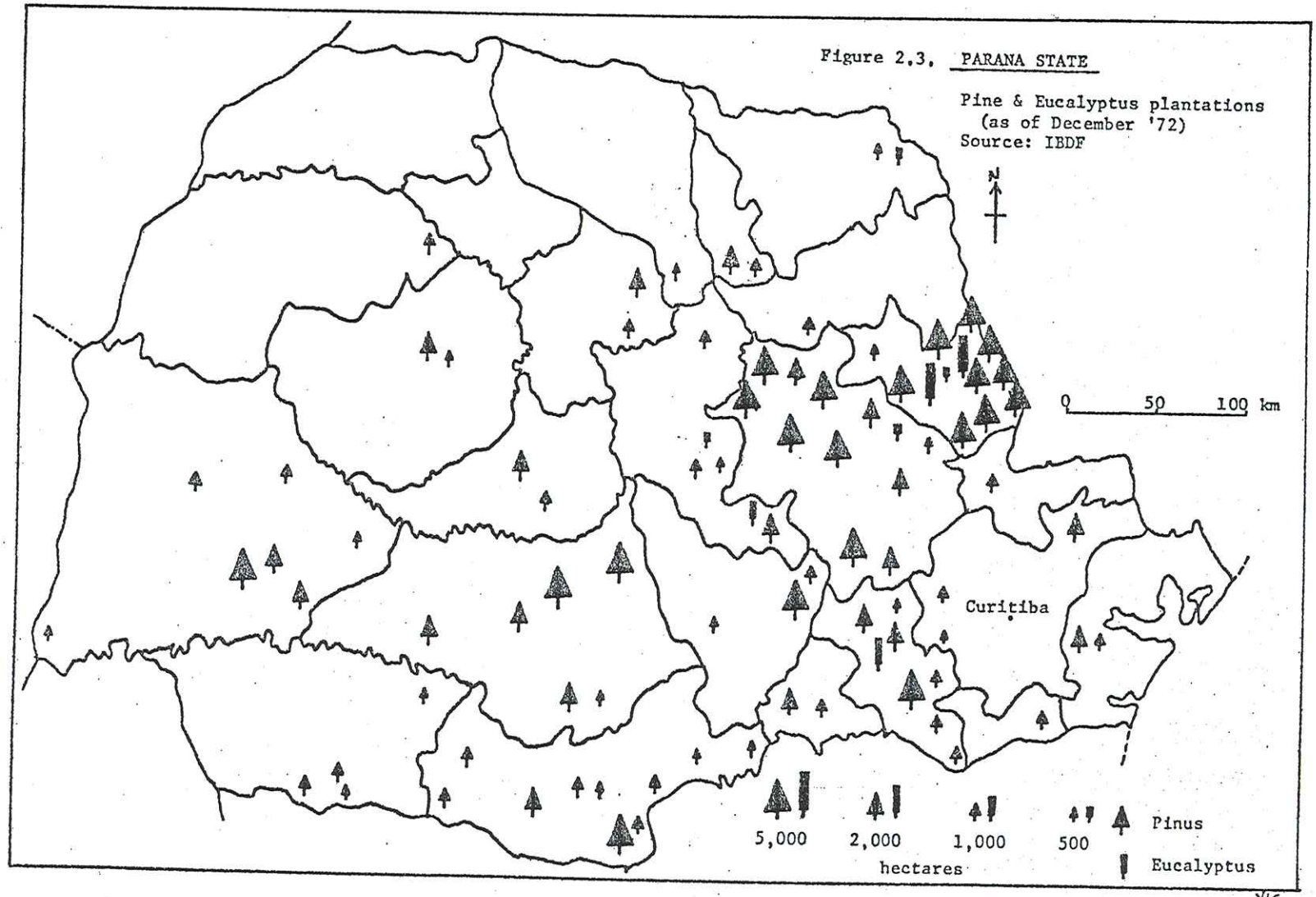


Figure 2.3. PARANA STATE

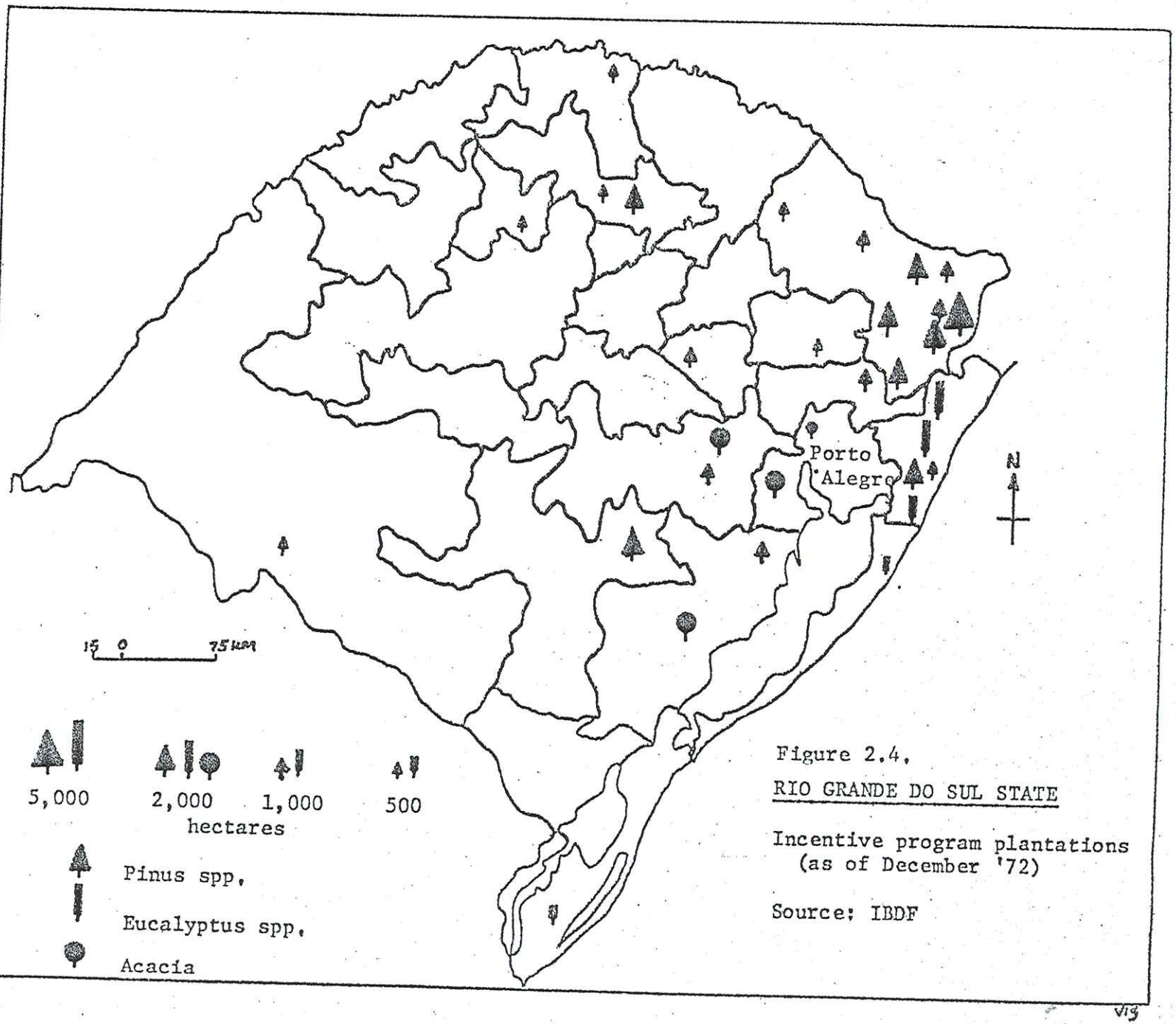


Figure 2.4.

RIO GRANDE DO SUL STATE

Incentive program plantations (as of December '72)

Source: IBDF

part of which must have been subjected to cuts during the last three years, was reported as of December 1970(14). Only a more detailed survey could reveal the exact area and location of all the plantations existing in the State.

Acacia is planted to produce tannin from the bark. The wood is being used somewhat by pulpmills and particleboard mills, but is being used largely as fuelwood. More details for this species are given in Chapter IV.

Average growth rate for the recent plantations of Eucalyptus is 30 steres/ha/year; Pinus, 25 steres/ha/year, with lower growth rates (18 steres/ha/year) in the plantations located in the sandy soils along the coast (15). Acacia can produce 170 steres of debarked wood per hectare in seven years rotation.(16).

Pulp and Paper Industry

The pulp and paper industry has been in dynamic expansion, especially since 1965. The improvements of techniques for pulping Eucalyptus, the availability of raw material, the growth of the market, and the possibilities of exports have been changing the structure of the industry.

Pulp

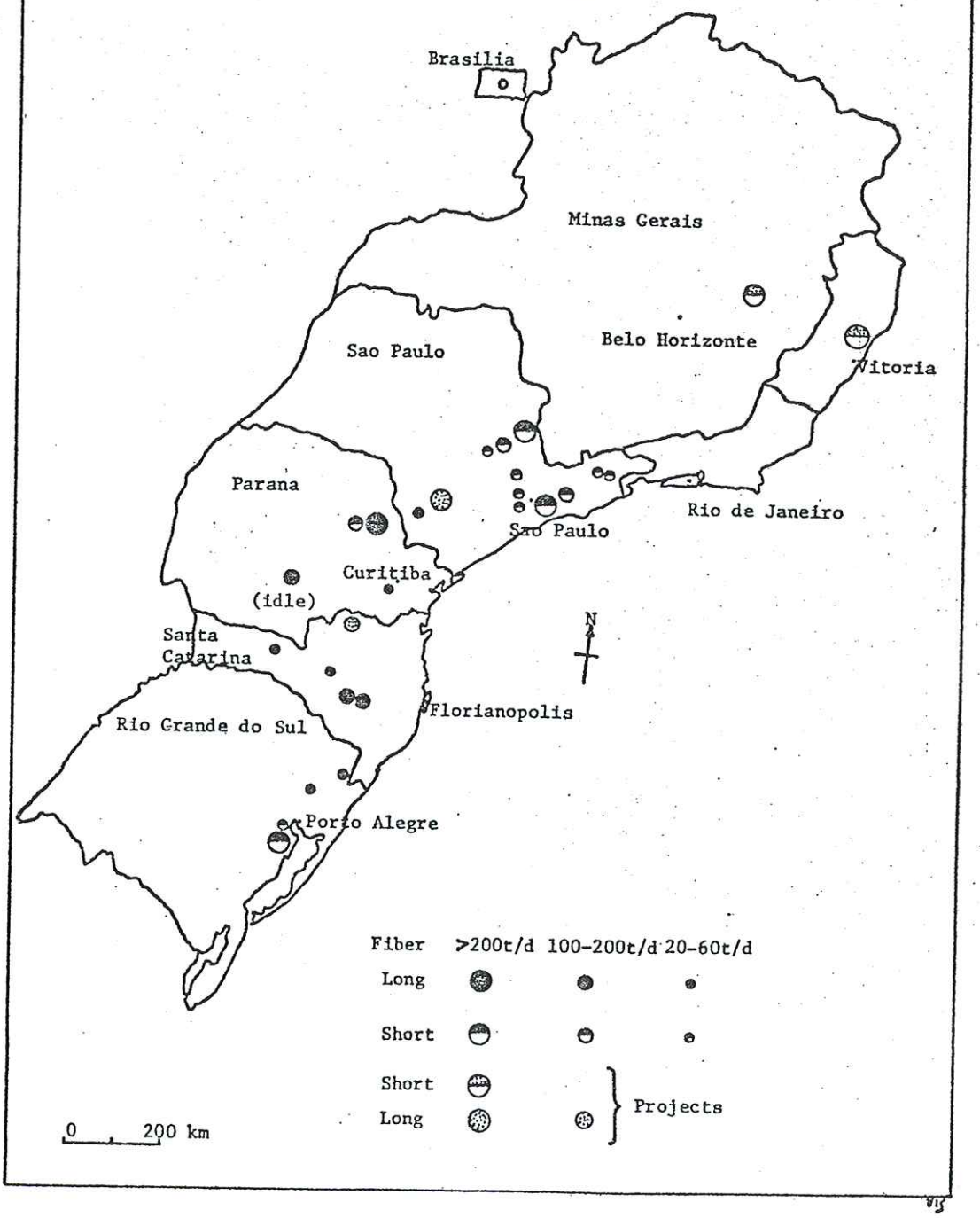
The location of existing pulpmills and new projects is presented in Figure 2-5.

(14) IBDF, "Zoneamento Economico Florestal do Estado do Rio Grando do Sul", Curitiba, 1971.

(15) L. Golfari, op.cit.

(16) IBDF, op.cit., p. 72.

Figure 2.5. PULPMILLS LOCATION IN BRAZIL



The new mills are planned with considerations for economies of scale. The changes in concentration from 1967 to 1972 are illustrated in Figure 2-6. However, the concentration is still in the process of changing since three large mill projects are still under way.

In the early 1950's Parana pine, a softwood, was the main raw material. But this raw material is becoming scarce while plantations of Eucalyptus are becoming available as a source of pulpwood. While the production of pulp in 1950 was practically 100 percent long fiber pulp, in 1972 short fiber chemical and semi-chemical pulp accounted for 65 percent of the total pulp production, with Eucalyptus as the main raw material.

Today domestic pulp production is more than eleven times the 1950 production. At that time imports of pulp were almost three times the domestic production; presently the pulp trade is aiming toward a situation of net exports.

The time series data of production, imports, and exports, as well as the fiber length of pulp produced and consumed in the country are shown in Table 2-5.

Using data published by a Pulp and Paper Association (APFPC)* it was possible to prepare Table 2-6, showing the main fibrous raw materials and processes used in the pulp production during 1971. In the same Table, it is shown that in 1971, woodpulp accounted for 92.2 percent of total production.

*APFPC - Associaçao Paulista de Fabricantes de Papel e Celulose

Figure 2.6. CONCENTRATION – PULP INDUSTRY IN BRAZIL
THE TEN LARGEST PRODUCERS IN 1967 AND 1972

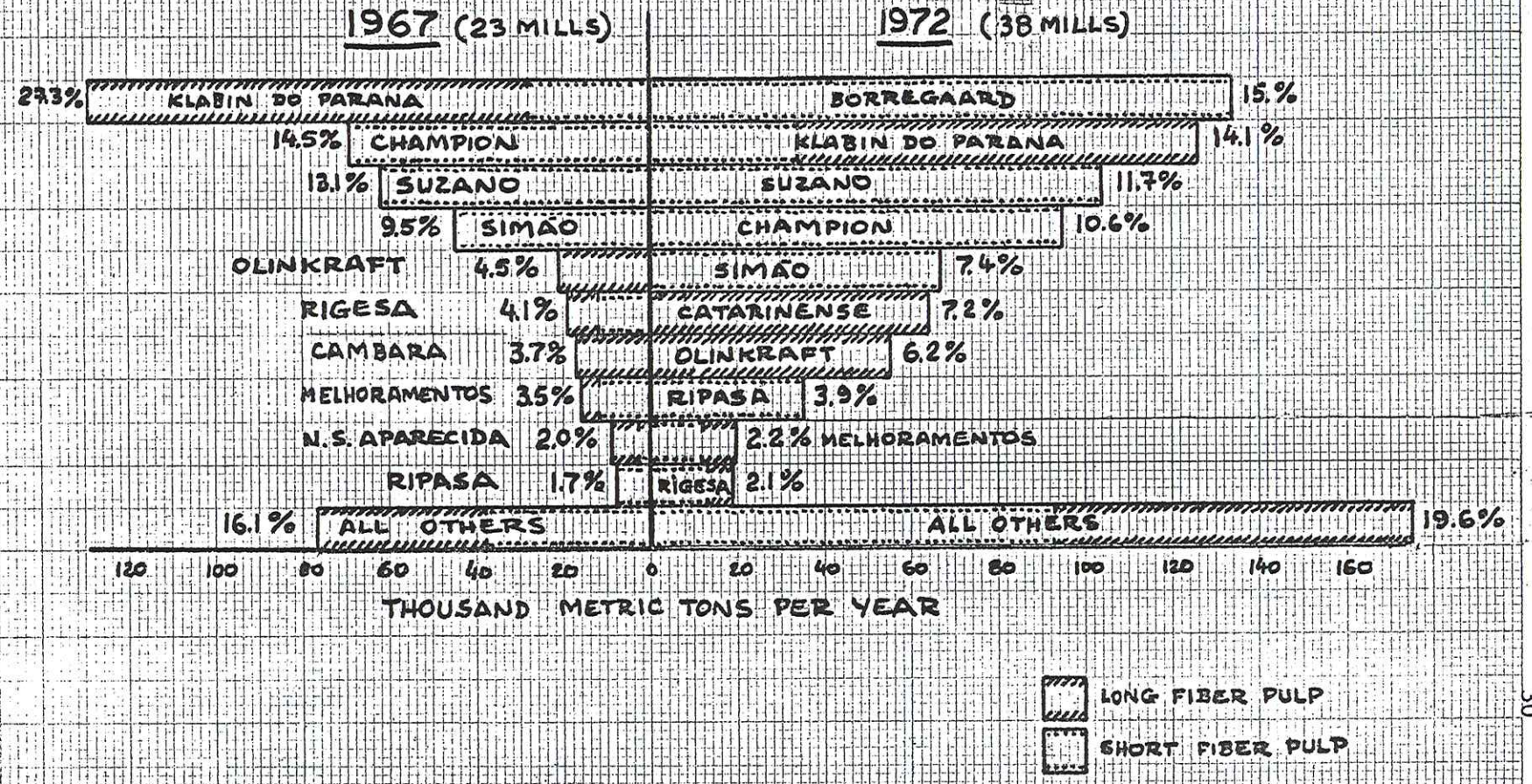


Table 2-5. -- PRODUCTION, NET TRADE, AND APPARENT CONSUMPTION OF PULP AND GROUNDWOOD—BRAZIL, 1950-1972

(Thousand metric tons)

year	Production							imports	exports	net trade	Apparent Consumption			Groundwood (consumption)
	long-fiber			short-fiber			total				TOTAL	percentage		
	bleached	unbleached	total	bleached	unbleached	total						long-fiber	short-fiber	
1950	13.4	24.9	38.3	1.1	0.4	1.5	39.9	112.0	-	-112.0	152.0	59.4	0.6	-
1951	15.4	27.0	42.4	1.4	1.0	2.4	44.9	110.5	-	-110.5	155.5	57.3	0.9	-
1952	19.6	25.7	45.3	1.4	7.6	9.1	54.4	80.3	-	-80.3	135.3	46.6	3.6	-
1953	24.2	23.3	47.3	3.0	5.3	8.3	55.9	87.8	-	-87.8	143.8	45.1	4.1	-
1954	23.0	23.9	46.9	4.3	12.6	16.9	63.9	150.9	-	-150.9	214.9	60.9	5.2	-
1955	23.0	27.1	50.1	6.8	16.1	22.9	73.1	100.2	-	-100.2	173.3	43.5	6.6	72.9
1956	25.1	26.8	51.9	8.3	17.4	25.7	77.8	116.2	-	-116.2	194.0	42.6	6.5	75.9
1957	27.7	28.0	55.7	12.1	17.9	30.1	85.9	103.8	-	-103.8	189.8	42.2	8.0	79.4
1958	26.9	40.0	66.9	23.3	29.0	52.3	119.4	94.4	-	-94.4	213.8	37.3	12.1	86.0
1959	31.8	47.6	79.4	29.8	35.3	65.1	144.6	88.1	-	-88.1	232.8	36.4	14.2	84.6
1960	32.0	48.2	80.2	61.7	58.1	119.8	200.2	81.1	6.3	-74.8	275.0	32.0	23.7	86.2
1961	34.9	60.5	95.4	75.8	57.9	133.6	229.2	47.4	2.9	-44.5	273.7	26.8	24.5	93.6
1962	32.6	83.5	116.1	98.6	63.3	161.9	278.1	43.2	4.7	-38.5	316.6	26.5	26.2	99.1
1963	28.8	107.5	136.3	120.7	62.3	183.0	319.5	32.1	2.6	-29.5	349.0	25.6	27.6	128.0
1964	27.3	121.3	148.6	132.8	62.2	195.0	343.7	13.6	10.4	-2.4	347.0	21.8	26.5	157.9
1965	32.5	133.6	166.2	146.7	57.1	203.8	370.0	6.2	37.5	+31.1	338.8	21.9	26.8	193.0
1966	31.7	181.8	213.5	181.7	56.2	237.9	451.6	14.0	17.3	+3.3	448.3	27.0	28.1	203.0
1967	28.5	153.8	182.3	200.5	76.2	276.7	459.1	25.0	8.9	-16.1	475.2	23.6	31.5	225.6
1968	23.9	185.9	209.8	240.8	66.3	307.2	517.1	35.0	7.9	-27.1	544.2	26.5	33.1	221.1
1969	24.2	202.6	226.9	259.8	80.5	340.3	567.3	21.8	18.5	-3.3	570.6	24.5	34.3	221.9
1970	44.6	233.5	278.1	291.2	94.6	385.9	664.0	28.2	27.9	-0.3	664.3	25.2	33.2	228.3
1971	52.5	239.5	292.1	325.4	103.9	429.3	721.5	68.7	23.1	-46.5	767.1	23.0	37.0	n.a.
1972	48.9	259.6	308.6	346.7	242.9	589.7	898.3	167.5/1	134.2	-33.3	931.6	n.a.	n.a.	n.a.

/1 Authorized imports but type of fiber not discriminated; n.a. - not available

Sources: Leone, Consultoria e Planejamento.
APFPC - Associacao Paulista de Fabricantes de Papel e Celulose.
Carteira de Comericio Exterior, Banco do Brasil SA.
FAO Yearbook of Forest Products Statistics, various issues.

Unfortunately, the statistics of APFPC for groundwood do not account for all producers, and the figures on the product (see Table 2-5) were taken from FAO Yearbook of Forest Products(17), where the figures represent estimated consumption.

Regarding the import/export figures, most of the imports consist of long fiber pulp with the exception of the two last years when bleached short fiber pulp was also imported. In 1972 one single pulpmill in the State of Rio Grande do Sul exported 116,892 tons of unbleached short fiber pulp to Norway with a FOB value of US $9,965,154.00, equivalent to an average FOB price of US $85.00/ton against an average FOB price of US $74.00/ton for the 6,447 tons of groundwood, and against an average FOB price ranging from US $155 to US $193/ton for the other 5,800 tons of unbleached chemical pulp exported in the same year(18).

Expansion Plans of Pulp Production

Fourteen mills have reported plans for expansion throughout 1978. In this period six new mills are expected to come on stream. Table 2-7 contains the list of the expansion plans and new projects known as of July, 1973, with observations on the process, fiber raw material to be used, and State of location.

The additional capacity up to 1978 is summarized in Table 2-8. The projected total installed capacity is presented in Table 2-9.

It appears that within the twelve year period of this study additional large pulpmills can be established, one in the Triangulo

(17) FAO/UN, Yearbook of Forest Products, Rome, Italy, 1972.

(18) Carteira de Comercio Exterior, "Exportaçao Efetiva - Jan./Dec. 1972", Banco do Brasil SA, Rio de Janeiro, 1973, mimeogr.

Table 2-6. -- CHEMICAL AND SEMI-CHEMICAL PULP PRODUCTION AND FIBROUS RAW MATERIALS USED - 1971

(Thousand metric tons)

Raw material	pulp				
	sulphate	sulphite	semi-chemical	total	percent
Softwood	191.8	74.9	7.4	274.1	38.0
Eucalyptus	294.5	19.5	65.0	379.0	52.5
Acacia & other broadleaves	6.1	-	5.3	11.4	1.6
sub-total				664.5	92.2
Bagasse	-	-	38.8	38.8	5.4
Bamboo	-	-	6.1	6.1	0.8
Linter	0.2	-	2.0	2.2	0.3
Sisal & straw	3.8	-	5.6	9.4	1.3
sub-total				56.5	7.8
Total	496.4	94.4	130.2	721.0	100.0

Source: APFPC, "Estatistica de Produçao/Papel e Celulose 1971", Sao Paulo, 1972

Mineiro area in Minas Gerais State to utilize Eucalyptus or Pinus, the other in Mato Grosso State where some 24,000 ha of tree-planting projects of Eucalyptus were reported as approved by IBDF. These plantations apparently are located too far away from the present pulpwood markets and the forest investments are being made with the purpose of attracting investments for pulpmill construction. It must

Table 2-7. -- PULP: EXPANSION PLANS AND NEW PROJECTS - BRAZIL, BY COMPANY AND YEAR
(metric tons/day) (known as of July 1973)

Company	State	Raw Material	1973	1974	1975	1976	1977	1978
RIGESA Celulose, Papel e Embalagens Ltda[a]	- SC	pine						
unbleached sulphite			-	160	-	40	-	-
OLINKRAFT Celulose e Papel Ltda	- SC	pine						
unbleached neutral sulphite			-	-	100	-	-	-
unbleached sulphate			-	-	-	200	-	-
BRASKRAFT (Olinkraft/Plantar)[a]	- SP	pine	-	-	-	-	600	-
IKPC-Ind. Klabin do Parana de Celulose	- PR	pine						
unbleached sulphate			-	-	-	-	400	-
Elias Cury	- PR	pine						
unbleached sulphate			50	-	-	-	-	-
Industrias de Papel SIMAO SA	- SP	Eucalyptus						
bleached sulphate			110	-	-	-	-	-
Cia, SUZANO de Papel e Celulose	- SP	Eucalyptus						
bleached sulphate			-	600	-	-	-	-
Ind, Reunidas IRMAOS SPINA SA	- SP	Eucalyptus						
bleached sulphate			-	50	-	50	-	-
Cia MINEIRA de PAPEIS	- MG	Eucalyptus						
bleached sulphate			-	-	100	-	-	-
ARACRUZ Celulose[a,b]	- ES	Eucalyptus						
bleached sulphate			-	-	-	-	1000	-
CENIBRA-Cel. Nip Brasileira[a,b]	- MG	Eucalyptus						
bleached sulphate			-	-	-	225	375	150
CHAMPION Papel e Celulose SA	- SP	Eucalyptus						
bleached sulphate			-	-	-	-	300	-
RIPASA SA Celulose e Papel	- SP	Eucalyptus						
bleached sulphate			-	-	280	-	-	-
Cia Agricola e Indl, CICERO PRADO	- SP	Eucalyptus						
bleached sulphate			60	-	-	-	-	-
CEPALMA, Celulose e Pap. do Maranhao SA[a]	- MA	Babaçu (palm tree)						
unbleached sulphate		& sisal & others	120	-	-	-	-	-
PONSA - Papelas Ondulado do Nordeste SA[a]	- PE	Bagasse						
unbleached soda			60	-	-	-	-	-
Com. e Ind. de Papeis SANTO AMARO SA	- BA	Bamboo & sisal						
unbleached sulphate			-	-	100	-	-	-
BORREGAARD[a,b]	- RS	Eucalyptus & Acacia						
unbleached sulphate (to full capacity)			400	-	-	-	-	-
		Total	800	810	580	515	2675	150

[a]New mills, [b]for export

Sources: Leone, Consultoria e Planejamento; APFPC - Associacao Paulista de Fabricantes de Celulose e Papel; BNDE - Banco Nacional de Desenvolvimento Economico

also be considered that the 35,000 ha of Gmelina arborea planted in the Amazon region along the Jari river, will most likely be utilized in pulp production. Besides the new pulpmill project under way in Minas Gerais State, Companhia Vale do Rio Doce negotiations with a Japanese consortium on exports of Eucalyptus wood-chips may result, instead of wood-chips exports, in one more pulpmill to be located in Espirito Santo State where Eucalyptus planted by this company will amount to 21,000 ha by the end of 1973.

Table 2-8. -- INCREASE IN CHEMICAL AND SEMI-CHEMICAL PULP CAPACITY: 1973-1978

(Daily metric tons) (Known as of July 1973)

year	long fiber bleached	long fiber unbleached	short fiber bleached	short fiber unbleached	total
1973	-	50	170	580	800
1974	-	160	650	-	810
1975	-	200	380	-	580
1976	-	240	275	-	515
1977	-	1000	1675	-	2675
1978	-	-	150	-	150
	Thousand metric tons (340 days/year basis)				
1973	-	17	58	197	271
1974	-	54	221	-	275
1975	-	68	129	-	197
1976	-	81	93	-	174
1977	-	340	569	-	909
1978	-	-	51	-	51

Source: Leone, Consultoria e Planejamento
APFPC - Associacao Paulista de Fabricantes de Celulose e Papel
BNDE - Banco Nacional de Desenvolvimento Economico

Table 2-9. -- PROJECTED INSTALLED CAPACITY FOR CHEMICAL AND SEMI-CHEMICAL PULP: 1973-1978

	(Thousand metric tons)						
	Long fiber		Short fiber		Long	Short	
Year	bleached	unleached	bleached	unbleached	fiber	fiber	TOTAL
1972	48.9	259.7	346.7	242.9	308.6	589.6	898.2
			Projections				
1973	49	276	404	440	325	844	1169
1974	49	330	625	440	379	1065	1444
1975	49	398	754	440	447	1194	1641
1976	49	479	847	440	528	1287	1815
1977	49	819	1416	440	868	1856	2724
1978	49	819	1467	440	868	1907	2775

Source: Tables 2-5 and 2-8

Paper

The domestic production of paper in 1950 was 253,100 tons and the total consumption was 321,500 tons for a consumption per capita of 6.2 kilos per year. In 1972 the production was 1,446,000 tons and the apparent consumption was 1,700,200 tons, for a consumption per capita of 17.2 kilos per year.

Brazil is still importing paper, mostly newsprint, but other papers also, due to the rapid increase in consumption that has not been captured by domestic production. The time series data on paper production, imports, exports, total and per capita consumption, as well as the individual consumption of the four types of paper (Printing

& Writing; Newsprint; Packaging & Cardboard & Paperboard; and Industrial & Others) are shown in Table 2-10. It is interesting to observe the increase in consumption that, from a negative growth in 1965, has passed to very high rates of growth in the last seven years, excepting 1969.

As for the expansion plans of paper production, many papermills are increasing their production. Excluding one 800t/d pulpmill already in operation and two other projects (750t/d and 1000t/d) oriented to exports of pulp, most of the pulpmills are integrated with paper production. Their increase in pulp production will be followed by an increase in paper production.

A specific survey has not been carried out on paper production expansion plans because such programs are not prepared more than a couple of years in advance of the start-up date of the additional machine. Besides, such plans change in this time span for different grades of paper and results would not be precise even as projections.

However, it is important to note that as new economic size papermills come on stream, many of the 135 mills in operation in 1971(19) will find it difficult to compete with larger mills that can produce the same product at lower costs. This implies that some small papermills, especially those depending on market pulp, will close down or be bought out.

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(19) M. L. Pilar et al. (Working Group no. 6), "Estatistica da Produçao/Papel e Celulose 1971", Associaçao Paulista de Fabricantes de Papel e Celulose, Sao Paulo, 1972.

Table 2-10. -- PRODUCTION AND APPARENT CONSUMPTION OF PAPER IN BRAZIL

(thousand metric tons)

year	Production	Imports	Exports	Apparent Consumption TOTAL	annual increase (%)	writing & printing	newsprint	packaging & cardboard & paperboard	Industrial & Others	kilos per capita	annual increase (%)
1950	253.1	68.4	-	321.5	-	66.1	98.4	140.6	16.3	6.2	
1951	266.8	90.5	-	357.3	11.1	66.8	120.1	149.5	18.9	6.7	8.1
1952	269.4	115.5	-	384.9	7.7	66.3	144.4	155.2	19.0	7.0	4.5
1953	300.2	112.2	0.1	412.3	7.1	76.4	146.2	168.2	21.5	7.3	4.3
1954	324.8	143.6	-	468.4	13.6	81.7	161.1	195.9	29.6	8.0	9.6
1955	346.1	146.4	-	492.5	5.1	88.1	167.6	203.2	33.6	8.2	2.5
1956	395.2	165.2	-	560.4	13.8	104.4	175.9	231.1	49.1	9.0	9.7
1957	378.4	210.1	-	588.5	5.0	109.7	222.5	218.9	37.5	9.3	3.3
1958	432.8	174.6	-	607.4	3.2	118.4	204.2	248.5	36.4	9.2	-0.1
1959	460.2	172.3	-	632.5	4.1	114.5	212.1	264.3	41.5	9.3	0.1
1960	505.1	187.8	0.3	692.6	9.5	124.1	230.3	293.2	45.0	9.9	6.4
1961	553.4	167.4	0.2	700.6	1.2	124.0	211.1	316.3	49.2	9.7	-2.0
1962	601.8	140.1	0.2	741.7	5.9	148.7	187.8	350.7	54.6	10.0	3.1
1963	656.6	132.4	0.1	789.0	6.4	160.3	189.7	391.4	47.6	10.3	3.0
1964	718.1	79.8	0.3	797.8	1.1	164.1	173.7	410.2	49.7	10.1	-1.9
1965	694.8	64.3	0.2	758.9	-4.8	154.6	169.2	380.1	55.0	9.4	-6.7
1966	812.8	69.2	0.3	881.8	16.2	180.9	174.0	470.5	56.3	10.6	12.8
1967	862.7	106.3	0.3	968.7	9.9	218.2	187.1	496.4	66.9	11.3	6.6
1968	912.4	168.9	0.2	1081.1	11.6	245.5	235.0	526.9	73.7	12.2	8.0
1969	969.8	150.1	0.6	1119.3	3.5	255.7	232.0	556.0	75.4	12.3	0.1
1970	1135.8	186.3	1.8	1320.3	18.0	282.1	251.8	684.5	101.9	14.1	14.6
1971	1300.5	214.1	3.1	1511.5	14.5	347.1	269.7	784.7	110.0	15.7	11.3
1972	1446.1	264.0/1	9.9	1700.2	12.5					17.2	9.5

/1 authorized imports

Sources: Leone, Consultoria e Planejamento
APFPC - Associacao Paulista de Fabricantes de Papel e Celulose

CHAPTER III

FORECASTS

Because of the rapid growth in consumption of paper, appraisals of future trends are a continuous need of businessmen concerned with expansion plans for production. Appraisals of future trends should also be a continuous need of Government administrators concerned with the availability and adequate allocation of resources.

Projections of future trends can be obtained through different forecasting models, as discussed below.

Models for Projection of Paper Consumption

There are numerous variations of models and ways for projecting long-run trends in consumption. However, they can be grouped into four types: the input-output model, the multiequation model, the regression model, and the graphic model(1). In the particular case of Brazil, the first two models cannot be used due to the shortage of statistical data. The graphic and regression models are appropriate models for projecting future consumption of paper because they can be adjusted to the characteristics of the economy (historical data). However, the graphic model is largely dependent on the experience of the person who does the extrapolation, so it is preferred for making short-run projections. Therefore, the regression model seems to be the most appropriate model for projecting future Brazilian consumption

(1) D. Hair, "Use of Regression Equations for Projecting Trends in Demand for Paper and Board", US Forest Service, Forest Resources no. 18, Washington, D.C., 1967, p.2.

of paper. The regression model also has the advantage of being relatively easy to manage.

According to D. Hair(2), for several decades the regression model has been almost universally used for projecting long-run trends in demand for paper and board.

The quality of the results obtained from the regression model depends upon the independent variables used, their functional relationship with the dependent variable (paper consumption in this case). The validity of such projections rests in part upon the assumption that the relationship in the base period will continue through the projection period.

The Selected Model

Stepwise regression and multiple regression were used in this study. Stepwise regression was used since the computing process eliminates those variables whose explanation of the dependent variable is not significant. Excluding newsprint, the other three types of papers (Writing & Printing; Packaging & Cardboard & Paperboard; and Industrial & Others) showed very high coefficients of determination and correlation, with a significant "F" test. Such statistical measures made it possible to carry out the projections.

The model used for the projections is as follows:

$$Y = f[X1,X2,X3,X4]$$

(2) Hair, op. cit., p. 6

Variables

The dependent variables in this model are total paper consumption and/or per capita paper consumption for:

- all papers
- printing & writing papers
- newsprint
- packaging paper & cardboard & paperboard
- industrial papers & others

The independent variables are:

X1 - population
X2 - index of real production (GDP)
X3 - index of per capita real production (per capita GDP)
X4 - index of industrial production

It might be asked why X3 is used when X1 and X2 are already included in the model. The variable X3 was used because it proved in some cases to explain the dependent variables better than the other two combined. The regression equations were built on time series data from 1950 to 1971/72. Excluding population, the other three variables (economic measures) were used in the form of indexes representing real value (i.e., deflated value).

The various sets of equations prepared for this study are shown in Table 3-1.

Functional Relationship Between Chosen Variables

The independent variable is a major determinant of the projected values for a dependent variable. Two criteria are observed in choosing independent variables:

Table 3-1. -- Statistical measures obtained from regression equations tested for use in projections

Paper consumption in Brazil

STEPWISE REGRESSION	regression coefficients a	b_1	b_2	b_3	b_4	standard error of estimate	standard errors of b coefficients b_1	b_2	b_3	b_4	R	R^2	DF	F
Total paper (data 50-72)														
=f(X1,X2,)	354.257	-11.0054	5.3524	-	-	42.020	3.2108	0.4800	-	-	.99	.99	22	822.0
=f(x1,X2, X4)	353.318	-11.1981	5.5936	-	-0.1377	43.100	3.8200	2.4718		1.3832	.99	.98	22	520.9
=f(X3,X4)	357.710	-	-	-3.3916	3.2098	49.033	-	-	2.8107	0.6609	.99	.98	22	601.0
Paper per capita (50-72)														
=f(X1,X2)	8.210	-0.1116	0.0439	-	-	0.549	0.0419	0.0062	-	-	.98	.96	22	263.1
=f(X1,X2, X4)	8.214	-0.1108	0.0429	-	0.0005	0.563	0.4999	0.0323	-	0.0181	.98	.96	22	166.6
=f(X4)	4.901	-	-	-	0.0178	0.602	-	-	-	0.0008	.97	.95	22	433.9
Writing & Printing (50-71)														
=f(X1,X2,X3)	267.678	-3.0668	2.3744	-2.7909	-	10.537	1.0543	0.2931	0.6365	-	.99	.98	21	367.4
=f(X1,X2)	61.861	-2.8022	1.3211	-	-	14.7488	1.4734	.2350	-	-	.98	.96	21	276.4
=f(X3,X4)	189.486	-	-	-2.3506	1.1289	13.2907	-	-	.7719	.1837	.98	.97	21	342.6
Newsprint (50-71)														
=f(X1,X2,X3)	-103.745	-1.3741	-0.7499	3.7170	-	24.7900	2.4805	.6895	1.4975	-	.83	.70	21	14.3
=f(X4)	120.166	-	-	-	.2495	27.3367	-	-	-	.0453	.77	.60	21	30.2
=f(X3,X4)	-150.564	-	-	3.2085	-0.5085	25.0202	-	-	1.4532	.3458	.82	.68	21	20.4
Packaging & Cardboard (50-71)														
=F(X1,X2,X3)	391.352	-4.7289	4.4596	-4.5580	-	18.3564	1.8368	.5106	1.1089	-	.99	.99	21	657.1
=f(X1,X2)	55.222	-4.2968	2.7394	-	-	24.8769	2.4851	.3964	-	-	.99	.98	21	532.0
=f(X3,X4)	276.529	-	-	-3.5751	2.1888	23.8556	-	-	1.3855	.3297	.99	.98	21	579.4
Industrial & others (50-71)														
=f(X1,X2, X4)	29.4919	-1.3068	.6824	-	-0.1288	6.1472	.6741	.3594	-	.1973	.97	.94	21	107.6
=f(X4)	-0.9203	-	-	-	.1820	6.5180	-	-	-	.0108	.96	.93	21	283.0
MULTIPLE REGRESSION														
Total paper (data 50-71)														
=f(X1,X2,X3,X4)	606.1159	-9.9162	6.1255	-3.8795	.2906	42.7303	4.6699	2.5784	2.6220	1.4091	.99	.98	21	276.2
=f(X1,X2, X4)	316.8747	-10.0476	5.3011	-	-0.0754	44.1192	4.8208	2.5993	-	1.4323	.99	.98	21	344.8
=f(X3,X4)	335.7827	-	-	-2.9577	3.0458	47.3694	-	-	-2.7822	.6615	.98	.97	21	446.9
Paper per capita (50-71)														
=f(X1,X2,X3,X4)	5.8823	-0.0964	.0319	.0256	.0000	.5852	.0639	.0353	.0359	.0193	.97	.94	21	78.0
=f(X1,X2, X4)	7.791	-0.0955	.0374	-	.0024	.577	.0630	.0340	-	.0187	.97	.94	21	106.7
=f(X3,X4)	3.030	-	-	.0243	.0113	.5894	-	-	.0346	.0082	.97	.94	21	152.7
Writing & Printing (50-71)														
=f(X1,X2,X3,X4)	271.478	-2.9119	2.1856	-2.8289	.1162	10.808	1.1812	.6522	.6632	.3564	.99	.98	21	261.9
=f(X1,X2, X4)	60.565	-3.0078	1.5844	-	-0.1507	15.113	1.6514	.8904	-	0.4906	.98	.96	21	175.5
=f(X3,X4)	195.224	-	-	-2.4141	1.1429	13.236	-	-	.07774	.1848	.98	.97	21	345.4
Newsprint (data 50-71)														
=f(X1,X2,X3,X4)	-101.077	-1.2653	-0.8824	3.6903	.0816	25.501	2.7870	1.5388	1.5648	.8409	.83	.70	21	10.1
=f(X1,X2, X4)	174.0564	-1.1403	-0.0981	-	.4298	28.550	3.1197	1.6821	-	.9269	.78	.60	21	9.3
=f(X3,X4)	-149.041	-	-	3.1879	-0.5030	25.078	-	-	1.4729	.3502	.82	.68	21	20.3
Packaging & Cardboard (50-71)														
=f(X1,X2,X3,X4)	397.947	-4.4600	4.1319	-4.6239	.2017	18.830	2.0579	1.1362	1.1554	.6209	.99	.99	21	468.3
=f(X1,X2, X4)	53.207	-4.6167	3.1493	-	-0.2345	25.501	2.7865	1.5025	-	.8279	.99	.98	21	337.5
=f(X3,X4)	287.502	-	-	-3.6964	2.2155	23.752	-	-	1.3950	.3317	.99	.98	21	584.5
Industrial & Others (50-71)														
=f(X1,X2,X3,X4)	37.457	-1.2892	.6949	-0.1098	-0.1126	6.318	.6905	.3812	.3877	.2083	.97	.94	21	76.3
=f(X1,X2, X4)	29.265	-1.2929	.6715	-	-0.1230	6.155	.6725	.3626	-	.1998	.97	.94	21	107.2
=f(X3,X4)	1.488	-	-	-0.0278	.1884	6.6771	-	-	.3921	.0932	.96	.93	21	134.8

X1 = population X2 = Index of real production X3= index of per capita real production X4= index of industrial production

1. The closeness of the historical functional relationships between the independent and dependent variables.

2. The availability of long-run estimates or projections of future values of the independent variables.

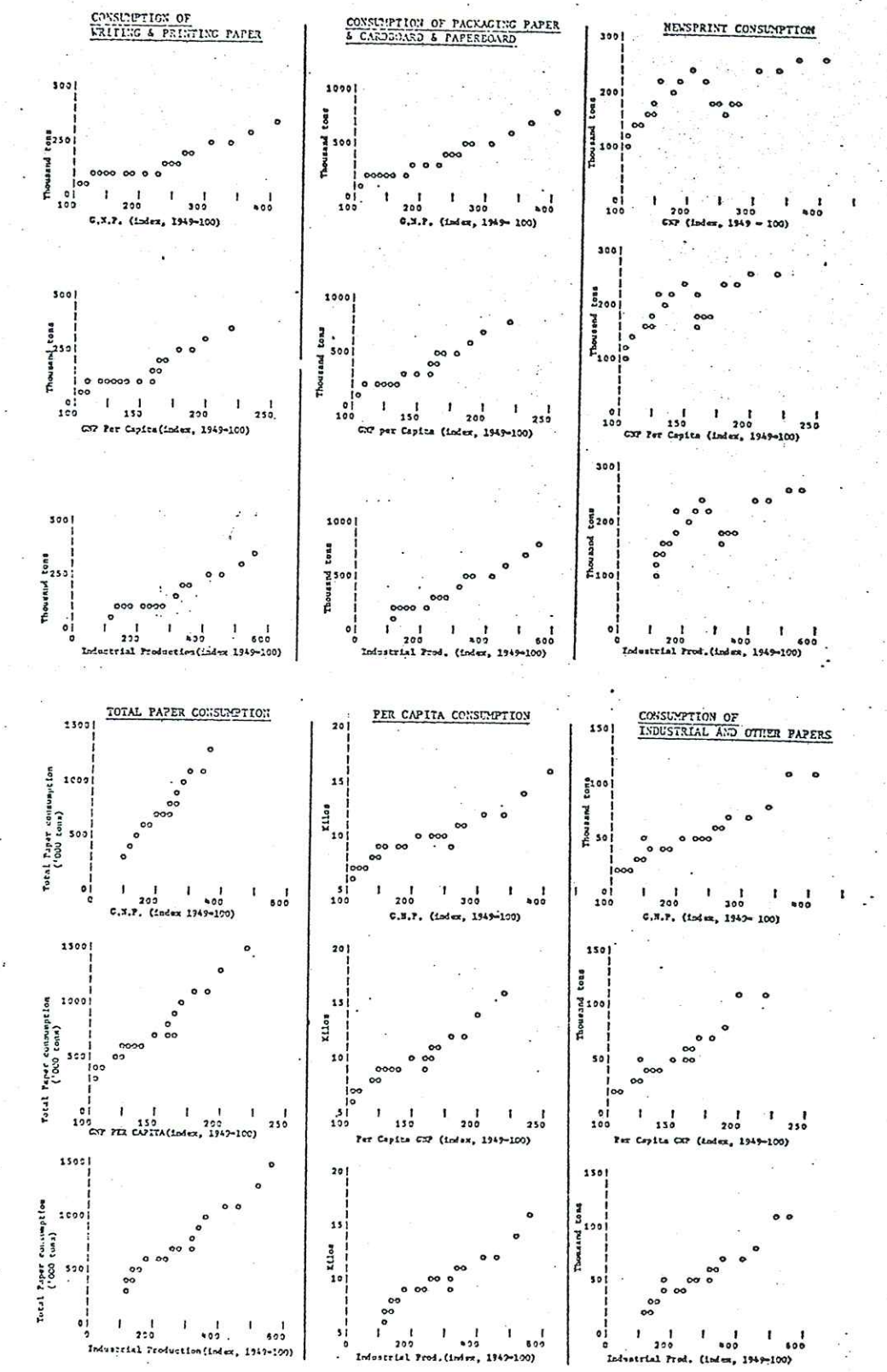
The second criterion, in this case, can be satisfied using the Government economic policy for the present decade, from which future values can be anticipated.

The first criterion can be satisfied in different ways, especially (a) correlation and determination coefficients for a significant "F" test; (b) the graphical relationship of dependent and independent variables; (c) income elasticity of demand.

The statistical correlation and determination coefficients, besides other statistical measures, are shown for all equations in Table 3-1.

The graphical relationships between dependent and independent variables are shown in Figure 3-1. As can be observed the weakest relationship (as expressed by R^2 values) is that between newsprint and the independent variables. This is due to the high imports of newsprint in the 1950's having subsidized exchange rates, with the result that newsprint was diverted to end uses other than the printing of newspapers. After the control of such imports, consumption of newsprint decreased but since the mid-sixties has again been rising steadily with the development of its own market.

Figure 3.1. PAPER CONSUMPTION IN RELATION TO ECONOMIC VARIABLES
(BRAZIL, DATA: 1950-1970/71)



As a visual aid, the histograms in Figure 3-2 have also been developed. Here, economic growth and increase in paper consumption are plotted together. The histograms in Figure 3-2 show that the increase in one variable is not automatically followed by an increase in the other. On the average, however, they do rise together, with paper consumption rising faster than the economy (charts 1 and 2 of Figure 3-2), but rising slower than overall industrial production (chart 3 of Figure 3-2).

The income elasticity of demand for total and per capita consumption of paper is shown in Table 3-2.

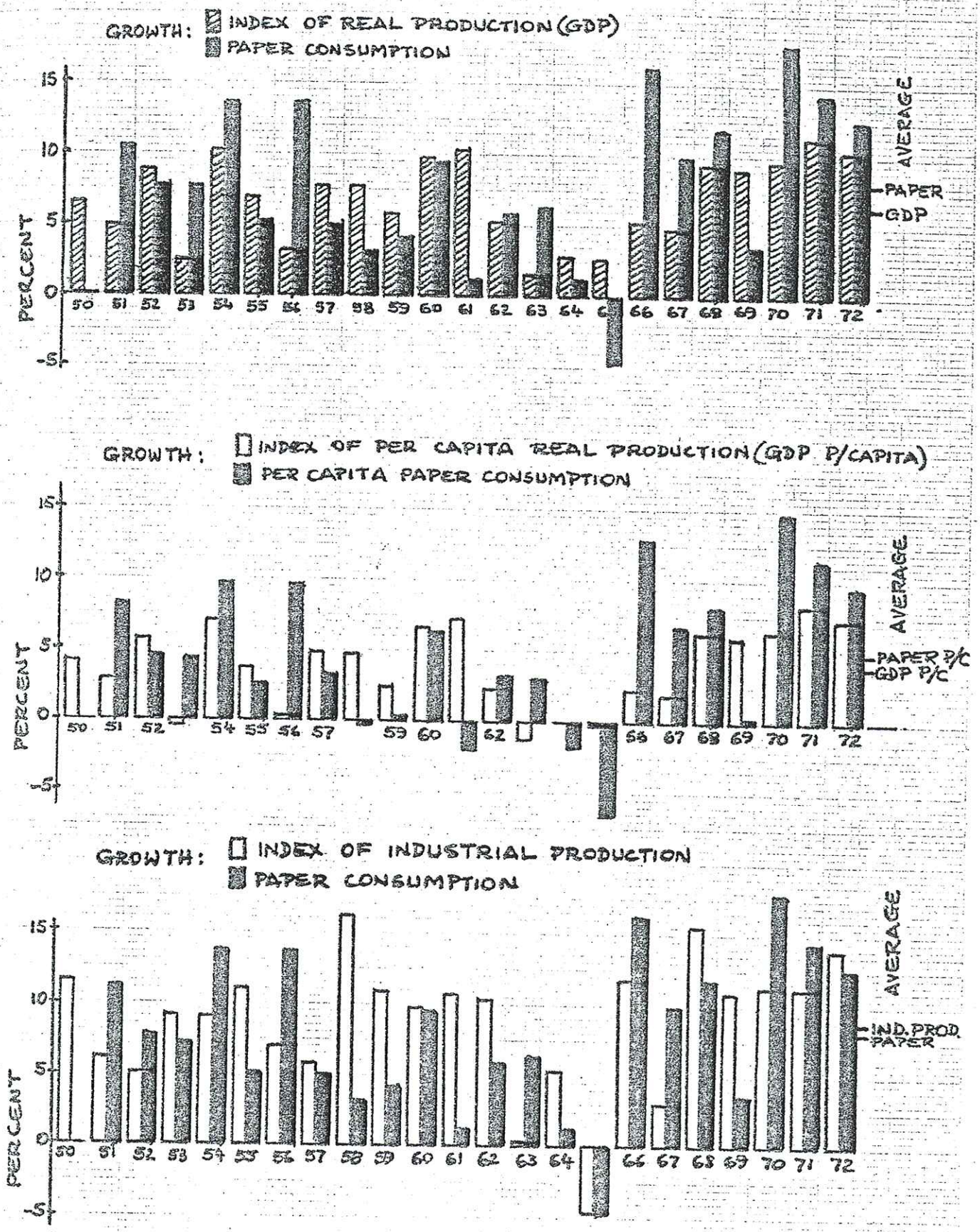
Table 3-2. -- ELASTICITY OF INCOME WITH RESPECT TO PAPER CONSUMPTION

period	total paper consumption and total GDP $\frac{\Delta Q/Q}{\Delta GDP/GDP}$	per capita paper consumption and per capita GDP $\frac{\Delta q/q}{\Delta pcGDP/pcGDP}$
1950-55	1.29	1.50
1955-60	1.03	1.00
1960-65	0.41	-0.65
1965-70	1.50	1.80
1970-72	1.22	1.28
1968-72	1.17	1.27

Note: ΔQ and Δq - change in quantity (total and per capita paper consumption); ΔGDP and $\Delta pcGDP$ - change in GDP (total and per capita).

FIGURE 3.2.

ANNUAL PERCENTAGE CHANGE - BRAZIL



Except for the period of 1960-65, when the country was in a state of great political change, the indexes of elasticity of income with respect to paper consumption show that a unit increase in income corresponds to more than a unit increase in consumption of paper. From this historical analysis we can assume that a similar relationship will hold during the next twelve years; i.e., consumption of paper rising at a faster rate than the economy as a whole. From analyses of paper consumption in other countries(3), history shows that a 'saturation' level of paper consumption in Brazil is far from being reached, and that the market for paper will continue to expand along with expansion of the economy.

Assumptions

Any study of future trends, such as this forecast, has the disadvantage of dealing with an unknown future. An important factor in forecasting is the availability and accuracy of future values of the independent variables. These values can only be derived from projections. They also include assumptions and their accuracy depends upon the clarity of the forecaster's vision of the future.

This study was carried out using the goals and economic policy established by the Government for the 1970's. An assumption is made that these goals will be achieved. The economic policy of the Government is to assure that the economy grows by eight to ten percent per year. The main goal is to double average per capita income in the

(3) FAO/UN, "World Demand for Paper to 1975", Rome, Italy, 1960.

period from 1969 to 1980(4). The achievement of these goals depends on the economic drive of a Government that has proven during the last five years to be capable of reaching such goals. As a matter of fact, the growth obtained in the last five year period has been higher than the established goal (see Table 2-1). For the purpose of this study it has been assumed that the economy will reach the average growth of nine percent per year, while the industry will grow at a rate of eleven percent per year. It is also assumed that this growth will continue through 1985. For the sake of comparison an alternative hypothesis has been assumed, i.e., economic growth of seven percent per year. This is an attempt to provide more realistic forecasts in the event of possible decrease in the anticipated growth rate. Also, a range will thus be obtained in the projections of paper consumption.

From these established overall goals it has been possible to project the indexes of future values of GDP, per capita GDP, and industrial production. These projections are shown in Table 3-3.

Population is another of the independent variables. Projections to 1980 are available(5). The projections 1980-85 have been produced for a population growth of 2.7 percent per year, based on analysis of Figure 3-3; it is assumed that birth rate and death rate will decrease in the next decade in the same proportion as in the last decade. Therefore, population growth rate will decrease by as much as it did in the last decade.

(4) Brasil, "Sintese: Metas e Bases para Açao do Governo", September 1970, pp. 19-20.

(5) J. L. Madeira and C. C. Simoes, "Estimativas da populacao urbana e rural, segundo unidades da Federacao, de 1960/1980 por uma nova metodologia", IBGE, Boletim Demografico CBED, vol. 2, no. 4, 1972.

Table 3-3. --POPULATION AND ECONOMIC GROWTH: PROJECTIONS 1973-1985

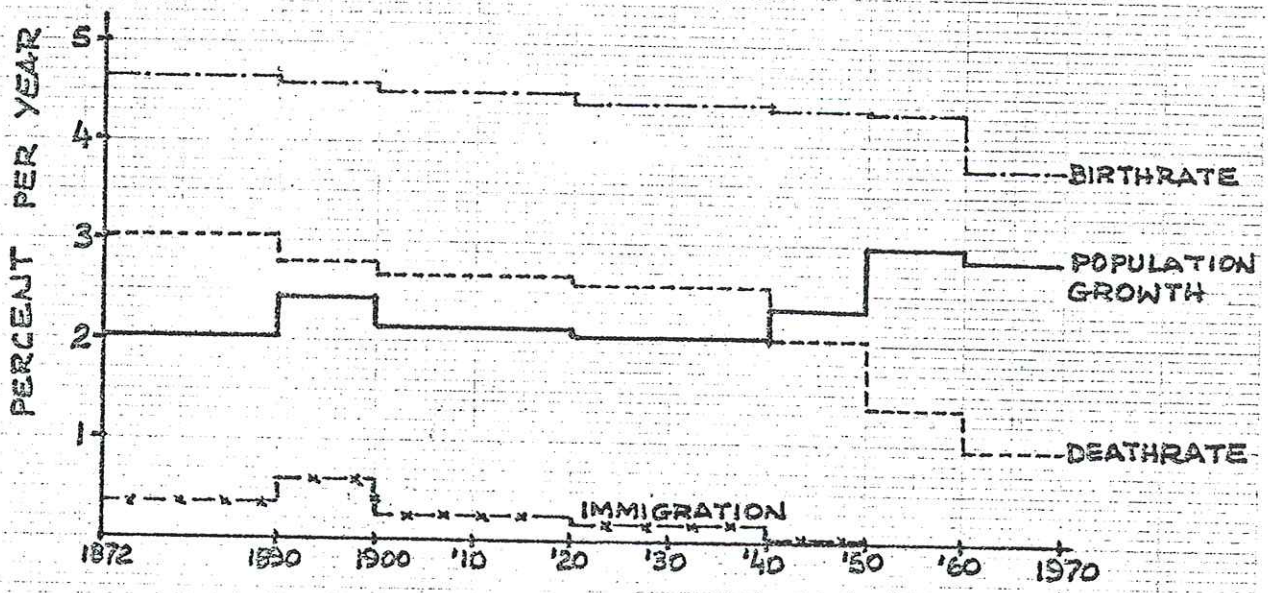
Year	Population[a] (millions)	Indexes (1949=100)					
		GDP		Per capita GDP		Ind. production	
		9%	7%	6.2%	4.2%	11%	9%
		(.....hypotheses of economic growth.....)					
1972	98.85	452.7		234.0		647.5	
		Projections					
1973	101.70	493.4	484.3	248.5	243.8	718.7	705.7
1974	104.64	537.8	518.2	262.9	254.0	797.7	769.2
1975	107.66	586.2	554.5	280.2	264.7	885.5	838.5
1976	110.76	639.0	593.3	297.6	275.8	982.9	913.9
1977	113.96	696.5	634.9	316.1	287.4	1091.0	996.2
1978	117.25	759.2	679.3	335.7	299.5	1211.0	1085.9
1979	120.63	827.5	726.9	356.5	312.0	1344.3	1183.6
1980	124.11	902.0	777.8	378.6	325.2	1492.1	1290.1
1981	127.46*	983.2	832.2	402.4*	339.1*	1656.3	1406.3
1982	130.90*	1071.7	890.5	427.7*	353.7*	1838.5	1532.8
1983	134.43*	1168.1	952.8	454.7*	368.9*	2040.7	1670.8
1984	138.06*	1273.2	1019.5	483.4*	384.8*	2265.2	1821.1
1985	141.79*	1387.8	1090.9	513.8*	401.3*	2514.4	1985.1

*Assuming a population growth of 2.7 percent per year.

Sources: [a]Instituto Brasileiro de Estatistica(IBGE),"Estimativas da populaçao urbana e rural, segundo as Unidades da Federaçao, de 1960/1980 por uma nova metodologia", by J.Lyra Madeira and C.C.Simoes, Boletin Demografico CBED, vol.2, no.4, April/June 1972, Rio de Janeiro, 1972

FIGURE 3.3.

1872-1970 DEMOGRAPHIC MEASURES-BRAZIL



SOURCE: IBGE, INSTITUTO BRASILEIRO DE ESTATISTICA, BOLETIM DEMOGRAFICO

An important activity that is expected to have a positive effect on future paper consumption is the education program being carried out in the country. Recent information indicates that illiteracy is decreasing rapidly and that the Government target is to achieve 90 percent literacy by 1980(6). To some extent degree of literacy is also associated with income level. Should, however, literacy rise faster (or slower) than income, its effect on paper consumption will not be taken into account in the model.

Projections of Paper Consumption: 1973-1985

Based on the assumptions stated above and using stepwise regression equations, consumption for the various types of paper has been projected (forecasted) for the period from 1973 to 1985. Two levels of projections have been worked out, one for an economic growth of nine percent per year, and one for an economic growth of seven percent per year. The results are presented in Tables 3-4 and 3-5 respectively.

As the reader will notice, for both levels of projections and for each type of paper an upper (H) and a lower (L) limit have been forecasted from the results of the different equations. Therefore, the results represent a range of projections that seems to be more realistic than a single extrapolation of each model. All the projections are shown graphically in Figures 3-4 to 3-9 where the reader can more easily observe the development of future trends and their relationship with past trends, as well as observe the range between upper and lower

(6) Brazilian Consulate General, Brazilian Bulletin, vol. 27, no. 548, Jan. 1973, New York, p. 6.

Table 3-4. -- PAPER CONSUMPTION: PROJECTIONS 1973-1985

Bases for projections:
GDP: 9%/year
Per capita GDP: 6.2%/year
Industrial productions: 11%/year

(thousand metric tons)

year	all papers		Writing & Printing		Newsprint		Packaging & Cardboard & Paperboard		Industrial & Others	TOTAL (sum)		per capita paper consumption (kilos)[a]	
	H	L	H	L	H	L	H	L	H&L	H	L	H	L
1973	1881	1875	433	433	299	299	978	978	140	1850	1850	18.5	18.1
1974	2103	2081	487	487	319	319	1092	1092	157	2055	2055	20.1	19.6
1975	2357	2306	547	547	341	341	1219	1219	174	2281	2281	21.9	21.1
1976	2647	2550	614	614	365	365	1360	1360	194	2533	2533	23.9	22.8
1977	2962	2828	689	689	392	392	1534	1517	215	2830	2813	26.0	24.6
1978	3330	3127	773	773	422	413	1727	1692	238	3160	3116	28.4	26.5
1979	3739	3455	869	867	455	435	1944	1886	263	3531	3451	31.0	28.6
1980	4207	3816	983	972	492	456	2188	2101	290	3953	3819	33.9	30.7
1981	4728	4213	1113	1088	533	479	2463	2339	320	4429	4226	37.1	33.1
1982	5314	4649	1259	1216	578	502	2771	2601	352	4960	4671	40.6	35.6
1983	5982	5126	1424	1359	629	525	3117	2892	388	5558	5164	44.5	38.4
1984	6723	5649	1610	1518	685	548	3506	3213	426	6227	5705	48.7	41.3
1985	7557	6220	1820	1694	747	570	3943	3567	467	6977	6298	53.3	44.4

H - upper limit; L - lower limit

[a]Per capita paper consumption: 'H' derived from upper limit in projections of 'all papers': 'L' derived from lower limit of the sum of individual projections.

Table 3-5. -- PAPER CONSUMPTION: PROJECTIONS 1973-1985

Bases for projections:
GDP: 7%/year
Per capita GDP: 4.2%/year
Industrial production: 9%/year

(thousand metric tons)

year	all papers		Writing & Printing		Newsprint		Packaging & Cardboard & Paperboard		Industrial & Others		TOTAL (sum)		per capita paper consumption (kilos)[a]	
	H	L	H	L	H	L	H	L	H	L	H	L	H	L
1973	1840	1795	420	420	296	296	949	944	127	136	1792	1796	18.1	17.6
1974	2009	1965	461	461	307	307	1052	1025	139	147	1959	1940	19.2	18.5
1975	2207	2137	513	513	329	316	1165	1111	151	159	2158	2099	20.5	19.5
1976	2425	2310	572	572	348	324	1290	1204	165	171	2375	2271	21.9	20.5
1977	2655	2498	638	638	368	331	1429	1304	180	185	2615	2458	23.3	21.5
1978	2919	2699	711	685	391	338	1582	1412	196	199	2880	2634	24.9	22.4
1979	3208	2917	792	752	410	345	1751	1528	214	215	3167	2905	26.6	24.0
1980	3537	3151	881	826	442	351	1937	1652	233	231	3493	3060	28.5	24.6
1981	3887	2405	979	906	471	357	2142	1787	255	249	3847	3299	30.5	25.8
1982	4280	3678	1088	993	502	363	2367	1932	278	268	4235	3556	32.7	27.1
1983	4705	3974	1208	1088	537	368	2614	2087	303	288	4662	3831	35.0	28.5
1984	5177	4291	1340	1191	574	372	2886	2254	330	310	5130	4127	37.5	29.9
1985	5699	4632	1487	1303	615	374	3186	2434	360	332	5648	4443	40.2	31.3

H - upper limit; L - lower limit

[a]Per capita paper consumption: 'H' derived from upper limit in projections of 'all papers': 'L' derived from lower limit of the sum of individual projections.

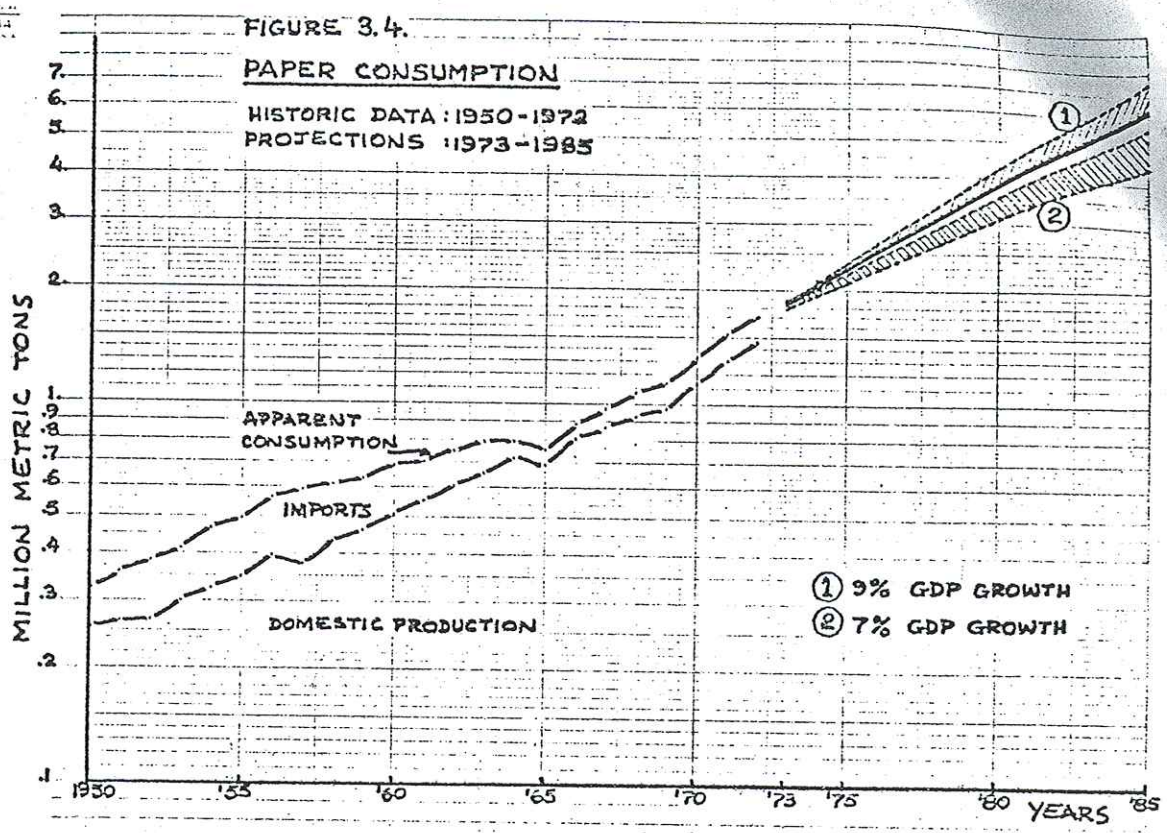


FIGURE 3.4.
PAPER CONSUMPTION
HISTORIC DATA: 1950-1972
PROJECTIONS: 1973-1985
MILLION METRIC TONS
APPARENT CONSUMPTION
IMPORTS
DOMESTIC PRODUCTION
① 9% GDP GROWTH
② 7% GDP GROWTH
YEARS

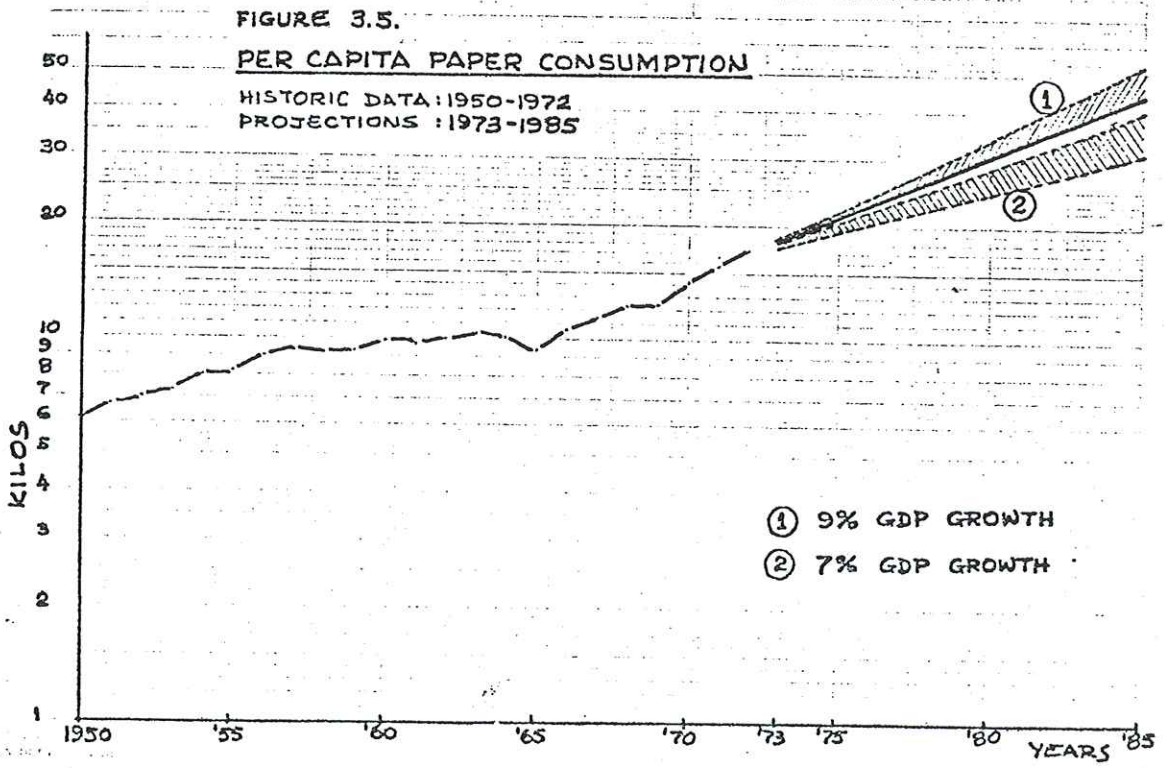


FIGURE 3.5.
PER CAPITA PAPER CONSUMPTION
HISTORIC DATA: 1950-1972
PROJECTIONS: 1973-1985
KILOS
① 9% GDP GROWTH
② 7% GDP GROWTH
YEARS

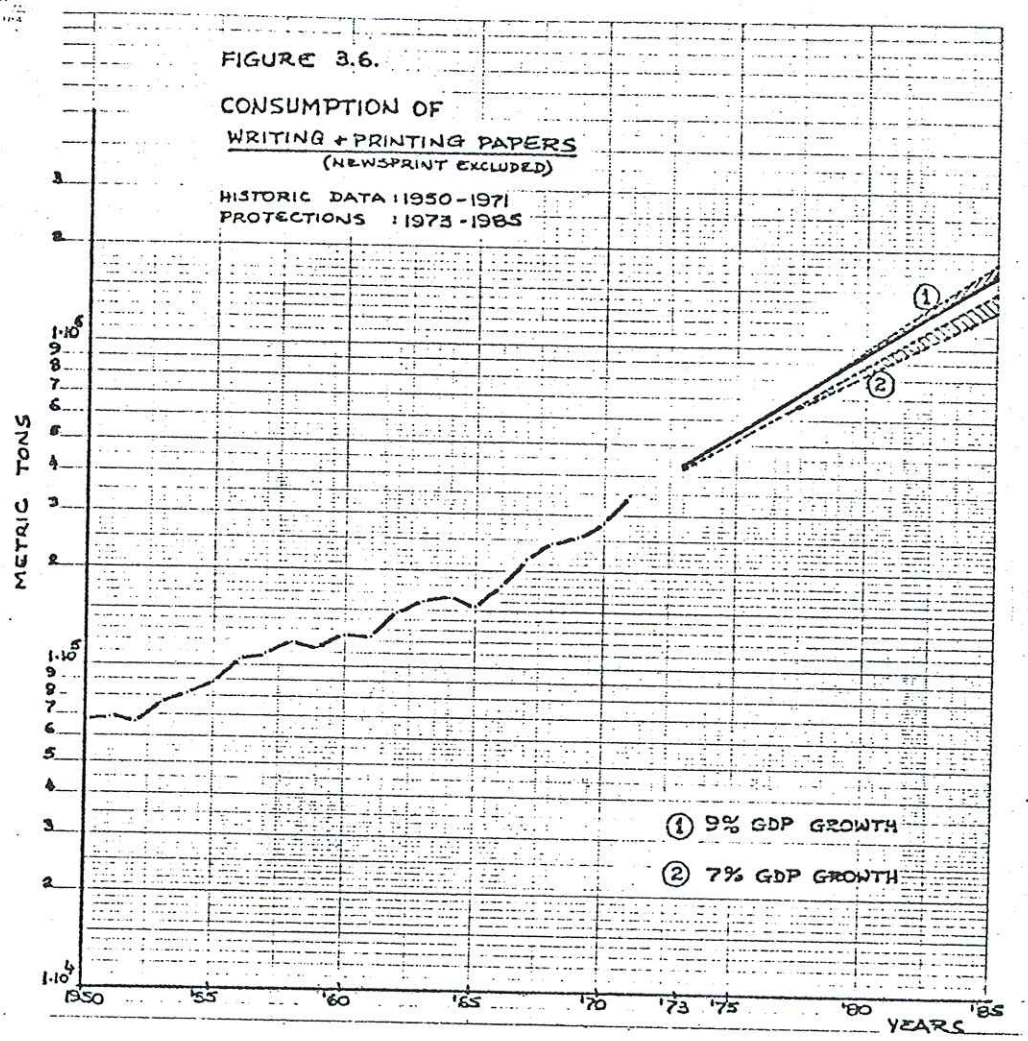


FIGURE 3.6.
CONSUMPTION OF
WRITING + PRINTING PAPERS
(NEWSPRINT EXCLUDED)
HISTORIC DATA : 1950-1971
PROTECTIONS : 1973-1985
METRIC TONS
1·10^6
1·10^5
1·10^4
1950
'55
'60
'65
'70
'73
'75
'80
'85
YEARS
① 9% GDP GROWTH
② 7% GDP GROWTH

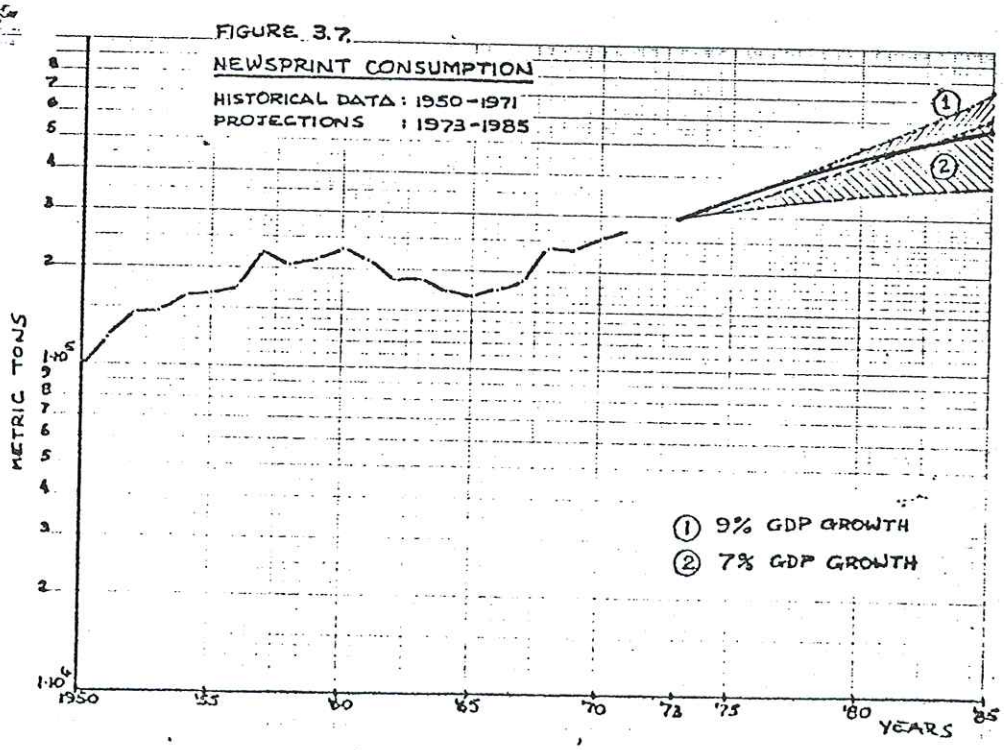


FIGURE 3.7.
NEWSPRINT CONSUMPTION
HISTORICAL DATA : 1950-1971
PROTECTIONS : 1973-1985
METRIC TONS
1·10^5
1·10^4
1950
'55
'60
'65
'70
'73
'75
'80
'85
YEARS
① 9% GDP GROWTH
② 7% GDP GROWTH

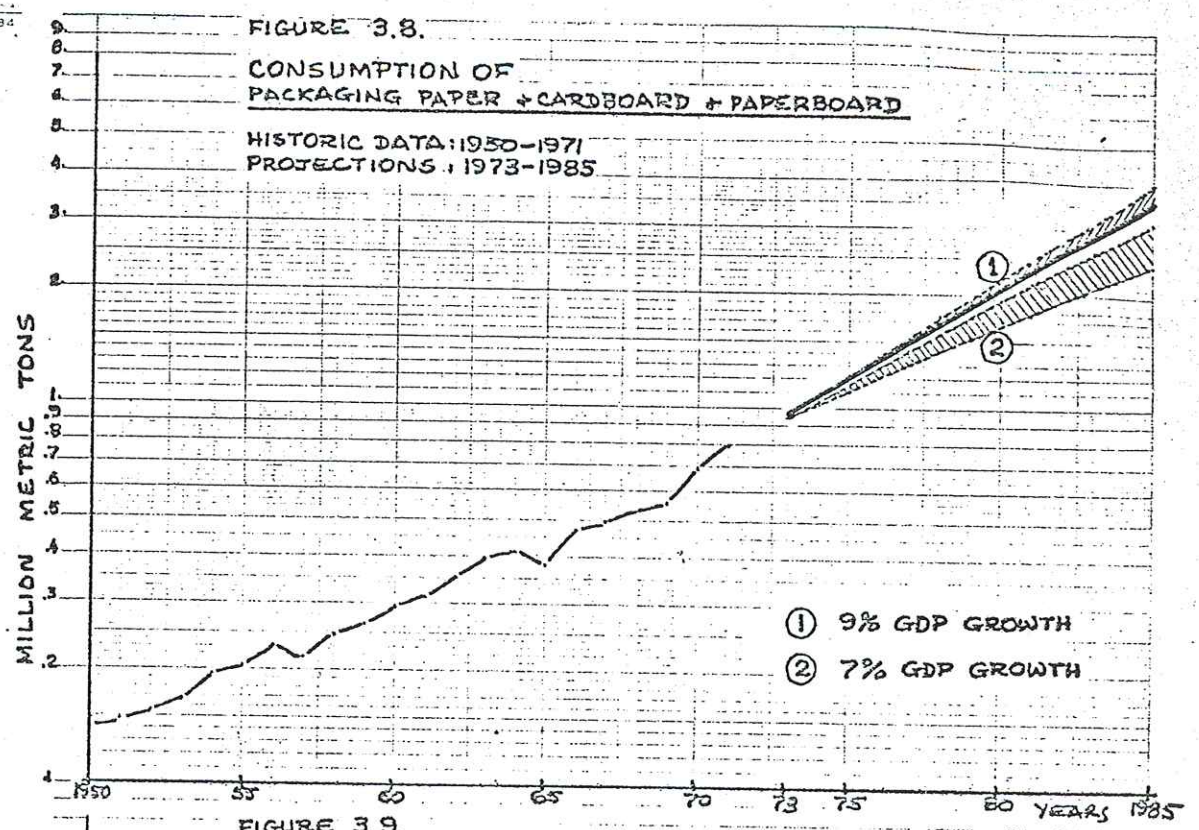


FIGURE 3.8.
CONSUMPTION OF
PACKAGING PAPER + CARDBOARD + PAPERBOARD
HISTORIC DATA: 1950-1971
PROJECTIONS : 1973-1985
MILLION METRIC TONS
1 9% GDP GROWTH
2 7% GDP GROWTH
1950
55
60
65
70
73
75
80
YEARS
1985

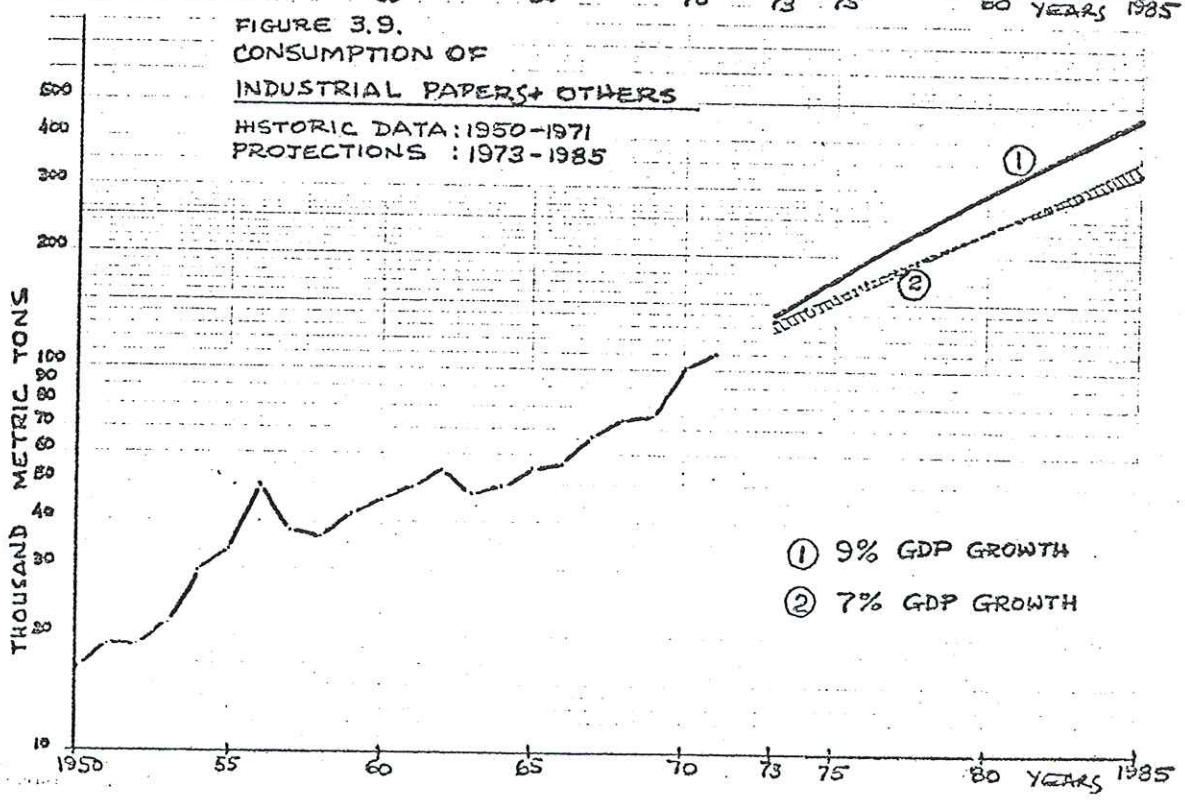


FIGURE 3.9.
CONSUMPTION OF
INDUSTRIAL PAPERS + OTHERS
HISTORIC DATA: 1950-1971
PROJECTIONS : 1973-1985
THOUSAND METRIC TONS
1 9% GDP GROWTH
2 7% GDP GROWTH
1950
55
60
65
70
73
75
80
YEARS
1985

limits of projections for each hypothesis of economic growth.

However, projections of future trends for paper consumption were an intermediate step in this study, carried out to forecast future consumption of pulp and, finally, pulpwood. To accomplish the final objective it was necessary to select the future level of paper consumption that would be used as a basis for the forecast of pulp consumption. This selection was done using the following analysis of the obtained forecasts: the range of projections calculated at the level of seven percent economic growth are assumed to be too conservative and do not fit into the actual economic planning of the country. On the other hand, the upper limit of projections calculated at the level of nine percent economic growth is assumed to be too optimistic. Consequently, the lower limit of projections at the level of nine percent economic growth seems to represent a realistic (and conservative) estimate of future trends of paper consumption. The reader will observe that this limit has been drawn in Figures 3.4 to 3.9 as a continuous line.

These selected projections that have been the basis for the forecast of future consumption of pulp are summarized in Table 3-6.

The projections shown in Table 3-6 have been expressed graphically in Figures 3.10 and 3.11 in order to illustrate the composition or the 'structure' of the forecasted market for the different types of paper.

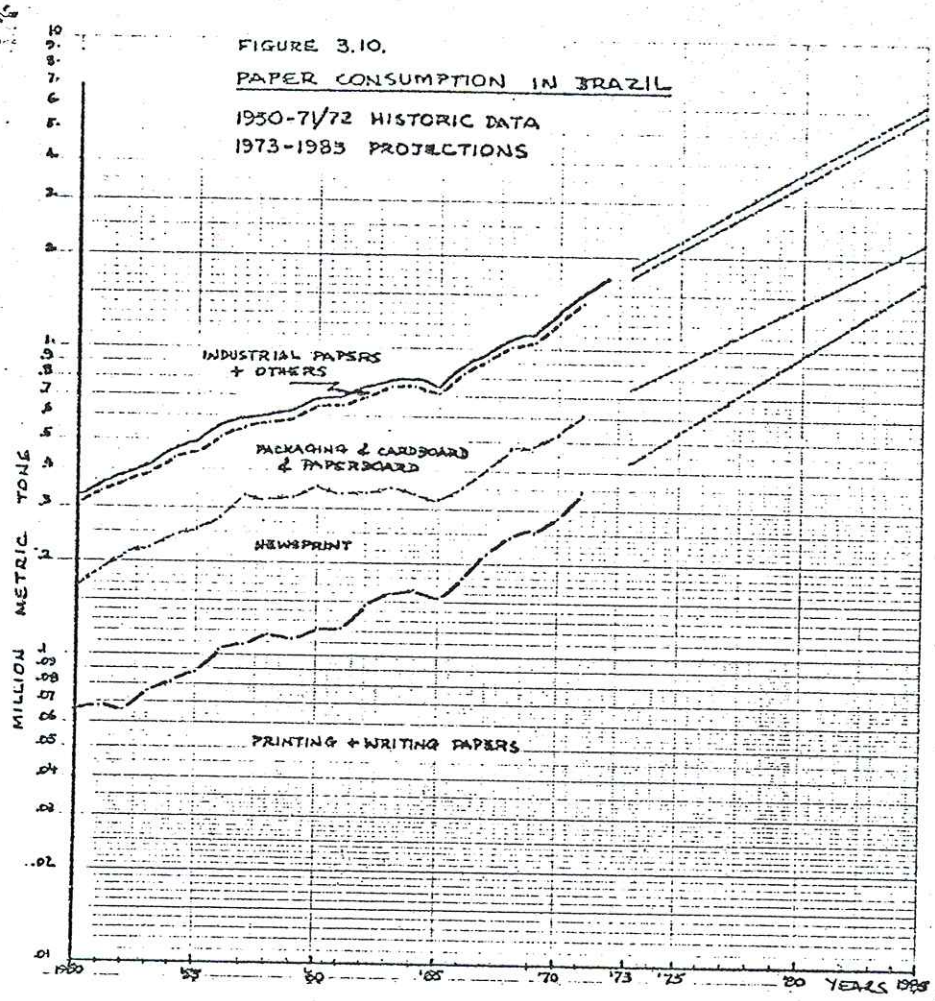


FIGURE 3.10.
PAPER CONSUMPTION IN BRAZIL
1950-71/72 HISTORIC DATA
1973-1985 PROJECTIONS
INDUSTRIAL PAPERS + OTHERS
PACKAGING & CARDBOARD & PAPERBOARD
NEWSPRINT
PRINTING + WRITING PAPERS
MILLION METRIC TONS
YEARS

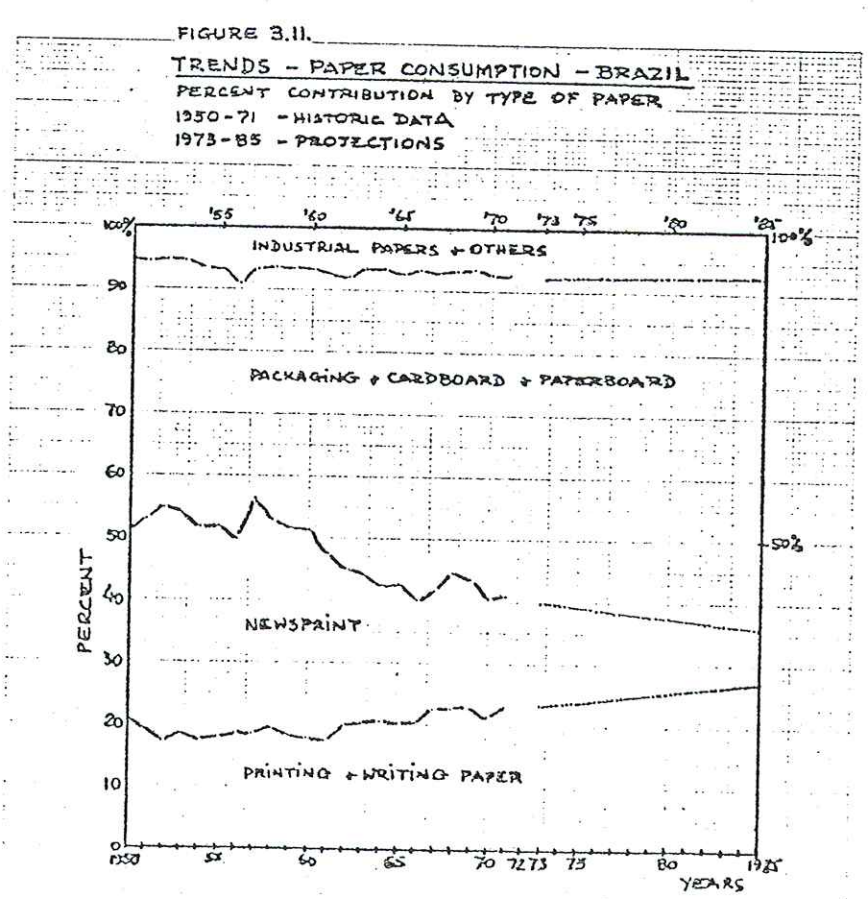


FIGURE 3.11.
TRENDS - PAPER CONSUMPTION - BRAZIL
PERCENT CONTRIBUTION BY TYPE OF PAPER
1950-71 - HISTORIC DATA
1973-85 - PROJECTIONS
INDUSTRIAL PAPERS + OTHERS
PACKAGING + CARDBOARD + PAPERBOARD
NEWSPRINT
PRINTING + WRITING PAPER
PERCENT
YEARS

Table 3-6. -- FUTURE PAPER CONSUMPTION: 1973-1985

(Thousand metric tons)

Year	Writing & Printing	Newsprint	Packaging & Cardboard & Paperboard	Industrial & Others	TOTAL (sum)
1973	433	299	978	140	1850
1974	487	319	1092	157	2055
1975	547	341	1219	174	2281
1976	614	365	1360	194	2533
1977	689	392	1517	215	2813
1978	773	413	1592	238	3116
1979	867	435	1886	263	3451
1980	972	456	2101	290	3819
1981	1088	479	2339	320	4226
1982	1216	502	2601	352	4671
1983	1359	525	2892	388	5164
1984	1518	548	3213	426	5705
1985	1694	570	3567	467	6298

Future Production of Wood from Plantations

"Long-term forecasts or projections of supply might be made in order to understand any one of a whole array of different sort of economic problems. For example, the supply of standing timber might be forecasted for an area for dates in the future in order to determine whether or not additional land area should be used for timber growing.... The phrase 'long-term forecasting' embraces a good many types of problems. For each of these several types, the time horizon to be used, the selection of essential variables for study, and even the methodology may be different, depending on what is appropriate for the particular problem at hand"(7).

"...much greater difficulties arise when trying to forecast production (of wood) from privately owned woodlands because owners may have widely differ ing objectives and the felling

(7) H. J. Vaux, "Long Term Supply Forecasts", In Forecasting in Forestry and Economy, pp. 28-34, Folia Forestalia 101, Institutum Forestale Finniae, Helsinki, 1971.

on individual estates may vary drastically from year to year for very good reasons connected with changes in their personal circumstances"(8).

The citations above emphasize the situation faced by this wood supply study. First, long-term forecasting is necessary in order to determine whether or not the present reforestation program is large enough to meet the demands for wood as raw material. Second, long-term forecasting embraces many types of problems, as explained by Hummel and Davidson. For plantation of Eucalyptus, that was introduced in Brazil in the 1920's, a tradition of silvicultural practice exists. On the other hand, not much is known about Pinus plantations, which were started in the late 1950's. Furthermore, the scope of this study is wide and it is practically impossible, in a simple model of forecasting, to put together the various and different objectives of all the forest plantations owners in order to project future production of wood. However, through the survey for this study it was possible to assess the present growing stock in terms of area, species, age of plantations, and rate of growth.

These variables were essential for forecasting wood production. However, this projection is no more than a simple simulation, in which all woodland owners' interests are put together in terms of one common forest management regime.

This study would be considerably improved if the forest stands were delimited in homogeneous areas regarding species, growth rates,

(8) F. C. Hummel, and J. L. Davidson, "The Planning and Development of Market for Man-made Forests", VII World Forestry Congress, Buenos Aires, Argentina, 1972, p. 14.

and planned end uses for the wood under production. Information on cull and mortality of plantations would also improve the quality of the study. But a survey at such a level of detail cannot be carried out by simple means of a survey and in a short period of time.

Besides being a simple simulation, this forecast is expected to represent the physical situation regarding wood supply. Furthermore, this approach is essential to IBDF, so they might better assess the trends of future supply and demand of wood and, in this case, of pulpwood so as to satisfy more completely the needs of pulp and paper in the economy.

The effort in this study is also justified since the official forest policy is directed towards planted forests as the main source of pulpwood so as to save the remaining resources of Parana pine.

Pinus

Industrial plantations of Pinus were started in Brazil one decade ago. Therefore the country does not yet have experience over entire rotations of wood production with these species. However, many experiments are being observed and the first thinnings are already being used in pulp and particleboard production, and, on an experimental scale, in lumber production.

Great expectations exist that this softwood will serve as a substitute for Parana pine in long fiber pulp production. It is therefore important to take a closer look at what can be expected from

this new resource being created.

In order to better understand this new resource it is worthwhile to mention the way Pinus plantations are formed in Brazil. Instead of natural regeneration or direct seeding, the seedlings are planted systematically, either manually or mechanically. This results in a fairly homogeneous number of trees per hectare, ranging from 1,800 to 2,500 or an average of 2,000 trees per hectare. In general the soil requires extensive preparation and the stands are submitted to weed cleaning during the first two years in order to alleviate space competition. In a recent study(9) it has been estimated, based on height measurements, that the plantations have an average yield per hectare ranging from 16 to 34 steres/ha/year. However, as the forest plantation program proceeds, special attention is being given to the ecological suitability of the species, which has improved considerably the yields per hectare. The low yield per hectare of 16 steres is due especially to the plantations created during the early stages of the program when species were planted outside regions of proper ecological conditions.

In the study mentioned above it is estimated that for a rotation length of 35 years in most plantations, an average yield per hectare of 22 steres per year can be expected. However, rotation length will depend upon the culmination of the annual growth in volume, as well as on the planned uses for the wood. According to Koch(10),

(9) L. Golfari, "Conifers Suitable for Reforestation in the States of Parana, Santa Catarina, and Rio Grande do Sul", FAO/UN, Rome, 1970, p. 38.

(10) P. Koch, Utilization of the Southern Pines, USDA Forest Service, Agriculture Handbook no. 420, Washington, D.C., 1972, p. 29.

Pinus elliottii on its best sites in the USA has annual growth (in volume) culminating at about 20 years of age, and falling off gradually thereafter. Nevertheless, comparisons of yields in Brazil and USA are questionable because the best yield per hectare in the USA corresponds to a low one in Brazil. Only after a full cycle of large plantations can comparisons be made and evaluated.

In order to carry out the present study it was necessary to use a simulation of a regime of thinnings for a rotation length of 25 years. This simulation is based on figures estimated and published by the Forest Institute of Sao Paulo(11). The figures are shown in Table 3-7. These figures compare favorably with the general thinking regarding silvicultural management of Pinus plantations throughout Southern States of Brazil. Besides, the figures are based on an average growth of 23 steres/ha/year that, as explained by the authors, is considered to be a low average so as to allow for those plantations which are not properly located according to ecological considerations. These figures were prepared for the conditions of Sao Paulo State but they can be extended to the other States since plantations, outside Sao Paulo, tend to have an overall average growth of approximately 25 steres/ha/year(12). It is also preferable to work with low estimates, as they provide a margin of security in terms of forecasts.

Table 3-7 represents "potential" yield. It is based on basal area and volumetric growth assuming the application of a thinning

(11) M. A. Victor et al., "Evoluçao, Estagio Atual e Perspectivas das Florestas Exoticas em Sao Paulo", Instituto Florestal de Sao Paulo, Boletin no. 1, 1972, p. 27.

(12) L. Golfari, Personal Communication, (Belo Horizonte, 1973).

Table 3-7. -- YIELD PER HECTARE - PINUS

thinning	age (years)	pulpwood (steres, debarked)	sawlogs (m3, debarked)
First	7	51	-
Second	11	60	-
Third	15	58	5
Fourth	20	76	19
Final cut	25	108	76

Source: Instituto Florestal de Sao Paulo, Boletin no. 1, 1972, for a yield of 23 steres/ha/year, volume with bark, or 20 steres/ha/year bark excluded; bark content = 15 percent

treatment that does not result in a loss of increment of growth. After the second thinning, the figures are projections carefully elaborated in order to best represent expected future production. To a certain extent the figures in Table 3-7 represent mandatory cuttings (or thinnings) if wood production is to be maximized in such dense plantations. Other tentative projections have been made(13) in order to estimate the potential yield from plantations, but they are based on higher yield per hectare. It is for this reason that Table 3-7 represents a more reliable basis for forecasting.

The area estimated as planted with Pinus, by State, is given in Table 3-8. From 1967 on, the figures represent mainly the area of tree planting projects approved by IBDF. It is also assumed in Table 3-8 that Pinus plantations will continue to be developed up to 1980 at

(13) IBDF, "Zoneamento Economico Florestal do Estado de Santa Catarina", 1970, pp. 33-36; and "Zoneamento Economico Florestal do Estado do Rio Grande do Sul", 1971, pp. 66-72.

1972 rates,

Table 3-8. -- PINUS PLANTATIONS

(Thousand hectares)

year	States					TOTAL	Special region
	Sao Paulo (a)	Parana (b)	Santa Catarina (c)	Rio Grande do Sul (d)	Minas Gerais (f)		South of Sao Paulo (g)
1960	2	-	-	-	-	2.	.6
1961	3	.4	-	-	-	3.4	1.5
1962	4	.1	-	-	-	4.1	2.8
1963	13	.2	.3	-	-	13.5	1.7
1964	14	.8	1.6	-	-	16.4	1.5
1965	8	1.4	1.3	-	-	10.7	1.3
1966	6	.7	2.	-	-	8.7	1.8
1967	20	4.	5.	2.1	.5	31.6	8.4
1968	23	16.	13.	4.2	1.3	57.5	13.8
1969	24	25.	16.	6.5	1.7	73.2	23.8
1970	20	38.	18.	6.2	6.7	88.9	11.3
1971	23	45.	20.	4.7	8.0	100.7	13.7
1972	20	45.	20.	6.3	8.7	100.	15.
to 1972	180	176.6	97.2	30.0	26.9	510.7	97.2
			Projections				
1973 ⇓	20.	45.	20.	6.	10.	100.	15.
1980	20.	45.	20.	6.	10.	100.	15.

Sources: (a) Instituto Florestal de Sao Paulo; (b) IBDF Parano regional office, 20,000 ha of Araucaria excluded; (c) and (d) IBDF; (f) IBDF/Comissao de Zoneamento Economico Florestal; (g) IBDF regional office survey around Capao Bonito and Cerqueira Cesar.

In the simulation, by associating the thinning regime of Table 3-7

and the areas from Table 3-8, it was possible to derive the forecasts or projections of pulpwood physical supply that is shown in Table 3-9. The figures represent the volume of pulpwood (or wood) that is expected to be available for industrial uses on a yearly basis. As stated earlier, only 80 percent of the area was considered for the calculation of pulpwood production, in order to compensate for tree-planting projects not implemented.

Table 3-9. -- PULPWOOD PRODUCTION - PINUS: 1974-1985

(million steres, debarked wood)

year	States					TOTAL	Special region
	Sao Paulo	Parana	Santa Catarina	Rio Grande do Sul	Minas Gerais		South of Sao Paulo
1974	1.44	.17	.22	.09	.02	1.94	.50
1975	1.70	.69	.61	.17	.05	3.22	.79
1976	1.50	1.10	.72	.27	.07	3.66	1.30
1977	1.29	1.59	.83	.25	.27	4.23	.80
1978	2.50	2.04	1.07	.29	.35	6.25	1.23
1979	2.57	2.64	1.51	.45	.41	7.58	1.59
1980	2.46	3.10	1.64	.56	.49	8.25	2.19
1981	2.24	3.72	1.77	.54	.73	9.00	1.57
1982	3.09	4.19	2.01	.57	.82	10.68	2.17
1983	3.63	4.75	2.40	.74	.88	12.40	2.46
1984	3.74	5.20	2.62	.83	.97	13.36	3.01
1985	3.36	5.84	2.69	.82	1.20	13.91	2.36

Note: For further information on the method of calculation and results, see Tables A-1 to A-7 in Appendix A.

For the forecast of pulpwood production it was possible to

separate the pulpwood coming from trees to be cut before reaching eleven years to age. This pulpwood was called juvenile ('immature') wood due to its shorter fibers and lower specific gravity(14). Juvenile wood has a lower pulp yield. This study does not go further into the details in this respect, but an evaluation of the volume of juvenile wood can be found in Tables A-1 to A-7 in Appendix A.

The same plantations of Pinus will produce material, after 14 years of age, with large enough diameters to be used in conventional sawmills. The volume of wood for this purpose is not included in Table 3-9. For the reader's information, volume of harvestable sawlogs is shown in Table 3-10. These projections were obtained in a way similar to the pulpwood projections, based on Tables 3-7 and 3-8.

The total prospective harvestable wood volume (pulpwood and sawlogs) would be obtained by adding figures of Tables 3-9 and 3-10.

The volume of sawlogs in Table 3-10 is based on diameters presently used in sawmilling in Brazil. Moreover, available sawmilling technology is considerably advanced and in more developed countries (or where timber is more scarce) logs of very small diameters are utilized in sawmills. This is especially prevalent where the chip-and-saw or chipping headrigs systems are used for simultaneous production of chips and lumber(15). Pulpmills in Brazil are not yet prepared to receive chips in the woodyards, but if this is made possible, a substantial volume of pulpwood could be directed to lumber production first. If this

(14) C. E. B. Foelkel, "Unbleached Kraft Pulp Properties of Some of the Brazilian and U.S. Pines", M.S. Thesis, State University of New York, College of Environmental Science and Forestry, Syracuse, New York, August 1973, p. 6.

(15) Koch, op. cit., pp. 832-835.

Table 3-10. -- HARVESTABLE SAWLOGS VOLUME - PINUS: 1974-1985

(million m3, debarked round wood)

year	States					TOTAL	Special region
	Sao Paulo	Parana	Santa Catarina	Rio Grande do Sul	Minas Gerais		South of Sao Paulo
1974							
1975	.01					.01	
1976	.01					.01	.01
1977	.02					.02	.01
1978	.05					.05	.01
1979	.06		.01			.07	.01
1980	.06	.01	.01			.08	.02
1981	.07	.01	.01			.09	.04
1982	.14	.02	.02	.01		.19	.09
1983	.29	.07	.06	.02	.01	.45	.10
1984	.31	.11	.09	.03	.01	.55	.14
1985	.32	.17	.09	.02	.03	.63	.12

Note: Blank spaces relate to an annual production inferior to 10,000 m3. For further information on the method of calculation and results, see Tables A-1 and A-7, Appendix A.

development occurs, this study must be revised.

Eucalyptus

The forecast for pulpwood production from Eucalyptus plantations was done like that for production from Pinus. The most common rotation length in practice was associated with area and regime of clear-cuttings. Table 3-11 shows the data used for the projections of Eucalyptus pulpwood production.

Table 3-11. -- YIELD PER HECTARE - EUCALYPTUS

(steres, debarked wood)

State	First cut 7-8th year	Second cut 13th year	Third cut 18th year
Sao Paulo[a]	191	96	81
Minas Gerais[a]	191	96	81
Parana[a]	191	96	81
Espirito Santo[b]	208	145	105
Rio Grande do Sul[b]	208	145	105

Sources: (a) Instituto Florestal de Sao Paulo, Boletin no. 1, for 24 steres with bark/ha/year or 20.4 steres/ha/year, bark excluded; bark content = 15 percent.
(b) A. G. Bastos, IBDF/Comissao de Zoneamento de Minas Gerais, for 30 steres with bark/ha/year or 25.4 steres debarked wood/ha/year.

For the States of Sao Paulo, Minas Gerais, and Parana the yield per hectare adopted (24 steres with bark/ha/year) is based on the experience of the Forest Institute of Sao Paulo(16). As recognized by the authors, the figures are pessimistic (low average) but they were selected purposefully to stay within a margin of security in the evaluation of wood production. Experience with Eucalyptus plantations in Sao Paulo State began in the early 1920's, implying that this source of information is reliable.

The areas of the more recent Eucalyptus plantations in Rio Grande do Sul and Espirito Santo States are estimated, according to interviewed personnel(17), to have a higher yield per hectare. The

(16) Victor et al., op. cit.

(17) Personal communication, J. Mascarenhas (Vitoria, 1973), L. Golfari (Belo Horizonte, 1973).

Table 3-12. -- EUCALYPTUS PLANTATIONS

('000 ha)

year	Sao Paulo (a)	Minas Gerais (b)	Parana (c)	Rio Grande do Sul (d)	Espirito Santo (e)	TOTAL
1956	10	6	-	-	-	16
1957	10	7	-	-	-	17
1958	10	6	-	-	-	16
1959	10	8	-	-	-	18
1960	10	10	-	-	-	20
1961	10	11	.6	-	-	21.6
1962	15	7	.4	-	-	22.4
1963	27	9	.2	-	-	36.2
1964	23	6	.1	-	-	29.1
1965	9	4	.1	-	-	13.1
1966	28	6	.3	-	-	34.3
1967	10	10	.7	-	1	21.7
1968	22	12	.5	1.2	3	38.7
1969	17	24	1.0	2.3	5	49.3
1970	21	38	1.4	4.1	8	72.5
1971	54	42	4.	4.4	10	114.4
1972	50	54	4.	5.	18	131.
up to 1972	336	260	13.3	17.0	45	671.3
			Projections			
1973 ⇓ 1980	50	50	4.	8.	18	130.
	50	50	4.	8.	18	130.

Sources: (a) Instituto Florestal de Sao Paulo, Boletim no. 1,
(b), (c), (e) IBDF regional offices.
(d) IBDF regional office, information not available for plantations previous to 1968

average is around 30 steres/ha/year, volume with bark.

Table 3-12 shows the area estimated as reforested with Eucalyptus, by State. Table 3-12 includes plantations created since 1956 as explained in Chapter II.

By combining yield per hectare, area, and cutting regime, it was possible to derive the projections of pulpwood physical supply. The findings are in Table 3-13. Again, it is important to recall, as explained earlier, that the areas utilized in the calculations are 80 percent of the estimated area planted, given in Table 3-12.

Table 3-13. -- PULPWOOD PRODUCTION - EUCALYPTUS: 1974-1985

(million steres, debarked wood)

year	States						
	Sao Paulo	Parana	R. Gde. do Sul	Espirito Santo	Sub-Total	Minas Gerais	TOTAL
1974	5.69	.09			5.78	2.15	7.93
1975	3.33	.14		.17	3.64	2.52	6.16
1976	6.08	.09	.02	.50	6.69	2.91	9.60
1977	5.01	.16	.38	.83	6.38	4.65	11.03
1978	4.55	.22	.68	1.33	6.78	6.76	13.54
1979	11.05	.67	.73	1.66	14.11	7.59	21.70
1980	9.38	.69	.83	3.11	14.01	9.47	23.48
1981	11.08	.66	1.47	3.34	16.55	9.14	25.69
1982	10.44	.69	1.60	3.58	16.31	9.87	26.18
1983	9.84	.73	1.81	3.92	16.30	10.82	27.12
1984	13.60	.94	1.84	4.16	20.54	11.25	31.79
1985	12.13	.96	1.91	5.17	20.17	12.44	32.61

Note: Blank spaces relate to an annual production inferior to 10,000 m3. For further analysis of the results see Tables A-8 to A-12, Appendix A.

The production of wood in Minas Gerais State has purposely been added separately to the total. The steel and iron industry is heavily concentrated in this State and most of the wood produced there is under the control of this industry. A high percentage, 70 percent, of this wood will most likely be designated for charcoal production. However, plantations located in the extreme South-Western (Triangulo Mineiro region) and Southern parts of the State, because of the distance to the steel and iron mills, are assumed to be available for pulpwood purposes especially for the mills located in Sao Paulo State. Nevertheless, part of the Eucalyptus pulpwood will be used in Minas Gerais since one plant expansion (100t/d) plan and one new pulpmill project (750t/d) are under way (see Table 2-7).

CHAPTER IV

ANALYSIS OF RESULTS

One of the objectives of this study is to estimate future trends in pulpwood consumption. This will be done in this chapter. Based on comparisons of physical supply and consumption of pulpwood, the pulpwood balance is also presented.

Future Trends in Pulp and Pulpwood Consumption

For the projections of paper consumption, the equivalent consumption of pulp has been calculated. However, it was necessary to enter into details in order to determine the future consumption of long and short fiber pulp. The approach used is shown in Figure 4-1. The projections in this graph were arbitrarily drawn based on past trends, and on some assumptions justified by the following:

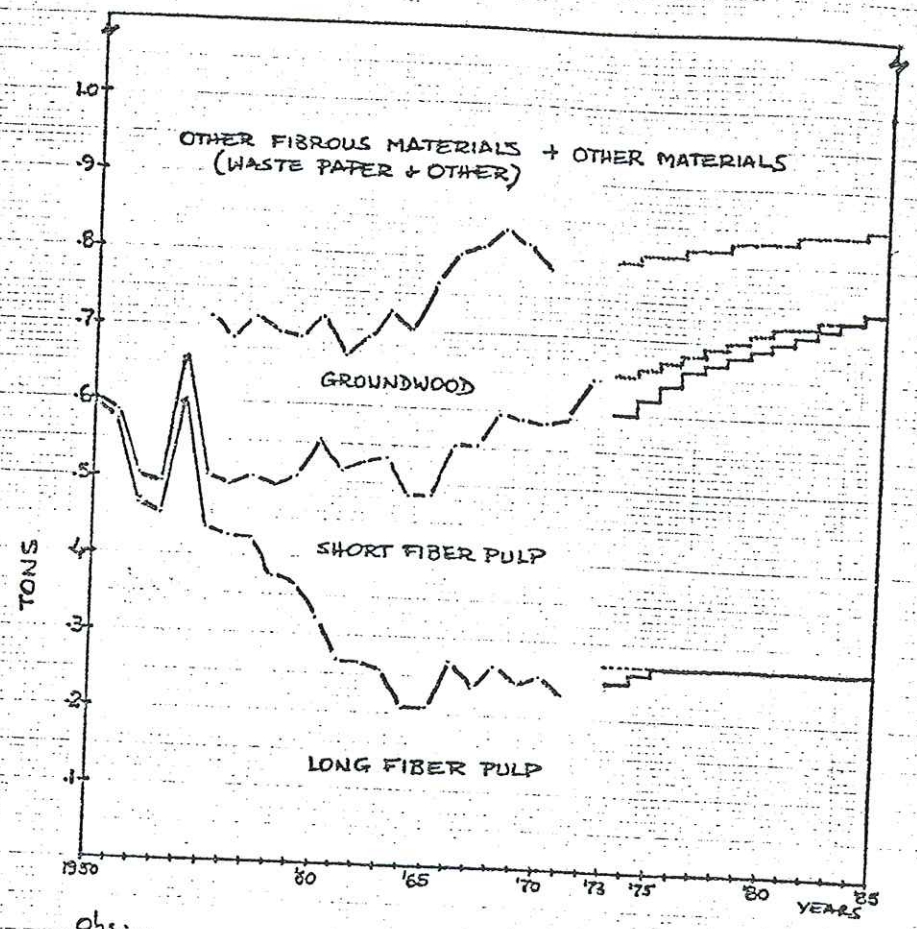
1. Consumption of virgin pulp per ton of paper has been rising steadily since 1965. This is due in part to difficulties in the allocation of increasing volumes of waste paper for recycling, and to improvements in paper quality. This trend, as a matter of fact, is similar to that of USA since the early 1940's, where an increase in the weight of virgin pulp per ton of paper produced can be observed(1). It is assumed that the contribution of virgin pulp per ton of paper produced will continue to rise in the period being studied.

2. Short fiber has replaced long fiber in the production of many

(1) D. Hair, "Use of Regression Equations for Projecting Trends in Demand for Paper and Board", US forest Service, Forest Resources Report no. 18, 1967, pp. 149-164.

FIGURE 4.1.

1950-1971/72 CONSUMPTION OF FIBROUS MATERIALS PER TON OF PAPER PRODUCED (TONS)
1973-1985: PROJECTION



Obs.:

— FUTURE TREND IF NEWSPRINT CONTINUES TO BE IMPORTED AS TRADITIONALLY

— CHANGE TO OCCUR IF ALL NEWSPRINT IS TO BE PRODUCED DOMESTICALLY

grades of paper. However, for the last five years the percent contribution of long fiber pulp has been constant, while the increasing percentage of pulp consumed per ton of paper produced is due to the use of more short fiber pulp. Assuming that the displacement of long fiber by short fiber pulp has reached a limit below which adequate resistance standards would be compromised for those types of paper for which long fiber is essential, the increase in tonnage of virgin pulp per ton of paper will be due to the increased use of short fiber pulp.

3. Based on the above reasoning, that an improvement in paper quality is expected, it is assumed that the percent contribution of groundwood in the production of paper will tend to diminish in the future. This assumption is reinforced by the existence of very small mills that use sawmill and forest residues of Parana pine as raw material. The increasing scarcity of this raw material, as well as competition from larger pulpmills competing for the same raw material, is expected to force such small producers out of business. A consequent reduction in groundwood production will occur. Compensation for this reduction could only be expected from larger mills that can utilize pulpwood from Pinus plantations. However, this raw material, due to its high resin content, will require some degree of chemical processing. Therefore, it is assumed that groundwood will be partially replaced by semi-chemical or even chemical pulp.

4. The approach used in Figure 4-1 deserves further explanation:

The dotted lines represent the trends for the situation where part of the consumed newsprint must be imported from abroad. However, the newsprint consumption trend will continue to rise (see Figure 3-4) and the consequent imports imply high foreign exchange spending. In 1972 this amounted to US $24,2 million. The establishment of one more newsprint mill in Brazil will result in high savings of foreign exchange. If softwood availability is lacking, Brazil would do well to study the economic feasibility of using bagasse to produce newsprint and/or other grades of paper as suggested during the 1970 FAO/ECLA/UNIDO Meeting in Mexico(2). However, thinnings from Pinus plantations could be used for this purpose, since similar operations exist in Chile where Pinus radiata is used as raw material, and the resin problem in the pulping process has been overcome (P.radiata has a resin content similar to that of P.taeda in Brazil). The dotted line projections in Figure 4-1 are accompanied by solid lines, which represent the situation in which Brazilian consumption of newsprint is assumed to be satisfied through domestic production. The solid line projections provide the basis for the projections of pulp (and pulpwood) consumption computed later on in this study.

The approach developed in Figure 4-1 was a necessary device in order to evaluate the consumption of the various types of pulp in future production of paper.

The capacity of mills being established for pulp exports was added to the domestic consumption of pulp. The result represents the

(2) Jaakko Pöyry & Co., "An Appraisal of the Newsprint Development Opportunities in Latin America", Paper V, FAO/ECLA/UNIDO Regional Consultation on the Development of the Forest and Pulp and Paper Industries in Latin America, Mexico, May 1970, mimeogr., p. 3.

total pulp capacity necessary to supply the domestic market and maintain the planned pulp exports; the figures are shown in Table 4-1.

In Table 4-1 the reader can also find a volumetric definition of wood and non-wood pulp that was worked out by taking into account the existing mills and new projects that use non-wood fibrous raw materials.

After evaluation of the volume of pulp production according to fiber length for domestic consumption and exports, it was possible to define the equivalent pulpwood consumption. The results are shown in Table 4-2.

The projections of pulpwood consumption are divided into softwood (long fiber pulpwood) and hardwood (short fiber pulpwood) categories. The volume of softwood was calculated assuming that Pinus would be the raw material utilized.

Studying kraft pulping of Pinus elliottii and P.taeda, and using thinnings from plantations of eight and eleven years of age respectively, Foelkel(3) found an average pulp yield (unbleached kraft pulp) of 49,6 percent (oven-dry wood) and a specific gravity of 0,331 g/cm3 for both species. Foelkel's findings infer that 6 m3(or 8,58 steres) of wood are necessary to produce one ton of unbleached kraft pulp. Allowing for a minimum of 12,5 percent hardwood in a mixture with softwood, the average ton of pulp will require 7,5 steres of softwood and 1,0 stere of hardwood. These figures were used in the development of Table 4-2.

(3) C. E. B. Foelkel, "Unbleached Kraft Pulp Properties of Some of the Brazilian and U.S. Pines", M.S. Thesis, State University of New York, College of Environmental Science and Forestry, Syracuse, New York, August 1973.

Table 4-1. -- PULP CONSUMPTION + EXPORTS : PROJECTIONS[a]

(Thousand metric tons)

year	paper cons.	chemical & semi-chemical pulp requirements	Long-fiber pulp			Short-fiber pulp					Total pulp (cons. + exports)	groundwood[b]
			Total	non-wood	wood	cons.	exports	Total	non-wood	wood		
1973	1850	1110	462	17	445	648	270/3	918	100/2	818	1380	370
1974	2055	1274	534	17	517	757	270	1027	100	927	1544	380
1975	2281	1459	615	51/1	564	844	270	1114	100	1014	1729	390
1976	2533	1671	683	51	632	988	327/4	1315	100	1215	1998	405
1977	2813	1884	759	51	708	1125	762/5	1887	100	1787	2646	421
1978	3116	2118	841	51	790	1277	800/6	2077	100	1977	2918	467
1979	3451	2381	931	51	880	1450	800	2250	100	2150	3181	483
1980	3819	2673	1031	51	980	1642	800	2442	100	2342	3473	496
1981	4226	3000	1141	51	1090	1859	800	2659	100	2559	3800	549
1982	4671	3363	1261	51	1210	2102	800	2902	100	2802	4163	560
1983	5164	3769	1394	51	1343	2375	800	3175	100	3075	4569	568
1984	5705	4221	1540	51	1489	2681	800	3481	100	3381	5021	627
1985	6298	4660	1700	51	1649	2960	800	3760	100	3660	5460	692

[a]Assuming no paper imports.
[b]Groundwood consumption if all newsprint is to be produced domestically.
/1 - 100t/d, bamboo, Santo Amaro.
/2 - 60t/d, bagasse, PONSA; and 120t/d, "babaçu" (palm tree), CEPALMA.
/3 - BORREGAARD, to full capacity of 800t/d.
/4 - CENIBRA, 75% export of initial production (225t/d).
/5 - CENIBRA, 75% export of production (500t/d); and ARACRUZ, 1000t/d.
/6 - CENIBRA, 75% export of production at full capacity (750t/d).

Table 4-2. -- PULPWOOD CONSUMPTION ('REQUIREMENTS') : PROJECTIONS

(Thousand steres)

Year	Softwood (Pinus)			Hardwood (Eucalyptus & Acacia)		
	chemical & semi-chemical pulp[a]	groundwood[b]	Total	chemical & semi-chemical pulp[c]	12.5% mixture with softwood	Total
1973	3,337	1,332	4,669	4,908	480	5,388
1974	3,877	1,368	5,245	5,562	558	6,120
1975	4,230	1,404	5,634	6,084	609	6,693
1976	4,740	1,458	6,198	7,290	682	7,972
1977	5,310	1,515	6,825	10,722	764	11,486
1978	5,925	1,681	7,606	11,862	853	12,715
1979	6,600	1,738	8,338	12,900	950	13,850
1980	7,350	1,785	9,135	14,052	1058	15,110
1981	8,175	1,976	10,151	15,354	1177	16,531
1982	9,075	2,016	11,091	16,812	1306	18,118
1983	10,072	2,044	12,116	18,450	1450	19,900
1984	11,165	2,257	13,422	20,286	1608	21,894
1985	12,367	2,491	14,858	21,960	1780	23,740

Source: Table 3-12.
Conversion factors:
[a]7.5 steres of Pinus for 1 ton unbleached pulp.
[b]3.6 steres of Pinus (2.5 m3r.) for 1 ton of groundwood.
[c]6.0 steres for one ton of pulp.

Other Wood Fiber Uses

Particleboard and fiberboard industries are also depending upon raw material from Eucalyptus and Pinus plantations, as well as from Acacia plantations in Rio Grande do Sul.

Seven particleboard mills are presently operating in Brazil, with

one new mill under construction in Bahia State. The production capacity, by State, is given in Table 4-3.

Table 4-3. -- PARTICLEBOARD PRODUCTION - 1972

State	Installed capacity (m3)	Production (m3)	Wood Consumption (steres)
Rio Grande do Sul	174,000	148,000	275,000
Sao Paulo	90,000	70,000	130,000
Parana	50,000	46,000	85,500
Bahia[a]	28,000	28,000	52,000

[a]One additional 50,000 m3 mill under construction.

Sources: FIESP, ID-Industria e Desenvolvimento, vol. V, no. 7, July 1972
Equivalent consumption of wood, conversion factor from FAO Yearbook of Forest Products: 1 m3 particleboard = 0.65 ton of particleboard = 1.3 m3 of wood = 1.86 steres of wood.

Two fiberboard mills are operating in Sao Paulo State with an estimated total production of 100,000 tons in 1972, half of which was compressed fiberboard. This production is equivalent to the consumption of 286,000 steres of wood(4), Eucalyptus in this case.

A summary of 1972 wood consumption for the production of fiberboard and particleboard is given in Table 4-4 as an initial attempt to discriminate between kinds of raw material being consumed.

No special effort was expended on projection techniques for

(4) Conversion factor from FAO Yearbook of Forest Products:
1 ton of fiberboard = 2.86 steres of roundwood.

Table 4-4. -- PARTICLE/FIBERBOARD INDUSTRIES - WOOD CONSUMPTION : 1972

(steres)

Raw material	States				TOTAL
	Sao Paulo	Parana	Rio Grande do Sul	Bahia[a]	
Eucalyptus	332,000	-	41,000		
Parana pine	-	85,500	75,000[b]		
Acacia	-	-	159,000		
Pinus	84,000	-	-		
Hardwood	332,000	-	200,000		532,000
Softwood	84,000	85,500	75,000		244,500

[a]Information not available regarding raw material used.
[b]Includes Podocarpus spp. (softwood)

Sources: Table 4-3 and Zoneamento Economico Florestal do Rio Grande do Sul

consumption of fiberboard and particleboard products. In an expanding economy like that of Brazil, it is expected that the market for these products will expand substantially in the future.

For the purpose of the present study, in order to allow for the availability of fibrous raw material, it is assumed that the consumption of raw material by fiberboard and particleboard industries will increase by ten percent per year in the period studied. This assumes unitary elasticity of income with respect to demand for such products. The projections of wood consumption are presented in Table 4-5.

Charcoal

Both in Sao Paulo and Minas Gerais States Eucalyptus is used in the production of charcoal. According to Victor et al.(5), 800,000 steres of Eucalyptus were estimated to be consumed in the production of charcoal within the State of Sao Paulo in 1972. During 1971 in Minas Gerais State, around 1,400,000 steres of Eucalyptus were transformed into charcoal(6).

For the purposes of this study, it is assumed that Eucalyptus wood consumption for charcoal production in Sao Paulo State will increase by ten percent per year. In Minas Gerais State it is assumed that 70 percent of the Eucalyptus wood production will be used for charcoal production since most of the plantations have been made by steel and iron companies.

The projections of these uses are also given in Table 4-5.

Table 4-5. -- WOOD CONSUMPTION IN THE COMPETITIVE USES FOR PULPWOOD: PROJECTIONS

(million steres)

year	fiber/particle-board (a)		Charcoal			Total consumption	
	hard-wood	soft-wood	Sao Paulo (b)	Minas Gerais (c)	Total	Hardwood	Softwood
1973	.5	.2	.8	1.4	2.2	2.7	.2
1974	.6	.3	.9	1.5	2.4	3.0	.3
1975	.7	.3	1.0	1.8	2.8	3.5	.3

(5) M. A. Victor et al., "Evoluçao, Estagio Atual e Perspectivas das Florestas Exoticas em Sao Paulo", Instituto Florestal, Bulletin no.1, 1972, p. 25.

(6) Grupo de Trabalho-Carvao Vegetal na Siderurgia, "Perspectivas do Abastecimento de Carvao Vegetal", IBDF, Belo Horizonte, 1972, p. 1.

Table 4-5. -- CONTINUED

year	fiber/particle-board (a)		charcoal			Total consumption	
	hard-wood	soft-wood	Sao Paulo (b)	Minas Gerais (c)	Total	Hardwood	Softwood
1976	.7	.3	1.1	2.1	3.2	3.9	.3
1977	.8	.4	1.2	3.3	4.5	5.3	.4
1978	.9	.4	1.4	4.7	6.1	7.0	.4
1979	1.0	.4	1.5	5.3	6.8	7.8	.4
1980	1.1	.5	1.7	6.6	8.3	9.4	.5
1981	1.2	.5	1.8	6.4	8.2	9.4	.5
1982	1.3	.6	2.0	6.9	8.9	10.2	.6
1983	1.5	.7	2.2	7.6	9.8	11.3	.7
1984	1.6	.7	2.5	7.9	10.4	12.0	.7
1985	1.8	.8	2.7	8.7	11.4	13.2	.8

Note: Lumber excluded.
(a) & (b) - accounting for a 10% per year increase in consumption.
(c) - assuming 70% of wood from Eucalyptus plantations in Minas Gerais State will be used in charcoal production.

Other Wood and Non-Wood Fiber Resources

Eucalyptus and Pinus excluded, the remaining fibrous raw materials for pulp and paper-making in Brazil are:

- Parana pine
- Acacia (wattle)
- Sugar cane bagasse
- bamboo and sisal
- "babaçu" (palm tree, *Orbignia sp.*)
- other agriculture residues

Parana pine

As mentioned in Chapter II, intensive exploitation of Parana pine forests for veneer/plywood, lumber, and pulp production is reducing drastically the remaining growing-stock of this native species. Presently, little is known in terms of the location and volume of the remaining resources. IBDF is carrying out a forest inventory, the results of which are expected to be available in late 1973. The survey will facilitate the evaluation of the remaining resources of Parana pine. However, the first observations of photo-mosaics being prepared in the aerial survey(7) show that reserves of Parana pine have been reduced drastically since the last inventory in 1967. Areas reported in 1967 with dense stands appear in the 1972 photos as having only a few small, scattered remaining trees.

Reforestation with this native species has not been as intensive as with Pinus and Eucalyptus. According to information from the IBDF regional office in Parana State, 20,000 ha have been reforested with this native pine, along with 4,000 ha in Rio Grande do Sul and Santa Catarina States. The reforestation, however, is nowhere near enough to compensate for the exploitation of the species.

The industrial uses of Parana pine during 1971 are summarized in Table 4-6.

As shown in Table 4-6 the Parana pine resources are being subjected to very heavy exploitation. In a survey in 1971(8) it was

(7) R. B. Ascoli, personal communication, (Rio de Janeiro, July 1973).

(8) IBDF, "Zoneamento Economico Florestal do Rio Grande do Sul", 1971, p. 29.

Table 4-6. -- PARANA PINE PRODUCTS: 1971

Product	Production
sawnwood[a]	3,900,000 m3
veneer/plywood[a]	320,000 m3
pulp[b]	274,164 tons
groundwood (for 1970)[c]	228,300 tons

Sources: [a]IBDF, Commerce Division
[b]APFPC, Associacao Paulista de Fabricantes de Papel e Celulose
[c]FAO Yearbook of Forest Products, figure for 1970 production

estimated that for each cubic meter of Parana pine lumber some 0.77 m3 of wood residues (bark and branches excluded) in the form of tops of trees and sawmill residues are produced. Assuming this has not changed since, it is possible to estimate that for 3.9 million m3 of lumber produced in 1971, some 3.0 million m3 of forest and sawmill residues were produced. In the same year the equivalent long fiber raw material consumed in the pulp and groundwood production was 1.8 million m3. This means that 1.2 million m3 of residues were not fully utilized. This figure is even larger, since the pulpmills are also harvesting small diameter trees. However, the analysis above is empirical and needs closer examination. It happens that the utilization of Parana pine residues is largely restricted by long distances to pulpmills from logging operations and sawmills.

The important point is that under intensive exploitation and low

rates of reforestation, the Parana pine resources are condemned to be exhausted in a few years. This means that softwood products will have to come from other sources. As mentioned previously the general expectation is that Pinus will substitute for Parana pine, especially as fibrous raw material, since most of the plantations are being considered for utilization in pulping.

Acacia

Acacia (or wattle) has been planted since the early 1930's in Rio Grande do Sul State for tannin production from the bark. Initially the wood was a by-product without specific uses besides fuelwood. Presently, it is used for pulping, for particleboard production and, continues to be used as fuelwood.

In 1971, it was reported that 45,000 ha planted with this species were in existence(9) and additional plantations have been made under the fiscal incentive program (see Table 2-4). This species can produce an average of 170 steres per hectare (debarked wood) in seven years rotation. After clear-cutting the area must be replanted.

Acacia pulpwood presently used in particleboard production amounts to 160,000 steres. Some 500,000 steres are planned to be consumed in one major and two small pulpmills during 1973(10).

In 1971, tannin production was 30,000 tons, requiring an annual cut of 1.6 million steres of wood(11). It was estimated in the same study that the tannin industry would reach a capacity of 52,000 tons

(9) IBDF, op. cit., p. 20.

(10) G. Speltz and M. Moreira, personal communication (Porto Alegre, July 1973).

(11) IBDF, op. cit., p. 72.

in 1980, which means an annual growth of around six percent. The same study also reports that one million steres of Acacia wood was being used as fuelwood in 1971.

This author understands that projections on hardwood pulpwood supply in Rio Grande do Sul must include the wood from Acacia plantations. However, lack of data for this species limits the possibility of projections regarding production of pulpwood from these plantations.

For the purpose of this study, it is assumed that Acacia pulpwood availability will increase from present industrial consumption by six percent per year, which is the forecasted growth for the tannin industry. The projections of Acacia wood supply are shown in a special column of Table 4-9.

Sugar Cane Bagasse

The production of sugar in Brazil during the 1971/72 season for the States producing more than 60,000 tons/year, is given in Table 4-7 in order to evaluate the volume of bagasse that could be available as fibrous raw material.

By analysing Table 4-7, it would be easy to reach the conclusion that Brazil could be self-sufficient in pulp (short fiber pulp) production simply by using bagasse. But this is not the case, and the reasons are many why this fibrous raw material is not more intensively used in the pulp production:

1. Bagasse is used in the sugar-mills as fuel;

Table 4-7. -- SUGAR PRODUCTION: 1971/72 HARVESTING

(metric tons)

Region/State	sugar	dry bagasse	chemical pulp equivalent
North-Northeast	1,849,000	2,144,800	832,000
Paraiba	89,900	104,200	40,400
Pernambuco	1,039,000	1,205,200	467,500
Alagoas	563,700	653,800	253,600
Other States	156,400	181,400	70,300
South-Central	3,537,300	4,103,200	1,591,700
Minas Gerais	237,100	275,000	106,600
Rio de Janeiro	443,200	514,100	199,400
Sao Paulo	2,596,700	3,012,100	1,168,500
Parana	166,600	193,200	74,900
Other States	93,700	108,700	42,100
BRAZIL	5,386,300	6,248,100	2,423,800

Sources: Instituto do Açucar e Alcool, "Resultado final da safra 1971/72", Divisao de Estudo e Planejamento, Servico de Estatistica e Cadastro.

Conversion factors:
1 ton of raw sugar = 1.16 ton dry bagasse = 0,45 ton of chemical pulp (from "A Review of Bagasse Technology for the Production of Pulp and Paper", by Sandwell and Co., paper IB presented at the ECLA/FAO/UNIDO Regional Consultation on the Development of the Forest and Pulp and Paper Industries in Latin America, Mexico, 1970),

2. Sugar plantations and cane mills are widely scattered and transportation cost is a limiting factor to utilizing this raw material in the volume necessary to run a medium or large size pulpmill;

3. The variable degree of milling the sugar cane and the wide

range of sugar content in the bagasse can present difficulties for the use in pulpmills of bagasse from various sources or sugar mills;

4. Sugar cane is an agriculture crop, the production of which may drastically change within a relative short span of time. This renders any reliance upon this raw material in large pulpmills as highly risky;

5. To operate the pulpmill year round, the bagasse must be stored during the harvesting season; deterioration of bagasse decreases the pulp yield of this raw material.

The above are some negative aspects of the utilization of sugar cane bagasse in pulp production.

In 1971 only 38,867 tons of pulp were produced from sugar cane bagasse, which is equivalent to 5.4 percent of the pulp production in that year. Besides a 60t/d pulpmill in Pernambuco, Northeast, that went on stream in early 1973, no other project was known by the time of this survey to turn bagasse into fiber products.

Apparently, from a statistical analysis of Table 4-7, States like Sao Paulo in the South and Pernambuco and Alagoas in the Northeast are the States where larger volumes of bagasse could be allocated for pulping. In the case of new capacities in the Northeast, bagasse seems to be a logical source of raw material because it is not only the major crop residue in the region, but it is also the major available source of lignocellulosic fibers for pulping purposes.

do Sul (See Figures 2-2, 2-3, and 2-4). Sufficient data were not available for Santa Catarina and Espirito Santo States. A study exists for Sao Paulo State in which the reader can find maps showing the spatial distribution of Eucalyptus and Pinus plantations created up to mid-1972 (13). By observing the spatial distribution of the plantations it is possible to determine the potential wood resources in relation to mill location.

> "The physical presence of timber growing-stock does not insure its being available for use. Social, political, and economic forces often act to prevent use of a potential resource"(14).

Economic forces, and to a certain extent political forces, are the most important elements that affect the economic supply of wood from plantations. Such forces can be price of wood, hauling and transporting costs, existence of competition, and transportation facilities. These forces determine the market area around the mills. The marketplace (mill) is surrounded by a market area from which the wood supply can be drawn. This market area and its shape can be substantially enlarged in those directions served by better roads, and particularly, by railroad. Only the forests located inside the (pulpwood) market area of the various individual pulpmills can be considered as a source of the economic supply of pulpwood.

Observing the spatial distribution of plantations and the present location of pulpmills (see Figure 2-6), it is possible to conclude that many plantations are presently located outside a radius of

(13) Victor et al., op. cit.

(14) V. A. Matt, "Analysis of Timber Supply: Minas Gerais, Brazil", Ph.D. Dissertation, State University of New York, College of Environmental Science and Forestry, Syracuse, New York, July 1973, p. 120.

economic accessibility (as far as transportation is concerned) from the mills. If the new mills that are to be established along with the expansion of the market are not located in sites where potential resources now exist, a shortage of wood must be expected. This problem must be of special concern to the public agencies directing the reforestation program. Mills, and pulpmills in particular, are raw material oriented, but require some infrastructure facilities. Water availability is one of the most important, along with power, labor, and transportation facilities. This leads to the conclusion that the reforestation program must be oriented in such a way that if plantations are established outside present market areas, they must at least be established in regions or areas with feasible sites for future mill construction or with good opportunity for transport development.

Pulpwood Availability

Given the scope of the present study, it is impossible to determine which plantations will contribute to the economic supply of wood for fiber production purposes. Such detail is a mandatory consideration in an economic study. It has to consider the differences between physical and economic supply. For the purpose of this study, however, physical supply and economic supply are treated as synonymous. This assumption is based on the following:

(a) The yields per hectare used in the calculations are indeed low yields; this compensates for part of the gap between physical

and economic supply;

(b) The reforestation rate has been considerably higher during the last three years than in previous years, which is due to larger projects in single blocks;

(c) For the last three years IBDF has been overseeing the location of new plantations, which should result in higher concentration of stands; this direction will be strengthened in the future since IBDF is becoming better prepared, in terms of experience and personnel, to conduct the program.

In order to have a more precise pulpwood supply study IBDF is urged to improve regional statistics for all existing plantations with information on species, area, growth rate, plantation age, rotation length, and commitment of plantations for specific end uses. These data are essential for a sophisticated wood supply study.

Pulpwood Balance

It has been shown in this study that the pulp and paper industry must sustain a high and steady growth if imports of pulp and paper are to be minimized. To sustain the increasing production of pulp an increasing volume of pulpwood will be consumed. An increasing volume of wood will also be consumed by the other industries competing for the same raw material.

The various projections of consumption of this type of wood have been added and compared with forecasted production of wood. The results,

on per year basis of the 'pulpwood balance', are shown in Tables 4-8 and 4-9 for softwood and hardwood, respectively.

Both long fiber and short fiber pulpwood, according to the findings in this study, will remain on the negative side; i.e., forecasted consumption is larger than forecasted production. An exception occurs for hardwood pulpwood in the period of 1979-1981 which is not sufficient to compensate for the previous and subsequent 'deficit'.

Before entering further analysis it is important to remind the reader that the pulpwood balances were determined assuming that reforestation will continue at 1972 rates. Therefore, the projections of pulpwood production for eight years from now include plantations to be established in 1973/74*. Bearing this in mind we can now go into more detail.

Softwood (Pinus)

The forecasted pulpwood production for 1974 from Pinus plantations is far below the forecasted consumption. However, the situation of long fiber pulpwood balance (see Table 4-8) will improve in the coming years. This is due to the availability of pulpwood from thinnings which will be increasing steadily. The plantations established in 1967 are expected to be subjected to first thinnings in 1974 and 1975.

For the determination of this long fiber pulpwood balance only Pinus was considered as a source of pulpwood. This is an attempt to show the amount of long fiber pulp production that can be based on

*As additional information, forecasts of pulpwood production from plantations established through 1972 are shown in Appendix B. Values in Figure B-8 might not match exactly with those in Tables 3-13 and 4-9 due to necessary use of an average yield per hectare.

Table 4-8. -- SOFTWOOD PULPWOOD BALANCE

(million steres)

Year	Consumption			Production	BALANCE
	pulp & groundwood	other fiber uses	TOTAL	(Pinus plantations)	
1973	4.6	.2	4.8		
1974	5.2	.3	5.5	1.9	-3.6
1975	5.6	.3	5.9	3.2	-2.7
1976	6.1	.3	6.4	3.6	-2.8
1977	6.8	.4	7.2	4.2	-3.0
1978	7.6	.4	8.0	6.2	-1.8
1979	8.3	.5	8.8	7.5	-1.3
1980	9.1	.5	9.6	8.2	-1.4
1981	10.1	.6	10.7	9.0	-1.7
1982	11.0	.6	11.6	10.6	-1.0
1983	12.1	.7	12.8	12.4	-0.4
1984	13.4	.8	14.2	13.3	-0.9
1985	14.8	.8	15.6	13.9	-1.7

Source: Tables 4-2, 4-5, and 3-9.

Table 4-9. -- HARDWOOD PULPWOOD BALANCE

(million steres)

Year	Consumption					Production			BALANCE
	pulp	12.5% mixture with softwood	other fiber uses	charcoal	TOTAL	Acacia	Euca-lyptus	TOTAL	
1973	4.9	.4	.5	2.2	8.0	.7			
1974	5.5	.5	.6	2.4	9.0	.7	7.9	8.6	-0.4
1975	6.0	.6	.7	2.8	10.1	.7	6.1	6.8	-3.3
1976	7.3	.6	.7	3.2	11.8	.8	9.6	10.4	-1.4
1977	10.7	.7	.8	4.5	16.7	.8	11.0	11.8	-4.9
1978	11.8	.8	.9	6.1	19.6	.9	13.5	14.4	-5.2
1979	12.9	.9	1.0	6.8	21.6	1.0	21.7	22.7	+1.1
1980	14.0	1.0	1.1	8.3	24.4	1.0	23.4	24.4	0.0
1981	15.3	1.1	1.2	8.2	25.8	1.1	25.6	26.7	+0.9
1982	16.8	1.3	1.3	8.9	28.3	1.1	26.1	27.2	-1.1
1983	18.4	1.4	1.5	9.8	31.1	1.2	27.1	28.3	-2.8
1984	20.2	1.6	1.6	10.4	33.8	1.3	31.7	33.0	-0.8
1985	21.9	1.7	1.8	11.4	36.8	1.4	32.6	34.0	-2.8

Source: Tables 4-2, 4-5, and 3-13.

Pinus plantations, and how long Parana pine is expected to be the main source of long fiber pulpwood.

As implied by the softwood pulpwood balance, although a rapid transition from Parana pine to Pinus pulpwood is expected to occur during the next two or three years, the 'deficit' (negative balance) of long fiber pulpwood will have to be compensated for by Parana pine during the present decade.

The long fiber balance, according to the findings of this study, has an annual deficit which decreases until 1983 and increases thereafter even if the reforestation program continues at present rates. However, if the reforestation program continues at lower rates, a serious decrease will occur in the production of softwood pulpwood, and long fiber pulp production will not keep pace with the development of the market. As a result, the consumption of long fiber pulp and paper products will depend on imports from foreign sources. At that point in time, due to the large size of the anticipated market, such imports will have a great negative effect on the balance of foreign exchange.

As far as pulpwood is concerned it seems that the present rate of reforestation with Pinus is still not high enough to cover all future raw material needs for the forecasted consumption of pulp and paper. Two solutions exist to equilibrate the pulpwood balance; first, an increase in the actual rate of reforestation; second, an intensification

of the forest management of existing stands or of plantations to be established, in order to increase the production of wood. In light of the heavy investments in the sector, it appears that the second solution is a more appropriate solution. Better selection of seeds, better selection of sites with orientation to the mill sites, and fertilization are some of the measures to be applied. However, it is worthwhile to observe that, if the sawmilling industry begins to rely heavily on this potential resource by using small diameter logs from the thinnings, the pulpwood balance will be strongly affected, and an increase in the rate of reforestation will be necessary. In this case the pulpwood balance will need to be revised.

Hardwood (Eucalyptus and Acacia)

Eucalyptus (and Acacia to a certain extent in the Porto Alegre region, Rio Grande do Sul State) is the main source of pulpwood in short fiber pulp production. The consumption of this raw material will greatly and steadily increase for the production of fiber products and charcoal.

The short fiber pulpwood balance developed in this study shows that even if reforestation continues at 1972 rates, the forecasted consumption of pulpwood will be greater than production, except for the period of 1979-1981.

The author believes that this negative balance does not necessarily call for an increase in reforestation rate; rather for intensified stand

management. Experiments with Eucalyptus have proven that the yield per hectare can be significantly improved by intensification of silvicultural practices such as fertilization, better selection of seeds, spacing, and silvicultural management. Mello et al.(15) conducting experiments with four species of Eucalyptus (E.saligna, E.grandis, E.alba, E.propinqua) sampled from five year old stands, reported yields per hectare that average 45.3 steres/ha/year (bark excluded). This is twice the yield used in the forecasts herein developed. Therefore, the adoption of better techniques in forest management can increase considerably the production of pulpwood, making it available for industrial purposes.

(15) H. A. Mello et al., "Influencia do espaçamento na Produçao de Madeira de Eucalypto em Solo de Cerrado", Instituto de Pesquisas e Estudos Florestais, Bulletin no. 2/3, Piracicaba, Sao Paulo, 1971, p. 8.

CHAPTER V

SUGGESTED CRITERIA TO GUIDE FOREST POLICY FOR PULPWOOD PRODUCTION

The objective in this chapter is not to determine forest policy but to suggest and discuss criteria that Government agencies, IBDF in particular, could follow in order to guide forest policy for pulpwood production.

Forest policy, by its very nature, must be concerned with long-term planning because the decisions of today concerning wood production will have effects in the distant future, when the trees are to be harvested. Therefore, planning in forestry must be carried out for a period long enough into the future so as to avoid sudden shortages of raw material. Brazil is learning this lesson the hard way, and lack of control and planning of the Parana pine resource is leading to its disappearance as a source of industrial raw material.

Because of the many goods and services provided by wood and forests, forest resources are needed today, just as they will be needed ten, twenty, forty, and more years from now. Fortunately, most forest resources are renewable and wood can be produced again in the same place it was harvested or even in places where it did not exist before. By requiring land, capital, and labor (and time) for its formation, forestry represents an economic activity per se. Forest activity (in terms of tree growing) can produce many externalities such as soil

and watershed protection, recreation facilities, wildlife protection, and even esthetic value. The three last externalities derived from tree-growing activities have become important elements of forest policy in developed countries; the first two, however, are important for any nation, as they are for Brazil. This study is not concerned with externalities; therefore we will disregard them. An overall forest policy, however, must consider all the outputs involved in the activity.

As applied to pulpwood production the criteria herein suggested to guide forest policy are:

1. pulpwood balance
2. saving of foreign exchange
3. internal rate of return from plantations
4. geographic location of economic activities

The four criteria have been selected because they cover most aspects of a forest program. The first two criteria are mainly concerned with the volume of pulpwood to be produced. The others have to do with ecological conditions, species to be planted, and the regional economic impact of forestry.

Pulpwood Balance

In the four previous chapters the main objective has been to estimate future trends in production and consumption of pulpwood. This has been done and the findings assembled to produce future trends in the pulpwood balance. The objective now is to discuss how the pulpwood balance can be used as a criterion to guide forest policy.

Annual pulpwood balance will be negative if annual cutting is larger than annual growth or increment, positive if increment is larger than cutting, and in equilibrium if increment is equal to cutting. A negative balance implies a depletion of growing stock while a positive balance implies an increase in inventory.

It has been assumed at the beginning of this study that Brazil seeks self-sufficiency in the production of pulp and most kinds of paper. In order to make this possible, the necessary raw materials must be available. Consequently, a forest policy concerned with a self-supplying economy in terms of pulp and paper must aim for a positive or equilibrated balance of pulpwood if existing resources are not to be depleted.

In determining forest policy, predictions of future trends in pulpwood balance can provide a regulating indicator for acceleration or deceleration of planting activity. If the future consumption of raw material is estimated, it is possible to adjust the forest program in a way to avoid future shortages of raw material.

A forest policy concerned with production of industrial wood must take into account that an adequate economic supply or a shortage of wood will benefit or harm not only the pulp and paper industry but also the other wood-fiber users such as particleboard and fiberboard industries. For some parts of Brazil a forest policy for pulpwood production must also be concerned with the future dependency of the

steel and iron industry on charcoal, which is partially obtained from Eucalyptus plantations.

The contribution of such industries to the economy will depend substantially (if not totally) on the adequate supply of wood raw material.

Analysing the pulpwood balance trends worked out in this study it is possible to observe that the balance is on the negative side for the years in the period studied. This certainly means that the present program being carried out is still not large enough to make available all the raw material (wood) needed in the near future for industrial purposes. As previously mentioned, two solutions to the problem exist: increase the rate of reforestation or increase yield per hectare through silvicultural management. With the present dimensions of annual investments in reforestation (US $117,6 million in 1972) it appears that the second solution is more appropriate, i.e., better selection of seeds, sites, fertilization, and intensification of silvicultural practices where it proves to be necessary. In the pursuit of solving this problem forestry schools and forest research centers should be required to make a contribution.

> "Fortunately forestry yields a versatile raw material which can be 'stored' on the stump or converted into a variety of products. Few other materials compare with wood in this respect"(1).

The citation above implies that a forest policy might very well aim for a positive balance of raw material. This is particularly valid

(1) G. F. Schreuder, "The Evaluation of Forest Investments in Underdeveloped Countries by Investment Criteria Standards", Commonwealth Forestry Review, vol. 49(4), no. 142, December 1970, pp. 368-374.

in the case of Pinus due to its higher versatility as raw material as opposed to Eucalyptus. As a general rule, forest policy is expected to aim for a positive balance (or, at least, equilibrated balance) of growth and cut of wood raw material. This is valid for pulpwood as it is for other forest outputs. The forest resources must be properly controlled and complemented by a reforestation program towards the equilibrium of annual increment (growth) and annual cutting. This equilibrium, however, must allow for the development of wood-using industries (or for the development of wood and wood-products markets), and it is for this reason that future trends of pulpwood balance is herein suggested as a criterion to guide forest policy concerning pulpwood production.

Saving of Foreign Exchange

The availability of fibrous raw material, if sufficient to permit the development of the pulp and paper industry along with the growth of the market, can save foreign exchange by avoiding importation of pulp and paper products. Pulp (or paper) exports can also substantially increase foreign exchange earnings. This study does not go into an analysis of comparative advantages of Brazil producing some goods and importing others; it analyzes simply the reasons why the saving of foreign exchange should be considered in the formulation of forest policy for pulpwood production.

The citations below emphasize some of the points to be considered

on the subject of saving of foreign exchange.

> "In many of the less developed countries forestry programs will have to be judged to a very great extent by their over-all effect on the balance of payments and the increase of national wealth as related to certain objectives.... Whatever the criteria adopted, the quality of decisions in determing the forestry plan will depend to a great extent on the knowledge and planning available for all the sectors of the economy, including the foreign trade related to each"(2).

> "No data are available on the balance of payment effect of primary forest industries.... However, the operation effect will be strongly positive especially in the case of pulp and paper because of imports substitution and exports (provided the principal raw material, wood, is available domestically)"(3).

> "Pulp and paper industry is capital intensive. Although investments are high, so is the value added.... On the other hand, the potential foreign exchange earnings and saving capacity of the pulp and paper industry is high"(4).

A forestry program must be related to the over-all planning of the economy. The saving of foreign exchange is only indirectly related to forest policy; it is related through wood and wood-fiber products that will be produced from domestic resources and consumed in the economy (substituting for imports) or exported.

It has been shown previously in this study that paper consumption will increase steadily in the near future. The potential capacity of saving of foreign exchange by the domestic industry becomes more significant as the market grows. However, this potential saving will only

(2) J. C. Westoby, "Forest Industries in the Attack on Economic Underdevelopment", Forestry and Forest Products Division, FAO, Rome 1962, p. 196.

(3) G. F. Schreuder, op. cit., p. 370.

(4) K. F. S. King, "Modernizing Institutions to Promote Forestry Development", The State of Food and Agriculture 1969, FAO, Rome, p. 20.

occur if the increasing demand of pulpwood is supplied by domestic resources. This means that the domestic availability of pulpwood can play an important role in saving of foreign exchange. In an attempt to illustrate the possibilities of earnings of foreign exchange, Table 5-1 shows the 1972 exports of pulp. The reader can evaluate the figures in terms of volume, FOB prices, and total earnings. However, a closer look at the variation of average FOB prices for different exports of unbleached chemical pulp is recommended; the proper selection of buyers is essential to maximize total earnings.

Besides present exports, additional pulpmill projects exist for the production of short fiber pulp for export (see Table 2-7). However, the potential foreign exchange earnings will not occur if a shortage of raw material exists or if the domestic market is not supplied first.

Traditionally, Brazil has been a net importer of newsprint. In 1971, 161,000 tons of newsprint were imported, which is equivalent to the production of a 500t/d newsprint mill, a large scale mill. In 1972, authorized imports amounted to US $24,2 million. Forecasts worked out in this study show that newsprint consumption will rise steadily, which means that imports will grow even more if domestic production is not increase. No new newsprint mill or mill expansion is presently planned because, despite the fact that newsprint production

P EXPORTS - 1972

	ric s	FOB average price (US $/ton)	FOB US dollars
	787.9		10,886,594
	700.	155	883,741
	892.9	85	9,965,154
	195.	195	37,699
	,874.9		1,105,047
	,874.9	188	1,105,047
	,447.7		474,004
	,550.	71	181,700
	50.	74	3,700
	3,746.5	74	278,945
Uruguay	101.2	95	9,659
Total earnings			12,465,645

Source: Carteira de Comercio Exterior, "Exportaçao Efetiva Jan/Dez, 1972", Banco do Brasil SA, Rio de Janeiro, 1973, p. 323, mimeogr.

is known for having the lowest profitability within the paper industry, the booming consumption of other papers in the economy is big enough to support any investor in paper production. This situation requires rational allocation of resources, especially long fiber pulpwood, but it is highly recommended that domestic financial agencies study the possibility of producing this product domestically in comparison to other investment alternatives with effect on saving of foreign exchange. A forest policy can strongly support this venture by assuring necessary quantities of raw material.

By considering the various points discussed above it is possible to conclude that forest policy can play an indirect, but important role in the balance of foreign exchange. This role is particularly important considering the possibilities of pulp exports and pulp and paper imports substitution. It is for this reason that saving of foreign exchange is herein suggested as a criterion to guide forest policy for pulpwood production.

Internal Rate of Return from Plantations

As stated in Chapter II, the main goal of the forestry fiscal incentive program is to make forestry a new and enduring economic activity that could (a) produce the demanded wood raw material, (b) neutralize the overcut being carried out in the existing forest resources, and (c) provide other services, such as soil and watershed protection.

These goals, without disregarding alternative land uses, can be obtained concomitantly if careful planning is designed toward maximization of benefits. Land is still largely available in the country and the reforestation program is still able to select the lands that can give the best contribution in the context of maximization of over-all benefits. However, for the landowner, the internal rate of return from forest plantations is one of the main reasons for continuing in the business of wood production or resorting to alternative activities. So, in order to make forestry an enduring activity a forest policy should encourage investments in those areas or regions where the highest internal rate of return can be obtained.

Assuming that costs of planting and forest management are homogeneous on a regional basis, some of the more important forces that influence the internal rate of return are price (rent) of land, site index (growth) and future price for stumpage. Price of stumpage is directly dependent on transportation costs between the forest and processing facilities. Therefore a high internal rate of return on wood production would be achieved for reforestation investments carried out on cheap land of good site index and close to processing facilities. Such a combination is not to be found easily. Each region deserves a special study of these factors in order to have its respective internal rate of return anticipated. The ranking of the anticipated rates of return will make it possible to determine the

regions or zones with higher internal rate of return in wood production, i.e., the regions with higher priority for investments.

The existing forest plantations in Brazil have already indicated where the species grow best. This experience is an important input in the determination of forest policy. The existing wood processing facilities are also a good indication for the location of Pinus and Eucalyptus (or other) plantations. As far as pulpwood production is concerned, the forest policy must take into account the pulpmill sites (where the mills are or could be located) since transportation cost of raw material from the forest to the mill has a negative effect on the rate of return to the forest owner.

The proper location of plantations in Brazil can make forestry an attractive business. The fast growth of Pinus and Eucalyptus can lead to high rates of return. In the States of Santa Catarina(5) and Rio Grande do Sul(6) it was found that large areas could provide an annual return ranging from six to sixteen percent for Pinus and/or Eucalyptus, respectively. While six percent is not an attractive return for investment, twelve or sixteen percent would be.

Forest policy should consider rate of return from plantations as a criterion to determine the interregional priorities in a forest program. Investments in reforestation should be encouraged, through proper means, in those regions where the highest internal rate of return can be obtained.

(5) IBDF, "Zoneamento Economico Florestal do Estado de Santa Catarina", 1970, p. 48.

(6) IBDF, "Zoneamento Economico Florestal do Estado do Rio Grande do Sul", 1971, maps 13 and 15.

Geographic Location of Economic Activities

This criterion in its role of guiding forest policy considers the creation of temporary or permanent job opportunities in remote areas. It is also related to the use of 'marginal' land, i.e., land set aside from agriculture or other uses, that could be more economically utilized if it supported forestry activity.

Forest planting by itself is not a labor intensive activity(7). However, it has merit when plantations are established in regions where other intensive activity does not exist. In such circumstances forestry can create job opportunities at various levels for the local population otherwise unemployed or underemployed. This aspect is wisely explored in the following citation:

> "... the establishment of plantations in new areas demand the application of manpower of various levels and skills. A large proportion of the administration and manual tasks in forestry can be broken up and distributed in a manner that permits economy of scarce or relatively scarce skills, while facilitating training at different levels"(8).

From the experience of one of the major companies working in mechanized reforestation in Sao Paulo State it was learned that each ten hectares to be planted creates one man-year job and that, during the first three years of silvicultural management after the seedlings are planted, each fifty hectares creates another man-year job(9). The employment figures are assumed to be much larger in cases of lower levels of mechanization. Even so, as far as reforestation is concerned, these figures could be used to show the low intensity of labor utilization,

(7) Schreuder, op. cit., p. 300.

(8) Westoby, op. cit., p. 195.

(9) Plantar, personal communication (Sao Paulo, 1973).

However, economic activity in the forestry sector is greatly expanded when the forest operations are related to some industrial activity. Direct and indirect jobs are created around forestry in the case of pulp and pulp and paper production, in logging, hauling, and transporting, besides the jobs created inside the mill in administration, and in the shipping of products. Klabin(10) reported that during 1971 seven major pulp and paper companies in Brazil were directly employing, in the industrial production and administration, around 11,100 persons, 5,600 with some skill. Furthermore, the same companies provided, on a yearly basis, around 8,300 jobs in logging, hauling, and transporting of raw material, plus 5,800 jobs in reforestation and forest management activities. This is a good example of the job opportunities created around pulp/paper production operations.

The great merit of a reforestation program is that, if associated with industrial activities such as pulp or pulp and paper production, it can transform an underdeveloped region into a geographic center of economic activities providing jobs and affecting income and skills distribution. In such circumstances forestry can be considered as a tool for regional development and economic stability so clearly defined in the following citation:

> "An important product of regional growth is infrastructure development. If forestry leads to effective structural growth, a region becomes more attractive to other activities and provides a wider range of opportunities for its residents.... One of the most common advantages attributed to regions dependent on a well managed forest resource is stability. Because trees are

(10) S. Klabin, "Industria, Economia Florestal e o Fator Humano - O Caso da Industrial Brasileira de Celulose e de Papel", World Forestry Congress, Buenos Aires, 1972, mimeogr., p. 8.

renewable, the basis of support is enduring"(11).

Examples of regional economic impact of pulp/paper operations can be certainly observed and measured in various locations such as Telemaco Borba in Parana State, and Lages and Tres Barras in Santa Catarina State.

The considerations above show that a forest policy, in the long-run, can play either a direct or indirect role in the regional distribution and intensity of economic activities. For this reason, geographic location of economic activities is herein suggested as a criterion to guide forest policy concerned with pulpwood production.

Recommendations for Policy Measures

In order for the economy to be self-sufficient in terms of production of pulp and paper, and in order to allow for the planned pulp exports, the pulpwood balance equilibrium must be pursued as the main criterion for forest policy concerned with pulpwood production. The dimensions of the forest program, the annual rates of reforestation as well as the measures of forest management must be such that an equilibrium of future pulpwood balance is reached.

In order to meet the future demand for pulpwood, and in light of the criteria discussed above, it is recommended that:

1. The reforestation program continue at the 1972 rates of plantation but with an intensification of silvicultural management in order to improve yield per hectare, and, consequently, total production

(11) D. E. Kromm, "Limitations on the Role of Forestry in Regional Development, Journal of Forestry", October 1972, pp. 630-633.

of pulpwood.

If measures are not undertaken to improve yield per hectare, the present rate of reforestation must be increased both in Pinus and Eucalyptus plantations to the extent that future production of pulpwood will equal future consumption;

2. The new forest plantations be concentrated around present (or feasible) pulpmill sites in order to make physical supply of pulpwood equivalent to economic supply;

3. Investments be encouraged for reforestation in those regions that can offer the highest internal rate of return from pulpwood production;

4. The species planted be those acceptable for pulping.

In light of this study it also seems appropriate to recommend that:

5. A similar study be conducted for the other outputs of forests, timber in particular, in order to facilitate the establishment of an over-all forest program.

6. Forest statistics be improved and data kept in permanent records. The records should be available for economic studies.

7. An 'industrial' section be created in the IBDF organization with a team of foresters experienced in forest industries and with advanced training in quantitative methods, forecasting, planning, and forestry economics in general. This team will be in charge of developing and updating studies on trends of consumption and production of forests

products. This team would also be in charge of orienting and advising forest industries as well as the IBDF administration in the utilization and formation of new forest resources.

CHAPTER VI

SUMMARY: FINDINGS AND CONCLUSIONS

Parallel forecasts of consumption and production of pulpwood to 1985 were carried out in this study to determine the extent to which existing man-made forests would fulfill the pulpwood needs in the future production of pulp and paper*.

The forecast for future consumption of pulpwood was carried out in three different steps. First, projections of consumption of paper were obtained using stepwise regression equations with multiple independent variables. Second, the projections of paper consumption were converted into equivalent consumption of long and short fiber pulp, to which production earmarked for export was added. Third, the projection figures of pulp consumption plus exports were converted into equivalent consumption of long and short fiber pulpwood. To the projections of pulpwood consumption in the production of pulp and paper, projections of the same type of wood used for other purposes (fiberboard, particleboard, and charcoal) were added; the result represents the total projected consumption of wood by the pulp industry and its competitors for wood.

The consumption forecasts for paper, pulp, and pulpwood were based on assumptions such as economic growth, industrial production, and population growth.

*The terms demand and supply are often used in the industry publications in lieu of consumption and production.

The projections of pulpwood production were worked out through simulation models based on area planted, species, and on assumptions of yield per hectare, rotation length, thinnings and clear-cutting regimes.

The future trend of pulpwood balance was derived by comparing the projections of annual pulpwood consumption and production.

The forecasting models used in this study have a wide variety of limitations; these shortcomings have been pointed out in Chapter I.

Four different criteria were discussed and suggested to guide forest policy for pulpwood production: pulpwood balance, saving of foreign exchange, internal rate of return from plantations, and geographic location of economic activities.

Findings

The key findings of this study are summarized below:

1. Assuming a nine percent economic growth, under conditions of unchanged relative prices, paper consumption in 1985 will be between 6.3 and 7.5 million metric tons, i.e., an annual average increase of 10.7 percent; consumption of writing and printing papers in 1985 will be 1.7 million tons (12.0 percent annual increase); newsprint, 570,000 tons (5.8 percent annual increase); packaging papers and cardboard and paperboard, 3.5 million tons (11.4 percent annual increase); industrial papers and others, 467,000 tons (10.9 percent annual increase).

2. If the existing pulpmill and new mills being established for pulp exports remain in the international market, pulp exports will amount to 800,000 tons in 1978.

3. Under conditions of Brazilian self-sufficiency for pulp and paper products, pulp consumption in 1985 will amount to 4.6 million metric tons, of which 1.7 million tons will be long fiber pulp. In order to maintain the level of exports and to supply the domestic market, additional capacity must be added to the industry beyond the presently known expansion plans and projects. This necessary additional capacity is summarized in Table 6-1 and represent by negative figures in the same Table.

4. Pulpwood requirements in 1985 will amount to 15.6 million steres, softwood, and 36.8 million steres, hardwood. These volumes account for wood used in the production of pulp, fiberboard, particleboard, and charcoal (see Tables 4-8 and 4-9 for wood annual requirements).

5. The forecast of potentially harvestable volume of pulpwood from man-made forests, assuming that the reforestation program continues at the 1972 rates of planting, will amount to 13.9 million steres, Pinus pulpwood, and 32.6 million steres, Eucalyptus pulpwood in 1985 (see Tables 3-9 and 3-13 for yearly harvestable volume figures).

6. As shown in Tables 4-8 and 4-9, the present reforestation program is not yet large enough to meet the pulpwood requirements of

Table 6-1. -- REQUIREMENTS OF ADDITIONAL CHEMICAL AND SEMI-CHEMICAL PULP PRODUCTION CAPACITY

(Thousand metric tons)

year	Long fiber pulp			Short fiber pulp		
	capacity, existing or under way	consumption	Difference	capacity, existing or under way	consumption plus exports	Difference
1973	325	462	-137	844	918	-74
1974	379	534	-155	1065	1027	+38
1975	447	615	-168	1194	1114	+80
1976	528	683	-155	1287	1315	-28
1977	868	759	+109	1856	1887	-31
1978	868	841	+ 27	1907	2077	-170
1979	868	931	- 63	1907	2250	-343
1980	868	1031	-163	1907	2442	-535
1981	868	1141	-273	1907	2659	-752
1982	868	1261	-393	1907	2902	-995
1983	868	1394	-526	1907	3175	-1268
1984	868	1540	-672	1907	3481	-1574
1985	868	1700	-832	1907	3760	-1853

Sources: Tables 2-9 and 4-1.

the industry.

The negative balance in the softwood pulpwood balance means that Parana pine will continue to be consumed as pulpwood at a volume that covers the 'deficit' shown in the pulpwood balance trend. However, this is a solution only for the present decade; thereafter Pinus are expected to be the major source of softwood for pulping.

Research Needs

Apart from the recommendations given in Chapter V, some additional research studies are mandatory for a better understanding of wood as raw material for pulp production:

1. A detailed study of man-made forests to determine which plantations will in fact be available for industrial purposes. Such a study must include information on transportation facilities and on distances of forest stands to pulpmill sites as well as information on the designated end-uses of plantations. The study should also point out the number, area, and investments of tree-planting projects approved but not implemented. The results would lead to a better information on existing plantations as well as facilitate the control of the fiscal incentive program.

2. A survey of the groundwood mills, their production, and raw material used;

3. A survey of the statistical figures on consumption of groundwood and waste paper in the production of paper;

4. An inventory of the Parana pine growing stock and a study of its economic availability for pulping purposes;

5. An inventory of Acacia (wattle) plantations in the State of Rio Grande do Sul and a study of its economic availability for pulping.

6. A study of economic feasibility of using chipping headrig (or chip-and-saw) systems in softwood lumber production in order to

maximize utilization of harvested wood.

Conclusions

1. As far as pulpwood is concerned, the volume to become available from existing man-made forests is far below the minimum necessary to cover, in the present decade and thereafter, the wood needs of the pulp industry and raw material competitive users (fiberboard, particleboard, and charcoal).

2. In order to allow for pulp exports and for the self-sufficiency of the economy in terms of pulp and paper products, the reforestation program must be enlarged or forest management in existing and future plantations must be intensified to increase production of wood. The second solution, i.e., intensification of forest management with continuation of 1972 rates of plantation, seems to be a more appropriate solution since it is unlikely that larger investments could be brought to the forest sub-sector. This measure calls for better selection of seeds and sites, fertilization, and silvicultural practices, along with an increased effort to locate new plantations close to the pulpwood markets as permitted by land costs.

This statement is valid both for Pinus and Eucalyptus plantations.

The future of the reforestation program will affect the flow of wood only after 1979. Before then any increase in the flow of wood will depend upon intensification of forest management if depletion of growing stock is to be avoided.

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APPENDIX A

COMPUTER PRINTOUTS: WOOD VOLUME FROM MAN-MADE FORESTS

Table A-1.

*** FORECAST 1974-1988 ***

PULPWOOD AND SAWLOG FROM MANMADE FORESTS IN BRAZIL - PINUS SPP. - SAO PAULO

YEAR	AREA	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
60	1600.	0.00	0.09	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00
		0.00	0.01	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00
61	2400.	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.26	0.00	0.00
		0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.18	0.00	0.00
62	3200.	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.35	0.00
		0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.24	0.00
63	10400.	0.62	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.79	0.00	0.00	0.00	0.00	1.12
		0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.79
64	11200.	0.00	0.67	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00
65	6400.	0.00	0.00	0.38	0.00	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00
66	4800.	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.36	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.09	0.00	0.00
67	16000.	0.82	0.00	0.00	0.00	0.96	0.00	0.00	0.00	0.93	0.00	0.00	0.00	0.00	1.22	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.30	0.00
68	18400.	0.00	0.94	0.00	0.00	0.00	1.10	0.00	0.00	0.00	1.07	0.00	0.00	0.00	0.00	1.40
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.35
69	19200.	0.00	0.00	0.98	0.00	0.00	0.00	1.15	0.00	0.00	0.00	1.11	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00
70	16000.	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.96	0.00	0.00	0.00	0.93	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00
71	18400.	0.00	0.00	0.00	0.00	0.94	0.00	0.00	0.00	1.10	0.00	0.00	0.00	1.07	0.00	0.00
		0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00
72	16000.	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.96	0.00	0.00	0.00	0.93	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
73	16000.	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.96	0.00	0.00	0.00	0.93
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
74	16000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.96	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75	16000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.96	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
76	16000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.96	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
77	16000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.96
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78	16000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
79	16000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	16000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PULPWOOD		1.44	1.70	1.50	1.29	2.50	2.57	2.46	2.24	3.09	3.63	3.74	3.36	3.47	4.27	4.41
IMMAT FIB		0.82	0.94	0.98	0.82	0.94	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.00
SAW LOGS		0.00	0.01	0.01	0.02	0.05	0.06	0.06	0.07	0.14	0.29	0.31	0.32	0.37	0.63	1.22

SUCHEK

FIRST ROW = PULPWOOD (1,000,000 M3 STERES
SECOND ROW = SAWLOGS (1,000,000 M3 SOLID)

Table A-2.

*** FORECAST 1974-1988 ***

PULPWOOD AND SAWLOG FROM MANMADE FORESTS IN BRAZIL - PINUS SPP. - PARANA

YEAR	AREA	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
61	320.	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.03	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.00	0.00
62	80.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
63	160.	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
64	640.	0.00	0.04	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
65	1120.	0.00	0.00	0.07	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
66	560.	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.04	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
67	3200.	0.16	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.24	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.06	0.00
68	12800.	0.00	0.65	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.74	0.00	0.00	0.00	0.00	0.97
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.24
69	20000.	0.00	0.00	1.02	0.00	0.00	0.00	1.20	0.00	0.00	0.00	1.16	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00
70	30400.	0.00	0.00	0.00	1.55	0.00	0.00	0.00	1.82	0.00	0.00	0.00	1.76	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00
71	36000.	0.00	0.00	0.00	0.00	1.84	0.00	0.00	0.00	2.16	0.00	0.00	0.00	2.09	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00
72	36000.	0.00	0.00	0.00	0.00	0.00	1.84	0.00	0.00	0.00	2.16	0.00	0.00	0.00	2.09	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00
73	36000.	0.00	0.00	0.00	0.00	0.00	0.00	1.84	0.00	0.00	0.00	2.16	0.00	0.00	0.00	2.09
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18
74	36000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.84	0.00	0.00	0.00	2.16	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75	36000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.84	0.00	0.00	0.00	2.16	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
76	36000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.84	0.00	0.00	0.00	2.16	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
77	36000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.84	0.00	0.00	0.00	2.16
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78	36000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.84	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
79	36000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.84	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	36000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.84	0.00
PULPWOOD		0.17	0.69	1.11	1.59	2.04	2.64	3.10	3.72	4.19	4.75	5.20	5.84	6.16	6.34	5.24
IMMAT FIB		0.16	0.65	1.02	1.55	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	0.00
SAW LOGS		0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.07	0.11	0.17	0.21	0.25	0.44

FIRST ROW = PULPWOOD (1.000.000 M3 STERES

SECOND ROW = SAWLOGS (1.000.000 M3 SOLID)

SUCHEK

Table A-3.

*** FORECAST 1974-1988 ***

PULPWOOD AND SAWLOG FROM MANMADE FORESTS IN BRAZIL - PINUS SPP. - SANTA CATARINA

YEAR	AREA	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
63	240.	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.03
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
64	1280.	0.00	0.08	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
65	1040.	0.00	0.00	0.06	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
66	1600.	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.12	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.03	0.00	0.00
67	4000.	0.20	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.30	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.08	0.00
68	10400.	0.00	0.53	0.00	0.00	0.00	0.62	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.79
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.20
69	12800.	0.00	0.00	0.65	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.74	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00
70	14400.	0.00	0.00	0.00	0.73	0.00	0.00	0.00	0.86	0.00	0.00	0.00	0.84	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00
71	16000.	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.96	0.00	0.00	0.00	0.93	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00
72	16000.	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.96	0.00	0.00	0.00	0.93	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
73	16000.	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.96	0.00	0.00	0.00	0.93
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
74	16000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.96	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75	16000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.96	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
76	16000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.96	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
77	16000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.96
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78	16000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
79	16000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	16000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PULPWOOD		0.22	0.61	0.72	0.83	1.07	1.51	1.64	1.77	2.01	2.40	2.62	2.69	2.83	3.01	2.70
IMMAT FIR		0.20	0.53	0.65	0.73	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.00
SAW LOGS		0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.06	0.09	0.09	0.11	0.16	0.30

SUCHEK

FIRST ROW = PULPWOOD (1,000,000 M3 STERES
SECOND ROW = SAWLOGS (1,000,000 M3 SOLID)

Table A-4.

*** FORECAST 1974-1988 ***

PULPWOOD AND SAWLOG FROM MANMADE FORESTS IN BRAZIL - PINUS SPP. - RIO GRANDE DO SUL

YEAR	AREA	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
67	1680.	0.09	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.13	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.03	0.00
68	3280.	0.00	0.17	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.25
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.06
69	5200.	0.00	0.00	0.27	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
70	4960.	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.29	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
71	3760.	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.22	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
72	5040.	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.29	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00
73	4800.	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.28
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
74	4800.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.29	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75	4900.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.29	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
76	4800.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.29	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
77	4800.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.29
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78	4800.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
79	4800.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	4800.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PULPWOOD		0.09	0.17	0.27	0.25	0.29	0.45	0.56	0.54	0.57	0.74	0.83	0.82	0.75	0.95	0.82
IMMAT FIR		0.09	0.17	0.27	0.25	0.19	0.26	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.00
SAW LOGS		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.02	0.02	0.06	0.09

SUCHEK

FIRST ROW = PULPWOOD (1,000,000 M3 STERES

Table A-5.

*** FORECAST 1974-1988 ***

PULPWOOD AND SAWLOG - FROM MANMADE FORESTS IN BRAZIL - PINUS SPP. - MINAS GERAIS

YEAR	AREA	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
67	400.	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.03	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
68	1040.	0.00	0.05	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.08
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02
69	1360.	0.00	0.00	0.07	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
70	5360.	0.00	0.00	0.00	0.27	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.31	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00
71	6400.	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.38	0.00	0.00	0.00	0.37	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00
72	6880.	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.41	0.00	0.00	0.00	0.40	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00
73	8000.	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.46
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
74	8000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.00	0.00	0.48	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75	8000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.00	0.00	0.48	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
76	8000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.00	0.00	0.48	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
77	8000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.00	0.00	0.48
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78	8000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
79	8000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	8000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PULPWOOD		0.02	0.05	0.07	0.27	0.35	0.41	0.49	0.73	0.82	0.88	0.97	1.20	1.26	1.32	1.02
IMMAT FIR		0.02	0.05	0.07	0.27	0.33	0.35	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.00
SAW LOGS		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.03	0.04	0.06

FIRST ROW = PULPWOOD (1,000,000 M3 STERES

SECOND ROW = SAWLOGS (1,000,000 M3 SOLID)

SUCHEK

Table A-6.

*** FORECAST 1974-1988 ***

PULPWOOD AND SAWLOGS FROM MANMADE FORESTS - PINUS SPP. - ALL COUNTRY

YEAR	AREA	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
60	1600.	0.0	0.09	0.0	0.0	0.0	0.0	0.12	0.0	0.0	0.0	0.0	0.17	0.0	0.0	0.0
		0.0	0.01	0.0	0.0	0.0	0.0	0.03	0.0	0.0	0.0	0.0	0.12	0.0	0.0	0.0
61	2720.	0.0	0.0	0.16	0.0	0.0	0.0	0.0	0.21	0.0	0.0	0.0	0.0	0.29	0.0	0.0
		0.0	0.0	0.01	0.0	0.0	0.0	0.0	0.05	0.0	0.0	0.0	0.0	0.21	0.0	0.0
62	3280.	0.0	0.0	0.0	0.19	0.0	0.0	0.0	0.0	0.25	0.0	0.0	0.0	0.0	0.35	0.0
		0.0	0.0	0.0	0.02	0.0	0.0	0.0	0.0	0.06	0.0	0.0	0.0	0.0	0.25	0.0
63	10800.	0.65	0.0	0.0	0.0	0.63	0.0	0.0	0.0	0.0	0.82	0.0	0.0	0.0	0.0	1.17
		0.0	0.0	0.0	0.0	0.05	0.0	0.0	0.0	0.0	0.21	0.0	0.0	0.0	0.0	0.82
64	13120.	0.0	0.79	0.0	0.0	0.0	0.76	0.0	0.0	0.0	0.0	1.09	0.0	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.07	0.0	0.0	0.0	0.25	0.0	0.0	0.0	0.0	0.0
65	6560.	0.0	0.0	0.51	0.0	0.0	0.0	0.50	0.0	0.0	0.0	0.0	0.65	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.04	0.0	0.0	0.0	0.0	0.16	0.0	0.0	0.0
66	6960.	0.0	0.0	0.0	0.42	0.0	0.0	0.0	0.40	0.0	0.0	0.0	0.0	0.53	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.03	0.0	0.0	0.0	0.0	0.13	0.0	0.0
67	25280.	1.29	0.0	0.0	0.0	1.52	0.0	0.0	0.0	1.47	0.0	0.0	0.0	0.0	1.92	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.0	0.0	0.0	0.0	0.49	0.0
68	48000.	0.0	2.35	0.0	0.0	0.0	2.76	0.0	0.0	0.0	2.67	0.0	0.0	0.0	0.0	3.50
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.23	0.0	0.0	0.0	0.0	0.87
69	56560.	0.0	0.0	2.99	0.0	0.0	0.0	3.51	0.0	0.0	0.0	3.40	0.0	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.29	0.0	0.0	0.0	0.0
70	71120.	0.0	0.0	0.0	3.63	0.0	0.0	0.0	4.27	0.0	0.0	0.0	4.12	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.36	0.0	0.0	0.0
71	80560.	0.0	0.0	0.0	0.0	4.11	0.0	0.0	0.0	4.83	0.0	0.0	0.0	4.67	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.40	0.0	0.0
72	80000.	0.0	0.0	0.0	0.0	0.0	4.08	0.0	0.0	0.0	4.80	0.0	0.0	0.0	4.64	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.40	0.0
73	80000.	0.0	0.0	0.0	0.0	0.0	0.0	4.08	0.0	0.0	0.0	4.80	0.0	0.0	0.0	4.64
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.40
74	80000.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.08	0.0	0.0	0.0	4.80	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75	80000.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.08	0.0	0.0	0.0	4.80	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
76	80000.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.08	0.0	0.0	0.0	4.80	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
77	80000.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.08	0.0	0.0	0.0	4.80
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
78	80000.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.08	0.0	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
79	80000.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.08	0.0	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80	80000.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.08	0.0
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PULPWOOD		1.94	3.23	3.06	4.23	6.25	7.60	8.21	8.96	10.63	12.37	13.27	13.83	14.38	15.80	14.10
INMAT.FIB.		1.29	2.35	2.99	3.63	4.11	4.08	4.08	4.08	4.08	4.86	4.08	4.08	4.08	4.08	0.0
SAWLOGS		0.0	0.01	0.01	0.02	0.05	0.07	0.07	0.09	0.19	0.44	0.54	0.64	0.74	1.13	2.09

SUCHEK

FIRST ROW = PULPWOOD (1,000,000 M3 STERES)
SECOND ROW = SAWLOGS (1,000,000 M3 PILED)

Table A-7.

*** FORECAST 1974-1988 ***

PULPWOOD AND SAWLOG FROM MANMADE FORESTS IN BRAZIL - PINUS SPP - SOUTH SP

YEAR	AREA	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
60	480.	0.00	0.03	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00
61	1200.	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.15	0.00	0.00
		0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.11	0.00	0.00
62	2240.	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.29	0.00
		0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.20	0.00
63	1360.	0.10	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.17
		0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.12
64	1200.	0.00	0.09	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
65	1040.	0.00	0.00	0.07	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
66	1440.	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.13	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.03	0.00	0.00
67	6720.	0.40	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.47	0.00	0.00	0.00	0.00	0.59	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.15	0.00
68	11040.	0.00	0.66	0.00	0.00	0.00	0.78	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.00	0.97
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.25
69	19040.	0.00	0.00	1.14	0.00	0.00	0.00	1.35	0.00	0.00	0.00	1.33	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00
70	9040.	0.00	0.00	0.00	0.54	0.00	0.00	0.00	0.64	0.00	0.00	0.00	0.63	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00
71	10960.	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.78	0.00	0.00	0.00	0.77	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00
72	12000.	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.84	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00
73	12000.	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.84
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
74	12000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.00	0.85	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75	12000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.00	0.85	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
76	12000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.00	0.85	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
77	12000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.00	0.85
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78	12000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
79	12000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80	12000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PULPWOOD		0.50	0.78	1.30	0.80	1.23	1.59	2.19	1.57	2.17	2.46	3.01	2.36	2.62	3.29	2.84
IMMAT FIR		0.40	0.66	1.14	0.54	0.66	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.00
SAW LOGS		0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.04	0.09	0.10	0.14	0.12	0.21	0.43	0.45

FIRST ROW = PULPWOOD (1,000,000 M3 STERES

SECOND ROW = SAWLOGS (1,000,000 M3 SOLID)

SUCHEK

Table A-8.

*** FORECAST 1974-1988 ***

PULPWOOD FROM MANMADE FORESTS IN BRAZIL - EUCALYPTUS SPP. - SAO PAULO

YEAR	AREA	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
56	8000.	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
57	8000.	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
58	8000.	0.00	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
59	8000.	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60	8000.	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
61	8000.	0.77	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
62	12000.	0.00	1.15	0.00	0.00	0.00	0.00	0.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
63	21600.	0.00	0.00	2.07	0.00	0.00	0.00	0.00	1.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00
64	18400.	0.00	0.00	0.00	1.77	0.00	0.00	0.00	0.00	1.49	0.00	0.00	0.00	0.00	0.00	0.00
65	7200.	0.00	0.00	0.00	0.00	0.69	0.00	0.00	0.00	0.00	0.58	0.00	0.00	0.00	0.00	0.00
66	22400.	4.29	0.00	0.00	0.00	0.00	2.15	0.00	0.00	0.00	0.00	1.81	0.00	0.00	0.00	0.00
67	8000.	0.00	1.53	0.00	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.00
68	17600.	0.00	0.00	3.36	0.00	0.00	0.00	0.00	1.69	0.00	0.00	0.00	0.00	1.43	0.00	0.00
69	13600.	0.00	0.00	0.00	2.60	0.00	0.00	0.00	0.00	1.31	0.00	0.00	0.00	0.00	1.10	0.00
70	16800.	0.00	0.00	0.00	0.00	3.21	0.00	0.00	0.00	0.00	1.61	0.00	0.00	0.00	0.00	1.36
71	43200.	0.00	0.00	0.00	0.00	0.00	8.25	0.00	0.00	0.00	0.00	4.15	0.00	0.00	0.00	0.00
72	40000.	0.00	0.00	0.00	0.00	0.00	0.00	7.64	0.00	0.00	0.00	0.00	3.84	0.00	0.00	0.00
73	40000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.64	0.00	0.00	0.00	0.00	3.84	0.00	0.00
74	40000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.64	0.00	0.00	0.00	0.00	3.84	0.00
75	40000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.64	0.00	0.00	0.00	0.00	3.84
76	40000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.64	0.00	0.00	0.00	0.00
77	40000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.64	0.00	0.00	0.00
78	40000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.64	0.00	0.00
79	40000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.64	0.00
80	40000.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.64
PULPWOOD		5.69	3.33	6.00	5.01	4.55	11.05	9.38	11.08	10.44	9.84	13.60	12.13	12.91	12.58	12.84

SUCHEK

PULPWOOD = 1,000,000 M3 STERES

Table A-9.

*** FORECAST 1974-1988 ***

PULPWOOD FROM MANMADE FORESTS IN BRAZIL - EUCALYPTUS SPP. - PARANA

YEAR	AREA	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
61	480.	0.05	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
62	320.	0.00	0.03	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
63	160.	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
64	80.	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
65	80.	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
66	240.	0.05	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
67	560.	0.00	0.11	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00
68	400.	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.03	0.00	0.00
69	800.	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.06	0.00
70	1120.	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.09
71	3200.	0.00	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00
72	3200.	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00
73	3200.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.00	0.31	0.00	0.00
74	3200.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.00	0.31	0.00
75	3200.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.00	0.31
76	3200.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.00
77	3200.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.00
78	3200.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.00	0.00
79	3200.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.00
80	3200.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61
PULPWOOD		0.09	0.14	0.09	0.16	0.22	0.67	0.69	0.66	0.69	0.73	0.94	0.96	0.95	0.98	1.01

PULPWOOD = 1,000,000 M3 STERES

SUCHEK

Table A-10.

*** FORECAST 1974-1988 ***

PULPWOOD FROM MANMADE FORESTS IN BRAZIL - EUCALYPTUS SPP. - RIO GRANDE DO SUL

YEAR	AREA	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
68	960.	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.10	0.00	0.00
69	1840.	0.00	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.27	0.00	0.00	0.00	0.00	0.19	0.00
70	3280.	0.00	0.00	0.00	0.00	0.68	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.00	0.34
71	3520.	0.00	0.00	0.00	0.00	0.00	0.73	0.00	0.00	0.00	0.00	0.51	0.00	0.00	0.00	0.00
72	4000.	0.00	0.00	0.00	0.00	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.58	0.00	0.00	0.00
73	6400.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33	0.00	0.00	0.00	0.00	0.93	0.00	0.00
74	6400.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33	0.00	0.00	0.00	0.00	0.93	0.00
75	6400.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33	0.00	0.00	0.00	0.00	0.93
76	6400.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33	0.00	0.00	0.00	0.00
77	6400.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33	0.00	0.00	0.00
78	6400.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33	0.00	0.00
79	6400.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33	0.00
80	6400.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33
PULPWOOD		0.00	0.00	0.20	0.38	0.68	0.73	0.83	1.47	1.60	1.81	1.84	1.91	2.36	2.45	2.60

PULPWOOD = 1,000,000 M3 STERES

SUCHEK

Table A-11.

*** FORECAST 1974-1988 ***

PULPWOOD FROM MANMADE FORESTS IN BRAZIL - EUCALYPTUS SPP. - ESPIRITO SANTO

YEAR	AREA	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
67	800.	0.00	0.17	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00
68	2400.	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.25	0.00	0.00
69	4000.	0.00	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.58	0.00	0.00	0.00	0.00	0.42	0.00
70	6400.	0.00	0.00	0.00	0.00	1.33	0.00	0.00	0.00	0.00	0.93	0.00	0.00	0.00	0.00	0.67
71	8000.	0.00	0.00	0.00	0.00	0.00	1.66	0.00	0.00	0.00	0.00	1.16	0.00	0.00	0.00	0.00
72	14400.	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	2.09	0.00	0.00	0.00
73	14400.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	2.09	0.00	0.00
74	14400.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	2.09	0.00
75	14400.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	2.09
76	14400.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00
77	14400.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00
78	14400.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00
79	14400.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00
80	14400.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
PULPWOOD		0.00	0.17	0.50	0.83	1.33	1.66	3.11	3.34	3.58	3.92	4.16	5.17	5.34	5.50	5.76

PULPWOOD = 1,000,000 M3 STERES

SUCHEK

Table A-12.

*** FORECAST 1974-1980 ***

PULPWOOD FROM MANMADE FORESTS IN BRAZIL - EUCALYPTUS SPP. - MINAS GERAIS

YEAR	AREA	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
56	5600.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
57	5000.	0.0	0.45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
58	4000.	0.0	0.0	0.39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59	6400.	0.0	0.0	0.0	0.52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	8000.	0.0	0.0	0.0	0.0	0.65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
61	8000.	0.84	0.0	0.0	0.0	0.0	0.71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62	5000.	0.0	0.54	0.0	0.0	0.0	0.0	0.45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63	7200.	0.0	0.0	0.69	0.0	0.0	0.0	0.0	0.58	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64	4800.	0.0	0.0	0.0	0.46	0.0	0.0	0.0	0.0	0.39	0.0	0.0	0.0	0.0	0.0	0.0
65	5200.	0.0	0.0	0.0	0.0	0.31	0.0	0.0	0.0	0.0	0.26	0.0	0.0	0.0	0.0	0.0
66	6000.	0.92	0.0	0.0	0.0	0.0	0.46	0.0	0.0	0.0	0.0	0.39	0.0	0.0	0.0	0.0
67	8000.	0.0	1.53	0.0	0.0	0.0	0.0	0.77	0.0	0.0	0.0	0.0	0.65	0.0	0.0	0.0
68	9000.	0.0	0.0	1.83	0.0	0.0	0.0	0.0	0.92	0.0	0.0	0.0	0.0	0.78	0.0	0.0
69	192.0	0.0	0.0	0.0	3.67	0.0	0.0	0.0	0.0	1.84	0.0	0.0	0.0	0.0	1.56	0.0
70	30400.	0.0	0.0	0.0	0.0	5.81	0.0	0.0	0.0	0.0	2.92	0.0	0.0	0.0	0.0	2.46
71	35000.	0.0	0.0	0.0	0.0	0.0	6.42	0.0	0.0	0.0	0.0	3.23	0.0	0.0	0.0	0.0
72	43200.	0.0	0.0	0.0	0.0	0.0	0.0	8.25	0.0	0.0	0.0	0.0	4.15	0.0	0.0	0.0
73	40000.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.64	0.0	0.0	0.0	0.0	3.84	0.0	0.0
74	40000.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.64	0.0	0.0	0.0	0.0	3.84	0.0
75	40000.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.64	0.0	0.0	0.0	0.0	3.84
76	40000.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.64	0.0	0.0	0.0	0.0
77	40000.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.64	0.0	0.0	0.0
78	40000.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.64	0.0	0.0
79	40000.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.64	0.0
80	40000.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.64
PULPWOOD		2.15	2.52	2.91	4.65	6.76	7.59	9.47	9.14	9.87	10.82	11.25	12.44	12.06	13.04	13.94

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PULPWOOD = 1,000,000 M3 STERES

APPENDIX B

COMPARATIVE FLOW OF WOOD FROM PLANTATIONS ESTABLISHED THROUGH 1972 AND FROM PLANTATIONS TO BE ESTABLISHED IN THE 1970's.

Figure B.1.

PULPWOOD AND SAWLOGS FROM MANMADE FORESTS - BRAZIL
PINUS SPP. - ALL COUNTRY

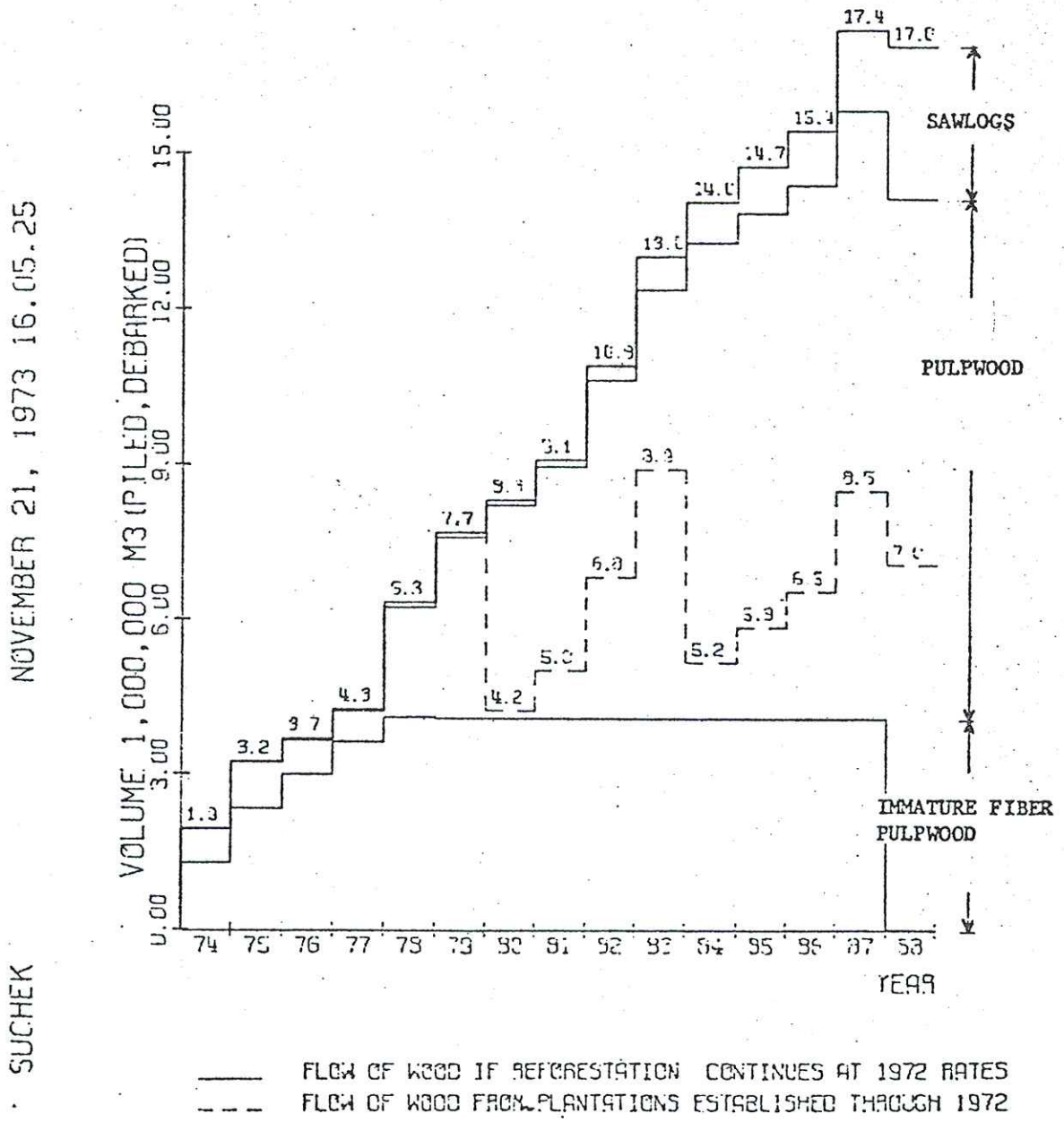

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Figure B.2.

PULPWOOD AND SAWLOGS FROM MANMADE FORESTS - BRAZIL
PINUS SPP. - SAO PAULO

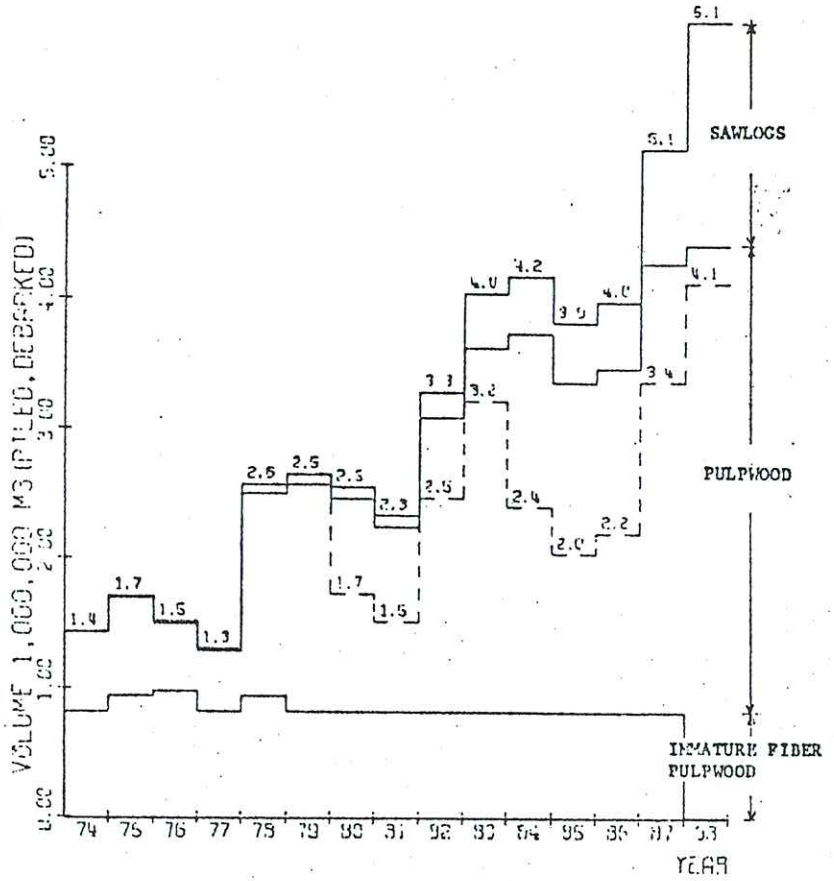


Figure B.3.

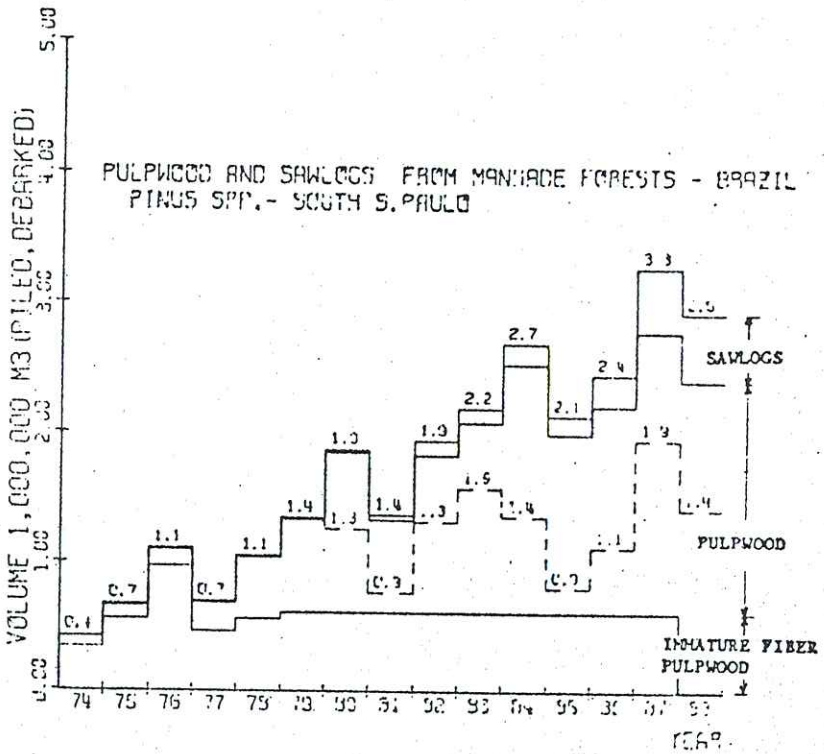


Figure B.4.

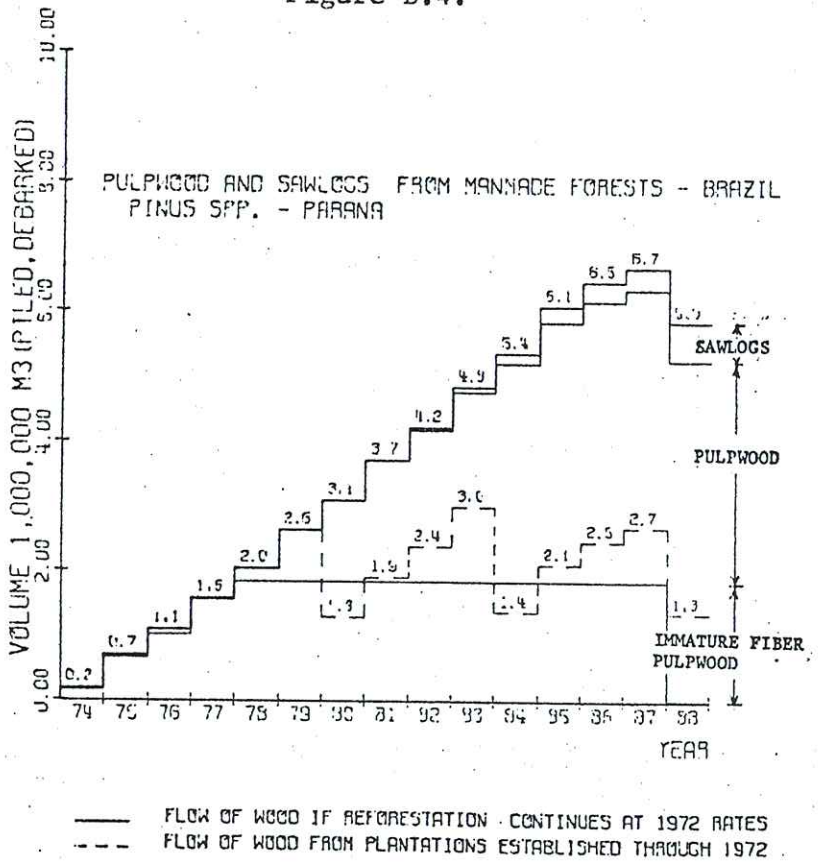


Figure B.5.

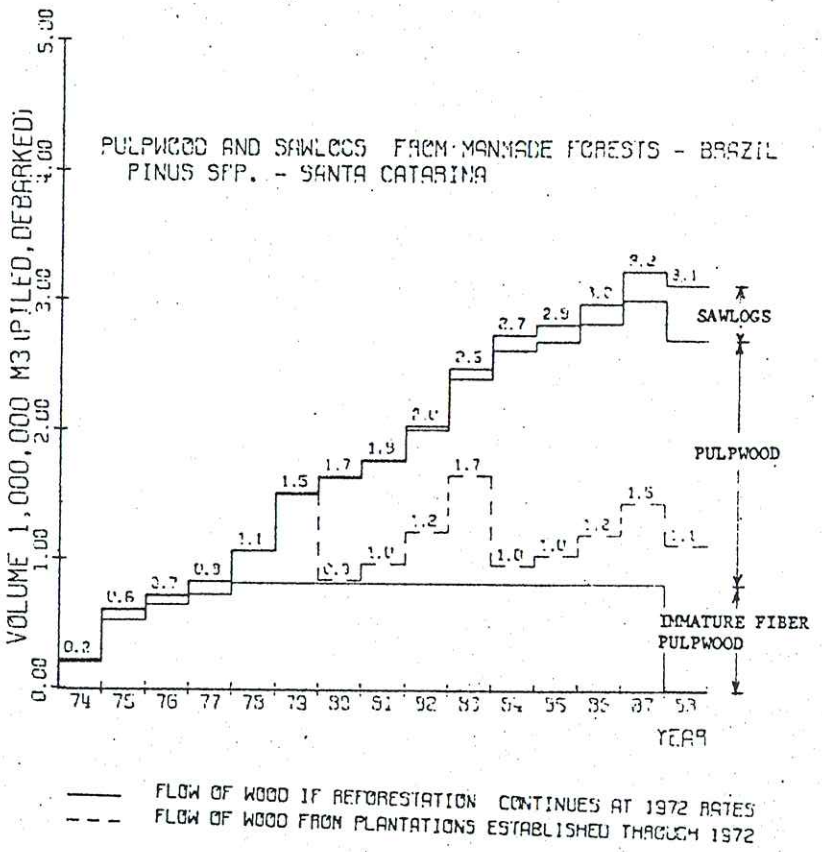


Figure B.6.

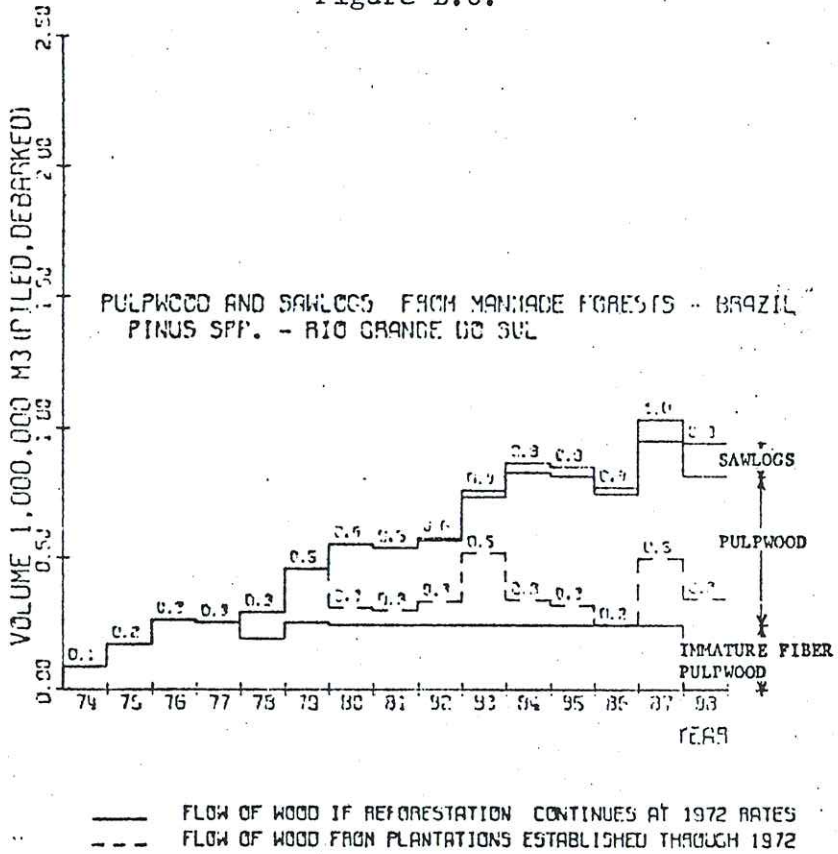


Figure B.7.

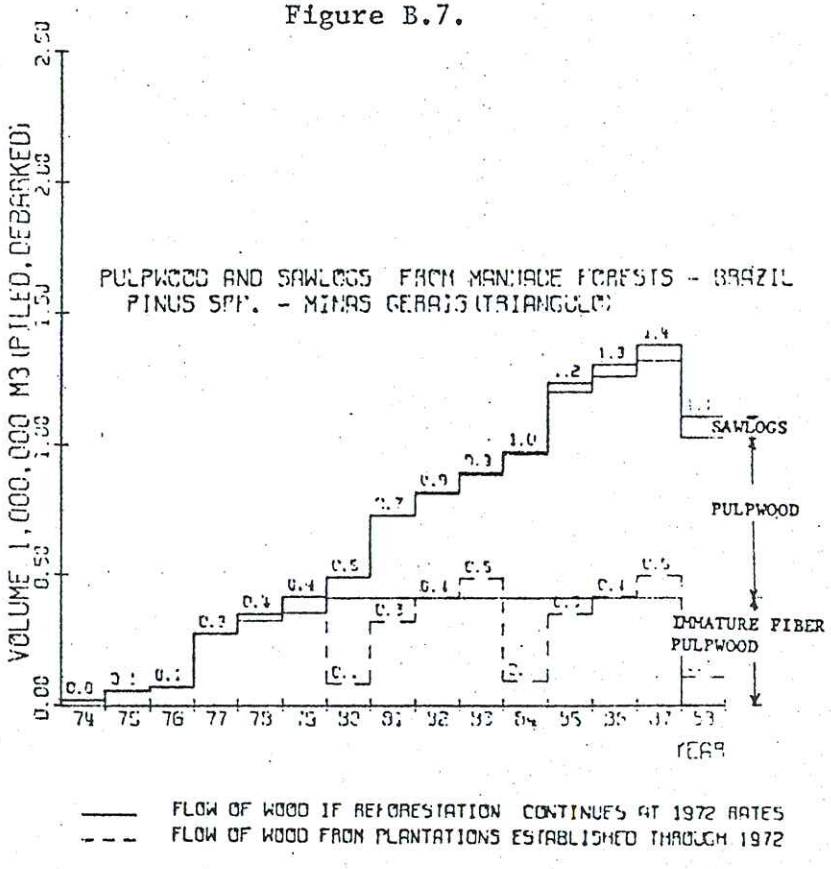


Figure B.8.

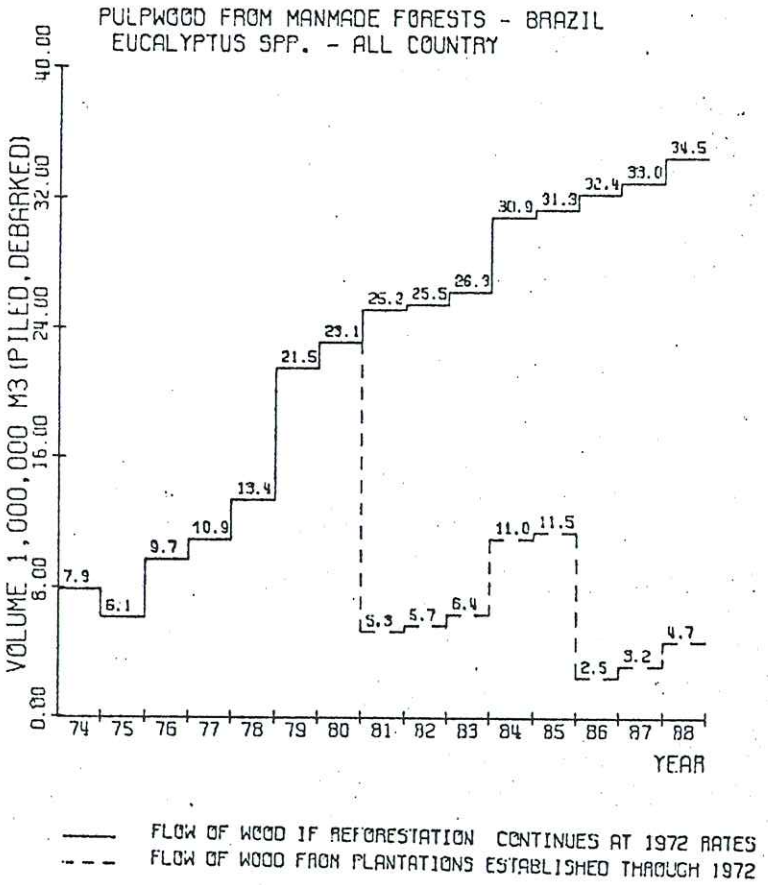


Figure B.9.

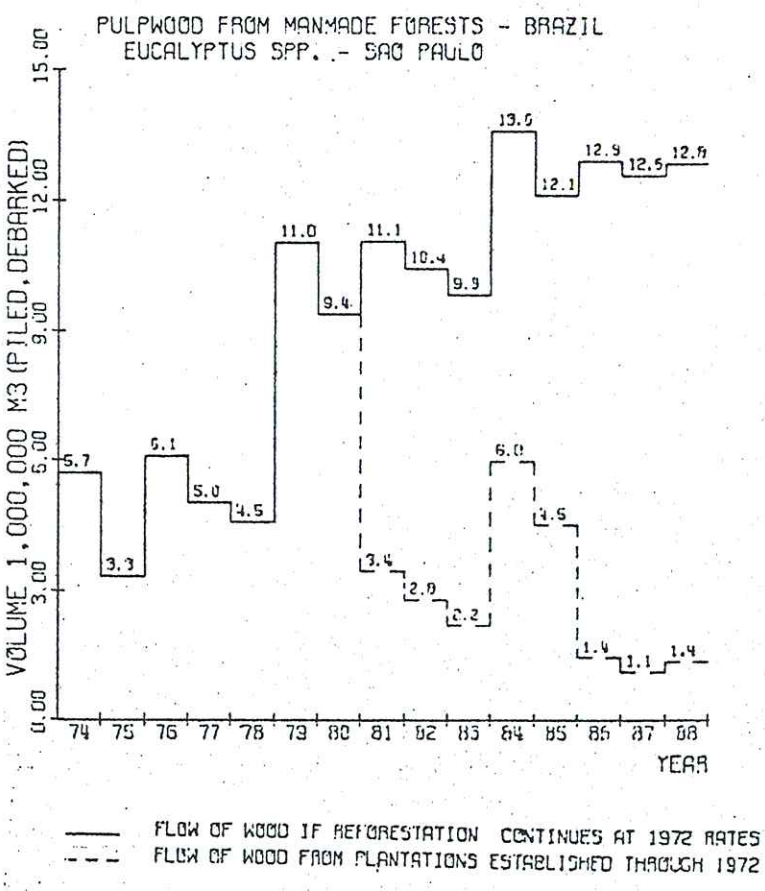


Figure B.10.

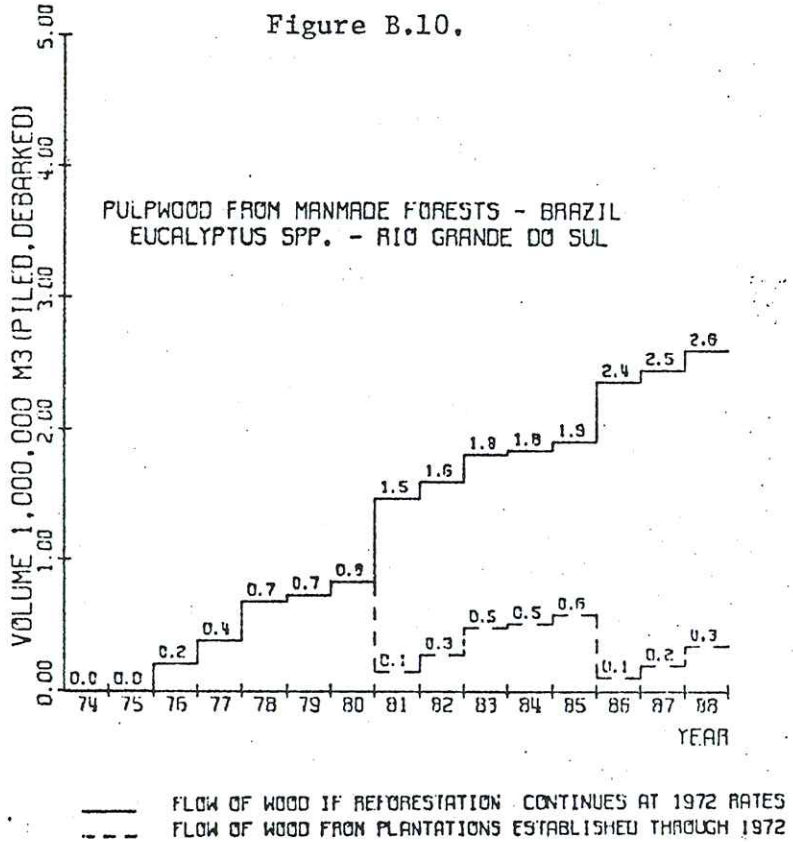


Figure B.11.

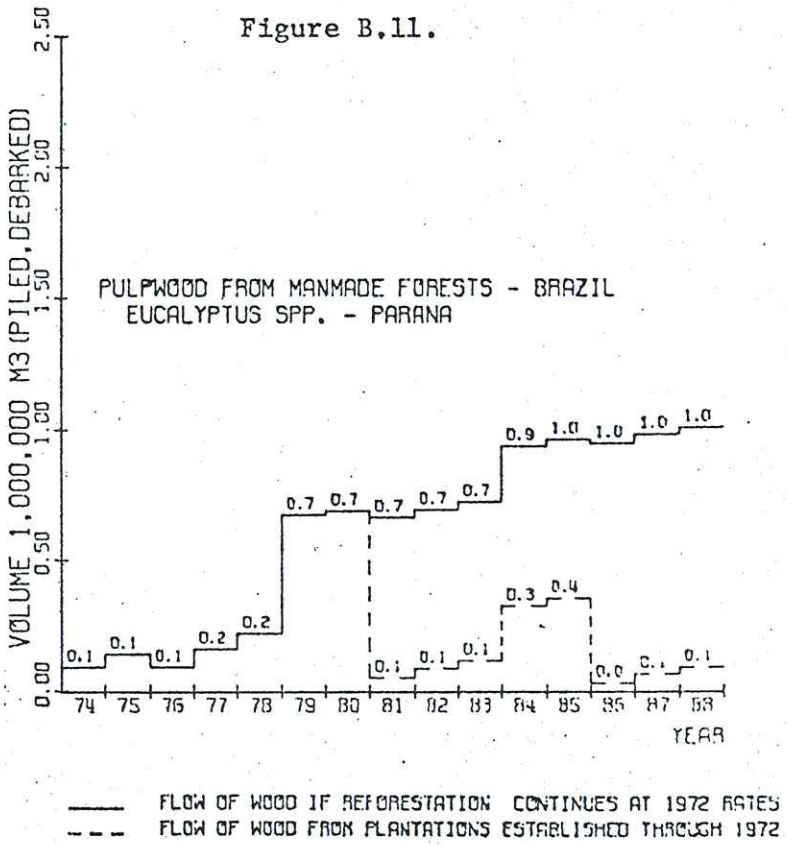


Figure B.12.

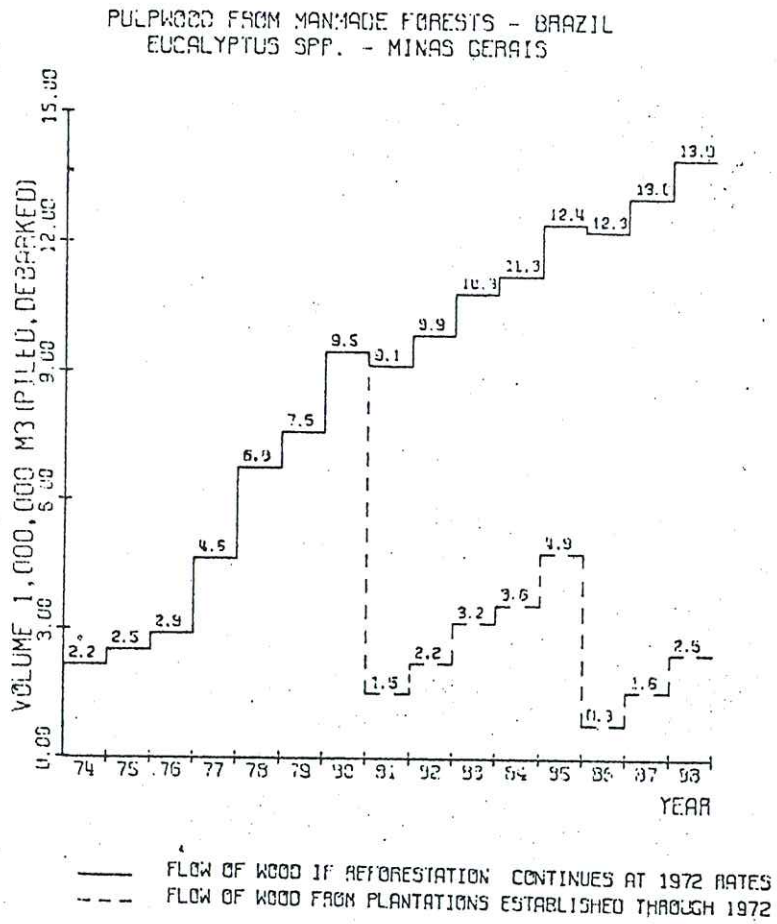
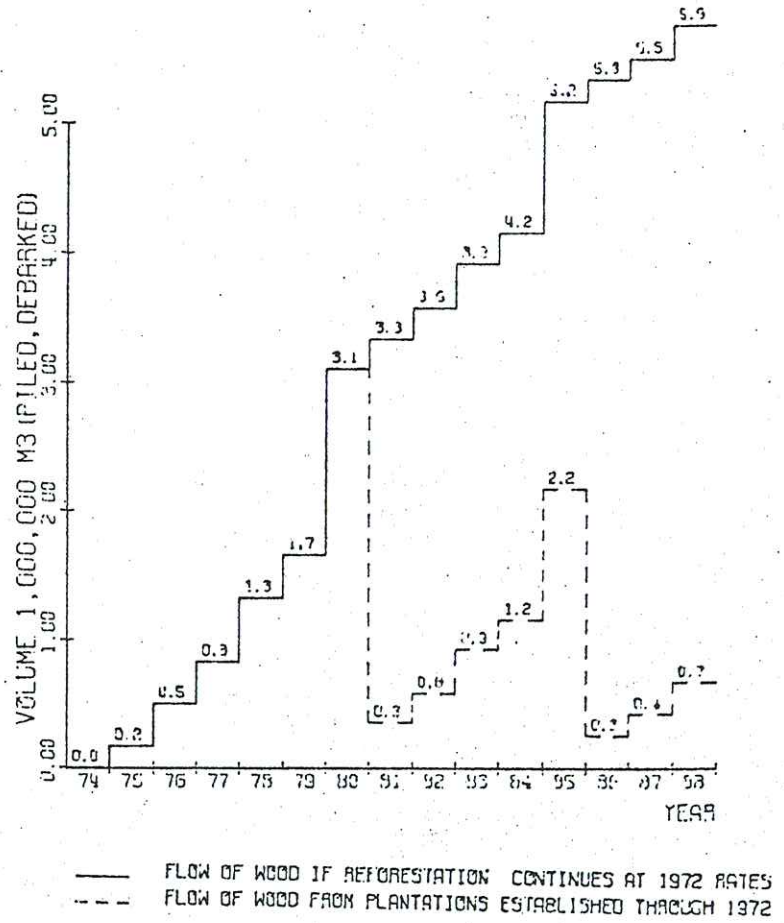


Figure B.13.



VITA

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Education:

	Name and Location	Dates	Degree
High School	Colegio Bom Jesus Curitiba, Parana, Brazil	1964-1966	
College	Faculdade de Florestas da Universidade Federal do Parana, Curitiba, Parana, Brazil	1967-1970	B.S.
	State University of New York College of Environmental Science and Forestry, Syracuse, New York, USA	1972-1973	M.S.

Employment Experience:

Employer	Dates	Position
Comissao de Zoneamento Economico Florestal (Instituto Brasileiro de Desenvolvimento Florestal), Curitiba, Parana, Brazil	1970-1971	Data processing analyst
FAO Project BRA, 45 Rio de Janeiro, Guanabara, Brazil	1971	Assistant to the FAO expert in forestry economics