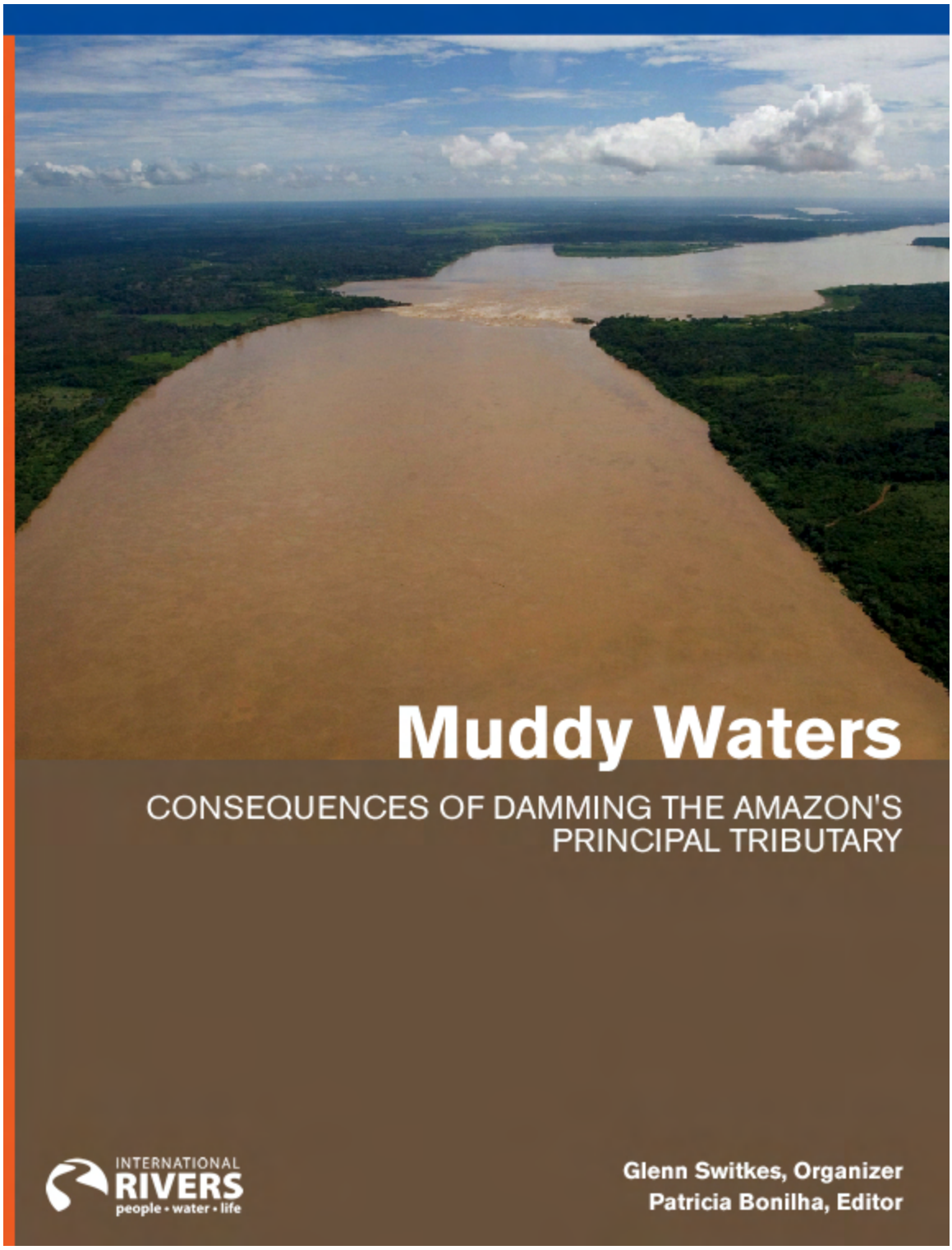

Muddy Waters

CONSEQUENCES OF DAMMING THE AMAZON'S PRINCIPAL TRIBUTARY

INTERNATIONAL RIVERS
people • water • life

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Introduction

In August 2003, the Brazilian state electric company Furnas and the private construction conglomerate Odebrecht presented, at a seminar in Rio de Janeiro organized by Brazil´s National Development Bank, BNDES, a plan for a hydroelectric and industrial waterway complex on the Madeira River, the principal tributary of the Amazon. The project was put forth as a key component of continental integration within the initiative IIRSA – the Initiative for the Integration of Regional Infrastructure in South America, promoted by the governments of the continent with the support of multilateral financial institutions, including the Andean Development Corporation (CAF), the Inter-American Development Bank (IDB), and the Financial Fund for the Development of the La Plata Basin (Fonplata).

Almost immediately, the Madeira project was promoted as the single energy project deemed “essential” to avoid electricity shortages in Brazil during the coming decade, supplanting the Belo Monte dam on the Xingu River, which the state electric company Eletronorte had tried to steer through technical and legal challenges and broad opposition from environmental and human rights groups during more than a decade. With Odebrecht being one of the principal financial supporters of the Lula presidential campaign, and Furnas benefitting from Lula´s commitment to restore energy planning to the state electric bureaucracy, the Madeira project benefitted from an unprecedented effort within the Lula government to push the project through the environmental licensing process at whatever cost.

Even as the government tried to present itself as environmentally responsible, drawing up new efforts to limit deforestation in the Amazon, it demanded the construction of the Madeira dams even if it meant transforming the analysis of the project´s impacts into a hollow farce, and the environmental protection agency Ibama was dismembered to ensure prompt approval for a project of uncertain environmental, social, and economic viability.

With the granting of a provisional environmental license for the Santo Antonio and Jirau dams on July 9, 2007, another page has been turned in the history of the Amazon, a story which has been always marked by greed, hate, and the tragic miscalculations of those in power. Considerable information will surface for many years to come concerning the interests behind the project, and the manipulations to attempt to justify it. But, at this moment, some are already speculating that, if the Madeira River hydroelectric project is indeed built, we may look back upon it as one of the most devastating mistakes made by the Lula administration.

The Madeira Hydroelectric and Hidrovia project – Cornerstone of IIRSA

Descending from the peaks of the snow-capped Andes to the tropical rainforest, the Beni and Mamoré (Bolivia) and Madre de Dios (Peru) rivers, principal tributaries of the Madeira River, are seen from the air as sinuous silt-laden yellow channels. As they meander downstream, they leave oxbow lakes, crescent-shaped pools which are cut off from the river channels.

In the Andes, the headwaters of the Madeira are born in snow melt on peaks which reach 5.000 meters above sea level. Within a distance of only 150 km, these headwaters drop off steeply to the Amazon lowlands. Along their course we view seemingly untouched tropical forests, and also extensive areas of deforestation for ranching and logging, in addition to ugly gouges cut for gold mining.

The Guaporé River (called the Itañez by the Bolivians) flows from the Mato Grosso highlands, joining the Mamoré near Costa Marques, Brasil, site of a fort built by the Portuguese in the late 18th century to defend their Amazon outposts against Spanish attack. A short distance downstream, the Mamoré passes the twin cities of Guajará-Mirim, Brasil and Guayaramerín, Bolivia.

The Madre de Dios and Beni flow together at Riberalta, Bolivia, and the Beni's confluence with the Mamoré just below Guajará-Mirim at Villa Bella, Bolivia, is the point at which the now-powerful river becomes known as the Madeira.

While the Negro River contributes a somewhat greater volume of water to the mighty Amazon at its confluence near Manaus, the Madeira is responsible for 35% of the sediments and nutrients that flow into the Amazon, making it its principal tributary in terms of the contribution it makes to the life and diversity of the Amazon. During high-water periods (December through May), the Madeira descends with the ferocity of a

frothing cauldron, eroding its banks and uprooting entire tree trunks, a characteristic which gave it its name.

The Madeira River basin covers about 20% of the total extension of the Amazon basin. The Madeira's principal tributary basin is that of the Mamoré (241,600 km^2), which flows from the Bolivian region of Chapare. The Guaporé River basin is 186,460 km^2 in extension, and flows from Mato Grosso. The Madre de Dios is the largest fluvial tributary of the Madeira in terms of its flow. The river covers only 7% of the basin of the Madeira, and half of its valley is in Peruvian territory.[1]

The Beni River basin is 133,000 km^2 in area, and drops from a height of about 3,500 meters at a point close to the capital city of La Paz. The upper Beni has been severely transformed by agriculture, while the Beni lowlands are still protected, principally by the difficulties of access to the region.

Like most Amazonian rivers of Andean origin, the Madeira is classified by scientists as a whitewater river, meaning that its headwaters carry enormous quantities of nutrients, depositing them and thus providing a relevant richness to the soils of the Madre de Dios and Beni region, contributing to the regions' high biodiversity – by some estimates the highest on the planet.[2]

The Madeira is also distinguished by the series of rapids over which it descends through its upper course. No other Andean tributary of the Amazon has such extensive rapids, with 18 occurring along a 350 km stretch upstream from Porto Velho, Rondônia.[3] This has made transportation between Guajará-Mirim and upstream destinations in Bolivia and Peru with Porto Velho impossible, particularly in the times which preceded the construction of the BR-364 highway and other roads in Rondônia, and this obstacle to river transportation has inspired engineers to plot ingenious ways to overcome the limitations that the Madeira presents.

A problematic gateway to the interior of the continent

The motivation to build the Madeira hydroelectric and hidrovia complex can perhaps be better understood by the fact that, for hundreds of years, there have been attempts to develop a transportation link between the Atlantic coast and the Amazon lowlands along the Brazil-Bolivia border. In the days of the Portuguese colonization of Brazil, rivers were the primary access to the interior. The initial Portuguese occupation of the western Amazon occurred in the Guaporé Valley, and Vila Bela da Santissima Trindade was founded in 1752 as the capital of the Captaincy-General of Mato Grosso and Cuiabá.[4]

With the discovery of gold in Cuiabá, and later with the surge in demand for Amazon rubber, the imperative of opening transport links into the Amazon focused on the exploitation of the region's natural wealth.

In 1860, Bolivia and Brazil agreed to construct the Madeira-Mamoré railway to facilitate transportation of minerals between Mato Grosso and Pará. This would furnish Bolivia with an outlet to the Atlantic and Brazil with an alternative to transporting goods south to Buenos Aires via the Paraguay and Paraná rivers. However, attempts to build the railway in 1862 and 1877 failed, due to a high rate of tropical illness amongst railway workers.

In 1903, Brazil and Bolivia signed the Treaty of Petropolis. Under the treaty, Brazil made a commitment to build the railway between Porto Velho and Guajará-Mirim, and in return Brazil annexed the territory of Acre from Bolivia. Work resumed in 1907 at the height of the rubber boom, at a time when rubber was Brazil's second most important commodity after coffee. The initial 90 km stretch was inaugurated in 1910 and the final stretch in 1912. The railway was nicknamed "The Devil's Railway" for the fact that thousands of workers lost their lives, principally due to malaria and other tropical diseases. With the end of the rubber boom, the railway was de-activated in the 1930's.[5]

Various plans were put forth over the years for engineering works which could provide a permanent transportation link between the Guaporé and Paraguay Rivers. Perhaps the most radical was that discussed between the Brazilian foreign ministry and the U.S.

Atomic Energy Commission in 1967 to excavate a canal between the Guaporé and the Paraguay Rivers using nuclear explosives. The plan never was concretized and by the early 1970's, engineers lost interest in employing "nuclear dynamite".[6] The proposal to construct this connection emerged once again during the development of the Initiative for the Integration of South American Regional Infrastructure (IIRSA) around 1999.[7]

The road to the west

Policies aimed at stimulating the "development" of Amazônia have always had social, economic, security, and geopolitical implications. Following the military coup of 1964, renewed attention was paid by the Brazilian government to the colonization of Amazonia. The 1966 decree establishing the Superintendency for Amazon Development (SUDAM) left it clear that the economic development of the region was also aimed at inducing migration to the area, in order to populate what was seen as a vast, empty area.[8]

The perceived importance of this strategy to reinforce national security was also emphasized, as with the phrase "occupy (the region), in order to not have to hand it over", attributed to the then-Minister of the Interior, General Albuquerque Lima.[9] In 1967, the Program for National Integration (PIN) was created, and in 1971, areas within 10 km of roads in Amazônia were designated as federal lands, and the National Institute of Agrarian Reform (INCRA) was given the task of distributing these lands for colonization projects.[10]

In 1980, The World Bank approved financing for the colonization project called Polonoroeste, whose centerpiece was financing for the paving of the Cuiabá-Porto Velho highway, the BR-364, and for the consolidation of the infrastructure of colonization projects at nodes along the highway and connecting road spurs. Of a total budget of US$1.6 billion, the World Bank provided US$443.4 million in loans.[11]

One million migrants came to Rondônia, as its population swelled from 111,000 in 1970 to 1,130,000 in 1991.[12] This resulted in widespread deforestation, conflicts between

settlers and indigenous peoples, and eventually in the concentration of a significant part of cleared lands in the hands of cattle ranchers. In a single decade (1978-1988), 2,580,000 ha, nearly 11% of the state, was deforested.[13]

The World Bank later approved another project, the Agricultural and Forestry Plan for Rondônia, or Planafloro, designed to slow deforestation in Rondônia and neighboring Mato Grosso states by implementing a system of zoning territories for agricultural or other economic uses, and for conservation and sustainable use. During the project period of 1993-2002, the Bank provided US$149 million of a total project budget of US$204 million. Despite the fact that 20% of Rondônia was formalized as conservation units, including 21 extractive reserves and the demarcation of nearly all indigenous territories in the state, the rate of deforestation actually increased between 1992 and 2001, when the total area devastated in Rondônia increased from 36,800 km^2, or 15% of the state, to 60,700 km^2 - 25% of Rondônia..[14]

With the explosive acceleration in the exploitation of the land and natural resources of Rondônia came the need for expanded electrical energy generation. Samuel dam, on the Jamari River, was already unable to meet the state's power needs when inaugurated in 1989.

A mega-dam at Teotônio Rapids on the Madeira River denominated MR-1, which would have had an installed capacity of 6854 MW, was projected as a bi-national project with Bolivia.[15]

Damming the Amazon

The powerful flow of the great rivers of the Amazon basin has long been the object of the dreams of Brazilian dam builders, and today after most of the rivers of southern Brazil have had the greater share of their generating potential exploited by large dams, two-thirds of the country's hydroelectric potential lies along the rivers of Amazônia.

The initial Amazon basin dams were Paredão (now called Coaracy Nunes, 78 MW, Amapá state) and Curuá-Una (30 MW, Pará state) which provided energy to the cities of Macapá and Santarém respectively. However, Brazil's military government had its sights on larger projects, and in the late 1970's initiated a set of larger and extremely controversial hydroelectric dams which triggered a reaction both in Brazil and internationally.

Tucuruí, on the Tocantins River is projected to reach a generating capacity of 7960 MW when the installation of additional turbines, currently underway, is completed. Tucuruí was built primarily to power two primary aluminum smelters operated by Brazilian and transnational companies in São Luís, Maranhão state (Alumar) and Barcarena, Pará (Albrás/Alunorte). These large industrial facilities consume about 60% of the energy generated by the dam, and Tucuruí has provided electricity to the plants at highly subsidized rates for more than two decades, with the total subsidy in the form of energy estimated at between US$193 and US$411 million per year.[16]

The impacts of Tucuruí have been well-documented. The dam's reservoir flooded 3,007 sq km of the rainforest.[17] A case study by the World Commission on Dams found that 25,000 – 35,000 people were displaced, and the Parakanã, Assurini, and Gavião indigenous groups were also directly affected.[18] .

Perhaps the most striking case of the Brazilian government's disdain for environmental and human rights considerations in dam building was that of Balbina, on the Uatumã River in Amazonas state. Balbina, designed to provide energy for Manaus, flooded 2,360 sq km and generates an average of only 112 MW (installed capacity 250 MW). The dam forced the resettlement of one-third of the Waimiri-Atroari indigenous tribe.[19]

Samuel dam in Rondônia state (216 MW) suffered from miscalculations during the planning stage which forced the construction of a system of dikes around 20% of the reservoir. The rising water table continues to affect additional areas of the forest adjacent

to the reservoir.[20] More than 3,000 people were officially affected, with many other families not offered compensation.

Additional dams built in the Amazon basin include Guaporé (120 MW, Guaporé River), and Serra da Mesa (1275 MW), Cana Brava (471 MW), Lajeado (902 MW), and Peixe Angical (452 MW), all on the Tocantins River. Currently in construction on the Tocantins are Estreito (1087 MW) and São Salvador (241 MW). Currently in the environmental licensing process are Belo Monte (11,182 MW, Xingu River) and Serra Quebrada (1,328 MW) and Marabá (2,150 MW) on the Tocantins River, Santo Antonio (300 MW, Jari River), Teles Pires (1,820 MW) and São Manoel (750 MW) on the Teles Pires River, Tabajara (350 MW, Ji-Paraná River), Torixoréu (408 MW) and Couto Magalhães (150 MW) on the Araguaia River, and Dardanelos (261 MW, Aripuanã River). At least 60 additional large hydroelectric dams are currently being planned for construction in the Amazon basin by the year 2030.[21][22]

It is worth noting that, despite the creation of an energy planning agency within the Mines and Energy Ministry (the Energy Research Company, or EPE) and a softening in the rhetoric of the energy sector to mention environmental considerations in dam building, energy planning is still undertaken in private consultation between the government, the state energy sector, and private construction, utility, and power generation companies, and without public input.

Only when the environmental licensing process enters its final stages are energy projects opened to public comment. As evidence of the continuing gulf between this rhetoric and reality is the decision by state company Eletronorte in late 2006 to submit Marabá Dam for licensing. The dam would displace more than 40.000 people, and would flood part of the Gavião indigenous reserve, which was already impacted by the construction of Tucuruí.

The Madeira hydroproject re-surfaces

In 2001, Brazilian construction giant Odebrecht and state electric company Furnas were authorized by regulatory agency Aneel to carry out a new hydroelectric inventory for the Madeira River. The inventory evaluated three potential dam sites, and concluded that by shifting the axis of the proposed dam from a single, bi-national dam at Teotónio Rapids, as had been proposed in the 1970's to two separate dams at Santo Antônio and Jirau Rapids, the dams could avoid flooding Bolivian territory, and lose little in energy generating capacity.

The partnership was new in several aspects. For one, state company Eletronorte had always been granted exclusivity for building dams in the Amazon region, and was seen as responsible for environmental and cultural disasters notorious in Brazil and internationally, such as Tucuruí and Balbina dams. Odebrecht and Furnas had worked together to build Manso dam in the *cerrado*, or savanna region of Mato Grosso, and the Madeira project would be their first inroad in the Amazon.

A construction giant

The Madeira project would be Odebrecht's biggest project ever. The company was first established in 1944. Today, Odebrecht is the largest Latin American company in both petrochemical and engineering and construction. Odebrecht had more than US$13 billion in receipts in 2006, about two-thirds from the Braskem petrochemical company, and one-third from Odebrecht´s engineering and construction activities. The engineering company has built large-scale projects in Latin America, Europe, Southern Africa, and the U.S. and nearly doubled its income in the two years 2002-2004, ringing up US$ 1.8 billion in contracts outside of Brazil in 2004. It has participated in the construction of Itaipú (Brasil-Paraguai), Pichi Picún Léufu (Argentina), Capanda (Angola) and the San Francisco (Ecuador) dams, among many others.[23] Odebrecht also built the second bridge over the Orinoco, and supervised the expansion of the Miami Airport. Odebrecht has already gained several contracts for building IIRSA projects in Peru, including the IIRSA

Norte Toll Road, the Interoceanica Sul, and the Proyecto Integral Olmos, as well as the TGS gas pipeline in Argentina.

Odebrecht's influence during the Lula government has also grown, perhaps partly because of its support for electoral candidates. Studies show that Construtora Odebrecht, Braskem, and CBPO Engenharia, all part of the Odebrecht Group, provided about US$8 million in donations to candidates of all parties.[24]

Furnas Centrais Elétricas is a holding company of the Brazilian state electric company Eletrobrás which was created in 1957 to build the Furnas hydroelectric plant in Minas Gerais state. Its headquarters was later transferred to Rio de Janeiro. Furnas operates primarily in energy generation projects in the southeast and central-western regions of Brazil. Em 2006, the president of Furnas´ Administrative Council, Aloisio Vasconcelos was named by President Lula to be the new President of Eletrobrás. In April, 2007, he left to assume the position of Chief Executive of the dam building equipment manufacturer Alstom's Brazil operations[25], an indication of the incestuous relationship between public and private companies in the electric sector. In 2005, Furnas had profits of over US$400 million. Furnas operates various hydroelectric dams in Brazil, including Serra da Mesa, Manso, and Peixe Angical.[26]

The companies say they are pioneers in proposing the use of low-head bulb turbines, in order to reduce the area flooded. The turbines would be installed in an unprecedented configuration of 44 turbines in the powerhouse of each dam. Bulb turbines have never been used for dams with more than 290 MW of installed capacity, and the enormous array of bulb turbines planned for the Madeira, and the fact they would be the largest of this type ever constructed have raised questions about the stability of the energy which would be generated[27].

The project plan was floated at a time when "the apple" of the electric sector's eye was still Belo Monte dam.

Energy from the Madeira – For whom?

In August, 2004, Brazil's energy planning was placed under the responsibility of a new agency, part of the Mines and Energy Ministry, called the Energy Research Company (EPE). In 2006, EPE completed a new ten-year electrical energy plan, which projects that to meet predicted PIB growth of 4.2% per year, electricity consumption will have to grow at 5.2% per year, meaning that Brazil will need more than 4,000 MW of new installed electrical power generation each year. About 40% of the country's new electricity generating capacity by 2016 (counting the projected coming on-line of the second phase of the Xingu complex) would come from the Madeira dams and Belo Monte.

The government's insistence on prioritizing mega-dams in the Amazon over smaller hydroelectric projects, which face fewer environmental, social, and financial obstacles to construct has been criticized by some industry spokesmen, including Cláudio Sales, President of the Acende Brasil Institute, whose members are electric utilities. In an opinion piece published in the Estado de São Paulo newspaper, Sales refers to the dams as "the white elephants of the Rio Madeira," and says "the project has been celebrated by equipment and construction companies, politicians and local businessmen as sources of contracts and income for at least the next 10 years. They have sufficient experience to know that pharaonic projects like this one, run by state companies, always greatly exceed initial costs and timetable…Will we be returning to the model adopted in the 1970´s, where the future of the sector was decided by generals in the government?" Sales goes on to argue that "it´s unacceptable that you begin any energy project without the transmission costs being made explicit and incorporated...without this, the price of energy of the Rio Madeira will be distorted because it will not include the extremely relevant cost of the transport of energy more than 2,000 km to the centers of consumption".[28]

Hydroelectricity is considered by Brazilian energy planners as the cheapest form of energy available to Brazil, and this is given as the justification for the 10-Year Plan maintaining the percentage – approximately 75% - of energy generation from hydroelectric dams.

When initially presented in 2003, the Santo Antônio and Jirau dams were said to have a total cost, including navigation locks, of US$ 5.5 billion. This cost was increased in the official studies for the project to more than US$ 9 billion, even though the number of turbines was decreased, and along with it the installed capacity of the dams (from a total of 7480 MW to 6450 MW). When Brazil's electrical energy regulatory agency, Aneel, approved project feasibility studies in April, 2007, with a revised installed capacity of 6,494.4 MW, the projected total cost of the two dams had risen to US$ 12.6 billion,[29], a 129% increase over initial estimates.

Projected costs for the project's transmission corridor have also skyrocketed. At the 2003 presentation at BNDES, additional costs for the electrical transmission to the central power grid were estimated at US$ 650 million, while latest estimates are for the 2,500 km power line cost about US$ 4.2 billion[30]. This puts the updated costs for the two dams and related transmission system to at least US$ 16.8 billion, and by some estimates as high as US$27 billion.

Even Odebrecht admits that the energy generation costs of the Madeira Complex will be among the highest in Brazil, about US$ 65/MWh. This figure does not include the transmission costs. Government energy planners dismiss the importance of these figures, saying the Madeira Complex is "of structural importance", and will help implement the infrastructure which will permit construction of other dams in the central and western Amazon.

Who will be the companies who willing to invest in the Madeira Complex? Some energy-intensive companies have expressed interest in the project, including CSN, Alcoa, and Gerdau. In visits to Brazil, Russian and Chinese investors also declared interest in investing in the Madeira project. [31]

Energy generation aside, Odebrecht and Furnas took advantage of a new program destined to push forward infrastructure integration between the countries of South

America to launch the Madeira project. The IIRSA proposal is for a project which would be the cornerstone of South American integration through the creation, according to the companies, of a *hidrovia*, or industrial waterway 4,225 long. The objective of the hidrovia is to permit barge trains to cross the rapids of the Madeira River, making it possible to transport upstream and downstream, from Puerto Maldonado and Riberalta, on the Madre de Dios and Beni Rivers, to the Amazon estuary and the Atlantic. Grains, minerals, timber, and other Brazilian products could be transported to Pacific ports via multimodal road connections.

The project for construction of Santo Antônio and Jirau dams was officially presented at a seminar on IIRSA organized by Brazil's National Bank for Economic and Social Development, BNDES, along with the Andean Development Corporation, or CAF, in Rio de Janeiro in August, 2003.[32] Significantly, to form the Madeira-Madre de Dios-Beni waterway, and permit navigation of barges from Porto Velho to Bolivia, additional rapids upstream from the Jirau reservoir would also have to be flooded, and to do so, two additional dams would need to be built upstream. These would be the Guajará-Mirim dam (bi-national Bolivia-Brazil), built at the Ribeirão Rapids, with an estimated installed capacity of 3,000 MW and the Cachuela Esperanza dam on Bolivia's Beni River (600 MW). The Guajará-Mirim dam could flood a significant portion of the cities of Guajará-Mirim, Brazil, and Guayaramerín, Bolivia, which have a combined population of 100,000. Cachuela Esperanza is a rapids in Pando province. The only figures publicly available for the cost of the Guajará-Mirim (US$2 billion) and Cachuela Esperanza dams (US$1.2 billion)[33], are likely under-estimated.

The Madeira project is considered the "anchor project" of the Peru-Brazil-Bolivia hub of IIRSA. This group of projects includes road links between the Andes region and Peruvian Pacific ports and a connecting road link via La Paz, Bolivia. The Peruvian highway, or "Interoceanic Highway" plans the paving of a 2,586 km road between Iñapari, on the Bolivian frontier with Acre, to the Pacific. Iñapari is now accessible from the Brazilian city of Assis Brasil via a newly-constructed bridge, establishing a paved road connection from Rondônia (and central Brazil) to Peru.

In his case study of the highway, Marc Dourojeanni emphasizes the fact that the road improvements have been rushed ahead before the completion of environmental impact studies, and that the impacts on protected areas of high biodiversity could be devastating.[34] The official cost of the road is US$ 1.07 billion, and financing has been extended by PROEX, Brazil's Ex-Im Bank (US$ 417 million) and by the CAF, the principal multilateral financial institution backing IIRSA (US$ 310 million).[35]

In Bolivia, the Northern Corridor highway (1,386 km including the Peru spur El Chorro-Cobija, estimated cost US$ 250 million) is also part of IIRSA, The paving of the road connecting Guayaramerín on the Mamoré River with La Paz is being financed by the Inter-American Development Bank (US$ 153.1 million)[36] and by the CAF(US$ 42 million).

In both cases, the logic of the IIRSA hub is based upon the synergy between the expansion of navigability of the Madeira which would be made possible by the submerging of rapids between Porto Velho and Cachuela Esperanza by constructing four dams, and the paving of road connections linking the Bolivian and Peruvian Amazon with Pacific ports. Recent news reports have also mentioned Brazil's interest in importing gold and manganese from the Pando and Beni regions of Bolivia.

Soy: Devouring the Amazon?

Despite the fact that Brazil has been promoting the Madeira complex as a "solution" to future energy needs, it is clear that the hidrovia has always been a key motivation for constructing the project. Odebrecht and Furnas said, in presenting the project in Rio de Janeiro that agricultural production would increase by 25 million tons per year, on seven million hectares, with most of this increase assumed to be soybeans and other grains in Brazil. The Guaporé-Madeira hidrovia, they say, would also lower transportation costs for seven million tons of fertilizers, seeds, and pesticides. In addition, the benefits for

Bolivia would include an increase in agricultural production of 24 million tons per year – here again, presumably expansion of soy cultivation.[37]

The incentive for this expansion would be the lowering of shipping costs by US$30 per ton as a result of the implantation of the hidrovia, resulting in the "consolidation of the agribusiness industrial pole in the western region". In the companies' presentations, the environmental consequences of converting potential large expanses of Amazônia and the Chaco savannas in Bolivia to soy plantations are totally ignored.

The effects of expansion of soy cultivation in the Amazon have raised international concern. Soy is now considered to be one of the principal causes of Amazon deforestation, and may already have destroyed as much as 1.2 million hectares.[38] In 2006, Greenpeace produced a map of areas in Amazônia with conditions favorable for plantation of soy, which confirms that the Guaporé valley in Rondônia, and areas of the middle Madeira in Amazonas state, as well as lands in eastern and central Acre could well be part of the next soy frontier.[39]

Bolivia has already been seriously affected by expansion of soy cultivation. According to the Bolivian government, over 600,000 hectares of forests have been cleared and converted to soy in just the past three years, principally in the departments of Beni, Pando, and Santa Cruz. The government says that many of the companies responsible are Brazilian owned, and that Bolivia, under the Evo Morales regime, will move to expropriate these lands for agrarian reform.[40] A new study by the Conservation Strategy Fund finds that soy expansion spurred by IIRSA road and hidrovia projects could affect more than 142,000 km^2, with greatest impacts in northwestern Bolivia.[41]

In addition to increasing demand for soy and other grains for animal feed, mounting pressure to expand areas of soy cultivation for biofuels may also have an impact, -- Europe aims to have 25% of its transportation fleet running on biofuels by 2030, and the United States is negotiating the import of biofuels from Brazil.

According to Sílvio Pestana, president of the Brazilian agricultural research agency, Embrapa, "The important thing is to make of the 50 million hectares of degraded pastures that we have…Over the next 30 years, we will need to produce 100 billion liters of biodiesel. For this, we will need 40 million hectares...The basic question regards investments. In order to restore 20 million degraded hectares, we will need US$ 25 billion. It´s still cheaper to cut the forest. [42]

Soy is not nearly as effective as sunflower, *mamona (*castor bean), cotton, or oil palm in efficiency of oil extraction and the proportion of energy required to cultivate grains and produce bio-fuels. Besides indications that at least 60%, and perhaps 90% of Brazil's bio-fuels will be produced by agribusiness.[43], there is also concern that family farmers will concentrate on supplying mamona and grains for bio-fuel programs, sacrificing their ability to produce a nutritious food supply for their families.

Steamrolling the Madeira project through environmental licensing

In May, 2005, following the completion of feasibility studies, Odebrecht and Furnas contacted the Brazilian Environment and Renewable Natural Resources Institute (Ibama) to officially initiate the licensing process for the Madeira dams.

Given that the Madeira is a river which flows through more than one state, and given the enormous potential impacts of the hydroelectric project, jurisdiction for licensing the project is Ibama's responsibility. The licensing process has several stages – first, a preliminary license (LP), to "approve the environmental feasibility of the project and to authorize its location and technological conception"; then an installation license (LI), authorizing the project's construction; followed by an operations license "conditional upon an inspection to verify whether all the requirements and technical details in the approved project were developed and met during construction, and whether they are in agreement with those foreseen in the LP and LI."[44]

What followed in the Madeira Complex licensing process was a long period of negotiation between the companies and Ibama regarding the scope of the studies to be analyzed for the environmental licensing process. Ibama issued a draft terms of reference (TORs), and then held a public hearing in Porto Velho to solicit comments. If any changes were made to the TORs as a result of public comments, they are not apparent.

The negotiations resulted in the scope of the studies shrinking to limit Ibama's field of vision in its analysis of potential impacts of the dams. On November 17, 2004, Norma Pinto Villela, of Furnas´ Environmental Division wrote a letter to Luis Felippe Kunz Júnior, of Ibama´s General Licensing Coordinating Group. Furnas complained that "the methodological approach (of the proposed TORs) calls for a cumulative impact study of projects already built, in the construction phase, and identified for the Madeira Basin, including the Madeira River Hidrovia. We understand that, if we look at the entire basin, with a total area of 1,420,000 km^2, the study may not be possible, not only because of the requirement to include the hidrovia in its scope, but also be the spatial dimension of the area being studied".[45]

Furnas argued for the removal of the hidrovia from the studies, saying in the letter "...the dam project includes construction of navigation locks…We understand that navigation on the stretch of the Madeira River upstream from Porto Velho will be the object of a specific licensing process, when this activity if offered in concession."[46]

Brazilian courts have been insistent on the need to analyze waterway projects such as the Paraguay-Paraná and Araguaia-Tocantins hidrovias as a whole, before granting licenses for specific port facilities, for example. Several dams, including Tucuruí on the Tocantins River have been criticized for the dam builders' failure to install locks to permit industrial shipping along the river system. In the case of the Madeira project, which Furnas, Odebrecht, and Eletrobrás had publicly sold as the first step in implanting the hidrovia as part of IIRSA, it soon became unclear as to whether navigation locks would even be included in the project, and the environmental studies were analyzed without any reference to the hidrovia.

Ibama agreed to limit the study area to the stretch between Porto Velho and Abunã (on the Bolivian border), withdrawing any requirement for studies on the impacts that barge traffic and port construction as part of the hidrovia could have on ecosystems, as well as on the role of the hidrovia in inducing conversion of forests to grain monocultures.

It should be emphasized that the hidrovia continues to be mentioned by Brazilian officials as one of the principal motives for building the Madeira hydroelectric complex. In approving the feasibility studies for the Madeira dam projects, the electrical energy regulatory agency Aneel noted "the Madeira River complex is also comprised of the hydroelectric dams at Guajará-Mirim...and Cachuela Esperanza…This complex will permit, besides electricity generation, navigability from Belém to the interior of Bolivia, contributing to the socio-economic development and integration of this entire region".[47].

As described in the article by Jorge Molina Carpio in this volume, Ibama made a very significant mistake (or deliberate omission, if that was the case) by permitting studies to be restricted to a zone of direct impact arbitrarily cut off at Abunã, on the Bolivian border. This permitted the project proponents to justifiably avoid carrying out adequate hydrology and sedimentation (studies which could conclusively establish whether or not the project, as designed, would affect territory in neighboring Bolivia. It also effectively relieved the consortium from responsibility for analyzing questions such as fish migrations and mercury transport on the basin level.

The TORs were entitled "Terms of Reference for the Elaboration of the Environmental Impact Study and respective Environmental Impact Report - EIA/RIMA – Hydroelectric projects on the Madeira River AHE Santo Antônio and AHE Jirau ***and associated transmission system" (our emphasis).*** Despite this fact, Furnas succeeded in negotiating the transmission lines and their impacts out of the purview of Ibama for licensing the project. Furnas argued that "the rule proposed by the new model (of energy) differs from that established for generation, that is not requiring a preliminary environmental license, but only that the following approved documents must be delivered to Aneel (Technical-

Economic Feasibility Report, Report on Details of Alternatives, and Environmental Characterization Report)...this permits the studies detailing the path of the transmission corridor, part of the line´s basic project, will be completed only after construction of the dam is underway. At that time, there will be greater precision regarding the line project…In this way, we suggest that item 5 of the terms of reference be revised, in order to contemplate the transmission corridor, whether than its eventual path, within the context of technical recommendations to be adopted in the EIA/RIMA of the hydroelectric projects and associated transmission system".[48]

Furnas' logic was accepted by Ibama in January, 2005, and the EIA only mentions a potential 10 km wide swath that the transmission system may eventually take, without any careful analysis of its potential impacts. The omission of the transmission system from analysis by Ibama was especially grave given the fact that the Brazilian interconnected system has no capacity to carry 6,450 MW of electrical energy, which would be the peak generation of the two Madeira River dams, between Rondônia and the interior of São Paulo. Therefore, one of the longest electricity transmission corridors in the world would have to be built – according to official estimates, at least 2.500 km long, at an estimated cost of US$ 4.5 billion.[49] By any estimation, this transmission line is an essential part of the Madeira project, and will have very significant environmental and social impacts – but the consideration of these impacts was removed from the TORs.

In May, 2005, the Environmental Impact Assessment (EIA-RIMA) was delivered to Ibama). Over the next year, Ibama requested several complementary studies, in areas including hydro-sedimentology, downstream impacts, fish, and water quality.[50] Finally, in September, 2006, Ibama accepted the studies as complete, and scheduled public hearings in Rondônia. Following initial delays due to a court order obtained by the Federal Attorney´s Office, the hearings were held at Abunã, Mutúm-Paraná, Jaci-Paraná, and in Porto Velho in November, 2006.

Throughout this period, a relentless barrage of political pressure to approve the projects echoed from authorities in the Brazilian government, ranging from the Mines and Energy

Minister, to the Director-General of Aneel to President Lula himself. The President of Eletrobrás, referring to problems in licensing large dams referred to Ibama and defenders of the environment as a whole by saying "or the government bangs its fist on the table and liberates these energy sector projects or these people (environmentalists) will bring Brazil to a halt...it´s absolutely necessary that the government approves the two dams on the Madeira River…this year".[51] Together with incessant industry complaints about "barriers to development" posed by Ibama's delays in licensing the project, an atmosphere was created whereby it appeared that the eventual decision on licensing would be made on political, rather than on technical grounds.

A clear case of the electric sector's attempts to pressure Ibama into rushing to judgment and approving the project was the letter sent by Brazil's Mines and Energy Minister, Silas Rondeau to Marina Silva, Environment Minister in December, 2005. In the letter, Rondeau states "given the importance of the Jirau and Santo Antônio dams on the Madeira River, and Belo Monte, on the Xingu River, considered strategic priorities for the government in order to meet energy demand in Brazil by 2011 – if these projects are not rapidly approved, it would be absolutely damaging to the expansion of electricity supplies and will mean risks to society in terms of the potential for sustained growth and development in our country – it is important and indispensible to ask Your Excellency, once again, to take decisive actions so that you accompany the studies by Ibama and the that the environmental license is issued as soon as possible". [52]

Furnas and Odebrecht publicly portrayed the massive project on the Amazon's principal tributary as "nearly without environmental impacts" even though the scrutiny being paid to the studies by Ibama made it clear the project's impacts would be extensive and would permanently affect the Madeira, its ecosystems, and many more people than just those whose homes and land would be flooded by the reservoirs.

On March 21, 2007, eight specialists of Ibama, responsible for distilling analyses based on the available technical information, presented a 221-page opinion. They found the project studies insufficient, the probability that the affected area and intensity of impacts

would be greater than that admitted to by the companies, and that the projects could well affect Bolivia. That is, the information available was inadequate for a precise evaluation of the project´s potential impacts. Their recommendations was: "Given the high degree of uncertainty involved in the process; the identification of affected areas not contemplated in the studies; the failure to assess various impacts which cannot be mitigated or controlled to guarantee the well-being of populations and the sustainable use of natural resources; and the necessary observance of the Precautionary Principle, the technical team concluded that it is not possible to attest to the environmental viability of the Santo Antônio and Jirau Hydroelectric Dams, making a new Environmental Impact Study necessary, on a broader scale; addressing impacts not only in national territory but also trans-border impacts, including the realization of new public hearings. Therefore, we recommend that the Preliminary License not be issued." [53]

Nine days later, Ibama´s then-director of licensing, Luiz Felippe Kunz, issued a dispatch affirming "I do not accept the Technical Report…requesting its revision, concerning its dubious conclusions being that …it suggests that a new Environmental Impact Study be carried out". Kunz affirmed that independent specialists would be contracted to examine fundamental questions, that Ibama´s lawyers would be consulted regarding the possibility of carrying out studies in neighboring countries, and changed the emphasis of Ibama´s work to "define complementary information" to the studies.[54] A few days later, Kunz was dismissed as licensing director as part of a process where Ibama was divided into two organs – one to administer protected areas, and the other to issue environmental licenses.[55]

At the same time, the Brazilian government initiated a counter-offensive to belittle the opinions of the Ibama technical staff and to create a succession of new "facts" which would guarantee the project´s viability. An essential component was the presentation of the report by French hydrologist Sultan Alam, who was given the task of evaluating the engineering project for Santo Antônio Dam regarding the impacts of sedimentation. Alam´s study, limited in its scope, used simplified models to argue that fine sediments would be swept through the turbines during the flood season. [56] It was solemnly

announced by the Chief Minister of the Presidential Cabinet, as the solution for all those problems which, according to the Ibama technical staff, would have been caused by sediments. An initial problem regarding sediments was discarded…(he) considered the project very adequate, saying that there was no chance that erosion or sedimentation would cause environmental problems for the two dams. On the contrary, he greatly praised them". [57]

Ibama continued to treat Alam´s theories, as well as the efficacy of building fish passage canals to permit migratory fish to swim upstream, with skepticism. However, Ibama´s provisional new leadership, led by Bazileu Alves Margarido, formerly Ministra Marina Silva´s Chefe do Gabinete was installed to ensure the issuance of the license. Instead of new studies, or even complementary studies, Margarido asked Odebrecht and Furnas to respond to a series of questions corresponding to the technical issues raised regarding the project.

The companies´ responses, delivered to Ibama on May 11, 2007 were a mere formality. Accepting the "new" theory of Alam´s that no sediments would accumulate in the reservoir, the companies defended the narrow scope of sediment modeling, and cited the limited terms of reference agreed to by Ibama as justification for evading discussion of the project´s potential impacts on Bolivia.[58]

On July 9, 2007, Ibama issued a provisional license for the Santo Antônio and Jirau dams, signed by Bazileu Alves Margarido. The 33 conditions for the license were nearly all monitoring programs to be carried out once the dam is operational. The requirements for multi-dimensional sediment modeling attest to continued doubts regarding sediment build-up in the reservoir, but by demanding these studies only after the preliminary license was granted, Ibama indicated that whatever their results, the project would be permitted to move ahead.[59]

Civil Society groups mobilize

Civil society organizations in Rondônia had begun to evolve during the period when the World Bank projects, particularly Planafloro were being executed. In 1994, the Rondônia Forum of NGOs and Social Movements petitioned the Bank's Inspection Panel for an investigation regarding alleged violations of Bank policies in the Planafloro project.

In the case of the Madeira project, new alliances of NGOs formed to confront the plans to dam the river. A vehicle for the formation of this alliance was the Rondônia Forum for Debates on Energia (Foren). In January, 2006, the alliance published the pamphlet "Long Live the Living Madeira River". The organizer of the text, Artur Moret, with a degree in Energy Planning and a professor at the Federal University of Rondônia (UNIR), said "we have to show what is behind the construction of these dams, and that this model for the integration of the Amazon does not contemplate the needs of its people…"[60] 5,000 copies of the 22-page text aimed at opinion makers were distributed. The text included themes such as a loss of Rondônia´s historic heritage, the expulsion of 2,000 river bank dwellers, impacts on fish, the swelling of the periphery of Porto Velho with migrants, sedimentation of the Madeira River upstream, and negative impacts on plants and animals in the Moji Canava and Serra Dois Irmãos ecological reserves which would be affected by the dams.

A key component of this effort was the setting up of the website www.riomadeiravivo.org to disseminate news and documents regarding the campaign and the Madeira project. Key groups in this alliance were the Research Group on Renewable and Sustainable Energy of UNIR, the Indigenist Missionary Council (CIMI), the Pastoral Land Commission (CPT), the environmental NGO Kanindé, the network Amazon Working Group (GTA), the Rondônia Rubber Tappers´ Organization (OSR), the NGO Rio Terra, and the Dam-Affected Peoples Movement (MAB) through its Rondônia branch APREMARA (Association for the Preservation of the Environment and the Rivers of the Amazon). Diverse materials were produced, including newsletters, fliers and videos, in order to better communicate to the public the enormous importance of the

Madeira River to the forest peoples, for the environmental equilibrium of the Amazon basin, and therefore, why the Madeira Complex should not be built.

A boat trip marked the International Day of Action Against Dams. Significantly, the Bishop of Porto Velho, Dom Moacir Grechi, participated in the event, and said, "I have nothing against progress. On the contrary, I would like to see every person in the Amazon, everyone in Rondônia living with dignity. But, I am obliged to take a stand when that progress is doubtful, especially when we take into account what has happened with all the other hydroelectric dams in Brazil. According to what we´ve heard, the social and environmental impacts of these dams have not been positive".[61]. The Bishop carried out a religious celebration in the historic Madeira-Mamoré Railway Square, in Porto Velho, to help bring the protest to the attention of the community.

In May, 2006, three events in Porto Velho helped dramatize the confrontation surrounding the Madeira projects. The Energy Work Group of the Brazilian Forum of NGOs and Social Movements for Environment and Development (FBOMS) met in Porto Velho, and a parallel event on IIRSA included participation of Brazil's Network on International Financial Institutions (Rede Brasil), the Brazilian Network for the Integration of Peoples (Rebrip) and entities from Bolivia and Peru. The event also included presentations by technical experts, including hydrologist Jorge Molina and Edinaldo de Castro e Silva, who has studied impacts of mercury bioaccumulation in dams. Following the event, the Environment and Mines and Energy Ministries gave a training on the environmental licensing process, which led to polemical discussions regarding impacts of dams, particularly among representatives of the Gavião and Arara tribes, who had gathered in Porto Velho to express their opposition to plans to dam the Ji-Paraná River.

The groups also turned out in force at a "public hearing" on the Madeira dams organized by the City government of Porto Velho. At the meeting, Mayor Roberto Sobrinho announced his support for the project, as long as it promoted local development. "We don´t want to only see the wires passing overhead," he told the audience. Representatives

of the Mines and Energy Ministry, the President´s Cabinet, and of Furnas and Odebrecht portrayed the dams as essential for the nation, and an Odebrecht engineer said "these dams are a new type, which will have nearly no environmental impacts" Statements by Mayor Sobrinho that "the river bank dwellers will not have to move away, only move back a little to remain on the shore of the reservoir" did little to allay the concerns of the populations threatened with relocation.[62] Members of the alliance opposing the project expressed their opposition to the project in strong terms, and representatives of fishermen and indigenous people of the region also made statements regarding impacts the project would cause.

While non-governmental organizations were active in Porto Velho, and in raising questions about the project on the national and international level, MAB focused its actions on alerting river bank dwellers to the threats posed by the dams. To dramatize its opposition, MAB organized in July, 2006 "A March for Life", with 200 MAB members, in addition to members of the movements of Landless Rural Workers Movement (MST) and of Small Farmers (MPA) with support from FOREN, marching 210 kilometers along the BR-364 highway from Abunã to Porto Velho. Along the course of its march, MAB spoke with local residents about the high price of energy, saying that the Madeira dams would primarily benefit industries, rather than the population-at-large.[63]

Taking a different tact, civil society groups organized a Festival of river bank dwellers in Porto Velho in November, 2006. Emphasizing art and culture of the populations living along the Madeira, the festival included discussion regarding the project and music by local musicians, including the Hip Hop Movement of the Forest and Quilomboclada.[64]

Efforts were also underway to influence decision makers on the national and international levels. In June, 2006, 40 organizations active in the campaign against the damming of the Madeira sent a letter to President Luis Inácio "Lula" da Silva. The letter stated that "The damming will cause irreversible damages to its diversity, particularly its fish, affecting fishing one of the bases of the regional economy, and therefore of the survival of thousands of families. The social, environmental, and economic impacts of the dams will

be observed from the upper Madeira to its mouth and also on the Amazon River" and suggested that Brasil would be wiser to provide incentives for energy efficiency as an alternative to building the dams.[65]

The following month, 58 organizations from 23 countries sent a letter to the president of the Inter-American Development Bank, Luis Alberto Moreno, urging the bank to not finance the Madeira Hydroelectric Complex. In the letter, the organizations stressed the project's dubious economic feasibility, and concluded "In our view, a decision to finance the damming of the Amazon´s second largest river should not be taken without extremely careful analysis of the direct and indirect impacts the project would have, including its effect in increasing the area deforested in the Western Amazon."[66]

The IDB's response was six months in coming. In December, 2006, the bank's External Relations Advisor, Alfredo Barnechea, responding on behalf of the bank's president wrote "We will consider our participation in the financing of the project and pay special attention to the related potential environmental and social issues, including thorough analysis of the direct and indirect impacts…These and other IIRSA projects involve areas of great biodiversity. My colleagues and I appreciate your bringing those issues to our attention."[67]

Bolivians don´t want the dams

Contacts were also made between national and international environmental groups and the Bolivian Environment and Development Forum, or Fobomade, which had led the fight to stop the El Bala dam planned for the Beni River nearly a decade before. Fobomade began informing officials of newly-elected President Evo Morales' government about the project's potential effects on forests in Pando province. In October, 2006, representatives of communities and indigenous peoples in the border regions of Riberalta and Guayeramerín issued a declaration demanding that the Bolivian government "urgently intervene with the Brazilian government and international agencies, such as the United Nations, in defense of our territory, our rivers, and the plants

and animals, the environment and our way of life…" The declaration noted that the flooding caused by Jirau dam would mean the loss of fertile floodplain soils and that stagnant waters upstream from the dams would affect the water quality and health of Bolivians.[68]

Small farmers in Pando also protested against the dams. "We are not willing to assume all the social and environmental costs of the projects, including health problems with the spread of diseases such as malaria", said the Executive-Secretary of the Pando Small Farmers Labor Federation Manuel Lima.[69]

As a result, on November 7, 2006, Bolivia's Foreign Minister David Choquehuanca sent a letter to Brazilian Foreign Relations Minister Celso Amorim, citing "concerns with the probable ecological and environmental impacts" of the Madeira dams. The letter stated that "we consider, among the probable impacts, the flooding of Bolivian territory as an effect of the reservoirs, which would affect on one hand the Amazon forests in the Madeira basin, very rich in Brazil nut trees, and on the other hand the possibilities of building other dams to satisfy regional and local energy demand". The letter mentioned the possibility of the dams flooding the area where the Cachuela Esperanza dam would be constructed, which had been the object of bilateral accords between the two countries in 1984 and 1988. Choquehuanca proposed that a bi-national commission be formed to evaluate the possible cross-border impacts of Jirau dam. Bolivian environmental officials also convened technical and scientific experts to evaluate the Madeira River Hydroelectric complex and its possible effects on their country.[70]

In February, 2007, representatives of communities, NGOs, and labor unions from both Bolivia and Brazil met in Cobija, on the Brazilian border, and issued a letter to President Morales of Bolivia and President Lula of Brazil opposing the dams. The letter states "…Considering that the impacts would include the flooding of extensive territories on which we survive by carrying out sustainable activities such as collecting Brazil nuts in the Amazonian forest, fishing, and seasonal floodplain agriculture; and would also mean an increase in the incidence of diseases such as malaria, dengue, etc. , and the

disappearance of species, the extinction of commercial fishing, and the expulsion of populations living on the flooded territories…" and called on the governments to "Suspend the licensing process and give up plans to build dams on the Madeira, in order to free us of the threat which is hanging of the lives of our peoples." The letter was signed by 38 representatives of communities and labor unions in the region.[71]

This position was apparently supported by the Morales government, and affirmed during the president's visit to Brasília in February, 2007. Despite the fact that Lula announced the two presidents had agreed to study construction of a bi-national dam on the Madeira, Morales insisted that the project of Santo Antônio e Jirau dams be suspended pending further studies, but no agreement was reached..[72]

Independent experts find Madeira studies don't hold water

In June, 2006, the Rondônia State Public Attorney´s Office signed an Environmental Agreement with Odebrecht representing the consortium promoting the Madeira River dams. Under the agreement, the consortium agreed to finance a series of independent studies coordinated by the Companhia Brasileira de Projetos e Empreendimentos (Cobrape), based in São Paulo to analyze the EIA-RIMA for the project, and to issue two reports with recommendations regarding the studies and the project.[73]

It is now clear that the directors of the Public Attorneys intended the studies only to legitimate the project, and to help define mitigation measures that would help deflect controversies which could arise during the final stages of the project's licensing process.[74]

A group of consultants was selected to carry out the studies, including nationally and internationally-renowned experts on the Amazon. What the Public Attorney perhaps did not expect was that the experts would find fatal flaws in the studies and criticize the feasibility of the project itself.

Bruce Forsberg and Alexandre Kemenes of the National Institute for Amazon Research (INPA) identified the possibility that the mapping of the future reservoir area used satellite photos without adjusting for the height of the vegetation in the images, which could be as much as 20 meters high. “A reduction of 20 meters in the base level of the MDE (digital elevation model) would result in an increase in the limits of the flooded area to a curve at 95 meters (above sea level), which would mean an increase of more than 100% in the flooded area shown in the map. If this error really took place, all the impact studies carried out until now would be flawed. The direct and indirect áreas of influence would have to be redefined and all studies and simulations re-done.”[75]

Philip Fearnside, also of INPA, weighed in with his opinion that Jirau dam would flood Bolivian territory: “Even under the operational plan with various water levels, the level of water would increase at the height of the confluence with the Abunã River, located 119 km upstream from Jirau, which is the beginning of the stretch where the Madeira River forms the border between Brazil and Bolivia. This elevation of the water level means that lands in Bolivia which normally are exposed during low-water periods would be flooded during these periods (Molina Carpio, 2006). Also, sedimentation would raise the level of the bed of the Madeira at the height of the mouth of the Abunã River, creating a backwater effect which would raise the level of the Abunã. The Abunã River is bi-national, forming part of the Brazil-Bolivia border. Effects on this river were not included in the feasibility studies nor in the Environmental Impact Assessment. Besides, this refers only to the normal operation level, and the extreme operating level of 92 meters above sea level would mean even greater flooding in Bolivia would take place when there are higher than normal flows.”[76]

José Galicia Tundisi, an expert on reservoir management who has worked extensively for Furnas, and his colleague Takako Matsumura-Tundisi also found the studies to be inadequate: “The analysis of questions on the sedimentology studies should always consider the river basin as the spatial unity for evaluation of the problem...Sedimentometric data presented by the project promoters were colected on the basis of samples of sediments in suspension, while river bed sediments were not

collected, due to the inexistence of adequate equipment in Brazil. In this way, we understand that estimates of the sediment load of the river bed were not adequately carried out, as the project promoter admits. The results are inadequate, and very imprecise. So, measures of the river bed sediments were abandoned. In not measuring the sediment load, which certainly must present a mobile nature, subsequent calculations will also be tainted."[77]

Ronaldo Barthem and Michael Goulding, arguably the world's foremost experts on migratory fish of Amazônia predicted problems ahead for fish stocks in the region, if the dams were to be built: "*Dourada* and *Babão* climb these rapids annually and reproduce at the headwaters of the Madeira River, on the slopes of the Andes. Therefore, at least the populations of Dourada and Babão are threatened by this project. With the intensification of fishing (in Bolivia and Peru) of the reproducers, the maintenance of the reproductive population will depend more on the maturing of individuals that migrate to the rapids and less by successive spawning of older individuals, which are exposed to fisheries on the river bank. With this, the complete blocking of the upstream path of migratory catfish will inevitably affect the reposition of reproducers and the tendency of these populations upstream from the rapids will be to be wiped out in a short length of time".
[78]

Barthem and Goulding conclude "The occurrence of a homing behavior would make these species very vulnerable to the damming, because the blocking of the river would eliminate a distinct population, even if it were only temporary. During the period of the blocking, individuals would not have Access to the spawning grounds upstream from the rapids and the number of reproducers at the headwaters of the Madeira would decline over time, with their complete disappearance depending on the intensity of fishing on the banks and the time of the blockage. Without the eggs produced in this area, there would not be a return migration and this population would become extinct."[79]

The MPE ignored most of the experts' critical findings regarding the project's feasibility and the environmental impact studies, and in a public meeting presented a summary

report which stressed the need for a plan to mitigate the project's impacts, where possible, in what they term "An Agenda of Socio-economic, Environmental, and Institutional Viabilization of the Santo Antonio and Jirau dams".[80]

Still, the publication of the experts' documents achieved good visibility in the Brazilian press and internationally, serving as another alert regarding the huge problems lying ahead.[81]

The Fight Continues

With the preliminary license for the dams approved, the electric sector scheduled the auction for the concession for the dams. Then, the battle for the concession began. Odebrecht was denounced by its competitor Camargo Corrêa, for having made a deal with turbine manufacturers Voith-Siemens, Alstom, and VA Tech, which were forbidden from furnishing cost estimates to other consortia.[82]

The winner of the December, 2007 auction, as expected, was the consortium led by Furnas (39%), Odebrecht Investimentos em Infraestrutura Ltda. (17.6%), Construtora Norberto Odebrecht S.A. (1%), Fundo de Investimentos e Participações Amazônia Energia (FIP), comprised of the Banif and Santander banks (20%), Andrade Gutierrez Participações S/A. (12.4%), and Cemig Geração e Transmissão S/A (10%). Their bid of approximately US$45/MWh as the price they would sell energy to the national grid was well below what was expected, and apparently the companies are counting on making money by selling 30% of the energy on the open market. There is the possibility that public pension funds and BNDES will enter as shareholders – BNDES is expected to finance up to 755 of the project costs.

The auction took only seven minutes, and was marked by protests, both in Brasília and in Porto Velho. In May, 2008, Jirau was auctioned, and surprisingly the winning consortium was that led by the French water and energy giant, Suez (50.1%), and which included construction company Camargo Corrêa (9.9%) and state electric companies Chesf and

Eletrosul (20% each). The consortium announced it would move the Jirau dam site 12.5 km downstream to lower construction costs, a move which still has to be approved by Aneel and Ibama. Odebrecht threatened legal action on the grounds that the auction rules did not permit substantial changes in the project.

It is probable that the bitter struggle for the future of the Madeira River will continue for quite a while. Given the dams´ potential impacts on Bolivia, various communities from that country presented a complaint to the Inter-American Human Rights Commission of the Organization of American States. A Bolivian government delegation met with Brazilian officials in August, 2007, to demand that more studies be carried out regarding the project´s potential effects on their country. Legal challenges to the license are taking place. And, social movements and NGOs vow to continue their fight to prevent the destruction of the Amazon´s principal tributary.

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