PROFILE

Political Benefits as Barriers to Assessment of Environmental Costs in Brazil's Amazonian Development Planning: The Example of the Jatapu Dam in Roraima

PHILIP M. FEARNSIDE*
National Institute for Research in the Amazon (INPA)
Coordenadoria de Pesquisas em Ecologia (CPEC)
C.P. 478
69011-970 Manaus, Amazonas, Brazil

REINALDO IMBROZIO BARBOSA
National Institute for Research in the Amazon (INPA)
Núcleo de Pesquisas de Roraima (NPRR)
C.P. 96
69301-970 Boa Vista, Roraima, Brazil

ABSTRACT / Development projects are rapidly changing the landscape in Brazilian Amazonia. Environmental impact assessments have been required since 1986, and the regulatory system is evolving as precedents are set by each new development project. The Jatapu Dam in Roraima provides an illustration of underlying impediments to assessment of environmental costs and to due consideration being given to these assessments when decisions are made. The high priority placed on the dam by the Roraima state government is unexplainable in terms of economic returns. The place of the dam in a long-term political strategy provides the best of several possible explanations, any one of which is incompatible with a "rational" weighing of economic and environmental costs and benefits. A number of lessons can be drawn from the experience of Jatapu, but some of the problems have no solution. The barriers to rational decision making illustrated by Jatapu apply to development projects in many parts of the world.

The Japatu Dam—or, more completely, the Alto Jatapu Hydroelectric Project—became an extraordinary political priority for Ottomar de Sousa Pinto, Governor of Roraima (1991–1994). In June 1994 engineers at the dam said that he had visited the site every two weeks throughout the 26 months that the dam had been under construction at that time (April 1992–June 1994), which corresponds to over 60 visits by the time the dam was inaugurated in December 1994. Even discounting for possible exaggeration, a very unusual degree of high-level interest is evident.

Jatapu is not a major environmental disaster, like the 2360-km² Balbina Reservoir, whose upper reaches are located only 250 km south of the Jatapu Dam. It illustrates, however, fundamental problems with the environmental review process in Brazil, especially when applied to a project that is a political priority. Jatapu was not decreed by one of Brazil's military dictatorships; rather, it is a product of the way democracy works in the present context. That the results are not always what might be best in terms of social and environmental considerations may provide indications of ways in which the decision-making process could be improved.

KEY WORDS: Jatapu Dam; Amazonia; Dams; Hydroelectric development; Brazil; Tropical forest; Environmental impact assessment

*Author to whom correspondence should be addressed.

Role of Politics in Development Decisions

Politics versus Economic "Rationality"

The course of events in the development of Amazonia often appears baffling when viewed from the perspective of what would be economically rational, either narrowly defined in terms of monetary returns or more broadly to include environmental and social impacts. What leads to a given development project taking on a high priority is often best understood in terms of the political benefits to the actors involved in promoting it. The balance between different types of costs and benefits must be examined if one is to understand how development projects really come to be, and how the decision-making process might be changed so that environmental and social problems are less frequent.

Figure 1. Brazil's Legal Amazon region.

Traditional benefit–cost analysis misses the mark in identifying what projects are most likely to be carried forward and to what extent environmental controls will be bypassed or simply ignored. High-priority projects gain a strength of their own, rendering any pretense of environmental assessment a mere formality on the way to completing the project. The Balbina Dam provides an example of the irreversible nature of projects once this process has been initiated (Fearnside 1989). Environmental studies of proposed Amazonian development projects almost never serve as a source of information to be considered in deciding whether the project should be undertaken (Fearnside 1986).

A Capsule Summary of Roraima Politics

Roraima is a state created by Brazil's October 1988 constitution from the formal Federal Territory of Roraima (known as the Federal Territory of Rio Branco from 1943 to 1962). From 1964 until 1985, when each recently created state was still a territory, Roraima was traditionally governed by the Brazilian Air Force, while Amapá was governed by the Navy, and Rondônia by the Army. Roraima is a 224,131-km² area in the extreme north of Brazil, bordering on Venezuela and Guyana (Figure 1). Its population at the 1991 census was 215,950, and its 1993 population was estimated to be 228,479 (Brazil IBGE 1993). Although small in absolute terms, in percentage terms Roraima has the fastest growing population in Brazil (9.5%/yr over the 1980–1991 period) and the highest proportional increase in deforestation rate (1990–1991 rate increased by 161% over the 1989–1990 rate) (Fearnside 1993, p. 542). Roraima's phenomenal population growth is mainly due to the state's gold rush and land rush, rather than reproduction.

Politics in Roraima largely revolves around a continuing struggle between two men: Ottomar de Sousa Pinto (known as Ottomar) and Romero Jucá Filho (known at Jucá). Ottomar is a former brigadier (the highest rank in the Brazilian Air Force) who served as governor from 1979 to 1983 (appointed by the military President João Figueiredo) and who was elected governor for the 1991–1994 period. Jucá was appointed governor for the 1988–1990 period after being removed from his former post as head of the National Indian Foundation (FUNAI) for having authorized FUNAI to serve as an intermediary in the illegal sale of timber from Indian lands.[1]

During the 1990 election campaign, Ottomar promised to bring 50,000 families of settlers to Roraima from other parts of Brazil, thereby more than doubling the population of the state.[2] Roraima's high deforestation rate is largely due to the past success of this strategy. Grateful colonists brought from other parts of Brazil make government settlement projects into "electoral corrals" whose votes are sufficient, in relation to Roraima's small population, to influence the outcome of elections (*Folha de São Paulo* 1994). Ottomar, who either founded or greatly expanded most of the state's colonization areas during his first term as governor (Freitas 1993, p. 199), enjoys the support of small farmers in the interior. From 1990 onwards Ottomar was also supported by large mining companies, while Jucá was supported by small goldminers (*Folha de Boa Vista* 1994a). Jucá also enjoys support of the urban population of Boa Vista, the state capital (1993 population estimate of the *município* (county) was 151,439; Brazil IBGE 1993). Large ranchers and loggers are divided between the two camps.

As a new state, Roraima enjoyed a honeymoon period

[1]For example, *Contrato Particular de Alienacão de Madeira* 008/86 between FUNAI and Madeireira Noroeste Ltda. Both Jucá and Ottomar have strong anti-environment stances. Jucá is best known for his efforts to obstruct the creation and demarcation of the Yanomami Indian reserve (Albert 1992, Moreira 1989) and for encouraging small goldminers (*garimpeiros*) to illegally invade the Yanomami area (Monbiot 1991, p. 126; Queiroz 1990; *Amazonas em Tempo* 1989). Diseases spread by the goldminers, in addition to a much smaller number of direct killings, resulted in an estimated 2017 deaths over the 1987–1993 period (Pellegrini and Magalhães 1994, see also *Veja* 1990). The Yanomami population at the beginning of this period was approximately 10,000 (Carlo Zaquini personal communication 1993), indicating that about 20% of the tribe perished over the six-year period.

[2]Recording of "Debate dos Candidatos a Governador/1990." Sindicato dos Trabalhadores em Educacão de Roraima-SINTER 22 September 1990; Barbosa (1994).

from 1988–1990, during which it received virtually all of its funds as constitutionally mandated transfers of federal monies (Federal Constitution, Transitory Dispositions, Article 14, Paragraph 4, Incision I). Following this period, the state government continues to receive a substantial part of its money through various kinds of transfers of federal funds. Since these transfers are not entirely based on population, Roraima receives proportionally more than other states. In Roraima's 1994 budget, 65.3% of the total came from federal transfers (Roraima 1993a; pp. 3–4). These funds usually appear in the state's annual budget under general categories (such as public works), but not for specific projects like Jatapu. The state's executive branch receives funds directly from the national treasury (rather than through the federal ministries), since these transfers are stipulated in Brazil's 1988 Federal Constitution (Article 159). In addition to these transfers, other funds are given directly to each state's executive branch through the various federal ministries; these funds, which have no specific destination in the federal budget, are often released on the bases of electoral advantages (Bonassa 1994).[3]

Jatapu Dam

The Jatapu Dam is located on the upper Jatapu River in the southeastern corner of the state of Roraima (Figure 2). The dam began to fill in April 1994. Power generation was expected to begin in June 1994, but due to a series of delays, it only began on 20 December 1994 when the dam was inaugurated with only one 2.5-MW turbine functioning, 11 days before the end of Ottomar's term in office. The second turbine was installed in March 1995; the dam will operate with two turbines (5-MW installed capacity) until power demand rises sufficiently to justify buying and installing the final two turbines (slots for the third and fourth turbines and for their intakes are included in the present structure). The government of Roraima expects completion of the dam's 10-MW nominal capacity to occur in 1999, five years after the first phase is on line. Demand in the area to be served is currently less than 1 MW.[4] The dam was built by Paranapanema Mineração, Indústria e Comércio, Ltda., for Energy Company of Roraima (CER), the state government's electrical company; the work was overseen by the Development Company of Roraima (CODESAIMA), a state government agency. Table 1 provides technical information on the dam.

The dam consists of a main barrage and six dikes, connecting a series of hills. The spillway is located on one of the dikes, and the power house on another (Figure 3). The spillway is in a zigzag labyrinth configuration to economize rock. The dam has no flood gates; the water overflows the spillway automatically when it reaches 116 m above mean sea level (originally planned to be 115 m).

The filling of the dam took only 45 days, as this was done at the beginning of the rainy season (one month later than scheduled). During construction, the river flow passed through two galleries, or passages, under the main dam located near the former channel of the river. These together could pass water at a maximum rate of 210 m^3/sec (CODESAIMA 1991, Chapter 2, p. 4). The capacity of the galleries was designed to accommodate the maximum flow expected in the dry season with a recurrence interval of once in five years (CODESAIMA 1991, Chapter 7, p. 6). In the rainy season, the maximum flow expected on average each year is 237.7 m^3/sec (Table 1), therefore exceeding the capacity of the two galleries together and greatly exceeding the capacity of one gallery. The deadline for completing the barrage, dikes, and spillway was therefore set by the annual cycle of seasons in Roraima, where the rains begin in April–May and peak in June–July. Given the frequency of bureaucratic delays in Brazil, some risk was involved. The reservoir was also bound to fill independent of human control, regardless of the approval status of the dam's various licenses. The design of the galleries to accommodate only the dry season streamflow indicated that the environmental review and licensing procedure, conducted after the progress of construction had made filling inevitable, was merely a sham.

The dam began to fill with the onset of the rains, despite the sluice gates of the galleries being open. At this point one of the galleries became obstructed. One employee identified the problem as a wooden shed that was swept into the mouth of the gallery, together with a log braced across the entrance. The resident engineer, however, said he did not know what obstructed the gallery. The reservoir filled and overflowed the spillway before expected. The spillway itself was completed, but the stone riprap along the overflow canal was incomplete except for the first few meters. The edges of the canal were therefore eroded, with landslides evident below the outflow. Had both galleries been obstructed,

[3] A significant part of the money spent by the executive branch of the Roraima state government in both the Jucá and Ottomar administrations was for projects designed to please voters rather than to give the state a sustainable economic base. For example, from 1992 to 1994, eight swimming pool complexes were built, complete with spouting concrete clowns and porpoises, and free bikinis and bathing suits were distributed to the population in the towns selected.

[4] Paulo Sérgio Lemos Latgé, president of CER, claims that demand in the area rose from 0.7 MW at the beginning of 1994 to 1.3 MW as of January 1995 (personal communication 1995).

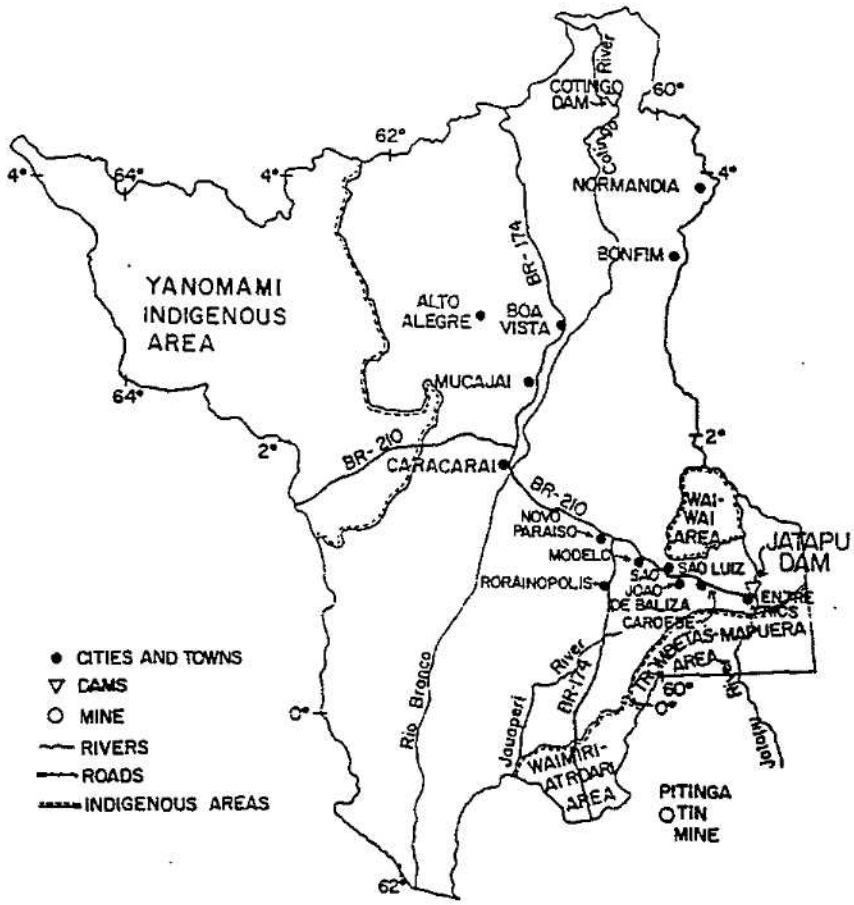

Figure 2. Roraima and the location of the Jatapu Dam.

or had the spillway itself not been completed, problems could obviously have been much more severe.

Information on the area flooded by the dam is sharply conflicting. The figure cited in technical documents is 15 km² (1500 ha) at the originally planned maximum normal operating level of 115 m above mean sea level (CODESAIMA 1991, Chapter 2, p. 4). The 15-km² figure is also given by the president of CER (Paulo Sérgio Lemos Latgé, personal communication 1995). The resident engineer, however, gives a figure of 30 km², based on a map made from aerial photographs shortly before filling the dam (Augusto Alberto Iglésias personal communication 1994). He also gives the normal operating level as 116 m, rather than the 115 m that appears in the viability study and environmental reports. Several adjustments were made in the topographic estimates during the construction process, resulting in elimination of one unnecessary dike and addition of height to one of the other dikes. Topography based on aerial photographs has the disadvantage of not being able to detect the ground level under the trees, being based instead on the crowns of the trees that can easily vary in height by several meters. A 1994 fax from the INTERTECHNE consulting firm to CER gives an area of 38 km² at an elevation of 116 m.[3] The 38-km² final area is 153% greater than the initially estimated 15 km²; if this figure is correct it represents a new Brazilian record for area underestimation. It is worth

[3]Information on the area of the reservoir is conflicting. Paulo Sérgio Lemos Latgé, president of CER, gives the following figures (personal communication 1995): at an elevation of 115 m the area of reservoir would be 15 km²; at an elevation of 120.5 m the area would be 32 km² and at 118 m the area would be 26 km². The reservoir and powerhouse could operate normally up to an elevation of 118 m. The minimum for normal operation would be 113 m.

An alternative area at elevation 120.6 m is 48 km², given in an INTERTECHNE (1994) report. This elevation is the maximum that the reservoir could reach in extreme rainfall events.

Table 1. Technical characteristics of the Jatapu Dam

	Viability study[a]	Other sources
Latitude	0°54′N	
Longitude	59°20′W	
Drainage area above dam (km²)	2950	
Mean annual precipitation (mm)	1600	
Mean monthly streamflow (m³/sec)	58.9	
Maximum mean monthly streamflow (m³/sec)	237.7	
Minimum mean monthly streamflow (m³/sec)	2.9	
5-year recurrence maximum streamflow in the dry season (capacity of galleries) (m³/sec)	210	
25-year recurrence flood streamflow (m³/sec)	770	
100-year recurrence flood streamflow (m³/sec)	1000	
1000-year recurrence flood streamflow (spillway capacity) (m³/sec)	1400	
Maximum normal operating level (normal pool level). (m above sea level)	115	116[b]
Minimum normal operating level (m above sea level)	110	
Maximum maximorum (m above sea level)	118	
Reservoir area at maximum normal operating level (ha)	1500	3800[c]
Reservoir area at minimum normal operating level (ha)	773	
Reservoir area at maximum maximorum (ha)	1930	
Reservoir total volume at maximum normal operating level (10⁶ m³)	94.4	200[d]
Live storage volume (10⁶ m³)	56.0	
Flood storage volume (10⁶ m³)	45.6	
Turbines (Francis, horizontal axis) (N, 2.5-MW capacity each)	4	
Maximum water flow per turbine (m³/sec)	11	11.3[e]
Expected useful life of reservoir (yr)	50	
Mean minimum monthly power output (MWh/mo)	1840	
Mean annual output at 5 MW installed (GWh/yr)	39.2	
Mean annual output at 10 MW installed (GWh/yr)	65.7	

[a]CODESAIMA (1991, Chapter 2, pp. 2–7).

[b]Augusto Alberto Iglésias (personal communication 1994).

[c]INTERTECHNE Consultores Associados S/C Ltda. (1994).

[d]INTERTECHNE Consultores Associados S/C Ltda. (1994), assuming normal operating level of 115 m.

[e]Plaques on turbines.

Figure 3. The Jatapu Reservoir.

noting that underestimation of areas of proposed hydroelectric reservoirs has become a pattern in Brazilian Amazonia: Tucuruí expanded by 13% from an initially esumated 2160 km² (Goodland 1980) to its current area of 2430 km² (Brazil Eletronorte nd [1987], pp. 24–25), while Balbina expanded by 90% from 1240 km² (Brazil Eletronorte/MONASA/ENGE-RIO 1976, p. B-55) to 2360 km² (Brazil Eletronorte 1987).

Considering the reservoir area to be 38 km² and the second phase capacity of 10 MW, the impoundment floods 380 ha/MW of installed capacity. This is high, even by Amazonian standards. The 250-MW Balbina Dam set the worst possible precedent by flooding 944 ha/MW of installed capacity. Considering the 5-MW capacity actually installed at Jatapu, the dam flooded 760 ha/MW, an impact per megawatt that approaches that of Balbina. The area flooded per megawatt at Jatapu is over 12 times the 62 ha/MW flooded by the 4000 MW Tucuruí Dam (this will remain about the same when the doubling of capacity contemplated for both dams is complete).

The Jatapu Reservoir could be operated at a water level 1.5 m higher than the present normal operating level without altering the power house, dam, or dikes (Augusto Alberto Iglésias personal communication 1994). The

Figure 4. One of the segments of the Jatapu Dam.

Figure 5. Tree crowns of forest flooded by the Jatapu Dam.

only change necessary would be adding height to the spillway. This could increase power output by 25%.

Further increase in output could be obtained by adding height to the dam. The dam and other structures have been built to allow future additions to their height (Augusto Alberto Iglésias personal communication 1994). The viability report extols the site's potential for future expansion (CODESAIMA 1991, Chapter 3, p. 9). If the normal operating level were raised by 5 m to 120 m above mean sea level, the same set of turbines and generators could have a maximum output of 12.7 MW (CODESAIMA 1991, Chapter 2, p. 2).

Environmental Review and Approval

No environmental impact assessment (EIA) or report on impacts on the environment (RIMA) was prepared for the Jatapu Dam. For large development projects implanted since 1986, these reports are required by Brazil's environmental legislation (Law No. 6938 of 31 August 1981, Articles 9 and 10), which is regulated by resolution 001 of 26 January 1986 of the National Council of the Environment (CONAMA). However, hydroelectric dams with installed capacity less than or equal to 10 MW are exempted (CONAMA resolution 001, Article 2, Incisions VII and XI). Jatapu, with exactly 10 MW, just escapes the EIA and RIMA.

The State Secretariat of the Environment, Interior and Justice (SEMAIJUS) is required to grant a preliminary license (LP) and an installation license (LI) before

construction can begin, and later an operating license (LO) before the dam can be filled. These decisions are to be based on an environmental control plan (PCA). As is the case with RIMAs, these plans are to be made by "qualified multidisciplinary teams" (CONAMA resolution 001 of 26 January 1986).

CODESAIMA contracted LABQUIM Estudos e Consultoria do Meio Ambiente Ltda., a consulting firm in Manaus, to produce the PCA. The firm consists of a limnologist and a secondary school graduate who acts as administrator. The technical team is described as follows in LABQUIM's PCA (CODESAIMA 1992, p. 72):

> The work was carried out by the technical and multidisciplinary team of LABQUIM-Estudos e Consultoria do Meio Ambiente Ltda., constituted of specialists in the different areas that make up the universe of a study of this nature. The specialized studies were coordinated by Dr. Antônio dos Santos, Technical Director, with the purpose of integrating the different areas involved

Antônio dos Santos (the limnologist), the only person from LABQUIM to visit the site, spent less than 24 h at Jatapu according to the CER geologist who accompanied him (Edimar Figueiredo Vasconcelos personal communications 1993, 1995). No collections were made. Even indirect information often included in such reports, such as interviews with local residents, was not gathered (Edimar Figueiredo Vasconcelos personal communication 1995).

The 72-page PCA report on Jatapu (CODESAIMA 1992) illustrates the common practice of environmental documents being hastily prepared by substituting names and numbers into a standard "boilerplate" text, a process that is facilitated by word-processing technology. The following year, LABQUIM produced a PCA for a proposed goldmining area in the Rio Negro (state of Amazonas), and inadvertently left in the obviously inappropriate section on corrosion of turbines (COOGAM 1993, Quadro 1). We emphasize that this practice is not unique to LABQUIM, but represents a general problem in Brazil's incipient environmental review system.

As will be explained later, IBAMA's Brasília headquarters subsequently rejected the Jatapu PCA (after a two-year delay). This occurred on 7 June 1994 (Jorge Luiz Brito Cunha Reis, IBAMA *parecer* No. 057/94-IBAMA/DIRCOF/DEREL/DIAP, Brasília). Neither IBAMA's delay in reacting to the PCA nor its rejection of the document affected the progress of construction.

One of the mysteries of Jatapu is why the State Secretariat of the Environment, Interior and Justice (SEMAIJUS) took 12 months to grant the preliminary license (LP) and 19 months to grant the installation license (LI). As a state agency, SEMAIJUS might be expected to grant any license that the governor wanted. The long delay is probably best interpreted as an illustration of how negligible and easily scorned the environmental review requirements were perceived to be.

In addition, a public civil suit (No. 93.0000540-5) brought by the Federal Public Prosecutor in Roraima placed the dam under a judicial embargo for a period of six months (beginning 1 October 1993) because the LP and LI had been granted after the dam was already under construction.*

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* "Judicial embargos are done by means of a Public Civil Suit (*Açdo Civil Pública*), a mechanism created by Law No. 7347 of 24 July 1985. In this case, the Federal Public Ministry of Roraima (MPF/RR) made a suit against the state of Roraima, CODESAIMA, CER, and Paranapanema (Process No. 93.0000540-5), sent to the Federal Justice Department in Roraima on 20 September 1993 by the Federal Prosecutor in Roraima. The embargo of 1 October 1993 was issued by the federal judge (Renato Martins Prates) before the 20-day period had expired that the Federal Prosecutor (Franklin Rodrigues da Costa) had allowed the state government to prepare documentation on the environmental licenses. The imminence of blasting to divert the river flow (scheduled for 2 October 1993) led the federal prosecutor to request the embargo before the 20 days had passed. However, despite the emphasis given to this by the state government's lawyers (*Folha de Boa Vista* 1993a), this was *not* the reasoning of the Federal Regional Court in Brasília in suspending the embargo (Renato Martins Prates and Carlos Alberto Queiroz Barreto personal communications 1995).

The LP was granted on 25 August 1992 and the LI on 23 March 1993 (MPF/RR 1993). The 23 March date for the LI is the date on the document; it was only published in Roraima's official gazette on 14 September 1993 (Roraima 1993b). A six-month delay in publication of such an important document is extremely unusual and suggests that the signature on the document may have been dated retroactively. Coincidentally, publication in the official gazette occurred on the *same day* that the Federal Public Prosecutor in Roraima delivered an official letter (*ofício* No. 083/93 MPF/RR) to Ottomar questioning the environmental licenses for Jatapu. Both the LP and LI are granted by the State Environmental Agency (SEMAIJUS). The embargo declaration from the Federal Public Ministry of Roraima (MPF/RR) also cited the lack of a license from the Brazilian Institute for Environment and Renewable Natural Resources (IBAMA) for deforestation of the construction site (the deforestation license has still not been granted even though the dam is now complete). The Roraima office of IBAMA had initiated the request to the Federal Public Ministry to emit the embargo order to judicially question (*interpelar judicialmente*) the dam (José Ponciano Dias Filho personal communication 1994). It is not known why SEMAIJUS did not simply grant the license at the correct time. Instead, a judicial maneuver was used to allow construction to continue without a valid license.

Confusion regarding the role of IBAMA in licensing hydroelectric dams is evident in Brazil's incipient environmental regulatory system. The Federal Prosecutor in Roraima holds that IBAMA must ratify (*homologar*) the licenses given by SEMAIJUS before they are valid (*Açdo Civil Pública* No. 93.0000540-5, Ministério Público Federal contra o Estado de Roraima, CODESAIMA, Paranapanema e IBAMA), while the Roraima office of IBAMA views its role as that of an "overseeing agent" (*agente fiscalizador*) that would only step in after an irregularity arises (José Ponciano Dias Filho personal communication 1995). The LP, LI, and LO for Jatapu have not been ratified by IBAMA.

The judicial embargo was suspended three days later by a judge in Brasília, allowing construction to continue pending issuing of a sentence by the judge in Boa Vista.[7] The series of delays that ensued in issuing a sentence was sufficient to allow completion of the dam. The length of delay, particularly after the federal judge had already given an embargo order, raises the possibility that the normal slowness of the judiciary might not be a sufficient explanation. Should the delay be a sign of political pressure, it would signal a blow to one of the bulwarks of the environmental protection system in Brazil: independence of the judiciary.

Perhaps the most dangerous precedent in the judicial history of Jatapu is the rationale that was used by the Federal Regional Court in Brasília for overturning the 1 October 1993 sustaining order (*liminar*) that halted construction. The justification was that continuing the embargo would cause economic damage to the state of Roraima (*Diário do Poder Justiciário (Estado de Roraima)*, 22 November 1994, p. 11). This opens the door to *any* large public work. Halting construction of any hydroelectric dam implies heavy financial costs. If monetary loss becomes the criterion, it will henceforward be impossible to stop such projects no matter how blatantly environmental requirements have been trampled. The justification goes further still, stating that "environmental damage" cannot justify a *liminar* to suspend construction.[8]

Halting construction of the dam was ordered by IBAMA on 21 July 1994 when administrative embargos were issued[9] against the Roraima state government and Paranapanema. However, CODESAIMA and Paranapanema obtained a *liminar* to allow construction to proceed while the judge decided on a new case involving Jatapu.[10] The new case was a counterattack of the state government, in which CODESAIMA accused IBAMA of issuing its embargo on the basis of allegedly spurious questions about the validity of licenses emitted by SEMAIJUS. This case was subsequently decided in favor of IBAMA.[11] This is the only one of the three simultaneous cases involving Jatapu on which a final decision has been reached.

After the 20 September 1994 decision in favor of IBAMA, work on the dam proceeded without IBAMA either enforcing its embargo or issuing a new one until the federal prosecutor reminded the superintendent of IBAMA in Boa Vista (Jane Wanderley de Melo) that she could be held legally responsible for not upholding federal requirements. She then dispatched IBAMA agents accompanied by federal police officers to Jatapu to halt construction. By this time the civil structures were already complete, the only work remaining being installation of the turbines, which was not considered to be covered by the embargo.

The IBAMA administrative embargo was lifted in November 1994 as a result of an "accord" between the government of Roraima and authorities in Brasília (Carlos Alberto Queiroz Barreto and Renato Martins Prates personal communications 1995). The IBAMA superintendent in Boa Vista apparently acted on the basis of orders from the president of IBAMA in Brasília. These orders were issued after a group led by Ottomar himself went to see the president of IBAMA (José Ponciano Dias Filho personal communication 1995). Lifting the embargo overrode both the technical staff and the judicial sector of IBAMA. All of this occurred in the 43-day period between the two rounds of the Brazilian elections.

[7]The initial embargo was decreed by Renato Martins Prates (Federal Judge in Boa Vista) and suspended by Hermenito Dourado (President of the Federal Regional Court, 1st Region, Brasília), thereby allowing work to continue while a sentence was awaited from Judge Renato Martins Prates. This sentence has never been written (as of February 1996, 29 months later). Apparently viewing Jatapu as a "hot potato," Judge Prates tossed the case to someone else as quickly as possible by claiming that the state courts were the competent authority to decide the matter. On 27 April 1994, the federal prosecutor (Franklin Rodrigues da Costa) submitted an appeal (*Agravo de Instrumento*, No. 94.0000437-0) maintaining that the federal courts were the proper authority (*Diário do Poder Justiciario (Estado de Roraima)*, 16 April, 1994, pp. 20–22). The case to decide the competent authority was therefore passed to the federal court in Brasília, where it still awaits judgement. According to Judge Prates (personal communication 1995), he would only pass a sentence once the competency question is decided, and even then only after obtaining a technical opinion (*parecer técnico*). The delay was long enough to allow completion of the major physical structures and could continue for a long time more

[8]*Parecer* of Judge Hermenito Dourado dated 4 October 1993 communicated to Judge Prates by OF. SCPLE., No.1032, 93, Poder Judiciário/Tribunal Regional Federal da 1ª Região, 6 October 1993)

[9]An "administrative embargo" is issued directly from IBAMA to those building the dam (the Government of Roraima and Paranapanema), rather than being issued through the federal prosecutor. The administrative embargos of 21 July 1994 were based on a *parecer* of IBAMA experts indicating a series of irregularities in the PCA and in the issuing of the LP and LI. The *parecer* (No. 057/94-IBAMA/DIRCOF/DEREL/DIAP, Brasília, 7 June 1994) provides the legal basis for Terms of Embargo/Interdiction No. 09152 (for CODESAIMA) and No. 09153 (for Paranapanema).

[10]Granted by Judge Renato Martins Prates of the Federal Court of Justice in Roraima (*Ofício* No. 236/94 do Poder Judiciario/Justica Federal de 1ª Instância, Secão Roraima).

[11]The case (*mandato de segurança* No 94.0000683-7) was decided by Judge Prates on 20 September 1994.

Impacts and Mitigatory Measures

Indigenous Peoples

The Jatapu Reservoir is 37 km downstream of the Wai-Wai Indigenous Area, inhabited by the Wai-Wai tribe, and 27 km upstream of the Trombetas-Mapuera Indigenous Area, inhabited by the same tribe. The dam blocks the traditional canoe route for movement of these Indians between the two reserves (CIR and CPI/SP 1993, p. 44). Those downstream of the dam will also suffer the effects of altered water quality in the Jatapu River, which can be expected to lose most of its fish. Poor water quality will also affect the Wai-Wai during their journeys on the river. The IBAMA *parecer* (No. 057/94 of 7 June 1994) cites lack of information on potential losses of fish or downstream water quality as one of the failings of the PCA. No mitigatory measures are planned for the indigenous peoples.

Local Population

According to the resident engineer, there was only one person living in the inundation area. This person was given a lot in the nearby Jatapu Settlement Project. Three families living near the dam but outside the inundation area have remained where they are.

Faunal Salvage

In December 1993, five months before the dam was to be filled, the municipal zoo of Rio de Janeiro was invited to submit a proposal for salvage and scientific use of the fauna in the reservoir area. The proposal was completed and submitted in April 1994, the same month that the reservoir was to be filled (RIOZÔO 1994). The proposal called for buying three boats and four 25-hp motors, among other equipment. In fact, no boat was purchased, the one boat present at the site—an aluminum rowboat with an aging 15-hp motor—being used for the operation. The salvage team was present for 15 days, concentrating its efforts mainly on the easily captured tortoises.

Faunal salvage, even when done on a larger scale, does little to soften the environmental impact of hydroelectric dams. Animals transported to nearby forest can be expected to enter into competition with animal populations already there, eventually leading to the death of approximately the same number of individuals as would be lost if they had been left to drown. However, the faunal salvage operation is often an important public relations investment. At Tucuruí, for example, video footage of faunal salvage was used extensively by Eletronorte (the federal electrical authority in Amazonia) to promote a favorable public image of the dam and of Eletronorte's environmental record. The faunal salvage at Jatapu was not mentioned in an IBAMA report of an inspection of the dam carried out when the RIOZÔO team was at the site; this omission is viewed by CER as evidence of bias against the dam on the part of IBAMA (Pualo Sérgio Lemos Latgé personal communication 1995).

Biomass Removal

Acid, anoxic water conditions in Amazonian reservoirs result from decomposition of vegetation in the flooded area. Removal of vegetation would minimize this problem, but the expense of doing so would be substantial. Other reservoirs in Amazonia, such as Curuá-Una, Tucuruí, Balbina, and Samuel, have been flooded without removal of any but a small portion of the vegetation in the flooded areas. This was also the case at Jatapu, where virtually no vegetation was removed.

The average turnover time of water in the reservoir is 18.5 days,[12] which is relatively rapid. This is a positive factor for water quality, although decaying vegetation will undoubtedly still lead to acid and anoxic conditions at the bottom of the reservoir. Bubbles of gas (probably methane) were readily evident when we visited the reservoir 45 days after closing the dam.

The vegetation in the reservoir area was dense tropical forest, classified by IBAMA as submontane ombrophilous dense forest (Ds) and submontane ombrophilous open forest (As) (Brazil IBGE and IBDF 1988). The approximate total biomasses of these vegetation types (unlogged) in Roraima as a whole are 403 and 350 t/ha (dry weight, including dead material), respectively, of which 307 and 267 t/ha, respectively, is above ground (Fearnside 1994).

Complete removal of biomass in the reservoir was never contemplated. Logging, however, was planned. The state government contracted a forest inventory by STCP Engenharia de Projetos, Ltda. (CODESAIMA 1993). The inventory was done to help convince loggers to exploit timber in the reservoir. The state government tried to interest loggers in removing the wood, but no agreement was reached. The short time (six months)

[12]This turnover time assumes the reservoir volume of 94.4×10^6 m³ given in the viability study; a volume of 200×10^6 m³ given by a more recent document would imply double this time (see Table 1). It should be remembered that this refers to an average over the year; because the water level will be below the spillway level for much of the year, outflow will be restricted to the 22 M³/sec capacity of two turbines (about one third the mean monthly streamflow over the full year), thereby approximately tripling the residence time during these months.

remaining between the October 1993 timber inventory and the officially expected date for filling the reservoir undoubtedly made logging prospects less attractive.

An inventory was requested by IBAMA on 22 March 1993. IBAMA officials say that the inventory was also part of an informal request by IBAMA regarding the documents that should be submitted in support of the state government's reply to the embargo that had resulted from the Federal Public Ministry's public civil suit (José Ponciano Dias Filho personal communication 1994). The head of the Paraná-based consulting firm contracted to do the inventory was hurriedly summoned to Boa Vista to deliver the report several days earlier than the contracted deadline (Joésio Siqueira personal communication 1993). Submission of the timber inventory by the consulting firm, and its forwarding by CER to the federal judge in Boa Vista, occurred on the same day (4 October 1993) that the *liminar* was granted in Brasília allowing construction to continue while the state government prepared its case in response to the public civil suit, a coincidence that is unlikely to have occurred by chance. It should be noted that lack of a timber inventory was not among the irregularities that had justified the embargo.

Monetary Costs and Benefits

A rough estimate of financial costs is given in Table 2. These include civil construction, electromechanical equipment (turbines, generators, crane, etc.), 145 km of 69-kV transmission line and 230 km of 13.8-kV line being built for the project. To these costs one must add a variety of uncounted costs that are also paid by the government of Roraima. These include the 11-km access road connecting the dam site to the Perimetral Norte Highway (BR-210) near the small town of Entre Rios, the viability study, the Environmental Control Plan (PCA), the survey of timber in the reservoir, a survey of rural electrification possibilities, the faunal salvage operation, government vehicles used to transport the transmission line poles, and government projects set up to use some of the energy from the dam (such as a factory for sweets and manioc flour in Caroebe), supervision by CODESAIMA of the construction process, and the frequent visits of the governor's helicopter and other aircraft.

According to the viability study, the area to be served had a 1990 (December) population of approximately 37,600, of which 10,800 were urban (CODESAIMA 1991, Chapter 3, p. 3). This appears to be greatly overestimated, as the IBGE census in 1991 counted only 19,188 people in the *municípios* of São João da Baliza and São Luiz; if one assumes that Novo Paraíso (in the *município* of Caracaraí) had a population of about 300, the estimated population of the area to be served by Jatapu was about 19,500 in 1991 and 21,000 in 1993. Making the optimistic assumption that all rural people are served (in addition to the urban population), and considering the estimated 1993 population, the cost of US$45.5 million (Table 2 for the 5-MW configuration), is over US$2100/inhabitant or US$10,800/household of five people. Making the more realistic assumption that only 10% of the rural population will be served, the cost is US$6000/person served or about US$30,200/household. The population of southeastern Roraima will undoubtedly increase in the future, lowering this figure accordingly. Even Roraima's phenomenal population growth would be hard pressed to bring these costs down to a reasonable level within a time horizon normally used for planning purposes.

Given the delays that occurred during construction, higher costs than initially foreseen were inevitable. The feasibility study, written before the dam was built, projected a cost of US$14.76 million for civil works in the 5-MW configuration (CODESAIMA 1991, Chapter 13, p. 4). The US$25–26 million actually spent (Paulo Sérgio Lemos Latgé personal communication 1995) is over 70% higher than the amount initially budgeted for this component. The president of CER gives the following reasons for the overrun: (1) there was not as much bedrock in the area as originally thought; (2) the characteristics of the soil were different than expected, requiring a wider base to the dam and a more gentle angle to the sides of it; and (3) recuperation of degraded areas (planting grass) was not included in the original budget (Paulo Sérgio Lemos Latgé personal communication 1995). Major overruns are commonplace in hydroelectric projects. Balbina, for example, cost more than double the amount initially foreseen in its feasibility study (see Fearnside 1989, p. 412).

Various views exist as to how much the dam actually cost. In a 12-page special advertisement on Roraima published in *Isto É* (one of Brazil's two major newsmagazines) between the two rounds of the 1994 elections, Ottomar cited a value of US$30 million for Jatapu while political rival Teresa Jucá gave a (probably exaggerated) value of US$180 million (*Isto É* 1994, pp. 79 and 86). A newspaper report on Jatapu indicates a cost of US$61 million, not counting transmission lines and roads (*Folha de Boa Vista* 1994b). If the US$61 million figure is correct, the costs for roads and transmission (from Table 2) would raise the total to US$73.7 million, or 60% greater than the US$45.5 million estimate from Table 2 used in the present paper. As some of the "other costs" included in Table 2 may not have been included in the newspaper account, the total could be higher still.

The cost considered here of US$45.5 million for the 5-MW configuration represents US$9106/kW of in-

Table 2. Monetary costs of the Jatapu Dam

	Cost (US$1000)	
	10-MW installed capacity	5-MW installed capacity
Direct costs		
Civil construction	15,290[a,b]	14,762[a,b]
Electromechanical equipment	6,536[a]	3,512[a]
Transmission line	11,000[a]	11,000[a]
Access road and bridges	660[a]	660[a]
Direct costs subtotal	33,486	29,934
Indirect costs		
Construction site engineering, infrastructure and administration	4,700[a,c]	4,700[a,c]
Other costs		
Viability study	200[c]	200[c]
Environmental Control Plan	50[c]	50[c]
Forest inventory	100[c]	100[c]
Rural electrification inventory	100[d]	100[d]
Transport of transmission poles	400[c]	400[c]
Factory for sweets and manioc flour	300[c]	300[c]
Governor's visits to dam site	520[c]	520[c]
Other costs subtotal:	1,670	1,670
Financing costs	0[f]	0[f]
Total cost	39,856	36,304

[a]Values from the feasibility study by CODESAIMA (1991, Chapter 13, p. 4).

[b]The resident engineer gives a value of US$23,000,000 for civil construction (Augusto Alberto Iglésias personal communication 1994).

[c]A guess.

[d]*Folha de Boa Vista* 1 April 1993.

[e]It is not clear whether the cost of CODESAIMA supervision is included in this total. If not, the amount might increase by about US$300,000.

[f]Jatapu was apparently not financed. The feasibility study (CODESAIMA 1991, Chapter 13, p. 5) presents an estimate at normal rates of interest (6%/semester, compounded semestrally), which amounts to 15% of the direct + indirect total by the time generation begins, or US$5,682,000 for the 10-MW configuration and US$5,150,100 for the 5-MW configuration.

stalled capacity—an astronomical figure, only to be surpassed if the true cost of construction indeed turns out to be 60% higher than the figure adopted here. Although larger dams generally have inherent cost advantages over smaller ones, especially when costs are considered without discounting (or interest over the construction period), economies of scale are insufficient to explain Jatapu's poor efficiency when compared with Amazonia's existing (large) dams, which themselves are no models of economy. Construction cost at Tucuruí was US$675/kW of installed capacity (*Veja* 1987, p. 30). The cost at Jatapu is triple Balbina's unenviable US$3000/kW (Fearnside 1989, p. 412).

Jatapu is apparently being paid for by the Roraima state government without financing. No interest has been included in the total costs estimated here (see Table 2). According to the feasibility study (CODESAIMA 1991, Chapter 13, p. 5), normal rates of interest would increase the cost by about US$5 million by the time generation was initially expected to begin for the 5-MW configuration (see Table 2). These costs, even if not paid in the form of loan interest, are indicative of an additional economic burden on Roraima not included in the cost estimates: the opportunity cost of capital.

Although Roraima has sufficient funds to pay the US$45.5 million cash outlay required for the 5-MW configuration, such an expense would not be possible without the large amounts of unearmarked (or at least highly flexible) federal funds the state receives. Roraima's budgets for 1992–1994 contain items for Jatapu totaling US$69.9 million (Brazil Senado Federal 1990, Roraima 1991, 1992, 1993a). These values are calculated using the exchange rate on the date of publication of each budget; insufficient correction for inflation can lead to significant reductions in real values by the time the funds are spent, possibly lowering the amounts to the neighborhood of the Jatapu expenditures of around US$45 million. It should be mentioned that the government of Roraima also spent funds on Jatapu in the form of "supplementary credits" that do not appear in the state's annual budget. For example, in the September 1992–September 1993 period, US$4.6 million in such credits for Jatapu appear in the official gazette.

The initial announcements of the dam invariably

Table 3. Industries the Roraima government expects to locate in the agroindustrial centers[a]

	Agroindustrial center	
	Anauá	Caroebe
Factory for sweets and fruit	100 kW	100 kW
Manioc flour mill	150 kW	150 kW
Milk pasteurization plant	150 kW	
Rice mill and drying facility	500 kW	800 kW
Irrigation system (300 ha in Anauá, 500 ha in Caroebe)	600 kW	1000 kW
Subtotals	1500 kW	1950 kW
Total installed capacity:	3450 kW	
Simultaneity factor:	50%	
Total demand:	1725 kW (1.7 MW)	

[a]Data source: CODESAIMA (1991, Chapter 3, pp. 5–8).

emphasized that agroindustrial centers (concentrations of factories for processing agricultural products) would use most of the energy, and, as a side benefit, surplus energy would become available to the population of southeastern Roraima. These enterprises were to make the dam a financially attractive investment for the state. Industries that the state government expects to implant in the agroindustrial centers are shown in Table 3. With the exception of a small factory built by the government for making sweets and manioc flour in Caroebe (*município* of São João da Baliza), none of these industries yet exists. In addition to the industries that the government hopes to mount through CODESAIMA, privately owned industries would theoretically be attracted to the centers by subsidized financing from Roraima's state bank (BANER); however, there is no evidence that any are planning to locate in the Jatapu area. The combined demand of the planned agroindustrial centers could be satisfied with only 1.7 MW (Table 3)—hardly enough to justify a 10-MW dam. The discourse regarding benefits of the dam changed radically as construction neared completion. Now the agroindustrial centers are no longer mentioned, and distributing electricity to the population has become the central justification. This was the subject of an intense advertising campaign in the months preceding the 3 October 1994 elections (e.g., *Diário de Roraima* 1994).

Ottomar promised free electricity to the surrounding population until the end of 1994 (the end of his term in office). His successor therefore had to take on the political onus of beginning to charge for electricity, a policy that took effect in mid-1995. Were monetary returns calculated with application of a discount rate, returns during the first year of operation would be especially important in the overall attractiveness of the dam, making an offer of free electricity unthinkable. In terms of political returns, however, the astuteness of such a move is undeniable.

In addition to direct benefits of electrical power, a variety of windfall financial benefits accrue to landowners in the area, especially the wealthier ones. Land values along the access road have increased dramatically, from less than US$500 per 60-ha agricultural lot in 1992 to over US$3000/lot in 1994 (Augusto Alberto Iglésias personal communication 1994). Several associates of the governor own ranches in the area to be served by the power.[13]

The Mystery that is Jatapu

The Grateful-Voters Hypothesis

Why was Jatapu built at a cost of about US$45 million? This enigma is not easily solved. Current generating capacity is approximately 2.4 MW in the towns to be served by Jatapu: the 1.8-MW thermoelectric plant in São João da Baliza, the 0.36-MW plant in Rorainópolis, plus four smaller plants totaling 0.192 MW. Since the entire area to be served by Jatapu currently had a demand of less than 1 MW when investments in Jatapu began, as the average load factor is only 13.2%,[14] all of the short-term economic and electoral benefits of Jatapu's power could have been had for only the US$8 million cost of the additional transmission lines. Part of the transmission system already exists in the form of a 13.8-kV line linking Caroebe, São Luiz, São João da Baliza, and Moderna, but this line is in need of repairs.

Certainly the economic benefits that constitute the official justification for the dam cannot explain the enigma. Direct political benefits, such as the votes of those who will receive power from the dam, are also insufficient. The area to be served had a population of approximately 18,000 at the time of the last (1990) election (considering the 19,500 estimated population at the time of the 1991 census, explained earlier), and approximately 6112 valid votes (assuming all of the estimated 85 voters in Novo Paraíso voted) were cast in the area in the second round of the elections (TRE/RR 1990). Of these voters, 63% were already Ottomar supporters in the second round of the 1990 election for governor. Considering the estimated 1994 population of 22,000 (representing approximately 7487 valid votes,

[13]These include federal deputy (congressperson) Francisco Rodrigues on the BR-174 Highway.

[14]The feasibility study (CODESAIMA 1991, Chapter 3, p. 4) claims a load factor "on the order of 20%," but the data in the report on which this is apparently based (for São João da Baliza and Rorainópolis in December 1990) indicate a load factor of 13.2%.

based on the proportions in 1990), and assuming the same percentage of residual support, the maximum possible increment in votes for Ottomar out of gratitude for power supply would be 2770 votes (assuming all voters in the area became Ottomar supporters). The incremental cost of US$16,400/potential vote is out of all proportion to the cost of obtaining the same electoral benefits by pleasing voters elsewhere in the state.

The Last-Monument Hypothesis

Ottomar Pinto, age 64, is in poor health. He has had two coronary bypass operations and frequently travels to southern Brazil for medical examinations. One possibility is that he wants to build Jatapu as a last monument by which he will be remembered after he passes from the scene, first politically and then physically. He has often mused to engineers at the construction site that Jatapu is a special personal challenge because he has built hundreds of public works during his life, but never a hydroelectric dam.

The last-monument hypothesis has one fatal flaw: it assumes that Ottomar is quitting politics. As one of his close associates explained succinctly, "*Ottomar nunca vai pendurar as chuteiras*" (Ottomar will never hang up his soccer shoes).

The Opportunities-for-Corruption Hypothesis

Corruption is a seldom-discussed factor in many development decisions. What its role is, if any, in answering the question of "Why Jatapu?" is unlikely to ever be more than conjecture. The volume of funds that flow in building such projects provides illicit, as well as licit, opportunities for profit. Ottomar was accused of a series of financial irregularities during his previous term as governor, especially involving CODESAIMA.[15] The prevalence of corruption in Brazil is well known, but it offers no more than an addition to the list of possibilities to explain the decision to build a dam that cannot be justified on the basis of traditional cost–benefit considerations in the public sphere.

The Paranapanema-Mine Hypothesis

The possibility that the power from Jatapu might be used for purposes other than the publicly announced ones has always been a source of speculation. Building a 10-MW dam in an area with less than 1 MW of power demand raises the possibility that power might be transmitted elsewhere. Paranapanema was a major contributor to Ottomar's 1990 election campaign for governor of Roraima (*Folha de Boa Vista* 1994a), and opposition politicians claim that the construction contract was awarded by irregular means because of this (State Deputy Vera Regina, interview on TVE Macuxi, Boa Vista, 9 December 1993, 7 pm). Opposition politicians have pointed out the possible conflict of interest implied by Paranapanema's subsidiary Mineradora Taboca holding mining rights to cassiterite (tin ore) deposits in the Jatapu River area near the dam, raising the possibility that these might later be exploited using power from the dam (Farias 1993). One would expect that opening a mine on the Jatapu River would await a rise in international tin prices, which are currently low (about US$5.50/kg in 1994, versus a previous high of US$17.60/kg). In addition, Paranapanema owns and operates one of the world's largest cassiterite mines at Pitinga, 200 km south of the dam in the state of Amazonas. However, both the small capacity of the Jatapu Dam and the political cost of subsidizing power for another state make it unlikely that electricity would be transmitted to Pitinga.

The Cotingo-Dam Hypothesis

A scenario that makes political sense of the phenomenal investment made in the Jatapu Dam involves, instead, the Cotingo Dam. Cotingo is expected to supply Boa Vista, Alto Alegre, Mucajaí, Caracaraí, Bonfim, and Normandia with power. The 1993–2002 Decennial Plan[16] of Eletrobrás (the federal power authority) makes Cotingo a priority, with completion of the first phase scheduled for 1999 (Brazil Eletrobrás 1992, p. 38). It should be remembered that delays are commonplace with hydroelectric projects, and the beginning of construction of Cotingo foreseen for 1994 had not yet begun by February 1996. Cotingo would have an installed capacity of 68 MW in its first phase, and 136 MW in a second phase (CER 1992, pp. 8–9). Cotingo would

[15]The *Folha de Roraima* (1982) newspaper abruptly ceased publication after making these charges in what was to be its last issue. These denunciations are reported to have been the fuse that led to the 2 December 1982 murder of João Batista de Melo Alencar, who was the journalist responsible and owner of the newspaper (*Folha de Boa Vista* 1983). Ottomar was accused of being one of two men who hired the gunmen who killed the journalist, leading to Ottomar's removal from office by then-president João Figueiredo (*Veja* 1983). Since the wealthy and powerful in Brazil are only very rarely brought to trial or convicted for any kind of wrongdoing, the lack of judicial consequences in the case provides virtually no indication of the correctness (or not) of the condemnation that the press meted out at the time.

[16]Cotingo only became a priority in 1991, at the initiative of the government of Roraima (CIR and CPI/SP 1993, p. 29). Cotingo is conspicuously absent from the 1990–1999 Decennial Plan (Brazil Eletrobrás 1989, p. 44), which announced the suspension of plans for the 27-MW Paredão Dam pending comparisons with thermoelectric alternatives.

guarantee the political future of any politician in Roraima who is able to claim credit for it. Ottomar is in a good position to do this, as he has been the most voluble spokesperson for the dam since his first term as governor (1979–1983). With Jatapu to his credit, Ottomar could claim credentials as a successful builder of dams. Ottomar's administration was able to obtain environmental approval for Cotingo on 25 October 1994 (between the first and second rounds of Brazilian elections, and two months before the end of Ottomar's term in office). The political benefit of votes won by building Cotingo would be especially valuable for Ottomar, as the major beneficiary of the dam would be the city of Boa Vista, where 55% of Roraima's population lived as of the 1991 census and where Ottomar has the least support: he got 49.3% of the valid votes in the *município* of Boa Vista (including rural areas surrounding the city) in the second round of the 1990 gubernatorial election (just behind Jucá with 50.7%), but won the election by getting 61.5% of the valid votes in the remainder of the state). Ottomar can either wait until the 1998 election to run again for governor, or he could run for mayor of Boa Vista in 1996 (a post now held by Maria Teresa Surita Jucá, wife of Ottomar's arch rival Romero Jucá), and then resign in 1998 (presumably leaving a trusted vice-mayor as substitute) to run again for governor. He would have the opportunity to build a base of support in the capital city. Ottomar will be free to concentrate his attention in the northern part of the state because the electoral support of the south will already be assured thanks to Jatapu and a series of other public works built there during his 1991–1994 term in office.

Ottomar's decision not to step down in May 1994 in order to run for one of the posts being disputed in the October 1994 election allowed him to finish development projects such as Jatapu completely within his term in office. This guaranteed that he will receive credit with the electorate for his accomplishments, and it foreclosed any possibility that the projects could be abandoned and questions raised as to their wisdom or probity.

Lessons for the Decision-Making Process

Limitations of State Environmental Agencies

The example of Jatapu illustrates the fragility of state-level environmental agencies and procedures when confronted with any project that is seen as a high priority by the state government. The present trend to transfer more responsibility for the environment from the federal government to state governments is inherently dangerous. The greater vulnerability of state agencies to pressure from political and entrepreneurial interests is not specific to Brazil, but applies generally throughout the world.

State-level environmental agencies in Brazilian Amazonia are weak. These agencies are to be strengthened under the Pilot Program to Conserve the Brazilian Rainforest, administered by the World Bank on behalf of the seven wealthy countries known as the G-7, which pledged money to the program at a Houston meeting in 1990. More than strengthening through better training, staffing, and equipment is needed, however. Mechanisms are needed to make environmental agencies independent.

Danger of Vague Criteria

Jatapu is testing the limits of the minimum that is acceptable for an environmental review. Waiting for criteria on the minimum acceptable for each item to be defined by precedents is a sure way to turn future environmental reviews into meaningless exercises. Proponents of each project can then argue that if such and such a project was approved, then this one should be too. Jatapu raises the question of what kind of an environmental control plan (PCA) would be unacceptable.

Terms in the present requirements need to be spelled out, such as what constitutes a "qualified multidisciplinary team." More explicit definition is needed of what goes into a report and what kind of field investigation is necessary to substantiate it. At present there is a pattern of environmental studies being quickly produced by substituting names and figures in standard boilerplate text. This pattern must be broken.

Tighter Control on Funding

Tighter control is needed on money granted from federal subsidy programs and from other outside sources. When federal and other funders abdicate their role in evaluating proposals and overseeing the use of funds, the role of political benefits is likely to be greater in determining how the money is used.

No Solution, But Not No Problem

It is often said that when there is no solution for something, then there is no problem. Many of the problems illustrated by Jatapu have no solution: political benefits can be expected to continue as a determining factor in setting priorities in elected governments. No one would want to revert to the appointed governments of the past. One can only hope that it will eventually become a political liability when electorally motivated projects offend rationality in other spheres. The slowness of such changes, however, means that the degree of control exercised by outside funders, including Brazil's

federal government, is likely to remain the principal factor capable of restraining future projects like Jatapu.

Jatapu's Lessons for the World

Jatapu provides an example of a series of barriers to properly assessing the costs of development and acting on the basis of those assessments. These barriers are common to many countries of the world, although the details will vary as to how political influence ramifies through the various agencies and the different levels and branches of government. Identifying points where changes might improve the results obtained in practice requires understanding how development decisions are really made—as opposed to how they might theoretically be made on the basis of cost–benefit analysis. Review and licensing systems that Brazil and many other countries have to assure that environmental costs are kept within acceptable limits are quite often unable to resist political pressures. How environmental control systems function in practice must be understood based on the experience gained from real-world events. Some generalizations are possible, such as the greater vulnerability of state as compared to federal agencies and the need for vigilance by funding sources (including the federal government). The urgency of identifying and implementing better mechanisms for assuring that environmental concerns are reflected in development decisions is evident.

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