

# DEFORESTATION AND DECISION-MAKING IN THE DEVELOPMENT OF BRAZILIAN AMAZONIA

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Many of the component events of the rapidly expanding human impact on Amazonian ecosystems are presently outside of the realm of the conscious decisions of human beings, in the form of government planners and agencies responsible for guiding the region's development. Many of the underlying processes are also poorly understood. The course of development must be brought under the control of rational and coherent long range strategies to prevent highly undesirable environmental impacts from occurring as a result of unwise types, patterns, and scales of development. The continuation of current trends will quickly lead to environmental impacts desired by no one.

## Making Choices on Development Priorities

Two broad classes can be identified among the funding priorities facing the Brazilian government in its role in guiding the future shape of the Amazonian landscape: projects to extract the region's wealth, and projects to investigate the biological and physical basis of that wealth and how it might be developed sustainably. The first class includes mines, dams, research on wood technology and logging, and agricultural or ranching programs such as SUDAM's fiscal incentives for cattle pasture. The

second group includes research on potentially sustainable forest management systems, basic ecological investigations of human and natural Amazonian ecosystems, and the demarcation of Amerindian reserves, national parks, and similar areas. The preference for projects in the first category is obvious from the resources allotted to developments in the first group relative to the second by Brazil's Secretariat Planning (SEPLAN). I believe the present favoring of the first group to be shortsighted and unwise because of two basic differences between the two groups: 1) the undesirable human and environmental effects of development in the first group, and 2) the fact that the first group can wait, while the second cannot.

The relatively low rank of parks and reserves among the competing priorities of the Brazilian government is evident from the minimal budget and staff allotted to the Brazilian Institute for Forestry Development (IBDF), and within this agency to the Department of Natural Parks and Equivalent Reserves. Faced with miniscule resources, the Department has had to cope with the continuing dilemma of how to allocate funds between expansion of the area decreed as reserves and protection of areas already created on paper. Given that the 1980's is the last decade in which significant areas of natural habitats are likely to be available for parks

and reserves, the evident choice of favoring expansion over protection would appear to be a wise one at the level of IBDF. At higher levels of government, however, where national resources are channelled into incentives for pasture and a long list of ephemeral development projects, a great mistake is being made.

The low priority attached to protecting natural habitats is also indicated by the history of parks and reserves that have been reduced in size, bisected by highways, or eliminated altogether. Parks and reserves invariably lose where any hint of conflict arises with economic interests, even if the parks or reserves have already been officially created with all the legal protection of the country's laws (Pádua, 1983). Environmental decision-making at present therefore suffers from both exclusion of scientific input when most of the fundamental choices are made, and from this low credence attached to such advice on environmental matters at the higher levels of government.

## Environmental Decision-Making at Present

Many fundamental decisions affecting the environment are not presently being made by active choices, but rather by default. This is the case with the continuation of many policies and practices which promote rapid de-

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forestation in Amazonia. In the case of some major development schemes, environmental impacts have been assessed through committees and studies, either as a result of provisions in Brazilian law enacted over the past decade, or as a result of the requirements of international lending agencies financing the developments (see Goodland, 1985). The relatively recent advent of scientific input on environmental questions related to development projects is encouraging, but it is not enough and does not enter into decision processes at the right time to affect the basic structure or existence of the projects in question. The developments at Carajás provide a good example, as do the Tucuruí, Balbina, and Samuel hydroelectric projects and the POLO-NOROESTE highway improvement and regional development project. Ecologists are never consulted *before* decisions to implant large-scale projects such as these are taken in fact. Input on environmental questions is only solicited later, with the limited purpose of suggesting ways to minimize the environmental damage caused by the projects already underway. Ecologists are brought in to take on the unpleasant task of dealing with environmental messes, rather than as sources of basic information considered in making the initial decisions. Such a "gun-slinger" approach to ecology is unlikely to be effective in assuring sustainable development and preserving environmental quality.

In the case of Carajás, environmental research and monitoring have been bureaucratically isolated from a large part of the complex of development schemes set in motion by the project. The Companhia do Vale do Rio Doce (CVRD) is responsible only for the iron ore mining project and the narrow strip of land used by the railway and port facilities. A variety of research programs and environmental advisory groups has been established in conjunction with the CVRD iron project. The much wider area affected by the administratively separate "Programa Grande Carajás" has no such environmental program.

The planning of national parks and equivalent reserves provides one of the few examples of advice from the scientific community being heeded at the planning stage. The refugia theory, despite a lively academic controversy over its validity for explaining the distributions of different species (see Prance, 1982), has provided a systematic means of trying to maximize the protection of biotic diversity within the limited areas that can be expected to remain

protected as undisturbed forest (Pádua and Quintão, 1982). In addition to selecting areas where centers of endemism assure maximal utility in species preservation per area, the biological content of neighboring areas must be considered if the ecological communities included within the reserve boundaries are to maintain themselves over the long term (Lovejoy and Oren, 1981; Lovejoy *et al.*, 1984). In the context of human occupation patterns in Amazonia, land use over wide areas must be rationally planned if uses, including reserves, are to be located with respect to each other in ways that minimize the probability of uncontrolled invasion of less intensively used patches

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of land from neighboring population concentrations (Fearnside, 1983b).

The most striking feature of parks and equivalent reserves in the Brazilian Amazon is that they are so small. So far only 8 million hectares, or 1.8% of the Legal Amazon, has been set aside even on paper, while the target for current plans totals a mere 18.5 million hectares, or 3.7% of the region (Pádua, 1983). In contrast, permanent preservation of 25% of the region's natural vegetation was recommended by the interministerial commission on forest policy in 1979 in the original version of the forest policy draft law. Neither the original version of the draft law nor any of its greatly weakened subsequent editions has ever been submitted to Brazil's National Congress.

In pointing out the small extent of Amazonian parks and reserves relative to the region's area and diversity, I hasten to add that the present system of parks and reserves is substantial in comparison with that of a decade ago, and that the progress achieved has been won at the cost of years of dedicated struggle within the various bureaucracies of the federal government. Maria Teresa de Jorge Pádua and Paulo Nogueira Neto have been leaders of this effort.

#### Deforestation

Estimates of deforested areas available from LANDSAT image interpretation must be examined closely in

order to evaluate the degree to which they reflect reality, and in order to detect trends. Widely-quoted results indicating that only 2.4% of the Brazilian Legal Amazon had been "altered" by 1980 (Brazil, Ministério da Agricultura, IBDF, 1983) must be scrutinized carefully. Part of the explanation for such a low value for deforested area can be found in the fact that LANDSAT data for 1980 had not yet been interpreted for three of the nine "federal units" (states or territories) of the Legal Amazon. These three federal units account for 40% of the total land area. The 1978 estimates for these three units — Amapá, Roraima and Amazonas — were used in the 1980

calculation as if no deforestation had occurred between 1978 and 1980. If one examines the data only for the 306,792,000 ha for which information is complete for 1980, the area where vegetative cover had been "altered" totals 12,154,681 ha, or 4% of the total. The three federal units for which data are lacking are not the focus of the most intense clearing, so the total figure for the Legal Amazon will probably lie between 2.4 and 4% when the missing data are eventually supplied. Roraima and Amazonas have both experienced increasing clearing in the past few years.

Another factor which may explain the low figure of 2.4% is the difficulty of distinguishing primary from secondary forest. That large areas of relatively old secondary forest are classified as primary forest is obvious from the INPE figures for altered vegetation in 1975 (see Fearnside, 1982). The Zona Bragantina in Pará has an area of 3 million hectares (Sioli, 1973). This entire area has been cleared since the first decades of the present century (Ackermann, 1966; Egler, 1961; Pentecado, 1967). The area of the Zona Bragantina alone is almost five times the area indicated as altered in the State of Pará by 1975, and is larger than the 2.8 million hectares indicated as altered in the entire Legal Amazon by that date!

The difficulty of distinguishing secondary growth from primary forest is only a part of the prob-

lem in evaluating "altered" vegetation. The LANDSAT data from Brazil's National Institute for Space Research (INPE) and Brazilian Institute for Forestry Development (IBDF) presented for "altered" vegetation would appear to go beyond the estimates of outright "deforestation" claimed by previous INPE reports. Vegetation cover, of course, can be seriously altered by logging and other forms of human disturbance without the complete removal of trees implied by conversion to cattle pasture or field crops. Given the difficulty in distinguishing secondary vegetation, the capability of the interpretation techniques to distinguish logged forest from unaltered forest is doubtful. Selective logging has already altered most of the large but unmeasured area of forests accessible from rivers and older highways. As commercial logging increases in response to the coming end of tropical hardwood stands in Southeast Asia (Routley and Routley, 1977), this forms of alteration without complete clearing can be expected to increase dramatically in Amazonia.

Close monitoring of deforestation is essential if the process is to be understood and controlled. It is disturbing to note that the delay in analyzing LANDSAT information on deforestation has been increasing. The 1978 clearing results were released two years later in 1980 (Tardin *et al.*, 1980), while the 1980 results were released three years after the fact (Brazil, Ministério da Agricultura, IBDF, 1983). Furthermore, the 1980 figures are not yet complete for the entire Legal Amazon, even after the long delay. Since equipment and interpretation procedures have already been perfected, one would hope that the importance of the results will lead to higher priority being placed on deforestation monitoring. Allocation of sufficient budgetary resources and staff could easily produce such estimates within a few months of the end of each year's relatively cloud-free dry season. Refinement of the results to produce clearing estimates by property will also be necessary if the technique is to have practical application in enforcement of environmental regulations.

Despite the limitations on present LANDSAT image interpretation techniques causing underestimates of deforestation and other forms of disturbance, the results of LANDSAT monitoring are extremely valuable in showing deforestation trends and foci. It makes little difference if the Amazon is deforested in 20, 40, or 80 years' time: what is important is whether decisions are taken to guarantee that specific areas are not

deforested *ever*, and that areas chosen for forest production systems not be lost to unsustainable land uses such as cattle pasture.

Projections of trends in deforestation have a valid role in illustrating the logical consequences of the processes operating during the period for which data are available. Such projections (Fearnside, 1982) should not be confused with predictions of future events. Projections are extensions of either observed or hypothetical trends through time. For example, one can calculate that the forest of any particular area would be gone by a given year *if* the exponential trend indicated by data from some parts of Amazonia applies to the

tation consistent with the ignoring of older cleared areas apparent in the LANDSAT results). Extension of the scale to 1985 is intended to remind the reader that these data are already old and that much clearing has taken place in the intervening years.

In the case of Rondônia data for clearing through 1983 is available (Brazil, Ministério da Agricultura, IBDF, 1985; Fearnside and Salati, 1985). The area deforested increased at slightly more than a linear rate in the 1980-1983 period, bringing the cumulative total to 5.74% of Rondônia's area. The available data pre-date the major surge of immigration to Rondônia that followed the asphaltting of the Marechal

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area in question, and *if* the rate of increase in cleared areas remains unchanged throughout the period. Understanding the logical consequences of exponential trends is important if action is to be taken to modify the social processes underlying deforestation which tend to produce exponential growth of cleared areas. These are positive feedback loops, such as the relationship of deforestation to road building. More roads lead to the entrance of more population while the presence of more population justifies the construction of still more roads. Deforestation then increases both by each individual landholder increasing felling when road access to markets arrives, and by the entrance of more individuals. The recent history of apparently exponential forest clearing in several states underscores the urgency of addressing the forces underlying the trends.

The "alteration" of vegetative cover indicated by LANDSAT data is presented graphically in Figure 1. The scale of years on the abscissa of each graph is shown extending from 1970 to 1985, although data are only available for the period 1975-1980 in the most complete cases. Placing the origin at 1970 allows the reader to visualize how explosively the cleared area has increased in succeeding years, since the relatively small but unmeasured 1970 areas can be considered insignificant (assuming an operational definition of "altered" vege-

Rondon (BR-364: Cuiabá-Porto Velho) Highway in 1984.

The data graphed in Figure 1 provide ample cause for concern. Three of the states for which 1980 data are available show strong indications of exponential growth in cleared areas over the period. These are Mato Grosso, Rondônia, and Acre. In two other states, Pará and Maranhão, clearing appears to have proceeded only slightly more rapidly than linearly. In only one case, that of Goiás, is there any indication of clearing having slowed by 1980. Of the three federative units for which 1980 data are unavailable, it is worth noting that Amazonas and especially Roraima have been the recipients of an increasing stream of migrants coming from Rondônia, just as Rondônia has been the recipient of migrants from Mato Grosso over the past decade. The trend is likely to continue, especially since the governors of both Amazonas and Roraima have announced their intention of attracting population from other regions by promotion of colonization schemes. As the frontier passes from Mato Grosso, Rondônia and Acre to Amazonas and Roraima, similar patterns of increase in cleared areas are likely.

The trends indicated in Figure 1 make it highly unlikely that the area of Amazonia cleared by the year 2000 will be as small as the 6% value put forward by the Global Environmen-

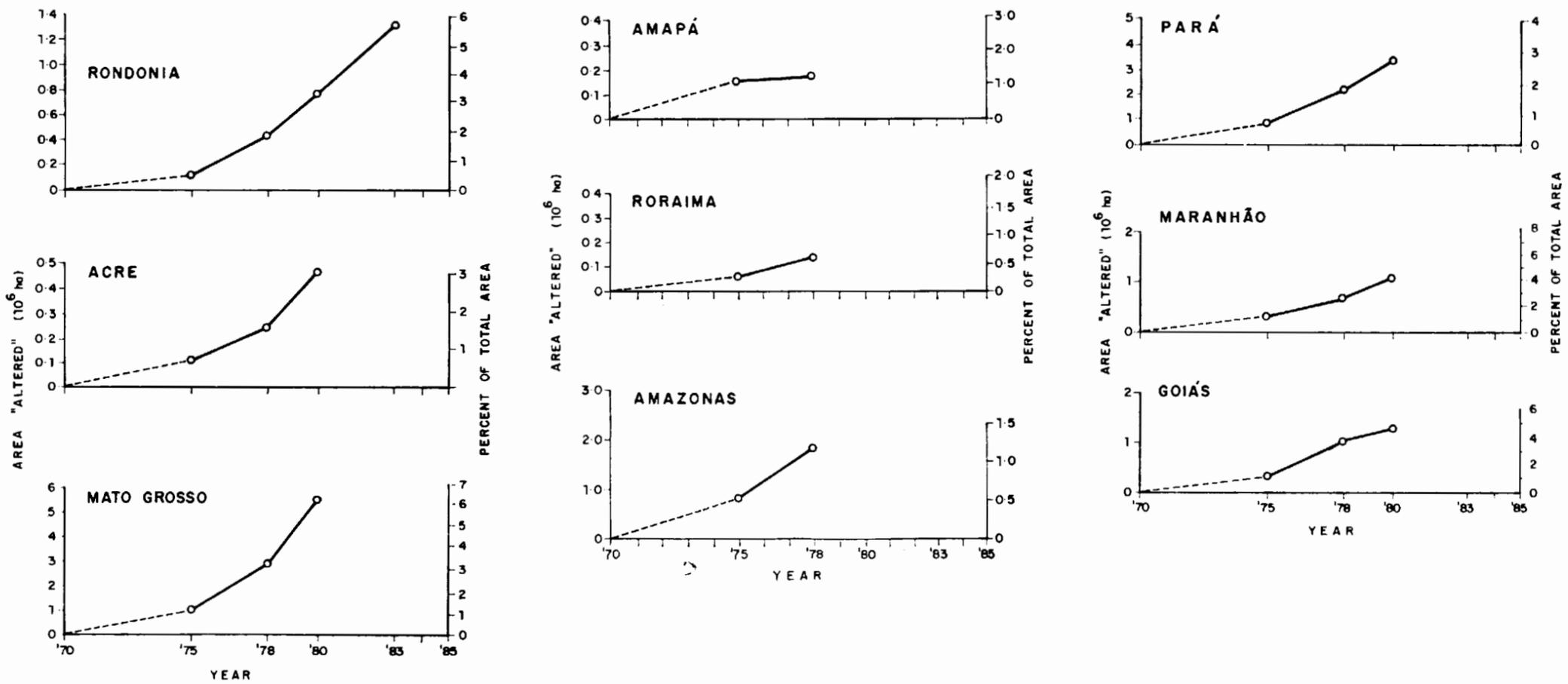


Fig. 1: Areas "altered" in the federal units of the Brazilian Legal Amazon. Area estimates are from studies of LANDSAT satellite imagery (see text for discussion of limitations). Data source: Brazil Ministério da Agricultura, IBDF (1983).

tal Monitoring System (Reader, 1982). Neither can the curves of Figure 1 be simply projected forward to the year 2000 as predictions of future events. Projections of trends can serve only as illustrations of the consequences of unaltered continuation of these trends.

The future course of deforestation will be the combined result of many forces, some acting to speed and some to slow the pace of felling. The forces causing the explosive felling of the past few years are still in place. These include fiscal incentives, despite the persistent myth that they have stopped. The 1979 decision of the Superintendency for Development of Amazonia (SUDAM) to discontinue new incentives for pasture in the "high forest" portion of the Brazilian Amazon both allows the hundreds of already approved projects to continue receiving full incentives for clearing and permits new projects to be approved in the portions of the region defined as "transition" forest. The policy of not approving new pasture projects in forested areas is also not followed in practice, as was revealed in July 1983 at the Interciencia Association Symposium in Belém by Fernando Campano, an official of the Pará State Agriculture Department (SAGRI) and member of the consulting board for SUDAM's renewable resources department. The policy change has merely meant that requests for fiscal incentives for pasture projects are no

longer reviewed by the renewable resources sector of SUDAM, but rather pass directly to the fiscal incentives sector and the deliberative council (CONDEL). In 1983 a major new pasture project was approved for Acre, a state wholly within the "high forest" zone, despite bitter debate in CONDEL.

Other forces speeding deforestation include subsidized bank loans with interest rates below the level of inflation, agricultural production for export and to a lesser degree for subsistence, and especially land speculation. Rapid clearing is an essential element in the strategy of speculators, both with and without legal title to the land holding in question. The act of clearing establishes *de facto* ownership of the land, and clearing will always be rapid as long as this system of land tenure remains in force (Fearnside, 1979).

A number of forces can be expected to act to slow forest clearing in the coming years. It is important to note, however, that slowing clearing is very different from stopping it. As long as the positive forces remain in place, clearing will proceed until the finite resource is eventually exhausted. Capital is not available either for banks to pay the full cost of financing and fiscal incentives already committed, or for investors to apply to felling from their own resources. The gap is even greater between capital reserves and the cost of the greatly in-

creased felling rate implied by continuation of an exponential trend to its logical conclusion. Other resources needed for greatly accelerated clearing, such as labor and petroleum, are also lacking. At some point the flow of migrants to the Amazon region may slow when the last remaining minifundios in Paraná and São Paulo are finally replaced by mechanized soya beans, wheat and sugar cane. It is wise to remember in this regard, however, that the number of potential migrants is very large in relation to the area of agricultural land available in the Amazon: if the 5 million square kilometers of the Legal Amazon were divided into 100 ha lots as the National Institute for Colonization and Agrarian Reform (INCRA) did on the Transamazon Highway, the region would just accommodate the 5 million landless migrant laborers now plying the rural areas of Paraná and São Paulo, not to mention the fast-growing populations of Brazil's semi-arid northeast, the cities, or the Amazon region itself.

As clearing proceeds, the decreasing quality of remaining unoccupied land should also reduce clearing motivated by desire for agricultural production. Clearing for cattle ranching and land speculation, however, is notoriously unaffected by poor land quality (Fearnside, 1983a). The relatively slow clearing of settlers after the first six years of residence (Fearnside, nd) should also

act to slow regional clearing increases as the size of Amazonia's resident population becomes larger relative to the annual flux of new arrivals.

Forces such as those mentioned above cannot be depended upon to stop deforestation — only to slow its pace. Clearing can be stopped only if conscious decisions are taken to do so before options for sustainable use of the forest, reserves and other options are irrevocably lost. Tempting as it might to believe that the many undesirable effects of large scale deforestation are so bad that clearing would surely not be allowed to reach such a scale, the question is "Who will stop it from happening?" The answer: "no one."

## Conclusions

Conscious decisions must replace the present unguided drifting with economic and social forces in directing development in Amazonia. Present trends, even if slowed, lead quickly to deforestation of the region and closing of options for sustainable development. Government choices should favor activities leading to long-term well-being of the region's residents and their descendants. A new framework for guiding decisions is needed, providing for explicit weighing of environmental effects and conflicting social and generational interests. Facing the limited nature of Amazonia's resources base is a prerequisite for adopting a complex of interdependent measure needed to assure sustainable development.<sup>1, 2</sup>

## NOTES

1. Presented in the session on "Amazonian Perspectives" at the Interciencia Association International Symposium on Amazonia, 7-13 July 1983, Belém, Pará, Brazil.
2. I thank J. G. Gunn and two anonymous reviewers for helpful comments.

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