

# PINE PLANTATIONS MANAGEMENT IN SOUTHERN BRAZIL: PROBLEMS AND OPPORTUNITIES

by

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**ABSTRACT:** The objective of this paper is to describe the forest sector of Southern Brazil. In the first part of the paper, a brief description is made concerning forest resources of the region - natural stands and pine reforestation. Comments about pine management are included in this section. General figures are presented with respect to primary timber industries in the south region of Brazil. Comparison of projected pine yields with industrial consumption levels indicates an expected shortage of timber by the end of the century. A simple financial analysis was carried out, showing that pine plantation investments have an IRR of 5.3 percent to 9.6 percent. Finally some problems and opportunities of Brazil's South Region to sustain its pine timber industries growing are discussed.

**KEYWORDS--**Brazil, forest resources, pine management, forest economics, reforestation.

## INTRODUCTION

Brazil is the largest country of South America. The country's population, around 140 million people, is concentrated in the South, Southeast and in coast portions of the Northeast.

Despite the vast remaining forest land (some 340 million hectares - 40 percent of Brazil's land area), natural forests have been largely eliminated from the most heavily populated and developed regions of Brazil. (see Table 1)

Wood consumption is around 300 million m<sup>3</sup> per year. Industrial timber production accounts for more than 132 million m<sup>3</sup>, of which 45 million m<sup>3</sup> are in mechanical

Table 1. Natural forests distribution and population - Brazil.

Region	Land Area (million ha)	Natural Forest Area (million/ha)	Forest as Percent of Land (%)	Population (million)
North	356	286	80	10
Northeast	154	14	9	42
Central-West	188	32	17	9
Southeast	92	8	9	63
South	56	6	11	22
TOTAL	846	347	41	146

Source: Associacao Brasileira de Productores de Madeira (1994), Associacao Brasileira de Productos de Madeira (1994) and Kronka, J.N. (1994).

wood industries, 60 million m<sup>3</sup> are in charcoal production and nearly 27 million m<sup>3</sup> are in the pulp and paper industry. Fuel wood accounts for more than 160 million m<sup>3</sup>.

From total roundwood production, 70 percent is supplied by natural stands and is mainly used as an energy source. The remaining timber supply originates from Eucalyptus and Pine plantations.

The forest sector accounts for some 4 percent of Brazil's Gross National Product (G.N.P), with a direct employment of 600 thousand people. Exportation of forest products is around US\$ 2.3 billion per year.

Brazil has been largely self-sufficient in timber products, but continued self-sufficiency, has become increasingly problematical. The natural forests of the South and Southeast regions, are no longer capable of sustaining a regular flow of wood production.

Increasing use of the Amazonian and interior forests are being made to supply the most populous and developed regions with timber. There are some obstacles to

promote those forests: scarcity of capital, limited current species marketability, inadequate access to the forests, long distances to developed timber industries and, as a major point, environmental concerns.

To correct the supply and demand of roundwood Brazil has launched a reforestation program in 1966. This program was based on the Fiscal Incentive Law which permitted individuals or firms to reduce their income tax payments to cover allowed expenditures for reforestations.

During more than twenty years - 1966 to 1987 - the Brazilian forest sector had one of the most important reforestation programs in the world. Some US\$ 6.0 billion were invested in forest plantations. As a result, 6.2 million hectares were reforested - 1.9 million with pine, 3.2 million with eucalyptus and 1.1 million of other species.

The focus of this paper, is to analyze pine reforestation in Southern Brazil. The objective is also to show the importance that those areas are playing in terms of national softwood.

## STUDY AREA

The study area considered in this paper is the Southern Region of Brazil. It is formed by four States - São Paulo, Paraná, Santa Catarina and Rio Grande do Sul - and it characterizes the central forestry problem of Brazil.

In the study area natural forests have been largely depleted. However, it is a center of timber products manufacturing and is a major timber products market area.

The geographic area of the Study Region is 83 million hectares (9.7 percent of Brazil's total land). Population in 1990 was estimated in 52.5 million (35.9 percent of nation's total). Average per capita income is US\$ 2150/year, in sharp contrast with an average of US\$ 1700 for the country as a whole. (Table 2)

## FOREST RESOURCES

### Natural Forests

The original forests were very extensive. Some studies point out that these original forests covered 57 million hectares, or 70 percent of the total land area. (Table 3)

Forest types ranged from tropical rain forest to woodland savanna (cerrado). Araucaria forests were prominent in Southern States (Santa Catarina and Paraná).

Forest lands were mainly cleared for agriculture and grazing purposes, but they were also cleared to supply the country's timber needs.

Today, the forest land is only 6.0 million hectares; no more than 8 percent of total area. States like São Paulo and Santa

Catarina still hold a forest cover around 10 percent of their total lands.

About one-third of remaining natural forests is in public ownership. The little natural forest that remains is concentrated in the Southeastern mountains where accessibility is limited. For practical purposes, natural forests of the Study Region cannot be considered as a significant future source of timber raw material.

### Reforestation

Forest plantations in Brazil cover an area estimated at 5.0 million hectares. Specifically for Brazil's South Region, this area is around 3.0 million hectares. (Table 4). More than half is pine plantations (1.5 million hectares) and 1.0 million with eucalyptus.

It is interesting to point out that São Paulo State owns some 58 percent of total eucalyptus reforested area in the South, and only 13 percent of Pine. On the other hand, Paraná and Santa Catarina are the most important States in terms of pine reforested area (60 percent of Brazil's planted area and 75 percent of the South Region).

Average annual rates of pine plantation in Brazil were strongly influenced by fiscal incentive legislation. Planted area increased rapidly through the fiscal incentive period - 1967/81. Due to legislative changes, annual and total planting areas plunged downward during the 1982/86. (Table 5)

In 1986, incentive legislation was eliminated from the forest sector. As a result, annual planting rates declined to 34 thousands hectares per year. In relation to

Table 2. Per capita income and population of study region by states.

Region/State	Per Capita Income (US\$/Years)	Population (million)
Study Region	2,146	52.5
States		
São Paulo	2,635	30.6
Paraná	1,800	8.3
Santa Catarina	1,950	4.5
Rio Grande do Sul	2,200	9.1

Source: Berger Consultores (1992).

the fiscal incentive period, there was an impressive reduction of 60 percent in annual planting.

#### Pine Management

Management of pine plantations is not as well defined as for eucalyptus.

Complete site preparation is required. Seedlings are two or three months of age when planted. Weed control is applied during the first years of plantation life. Initial spacing varies between 2.0 x 2.5 m and 3.0 x 1.5 m.

Average rotation age is 20 to 25 years. The first thinning is made at seven to nine years of age and is used for pulpwood or other small timber products. Subsequent thinnings are repeated at three to four years intervals. (Table 6)

Pine plantation yields range from 400 to 550 cubic meters per hectare. During a rotation the average yield distribution is 29 percent pulpwood, 45 percent sawlog and 26 percent plywood.

The majority of Brazilian pine forests have not been pruned. The effect of this procedure is that wood supply does not meet the requirements to produce high

grades of sawlog and plywood.

#### PRIMARY TIMBER INDUSTRIES

Pine wood consumption in Brazil is nearly 15.0 million cubic meters per year. The Southern Region accounts for 90 percent of the total, or some 14 million cubic meters. (Table 7)

Pulp and paper production dominates the timber industry of Brazil's South Region. There are presently some 27 pulp and paper mills, clustered mainly in São Paulo and Paraná States. Pine consumption is 7.7 million cubic meters.

The lumber industry is distributed throughout the entire Region. Sawmills are mostly small, ranging in lumber output from 5 cubic meters to 60 cubic meters per day. National lumber production is over 10 million cubic meters per year. The South Region produces 3.0 million cubic meters of lumber. The species used are pine (83 percent); Araucaria pine (10 percent) and natives (7 percent). Some 500 thousand cubic meters of pine lumber are exported to North America, North Africa and the Middle East.

Brazil's plywood industry has an output of 1.9 million cubic meter per year. The

Table 3. Study region natural forests.

Region/States	Original Area (1000 ha)	Percent of State Area	Remaining Area (1000 ha)	Percent of State Area
São Paulo	20,500	82	3,300	13
Paraná	16,920	85	1,195	6
Santa Catarina	8,075	85	1,048	11
Rio Grande do Sul	11,300	40	842	3

Source: Berger Consultores (1992), Governo do Estado de Sao Paulo (1993) and Kronka, J.N. (1994).

South Region is responsible for 80 percent of total national production. Pine roundwood consumption is around 1.1 million cubic meters and native species some 2.0 million.

Particleboard industries in the South Region have a pine consumption of 900 thousand cubic meters. However, other species like eucalyptus and acacia are used.

Fiberboard industries, charcoal production and wood energy do not have a significant pine consumption.

#### PROJECTED TIMBER YIELDS AND CONSUMPTION

Projected yields from pine plantations have been made on the basis of planted areas and average yields per hectare. Pine management is based on the assumption of a 20 year rotation age with three thinnings before final harvest. (Table 8)

The projected yields trend for Brazil is somewhat confused by annual fluctuations, however the trend is downward.

The pine yields projection for the Southern Region is similar to the general Brazilian situation. The projected trend is slightly constant up to year 2002. Then, it decreases very rapidly.

A comparative analysis of projected pine timber yields and current industrial consumption shows substantial deficits after the year 2002 .

The expected shortage will not affect all industries and States at the same time. Pulpwood and particleboard sectors have assured a great part of future supply through their own reforested areas. Lumber and plywood industries, on the other hand, will have to adjust their future supplies.

Alternative actions include eucalyptus as raw material, and/or to import pine roundwood from other Regions.

Today, sawlog yields overshadow small timber products from thinnings. This point, associated with the Brazilian economic crisis, has provided an incentive to the lumber industry to export part of total production. In 1990, total lumber export was 80 thousand cubic meters. In 1994, a total volume of 500 thousand cubic meters is expected.

#### ECONOMIC ANALYSIS OF PINE PLANTATIONS

Establishment and maintenance costs of pine plantations in Southern Brazil are, on average, around US\$ 1100/ha. Land price, judged suitable for reforestation, ranges

Table 4. Study region reforested area (1000 ha).

Region/States	Species			Total
	Pine	Eucalyptus	Other	
São Paulo	194	610	8	812
Paraná	662	221	66	949
Santa Catarina	483	32	24	539
Rio Grande do Sul		180	190	570
	200			
<b>TOTAL</b>	<b>1,539</b>	<b>1,043</b>	<b>288</b>	<b>2,870</b>

Source: Associação Brasileira de Produtores de Madeira (1994), Berger Consultores (1992), Berger, R. (1979), and Kronka, J.N. (1994).

Table 5. Average annual rates of pine reforestation - Brazil.

Period of Years	Total Reforested Area (1000ha)	Average Annual Area (1000ha)	Final Harvest Period (Years)
1967 - 1971	394	79	1987 - 1991
1972 - 1976	452	90	1992 - 1996
1977 - 1981	564	113	1997 - 2001
1982 - 1986	495	99	2002 - 2006
1987 - 1992	205	34	2007 - 2012

Source: Associação Brasileira de Produtores de Madeira (1994) and Berger, R. (1979).

from US\$ 1000/ha up to US\$ 1300/ha.

It is interesting to point out that both real prices of land as well as establishment costs of forest plantations, have been rising during the last years. From many possible reasons, two appear to have fundamental importance. In an inflationary economy buying land has become one of the best uses of capital. Labor wages are increasing due to continuous inclusion of social benefits.

Economic analysis indicates an average pine wood production cost of US\$ 4.2 per cubic meter at six percent interest rate. When land is included, average costs reach some US\$ 7.4 per cubic meter. Those

figures compared with market stumpage prices show mixed results. It apparently appears economically feasible to invest in pine wood production.

The internal rate of return (IRR) as a measure of long term investment profitability is 9.6 percent when land costs are ignored. Inclusion of land costs, reduces IRR to 5.3 percent. The results can be judged excellent, however the IRR must be comparable with other investment alternatives. Brazil's interest rate has been greater than 15 percent in the last years.

Table 6. Average yields from pine plantations (m<sup>3</sup>/ha).

Year	Cutting Treatment	Uses			Total Yield
		Pulpwood	Sawlog	Plywood	
8	thinning	50	10		60
12	thinning	45	45	20	110
16	thinning	30	70	40	140
20	Harvest	25	110	75	210

Source: Berger Consultores (1992) and Berger, R. (1979).

Table 7. Consumption of pine roundwood by primary timber industries - study region.

Industry	Number of Mills	Roundwood Consumption (1000m <sup>3</sup> )
Lumber	5,250	4,000
Plywood	262	1,100
Particleboard	7	911
Pulp and Paper	27	7,700

Source: Associacao Brasileira de Produtores de Madeira (1994), Berger Consultores (1992), Governo do Estado de Sao Paul (1993), and Revista da Madeira (1994).

Table 8. Projected timber yields from pine plantations compared with current industrial consumption - Brazil and study region (million m<sup>3</sup>).

Year	Brazil Projected Yields	Study Region			
		Projected Yields	Current Consumption	Net Balance	
				Annual	Accumulated
1995	25.2	17.4	13.7	3.7	3.7
1996	22.6	17.1	13.7	3.4	7.1
1997	24.9	15.5	13.7	1.8	8.9
1998	33.2	18.2	13.7	4.5	13.4
1999	20.1	11.1	13.7	(2.6)	10.8
2000	16.9	11.4	13.7	(2.3)	8.5
2001	19.6	11.1	13.7	(2.6)	5.9
2002	25.1	11.2	13.7	(2.5)	3.4
2003	9.3	4.6	13.7	(9.1)	(5.7)
2004	9.5	6.1	13.7	(7.6)	(13.3)
2005	8.9	5.8	13.7	(7.9)	(21.2)
2006	11.7	8.4	13.7	(5.3)	(26.5)

Source: Berger Consultores (1992).

Table 9. Average costs of establishment and maintenance of pine plantations - Study Region.

Item	Unit	Value	Obs.
1 - Forest Management */			
Establishment Cost	US\$/ha	650	--
Maintenance Costs	US\$/ha	450	--
2 - Price	US\$/ha	1,033	--
3 - Average Production Cost **/	US\$/m <sup>3</sup>	4.2	Land Cost Not Included
	US\$/m <sup>3</sup>	7.4	Land Cost Included

Source: Field Research

\*/ - Rotation age of 20 years

\*\*/ - Interest rate of 6 percent per year

Table 10. Stumpage prices of pine roundwood - study region.

Uses	Stumpage Price (US\$/m <sup>3</sup> )
Pulpwood	1.7 - 2.8
Sawlog	5.4 - 8.3
Plywood	11.5 - 12.2

Source: Field Research

Considering this analysis, it is easier to understand why buying land and investing in the Brazilian forest sector has not been an attractive investment to medium and large size business and businessmen.

The analysis was focused on current stumpage prices. Expected price increases, due to future shortage, can be an incentive to investors to apply their resources in pine wood production.

## CONCLUSION

The main conclusion of this paper can be stated in terms of problems and opportunities for Brazil's South Region Forest Sector.

## Problems

- a) Since the fiscal incentive was eliminated in 1986, no forest policy is in effect to promote forest plantation establishment in Brazil. In the South Region, only pulp and particleboard industries are conducting pine reforestation.
- b) Public Forest Agencies are much more concerned with environmental problems than with timber supply.
- c) Research on pine management and industrial wood uses are not well developed.
- d) Even though pine reforestation appears to be a sound and profitable invest-



ment, it is not attractive to medium and large businessmen. Lack of forest culture, long-term investment and uncertainty about the future Brazilian economy could be some of the reasons to explain private investors behavior regarding pine reforestation.

- e) The expected pine roundwood shortage will affect sawmill and plywood industries of Brazil's South Region by the end of the century. Log imports from other regions and increasing use of eucalyptus will be required to keep those industries in business.

#### Opportunities

Brazil's Southern Region has an excellent potential to expand its forest sector based on pine plantations.

- a) There is a large and suitable supply of land at lower prices.
- b) Good climate conditions to grow forests at competitive costs.
- c) Skilled labor availability and management capability for the establishment of pine plantations.
- d) Extraordinary pine forest yields associated with short rotation ages.
- e) The South Region of Brazil is the national center of timber products manufacturing, as well as the major timber market area.

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