

Serôa da Motta, Ronaldo

Working Paper — Digitized Version

Past and current policy issues concerning tropical deforestation in Brazil

Kiel Working Paper, No. 566

Provided in Cooperation with:

Kiel Institute for the World Economy – Leibniz Center for Research on Global Economic Challenges

Suggested Citation: Serôa da Motta, Ronaldo (1993) : Past and current policy issues concerning tropical deforestation in Brazil, Kiel Working Paper, No. 566, Kiel Institute of World Economics (IfW), Kiel

This Version is available at:

<https://hdl.handle.net/10419/47075>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Kieler Arbeitspapiere Kiel Working Papers

Kiel Working Paper No. 566

**Past and Current Policy Issues
Concerning Tropical Deforestation in Brazil***

by
Ronaldo Serôa da Motta**

March 1993

Institut für Weltwirtschaft an der Universität Kiel
The Kiel Institute of World Economics

ISSN 0342 - 0787

C 183185



Kiel Institute of World Economics
Düsternbrooker Weg 120, D-2300 Kiel
Department IV

Kiel Working Paper No. 566

**Past and Current Policy Issues
Concerning Tropical Deforestation in Brazil***

by
Ronaldo Serôa da Motta**

March 1993

40

- * This study is part of the Kiel Institute of World Economics' research project "International and National Economic Policy Measures to Reduce the Emission of Greenhouse Gases by Protection of Tropical Forests" financed under grant II/67 310 by Volkswagen-Stiftung. The paper has greatly benefited from discussions with Helio dos Santos Pereira, Randolph Zackos and Herbert Schubart.
- ** The author is a senior researcher at the Research Institute of Applied Economics (IPEA) in Rio de Janeiro, Brazil.

The authors themselves, not the Kiel Institute of World Economics, are responsible for the contents and distribution of Kiel Working Papers.

Since the series involves manuscripts in a preliminary form, interested readers are requested to direct criticisms and suggestions directly to the authors and to clear any quotations with them.

Abstract

This paper discusses past and current policies concerning tropical deforestation in Brazil. In the last few years, the Brazilian government has reviewed and changed many aspects of past policies that encouraged deforestation of the Brazilian Amazon forest. Although the new set of policies is not fully implemented and, therefore, its effectiveness in controlling deforestation cannot yet be measured, a qualitative analysis of these policies suggests that they should enhance forest preservation in Brazil.

1. Introduction

The deforestation rate in Brazilian Amazonia has been drastically reduced in the last few years. According to recent figures released by the Brazilian National Institute for Space Research [INPE (1992)] and shown in Table 1, the annual average deforestation rate dropped from 0.54 percent in the period 1978-1989 to 0.48 percent in 1988/89 and 0.30 percent in 1990/91. In terms of area, annual deforestation was reduced from an average of 21,130 km² in the period 1978-1989 to 11,130 km² in 1990/91.

Although the current annual deforested area is still large, deforestation has been slowed down for, at least, three reasons:

- (i) the impact of the recession on frontier expansion;
- (ii) the strengthening of monitoring and control by the environmental agencies; and
- (iii) changes in regional and sectoral policies which affected the region's economic activities.¹

There is no doubt that the deep recession and the lack of capital for new investment faced by the Brazilian economy has played an important role in slowing down the expansion of the agricultural frontier. Moreover, the Brazilian Institute of Environment and Natural Resources (IBAMA) has unquestionably improved its enforcement capability in controlling forest cutting and burning.

Many studies have already discussed the importance of governmental policies in the

¹ The influence of the uncertainty about the new constitution requirement on land tenure in 1988 and the long raining season period in 1989 affected the deforestation pattern, but the 1991 figures proved that these facts cannot easily explain the observed decline.

deforestation of the Amazon forest.² Very recently, the Brazilian government has made radical changes in these policies. However, it is very difficult to assess the role of recent changes in policies concerning tropical deforestation. Since these changes have only come about in the last two years, it is impossible to estimate their full effects on the recent decline of the deforestation rate. Therefore, the main aim of this paper is a description and analysis of the new policy framework being developed in Brazil toward rainforest preservation, particularly in the case of Amazonia. In doing so, the analysis will be more useful to understand how this deforestation decline can be assured in the future rather than attempting to ascribe to these new policies issues a formal relationship with the recent deforestation pattern.

The next section presents an overview of past governmental policies affecting Amazonian occupation, particularly over the last two decades, in order to establish which policies were then identified to demand revision or phasing out. The third section analyses the policy changes that have already taken place and those which are deemed to be carried out in the near future. Final comments are presented in the last section.

Table 1 - Annual Rate of Gross Deforestation in Legal Amazonia

	78-89		88/89		89/90		90/91	
	km ² /year	%/year	km ² /year	%/year	km ² /year	%/year	km ² /year	%/year
Acre	620	0.42	540	0.39	550	0.39	380	0.28
Amapa	60	0.06	130	0.12	250	0.23	410	0.37
Amazonas	1,510	0.10	1,180	0.08	520	0.04	980	0.07
Maranhao	2,450	1.79	1,420	1.30	1,100	1.03	670	0.63
Mato Grosso	5,140	1.01	5,960	1.31	1,020	0.90	2,840	0.64
Para	6,990	0.62	5,750	0.55	4,890	0.47	3,780	0.37
Rondonia	2,340	1.11	1,430	0.78	1,670	0.91	1,110	0.62
Roraima	290	0.18	630	0.39	150	0.10	420	0.27
Tocantins	1,650	2.97	730	2.00	580	1.61	440	1.26
Legal Amazonia	21,130	0.54	17,860	0.48	13,810	0.37	11,130	0.30

Source: INPE (1992)

² See, for example, Mahar (1989), Amelung and Diehl (1992), and Binswanger (1991).

2. The Occupation of Amazonia

2.1 Historical Overview

Economic activities in the Amazonian region were mostly undertaken in cycles due to external demand for regional commodities, installation of colonization settlements and governmental development programmes and policies.

Prior to the invention of rubber vulcanization in 1839 and its following worldwide commercialization, the region's exploitation only concerned some extractive goods and sparse agricultural activities such as, for example, cocoa. From that period on, rubber extraction became the main activity until its decline after World War I with the expansion of Asian production. In the interval, Japanese immigrants in the states of Pará and Amazonas introduced jute and spice cultivation. The rubber cycle in the region was also responsible for Henry Ford's initiative of industrial rubber plantation from 1927 to 1945.

With the launching of "Operation Amazonia" in 1966, livestock activities were encouraged in the region by governmental policies, though without significant impact on forest occupation. Following Henry Ford's initiative in rubber production, another American entrepreneur, Daniel Ludwig, started in 1967 the implementation of a huge agroforestry complex in the Jari River basin in the state of Pará. For economic reasons, this project was transferred to Brazilian owners in 1982 with government financing.

As will be discussed later, during the seventies the federal government began an ambitious programme of roads, mineral poles, colonization and fiscal incentives for crop and livestock activities which extremely diversified the region's production and generated a process of rapid urbanization with significant migration flows from the southern parts of the country. Discoveries of large mineral deposits created the conditions for the arrival of thousands of mineral prospectors.³ All these actions in the region caused a fast deforestation process which consequently affected also the local communities such as extractivists and indians.

³ It is estimated that around six hundred thousands of mineral prospectors are living in the region today.

2.2 Past Government Policies⁴

a) In the absence of environmental concern

In the last three decades the Brazilian government has designed and implemented many programmes and policies to spur economic development in the Amazon. The actions were based on import substitution industrialization and commercial agriculture according to the development strategy followed at that time. This strategy had no concern for environmental matters. In fact, it assumed that economic growth in Brazil should disregard environmental costs and consider them as granting comparative advantages instead. That is, free environmental good and services would make the Brazilian economy more competitive.

This plan of Amazonia integration included:

- i) road-building programmes to link the region to other parts of the country;
- ii) agricultural colonization schemes to absorb the surplus labour from other depressed regions; and
- iii) fiscal incentives to create a tax-free industrial zone in Manaus (capital city of the state of Amazonas) and also to make agricultural activities more attractive in the region.

As could be expected, migrants in search of land and employment opportunities flowed into the region.⁵ So did enterprises to take advantage of fiscal incentives to appropriate large areas of land for agricultural and livestock activities.

The tax-free zone in Manaus is fully established, though it made no contribution to create a technologically autonomous capacity in the region which could result in a promising export-led industrial sector. Consequently, with the current liberalization in the Brazilian economy, the tax-free zone is facing enormous economic problems due to the competitiveness arising from imports with lower tariff levels.

Today, the region is fairly urbanized and economically dependent on the exploitation of forest resources which is generally undertaken on a non-sustainable basis. It is estimated that in 1990 almost 56 percent of the total regional population lived in urban areas whereas this percentage was only 45 percent in 1970 [IBGE, a]. Moreover, livestock activities increased as many as seven times in the period 1970-1985 while extractivism did not reach three times and crops four times [IBGE, b].

⁴ For a discussion on environmental management in Brazil see Serôa da Motta (1991) from where this sub-section was partially extracted. See also Mahar (1989) for a detailed description of these policies.

⁵ The 1980 Population Census revealed that 764 thousand people flowed into the region in the 1970-80 period.

The result in terms of agricultural expansion is unquestionable. Taking into account only the Classic Amazon (the North region) in the period 1970-1985, the cultivated area almost doubled while the increase in the country as a whole was only 28 percent. The number of people employed in agriculture increased by 140 percent in the region whereas the national average was only 32 percent. However, land tenure followed the concentration pattern of the rest of the country. Almost 17 percent of the farms in the region are larger than 100 ha and occupy 78 percent of land used for agricultural and pasture activities.

The region's occupation is led by farmers who usually abandon their plots after a few years of use due to declining yields. Consequently, they move further into the forest and in their place come the large landowners to convert the areas into pasture. Since logging for the most part can be characterized as a by-product of agricultural conversion, it has also sharply increased in the last two decades (May, Reis, 1993).

The regional agriculture is characterised by increasing occupation of the forest, that is, deforestation. The environmental consequences of this development pattern are well known. Not only biodiversity is at stake but also the traditional and sustainable activities of the region based on gathering and fishing. However, unsustainability exists not only in environmental terms. There are also high opportunity costs of forest conversion for agriculture (see Box 1 for forest user cost estimates in Brazilian agriculture). Moreover, the poor condition of the roads to the consumer markets associated with the ascending cost of the inputs needed to make agriculture possible in the region, have made this activity financially less attractive for the small-scale farmers.

The failure of small-scale farming plus the pressing need for foreign currency to pay the increasing oil bill and external debt services induced the government to change its development strategy for the region. The main concern was the creation of export-oriented poles of development for livestock, forestry and mining. Although these plans were made in the mid-1970s, it was only during the 1980s that the first results appeared.

Mineral prospecting activities have led to the discovery of enormous gold, cassiterite and iron fields. The low capital intensity and high unit value of the first two make extraction by prospectors viable, and therefore these fields became spontaneous poles of attraction for migrants drawn from the depressed regions of the country as well as for those peasants of the region who did not succeed in small-scale agriculture. Gold prospectors are widespread all over the region living in precarious settlements. They practice mining in the river banks ("aluvião") using a highly polluting and rudimentary technology where lead is used to separate the mineral.

The planned official poles were concentrated in the Greater Carajás Programme, created in 1980, which is a mining-oriented project. Another main pole project was the POLONOROESTE programme created in 1981 to organize the fast and recent

development taking place in western Amazonia. Both programmes were designed with close attention to environmental problems in order to avoid the mistakes earlier made in the region. Unfortunately, they did not succeed.

Box 1: Sustainable Income of Agricultural Activities in Brazil

It is already widely recognized that there is a need to introduce an adjustment in the estimation of conventional income as estimated in National Accounts to arrive at a sustainable income measurement. A study carried out in the Brazilian Research Institute for Applied Economics (IPEA) has attempted to determine user cost values for loss in forest resources due to agricultural land conversion in Brazil. Its first version presented in Serôa da Motta and May (1992) has only measured user costs derived from wood production and, therefore, must be regarded as lower-limit value.

The method adopted considers user cost of forests, in a given period, as the potential natural growth of this forest valued at its stumpage value discounted over time. Time is a key parameter and determines the number of years left before the forest would be completely depleted if current deforestation rates are kept constant. Such a procedure assumes that this user cost value should be set aside from agriculture income to recover the loss of forest capital in terms of timber production. Although an up-to-date version of this research is under way, due to lack of data on agricultural production after 1980 and deforestation rate prior to 1970 at the time the aforementioned study was carried out, the resulting sustainable income measurements only cover the period 1971-1980 and are exclusively related to income generated by an average hectare converted to agricultural purposes. Nevertheless, the results presented in the following table clearly show the upward trend of user cost values which reached the level of 36 percent of the agriculture value added on one converted ha in year of 1980.

Years	User Cost (1000 US\$) (A)	Agricultural Output of Deforested Area (1000 US\$) (B)	(A)/(B) (%)
1971	13 739	127 690	11
1975	39 924	219 081	18
1978	88 543	292 188	30
1980	121 181	339 748	36

b) Mistargeting the environmental problems

– POLONOROESTE

The main aim of POLONOROESTE was to promote the necessary investments to assure a long term development of the northwest region of Brazil which includes the western Amazon states of Rondonia and Mato Grosso. Resources of US\$ 1.5 billion

were planned to be spent, of which 34 percent were supposed to come from the World Bank. The programme conception was based on the assumption that sustainable agricultural activity in the region was a matter of rational planning. In other words, by reproducing the infrastructure of the richest regions of Brazil, the region's development could be made sustainable and oriented towards small farmers. The programme's budget breakdown clearly reveals this commitment. Half of the budget was devoted to road construction and paving (BR-364 highway, see map on page 23), 25 percent to agricultural settlements, and 15 percent to agricultural research and extension. Health, protection of indian areas, land acquisition, administration and environmental services were covered by the remaining 10 percent. It is not the small share of the resources devoted to social and environmental services which reflects the mistargeting but the high share of road and settlement costs.

It can be recognized that all the conditions to attract low income and natural resource dependent activities were reinforced by the POLONOROESTE programme. At the same time, institutions and infrastructure failed to cope with this situation. As a result, deforestation was intensified in the Northwest region and in other neighbouring regions due to the migration flows stimulated by the programme investments. They pushed gold and cassiterite prospectors to more distant places in the forest. The threat to indians and communities of gatherers increased enormously.

– Greater Carajás Programme (PGC)

The PGC was launched in 1980 to develop five economic activities: mining, metallurgy, forestry, agriculture and livestock. To accomplish that, the government offered fiscal incentives and subsidised credit. A huge hydroelectric plant was built to provide cheap energy for the region (see map on page 23). The iron mining and metallurgy projects are already operating. The forestry projects are now being implemented and the agricultural and pasture projects have been phased out.

The whole programme is run by an inter-ministerial council. But the mining project is under the responsibility of a state-owned enterprise, Companhia Vale do Rio Doce (CVRD), and was initiated in 1983 with an estimated cost of US\$ 3.5 billion. At that time CVRD had developed some capacity to control the negative effects of mining on the environment from their projects in other regions of Brazil and it was concerned about the environmental consequences that might occur in the development of western Amazonas. The World Bank financing of US\$ 300 million was also conditioned on an environmental assessment of the project. Therefore, the iron project was implemented following a very detailed environmental study covering many aspects of the impacts and mitigative actions to be undertaken by CVRD.

The study recommendations were entirely followed regarding the iron ore project and

the railroad which links the mining sites to the port at São Luís (see map on page 23). Although the study had also shown some concern with the metallurgy programme, the implementation of the charcoal and pig iron projects was outside CVRD's responsibility since they are private initiatives.⁶ The PGC council however set strict reforestation requirements which were never followed in practice. The resultant deforestation is now reaching alarming levels and, consequently, moving charcoal sources to distant points. Therefore, it is not clear whether these metallurgy projects would remain financially feasible if reforestation requirements were followed or even because of the increasing cost of charcoal accelerated by long distance transportation.

The mining project can be considered an example of a well-conceived programme in environmental terms and the metallurgy projects as the opposite. However, both have failed when the entire PGC programme is taken into account. Once more, the nature of the region's environmental problems was ill-perceived. Even if the metallurgy programme had succeeded in reducing deforestation, the number of migrants drawn to the area to be engaged in open access and low income activities would not have been drastically reduced. Ironically, making the region more attractive was the programme's main contribution to the environmental degradation which is taking place there. Without taking this into consideration, the environmental procedures adopted in the mining project were, for the region as a whole, insufficient. Nevertheless, the phasing-out of the agricultural and pasture poles in the PGC programme can be envisaged as a change in the development approach to the region.

c) The conservation perspective

Another turning point is the Environmental and Indian Communities Protection Project (PMACI I) later undertaken to assess the environmental and social impacts caused by the paving of the road from Porto Velho to Rio Branco in western Amazonia⁷ (see map on page 23). The paving of the Porto Velho-Rio Branco highway was a strong demand of the local population engaged in commercial activities. This highway is a northern extension of the Cuiaba-Porto Velho highway which was paved as part of the POLONOROESTE programme (see map on page 23).

The assessment study was particularly aware of the environmental consequences caused in the region when access roads are built, but assumed that the paving could generate economic benefits for the region. The region's environment was studied according to a holistic approach. Demands and suggestions from local and indian communities were taken into account. The project intended to accommodate all the economic activities in

⁶ In fact CVRD is a direct investor in at least two plants.

⁷ The 1988 environmental impact assessment was assigned to IPEA and IBGE which are respectively, a research institute of applied economics and an institute of statistics and geography. Both are subordinated to the Ministry of Economy.

the region. Thus the proposed mitigative actions were towards forest preservation and the protection of gathering and indian communities. To accomplish this, the study gave priority to the creation of four extractivist reserves, three national forests, one ecological reserve and the demarcation of the indian areas. For the small-scale farmers in colonization settlements the project recommended more financial and technological aid to make agriculture sustainable. The study also recognized the need for compensating and relocating the people living in the areas devoted to these reserves, forests and indian communities.

The PMACI I introduces a new dimension in the planning of the Amazon region. It follows a conservation perspective where a compromise between preservation and development is assumed to be possible in the region. It is not surprising that environmentalists considered the project too development-oriented while the direct beneficiaries of the road paving regarded it too environmentally concerned. Monetary costs have not been estimated for the environmental components, nor for the relocation costs. There is no sound study on the financial and economic viability of the extractivist reserves. The debate still goes on and the paving work is being done by parts.

Economic theory tells us that the use of resources in open access areas leads to extinction when harvesting effort is costless or takes place at levels above the natural rate of regeneration. In the case of the Amazon region both conditions prevailed. The benefits of fiscal incentives made economic activities in the region very attractive at microeconomic levels. The facilities of roads and settlements drew a growing migratory flow of low income activities into the rural and urban areas of the country, increasing the demand for land which has, in most areas of the region, a low rate of regeneration. However, the resulting deforestation did not allow continuous agricultural harvesting and ranching. The pressure on the forest was increased by fiscal rules which use cleared land as condition for entitlement of the farmers to it. The same process is underway in the mining activity in the region. Fiscal benefits are not offered for prospectors but the individual's false expectation of large profits in gold and cassiterite prospecting activities, associated with the surplus of low income labour drawn from the agricultural projects, is spreading the activity all over the region. Although deforestation from mineral extraction is not significant, the environmental consequences in terms of water pollution and degradation of wetlands are not negligible. Timber production also increased in the region without proper management which contributes to the wasting of the region's natural resources (see Box 2 for results of an econometric study on the economic sources of deforestation in the Amazon). Thus, it seems plausible that government policies in the region should be changed to take into account the opportunity cost of exploiting the region's natural resources.

In the last two years the Brazilian government has changed the legislation affecting

forest conservation such as land, forestry and regional development policies. These pieces of legislation and policy changes are described in detail in the following section.

Box 2: Economic Sources of Deforestation in Amazonian Forests

A recent study by Reis (1991) undertaken in the Brazilian Research Institute of Applied Economics (IPEA) projected long term trends of deforestation in the Amazonian region and its effects on CO₂ emissions. The study starts from an equation which correlates deforested area to three types of economic activities (logging, livestock and crops) plus population and road extension. The equation has been estimated with cross-section data for 165 municipalities in the region for the year of 1985. The results indicate a high importance of crop activities, population and road extension and weak correlation to livestock and logging activities. Estimates of future growth of population, expansion of roads and economic activities were projected from spatial functions using data from previous censuses. The CO₂ emissions resulting from deforestation followed an equation which relates technical parameters from CO₂ contents in biomass due to be burnt. Making simulations with distinct hypotheses of projected population, road extension and economic growth, the author arrives at annual deforestation growth rate estimates between 4 and 5 percent in the next decade corresponding to cumulative emissions of CO₂ ranging from 21.3 to 59.2 x 10⁹ tons.

3. Recent Policy Changes

3.1 Land Policies

The rules for federal and state land reclamation in Brazil have been pointed out as one of the most important factors causing rapid deforestation.⁸ These rules state that claims must be based on land use such as area allocated to farming and, therefore, encourage land conversion. Such rules still exist but are difficult to change since a definition of forest management, which prevents purely speculative land claims is difficult to find.

Although the land tax system, however, was modified in 1992 to accept forest areas as productive land and land tax rates were reduced, agriculture income taxation is still moderate and induces further expansion of farming activities. Thus, not much has been changed in land allocation rules and taxation which could be considered an important incentive for reducing deforestation. But this does not mean that nothing has been done to curb land conversion in the Amazonian region.

In fact, the Brazilian government, following a constitutional requirement, has started the ecological-economic zoning, a very powerful instrument to discipline land

⁸ See Binswanger (1991) and World Bank (1992) for a detailed analysis of these issues.

occupation in the region. Decree N. 99540 of 21st September 1990 created the Commission for Coordination of Ecological-Economic Zoning in the National Territory (CCZEE) within the Secretariat of Strategic Affairs (SAE) linked to the Presidency of the Republic (see Box 3 for an effort of zoning in Brazil).

The first priority of CCZEE is to develop zoning in the Amazon region. According to Schubart (1992), this zoning will discriminate areas where preservation is totally required and other spaces where economic activities, under specific sustainable practices, can be undertaken. The project has three levels:

- (i) Environmental diagnoses of the region at the macroregion level where geographic spaces are analyzed according to their carrying capacity in physical and biological terms and the existing anthropogenic actions which have already taken place. Final reports are due by October 1992.
- (ii) Zoning in itself where selected macroregions are fully detailed due to their importance in the occupation process of the region. In these regions land uses are defined. Final report is due by February 1993.
- (iii) Critical specific area studies to design corrective actions to revert or prevent further environmental disturbance. Deadline not defined yet.

Zoning will be a crucial policy instrument to discipline the application of incentives and to direct public investments in the region. In this respect, as will be discussed in Section 3.3, a decree of June 1991 has already stated that fiscal incentives for crop and livestock activities must be in accordance with zoning criteria. Thus, through the use of zoning instruments, Brazil has opted for a middle way approach to Amazon occupation where preservation and economic growth are harmonized.

These efforts became clearer with the recent Presidential Decree N. 563 of 5th June 1992 creating a Pilot Programme for Tropical Forest Protection in Brazil to set up an institutional framework capable to implement several projects for forest protection. These projects will be financed by concessional loans and grants from countries of the G-7. These resources, around 250 million dollars, were first announced in the 1990 G-7 Summit in Houston. The main aim of the programme is to articulate all existing initiatives of forestry policies to ensure sustainability of tropical forest usage in the country. In this sense, zoning, monitoring, creation of preservation areas, forest management, research, environmental education and planning will be coordinated by one single commission. All related governmental agencies and non-governmental organizations will have a seat in this commission. The commission will also be responsible for setting norms for agreements with international funding agencies. The executive secretariat of the commission will be the Department of Technical and Scientific Affairs and Cooperation of the Secretariat of Environment.

Box 3: Agricultural Expansion Possibilities in Brazil

Nowadays 26 percent of the Brazilian population lives in rural areas. Agricultural production represents 11 percent of the country's GDP and almost half of export value. However, Brazilian agricultural yields can certainly be greatly improved compared to world parameters. In the following table it can be seen that even in São Paulo state, the most advanced of Brazil, yields fall far below the averages reached, for example, in USA and the national average deviations are still larger.

Products	Average Yields (ton/ha/year)		
	USA	São Paulo	Brazil
Rice	5.1	3.3	1.4
Oat	2.0	--	0.9
Potato	31.0	25.0	10.0
Sugar cane	84.0	75.0	54.0
Beans	1.6	0.9	0.5
Maize	6.9	3.1	1.4
Soya	2.2	1.8	1.4
Sorgum	4.0	2.6	2.1
Milk ^a	5.5	0.9	0.7
Eggs ^b	235.0	230.0	113.0

^aCow/year x ton. - ^bChicken/year.

Source: Souza Reis (1991).

Even if productivity gains are not feasible due to technical constraints, or because of the need to avoid the use of chemical inputs for environmental reasons, land is still fairly available in many regions of the country.

A zoning study undertaken by EMBRAPA (1991), the Brazilian Company for Agricultural Research, linked to the Ministry of Agriculture, determined land availability in Brazil by classes of soil uses according to ecological criteria. The first part of the following table shows this study's estimates. Since EMBRAPA figures measure gross availability, i. e., total area with and without activities, the second part of the table presents EMBRAPA estimates for crop and livestock classes deducted from currently utilized area determined by the 1985 Agricultural Census which will be denominated as net availability. These net values are calculated for all classes (total) and also for crop and livestock.

Land Ecological Suitability by Regions (km ²)	Brazil	North	Northeast	Central	Southeast	South
Total Gross Availability	8 511,940	3 618,340	1 555,950	1 871,971	913,206	552,473
Preservation	2 632,189	1 136,958	665,954	712,876	63,843	52,558
Extractivism	2 374,030	2 097,437	211,051	65,542	--	--
Livestock	996,649	68,958	407,610	--	389,209	130,872
Crop	2 509,072	314,987	271,335	1 093,553	460,154	369,043
Total Net Availability ^a	1 880,967	270,083	130,555	1 012,835	315,031	208,592
	(22)	(7)	(8)	(54)	(34)	(38)
Livestock	-795,234	-139,806	56,129	-592,441	-35,665	-83,451
Crop	1 880,967	270,083	74,426	1 012,835	315,031	208,592

^aPercentage shares of gross availability in parentheses.

Source: EMBRAPA (1991).

As can be seen, the net land availability for agricultural purposes is still relatively large in Brazil with a total area of 1 880 967 km² which represents 75 percent of the area already under utilization in the country as a whole. Besides 85 percent of this net availability is located in extra-Amazonian regions. In the case of livestock, this activity is already occupying inappropriate areas as shown by the negative values of net availability. This value is proportionally larger in North and Central regions where Amazonian forests are located.

Summing up, agricultural activities may be expanded in Brazil without causing forest clearing and disturbing fragile ecosystems. Livestock, however, must be compelled to reduce its spatial occupation since it is already exceeding its ecological areas. The new agricultural credit policies will be based on this EMBRAPA zoning. Thus those farmers following this zoning criteria will be entitled to improved financing terms.

As will be discussed in the next sections, such a broad view of the Amazonian question seems to be the only way to make further improvements in forest preservation in Brazil.

3.2 Forestry Policies

a) Free logging era.

According to the Forest Code,⁹ property rights in forests in Brazil are very limited. Its Article 1 states:

Art. 1 The existing forest in national territory and other forms of vegetation, recognizing the utility of the soil covered by those, are assets of common interest for all inhabitants of the country, the property rights are thus undertaken within the limitations of general legislation and particularly according to what is stated in this code.

The code continues defining areas of permanent preservation and creation of national parks and forest and ecological reserves (see in Box 4 a description and current magnitudes of these areas). Farming and logging are also restricted by the code when vegetation is at stake. The use of charcoal for industrial purposes is only allowed if supply is from reforestation¹⁰. The use of fire and chainsaws are regulated by licenses issued by the federal environmental agency. The code also defines authority levels, sanctions and fines.

With regard to the Amazon region, Articles 15 and 44 are very important and say:

Art. 15 Empirical exploitation of primary forest in the Amazonas river basin is forbidden, and it can only be exploited according to technical management plans which will be defined by regulation of the Public Authority by one year from approval of this Act.

Art. 44 In the North region and in the northern part of the Central region, as long as the decree in Art. 15 is not regulated, wood exploitation is only allowed if 50 percent of the property area is kept with forest.

According to Art. 15, logging in itself would be of no harm since it should be undertaken on a sustainable basis. However, the regulation of this article was only defined in 1991. Up to this date, logging was an almost free enterprise in the region due to the deforestation allowance given in Art. 44. This allowance created another incentive for farming when clearing can realize profits in selling trees. In fact sawmills follow the route of agriculture expansion and they help to create the infrastructure, such

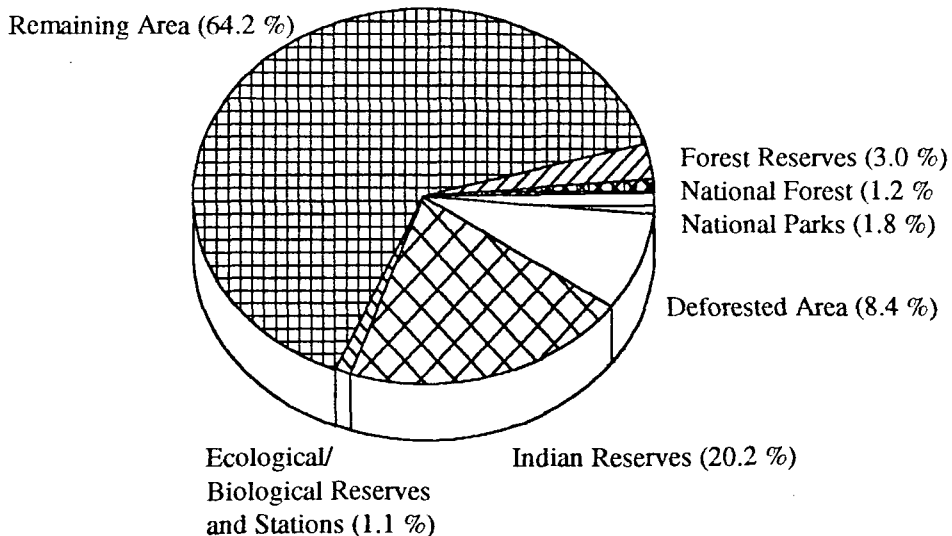
⁹ This code dates from 1934 and was revised in 1965.

¹⁰ There is a "tree tax" collected by IBAMA levied on those not using wood from reforestation. This tax revenue is employed in reforestation projects. It has been considered to transfer these resources to NGO's willing to implement reforestation projects since IBAMA so far has failed to do so.

as ports and roads, to allow further advance of farming and the transportation of their wood output. Since logging has not been forced to comply with sustainable management, sawmills became important partners of farmers and autonomous workers who went into the forest to select the high value trees. Therefore, it has been almost impossible to dissociate logging from farming in forest conversion.

Box 4: Conservation Units in Amazonian Region

The Brazilian Forest Code has established several kinds of conservation units classified as those aimed at indirect use, such as National Parks and Biological Stations and Reserves, and those considered to be of direct use such as National Forest and Indian and Extractivist Reserves. The former are designed to protect biodiversity whereas the latter allow multiple uses such as logging, mining, farming and extractivism on a sustainable basis without, however, conceding private property rights. With few exceptions, for example the National Forest of Tapajos, most of these units are still facing problems of border delimitation, land titling and lack of management programmes due to weak budget, and in some cases, political will. In the figure below the number and proportional areas of these units are presented. Apart from Indian Reserves, the other conservation units do not exceed 7.1 percent of total regional area, which can be considered as a very low figure to preserve the rich biodiversity of the Amazonian forest.



Note: Total area of 507 510,800 ha including the states of Amazonas, Pará, Rondônia, Amapá, Roraima, Acre, Maranhão, Tocantins, and Mato Grosso.

In Table 2 the trend of the Brazilian timber production (industrial roundwood) towards the Amazonian region is very clear.

Table 2 - Timber Production in Brazil by Regions (m³), 1977/89^a

Year	Brazilian Regions					
	North	Northeast	Southeast	South	Center	Total
1977		115,920	19 41,607	8 136,459	8,260	27 702,246
1978		89,246	27 759,907	11 454,735	7,130	33 311,018
1979	572,400	144,515	25 520,870	18 461,552	6,238	44 705,575
1980	1 390,560	251,300	27 857,469	12 317,098	10,755	41 827,182
1981	946,001	248,812	26 135,170	15 243,068	3,000	42 576,051
1982	14 652,409	6 893,507	1 255,387	10 905,603	3 275,165	36 982,071
1983	16 094,203	7 192,606	1 681,819	10 212,383	3 437,280	38 618,291
1984	17 388,859	7 710,250	2 245,922	9 033,824	3 545,106	39 923,961
1985	19 793,218	8 560,163	1 869,137	8 910,036	3 751,643	42 884,197
1986	22 238,729	8 637,129	1 606,806	8 486,357	3 701,131	44 670,152
1987	24 606,120	8 659,523	1 278,371	7 866,562	3 333,291	45 743,867
1988	32 007,973	8 188,766	1 043,983	7 256,833	3 674,688	52 172,243
1989	47 486,251	7 826,881	987,006	6 906,332	2 643,947	65 850,417

^aOnly roundwood.

Source: IBGE, c.

Timber production in the North Region increased as many as 34 times in the period 1980-89 while in other regions production levels stagnated since 1982 and represent today no more than a quarter of the total production in the country.

b) Under sustainable management requirement

To correct the allowance of Art. 44 and discipline Art. 15 of the Forest Code, a Normative Instruction N^o 80 of IBAMA related to sustainable exploitation of forest in the Amazonas river basin came into effect on 24th September 1991.

This instruction covers a whole set of requirements that need to be followed by sawmills in the region to obtain licenses for logging.¹¹ These requirements should be met in project proposals to obtain licenses and can be summarized as follows

- (i) Description of technical and economic objectives and justifications of the proposed forest management for logging.
- (ii) Characterization of the region where management will take place according to physical issues, such as climate, soil, hydrography and topology; biological issues such as vegetation and fauna; and socio-economic issues in general.
- (iii) Analysis of the forest management in terms of the description of exploited area and complete inventory of the forest to be logged.

¹¹ Transportation of forest products also requires licenses and its regulation was recently revised (Portaria N. 139 of June 5, 1992) in order to curb illegal issuances.

- (iv) The exploitation system must be fully described and comply with specific rules stated in the instructions regarding land parcels, cutting procedures and cycles, road system and sample analysis.
- (v) An assessment of environmental impacts must be presented with resulting mitigation actions.
- (vi) A physical and financing profile of the management plan is also required.
- (vii) A set of documents must be provided such as a technical responsibility statement, proof of land ownership, a certificate confirming that the exploited forest is not an Indian reserve and a contract of technical supervision assistance.

The license ("guias florestais") will be issued after IBAMA analyses the application and its renewal will be on a yearly basis and decided based upon a report of activities presented by the sawmill where changes in the original project have to be notified. The license states the kind of tree and the respective volume allowed to be exploited. Once legal requirements are met there is no limit in yearly renewals.

The number of projects and their total area already submitted to IBAMA following the requirements of Instruction No. 80, are presented in Table 3.

Table 3 - Sustainable Logging Activity in Amazonian Region Under IBAMA - Supervision^a

State	Number of Sawmills	Total Area (ha)	Average Area (ha)
Acre	20	41,898	2 094.90
Amapá	59	25,031	424.25
Amazonas	40	388,062	9 701.56
Pará	298	448,607	1 505.39
Rondonia	515	233,246	452.91

^aReference date: January 1992

Source: IBAMA (1991).

As can be seen in this table, the exploited area in Amazonas is much greater than in other states. Such a pattern confirms the partnership of farming and logging since in this state farming activity shows lesser density and, therefore, sawmills need to cover a larger area of exploitation.

c) Sustainable logging viability

As has been discussed in previous sections, supply of timber to sawmills is highly dependent on forest conversion for farming. Unless the enforcement of Instruction No. 80 is very effective, sawmills will keep reckoning on wood supply from deforestation

procedures which allow them to obtain wood at very low cost.

One reason for that are the selective logging practices adopted in the region just where the diversity of species of trees is very large. In IBAMA (1991) it is estimated that only five species of wood (peroba, mogno, cedro, sucupira and ipê), out of almost 40 Amazonian species with regular acceptance in the international market, accounts for 74 percent of Brazilian timber exports. Following such selective practice, sustainable logging demands enormous areas of forest to become profitable since very few trees are taken per hectare. In that case, sawmills prefer to use external supply rather than develop their own sustainable management plan which will force them to exploit large areas of forests¹².

The technology adopted by the sawmills is also very rudimentary causing very low productivity and product quality in the sector. Because of that, as shown in Table 4, Brazilian exports have failed to be competitive and in 1989 did not exceed 2 percent of total world exports, though the country has one of the largest forest areas on the planet¹³.

Summing up, only after 1991 were timber extraction and processing in the Amazonian region required to pursue practices with sustainable forest management plans. Even so, the current production pattern of these activities, concentrated in very few kinds of wood and very low processing technology, cannot assure that those requirements of sustainable procedures will succeed. To accomplish that, environmental agencies will need a very complex institutional capacity which may turn out to be unaffordable to them. Therefore, flows of wood made available from farming expansion in the region are still prone to be regarded as the major suppliers for the timber sector in the region.

However, it is already recognized that those few species currently produced will be completely depleted in a very short time in the areas now being exploited¹⁴. As pointed out by Pereira (1992), following the traditional pattern, the sector will be forced to move to new areas such as western Pará State, where the Transamazonic highway will lead them into the forest. Without clear evidence so far, it is expected that the timber sector will finance secondary road construction in these new areas to facilitate its expansion. In this case, the sector will play an important role in the expansion of farming and mining activities in the region.

¹² In the south of the country, due to the depletion levels of native forests in the regions, almost 60 percent of timber production is now derived from industrial forests. See IBAMA (1991).

¹³ The Amazonian wood is not similar to that produced in Asian forests and presents a much higher diversity which is an economic disadvantage in terms of export volume. However, Asian production is bound to decline at fast rates in the near future due to exhaustion and will necessarily increase Brazilian's share.

¹⁴ Although not officially acknowledged, Indian reserves have also been exploited and, in some cases, through commercial agreements with the indians living in these reserves.

Table 4 - World Timber Exports, 1985-1989

	Wood rough, squared (1 000 US\$) ^a			Wood shaped, sleeper (1 000 US\$) ^a		
	1985	1987	1989	1985	1987	1989
Brazil	2,741 (0.1)	2,134 (*.*)	5,279 (*.*)	121,269 (1.4)	376,647 (2.9)	275,718 (1.8)
Africa	383,453 (10.2)	581,847 (11.0)	903,931 (12.9)	127,710 (1.5)	127,558 (1.0)	385,137 (2.6)
Americas ^b	1 466,630 (39.2)	1 978,952 (37.5)	2 626,912 (37.4)	4 373,710 (49.8)	6 202,305 (47.9)	7 095,407 (47.1)
Asia	1 302,719 (34.8)	1 808,611 (34.3)	2 406,456 (34.3)	1 064,572 (12.1)	1 696,251 (13.1)	2 282,769 (15.2)
Middle East	7,392 (0.2)	5,013 (0.1)	751 (*.*)	28,927 (0.3)	8,573 (*.*)	11,437 (*.*)
Europe	485,726 (13.0)	730,365 (13.8)	810,576 (11.6)	2 997,984 (34.1)	4 452,175 (34.4)	4 949,067 (32.8)
Oceania	96,349 (2.6)	170,097 (3.2)	264,854 (3.8)	75,015 (0.9)	74,490 (0.6)	72,290 (0.5)

^aPercentage shares in parentheses. - ^bNot including Brazil. - *.* = less than 0.05 percent.

Source: United Nations (1990).

It is worth mentioning that selective logging, even without cutting down all trees, poses a serious threat to the forest. In order to cut one tree, without good management practices, several other trees are usually spoiled because of the way cutting is done and access is made into the forest. In this way, ecosystems are disturbed causing losses of biodiversity and other environmental damages. Therefore, world consumer behaviour can also play an important role in this process if timber importers from Brazil start to consider other kinds of wood in order to assure higher productivity in each ha exploited. More than that, wood consumers should be prepared to pay some kind of compensation, say a forest tax, in order to create funds to finance sustainable management through economic incentives to those who adopt these practices. Countries where these forests are located, such as Brazil, must consequently be prepared to follow well designed forestry policies. Additionally, it will also be highly important to enhance capability of environmental agencies to enforce legislation and policies. All these changes will help to make sustainable logging viable in the Amazon region and transform this activity toward environmentally and economically sound options.

3.3 Regional Development Policies

a) Development projects

Nowadays no megaproject, as those described in Section 2, is planned for the Amazon

region. In fact, corrective programmes are in place to revert some environmental impacts arising from previous megaprojects.

That is the case of PLANAFLORO (National Plan for Forests in Rondonia State) which was created for the state of Rondonia in 1990, with financing from the World Bank, to mitigate the deforestation consequences of previous development programmes in the region.

Another corrective programme is the Forestry Poles of Eastern Amazonas conceived by the Vale do Rio Doce Steel Company (CVRD) which controls the Carajás Programme. This programme was first presented in 1989 by CVRD (1989) intending to reforest a degraded area of 1 million ha in the influence area of the Carajás Mining Project, along the project's railway area, demanding annual investment of 1 billion dollars in ten years time. This reforestation not only meets forest resources demand of the existing siderurgy plants (pig iron production), which was the main cause of deforestation, but also makes viable the installation of an ambitious industrial sector in the region based on forest inputs. Thus ten pulp and paper plants were planned to be located in the region, each one with a production level of 420 thousand tons per year. Total investment is planned to sum up in ten years time to a value of 6,5 billion dollars with annual revenues of 2,2 billion dollars and the generation of 40.000 direct and 80.000 indirect employment occupations. Apart from that, the project will also allow carbon capture in the atmosphere. All these investments will follow strict environmental criteria based on the high technology level already adopted by CVRD in reforestation and pulp and paper production. It is also worth mentioning that according to the Forestry Poles conception, the expansion of pig iron production will not be supported since its low rentability considering international price trends is recognized.

Forestry Poles have not succeeded yet due to the sensitivity issues concerning the use of natural resources in the region and also because of the lack of financial resources. In 1991, in order to create an institutional framework for the launching of the programme, the Secretariat of Regional Development (SDR) published an instruction (Portaria N. 145 of June 12, 1991) creating an Interministerial Chamber to advice SDR in its function of supervising the programme implementation. Representatives of this chamber are the governors of the three states crossed by the Carajás railway (Pará, Maranhão and Tocantins), the Secretariat of Strategic Affairs (SAE), the Secretary of Environment (SEMAM), the Secretariat of Science and Technology (SCT), the Ministry of Economy (MEFP), the Vale do Rio Doce Steel Company (CVRD) and the Research Center of Humid Tropics. Despite the existence of this chamber the programme has not been fully implemented so far (see in Box 5 a description of another forestry programme proposed for Brazil).

Box 5: Project FLORAM

During the years 1989 and 1990 the Institute of Advanced Studies of São Paulo University in Brazil elaborated a project denominated as FLORAM which is an ambitious programme on reforestation in Brazil (see Estudos Avançados (1991)). The Project's aims are to revert greenhouse effects by capturing carbon from fitomass growth, to preserve regional ecosystems and soil quality, and to provide supply of wood for industrial purposes. The project considers three kinds of reforestation: (i) corrective forest for conservation purposes; (ii) industrial forests; and (iii) mixed forests for conservation and industrial ends. These forests would cover an area of 20 million ha intended to be reforested in 30 years time. This area is equivalent to 2.4 percent of total Brazilian territory and approximately 0.5 percent of total world forest. It is also expected to capture carbon at a level of 4.3 percent of total surplus carbon in the global atmosphere. The project's investments will mostly take place in degraded areas and attempt to introduce the concept of social forestry. The implementation costs vary from US\$ 200 to US\$ 1,500 per ha according to the level of soil productivity. FLORAM was not yet incorporated in governmental policies but its concepts and aims are in some way part of forest policy discussion in Brazil, though with distinct approaches, as it is the case of Forestry Poles described in detail in Section 3.3 (a). There is no doubt, however, that FLORAM implementation would only be possible through large external transfers.

Oil exploration is still expanding in the Urucu River basin (see map on page 23) in the western part of Amazonas State. The production level is expected to reach 3270 m³/day of oil and 11300 m³/day of natural gas. There is also a project to use part of this natural gas volume to produce electricity in the cities of Porto Velho and Manaus, the capitals of Rondoniã and Amazonas respectively. The use of natural gas, a clean source of energy, in those cities will avoid the burning of diesel oil and building of dams, but it will require the implantation of 1200 km of pipelines crossing the forest to transport gas to consumer points. This has already generated environmental concerns. According to PETROBRÁS (1992), the state oil company responsible for the project, environmental impacts tend to be nearly nil due to very small forest clearing needed to place the pipeline. Nevertheless, there is still concern that such a long pipeline may contribute to open new access to that part of the region which is still showing low levels of economic activity. Therefore, the project implementation has been delayed waiting for the results of environmental impact studies which are taking into account all these facts.

b) Fiscal incentives

As described in Section 2, fiscal incentives have played an important role in expanding forest conversion for farming. The most powerful incentive was subsidized credit from FINAM (Fund for Investments in Amazonia). From this fund, any corporation in Brazil could take up to a 50 percent credit against its income tax liabilities to invest in projects located in the Amazonian region. Using these resources, big agricultural and livestock

projects were launched in the region without sound economic results but resulting in large areas of forest clearing ¹⁵.

In order to revert this situation, a new legislation, Law N. 8167 of 16th January 1991, on fiscal incentives based on income tax breaks was passed and regulated by Decree 101 of 17th April 1991. The main aim of this new legislation was to improve the application of all regional and sectoral fiscal incentives in order to discipline the investments and avoid misuse of resources that had occurred so far¹⁶. Paragraph 2 of Article 15 of Decree 101 is very specific about agriculture investments with fiscal incentives in the Amazonian region which are supported by the regional fund FINAM. This paragraph says:

The applications of incentives in crop and livestock activities can only be done in areas with recognized vocation for these activities as confirmed in the ecological-economic zoning, or in the absence of that, by any ecological-economic pre-zoning, in accordance to legal requirements and governmental policies of environmental preservation, taking into account social conflicts, and by previous consent of the Secretariat of Strategic Affairs (SAE), the National Institute of Colonization and Agrarian Reform (INCRA), the Brazilian Institute of Environment and Natural Resources (IBAMA) and the National Indian Foundation (FUNAI).

Such requirements have become a matter of bureaucratic dispute between SUDAM, which is the Amazonian development agency coordinating FINAM, and those other agencies from which, according to Decree 101, consent should be obtained.

As mentioned in Section 3.1, zoning in the Amazon region is not yet completed and, therefore, SAE, the responsible agency, could not easily answer SUDAM demands. Moreover, the current project proposals for fiscal incentives do not provide enough information to allow a detailed analysis by IBAMA. Therefore, since the publication of Decree 101 the consent of those agencies was made on *ad hoc* basis. To discipline these procedures, IBAMA has recently published an instruction (Portaria N. 138 of 5th June 1992) with a set of requirements to be met by those projects using FINAM resources which include a topographic survey, fauna and flora inventories, environmental impact assessment and so on.

In the case of SAE, no official formal procedure has been established since zoning is not yet finished. However, SAE intends to follow IBAMA initiatives and make analysis on the basis of some results already available from zoning studies.

¹⁵ For a detailed discussion of these issues see Gasques and Yokomizo (1986), Mahar (1989) and Binswanger (1991).

¹⁶ See Bezerra (1990) for a detailed analysis undertaken by the Fiscal Incentive Commission on these issues of resources application.

All these changes in fiscal incentives legislation have not deeply affected the application of resources from FINAM. According to SUDAM sources, in 1991 a total of 180.5 million dollars were released to project implementation and 129 projects were approved following the new legislation. From January to April of 1992 the released resources add up to the value of 81 million dollars while 66 projects were approved. It was not possible to find out how resources are allocated among activities. However, FINAM is still financing sawmills and farming activities. That is, these activities are still subsidized in the Amazonian region though, according to the new legislation, under very stringent environmental restrictions.

4. Final Comments

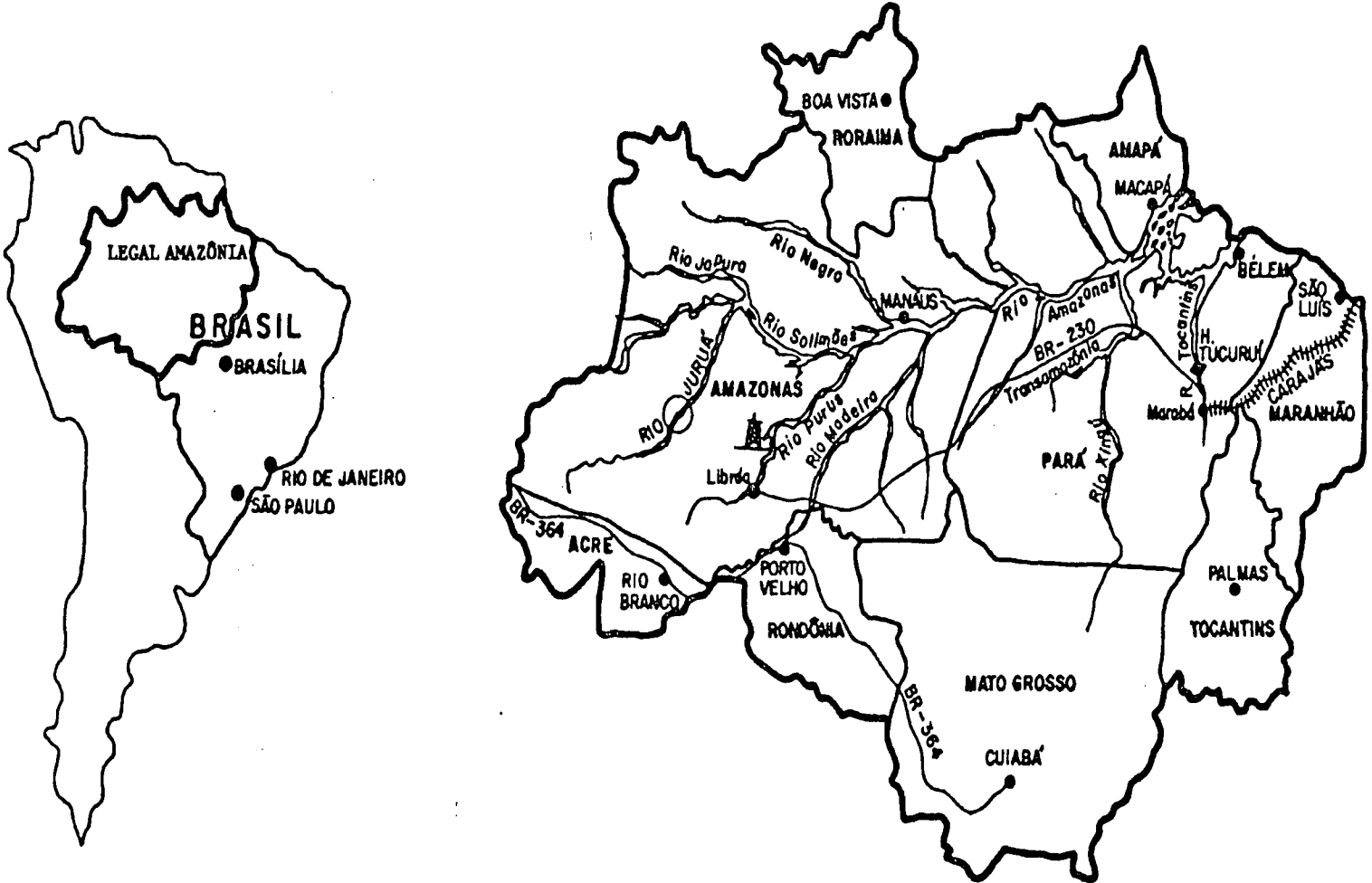
Much has been changed in policies which were considered to affect tropical deforestation in Brazil. As has been discussed, these changes could be summarized as follows:

- The land tax is now defined considering forest areas as productive land, thereby reducing the tax rate.
- Ecological-economic zoning of Amazonia has already started to be developed to guide application of fiscal incentives and investments in the region.
- Plans for sustainable management of logging are required following very stringent environmental restrictions.
- The use of fiscal incentives in the region needs to comply with zoning criteria and consent of the environmental agency and other governmental agencies responsible for agrarian reform and indian rights.
- And, finally, an interministerial commission for planning of tropical forest exploitation was set up.

Since these modifications were only introduced in the last two years and some are not yet fully implemented, it is difficult to determine their impact on the recent declining trend of forest clearing. These new policy measures, however, will not be sufficient to assure a sustainable development of the region. Economic incentives for conserving forests rather than converting them for farming or logging purposes must be worked out. Well designed forestry planning is urgently needed to assure that all current actions and policies will be consistently implemented. Above all, enforcement capability of environmental and non-environmental agencies working in the region must be strengthened to deal with that new approach. There is no doubt that international compensation is economically justified from those benefiting from forest resources consumption and also from environmental services arising from forest preservation.¹⁷

¹⁷ See Serôa da Motta and Reis (1992) for discussion on these issues.

Legal Amazônia



References

- Amelung, T. and M. Diehl (1992), *Deforestation of Tropical Rain Forests - Economic Causes and Impact on Development*. Kieler Studien, 241. Tübingen: J.C.B. Mohr.
- Bezerra, A. F. (1990), "Os Incentivos Fiscais Regionais: FINAM e FINOR". *Revista Econômica do Nordeste*, Vol. 12, No. 1.
- Binswanger, H. P. (1991), "Brazilian Policies That Encourage Deforestation in the Amazon". *World Development*, Vol. 19, No. 7.
- CVRD (1989), *Pólos Florestais na Amazônia Oriental*, Cia. Vale do Rio Doce.
- EMBRAPA (1991), "Delineamento Macro-Ecológico do Brasil". *Boletim de Pesquisa*, No. 37, Serviço Nacional de Levantamento e Conservação de Solos, 1991.
- Estudos Avançados (1990), "Projeto FLORAM". *Uma Plataforma*, Vol. 4, No. 9.
- Gasques, J.S. and C. Yokomizo (1986), "Avaliação dos Incentivos Fiscais na Amazônia". *Proceedings of XIV Encontro Nacional de Economia*, ANPEC.
- IBAMA (1991), *Programa Nacional de Conservação e Desenvolvimento Florestal Sustentado*, SEMAM/IBAMA.
- IBGE, a (several years), *Population Census*.
- IBGE, b (several years), *Agricultural Census*.
- IBGE, c (several years), *Statistical Yearbook*.
- INPE (1992), *Deforestation in Brazilian Amazonia*. Instituto de Pesquisas Espaciais.
- Mahar, D.J. (1989), *Government Policies and Deforestation in Brazil's Amazon Region*. Washington, D.C.: The World Bank.
- May, P. H. and E. J. Reis (1993), *The User Structure in Brazil's Tropical Rain Forest*. Kiel Working Paper No. 565. Kiel Institute of World Economics, Kiel.
- Pereira, H. S. (1992), *Programa de Manejo e Gestão dos Recursos Florestais*, SEMAM, (mimeo.).
- PETROBRÁS (1992), *Aproveitamento dos Hidrocarbonetos do Estado do Amazonas (Região de Urucu) - Estudo de Impacto Ambiental*. PETROBRÁS/IESA.
- Reis, E. J. (1992), *A Amazônia e o Efeito-Estufa*. In: *Perspectivas da Economia Brasileira - 1992*. Rio de Janeiro: IPEA.
- Schubart, H. (1992), "Planejando a Ocupação Sustentável do Território Nacional: O Exemplo da Amazônia." *Planejamento e Políticas Públicas*, No. 7.

- Serôa da Motta, R. (1991), Recent Evolution of Environmental Management in the Brazilian Public Sector: Issues and Recommendations. In: Ercal, D. (ed.): Environmental Management in Developing Countries. Paris: OECD.
- Serôa da Motta, R. and P. H. May (1992), Loss in Forest Resource Values Due to Agricultural Land Conversion in Brazil. Texto para Discussão, No. 248. IPEA, Rio de Janeiro.
- Serôa da Motta, R. and E. J. Reis (1992), O Financiamento do Processo de Desenvolvimento. In: Subsídios Técnicos Para o Relatório Nacional da UNCED-92 and published in Revista de Administração Pública, Vol. 26, No. 1, 1992.
- Souza Reis, A. C. (1992), A Agricultura Tropical e Produção de Alimentos. In: Subsídios Técnicos para a Elaboração do Relatório Nacional do Brasil para a UNCED-92. Secretaria de Meio Ambiente da Presidência da República, 1992.
- United Nations (1990), 1989 Yearbook of International Trade Statistics. New York.
- World Bank (1992), An Analysis of Environmental Problems in the Amazon. Report No. 9104 - BR. The World Bank, Latin American and Caribbean Region, Brazil Department.