LAND-USE TRENDS IN THE BRAZILIAN AMAZON REGION AS FACTORS IN ACCELERATING DEFORESTATION

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SUMMARY

In Amazonia, land-uses requiring large inputs of labor and other resources per hectare, such as annual and perennial crops, can be expected to decrease in relative importance as compared with uses such as cattle ranching and forest cutting for timber and charcoal. Cattle ranching has already claimed the largest share of cleared areas in the region, even in comparatively fertile areas including Rondônia in southwestern Amazonia where crops such as cacao account for most credit disbursement and official fanfare. The trend to cattle pasture includes expansion within small-farmer settlement zones--a process spurred by turnover in the colonist population. In other areas of the region, the trend to ranching stems from continued proliferation and expansion of large concerns, which profit both from speculative gains and various governmental subsidies.

Timber extraction can be expected to increase in impact substantially in Amazonia, as heavily-logged Asian forests dwindle. Charcoal extraction for use in steel production associated with the massive iron-ore deposits being developed at Serra dos Carajás appear likely to have a major impact on rainforests in the eastern Amazon region. Deforested areas can continue to grow faster than the region's already explosive population growth due partly to these land-use shifts.

INTRODUCTION

Forms of development currently increasing in the Brazilian Amazon region allow a small population to exert a great impact on the region's rainforest. Trends in land-use are a significant factor in deforestation, along with the continued explosive growth of the region's human population fueled largely by migration from southern Brazil.

The amount and rate of deforestation varies greatly among the regions of the Amazon. The greatest concentrations are located along the north-south swath of the Belém-Brasília Highway (BR-010) and its tributary roads, and along the east-west path of the Cuiabá-Porto Velho Highway (BR-364) in Rondônia. Average figures for forest clearing therefore give little idea of the human impact in areas of intensive settlement (Fearnside, 1982). In Rondônia, a state in the southwest corner of the Brazilian Amazon, intense migration resulted in an increase in the human population at a rate of 14.6% per year between 1970 and 1980, a doubling time of less than five years. By contrast, the Northern Region (Rondônia, Acre, Amazonas, Pará, Amapá, Roraima, and Mato Grosso), grew by only 5.0% per year over the period, while Brazil as a whole grew at 2.5% per year (calculated from Brazil, Presidência da República, IBGE, 1981: 5).

Land occupancy throughout rural Brazil has traditionally been polarized between large land-holdings and many tiny peasant farms--a pattern carried over into the present occupation of rainforest areas in Amazonia (see Hebette & Acevedo, 1979; Wood & Wilson, 1982; Fearnside, nd-a). Government-directed small-farmer settlement programs have usually begun with cleared areas planted to annual crops such as upland rice (see Goodland & Irwin, 1975; Moran, 1976, 1981; Fearnside, 1978; nd-b, Smith, 1978, 1981). The annual crops are usually planted on any given patch of cleared land for a period of only one or two years (Fig. 1), after which falling production forces farmers either to allow the area to lie fallow under "second" growth, or to plant to pasture. This latter is an increasingly common choice, particularly in the light of the increased sale-value of land that is already planted with pasture grasses. In areas of "small" farmers, such as the government colonization areas of the Transamazon Highway in Pará and the Cuiabá-Porto Velho Highway in Rondônia, far more land is planted to pasture than any other land-use.

In the Ouro Preto Colonization Project in Rondônia, an area where perennial crops have been heavily promoted, one survey of 105 lots undertaken in 1980 indicated 39.5% of the deforested land to be in pasture, as compared with 11.8% in annual crops and 20.0% in perennials (Furley & Leite, nd.); another 1980 survey in the same colonization project indicated 49% of the cleared area to be pasture in 100 sampled lots (Léna, 1981). Although almost all farmers plant some annual crops, such as rice, pasture is nevertheless far more important in terms of area.

The relative importance of pasture tends to be greater in areas of large rather than of small properties. But even in areas of small properties, both inside and outside of planned settlement schemes, the small farmers are being replaced by other types of family and corporate enterprises, leading to rapid increase in cattle pasture (Fearnside, 1980a). In the vast tracts

outside of these areas, land is settled directly by large enterprises engaged in cattle ranching, plantation agriculture, and forest exploitation.

RANCHING

In recent years, cattle ranching has become the most widespread form of land-use in the Brazilian Amazon, rapidly altering the landscape in the region's accessible portions (Figs. 2 and 3). Large cattle ranching enterprises have been established along the Belém-Brasília Highway and associated branch roads in eastern and southern Pará, and in the Amazonian parts of Maranhão, Goiás, and Mato Grosso states. These include Volkswagen (139,000 ha), Armour-Swift/Brascan/King Ranch (72,000 ha), Liquigas (678,000 ha), and many other large corporate investors (see Goodland, 1980; Myers 1980a,b). Somewhat smaller ranching enterprises, usually with holdings of less than 10,000 ha, predominate in other regions of rapid deforestation such as Acre, Rondônia, and central Pará, although a few holdings in these areas are far larger.

The Brazilian Enterprise for Research in Agriculture and Cattle Ranching (EMBRAPA) estimates that 1.5 million hectares of pasture had been planted in the Brazilian Amazon by 1977 (Serrão & Falesi, 1977), 85% of which were Guinea Grass (colonião: Panicum maximum). An area of 500,000 ha (33%) of planted pasture was considered "degraded," or invaded by second growth, by 1978 (Serrão et al., 1979: 202). In addition to planted pastures, most of the 15 million hectares of "natural" upland grasslands and 1.5 million hectares of várzea (floodplain) grasslands in the region are used for cattle. Most "natural" grassland areas are found in the federal territories of Roraima and Amapá, and in the area of Humaitá in the southern part of the state of Amazonas, while the periodically flooded (várzea) grasslands are along the Amazonas (Lower Amazon) and Solimões (Upper Amazon) Rivers, and in coastal areas of the "freshwater ocean" near Belém.

The rush to implant cattle ranches in the Brazilian Amazon region has been speeded (until recently) by generous government inducements in the form of tax incentives and loans with negative interest rates in real terms (after considering inflation) (cf. Fearnside, 1979a; Bunker, 1980). Loans given by the Banco da Amazônia S.A. (BASA), after project approval by the Superintendency for Development of the Amazon (SUDAM), undergo adjustments for inflation at official rates, invariably lower than actual inflation. Loans have two-year grace periods before payments begin, though the original repayment schedule of seven years has been reduced to five years for more recent loans. Part of the tax owed on income earned elsewhere in Brazil by companies undertaking the projects can be applied towards capitalizing ranching enterprises. An additional program provides direct subsidies to approved projects. Tax incentives and other subsidies accounted for 72% of the funds invested in Amazonian cattle ranches in 1977 (Kohlhepp, 1980: 71).

In 1979, the government declared a moratorium on SUDAM approval of fiscal incentives for new ranching projects in those parts of Amazonia classified as rainforest, although incentives for projects already underway continue. The part of the Legal Amazon with cerrado (scrubland)

vegetation, as well as a large area classified as "transition" forest, continue to receive incentives for new projects.

Between 1967 and 1978, SUDAM approved 335 ranching projects in the Legal Amazon, covering an area of 7,887,169 ha (de Almeida, 1978: 28). But fiscal incentives, while important, are not the only force leading to deforestation for cattle ranches: a survey of 445,843 ha of clearing in rainforest (Tardin et al., 1978: 19) indicated that nearly half was cleared without incentives.

The appreciation of land values provides an additional powerful incentive for the rush to pasture, motivating investors to undertake ranching operations in Amazonia despite poor agronomic prospects. The ranching operations themselves produce a meagre amount of beef, and there is little reason to expect that production can be economically sustainable over an extended period. A SUDAM survey of 12 large ranches in Pará found annual net profits to be only about US$ 3 per ha after ten years, and less that US$ 6 per ha after 20 years (Serete S.A. Engenharia & Brazil, Ministério do Interior, SUDAM, 1972: 13-23 cited by Mahar, 1979: 123). A number of ranches surveyed were operating at a loss.

The size of ranches has a marked effect on land values, which are influenced by the varied enforcement of conflicting laws and government policies in different parts of Amazonia. In Rondônia, INCRA (National Institute for Colonization and Agrarian Reform) has enforced government policy of not distributing public lands (terras devolutas) in parcels larger than 2000 ha. This law (Law No. 2597 Art. 8 of 1955) is sometimes circumvented by registering several continguous parcels in the names of different family members.

Developers of large cattle-ranches consequently have preferred Mato Grosso and Acre, where this law has not been enforced. This policy has resulted in land values in Acre six times higher than those in Rondônia, according to one report (Théry, 1976: 96). SUDAM has confirmed its preference for large ranching projects by requiring a minimum of 25,000 ha to qualify for incentives (Cardoso & Mu"ller, 1978: 162).

Increase in land value can make even a marginal ranching operation highly profitable in the long run, provided title to the property can be obtained and held. Qualifying for a piece of paper with a few signatures and rubber stamps can thus add much more to a property's value than the production of beef cattle. Clearing land and planting pasture is one way of maintaining claim to the land and qualifying for the título definitivo (definitive title).

Speculators have often opted for cattle ranching because the cost per hectare of implantation is low compared with other uses. Increases in the prices of pasture land are spectacular by any standard; thus in Amazonian Mato Grosso, real prices of pasture lands (after discounting inflation) increased at an annual rate of 38% during the 1970-75 period (Mahar, 1979: 124). These gains could be realized without any agricultural production whatsoever. Furthermore, the resale value of the land has a tendency to become detached from the land's theoretical value in terms of expected future production (Found, 1971: 24)--to the extent such

that it is treated as a commodity like gold bullion or rare stamps, whose value does not derive from actual usefulness as a production input. Indeed, continued productivity for these pastures is highly unlikely (Hecht, 1981; Fearnside, 1979b, 1980b). The root of the motivation to bid the price of land far above its value for production is undoubtedly desire for shelter from Brazil's approximately 100% per year monetary inflation. Recent land speculation in Amazonian pasturelands probably could be counted among the most profitable investments on earth, providing a powerful motive for rapid occupation and implanting of pasture by speculators.

PERENNIAL CROP PLANTATIONS

Monospecific stands of a number of crops are becoming increasingly important in the development of Amazon terra firme. Although present areas are small relative to both the Amazon's total area and to areas being planted in pasture, plans for expansion continue.

Rubber, (Hevea brasiliensis) is a major priority. Brazil, once the world's major source of rubber, was forced to import 47% of its natural rubber needs in 1982 (A Critíca, 24 Sept. 1982: 7). Rubber is promoted by a special government organ, SUDHEVEA, under a program called PROBOR, as well as through the fiscal incentives of SUDAM. By 1979, 15,000 of the 19,000 ha of rubber that had been planted under the PROBOR program were considered satisfactory, with the target for the program set at 40,000 ha (Morais, 1979). Amazonas State alone intended to plant 50,000 ha in 1981.

Cacao (Theobroma cacao) plantations are financed both for small farmers in some of the planned colonization projects of the Transamazon Highway and Rondônia, and in neighboring areas of 500-2000 ha parcels sold through licitação (closed tenders). A government plan undertaken by CEPLAC (the government cacao promotion and research organ) calls for financing 200,000 ha of cacao in the Amazon over a 15-year period (Alvim, 1977a: 350). In Rondônia, the area in cacao is estimated to have increased from 17,528 ha in 1978 to 33,528 has in 1980 (Brazil, Governo do Território Federal de Rondônia, CEPA-RO, 1980: quadra 20). The world market price for cacao has been falling in real terms since 1977--a trend that the World Bank expects to continue through 1990 (Skillings & Tcheyan, 1979; International Bank for Reconstruction and Development, 1981). Future expansion can therefore be expected to slow down sharply.

Black pepper (Piper nigrum) has been planted without government inducements in several areas of Pará and Amazonas. More recently, government financing has been made available for black pepper, which is mostly grown by colonists in the Transamazon Highway area (Fig. 4). Areas under black pepper in Pará increased from 5674 ha in 1973 to 8197 ha in 1976 (Homma & Miranda Filho, 1979: 18). A fungal disease (Fusarium solani f. piperi) has forced the abandonment of older plantations and caused planters to migrate to new locations (Fearnside, 1980c).

African oil palm (Elaeis guineensis) may become more widespread as a plantation crop in future years. A project by a French firm for a 33,000 ha plantation near Tefé, in the State of

Amazonas (de Almeida, 1977) was expected to begin in 1981 but on a smaller scale than originally contemplated (P. de T. Alvim, personal communication, 1980). Meanwhile, an experimental plantation of France's Institute de Recherche pour les Huilles Oleaginneaux (IRHO) had 1500 ha planted near Belém by 1977, with plans to expand with an additional 3500 ha (de Almeida, 1978: 31). This experimental work has led to a commercial enterprise, Dendê do Pará S.A. (DENPASA), with 2500 ha producing by 1979 (Muller, 1979).

Guarana (Paullinia cupana), a sapindaceous woody climber that is used in a soft drink, is a native plant grown in relatively small plantations. It is especially common in areas of Amazonas State near Maués, and between Manaus and Manacapuru. SUDAM incentives have been tentatively approved for processing plants (de Almeida, 1978: 31). Government plans to finance extension of guarana culture in other areas, including the Transamazon Highway, have so far remained on paper.

Coffee (Coffea spp.) plantations have been financed in Rondônia for colonists with 100 ha lots in planned colonization projects. The area under coffee in Rondônia is increasing rapidly--being estimated to have jumped from 20,091 ha in 1978 to 32,638 ha in 1980--with the area in production rising from 6,630 ha to 19,567 ha in the same period (Brazil, Governo de Território Federal de Rondônia, CEPA-RO, 1980, quadra 18). A much smaller number of colonists have planted coffee in the Altamira area of the Transamazon Highway in Pará. As in the case of cacao and other perennial crops, the limited capacity of world markets to absorb vastly-increased quantities of the product can be expected to slow expansion of planted areas long before any significant part of this region's vast area is converted to these crops.

Silvicultural (tree) plantations have been increasing in the Amazon, and are being encouraged as an appropriate form of development for the region (Alvim, 1977a,b, 1978a,b,c). Plantations could supply the country's wood and paper needs from a much smaller area than would be the case if natural forest were used. They could have an especially important effect in reducing pressure for rainforest felling if installed in previously- cleared areas.

Hardwood species have so far only been planted in experimental settings, but fast-growing species for pulp, plywood, and sawlogs have been planted in an increasing number of commercial plantations. ICOMI, a manganese-mining operation in which Bethlehem Steel has a 49% interest, has planted 20,000 ha of Carribean Pine (Pinus caribaea) in Amapá Territory. Georgia Pacific has been planting Pinus caribaea on their 500,000 ha property near Portel in the State of Pará (Cardoso & Mu"ller, 1978: 161).

Best known are the plantations of Companhia do Jari, (formerly Jari Florestal e Agropecuária Ltda.), better known simply as "Jari." Jari, an estate claiming 1.6 million hectares, was originally developed by the shipping magnate Daniel K. Ludwig. In 1982 a controlling interest estate's silviculture and mining projects was sold to a group of Brazilian firms now numbering 23. The property straddles the Jari River, the tributary to the Amazon forming the boundary between Pará and Amapá. The first plantations were installed in 1969, and by mid-1981 a total of 105,637 ha had been planted in monospecific silvicultural plantations: 50%

Gmelina arborea, 35% Pinus caribaea var. hondurensis, and 15% Eucalyptus deglupta (Woessner, 1980).

Planners in Brazil have suggested that the project at Jari be emulated on a large scale in other parts of the Amazon Basin. Paulo de Tarso Alvim (1978c), an influential voice in Amazon development planning, believes that the results obtained at Jari "clearly demonstrate the enormous potential for commercial silviculture of the Amazon." Others have suggested that Jari represents an "experiment" that will provide a development model once it proves itself by making a profit. Ample reason exists to doubt the wisdom of applying Jari as a model for large-scale developments in other parts of the Amazon (Fearnside & Rankin 1980, 1982a).

Despite severe problems with sustaining silviculture at Jari, however, plans were announced by the Executive Secretary of the Interministerial Council of the Grande Carajás Program calling for plantations 24 times the size of those at Jari, as part of massive mining and regional development schemes in the southeastern part of Amazonia (Nestor Jost, presentation to the Brazilian Society for the Progress of Science (SBPC), Campinas, São Paulo, 12 July 1982; see Fearnside & Rankin, l982b; Spectrum, 1982: 543).

Charcoal derived from Eucalyptus plantations at Carajás is to be supplemented with production from native forests in processing some of the iron ore into steel. Plans include a network of collection points to purchase charcoal from caboclos (traditional Amazonian small farmers) and even from Amerindian populations (N. Jost, op. cit.). Also planned is large-scale harvesting of the smaller trees in alternating strips of forest included in large estates (information from delegation of Projeto Carajás engineers visiting INPA, 24 August 1982). The economic attractiveness of smelting locally as much as possible of the 18 thousand million metric tons Carajás iron-ore deposit poses an immediate threat to vast areas of forest. While immediate plans for plantations and forest exploitation are focused on the area of the mining project's railway line that is currently under constructon in southeastern Pará and northwestern Maranhão, the Greater Carajás Project encompasses a special development zone occupying approximately one-sixth of Brazil's Legal Amazon (Brazil, Comissão Interministerial do Programa Grande Carajás, 1981).

FOREST EXPLOITATION

Currently, forest exploitation is the subject of intense debate in Brazil. The Renewable Natural Resources Department of the Superintendency for Development of the Amazon (SUDAM) has proposed that "agricultural colonization" in Amazonia be replaced by "forestry colonization" in development plans. "The development of forestry colonization should be attempted through the creation of Income Forests (Florestas de Rendimento), which would offer a chance for population nuclei to spring up in the Amazonian "hinterland" with a tendency towards stable and significant growth from the socio-economic point of view." (Pandolfo, 1978: 66). These "Income Forests," a set of 12 areas totalling 39,504,000 ha (Pandolfo, 1978: 22), or 7.9% of Brazil's Legal Amazon, would be the responsibility of a government enterprise which would include the extraction and management techniques to be applied, and would supervise

"the contracts of exploitation concessions" (Pandolfo, 1978: 50). Reafforestation after cutting would be done by the government, with the cost paid by the logging enterprises (Pandolfo, 1978: 63).

Forest exploitation became an issue of public controversy in Brazil when concrete plans were laid for the granting of exploitation concessions. In December 1978 a report was submitted to the Brazilian government by an FAO forestry expert based on a two-week visit to Brazil (Schmithüsen, 1978: 7). The report suggests that "forest utilization contracts" be instituted to grant private firms logging concessions on government land in Amazonia. The report states: "This form of forest concession basically constitutes a risk contract between the government and the private sector" (Schmithu"sen, 1978: 13). Some press reports claim the plan would cover 56 million hectares (11.2% of the Legal Amazon, or 20% of the "dense" forests) (Frota Neto, 1978), while others give figures as high as 40% of the "Amazonian forest" (A Crítica, (Manaus), 23 Dec. 1978: 3). No area figures were given in the original report (Schmithüsen, 1978). Clara Pandolfo, the proponent of the SUDAM "Income Forest" scheme, has denied there is "any relation or similarity between the Income Forests... and the so-called 'risk contracts'" (Pandolfo, 1979: 2).

While head of the now extinct Project for the Development of Forestry Research (PRODEPEF), Mauro Reis called for establishing "conservation units for the purposes of multiple-use," including the "rational logging and production of wood for industrial use" (Reis, 1978: 19). The proposal states that "the liberation of these areas, however, should only occur after Brazil has the technology and 'know how' needed to rationally manage the heterogeneous tropical forest of Amazonia" (Reis, 1978: 12). It is also cautioned that "in truth, a self-sustained system of production for the dense tropical forest for industrial ends, based on the model considered here, has not yet been developed" (Reis, 1978: 14).

Following the public outcry in Brazil which was sparked by announcement of the forest utilization contracts ("risk contracts") scheme, all decisions concerning implementing new schemes were postponed pending a complete revision of Amazonian forest policy. A special interministerial commission was formed to produce a new draft law in a period of only 120 days, which ended on 10 October 1979. Recent drafts of the proposed law have removed many restrictions on deforestation and ranching included in the commission's original version. The types of colonization to be promoted in the region, and policies concerning fiscal incentives for ranching, forestry, and other development schemes, as well as many other related issues, are all included under the rubric of "forestry policy."

CONCLUSIONS

Saturation of world markets for such crops as cacao and coffee seems likely to ensure that the areas planted to these remain unprofitable and hence small relative to the size of the region. Other reasons to expect only a slow expansion of tree crops in the foreseeable future include the high investments of labor and capital needed to install them as compared with other land-uses, the limited extent of adequately fertile soils, reduction in credit due to Brazil's current

economic difficulties, ever-increasing costs, production losses due to plant diseases, and the relatively small value of such crops in holding land claims for speculative purposes.

In contrast, land-intensive uses such as cattle ranching and extraction of wood for charcoal and timber give every indication of likely rapid expansion. These uses provoke a maximum disturbance of rainforest relative to the input of human labor, almost all effort required being used directly in building access roads and cutting the rainforest itself. These land-use trends multiply the effect on the forest of rising human population, with consequent rapid deforestation or heavy disturbance of vast areas.