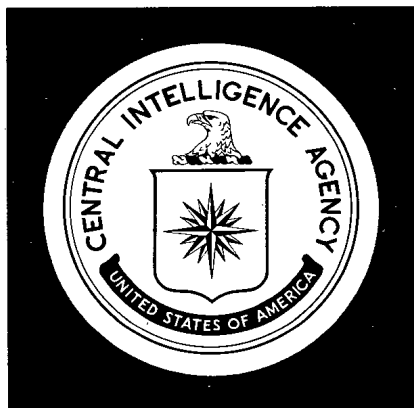


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DIRECTORATE OF  
INTELLIGENCE

# Intelligence Report

*Amazonian Brazil:  
Environmental Challenge to Regional Development*

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CIA/BGI GR 72-10  
June 1972

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## CENTRAL INTELLIGENCE AGENCY

Directorate of Intelligence

June 1972

**AMAZONIAN BRAZIL: Environmental Challenge to Regional Development****INTRODUCTION**

1. As Brazil forges rapidly ahead in industrial development and turns also to the settlement and development of her largely empty interior, a new awareness has grown among her neighbors that Brazil is serious in her bid to become a world power. Although the ambitions and resources attributed to her may be exaggerated—and the apprehensions of her rivals as well—Brazil, nevertheless, is increasingly playing the role of the dominant power in South America. As such, her intentions and her development capabilities become of increasing intelligence interest.

2. Brazil is now engaged in a massive program to integrate Amazonia into the national life of the country. Remote and, until recently, accessible only by water or air transportation, Amazonia has functioned more as an “overseas colony” than as an integral part of Brazil. This colonial status is reflected in Amazonia’s economy, which is based on the “exportation” of raw materials and the “importation” of manufactured goods and many of its foodstuffs from southeastern Brazil and foreign countries. The sparse population, strung out along the rivers and along the few land transportation lines, effectively occupies only a small part of the total land area, and the government perceives Amazonia as one of the few remaining empty areas in the world having a settlement potential for large numbers of people. It would like to see rapid settlement of the region in order to enhance the country’s overall economic growth; absorb much of the excess population of the troubled, adjacent Northeastern Region; afford security advantages in having its remote frontiers more accessible; and symbolize Brazil’s coming of age and achieving its manifest destiny.

3. Amazonia, like Texas, is a name that evokes superlatives—both positive and negative. Much of Amazonia remains unexplored, and knowledge of many aspects of its environment is minimal. A systematic resource survey, based on airborne radar imagery, is underway and, hopefully, will provide much of the information needed to identify and indicate the magnitude of the resource base and to plan for its rational development. In the meantime many misconceptions persist in the public mind regarding this land with its great expanses of rain forest, its tremendous rivers, and its equatorial climate. Publicity relating to the development program has focused

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national attention on the region and prompted some extravagant claims for the development potential as well as exaggerated warnings of the ecological dangers inherent in developing the region.

4. The extreme optimists envisage the future Amazonia as a vast tropical breadbasket that will feed the hungry people of the world. The extreme pessimists warn that cutting the rain forests will completely alter the ecological balance and bring on desert-like conditions. The most likely prospect lies somewhere between these extremes. At best, the program will develop selected areas of Amazonia to full participation in the national economy and, by increased accessibility, may break the near-feudal control exercised by a small group of landowners and entrepreneurs over forest workers in the interior. At worst, it will transplant an uneconomic system of subsistence agriculture from a poverty scene in the dry Northeast to a new poverty scene in superhumid Amazonia and initiate a gradual degradation of the physical environment in the affected areas.

**THE ENVIRONMENT**

5. In terms of human settlement and land use two distinct habitats occur in Amazonia—the dry land (*terra firme*) and the land subject to periodic flooding (*varzea*). The latter includes the broad flood plains that extend along the Amazon River and the lower courses of its principal tributaries (see fold-out map at end of report). It becomes essentially a water landscape at the height of the rainy season and appears an unlikely site for population concentration; yet much of the present human activity of the region focuses on this zone. The settlements and habitations are located on the natural levees of the rivers, on stilts on lower ground, and on *terra firme* adjacent to the flood plains. Economic activities have a seasonal rhythm, attuned to the rise and fall of the rivers (Figure 1). During the low water period jute and various food crops are grown on cleared areas of the flood plains (Figure 2), cattle are grazed on natural grassland, and products are extracted from the forests. The rivers are the principal arteries of movement and commerce (Figure 3), and the significant commercial and administrative centers for the region are all river ports. Of these, only Belem can be described as a modern urban center. Manaus is rapidly urbanizing (Figure 4), however, under the stimulus of a free zone in which duty-free trade and tax-free industrial production are authorized.

6. The sparsely populated *terra firme* comprises the bulk of Amazonia.<sup>1</sup> This land, which rises in successive steps to the north and south of the *varzea*, includes the extensive Amazon Plain, massive steep-sided tablelands at the highest level, and various flat to hilly plateaus at intermediate levels. A dense network of river valleys cuts across all levels, fragmenting the land. The pronounced surface irregularities tend to be hidden by the dense forest mantle that covers more than half the area and constitutes the world's largest tropical timber reserve. The heterogeneity of the forest

<sup>1</sup>In this report the term *Amazonia* is applied broadly to the area encompassed by the Amazon hydrographic basin. Within Brazil a small region is designated the *Northern Region* for statistical reporting and consists of the states of Acre, Amazonas, and Para, and the territories of Amapa, Rondonia, and Roraima. Another region, *Legal Amazonia*, was established for planning and development purposes and includes the *Northern Region* plus parts of the states of Goias, Maranhao, and Mato Grosso that extend outside the Amazon Basin into the adjacent Northeastern and Central-West physiographic regions.

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FIGURE 1. At high water stage fodder for cattle is cut and brought to corrals by boat.



FIGURE 2. Jute harvesting in the varzea.

FIGURE 3. River boats loaded with forest products.



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FIGURE 4. New housing project at Manaus.

stands makes them difficult to log on an intensive commercial basis, but considerable progress has been made during the last decade in introducing large-scale logging operations for lumber and veneers. Much more widespread are the traditional seasonal forest activities of extracting rubber and Brazil nuts, supplemented by slash-and-burn subsistence agriculture.

7. Commercial agriculture is concentrated primarily in the area tributary to Belem, where black pepper and malva (a hardy fiber plant) are grown for the national and foreign markets, and food crops are raised for the local urban market. The natural fertility of the *terra firme* soils is generally low, and the meager nutrient reserves are quickly depleted under traditional methods of cultivation. Only high value crops, such as black pepper, can absorb the high cost of artificial fertilizing and be marketed profitably (Figure 5). Japanese colonists pioneered the successful cultivation of pepper in the area and introduced intensive farming methods.

8. Planted pastures have proved better adapted to present capabilities and needs, and cattle ranching is undergoing rapid expansion, particularly along the Belem-Brasilia Highway. The impact of the highway on the area has been great, triggering a spontaneous influx of settlers eager for farm land or to participate in the services sector.

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FIGURE 5. Black pepper field on the *terra firme*.



FIGURE 6. Tin mining dredge in Rondonia.

9. The *terra firme* is rich in mineral resources. Manganese and cassiterite (tin ore) are mined commercially in Amapa and Rondonia, respectively (Figure 6). Bauxite deposits are being developed in northern Para and very extensive high-grade iron deposits in southern Para. Large numbers of prospectors ascend the rivers seasonally to work alluvial sands for gold and diamonds (Figure 7).

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**FIGURE 7.** Primitive sluicing operation for washing gold-bearing alluvial sands.

10. The rapidly growing population of Amazonia exhibits a high proportion of young people—more than half of the population is less than 18 years old. The general level of literacy and technical skills is low, and the incidence of infectious diseases and dietary deficiencies is high. Thus, in addition to the need for a basic economic infrastructure, there is a critical need for educational and health facilities. The great distances over which the population is spread and the gaps in knowledge of tropical diseases add to the magnitude of the problem.

#### **THE DEVELOPMENT PROGRAM**

##### **Scope and Goals**

11. In June 1970, the government of Brazil announced a National Integration Program (NIP) to finance infrastructure projects in Amazonia and the Northeast and to promote the rapid integration of these regions with the national economy during the years 1971-1974. Major goals are to facilitate colonization of the Amazon Basin and, at

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the same time, relieve population pressure in the drought-plagued Northeast—a perennial problem area. Previous colonization projects have been low-priority piecemeal efforts, and the government now proposes a high-priority integrated program. The NIP capitalizes on the dramatic success of the Belem–Brasilia Highway in stimulating settlement and trade in eastern Amazonia, but attempts to avoid the chaotic situation resulting from spontaneous settlement along the route. It couples the construction of major penetration roads with controlled colonization of the land along the routes. Its stated goal is to implant a viable agriculture-based society in the colonized areas.

12. The planned road network, a colossal 9,000 miles in extent, includes as key elements the east-west Transamazonian Highway and the north-south Cuiaba–Santarem Highway (Figure 8). The former will extend from the Northeastern seaports of Recife and Joao Pessoa westward across both the dry Northeastern interior and the Amazon rain forest to the western frontier with Peru. The route incorporates some existing highway segments within the Northeastern Region. The second trunk highway links Santarem, a significant Amazon river port, with Cuiaba, the capital of Mato Grosso state. Other roads will extend from these trunk highways to the borders of neighboring countries along the periphery of the Amazon Basin. The highway network is intended to open vast areas to settlement and trade, link them to established road networks in the east and south, and supplement the Amazon network of natural waterways. River port facilities will be improved at key connecting points, and a tug and barge fleet developed. Construction of the Transamazonian Highway is being handled by private firms under contract to the Ministry of Transportation, with the stipulation that unemployed Northeastern laborers be hired for the road crews. The Cuiaba–Santarem Highway is being constructed by construction battalions of the Brazilian Army Engineers under Ministry of Transportation coordination—as were the earlier Belem–Brasilia and Cuiaba–Porto Velho highways.

13. To expedite colonization of Amazonia the government authorized expropriation of one large block of land, the Transamazonian Polygon, in central Para state, plus strips of land 60 miles wide along either side of the planned federal highways. In the absence of accurate land surveys, estimates of the total land area affected vary considerably, but a rough approximation is one-fourth of Brazil's territory.

14. The National Colonization and Agrarian Reform Agency (INCRA), Ministry of Agriculture, has been given the task of selecting, moving, and establishing 100,000 families (500,000 persons) on homestead plots along the highway axes within five years (i.e., by June 1975). As sections of highway are completed INCRA begins parcelling out homestead sites on the bordering strips of land—initially within six miles of the road. The initial zone of settlement is between Maraba and Itaituba along the Transamazonian Highway. The colonists are settled in farm villages, *agrovilas*, spaced three to six miles apart (Figure 9). INCRA provides each family a small wooden house (Figure 10) and provisional title to a 250-acre plot near the village. Five acres of land are cleared for each farmer (Figure 11), and he is given seeds, tools, and technical orientation, enabling him to plant a first subsistence crop. He is also paid a minimum salary for five months. At the end of this period he is essentially on his own, although he is guaranteed minimum crop prices for two years. His provisional land title permits

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FIGURE 8. President Medici and Transportation Minister Andreazza at the inauguration of a segment of the Transamazonian Highway.

him to borrow up to \$2,250 for clearing more land and buying tools and seeds. Indirect support is provided the colonists in the form of schools, technical assistance, and medical and dental care.

15. Each *agrovila*, consisting of about 50 family dwellings, is to have a few basic services, such as an elementary school, church, dispensary or pharmacy, butcher shop, general store, and grain warehouse. For each group of 20 *agrovilas* a larger center, an *agropolis*, would provide additional services, such as a health clinic, saw mill, bank, warehouses, and stores. A still larger center, the *ruropolis*, would serve clusters of three or four *agropoles*. Each *ruropolis* would have such services as an agricultural coop-

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FIGURE 9. One of the first *agrovilas* constructed within the Transamazonian Polygon.

erative, storage silos, an agricultural extension station, intermediate-level schools, hospitals, banks, an airport, and light industry. The highway construction support bases would serve as the nuclei for developing the *ruropoles*. The construction companies are obligated to turn over these encampments with supporting infrastructure to INCRA as the road sections are completed. The first *ruropoles* to be established are Altamira, Maraba, Itaituba, and Santarem.

16. Some of the road sections and the adjacent lands earmarked for colonization are in areas traditionally occupied by semi-nomadic tribes of forest Indians. From past experience the government is aware that bloody encounters occasionally erupt when whites penetrate tribal lands. To forestall such encounters the government has adopted

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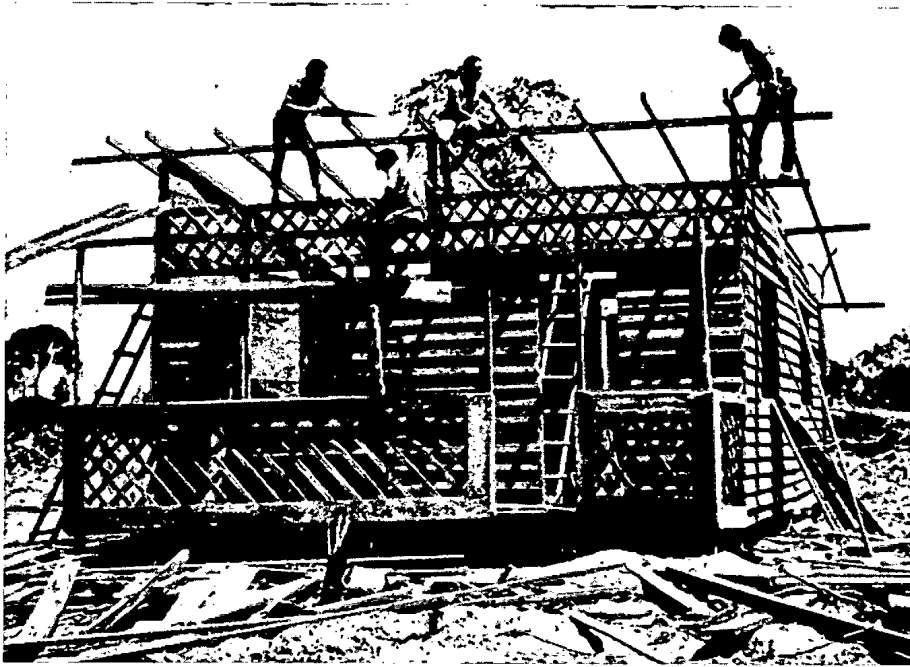


FIGURE 10.- Lumber from local forests is used in constructing the small houses for colonists.

a plan of pacification and resettlement. The National Indian Foundation (FUNAI) is establishing 15 Indian posts along the route of the Transamazonian Highway from which pacification teams will be sent out to contact isolated tribes in advance of construction work. The teams will attempt to prepare the Indians for contact with the whites through a program of medical, technical, and economic assistance. The overall goal is the gradual acculturation and integration of the tribes into the national community. In order to ease the transition several large forested areas have been set aside as reservations for the voluntary resettlement of pacified tribes. Within the framework of their own tribal institutions and customs they may practice traditional activities in a familiar forest environment. FUNAI teams will introduce new concepts and techniques by demonstration and example. Hopefully the reservations will serve as showcases to attract additional tribes to resettle. Somewhat similar, but smaller scale, efforts to resettle and acculturate Indian tribes have been undertaken by various missionary groups (Figure 12).

17. Other projects officially included within the National Integration Program are Project Radam and the Curua-Una Hydroelectric Project. The former is an aerial survey of the region using side-looking radar that can penetrate the cloud cover that blankets parts of the area throughout the year. Some 520,000 square miles will be surveyed for purposes of analyzing the resource base and preparing base maps for use in planning settlement areas, land use, areas favorable to mining, new roads, and other elements of infrastructure. The Carua-Una hydroelectric powerplant, located near

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FIGURE 11. Five acres of the 250-acre homestead tracts are cleared immediately to plant a subsistence crop.

Santarem, is scheduled for completion in 1973. With an initial installed capacity of 20,000 kilowatts, it will serve the area of the Transamazonian and Cuiaba-Santarem highways.

18. The National Integration Program is funded by an allocation of 30 percent of the money deposited under the "fiscal incentives" program. Established in 1966, this program permits Brazilian firms to deposit up to 50 percent of their income tax each year for investment in government-approved development projects in *Legal Amazonia* and the Northeast. Investments may be made in industrial, livestock raising,

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FIGURE 12. Xavante Indians learning new agricultural techniques at the Sao Marcos mission in Mato Grosso.

agricultural, or basic service projects. The main emphasis has been placed on the development of industry, particularly within the Northeast. The Superintendency for the Development of Amazonia (SUDAM) administers the program in Amazonia, and the Superintendency for the Development of the Northeast (SUDENE) handles the program in the Northeast. SUDAM has helped establish a variety of small industries in Belem and Manaus; programmed intensive geological and mineralogical investigations for mining development; fostered agricultural research; and, as of December 1971, had approved a total of more than 250 cattle ranching projects. Most of the large cattle ranches are located in southern Para and in northern Goias and Mato Grosso on land accessible from the Belem-Brasilia and Cuiaba-Porto Velho highways.

19. In July 1971 the government announced a new agricultural development program, PROTERRA, to complement the NIP. Entitled "Program of Redistribution of Land and Stimulation of Agriculture in the North and Northeast," it is to be funded

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by an allocation of 20 percent of the "fiscal incentives" program deposits for the period 1972 to 1976. This allocation, together with the 30 percent allocation for the NIP, leaves SUDAM and SUDENE with freedom of choice in the use of only 50 percent of the deposits originally authorized for investment projects. PROTERRA authorizes cash payments for expropriation and distribution of land in the social interest. According to the initial statement the resources can be used to buy lands, lend land-purchase funds to small and medium farmers, finance agro-industry, subsidize agricultural production, expand agricultural research, and improve the marketing infrastructure; however, aspects of how the program is to be structured and implemented have yet to be worked out.

### Program Implementation and Environmental Problems

#### *Highways through the rain forest—much more than just clearing the right-of-way*

20. Highway construction is progressing nearly on schedule. Heavy equipment becomes immobilized during the height of the rainy season, and, therefore, road crews work around the clock during the dry season<sup>2</sup> in order to meet deadlines (Figure 13). Engineering studies were not made prior to starting road construction. As forest clearing progressed, the terrain was revealed to be more rugged than had been anticipated (Figure 14). The additional cuts and fills required, plus the need for raised roadbeds in the extensive areas with poor drainage (Figure 15), will probably lead to a significant increase in construction costs over original estimates. Herculean efforts have been required to meet logistical support requirements on a continuing basis. Heavy equipment and construction supplies are brought to the main support bases by river boat from Belem. Unfortunately, the best period for navigation coincides with the rainy season when construction work is at a near standstill. Conversely, road construction progresses most rapidly during the dry season, when the water level on the rivers is low and navigation is hampered by innumerable sand bars.

21. Another logistical problem is that of providing support for small advance teams that range ahead of the main work fronts clearing the forest cover from the roadway. This support is provided in large part by airdrops from light airplanes. Road crews continually face the discomforts of myriads of stinging insects and conditions of high daytime temperatures, high relative humidity, and sudden downpours. They also suffer from frequent bouts of malaria and dysentery. Nevertheless, work schedules are being maintained, and the Ministry of Transportation has amply demonstrated its technical competence to construct highways through areas of rain forest.

22. Initially most of the roads will have a gravel surface, temporary wooden bridges over the smaller streams, and ferries on the larger rivers. The Manaus-Porto Velho Highway will be paved at the outset, and paving is in progress along the older Belem-Brasilia Highway (Figure 16). If the intensity of traffic generated by the roads is sufficient to warrant improvements in design standards, all or segments of the other roads will be paved, and permanent bridge structures will be added. Meanwhile, the task of maintaining such an extensive network of unpaved roads against the ravages of the rainy seasons is likely to be formidable and costly.

<sup>2</sup>The dry season, a relative term, is the less rainy period extending from late May through September.

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FIGURE 13. Heavy construction equipment must be used to capacity during the less rainy period when the heavy red clay soils are more manageable.

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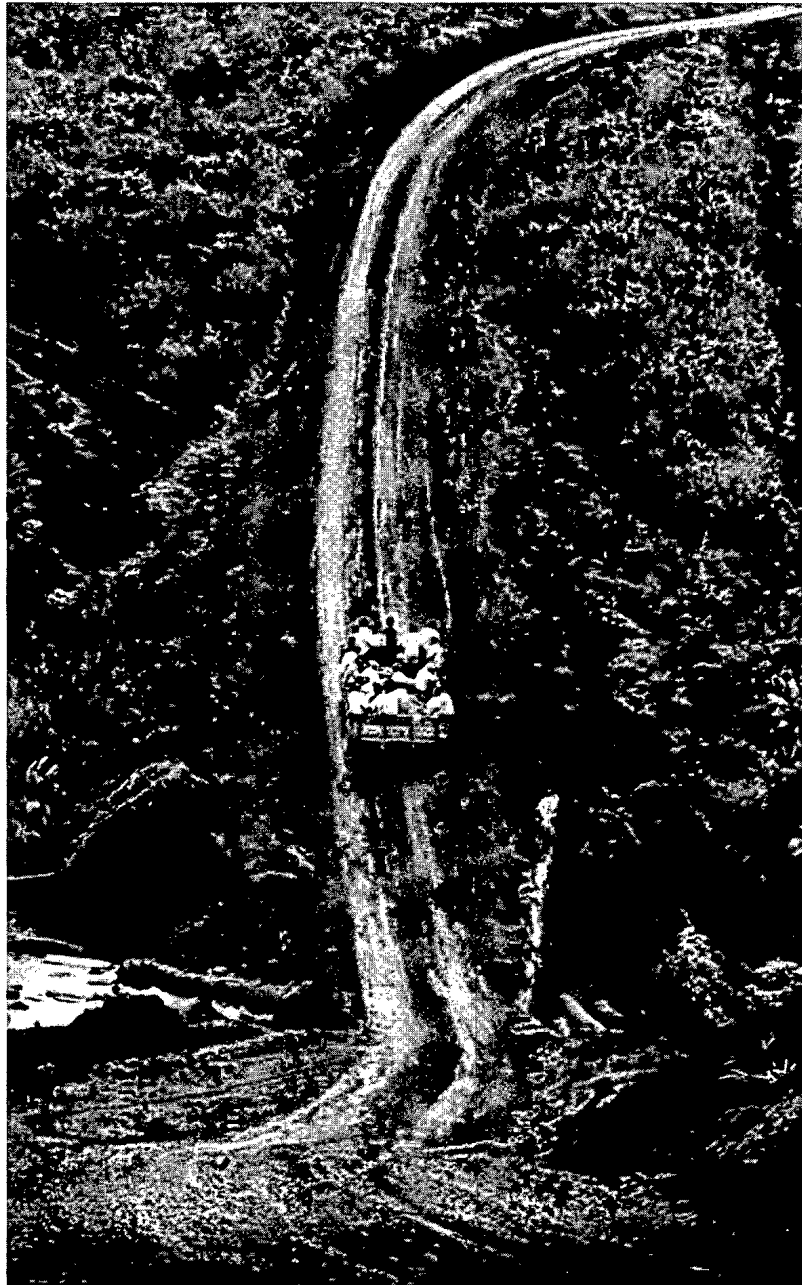


FIGURE 14. A truck transports colonists along a hilly section of the Transamazonian Highway.

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FIGURE 15. Surface drainage has been a particularly difficult engineering problem in constructing the Manaus-Porto Velho Highway.

23. The government has been sharply criticized for not making economic feasibility studies of the roads before authorizing their construction. Critics point out that the east-west Transamazonian Highway will link the impoverished Northeast to the undeveloped interior of Amazonia, and will have little basis for generating traffic. It will be in no way comparable to the north-south Belem-Brasilia Highway that linked undeveloped Amazonia with the highly developed and industrialized Southeastern Region, thus generating trade, traffic, and settlement along the route. The government takes the position that the individual roads of the planned network are not justified on the basis of direct benefits to road users. Rather, justification is seen in terms of the overall economic, social, and political benefits that will accrue to the country from colonizing the area and achieving a more balanced regional growth. The Transamazonian Highway, in particular, is intended to stimulate and support settlement movement from the Northeast to Amazonia; to supplement the natural waterway system of the Amazon Basin; and to provide an outlet for the products of the region. In the latter function, it may serve less as an east-west trunk road than as a feeder road for the north-south trunk roads and waterways.

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FIGURE 16. Truck traffic on the lengthy unpaved part of the Belem-Brasilia Highway must cope with mud and washouts in the rainy season and dust in the dry season.

*Agricultural Colonization—altering a fragile ecosystem*

24. If the government's ability to construct highways has been demonstrated, its ability to successfully carry out an ambitious colonization effort is yet to be proved. A high degree of coordination between ministries will be required, and sufficient economic and technological assistance must be provided the colonists to insure their advancement beyond the stage of mere subsistence agriculture.

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25. The tropical rain forest appears as the expression of a rich environment, but it flourishes on the basis of a fragile ecological balance—a continuous recycling of nutrients.<sup>3</sup> When the forest is cut, the nutrient cycle is broken, and only a minimal nutrient reserve remains in the soil. Under traditional slash-and-burn agricultural practices, the felled trees are burned on the ground, releasing the plant nutrients in a soluble form in the ash. Crops are then planted by hand among the charred logs, utilizing the ash as fertilizer. Good yields are obtained the first year or two, fed by the available ash and the small soil reserve of nutrients; but heavy rains leach away soluble materials from the ash, and a net loss of nutrients occurs at each harvest.

26. On the *varzea* this nutrient loss is replenished by the annual deposition of silt. On the *terra firme*, however, the fertility normally is not restored by natural means, and chemical fertilizers are not commonly used. They are costly to apply, and the artificial mineral salts are rapidly leached from the soil unless applied scientifically. With neither natural nor artificial replenishment, the soil fertility and crop yields continue to diminish until the subsistence farmer abandons the depleted land to natural regrowth and then repeats the sequence on new land.

27. Two categories of *terra firme* soils are exceptional in having a renewal of mineral nutrients in the subsoil due to active weathering of mineral-rich parent rock at shallow depths. These soils—*terra roxa* and red-yellow podzolic soils—are confined to hilly sections of the intermediate plateaus underlain by crystalline rock. They have not been accurately mapped as yet, and their areal extent has not been established. A broad belt of *terra roxa* has been identified in the Transamazonian Polygon, between Altamira and Itaituba, and settlement priority has been given to this area. These soils have a good potential for traditional (low-capitalization) agriculture.

28. Colonists are urged to plant short-cycle food crops (beans, corn, manioc, rice, and bananas) as subsistence crops and longer cycle, deep-rooted crops or tree crops (pepper, sugarcane, coffee, cacao, guarana, oil palm, cashews, and rubber) as cash crops. The soils are generally unsuited to the methods of mechanized row-crop cultivation common in temperate zones. These methods generally require baring the ground and deep plowing, which would subject tropical soils to intense leaching and erosion (Figure 17). The use of minimum tillage methods, however, may make the future introduction of mechanized agriculture feasible in Amazonia on selected land of flat to moderate relief.

29. Although INCRA attempts to select colonists with farm experience, personal initiative, and a reputation for hard work, the adequacy of the technical guidance provided the colonists may well spell the success or failure of the settlement program. Whether from the Northeast or the South, the colonists are unused to the Amazonian environment and must be taught how to cope with an excess of water, unknown plant diseases and pests, different planting/harvesting schedules, and modern land

<sup>3</sup>The vegetation assimilates nutrients from the soil; plant offal (dead leaves, twigs, fruit, branches) falls to the ground; and bacteria rapidly decompose the organic matter releasing the mineral nutrients and returning them to the soil. Only slight nutrient losses occur in the cycle, and they are covered by nutrients contained in rain water and by nutrient reserves in the soil.

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FIGURE 17. Bare ground quickly erodes under the powerful onslaught of tropical downpours.

management techniques adapted to the region. Traditional slash-and-burn agriculture is ingrained in the rural *Nordestino* as part of his cultural heritage, and his ways may be difficult to change unless agricultural extension assistance is provided over an extended period. INCRA officials are conducting initial technical orientation, and

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agricultural extension facilities are planned for the larger centers. Critics have questioned the capability of the Ministry of Agriculture to man and support a wide network of extension service posts on a continuing basis.

***Cattle Ranching—transforming rain forest to planted pastures***

30. Cattle ranching is being promoted through SUDAM as a feasible alternative to intensive cultivation in Amazonia. Pasture grasses do well on the red-yellow podzolic soils and protect the soils from both erosion and laterization processes. Abundant rainfall insures pasturage throughout the year and eliminates the need for confinement feeding or supplemental feeding common to other regions. The pasture grasses are shallow rooted and will gradually deplete the soils after the first three or four years, and fertilizers will be needed. The SUDAM program does foster enlightened management practices, such as pasture rotation and use of soil correctives. Critics warn, however, that artificial fertilization of large pasture acreages may be uneconomic. They predict that investors under the "fiscal incentives" program will be tempted to take their short-term profits while the pasturage is good and then abandon the land when the fertility declines. They point to the history of large-scale abandonment of old land for new in Sao Paulo State as a case in point. If large acreages of land in Amazonia are cleared for pasture and later abandoned to natural regeneration, a rain forest vegetation will not be restored. Lacking a nearby natural source of seeds and wild life to disseminate them, a biologically less productive type of vegetation will develop—most likely a woodland savanna.

31. Such large-scale ranching ventures as the fazenda being developed by the King Ranch-Swift-Armour consortium in Para are certainly conceived as long-term operations. Heavy capital investments are being made to knock down forests, develop pastures, bring in legumes, build an extensive infrastructure, and develop improved breeding stock adapted to the ecological conditions. Planners for the consortium consider that the location of the Amazon Basin close to North American and European markets will give it a competitive advantage vis-a-vis producers in Australia, Argentina, and even southern Brazil. The capability of controlling the spread of disease and pests is an unknown factor in developing planted pastures in the tropics. Disease vectors are numerous, and diseases have caused great damage to other monocultures, such as rubber plantations, and, to a lesser extent, pepper plantings. The very heterogeneity of the rain forests appears to act as a mechanism to hold disease and pest organisms in check within the stands. No comparable natural check is present in homogeneous stands.

***Forestry—introduction of exotic trees and controlled exploitation of the natural forest***

32. The potential problem of disease has not deterred an experimental undertaking to develop the largest planted forest in the world on the extensive D. K. Ludwig holdings in Para and Amapa states. Thousands of acres of rain forest have been leveled and replanted with 17 million *Gmelina arborea* seedlings—a fast-growing south Asian tree that is an excellent source of paper pulp. One hundred million new trees are projected by 1980 in anticipation of a world shortage of cellulose for paper.

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33. Several large-scale lumbering operations are underway in the natural rain forest despite the problems of wide dispersion of commercial timber species and the high specific gravity of some species. Logs with high specific gravity are impossible to float downriver by normal means and are difficult to mill. With encouragement from SUDAM and UN/FAO, the lumbering operations are being expanded to include the production of hardwood veneers and plywood.

34. Ecologists have become concerned at the unprecedented rate of cutting of Amazonian forests in recent years for timber and to establish agricultural settlements and cattle ranches. They fear that without adequate controls, widespread destruction of the forests will lead to a general degradation of the environment (Figure 18). The forest vegetation has a direct effect upon the water balance through the processes of absorption and transpiration. Removal of the forest cover tends to decrease atmospheric humidity and greatly increases the amount and regularity of surface runoff. This, in turn, increases erosion, flooding, and silting. The tree canopy shades the forest floor, and its removal increases the soil temperature and reduces the soil moisture content proportionally. The forest also absorbs carbon dioxide from the air and, through photosynthesis, gives off oxygen. The amount of oxygen generated by the Amazon forest is sufficiently great to be significant in terms of the earth's total supply. No measure is available of the environmental effects that would result from clearing the forest from an area this large, but it would have a marked negative effect on the agricultural potential of the area through its impact on the climate, water supply, and soils.

35. The government is aware of the problem and, through SUDAM and UN/FAO, has introduced training programs in milling and forest management technology. The lumbering enterprises approved by SUDAM also employ selective cutting methods. Legislation has been passed which prohibits the cutting of more than 50 percent of the forest cover on land homesteaded under NIP or developed through the "fiscal incentives" program. It specifically forbids cutting the forest cover along river courses and on steep slopes. Furthermore, areas whose soils are unsuited to large-scale agricultural colonization are likely to remain as forest reserves.

***Indian Pacification and Resettlement—for whose good?***

36. Several forested areas have been set aside as Indian Reservations in which resettled Indians may practice traditional activities of hunting, fishing, and subsistence agriculture. The stated policy is to give the tribes permanent possession of the lands and to protect their rights to the natural resources through FUNAI supervision. The government plan to move tribes to the reservations from lands along the highway routes precipitated a storm of protest from social scientists. Calling the government policy inhuman, the critics stated that the Indians and their worldly and cultural goods were being considered as useless or harmful obstacles in the way of the progress and development of the country. The government policy was based on a need for unencumbered land on which to resettle colonists from the Northeast; a need to protect the Indians from the harmful side effects of too rapid engulfment by civilization—disease, exploitation, and cultural shock; and a need to forestall any violent confrontation between the Indians and the road crews and settlers. Each of the

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FIGURE 18. Critics of the development program warn of ecological hazards in deforestation of land for ranching and agriculture unless adequate management controls are maintained.

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pacification teams formed to contact isolated tribes includes an experienced FUNAI agent as leader, a male nurse, several workers, and several acculturated Indian interpreters from the Xingu Park. The teams are technically qualified to carry out their mission, but successful contact and pacification efforts require unlimited patience and time (Figure 19). Since road construction is geared to a timetable, and construction is progressing rapidly, time is the critical factor for the pacification teams. Despite good intentions, it seems inevitable that dislocations and some clashes will occur.

**OUTLOOK**

37. Considering the two key elements of the National Integration Program, it appears that the government has the capability to carry through construction of the planned trunk highways, but it is too early to predict whether or not it can successfully meet the goals of the directed colonization plan. The likelihood of success hinges on



FIGURE 19. The assorted gear of a pacification team is moved by boat to an isolated contact point.

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several "ifs"—if the government limits agricultural settlement to the better soils; if it commits sufficient resources for infrastructure; and if it successfully resists pressures from special interest groups to divert funds to alternative programs in other regions.

38. Given adequate funds to carry it out, the design of the colonization program is practical. The settling of colonists in *agrovilas* supported by a well-spaced network of larger centers should greatly facilitate establishing and administering public services. In contrast, many of the dozens of jerry-built localities that sprang up along the Belem-Brasilia Highway are still without basic services because of the difficulty of extending the services to small settlements spaced out over great distances. Many of these settlements developed around nuclei of a filling station, restaurant, and rooming house, and have no economic base other than service to truck drivers.

39. In a recent speech President Medici expressed his intent to begin concentrating resources on support services for the new urban centers along the Transamazonian and Cuiaba-Santarem highways in order that they become catalyzing centers for the surrounding areas. He pledged every cooperation to municipal and state governments to provide the centers with services of water, sewers, light, telephone, education, health, welfare, and security; and he appealed to the business sector to cooperate in building *agrovilas*, opening access roads, and undertaking agricultural and livestock projects. He did not, however, specify whether additional funds would be committed; nor did he indicate what additional incentives, if any, would be offered the business sector for participation.

40. The funds originally projected for the colonization part of the NIP are considered inadequate to finance such an ambitious infrastructure, and the business sector has shown little inclination to invest in *agrovilas* or to open access roads. It has invested in large-scale agricultural and livestock projects—ones that are labor extensive. The government may, of course, make an additional resource commitment, since the program has captured the public imagination and appeals to national pride much as did the construction of the national capital at Brasilia. To allow the program to fail, considering the tremendous momentum generated, could be politically imprudent.

41. The program is unlikely to have any appreciable effect on the problem of overpopulation in the Northeast. The number of laborers required for road construction is not large enough to have a measurable impact on the Northeast, and only small numbers of unemployed *Nordestinos* meet the eligibility requirements to qualify as agricultural colonists. Initially it was announced that road construction workers and their families would be the first colonists, but INCRA soon discovered that many had no farming background and few had any intention of remaining in Amazonia after completing their job. INCRA then sought to recruit literate, experienced, and progressive farmers from the Northeast, but was unable to find enough qualified applicants to fill the quotas. The search for prospective colonists was then expanded to all of Brazil, although stress was still placed on finding as many as possible in the Northeast (Figure 20).

42. Considerable publicity attended the recruitment of several groups of well-qualified farmers from Rio Grande do Sul (Figure 21). It was later reported that more

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FIGURE 20. A Nordesteño family, selected as colonists, approaches its new home in an *agrovila*.



FIGURE 21. A group of farmers from Rio Grande do Sul who chose to settle in Amazonia.

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than half returned home to Rio Grande do Sul because of difficulty in adjusting to the heat, bad food, and insects; loss of confidence in the undertaking when some of the promised assistance did not materialize; and, finally, displeasure with the policy of "integrating" the *agrovilas*, with consequent separation from friends and loss of regional identity.

43. Traditionally, *Nordestinos* have had very strong ties to family and land in the Northeast. In past efforts to induce some of them to move to rural areas in regions outside the Northeast, *Nordestinos* have tended to stay in a new location for a relatively brief period and then return to the Northeast unless they were able to transfer their entire extended family to the new location.

44. The government says that some defections are to be expected, but contends that they will be relatively few. For most colonists, hopes run high that the initial hard and precarious pioneer life will soon lead to a much better life for themselves and their children, and they intend to stick it out.

45. In the long run, the National Integration Program should pay dividends in terms of national development. The construction of the highways and the settlement of selected areas should also afford the government some of the additional security advantages that it feels essential in this region. Finally, as a symbol, the successful completion of the program would enhance national pride and increase public confidence in the government's ability to achieve its goals, and, on the international scene, it would serve as a further indicator of Brazilian strength and development capability.



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