Potential Impacts of a Proposed Amazon Hydropower Project

Janet M. Chernela

Once again, multilateral banks will face the proposition of flooding the Amazon with dollars. The World Bank's Power Sector II loan, a proposed loan of $250 million designated for the Brazilian "Energy Sector" rather than for any specifically named project, might be scheduled to come before the Bank's Executive Board for a vote as early as September 1988.

The implications and potential consequences of this loan must be considered very carefully. Given the World Bank's reiterated expression of its concerns for the environment, including the needs of rural and "tribal" peoples, this article outlines some of the potentially deleterious consequences for both the social and physical environments.[1]

One of the main projects that might be funded by the Power Sector II loan is a hydroelectric project in the eastern Amazon basin, an area known for its remaining pristine tropical rain forests and large number of diverse indigenous populations. The multipurpose Altamira-Xingú dam complex, in the state of Pará, will divert water from the Xingú River, a southern tributary of the Amazon, to create one of the world's largest reservoirs. It promises to dwarf any existing hydroelectric project in Brazil.

Potential Social Impacts

A series of as many as 47 potential dam sites are under examination—24 on the Xingú and another 23 on its tributary streams, the Iriri, Curua and the Bacajá (Andrade and Oliveira 1988). Just two of these dams, the Babaquara and the Kararão, are expected to flood between 4,735 and 7,365 km² on the lower Xingú. If only five of the dams now under consideration are constructed, approximately 18,000 km² will be flooded (Andrade and Oliveira 1988), forming the largest artificially created body of water yet known.

In addition to devastating thousands of acres of tropical woodlands, the dam complex and the associated reservoirs would necessitate the relocation of approximately 9,000 indigenous peoples (Gallagher 1988:2). Two downriver inundations (the Kararão and Babaquara) will directly displace the following indigenous groups: Paquicamba, Koatinemo, Yuruna (or Juruna), Arara, Kararão, Kikrin, Arawetê and Parakaná. Three other dams on the lower Xingú and two on the Iriri River will affect the Xipaia-Curuaia and several uncontacted indigenous groups inhabiting the region surrounding the upper Iriri. Subsequent dams planned further upriver on the Xingú will inundate official reserve lands, legally recognized as belonging to four groups of Kayapó: the Kokraimoro, Aukre, Kuben-kra-kei and Kikretum, as well as many other Kayapó groups situated inside the well-known Xingú National Park.[2] The different nations mentioned here will be directly affected (i.e., displaced) by flooding; the number of indigenous groups affected by the project grows, however, when related, indirect impacts such as access roads, electrical installations and centers of operations are considered. Other populations likely to be affected by the full complex include the Amanaye, Anambe, Tocantins Asuriní, Xingú Asuriní, Gavião, Mekranotí, Arredios (including Puro and Pituiaro), Suruí, Tembe, Turiwara and Kuraia (Andrade and Oliveira 1988). In sum, it is not unreasonable to predict that the project could directly or indirectly affect at least 24 distinct indigenous populations.

The Xingú River valley has long remained remote from the wide-reaching communication networks of large urban centers and industry. It can be considered a refuge area for representative language groups of the major linguistic stocks in lowland South America, harboring speakers of all four major linguistic trunks: Cariban, Gé, Arawakan and Tupian. Indeed, many of the groups inhabiting the region moved gradually upriver in order to distance themselves from European contact. The Yuruna, for example, have migrated more than 1,000 miles upriver since the sixteenth century when their habitations on the Amazon River were noted by de Carvajal (Nimuendajú 1946-50).

Resettlement and Its Consequences

Forced resettlement of any kind carries an inestimable cost. An acceptable, or even successful, resettlement scheme would be one in which disease and other harmful consequences of relocation were mitigated. Under the best of conditions, a resettlement program would be one in which no human life was lost. Yet the cases to be reviewed in Amazonia will illustrate that this goal is difficult to achieve.

Even if resettlement were to be successful in the sense of saving lives, any resettlement scheme promotes cultural disintegration. *Culture* is a body of cumulative knowledge, constructed over millenia. This definition of culture is best illustrated in the case of the Kayapó, one of the groups directly threatened by the dam complex. The richness of Kayapó thought and expression has been documented by many researchers (Turner 1965, 1979; Bamberger 1967, 1979; Posey 1981, 1982; and Werner 1984, to name a few).

Within the complex, integrated body of meanings

that constitutes *culture* is a vast quantity of information regarding the local biological and physical environment. This information includes not only ways to utilize the environment, but also, as Posey (1982) convincingly argues, measures necessary to sustain it. Western scientists have only begun to penetrate the vast amount of valuable environmental knowledge contained in traditional belief systems, as well as the cumulative observations of tribal peoples who have inhabited a single region for many generations. The death of traditional culture will cut short our access to valuable information on the tropical rain forest and its uses.

Two Recent Hydropower Projects and Their Impact on Indigenous Peoples

Elsewhere in Amazonia, where similar projects on a smaller scale were undertaken, the consequences for indigenous peoples have been disastrous. These projects, which were initially declined by the World Bank, were subsequently funded by them as part of Sector Loan 1 to the electrical power sector. The hydroelectric project at Balbina is situated in pristine tropical rain forest in the state of Amazonas, some 145 km from the city of Manaus. To generate 240 megawatts (mw) of electricity intended for Manaus, a reservoir of 2,346 km² was created. The Balbina project inundated about 311 km² of indigenous area,[3] including the lands of the Waimiri-Atroari peoples. Although the Waimiri-Atroari had suffered from a series of massacres and introduced epidemics since the late nineteenth century, in 1975 some 1,000 persons still lived on lands legally decreed them by the government in 1971. In 1981, the area belonging to the Waimiri-Atroari was reduced by one-third to allow for the entrance of mining interests and the Balbina hydroelectric project. Although the project forced the resettlement of the Waimiri-Atroari population, by April 1987 no resettlement plan was underway. Today, fewer than 400 Waimiri-Atroari survive (Schwartzman 1987:2), the others victims of introduced diseases.

Mekranotí Kayapó, Xingú Basin. ©D. Werner

The hydroelectric project at Tucuruí on the Tocantins affluent of the Amazon, in the state of Pará, flooded some 2,430 km² to produce 3,960 mw of electricity (Biswas 1983:33). Nearly 60–70 percent of the indigenous territory in Tucuruí was invaded by roads, tractors, towers and clearings for operations (Andrade and Oliveira 1988). The new city of Tucuruí was constructed across the river from one indigenous group, the Gavião. When transmission towers were constructed alongside them, the Gavião abandoned their territory.[4] Thirty-six percent of the lands flooded by the reservoir at Tucuruí belonged to the Parakaná nation. Two groups of Parakaná, the Paranatí and Marudjewara, found their territories inundated by the reservoir of Tucuruí. According to Paiaka Kayapó, many Parakaná were not advised of the necessity to resettle (Paiaka Kayapó, address to the World Bank, February 1988). He reports from their own accounts: fleeing from the rising waters, some found themselves on the lands of large landholders, who shot them as trespassers; others fled to the road where they were arrested by the police. Eventually resettled onto unfamiliar, uncultivated lands, they were confronted by hostile whites who challenged their entitlement. This was not the first forced relocation of the Parakaná; they had been forcibly relocated five times in the six years between 1971 and 1977 (CEDI 1985). Today, a remaining group of Parakaná are threatened by the Altamira-Xingú complex.

In "The Environmental Assessment of the Tucuruí Hydroproject," Goodland (1978) seriously addresses the problem of diseases introduced from impounding water. The report describes vector habitats and, when possible, suggests measures for monitoring and biological control. The report recommends several biological steps to prevent malaria, for example—among them the introduction of fish that feed on mosquito larvae. Other diseases that are potential hazards of the reservoir formation are schistosomiasis, an incurable disease transmitted by a snail vector that inhabits stagnant or slow-moving water; leishmaniasis, an infection of the cutaneous tissues (with symptoms similar to leprosy) transmitted by a sandfly vector known to inhabit newly cleared forest edges; and onchocerciasis, or river blindness, whose vector is the blackfly *simulid*(e), with breeding patterns closely linked to conditions of water turbidity. Two of the four diseases, schistosomiasis and onchocerciasis, had not existed in the area before the onset of the project. Although no recent site reports indicate the current status of these

diseases, secondary sources do indicate that malaria, schistosomiasis and river blindness are now found at Tucuruí (George 1988:601).

The Xingú River

The previous examples indicate some of the probable social consequences of a project such as the Altamira-Xingú, consequences that could result from the habitat changes accompanying water empoundment, deforestation and other major alterations in the local habitat. Our discussion thus far has focused on the potential impacts to the indigenous inhabitants of the region. Although the two are not in fact separable, the biophysical impacts of the damming proposal should also be considered. Taking into account changes in the watershed itself, it becomes clear that a project with such wide-reaching potential for destruction must be avoided at all costs. The Altamira-Xingú hydroelectric complex threatens not only numerous and diverse indigenous nations, but also an important environmental zone that is rich in economic resources.

The Xingú River, approximately 1,500 miles long, is one of the few productive clear-water rivers in the Amazon system. Ecologists characterize Amazonian river types into black, white and clear waters, each name referring to a specific set of hydrochemical features.[5] Each river type is subject to factors that limit primary production; this, in turn, affects the total biomass productivity of the river. In white-water rivers, which have high nutrient content due to rich suspended solids carried from the Andes, these same suspended particles obstruct the passage of sunlight and thus limit photosynthetic action. In black-water rivers (which are the color of tea) light *can* penetrate to several meters, yet factors such as acidity, nutrient deficiency and lack of substantial oxygen limit *in situ* productivity. The clear-water rivers in the Amazon have fewer limiting factors for productivity than either the black- or white-water rivers. Only the clear-water rivers allow light to penetrate to relatively deep levels, thus encouraging photosynthesis without inhibiting productivity through the inhospitable limnochemical conditions that characterize black-water rivers. Many clear-water rivers have low levels of nutrient content, which generally prevent the development of extensive aquatic communities (Goulding 1981:15). Several clear-water rivers, however, do carry substantial nutrient loads, promoting the growth of phytoplankton, on which higher aquatic organisms feed. Such clear-water rivers (called by some "green-water rivers"), although highly productive in flora and fauna, are relatively scarce in the Amazon system. The Xingú River is one of the few clear-water rivers rich in aquatic wildlife.

Several scientists have remarked on the unusual abundance of fish in the Xingú. Kalervo Oberg, whose work also took him to the highly productive rivers of northwestern North America, describes the fishery harvests of the upper Xingú in this way:

> The Kuluene [a tributary stream of the Xingú] and Upper Xingú proper are plentifully stocked with many varieties of fish. In one catch of some 80 fish, 20 species were counted. In my experience these waters were the richest ever seen. Fishing in the main streams with hook and line for 1 minute was usually sufficient to catch a fish or to lose the bait from the hook (Oberg 1953:25).

In researching the migratory patterns of Amazonian fish, Goulding (1981) observed that numerous species hatch on the main river or near the mouths of tributaries, migrate upriver as juveniles and descend the same streams as adults. If a dam complex were built on this valuable river system, many species whose life cycles require migrating through the blocked areas would be completely lost. Furthermore, the changed water conditions will result in a loss of all the fish species that inhabit or in other ways are dependent upon rapidly flowing waters. Unless fish ladders are provided, the amount of valuable wildlife to be lost by such a system of dams and associated reservoirs would be devastating. Furthermore, since fish are the principal protein food of the Xingúan Indians (Oberg 1953:25), indigenous groups living upstream from the dam complex would experience a dramatic decline in their main source of sustenance.

Certain technical considerations deserve some mention, for they carry implications for the future of the watershed and the advisability of the project. Deforestation and changes in hydrological patterns are likely to produce soil erosion, siltation and unforeseen flooding. Sediment deposits from soil erosion may in turn jeopardize the turbine blades, affecting the turbidity of the water, the conditions for a healthy fish population and the life of the generating facility. Nutrient inflows from sediment may cause eutrophication (decreased oxygen content) and aquatic weed problems. The sediment caused by erosion might eventually displace the water in the reservoir, pollute the drinking water and ultimately decrease the storage capacity and utility of the operation. Similar scenarios have occurred in many parts of the world and have been carefully documented (see, for example, Dixon et al. 1986). Tucuruí, the hydropower project that flooded 60–70 percent of indigenous lands in the area, is facing such difficulties.

Costs

Funding for electric power projects was one of the first loans from the World Bank to Latin American nations. The first request to the World Bank for substantial funds for a developing country came from Brazil in 1947 for a loan to expand Brazil's electrical power capacity (Payer 1982:103). Since its first loan to Brazil's electrical power complex in 1949 (then owned by a private Canadian corporation), the World Bank has invested $3.1 billion in this sector (Foster 1986). The combined result of government priorities and World Bank preference, electrical power continues to account for a major portion of the Bank's lending. In the case of Brazil, "According to a well-established government programme, hydroelectric production will increase at an average rate of 11.3 percent until 1995" (Biswas 1983:33). This estimate has proven to be conservative: in the single year 1985–1986, Bank lending to the energy sector totaled more than $1.3 billion (George

1988:601), one-third of the total investment to this sector in Brazil since its first loan in 1949.

The Altamira-Xingú dam complex, estimated to cost a total of $10.6 billion, is expected to generate at least 17,000 mw of electricity for hypothetical "boomtowns,"[6] for mineral exploitation and processing and for population centers or industries located hundreds or indeed thousands of miles from the site. Since Brazilian electricity is largely subsidized by the government, the costs of energy-expensive mineral processing, such as the smelting of aluminum, will eventually be transferred to the taxpayer. The estimated cost of the project is approximately 10 percent of Brazil's current indebtedness. The burden of the increased debt together with other costs (such as subsidies to large transnational corporations) will be borne by Brazilian taxpayers and by the people displaced and otherwise affected by the construction of the project.

Accountability

Multilateral banks such as the World Bank would be remiss to finance any area or sector in which financial assistance could result in broad-scale social and natural devastation; such consequences contradict the Bank's own guidelines. In its public statement on indigenous peoples and Bank policy, entitled "Tribal Peoples and Economic Development," the World Bank states its intention not to undertake projects in areas inhabited by indigenous peoples "unless the tribal society is in agreement with the project." The same publication, a document which must be taken as policy, assures self-determination of tribal peoples, guarantee of their land rights and respect and maintenance of their ethnic identity and cultural autonomy.

Two more recent World Bank statements reiterate its strong official stance with regard to the social and environmental impacts of projects that utilize their funds. The Bank Development Committee's Report, released in April 1987 and entitled "Environmental Growth and Development," and President Conable's address to the World Resources Institute on 5 May 1987 both express the World Bank's concern for the environment.

Whether sector loans are subject to the Bank's accountability for any single project within the sector is an issue of controversy. This is of specific importance to the Altamira-Xingú complex, since it falls within a loan to Brazil targeted for the electrical power sector rather than one specifically defined project. Yet despite statements that sector loans do not come under the same scrutiny as individual projects by the Bank's environmental advisors, World Bank Chief of Environmental Operations and Strategy Dr. Jane Pratt informed the New England Environmental Conference (27 March 1988) that "The Bank has both the capacity and the authority to review environmental impact on individual projects within sector loans" (Pratt 1988).

Environmental groups such as the Environmental Defense Fund and the National Wildlife Federation have questioned the economic rationale of these projects (see, for example, Rich 1985). Pressure from these groups previously influenced the US executive director of the World Bank to vote against allocating a $500 million loan to Brazil's first Power Sector.

When Sector Loan I to the Brazilian electric power sector was voted upon in June 1986, Hugh W. Foster, the US alternate executive director to the Board of Executive Directors, explained his opposition in these terms:

> We have serious concerns about the potential environmental impact of several of the projects to be financed by this loan ... [including] the total absence of any possibility that the resettlement will take place without extensive human suffering and bitter recriminations.... There has been virtually no planning to address the needs of the Amerindian population or the need for protection of the environment in the immediate area of the dam. Furthermore, the dam will flood a portion of an Indian reserve which previous Bank financing helped establish. This is pure folly (Foster 1986).

Since many of the flaws recognized in Sector Loan I persist in Sector Loan II to the same sector, we can only hope that in evaulating Sector Loan II, the US executive director will continue to maintain the model standards set by its decision regarding Sector Loan I.

Brazilian national policy is also restricted by guidelines set by its environmental agencies. Brazilian national policy, as established by the National Council on the Environment (CONAMA),[7] states that any activity that would "modify the environment" requires its approval. Such an evaluation requires a report on environmental impact (Relatorio de Impacto Ambiental, or RIMA) based upon field study. There is no evidence that such environmental impacts of the Altamira-Xingú project have been studied or that alternatives to the project have been considered. In the case of Tucuruí the impact assessment studies were carried out in less than one month (Andrade and Oliveira 1988). Moreover, such studies must be conducted by expert and independent monitoring teams to ensure that the impact studies do not merely serve the interests of the project designers. On the other hand, post-impact studies, where carried out, have shown populations decimated by the effects of disease and improper relocation schemes, severe physical and psychological stress and increased impoverishment, as well as massive ecological destruction evidenced by the extinction of many endemic or endangered species.

What constitutes a satisfactory assessment of the costs of such a project? To the project's estimated $10.6 billion must be added the lives of indigenous people and an inestimable number of plant and animal species. Are we willing to support projects that will illegally uproot thousands of Indians from their rightful homelands in order to further development schemes in which they will have no decision-making role, and as a result of which many will lose their lives? Numerous precedents suggest that an entire watershed could be destroyed by this project, and its peoples forced to bear the immense yet hidden costs of a scheme from which they will not benefit.□

Janet M. Chernela is a Fellow of Cultural Survival. In February 1988, with Darrell Posey, Barbara Bramble and Bruce Rich, she accompanied Kayapó leaders Paiaka and Kubei-I in their fact-finding mission to the World Bank.

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Notes

1. Both Brazilian law and World Bank policy statements combine environmental impact into two components, "socioeconomic" and "natural." The Brazilian National Council on the Environment defines environment to include characteristics that are physical and biological as well as socioeconomic.

2. The Xingú National Park was guaranteed as indigenous territory to numerous groups who were relocated there. A substantial portion of the park has already been lost to make way for the construction of the Highway B.R. 080 in 1971.

3. The areas reached by the dams were excluded from the demarcation of the area.

4. After seven years of struggle, they were recently compensated by the government (Andrade and Oliveira 1988).

5. The two major contributing affluents of the Amazon, the Solimões and the Rio Negro, are white- and black-water rivers, respectively. In addition to the Xingú River, the Tapajos and Tocantins and the right-bank tributaries of the Madeira are clear-water rivers.

6. Generating an expected 17,000 mw, the Altamira-Xingú complex would produce nearly 30 percent more energy than that produced by Itaipu, which utilizes hydropower produced by the immense Iguassu Falls. One argument is that Itaipu is underused. Improving and expanding the energy output of Itaipu is one of the economically sound alternatives to the more massive, costly and environmentally destructive Altamira-Xingú complex.

7. CONAMA res. 001/86, via Brazilian federal Law Number 6,938 of 8/31/1981.

References

Andrade, L. and L.A. Oliveira Santos
1988 *Hydroelectrics of the Xingú and Indigenous People*. São Paulo: Pro-Indian Commission of São Paulo, in press.

Bamberger, J.
1967 Environment and Cultural Classification. Cambridge, MA: Harvard University Ph.D. Dissertation.
1979 Exit and Voice in Central Brazil: The Politics of Flight in Kayapó Society. In D. Maybury-Lewis, ed. *Dialectical Societies*. pp. 130–146. Cambridge, MA: Harvard University Press.

Biswas, A.K.
1983 World Status Report on Hydroelectric Energy. *Mazingira* 7(3).

CEDI (Centro Ecumenico de Documentacão e Informacão)
1985 *"Sudeste do Pará." Povos Indígenas no Brasil*, vol. 8. São Paulo: CEDI.

Dixon, J.A. et al.
1986 Economic Analysis of the Environmental Impacts of Development Projects. Asian Development Bank Economic Staff Paper No. 31.

Foster, H.W.
1986 Statement on Brazil Electric Power Sector Loan, 19 June.

Gallagher, C.
1988 Indian Leaders Plant One Foot in Forest, Other on Concrete. *Miami Herald*. 17 March.

George, S.
1988 Financing Ecocide in the Third World. *The Nation* 246(17):601–606.

Goldsmith, E.
1987 *The Ecologist* 17(2/3).

Goodland, R.
1978 The Environmental Assessment of the Tucuruí Hydroproject, Río Tocantins, Amazonia, Brazil. Brasilia: Electronorte, S.A.

Goulding, M.
1981 *The Fishes and the Forest: Explorations in Amazonian Natural History*. Berkeley: University of California Press.

Nimuendajú, C.
1946-50 Tribes of the Upper Xingú Basin. In J. Steward, ed. *Handbook of South American Indians: Vol. 3, The Tropical Forest Cultures*. Bureau of American Ethnology, Bulletin 143. Washington, DC: Smithsonian Institution.

Oberg, K.
1953 *Indian Tribes of Northern Mato Grosso, Brazil*. Institute of Social Anthropology, Publication No. 15. Washington, DC: Smithsonian Institution.

Payer, C.
1982 *The World Bank: A Critical Analysis*. New York: Monthly Review Press.

Posey, D.
1981 Wasps, Warriors, and Fearless Men: Ethnoentomology of the Kayapó Indians of Central Brazil. *Journal of Ethnobiology* 1(1):165–174.
1982 The Keepers of the Forest. *New York Botanical Garden Magazine* 6(1):18–24.

Pratt, J.
1988 Panel presentation, New England Environmental Conference, 27 March, Tufts University, Medford, MA.

Rich, B.
1985 Multi-lateral Development Banks: Their Role in Destroying the Global Environment. *The Ecologist* 15(1/2).

Schwartzman, S.
1987 Memorandum: Environmental and Social Concerns Related to the World Bank. Environmental Defense Fund. 11 January.

Turner, T.
1965 Social Structure and Political Organization Among the Northern Cayapó. Harvard University Ph.D. Dissertation.
1979 Kinship, Household, and Common Structure Among the Kayapó. In D. Maybury-Lewis, ed. *Dialectical Societies*. Cambridge, MA: Harvard University Press.

Werner, D.
1984 *The Amazon Journey: An Anthropologist's Year Among Brazil's Mekranoti Indians*. New York: Simon & Schuster.