FOREST INDUSTRIES IN SOUTH AMERICAN COUNTRIES[*]

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ABSTRACT

This paper analyzes the performance of forest industries in South American countries. Special attention is given to the relationships that exist between the evolution of forest industries and the exploitation of natural and planted forest as well as on the role of national governments in stimulating that kind of industries. South America has large natural forest areas and excellent natural conditions for planting trees. However, forest industries have not grown in a way that permit sustainable exploitation of natural forests and improve the Gross National Product and Trade Balance of South America's countries. This paper suggests how the latter can be done better.

Key words: forest industries, South America, public policies

1 - Introduction

The purpose of this paper is to analyze the performance of forest industries in South American countries. Especially, this paper focuses on the relationships that exist between the evolution of forest industries and the exploitation of natural and planted forests as well as on the role of local governments in stimulating forest industries.

The South American countries have a significant share of the world's forests, especially tropical forests. In 2000, South America's forests (both natural and planted forests) covered 874 million hectares (COFO, 2001, p. 34), which were equivalent to 22.7% of the world's forests[1]. Considering only tropical natural forests, in 2000 South America had 46.5% of them, while Africa and Asia had, respectively, 35.8% and 13.3% of these forests (Matthews, 2001, p. 10).

South America's forests are divided into two groups: a) tropical South America's forests, b) temperate South America's forests. Tropical forests comprised 94% of South America's forests in 2000, and they covered 58% of tropical South American countries' territory[2] (COFO, 2001, p. 34). Brazil is the largest country among the tropical South American countries, and it had 60.9%

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of South America's forests in 2000. Other countries belonging to that group are: Bolivia, Colombia, Ecuador, French Guiana, Guyana, Paraguay, Peru, Suriname, and Venezuela.

Chile is the most important country among temperate South American countries when analyzing forest activities. That country had 19% of South America's reforestation area in 2000 (COFO, 2001, p. 34), what was inferior only in relation to Brazil's reforestation area. Other countries in that group are Argentina and Uruguay.

The forests of South American countries have a large biodiversity. According to Keipi (1999, p. 1), Latin American and Caribbean forests (most of them placed in South American countries) "contains more trees, shrubs, and other plants than any other continent – about 85,000 species. This corresponds to some 31 percent of the world total of 270,000 species".

Natural and planted forests have been considered an important agent in the control of greenhouse effect in the world. The clear-cutting of tropical forests and the conversion of land for other agricultural purpose in South American countries, especially in the Amazon River Basin, has been condemned by several organizations. The latter defend the conservation of forest cover in that region.

Despite South America's huge natural forest cover and its importance for the world, forest industries are not fully and adequately developed in South American countries, except partially in Brazil and Chile. Simula (1999, p. 197) asserts that the Latin American countries answered for only 4% of world trade of wood-based forest products in 1993. Brazil and Chile were responsible, respectively, for 52% and 29% of Latin American forest exports in 1993.

If forest industries are not well developed in South America, how can that region have any interest in keeping its natural forest cover or planting forests? The answer for that question has not been provided yet.

Several authors discuss the causes and consequences of South American deforestation, for example, Binswanger (1991); Mahar (1989); Browder (1992); Cunha (1988); Fearnside (1990); Palo, Mery and Lehto (1996); and Aguerre and Denegri (1996). Others authors – like Bacha (1995), Beattie (1995), Constantino (1995), Haltia and Keipi (1999), Néris (2001) and Southgate (1995) – have analyzed the policies established to stimulate reforestation in specific countries. A few authors – such as Messner (1993), Stewart and Gibson (1994) and SBS(2000) – have evaluated forest industries in specific countries. Blackman et al (1995) make an overview of

Argentina, Brazil and Chile forest sectors, considering data set until 1994. The latter work only briefly compare the three most important forest sectors in South America, paying little attention to structural differences among these countries, and it does not evaluate how public policies have influenced the way that forest industries use forest resources.

This paper is divided in five sections, including this introduction. In section 2, some aspects about forest production and industries in South America are pointed out. In that section, special attention is paid to the differences that exist among countries. The deforestation and its relationship with forest industries are analyzed in section 3, and the following section analyzes the reforestation in South America and its relationship with forest industries. Finally, the conclusion of this paper appears in section 5.

2 - Forest production and industries in South America

Forests can be used in order to generate nonmarket ecological benefits, as a source of ecotourism, and to produce forest-based products.

According to Camino (1999, p. 101), "nonmarket ecological benefits produced by forests include carbon storage and fixation from the atmosphere, preserving water resources and watersheds, protecting species with pharmaceutical values, and regulating the climate". These services have not been charged but, if this is possible, the revenue from forests will increase substantially[3].

Ecotourism has been proved economically viable in several cases, and it represented 7% of international tourism in 1992. It also helps to conserve natural forests (Dourojeanni, 1999, p. 90).

Forest-based products are divided into two groups: a) wood and wood-based products; and, b) nonwood products (Simula, 1999, p. 197). The first group includes:

- Primary products, such as firewood, charcoal, logs, and chips;
- Primarily processed products, such as sawnwood, wood-based panels, pulp and paper;
- Further processed, value-added products (builder's woodwork, wooden furniture, converted paper and paperboard products, etc.).

Nonwood forest products (NWFPs) "cover a wide range of items from medicinal and aromatic plants and their extracts to nuts, fruits, resins, tannins, waxes and artisan products. The

FAO has identified 116 commercial NWFPs. Markets have traditionally been local or regional, but many products also enter international trade" (Simula, 1999, p. 200).

In this paper, only wood and wood-based products are analyzed. They represent 93% of the global forest trade (Simula, 1999, p. 197). Further processed, value-added products are not considered because they involve a secondary transformation of wood, and there is controversy about what can and what cannot be classified in that category[4].

For the purpose of this paper, forest industries comprise basically three groups: production of firewood and charcoal, mechanical processing of wood, and pulp and paper production.

Firewood and charcoal are mainly used to produce energy. The former is used in houses as well as in rural and small urban industries, such as bakeries. Charcoal is used in industries, mainly by pig iron makers. The latter use charcoal as a source of energy as well as raw material in pig iron production.

Mechanically wood-processing industries comprise sawmills, plywood and veneer factories, and more value-added wood-based panel factories. The latter mainly include particle board, hardwood fiberboard, Medium Density Fiberboard (MDF) and Oriented Strand Board (OSB) makers.

In South America as well as in other areas (such as North America, for example), large pulp and paper makers are normally integrated vertically, building large industrial plants that have total control of the productive chain – from raw material until the paper production. There are, however, small paper makers and large pulp makers, which do not have vertical integration between paper and pulp production.

2.1 - Forest production

FAO's Forestry Yearbook is a unique source of data that offers information about production and foreign trade of forest products for all countries around the world. According to FAO (2002) "The compilation of the Forest Products database has been made possible by the cooperation of governments which have supplied most of the information in the form of replies to annual questionnaires. Where countries have not reported statistics to FAO or have reported only partially, the information has been taken from national yearbooks, from reports or from unofficial

publications. Where official statistics were not available an indication is given identifying the use of FAO estimates (F) or data from nonofficial sources (*)".

Despite FAO's methodological efforts, at least two deficiencies can be pointed out: first, some data are estimated and periodically altered. The last updated data happened on December 19th, 2001, and it is possible that the new updated data change the current information. Second, some FAO's information are different from official information, spite of FAO says it uses official information. The last updated FAO's information overestimate Brazil's production of roundwood, wood-based panel and charcoal. The same problem happens for Argentina and Guyana's charcoal production.

According to March 2001 FAO's data set[5], Brazil's roundwood production has decreased during the 1990s. However, December 2001 FAO's data set[6] show an opposite situation. The scenario showed at March 2001 FAO's data set is more close to the one showed by Brazilian Institute of Geography and Statistic (IBGE), which is Brazil's official agency of statistics. December 2001 FAO's data set show that Argentina's charcoal production enlarged by 3.5 times between 1998 and 1999, while Guyana's charcoal production raised by 40 times. There is no evidence that these increases happened.

Due to these strange situation, this paper uses March 2001 FAO's data set, avoiding using data that were estimated. Table 1 shows the evolution of roundwood production in South American countries. In 1998, these countries produced 292 million m^3 of roundwood, which was equivalent to 9% of the world's roundwood production. It is a relatively small percentage when it is taken into consideration that South America had 22.7% of the world's forests in 2000.

Insert table 1 here

Among the tropical South American countries, Brazil is the most important producer of roundwood. Among the temperate South American countries, Chile has been the most important producer of roundwood. The majority of South America's countries have increased their roundwood production during the last decade; however, this is not the case for Brazil, Argentina and French Guiana. The increase in roundwood production in Chile and Uruguay, especially during the last decade, is associated with national policies established to foster reforestation in these countries (as it will be commented in section 4). Meanwhile, the reduction of Brazil's

roundwood production is linked to the limitations that happened in the exploitation of natural forests.

Firewood is the most important product obtained from forest exploitation in South American countries, especially in tropical countries (table 2). In Bolivia, Colombia and Peru at least 80% of roundwood production was used as firewood in 1998.

Insert table 2 here

Charcoal production is very important in Brazil, Colombia, Paraguay, and Argentina. In these countries, pig iron makers use charcoal as a source of energy and as a raw material in the production of pig iron.

Wood-based panel productions have increased in Brazil, Chile, Argentina, and Ecuador. Brazil and Chile are the most important producers of that kind of forest product (table 3).

Insert table 3 here

Examining with more details the wood-based panel production (tables 3 and 4), it is easy to observe that Brazil, Chile and Argentina answered for the largest share of all kind of wood-based panels. These three countries have increased the production of more value-added products such as hardboard fiberboard, MDF, and particle board.

Insert table 4 here

Pulpwood and particle production increased tremendously in Brazil up to 1990 and until 1997 in Chile. Both countries have significant participation in the international pulp market. Pulp is produced basically from wood, and it is allocated to paper production in South American countries (table 5). Argentina, Colombia and Venezuela use other non-wood fibers to produce pulp. Brazil, Chile and Uruguay, however, use basically wood fibers in order to make paper.

Insert table 5 here

2.2 - Forest industries in South American countries

This section begins with an analysis of policies established to foster forest industries in South American countries (item 2.2.1). This analysis is important to understand some features of these industries in South America (item 2.2.2). By the reason of Brazil and Chile are the most important producers of forest products in South America (as demonstrated above), the structures of their forest industries are compared in item 2.2.3.

2.2.1 – Forest Policies

Forest policies are a set of governmental measures established to stimulate and regulate exploitation of natural forest, forest planting, and forest industries.

Forest policies in South American countries were drafted in coherence with national goals and took place side-by-side with other sector development policies. According to Stewart and Gibson (1994, p. 3) “The set of policies that have strongly influenced land use decisions and affected the development of forest industries in Latin America are not, as it may seem, a collection of dispersed, haphazard measures, but rather components of a coherent government strategy devised to achieve specific goals.”

In the 1950s and 1960s, South American countries adopted the import substitution industrialization model (ISI). In this model, the industrial sector was placed as the major economic sector in the economy, and policies were established in order to substitute imports by domestic production. The main economic instruments used in that kind of development strategic were (according to Baer, 1972, p. 98): subsidized loans for favored industries; high tax on the import of final goods, but not on imports of raw materials and capital goods for new industries; overvalued currency in order to make the import of industrial equipment cheaper; government’s participation on the capital of some enterprises; and construction of public infrastructure designed to complement industries.

In the case of forest industries, the main policies adopted were: log export ban; high tariff and non-tariff barriers on the import of forest processed products (Stewart & Gibson, 1994, p. 4); subsidized loans for building industrial plants, such as pulp and paper factories (Soto B., 1992); monetary stimulus for planting forests (Bacha, 1995; Beattie, 1995); and no effective restriction in relation to natural forest exploitation. These policies were implemented in different intensities

by South American countries, and it explains the larger dimension of forest industries in Brazil, Argentina and Chile than in other South American countries.

The ISI model caused some forest industries to be inefficient in some South American countries. According to Stewart and Gibson (1994), at the end of the 1980s plywood production was economically viable in Bolivia and Ecuador only because log prices were low. That situation was caused by the log export prohibition, and it fostered an increase in deforestation.

By the late of 1960s and during the 1970s, South American countries changed their industrial policies to stimulate export-oriented industries. Measures were taken to decrease the level of effective protection and monopoly profits, and giving incentives to firms to rationalize their operations (Baer, 1972, p. 110).

South American countries granted different forms of subsidies for enterprises that allocate parts of their production for foreign markets. In the case of forest industries, subsidies were granted to build pulp, paper and fiberboard factories. Development banks charged low interest rates in their loans to help investments in large factories[7] or governments participated in the capital of these factories[8].

Fiscal crises, high inflation rates and negative balances of payment fostered the South American countries to change their industrial policies since the 1980s. The new policies have been based on tariff reduction; dropping of non-tariff barriers to the import of processed products similar to the domestic ones; reduction of fiscal and credit subsidies in the context of structural fiscal adjustment; banking system restructuring; privatization; foreign trade liberalization; and more freedom for international capital flows. However, for specific industries that can improve the trade balance and the Gross National Product, some South American countries have kept old stimuli, such as reduction in business taxes and access to advantageous public loans. These new policies have been established in different intensity, time and extension by South American countries. Chile, for example, was the first South American country to pursuit this new economic model in the 1980s (Messner, 1993). Brazil only adopted this model in the 1990s (Baumann, 2000).

Especially for forest industries, national governments reduced tariffs charged in the imports of wood-based processed products and stopped the grants of new subsidized loans for building new wood-based industrial plants. Some countries also finished the stimulus for planting

forest, such as Brazil in 1988 and Chile in 1994. However, other countries have kept these stimuli, such as Argentina; and other countries – such as Colombia, Ecuador and Paraguay – have created them (Haltia & Keipi, 1999, p. 67).

As a result of the new economic model, reorganization has happened in South American industries, inclusively in forest industries. That reorganization is characterized by the fusion of enterprises, downsizing process, and closing of unprofitable industrial plants. The number of industrial firms and the amount of persons engaged in them have diminished. The new economic development model, however, has not been followed by effective measures that assure a sustainable exploitation of natural forests (Rodriguez, 1999, p. 4-5).

2.2.2 – Features of Forest Industries in South American Countries

The scarcity of information restricts the analysis of forest industries' performance in South American countries. However, from existing information the following can be concluded: a) illegal operations have happened in some forest industries, especially in the sawnwood industry; b) forest industries are not the most dynamic industrial sector in South American countries. Nonetheless, these industries have been a net exporter in several countries or have a potential to improve their trade balance. This fact is important for economies that need to improve their balance of payment, such as South American countries.

Industrial information is available for legal businesses and for minimum-sized enterprises. Most South American countries have only surveys about industrial activities, and they have only gathered information for enterprises with a minimum size, which varies among the countries. For example, in Bolivia, Peru, Uruguay, and Venezuela only industrial firms with five or more employees are reported. In Paraguay that population is formed by industrial enterprises with seven or more employees. In Colombia, Ecuador, and Chile only industrial firms with ten or more employees are considered (United Nations, 1999 and 2000). Only Argentina and Brazil have, respectively, a complete or partial industrial census[9] for specific years during the 1990s.

No official data set in South American countries includes all forest industries, especially the illegal ones. These are a part of the informal sector. Informal forest enterprises are industrial firms that do not have legal permission to operate or, having that permission, do not fully respect the forest laws. In South America, these kinds of firms appear mainly in the Amazon

Basin Region and use native logs. Due to their inherent characteristic, informal forest enterprises cannot be easily counted. Some predictions, however, can be made when official data are compared with data collected by other institutions that work closely with forest industries.

In Brazil, for example, Zugman (2000, p.2) states that 9,630 sawmills existed in 1999. Otherwise, the Brazilian Institute of Geography and Statistics (IBGE, 2001) states that this number was 3,248 in 1996 and 3,174 in 1997. Probably, the official number of sawmills in Brazil would be about 3.2 thousand in 1999, because that number was slightly altered in 1997 in relation to 1996, and there is no additional information about significant change in that variable since then. As a result of this data, it is possible to conclude that there are roughly 6.4 thousand informal sawmills in Brazil. In other words, formal sawmills are half as many as the informal ones.

Normally, informal enterprises employ a small number of workers into each firm. Taking this into consideration, it is possible to evaluate the importance of informal enterprises in the sawnwood industry. In Chile, for example, the National Institute of Statistics (INE, 2001) states that there were 395 sawmills in 1996 employing 10 or more people. Messner (1993), however, declares that 1.2 thousand sawmills existed in Chile in beginning of the 1990s. Hence, about 800 sawmills (67% of them) were potentially operating informally. In Bolivia, according to Stewart and Gibson (1994, p.3), there were 217 sawmills in 1990. United Nations (2000), however, only registered 99 sawmills with five or more employees operating in 1995. In Ecuador, according to Stewart and Gibson (1994, p.3), 435 sawmills were operating in 1987. For the same country, United Nations (2000) computed only 24 sawmills with ten or more persons engaged in 1995.

The above examples of Chile, Bolivia, and Ecuador imply that small sawmills answered for the large numerical share of the sawnwood industry. Besides that, it is common sense, especially in the Amazon Basin Region, that a large parcel of small sawmills operates illegally.

Illegal operation also happens in plywood and veneer production, where enterprises have authorization to operate, but they use logs from unauthorized exploitation. However, no quantitative information exists about the dimension of that illegal conduct.

The pulp and paper sector uses logs from reforestation, and it is normally comprised of law-abiding enterprises. That conduct is part of pulp makers' strategy to overcome environmental barriers for exporting to some countries, especially European ones (Hilgemberg, 2000).

The importance of forest industries in the South American industrial sector varies among countries. They can be divided into three groups according to the importance of forest industries in their industrial sectors. The first one consists of Argentina, Peru, Uruguay, and Venezuela where forest industrial production answers for approximately 3% of the total industrial production. The second group includes Brazil, Bolivia, Colombia, and Ecuador where forest industrial productions range from 4.8% to 6% of the total industrial production. Chile and Paraguay form the third group. Around 10% of Chile's industrial production originates from forest industries, and about 13% of the Paraguayan industrial workforce is employed in forest industries (table 6).

Insert here Table 6

The evolution of "Index numbers of industrial production" (United Nations, 1999 and 2000) indicates that forest industries in the 1990s had increased less than other sectors, such as rubber and plastic production, transport equipment, and non-electrical machinery. That result came in part from public policies that have been encouraging new industrial activities but do not give the same stimulus to traditional activities.

Despite forest industries are not ranked among the most dynamics ones; they contribute to improve trade balances or have a great potential to do that. Table 7 shows the forest industries trade balance in recent years for all South American countries. For most of them (except Argentina and Venezuela), wood industries have been a net exporter. The pulp and paper sector's trade balance, however, is only positive for Brazil and Chile.

Insert here Table 7

By comparing the forest trade balance with the total trade balance, it is possible to conclude that new stimulus addressed to enlarge forest industries production can improve the trade balance in South American countries. This stimulus has been considered recently in some countries. In Brazil, for example, part of forest industries have been considered in the new program addressed to stimulate industrial sectors. The "Forúm de Competitividade" discussed several measures to stimulate furniture and mechanically wood-processing industries in order to increase furniture export by 71.3% in the next three years.

New stimuli to foster forest industries can, on one hand, improve the foreign trade balance and, on the other hand, be conditioned to a sustainable exploitation of natural forests. For example, official loans and temporary tax incentives (such as a reduction in business taxes) can be given only to enterprises that direct share of their production to foreign markets and prove that their demand of raw forest material will be taken from reforested areas or from natural forests exploited by using sustainable techniques.

2.2.3 – Comparison between forest industries in Brazil and Chile

It is interesting to make a comparison between forest industries in Brazil and Chile for four reasons: first, both countries are the most important producers of industrial wood-based products in South America; second, there are some different features in relation to their forest industries' structures; third, there is more available information about their forest industries; and fourth, their experiences have been considered as successful for other South American countries.

Forest industries have a more relative importance in the Chilean economy than they have in the Brazilian economy. At the beginning of the 1990s, forest industries answered for more than 3% of Chile's GNP and about 10% of its total export value (Mery, 1996, p. 249). In the middle of the same decade, these industries represented 2.2% of Brazil's GNP and 6.9% of its total export value[10]. In 1999, forest products answered for 8.9% and 4.3%, respectively, of Chile and Brazil's total exports. These values prove that forest industries are more important in Chilean economy than in Brazilian economy.

Different features exist between the Brazilian and Chilean forest industries in relation to technology and raw material used, as well as their organization, concentration and market-orientation.

Both countries (Brazil and Chile) have a heterogeneous sawnwood industry structure. Small mills exist in larger numbers, but their production share is smaller than their numerical share. In 1999, Brazil had 9,630 sawmills, while Chile had about 1.2 thousand sawmills in the middle of the same decade. Large sawmills have modern equipment in both countries, while small sawmills use out of date technology.

Large sawmills normally belong to pulp makers, and they are more present in Chile than in Brazil. In Chile, the two largest pulp makers Arauco and CMPC have been supporting large

sawmills[11] that used wood from reforestation, mainly radiata pine. Meanwhile, in Brazil only the largest pulp maker[12] Aracruz has a large sawmill, but the sawn timber for that company represents a small share of its total sales when it is compared with the importance of sawn timber sales in Chilean pulp makers' total sales[13].

Technological inequality is especially strong among Brazil's sawmills because a significant number of them are located in the Amazon Region and operate illegally. Besides, these small Amazonian sawmills use native logs whereas most of Chile's sawmills, including the small ones, mainly use logs from reforestation. According to Abracave (2000), in 1999, 69.2% of the Brazilian sawmill's log consumption came from natural forests. In Chile, roundwood from natural forests are mainly used to produce chips and plywood. According to Robert Flynn & Associates (1996), about 16% of wood used in Chile's forest industries came from natural forests in 1995, and 74% of it was transformed into chips.

At the end of the 1990s, Brazil had about 350 plywood and veneer mills and 15 other factories of more value-added wood-based panels (SBS, 2000). Basically, these plywood and veneer mills have used logs from natural forests. In 1999, 77.1% of their log consumption came from the natural forest (Abracave, 2000). Otherwise, more value-added wood-based panel factories use only roundwood from reforestation. Among them, there are three industrial plants[14] of MDF and two that produce hardboard. The MDF production recently started in Brazil. The first factory began its production in 1997, and the third one at the end of 2000.

Generally, plywood and veneer mills are medium-sized factories in Brazil, using traditional technology, while hardboard and MDF plants use modern technology. A significant part of plywood and veneer production as well as hardboard production is directed to foreign markets, meanwhile MDF and particle board production is strongly geared to the domestic market. In 1999, 50% of the plywood and the veneer production were exported. These shares for hardboard, particle board and MDF production were, respectively, 38.3%, 1.9% and 4.9% (SBS, 2000).

In Chile, there are less plywood and veneer mills than in Brazil. At the beginning of the 1990s, there were ten small plywood and veneer mills in Chile. The latter, however, use basically roundwood from reforestation, and they are directed to the domestic market (Mery, 1996). In the second half of the 1990s, Chile's plywood production had a great expansion when the largest

Chilean pulp maker Arauco opened a large plywood mill. It changed the concentration in the Chile's plywood industry. In 1999, Arauco's plywood factory captured over 40% of Chilean plywood production (Arauco, 2001).

In 1996, Brazil had 2,327 establishments in the pulp and paper sector. Among them, 71 were dedicated to produce pulp (IBGE, 2001). At the same year, Chile had 85 establishments in the pulp and paper sector (INE, 2001); ten of them were large pulp mills owned by six large firms.

In both Brazil and Chile there are large, modern and competitive pulp mills. They use only roundwood from reforestation. *Pinus radiata* is the most important kind of tree used in Chile, while in Brazil both eucalyptus and pinus are used to produce pulp.

Eucalyptus and pinus flourish in both countries (table 8), and they give to their pulp industries a comparative cost advantage in relation to other producing countries of pulp (table 9). The small cost of wood in Brazil and Chile overcomes the negative impact of depreciation and interest costs over the pulp production cost[15].

Insert here tables 8 and 9

Brazil has a dominant position on the eucalyptus pulp market. In 1997, Brazil produced 50% of the world's eucalyptus pulp production, and it was responsible for 45% of the world's exports of that kind of pulp (table 10).

Insert here table 10

The pulp industry is more concentrated and export-orientated in Chile than in Brazil. According to Robert Flynn & Associates (1996), the top two Chilean pulp producers answered for 75% of the pulp production in 1995. In Brazil, at the same time, the top two pulp producers accounted for about 32% of the national pulp production. In 1999, Chile's pulp exports were equivalent to 78.3% of its production. In Brazil, that ratio was 41.9% at the same year (FAO's Forestry Yearbook). Similar market-orientation happens in relation to paper and paperboard production[16].

The largest Chilean forest enterprises have been expanding their operation in neighboring countries[17] more than Brazilian companies do. This expansion is the result of two facts (Lignum,

2001): (a) Chilean forest industries are looking for more scale economies, and Chile's domestic market cannot afford it; (b) forest planting costs are lower in other South American countries than they are in Chile.

3 - Deforestation in South America and its relationship with forest industries

Natural forests covered 950 million hectares in South America in 1980, but it was reduced to 886 million hectares in 1990 and reached 864 million hectares in 2000 (table 11). Deforestation counted for 6.5 million hectares per year during the time period from 1981 to 1990 and 2.2 million hectares per year in the following ten years. According to Matthews (2001), the deforestation rate in the time period from 1991 to 2000 was underestimated by FAO, because in 2000 that institution adopted a different classification of forests in relation to what was used in 1990. It explains why natural forests increased in Bolivia, Chile, Paraguay, Uruguay and Venezuela between 1990 and 2000. There is no evidence that it, in reality, had happened. If these five countries were supposed to keep unchanged their natural forests between 1990 and 2000, the deforestation would count for 4.6 million hectares per year in South America between these years.

Insert here table 11

There are various causes explaining the deforestation in South America, such as: agriculture and cattle ranching expansion, mining, infrastructure construction (for example, construction of roads and hydroelectric power plants), and logging.

Logging is not the main cause of deforestation, but it permits other agents to magnify the dimension of deforestation. As loggers build roads into closed forests, small farmers, especially stakeholders, get access into these areas, and they begin a slash and burn agriculture. The latter is a more important deforestation cause than the logging. Normally, logging is conducted without any sustainable techniques, despite the fact that there are norms impelling that conduct (Camino, 1999, p. 102). If only logging is taking place in a specific area (in other words, stakeholders are kept away from these areas) the forest will diminish its biodiversity, especially its valued tree species.

The above situations (only unsustainable logging and it followed by slash and burn agriculture) have been happening in South American countries, especially in the Amazon Basin

Region. In that area, mechanically wood-processing industries use only native logs and there is little or no concern about sustainable exploitation of natural forests. According to Tockman (2001, p. 14) "… As much as 80 percent of the logging that occurs in Brazil's Amazon forest is illegal". Therefore, nobody can expect that these loggers are using sustainable techniques. Rocha (1999) administered a survey among forest industries in Rondônia (a Brazilian state located in the Amazon Basin), and she found out that entrepreneurs preferred to change the location of their sawmills or close them, but they do not do sustainable exploitation of natural forests.

Unsustainable logging also happens in South America's natural temperate forests. Tockman (2001, p. 15) asserts about Chile's natural forests "… according to the University Austral of Valdivia, only 20 percent of forests logged are done under management plans. The Central Bank of Chile has estimated that all Chile's native forests will be eliminated by 2015 if current rates of deforestation continue".

That scenario, however, can be altered. There are several experiences that show the sustainable exploitation of natural forest is equal or more profitable than its irrational exploitation (see, for example, Cartepillar, 1996, about Brazil; and Razetto, 1999, about Peru). However, the short-term vision of sawmill owners and farmers obstruct them in adopting these techniques. In order to change this attitude, federal and state governments can adopt several policies that reduce the profit of actual exploitation of natural forest and enlarge the profit of enterprises that use sustainable exploitation of natural forests. These policies can be: different income and businesses tariffs (higher for unsustainable exploitation and lower for sustainable one), charge of low interest rate in official loans only lent for sawmills that use roundwood from sustainable exploitation, and a tighter law enforcement that avoids illegal operations[18].

4 - Reforestation in South America and its relations with forest industries

Some forest industries in South America use only roundwood from reforestation. This is the case of pulp mills as well as the more value-added wood-based panel factories (chiefly MDF and hardboard makers). It is due to mainly three factors: first, these industries need a more sure source of roundwood; second, by using roundwood only from reforestation, these industries avoid partially environmental barriers for their exports; third, some incentives were granted in the past, or they are granted currently, which enlarge the profits of tree planting.

In the past, pulp makers in Brazil only used roundwood from natural forests. The huge amount of pine forests in the southern part of that country (especially of Paraná pine, *Araucaria Angustifolia*) permitted the pulp makers to use them. However, the reduction of these natural forests motivated pulp makers to look for other sources of wood, and reforestation was considered as an important alternative (Bacha, 1996).

In the 1960s, Brazil initiated a specific program to foster reforestation. The Brazilian incentives for reforestation were mainly based on a partial reimbursement of the income tax paid for enterprises that decided to plant forests. The Program of Fiscal Incentives for Forestation and Reforestation was implemented from 1966 to 1988, and it granted US$ 10.86 billion (December 1998 dollars), which should imply the reforestation of 6.2 million hectares (Bacha, 1995).

Other South American countries followed Brazil's example, and they implemented other programs to foster reforestation. However, the scheme and the time period of these programs were different. Chile implemented, from 1974 to 1994, a system of cost reduction for enterprises that decide to plant forest. If the plantation was successful, the government reimbursed at least 75% of the implantation costs[19]. That subsidy program was based on results, where "the subsidy came after the beneficiaries had already planted the trees" (Beattie, 1995, p. 24). According to Blackman et al (1995, p. 19), the Chilean government spent US$ 140 million as subsidies in order to stimulate the reforestation of 1.8 million hectares. It is considered a successful program to stimulate reforestation. In fact, the Chilean government only spent US$ 77.78 per hectare reforested, while Brazil spent US$ 1,751.61 per hectare reforested. Since 1994, Law 19,561 has given fiscal relief for small farmers in Chile that decided to plant forests. Half of forestry enterprises' revenue was free of taxation, and they were exempted from paying rural property tax (SBS, 2000, p. 32).

Argentina implemented, from 1992 to 1998, a system where part of the costs of planting, trimming, and harvesting was paid by the Federal Government. That program used an auction system in order to reduce the government expenditures. According to Constantino (1995, p. 22), "In this game each producer has to offer a certain amount of land in exchange for a given amount of money and the producer who has the capacity to offer more land for that money gets the financial incentive". In 1998, another program (Law 25,080, called Investments in Forest Plantation) was established in Argentina, exempting forestry farmers from paying rural property

tax and implementing other tax schemes that makes forest planting more profitable (SBS, 2000, p. 32).

Since 1987, Uruguay has been granting (based on Law 15,939) loans with favorable conditions for planting forests, and grants that cover half of forest planting costs in the first year (SBS, 2000, p. 33).

Ecuador began on May 1993 the Main Plan of Reforestation ("Plan Maestro de Forestácion, PLANFOR) that would plant 100 thousand hectares of forest from 1993 to 1997, and 600 thousand hectares from 1993 to 2012. According to Southgate (1995), the Ecuadorian government shares with the farmer the costs of planting and initial maintenance. The information available indicates that these goals have not been reached[20].

Paraguay resumed the grants of fiscal incentives for reforestation in 1995 (Law 536). The most important stimuli are: forestry enterprises do not pay half of their rural property tax, and wood-based industries have a 10% reduction in their income tax (SBS, 2000, p. 33).

The incentives described above and the need of wood-based industries in having a sure source of wood are the main reasons for large forest industries, such as pulp and fiberboard makers, to plant forest. Besides, these enterprises have used, since the end of the 1980s, their planted forest as a marketing strategy in markets where consumers are more concerned about environmental issues (Bacha, 1996). Due to the fact that pulp and fiberboard productions are concentrated in Brazil and Chile, reforested areas are also concentrated in these countries (table 11).

An important observation that comes from Table 11 is that planted forest stocks during the 1990s have only expanded in countries that have given incentives to that activity. This is the case of Argentina, Paraguay and Uruguay during the 1990s. Brazil ended the grants of monetary incentives for planting forests in 1988, and its stocks of planted forests were stagnated during the 1990s. It is a serious problem because Brazil's roundwood production has decreased during the last decade (as it was seen at item 2.1). Therefore, some forest industries can be hindered in their expansion in the future due to roundwood scarcity. It is a threat for a country that has one-third of the remaining tropical forests in the world.

5 – Conclusion

This paper analyzed the performance of forest industries in South American countries. The scarcity of data is the main restriction for analyzing forest industries in that region. However, important conclusions can be stated. Despite the fact the South America has a significant share of the world's forests, forest industries have not been developed completely and adequately there. In tropical South American countries, the roundwood is used as fuel and for industrial processing; meanwhile in temperate South America, roundwood is used mainly for industrial processing. Brazil and Chile have the more developed forest industries in South America, but there are some areas of their industrial structure that differ between the two countries. Chilean forest industries are more based on roundwood from reforestation than Brazilian forest industries. In general, Chilean forest industries are more export-oriented than Brazilian ones, and Chilean forest enterprises are opening branches in other South American countries. Some aspects of Brazilian and Chilean forest sector are considered good examples for other South American countries. Due to that, they have been granting stimulus for planting trees, wishing to enlarge their forest industries.

Natural forests have not been exploited in a sustainable way in other to guarantee the continuity of forest industries. However, that practice can be adopted without any negative impact against forest industries. It is interesting to point out that forest industries have neither been considered a strategic sector to improve foreign trade balance in South American countries nor an activity that can assure a rational exploitation of natural forests. However, both objectives can be achieved together. Credit and fiscal policies can be used in order to stimulate forest industries that allocate a share of their production for foreign markets and simultaneously use roundwood from reforestation or/and from natural forests exploited with sustainable techniques.

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Table 1 – Roundwood* production in South American countries – particular years (values in thousand cubic meters)

Country	1970	1980	1990	1998
Argentina	6,221	8,166	9,824	5,741
Bolivia	948	1,344	1,491	1,606
Brazil	120,150	183,502	205,565	197,816
Chile	9,214	13,326	22,085	31,670
Colombia	11,600	13,918	17,034	17,537
Ecuador	3,528	5,639	6,644	11,340
French Guiana	53	242	248	120
Guyana	243	198	160	419
Paraguay	3,333	5,814	7,466	8,097
Peru	5,749	8,092	7,591	9,157
Suriname	212	357	106	144
Uruguay	1,868	2,244	3,219	6,163
Venezuela	970	1,217	1,688	2,101
Total of South America	164,089	244,059	283,121	291,911

Source: FAO's data set (http://www.fao.org)
Note: * roundwood is wood in the rough. It comprises all wood obtained from removals that were transformed in commodities (sawlogs, veneer logs, pulpwood, other industrial roundwood, charchoal and firewood) or lost.

Table 2 - chief forest products elaborated in the first transformation by South America's countries – particular years

Country	Pulpwood and particles[A] (thousand m^3)				Sawnwood[B] (thousand m^3)				Wood-based panels[C] (thousand m^3)				Charcoal (metric tone)				Firewood (thousand m^3)			
	1970	1980	1990	1997	1970	1980	1990	1997	1970	1980	1990	1998	1970	1980	1990	1998	1970	1980	1990	1998
Argentina	1,542	1,842	3,584	3,577	736	846	950	1,711	193	427	272	754	522	368	294	144	3,149	4,096	3,000	1,103
Bolivia				383	72	212	102	180	1.3	23.9	18.7	23	9	11	14	4	717	911	1,119	1,355
Brazil	3,510	20,900	30,701	30,701	8,035	14,881	17,179	19,091	819	2,482	2,892	3,098	3,776	4,778	4,631	3,600	96,212	121,780	131,288	114,052
Chile	1,650	3,056	6,032	7,063	1,075	2,297	3,327	4,661	57	115	349	971	35	41	48	54	4,589	5,125	7,699	10,356
Colombia	185	569	589	589	1,100	*970	813	1,085	77	111	183	113	346	429	528	661	8,749	10,864	13,351	16,712
Ecuador	0	0	330	682	704	905	1,641	2,079	20	87	46	419	240	323	173	78	2,022	3,610	3,113	5,420
French Guiana					12	19	19	15	1	0	0	0	0	1	1	2	16	54	60	60
Guyana				2	87	70	50	57	0	0	0	76	0	1	0.6	0.5	9	9	10	11
Paraguay					214	655	228	550	15	95	113	161	114	152	120	384	2,527	3,402	3,966	4,220
Peru	20	25	5	0	351	611	499	482	54	84	27	58	7	10	12	14	4,662	6,104	6,518	7,328
Suriname					53	79	44	41	35	23	7	7.1	2	2	3	3	5	20	0.4	1
Uruguay	25	135	127	217	73	99	229	269	18	16	10	5.5	84	87	93	99	1,720	2,002	2,377	4,335
Venezuela				46	328	349	201	250	59	136	225	94	0	0	24	10	412	581	750	894
South America	6,932	26,527	41,368	43,260	12,840	21,993	25,282	30,471	1,349	3,600	4,143	5,780	5,135	6,203	5,942	5,054	124,789	158,558	173,251	165,847

Source: FAO's data set (http://www.fao.org)

Notes: A) pulpwood is wood in the rough other than logs, for pulp, particle board or fiberboard production. B) Sleepers are included in that group. C) Wood-based panels include the following commodities: plywood, veneer sheets, particle board and fiberboard.

Table 3 - chief wood-based panels production in South American countries – particular years (values in thousand m^3)

Country	Plywood				Veneer sheets				Particle board				fiberboard			
	1970	1980	1990	1998	1970	1980	1990	1998	1970	1980	1990	1998	1970	1980	1990	1998
Argentina	48	53	37	62	4.1	16	26	2	117	268	142	442	24.2	90	67	248
Bolivia	1.3	5.9	7	4	0	10	1.7	8	0	8	10	7	0	0	0	4
Brazil	342	826	1,300	1,500	96	216	234	240	112	660	660	660	269	780	698	698
Chile	12.9	19.8	40	129	2.3	6.9	9	104	22.4	43	178	321	20	45	122	417
Colombia	52	52	64	25	4.6	9	7	1	9.1	31	93	69	11.5	19	19	18
Ecuador	20	59	20	109	0	2	1	185	0	26	25	94	0	0	0	31
French Guyana					1	0	0	0								
Guyana	0	0	0	76												
Paraguay	6.5	30	10	100	8.3	63	102	60	0.5	2	1	1				
Peru	33	49	24	57	13.6	35	3.3	1	7.2	0	0	0				
Suriname	18	17	6	7					16.8	5.5	0.5	0.1				
Uruguay	12	7	4.1	3.2					1.5	7	3.5	1	4.2	2	2.7	1.3
Venezuela	33	55	52	0	0	0	112	29	24	65	52	65	2	16	9	0
South America	579	1,174	1,564	2,072	129.9	357.9	496	630	311	1,116	1,165	1,660	331	952	918	1,417

Source: FAO's data set (http://www.fao.org)

Table 4 – Chief Fiberboard Production – particular years (values in thousand m^3)

Country	Insulating Board				MDF				hardboard			
	1970	1980	1990	1998	1970	1980	1990	1998	1970	1980	1990	1998
Argentina		23	14					175				73
Bolivia								4				
Brazil	160	200	61	61				167				637
Chile								362				55
Colombia	1.6	4	4									18
Ecuador												31
Uruguay												1.3
Venezuela	2	16	9									
South America	164	243	88	61				708				815

Source: FAO's data set (http://www.fao.org)

Note: FAO does not report any fiberboard production in French Guiana, Guyana, Paraguay, Peru and Suriname.

Table 5 – pulp and paper production in South American countries – particular years (values in thousand metric tones)

Country	Pulp for paper [A]				Wood pulp [B]				Paper and paperboard [C]			
	1970	1980	1990	1998	1970	1980	1990	1998	1970	1980	1990	1998
Argentina	202	349	722	724	166	309	605	616	644	713	891	978
Bolivia	0.4	0.6	0	0					0.5	0.5	5	2
Brazil	867	3,143	4,364	6,720	811	3,089	4,307	6,774	1,099	3,361	4,844	6,524
Chile	356	763	804	2,210	356	763	804	2,210	234	356	462	642
Colombia	112	207	266	313	42	123	169	176	220	351	494	712
Ecuador	2.2	5	0.5	2.2	0	0	0	2.2	8	26	44	91
Paraguay									0.4	13	12	13
Peru	58	147	132	17	0	7	73		124	205	263	63
Uruguay	10	24	26	35	6	24	26	35	40	52	61	88
Venezuela	23	63	96	137	0	7	8	137	250	501	610	637
South America	1,631	4,702	6,411	10,158	1,381	4,322	5,992	9,950	2,620	5,579	7,686	9,750

Source: FAO's data set (http://www.fao.org). There is not any information about pulp and paper production for French Guiana, Guyana and Suriname.

Notes: A) pulp for paper includes wood and other fiber pulp allocated to produce paper. Other fiber pulp are from straw, bamboo, bagasse, esparto, other reeds or grasses, cotton linters, flax, hemp, rags and other textile wastes.

B) wood pulp is an aggregate that includes mechanical, semi-chemical, chemical and dissolving wood pulp.

C) "paper and paperboard" include newsprint, printing and writing paper, other papers, and paperboard.

Table 6 – Importance of forest industries in South American countries

Country	year	Activity	Shares in (values in percentages)		
			Number of establishments	Number of employees	Total industrial production
Argentine	1993	Manufacture of woods	5.61	2.48	0.92
		Paper and pulp sector	0.93	2.36	2.38
		Total forest industries	6.54	4.84	3.30
Bolivia	1995	Manufacture of woods	8.66	6.38	3.12
		Paper and pulp sector	1.47	3.55	2.16
		Total forest industries	10.13	9.93	5.28
Brazil	1997	Manufacture of woods	5.35	3.70	1.23
		Paper and pulp sector	1.84	2.80	3.56
		Total forest industries	7.19	6.50	4.79
Chile	1996	Manufacture of woods	7.23	6.82	4.26
		Paper and pulp sector	1.56	3.16	5.59
		Total forest industries	8.79	9.98	9.85
Colombia	1996	Manufacture of woods	2.58	1.24	0.70
		Paper and pulp sector	2.28	2.66	4.48
		Total forest industries	4.86	3.90	5.18
Ecuador	1997	Manufacture of woods	3.82	3.21	1.19
		Paper and pulp sector	2.67	4.05	4.75
		Total forest industries	6.49	7.26	5.94
Paraguay	1995	Manufacture of woods	16.57	11.91	...
		Paper and pulp sector	1.06	1.32	...
		Total forest industries	17.63	13.23	...
Peru	1994	Manufacture of woods	4.25	2.81	0.89
		Paper and pulp sector	1.26	1.94	1.84
		Total forest industries	5.51	4.75	2.73
Uruguay	1995	Manufacture of woods	...	1.17	0.37
		Paper and pulp sector	...	2.04	2.36
		Total forest industries	...	3.21	2.73
Venezuela	1995	Manufacture of woods	2.81	1.54	0.37
		Paper and pulp sector	1.10	2.82	2.92
		Total forest industries	3.91	4.36	3.29

Source: United Nations (1999 and 2000)
Note: ... this data is not available

Table 7 - Forest trade balance in South American countries - 1998 and 1999 (thousand US$)

country	Wood industries		Pulp and paper sector		Subtotal	
	1998	1999	1998	1999	1998	1999
Argentina	-32,445	-30,914	-628,842	-507,093	-661,287	-538,007
Bolivia	45,168	21,634	-35,967	-36,199	9,201	-14,565
Brazil	633,272	916,444	676,085	843,401	1,309,357	1,759,845
Chile	329,578	417,909	575,136	792,871	904,714	1,210,780
Colombia	-12,128	1,232	-263,854	-233,354	-275,982	-232,122
Ecuador	58,838	51,172	-200,402	-200,402	-141,564	-149,230
French Guiana	691	691	-624	-624	67	67
Guyana	30,014	36,047	-3,239	-3,239	26,775	32,808
Paraguay	77,460	82,375	-34,375	-25,680	43,085	56,695
Peru	27,631	50,400	-145,910	-143,541	-118,279	-93,141
Suriname	4,100	3,249	-1,277	-1,353	2,823	1,896
Uruguay	61,321	42,628	-45,311	-44,121	16,010	-1,493
Venezuela	-27,303	-27,169	-162,412	-184,600	-189,715	-211,769

Source: FAO's data set (http://www.fao.org)

Table 8 – annual increment and rotation age of forests in specific countries

Specie	country	Annual increment (m^3/ha/year)	Rotation age (number of years)
Short fiber			
Eucalyptus spp.	Brazil	46.0	7
Eucalyptus grandis	South Africa	20.0	8-10
Eucalyptus globulus	Chile	20.0	10-12
Eucalyptus globulus	Portugal	12.0	8-10
Eucalyptus globulus	Spain	10.0	12-15
Birch	Sweden	5.5	35-40
Birch	Finland	4.0	35-40
Long fiber			
Pinus radiata	Chile	22.0	25
Pinus radiata	New Zealand	22.0	25
Pinus spp.	Brazil	33.7	15-20
Pinus ellioti/Pinus taeda	USA	10.0	25
Douglas Fir	Canada (shore)	6.6	45
Picea abies	Sweden	4.0	70-80
Picea abies	Finland	3.6	70-80
Picea glauca	Canada (inland)	2.5	55
Picea marina	Canada (East)	2.0	90

Source: SBS(2000, p. 23), citing Portocel. Annual increment for Brazil are information from Bracelpa.

Table 9 – cost structure of short fiber pulp in specific countries – values in US$ per ton delivery in Europe (third quarter of 1994)

Item	Brazil	Southern of the USA	Canada	Finland	Sweden	Portugal	Chile
Wood	93	106	136	230	225	185	136
Energy	10	18	25	4	11	16	9
Chemical inputs	34	53	42	39	39	40	51
Labor	18	38	53	37	37	39	23
Transportation	72	67	59	40	35	40	60
Others	41	49	43	21	37	58	29
Variable cost	268	331	358	371	384	378	308
Administrative costs	33	38	45	38	40	57	34
Depreciation	85	67	48	57	42	60	87
Interest	67	44	48	60	44	55	50
Total cost	453	480	499	526	510	550	479

Source: Risi Pulpland Paper Review, cited in "A política de desenvolvimento do complexo celulose-papel: 1995-2005". ANFPC, August 25th, 1995.

Table 10 – Chief producer and exporting countries of eucalyptus cellulose in the World - 1997

Country	Share in world's production (%)	Share in world's export (%)
Brazil	50	45
Portugal	19	20
Spain	15	17
Chile	5	5
South Africa	5	4
Other countries	6	9

Source: Hilgemberg (2000), citing VALENÇA, A. C. V.; MATTOS, R. L. G. Papel e celulose: comércio exterior. Rio de Janeiro: BNDES, Jul./1999, 12p. (Informes setoriais - Produtos Florestais)

Table 11 – evolution of natural and planted forests in South American countries – selected years

Country	Forests in 1980 (thousand hectares			Forests in 1990 (thousand hectares)			Forests in 2000 (thousand hectares)			Annual change of natural forests (thousand hectares)	
	Natural	Planted	Total	Natural	Planted	Total	Natural	Planted	Total	1981-1990	1991-2000
Argentina	36,029	501	36,530	33,889	547	34,436	33,722	926	34,648	-214	-16.7
Bolivia	55,567	18	55,585	49,317	28	49,345	53,022	46	53,068	-625	371
Brazil*	597,817	5,016	602,833	561,107	4,900	566,007	527,499	4,982	532,481	-3,671	-3,361
Chile	7,618	470	8,088	7,018	1,015	8,033	13,519	2,017	15,536	-60	650
Colombia	57,734	37	57,771	54,064	126	54,190	49,460	141	49,601	-367	-460
Ecuador	14,342	30	14,372	11,962	45	12,007	10,390	167	10,557	-238	-157
French Guiana	7,997	0	7,997	7,997	0	7,997	7,925	1	7,926	0	-7.2
Guyana	18,596	0	18,596	18,416	8	18,424	16,867	12	16,879	-18	-155
Paraguay	16,889	2	16,891	12,859	9	12,868	23,345	27	23,372	-403	1,049
Peru	70,616	96	70,712	67,906	184	68,090	64,575	640	65,215	-271	-333
Suriname	14,898	6	14,904	14,768	8	14,776	14,100	13	14,113	-13	-66.8
Uruguay	667	136	803	657	156	813	670	622	1,292	-1	1.3
Venezuela	51,680	87	51,767	45,690	253	45,943	48,643	863	49,506	-599	295.3
South America	950,450	6,399	956,849	885,650	7,279	892,929	863,737	10,455	874,194	-6,480	-2,190

Source: FAO(1995) and COFO(2001).
Note: (*) planted forests in Brazil in 1980 is a information from Brazil's Agricultural Census.

[1] According to Matthews (2001), Food and Agriculture Organization (FAO) introduced some methodological alterations in its Forest Resources Assessment 2000 in relation to what was done in 1990. As a result of them, COFO(2001) overestimates the world's forest. However, that overestimate is lower for South America than to other continents. Due to it, it is possible to guess that South America retained in 2000 at least 22.7% of the world's forests.

[2] In 2000, forests covered 48.3% of Bolivia's territory. These shares were 62.3% for Brazil, 43.6% for Colombia, 37.2% for Ecuador, 90% for French Guiana, 78.5% for Guyana, 57.5% for Paraguay, 50.7% for Peru, 86.4% for Suriname, and 54.3% for Venezuela (COFO, 2001, p. 34).

[3] According to Camino (1999, p.101-102), "Owners of private forests in Mexico are losing a minimum of $ 4 billion every year from the nonmarket components of the forest's total economic value . . . Estimates of the total economic value of Costa Rican forests . . . show that owners of forested areas (including the state) fail to receive approximately 82 percent of the value of all forests (including protected areas), and 72 percent of the value per hectare from productive forests . . ."

[4] For example, pig iron makers in Brazil use charcoal as an energy source as well as raw material in the productive process. That share of pig iron production could be considered as further processed, value-added products. However, it appears strange to classify pig iron production in some countries as being a forest industry.

[5] It was printed at FAOSTAT 2001, CD-ROM made available last September 2001.

[6] It is available at FAO website (www.fao.org).

[7] See the case of Brazil's pulp and paper sector (Soto B., 1992).

[8] See Carrere and Lohmann (1996, p. 172-189) about the case of Chile. These authors state that the Federal Government first built, and after that it sold forest plantations and pulp mills at a low price to private enterprises.

[9] Partial industrial census is an industrial survey where all firms larger than a minimum size is inquired, but only a sample of firms smaller than that minimum size are inquired.

[10] These percentages for Brazil do not include the importance of pig iron made with charcoal. If that importance is taken into account, the shares of forest industries in GDP and total export revenue were, respectively, 3.1% and 8.3%.

[11] In 1999, Arauco's sawmills counted for 1.5 million m^3 of lumber production capacity (Arauco, 2001).

[12] Brazil's largest integrated pulp and paper maker Klabin is building a large sawmill.

[13] In 2000, only 0.06% of the Aracruz's total sales came from sawn timber sales (Aracruz, 2001), while that percentage was 24.3% for Arauco in 1999 (Arauco, 2001).

[14] One more factory is being built, and it will start its production at the end of 2001.

[15] Despite the data set in table 9 are out-of-date, they show a reality before the huge real Exchange rate alterations that happened in Brazil and Chile during the second half of the 1990s. The real Exchange rate in these countries appreciated from 1995 to 1997. In 1998 and especially in 1999 strong depreciation of Exchange rate took place.

[16] In 1995, one-third of Chile's paper and paperboard production was exported. During the same year, 80% of Brazil's paper and paperboard production were consumed by the domestic market (Robert Flynn & Associates, 1996). In 1999, these percentages were, respectively, 39% and 92% (FAO's Forestry Yearbook).

[17] The largest Chilean pulp maker Arauco is the owner of the Argentina's largest pulp mill (Arauco, 2001). The second largest Chile's pulp maker CMPC has paper mills in Argentina, Peru and Uruguay (CMPC, 2001). Masisa, a large Chilean wood-based panel producer, has mills in Brazil and Argentina.

[18] In the Brazilian Amazon Region, when forest agents arrest illegal sawnwood, they permit the defendant to have a guard of that material. Curiously, that sawnwood disappears and nobody can explain the reasons for that. In order to avoid that situation, the forest agencies can sell off directly that material to sawmills that adopt sustainable exploitation. The amount collected would help forest agencies to improve law enforcement.

[19] Beattie (1995, p. 24) says the reimbursement ranged from 75% to 90%. However, Niklitschek (1995, p. 34) says that reimbursement was 75% of plantation costs.

[20] Southgate (1995, p. 18) states "interest in the program seems to be waning". Douglas Southgate also states that "the Ecuadorian government never put much of its own money into PLANFOR; instead, it was hoping for international monies. Likewise, I don't think many hectares were ever reforested because of PLANFOR" (personal information transmitted on March 2001).