

**Water Quality and Resources in the Upper Xingu, Mato Grosso, Brazil**  
**Report for the World bank AquaBio Project<sup>1</sup>**

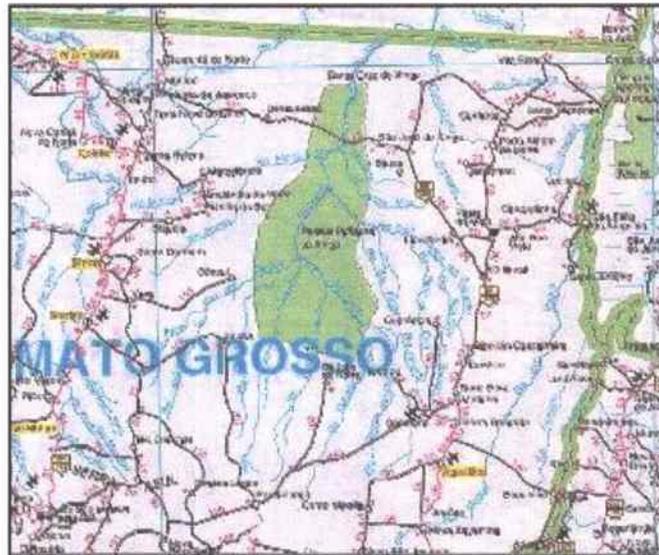
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**Abstract.** The headwaters of the Xingu river have been increasingly degraded by extensive deforestation and the run-off of waste and agricultural chemicals from intensifying soy cultivation and cattle ranching. The native peoples of the Upper Xingu have preserved the transitional forest and have maintained their own culture, but they are acutely aware of the contamination of their rivers. The villagers are uniquely vulnerable to declining water quality in that pollutants affect not only drinking water, but, potentially, fish (their primary source of protein) and manioc flour (which is washed in large quantities of water as part of its processing) and other foods. There have been epidemics of gastrointestinal diseases in the Xingu villages, and water quality has declined to the extent that each community now uses wells rather than river water. Analyses of samples of water from the Culiseu in June and July of this year were positive for the presence of E-Coli, indicative of continued fecal contamination of the water. The river system is further threatened by the construction of a new dam.

**Background.** The Upper Xingu region of Central Brazil is home to ca. 4,000 native peoples living in the Parque Indigena do Xingu, a vast reserve of c. 12,000 square miles. The *Xinguanos*, as they are known to Brazilians, are divided into nine separate ethnic communities speaking five unrelated languages and, within three of these groupings, mutually unintelligible dialects. They have nonetheless created a relatively homogeneous native culture based on intermarriage (c. 35% of marriages), trade and attendance at one another's rituals. The intermeshed kinship and political structure of the Xinguanos is relevant to considerations of AquaBio, in that they form loose federation in dealing with the outside world, as in their negotiations with Mato Grosso on the construction of a new dam (see below). Any projects by AquaBio in the area must take account (and may benefit from) this partly unified indigenous leadership.

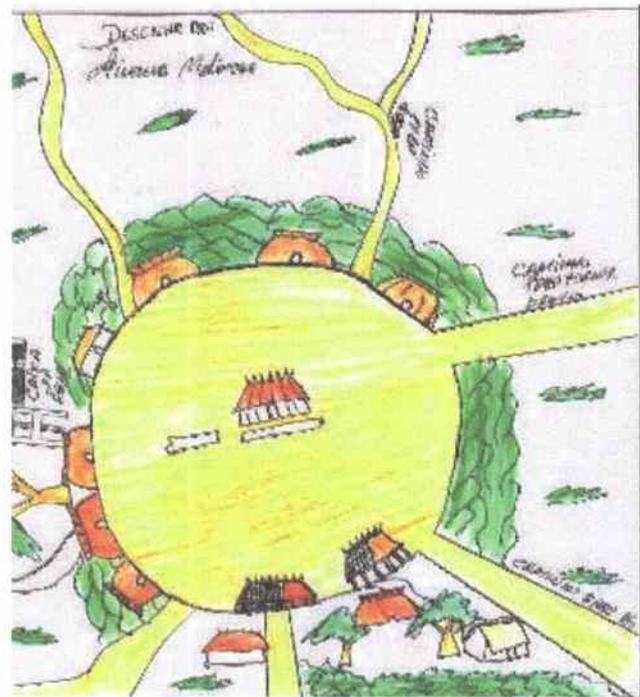
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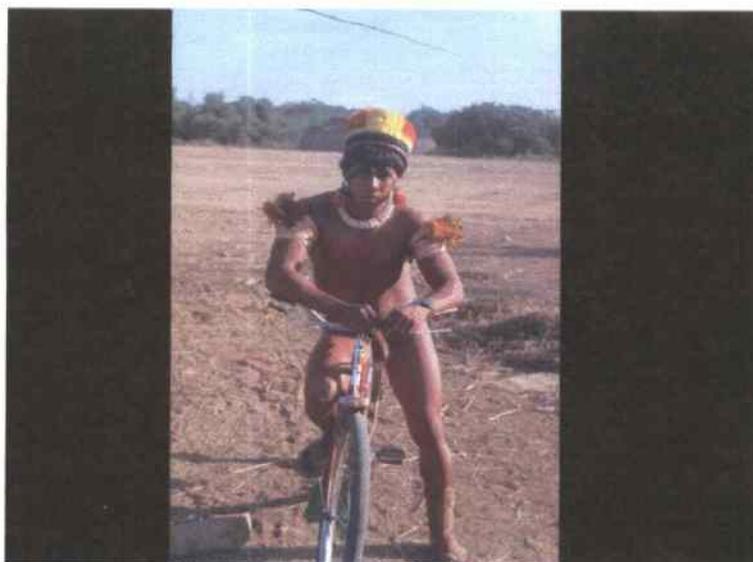
**Figure 1** The Mehinaku village of Uyaipuky, June, 2005. Note the water tower and fenced solar panels on the lower left (© Thomas Gregor, 2005).

**Below is Aiuruwa Mehinaku's drawing of his community, with the waterworks on the left and paths to the bathing area (a small stream) and the river labeled.**

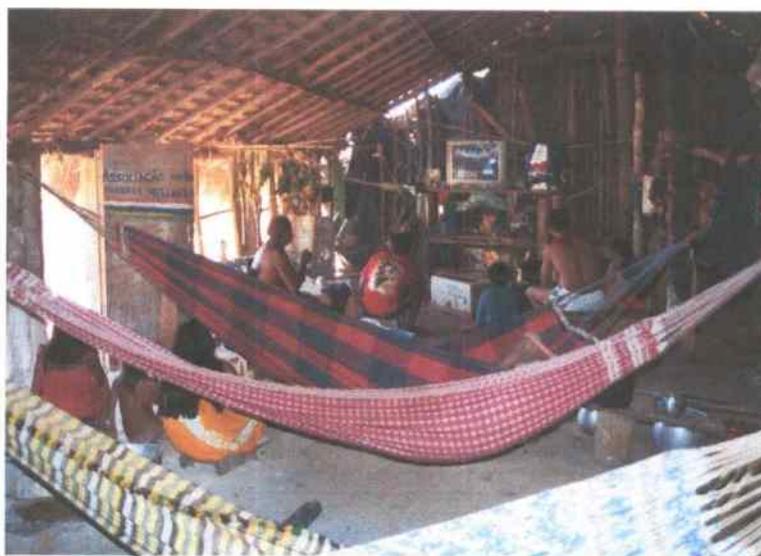


The region is well known among anthropologists as one in which native culture persists despite acculturative influences. To this day there is no missionization, roads, centralized electrical systems or an internally significant cash economy or wage labor. To be sure there are changes which are in striking contrast with my previous field trips (the first of which was in 1967). These, most visibly, are schools within many of the villages (certified through the 5<sup>th</sup> grade), television sets within some of the houses (connected to parabolic antennas and generators), motor boats, tractors, foot-treadle operated sewing machines, a few motor cycles, and many balloon tired bicycles (useful on forest paths and across the flood plain).

There has also been an attenuation of indigenous culture. The Mehinaku watch televised soap operas in the evening at a time when they used to recount myths to their children, and they are dependent on steel tools and fishing equipment in place of equipment crafted from natural materials. The process is abetted by an outward orientation of the villagers, who play regular soccer matches with teams from frontier cities, vote in metropolitan elections (one Mehinaku is a councilman [*vereador*] in Gaucha do Norte), and who are increasingly sophisticated and able to communicate with the “Kajiaba” (Brazilian). The contrast of cultures is at times visually jarring (see figures 2 and 3 below), but the overall picture is that of an essentially native culture and a struggle to maintain it in the face of temptations and encroachments from the outside. From the perspective of many Brazilians, the Xinguanos, who are physically prepossessing, beautifully adorned, and relatively free from contact with the outside, are quintessential native people. These are relevant data from the point of view of the project, in that, as a consequence, it is easier to mobilize support for the Xinguanos from Brazilian authorities. Moreover, the increasing sophistication of the villagers makes them excellent participants in demonstration or monitoring projects.



**Figure 2** Even in the absence of roads bicycles are all-purpose vehicles suitable for fishing trips or, adorned as in the photograph above, for visiting another community (© Thomas Gregor, 2005)



**Figure 3** The television is a major focus of interest even for those who do not speak Portuguese, for soccer games, world news and soap operas (© Thomas Gregor, 2005)

### **Dependence on Good Water: Rivers, Fish, Manioc Tubers and Drinking Water.**

**Rivers.** One of the larger tributaries of the Amazon, the Xingu is itself formed by five major rivers which course through its headwaters. During the dry season (April – September) the river channels are clearly visible, with white sand beaches along oxbows and bends. During the rainy season, the rivers spill over their banks, cover the flood planes and invade the forests. The region is poorly drained and vast areas are subject to flooding and some are more or less permanent swamps. When the Mehinaku villager recently divided (December of 2004) over allegations of witchcraft, the refugees had to move more than 40Kl upstream to the boundaries of the reservation before they came to solid ground suitable for a new village. The villages are permanent, or nearly so. The principal Mehinaku community, Uyaipyuku, is located along the Culiseu at 12:35 South, 53:25 West.

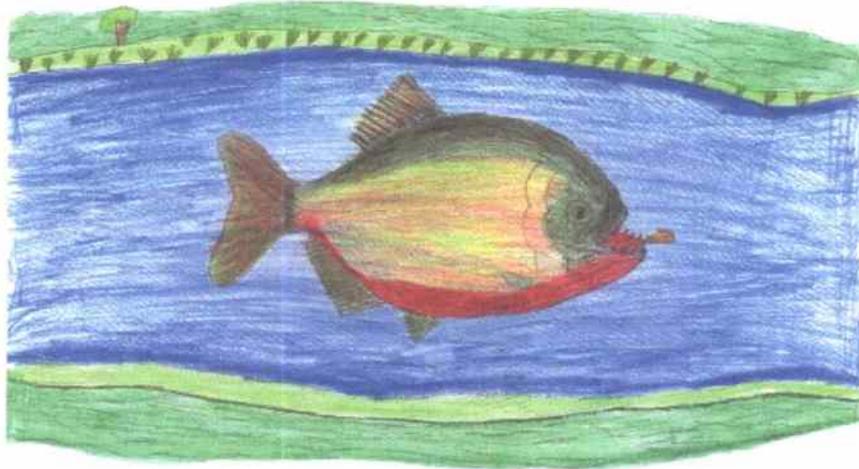


**Figure 4** The meandering rivers and oxbows are characteristic of the region (© Thomas Gregor, 2005)

**Water and diet.** The Xinguanos are uniquely dependent on good water quality in that they do not consume land animals as part of their diet. In the Xinguano world view, contact with the ground defiles and contaminates, so much so that individuals in liminal states, as in rituals of initiation, sit on mats or are carried from place to place. Animals are regarded as repulsive fare because they walk on the ground, and, as a result, are covered with ticks, wounds and dirt. Birds fly and monkeys live in trees, which makes them edible, although they are consumed in small quantities. Water is cleansing. Hence fish are the best food, in that they not only avoid the ground, but “they are constantly bathing.” The restriction on eating land animals is an ecological puzzle, in that the wild pig and deer, that could otherwise be hunted, destroy the villagers gardens. Nonetheless, the dependence on fish makes the villagers vulnerable to changes in water quality.

Given importance of water, it is understandably elaborated in myth and associated ritual practices. In indigenous cosmology the Xingu tributaries have their origins in mythic times,

when the sun broke a great ceramic cauldron containing all the waters of the region. Water itself has mythic origins, when it was found coursing through the root system of a giant tree. These considerations are relevant to Aquabio, in that for the Xinguanos, water is more than a source of material life. Water is sacred. It is linked to concepts of cleanliness, dietary, ritual practice, history and myth.



*Desenho: Karari Ribeiro*

**Figure 5** The villagers interest in fish shows up in many of their drawings, as in Karari's picture of a piranha.

**Fish.** The ecological "luxury" of depending nearly entirely on fish as a source of protein has been a successful adaptation for the Xinguanos. The rivers of the area, very much like the Pantanal of Mato Grosso, are highly productive. As an example, this July, two young men left the village before dawn. By early afternoon they returned with about 75 pounds of fish – enough, if evenly distributed, to feed the entire community for the day. This was a particularly successful trip, but not unexpected in the dry season. The changes that are unquestionably occurring in the ecosystem are not so glaringly evident that they have obviously reduced the catch at this time of year. During the wet season, fishing is far more problematic, and fishermen occasionally come home empty-handed. Traps and more extended trips make up some of the difference.



**Figure 6. Part of a day's catch: cooked fish are brought to men who have worked together on thatching a house** (© Thomas Gregor, 2005)

The dependence on fish as a protein source means that the Xinguanos are uniquely vulnerable to declining water quality. Mercury pollution is potentially a serious problem in the area, in that deforestation is directly associated with contamination by methyl mercury. Mercury contamination occurs through both man-made activities (as in gold mining) and from natural sources. In either case it is widely distributed throughout the environment by wind and rain, often at considerable distances from the point source. Studies in Canada (<http://www.ucar.edu/communications/staffnotes/0107/mercury.html>) have shown that mercury is deposited on forest foliage, and then concentrated and released in the course of wild fires. The massive deforestation and continued burning of the forest and foliage outside of the PIX, and the possible contamination of the rivers and fish, is potentially serious matter in the Xingu. The issue is particularly significant in that fish is the villagers' major source of protein. The problem is compounded by the fact the staple carbohydrate is also extremely susceptible to contamination from polluted water, as is discussed below.

**Manioc Processing and Salt (KCl).** Drinking water, until the 1980s, was uncontaminated by industrial or agricultural activity. On my initial trips to the region in the late 1960s, the nearest permanent Brazilian settlement was that of Xavantina, some 175 miles distant. I drank the water, directly from the rivers, with no concern about infection or toxicity. This excellent water quality was of the greatest importance to the villagers, not only for drinking, but also for processing manioc flour, which, along with fish, is the staple of their diet and the source of nearly all their carbohydrates for much of the year. Unprocessed, manioc contains toxic levels of prussic acid, a volatile cyanide based compound (HCN). In the course of turning a tuber into flour, the cyanide is dissolved in wash water, which is itself boiled, and then safely consumed as a sweet drink. A great volume of water is used to process each batch of manioc flour, so that impurities in the water will be concentrated in the flour. In this sense, the villagers not only drink river water, they consume it in their food.



**Figure 7. Manioc processing requires large volumes of water to wash away cyanide toxins, which are subsequently eliminated by boiling. Polluted water will yield contaminated flour** (© Thomas Gregor, 2005)

A second possible source of human ingestion of concentrated toxins is the production of salt (potassium chloride). This is a specialty of the Mehinaku (each of the Xingu groups is associated with a trade monopoly) who manufacture salt from the foliage of the water hyacinth. To the extent that the water is contaminated, the salt may be as well.

### **Degradation of the Xingu River Systems**

The demarcation of the Xingu reserve (completed in 1987) has protected nearly all of the villagers traditional lands but not the headwaters and the larger watershed of the region's rivers. Stimulated by demand from China and Japan, vast areas of the transitional forest in the region have been replaced by farms for soy, rice, and cattle ranching. As seen in the photo below, taken in July, 2005, the contrast between the indigenous areas, which are nearly entirely forested, and the surrounding farms is stark. New small frontier cities are now within miles of the reserved area, include Gaucha do Norte, initially settled by soy farmers from Rio Grande do Sul. Dramatic maps and photographs showing the extent of preservation of the forest in the PIX and deforestation beyond its borders are available at

[http://www.socioambiental.org/inst/camp/xingu/pgn/index\\_html](http://www.socioambiental.org/inst/camp/xingu/pgn/index_html).



**Figure 8** Approaching the Xingu reserve from the east, the forest has been replaced with plantings of soy beans, rice and cattle ranches (© Thomas Gregor, 2005).

**The impact of deforestation: fauna and witchcraft accusations.** The result of deforestation has been massive yet also subtle, leading to unexpected consequences, as, for example, increased accusations of witchcraft. Hence the Xingu region is currently richer in large fauna than has ever been the case in my many trips to the area. Jaguars were rare in the past. On numerous nights we heard them growling in the forest. Large bore, of a species previously unknown to the villagers, had begun to invade the gardens and destroy crops. These changes were presumably caused by habitat destruction outside of the region. The Mehinaku explanation was that witches within the villages had maliciously attracted these animals<sup>2</sup>.

**Water pollution and threats to health.** The environmental impact of pollution is visible in the garbage that accumulates along the banks of the river. During the dry season, with the retreat of the waters, one encounters trash in improbable places – garbage bags hanging from high up in the branches of trees bordering the rivers, empty plastic oil cans along the shore, soda bottles and other litter. These are not common, but they are a shock in what was formerly a pristine environment.

During the dry season, when I conducted my observations, the rivers were at their cleanest. With the first heavy rains the accumulated litter, herbicides and insecticides leached from the soils of the fazendas flushed down river in a wave of trash and contaminated water. Kunu Mehinaku (“Carlinho”), reported to me (November 21, 2005), that the river had turned “the color of chocolate.” The darkened water he described is quite unlike anything I have observed in the past in the Xingu, and is likely to be caused by the tremendous volume of soil and dust that is swept by the wind and rain from land that is unprotected by the root system of the forest. The land on to the east of the Culiseu tilts gradually towards the river, and the soil is notoriously friable. Edson Wegner, the very much concerned mayor of Gaucha do Norte, with whom I discussed the issue, explained that streets in Gaucha become torrents of mud which form deep channels. I

<sup>2</sup> I offered the habitat destruction explanation of the invasion of bore and jaguars to a villager who had insisted they were caused by witches. His response was “that too.”

observed the same phenomenon in the new Mehinaku village of Utawana, where the foot path from the Culiseu, in the course of less than one rainy season, had become a trench, in places more than a meter deep.

More ominous than the color of the water, was that with the beginning of the current rainy season there were significant fish kill. Since the first rains, however, the most obvious signs of pollution have waned, but as the waters rise the impact will, presumably, spread. By mid rainy season the rivers begin to overflow their banks, inundate the broad flood plains and even enter the margins of the forests, thereby saturating the environment with a mix of organic and chemical wastes. In evaluating and responding to the degradation of the river system, any effort at intervention must take into account that the riverine environment in the upper Xingu is far broader than the narrow river channels.

The impact on the health of the villages has in all likelihood been substantial. Since the intensification of deforestation, the Mehinaku village was struck with waves of gastrointestinal illnesses. According to once of the villagers:

“It started in 1996. Each year got worse. 1999 was the worst of all. There was diarrhea vomit, it was horrible. My brother almost died. We had stomach pains and it hurt when we urinated.”

In extreme cases, water contamination leads to an increased frequency of miscarriages, and there is anecdotal evidence that this occurred among the Mehinaku:

“My wife had four miscarriages, as did my sister . . . there were many others. No one knows if it was the water, or the diarrhea.”

We do not know with certainty if these illnesses were caused by contaminated water, but the timing of events, the presence of e-coli in the water (see below), and the improvement of the villagers health after the advent of wells is suggestive.

**Solar powered wells.** In 2002, in response to declining water quality, FUNASA (Fundação Nacional de Saúde) drilled wells in Upper Xingu villages. Costing c. R\$80,000, the Mehinaku water works include solar panels which power a pump that brings water up from more than 60 meters underground (see figure 9). The water is stored in a water tower, and connected to a network of pipes that carry it to a faucet in front of each house. The system works effectively and reliably, except during periods of rain when the pump does not function. The positive impact has been on village life can not be overstated. After the installation of wells, the epidemics of water born diarrhea no longer occurred. The benefits extend further, in that the village women formerly carried up to 20 liters of water in ceramic pots on their heads from the river, more than a kilometer distant. The consequences of such portage were (anecdotally), stillbirths and, over the period of a life time, damage to the spine.

At present, the waterworks are maintained by Kunu Mehinaku, who is employed by FUNASA as an “Agente Indigena de Saniamento” an environmental worker, who also disposes of garbage in a burn pit outside of the village. At present the village uses approximately 3500 liters of water

per day, far more than was ever brought from the river by human portage, the bulk of which is used for bathing, followed by manioc processing and drinking. The system is very reliable, the tank requiring only semi-annual cleaning by the FUNASA employee. The only negative aspect of the system is that the socialization that used to occur on the path to the bathing area is far less frequent. In general, the well and waterworks appears to be an effective intervention in which FUNASA can take pride.



**Figure 9** Faucets in front of each house provide ample water (© Thomas Gregor, 2005)

**Analysis of Culiseu River Water: Pesticides, Herbicides, Fertilizer, Biological Waste and Pathogens.**<sup>3</sup> I performed two field analyses of Culiseu water, one at the traditional village of Uyaipyuku in early June, the second in late July at Utawana, the new Mehinaku village at the border of the Xingu reserve. The results (particularly the negative findings) should not be regarded as definitive, as they do not meet the sampling procedures and other technical requirements for a proper analysis. Nonetheless, the “Watersafe” test kits I used claim to respond to the minimal levels of contaminants that define the Environmental Protection Agency’s current water safety standards. The tests for chemical pollution, notably lead, nitrates and nitrites (from fertilizer and other chemical waste [but not methyl mercury]) and potentially dangerous herbicides, such as Atrazine and Simazine, were negative. This is superficially reassuring, in that the claimed sensitivity for the tests is high (for example, the level considered safe for Atrazine is three parts per billion, or less than the equivalent of one drop in a swimming pool). Chronic exposure to Atrazine (the herbicide of choice for the cultivation of soy and one of the most commonly used herbicides in Brazil), may cause weight loss, damage to the cardiovascular system, cancer and retinal degeneration [see EPA fact sheet, <http://www.epa.gov/OGWDW/dwh/t-soc/atrazine.html>.] Atrazine is banned in France and Great Britain, though broadly used in the United States.

<sup>3</sup> Dr. William Hamilton, (PhD, PE,) was kind enough to advise me on sampling procedures and interpretation (and limitations) of the results of the technical tests. Dr. Hamilton is currently Project Engineer/Water Resources, Barge, Waggoner, Sumner & Cannon, Inc., Nashville, TN, and until recently /Assistant Professor of Engineering at Vanderbilt University.

Regrettably, my tests do not provide a full picture. They were conducted during the height of the dry season, more than two months after the last rains. Runoffs from the fields had come to a halt. Nonetheless, my test results for E-Coli, which is used as a general marker for intestinal tract bacterial contamination and a proxy for pathogens, were unmistakably positive at both Mehinaku villages, and above EPA limits. Untreated Culiseu water, even during the dry season, is probably unfit for human consumption.



**Figure 10: The agricultural chemicals used in fields outside of the Xingu reserve near Gaucha do Norte ultimately reach the Culiseu. The loose, dusty soil (note the wheel rims and truck body) may also be swept into the river system.**

The sources of bacterial contamination are apparent. They include runoffs from municipalities and towns along the Culiseu, including Gaucha do Norte; and the access of cattle to the Culiseu (some of which are periodically killed by jaguars, who leave the rotting carcasses by the river). During the rainy season these sources of contamination are much more extensive. According to Edson Wegner, mayor of Gaucha do Norte, the main streets of the town become torrents of water, which, along with waste from fazendas and cattle operations, eventually ends up in the Culiseu.



**Figure 11 Cattle ranches near Gaucha do Norte on land that was once forest** (© Thomas Gregor, 2005)

An additional source of fecal contamination in the Culiseu is from commercial fishing and even tourism (there is now a *pousada* on the Culiseu just beyond the limit of the Xingu park). The river waters are still sufficiently rich to attract fisherman who set up camp alongside the Culiseu and market their catch in Gaucha do Norte. The camps, two of which I visited, are rudely constructed, impermanent, and clearly intended for use during the dry season, although in one case the fisherman had invested the effort to build a stairway down to the river. The camps' latrines were near the water's edge and would clearly be a source of contamination with the advent of the rainy season.



**Figure 12 At the frontier: the southern limit of the PIX is marked by a floating sign warning fishermen against trespass** (© Thomas Gregor, 2005)



**Figure 13 Beyond the limit of the PIX, a boatload of fishermen wave from their craft** (© Thomas Gregor, 2005)



**Figure 14 Tamalui Mehinaku at a fishermen's camp on the edge of the Culiseu. The black plastic sheet in the background screens a latrine** (© Thomas Gregor, 2005)

**The Dam along the Culuene.** Water quality, the health of aquatic environments and even the presence of normal volume of water in the Xingu environment depends on governmental protection of the headwaters. During my visit there was great concern about the construction of a new dam along the headwaters of the Culuene, which can only have a negative impact on the environment and the lives of these down stream. In exchange for substantial resources (R\$ 1,330,000) and 50 hectares of land the villagers have held sacred, the Xinguanos agreed not to impede the construction of the dam. R\$ 300,000 will be used to construct a “training center” with unspecified aims, which some interpret as educating the villagers to deal with the environmental damage done by the dam. In addition, each of the villages will receive a smaller

sum for unspecified uses. The contract (see attached) is not signed by a representative of FUNAI, and would therefore seem to be of questionable legality.

In July of 2005 the Mehinaku held a public meeting in Uyaipuku (the traditional village) to discuss the dam. They had a copy of a videotape of recent construction work on the dam, and were very disturbed by what they saw in terms of its implications for fishing and water quality and volume. They did not believe the assertions by the company that fish ladders would permit migratory species to swim over the dam (see below). One of the younger men, echoing a generally held sentiment, said "What will our grandchildren say? That we gave all of this away for money that was long ago spent?"

When I questioned the villagers as to why they signed the contract, some of them said that they were coerced. They were told they had "three choices": fight the dam legally and lose; resist violently and be shot by Paranatinga Energia's "pistoleiros"; or accept the money and land. Equally relevant, is that the Mehinaku believed that they will not be immediately affected by a dam on the Culuene, which is of far greater importance to the Carib speaking communities. Hence they allowed them to make the decision.

On December 30th the web site *Amazonia* (<http://www.amazonia.org.br/noticias/noticia.cfm?id=192830>) published a news article in which Pirakuma, the brother of the most influential of the Xingu chiefs, Aritana, claimed that the agreement with Paranatinga Energia was improper. He alleged that the villagers had signed the contract without reading it, that the contract was highly technical, and that it was only now that they understood what they had signed. Moreover, Pirakuma stated that the Xinguanos would go to war if the work on the dam continued. More realistically (war is anathema to the Xinguanos) the Ministério Público Federal (MPF) and Funai, according to the article, have declared the contract to be without legal value in that the villagers were not adequately consulted.

From the perspective of an outsider, the contract is problematic, though not because it was too technical or hard to understand. The issue in question is the alleged element of coercion (the "three choices") and the fact that the contract never specifies what the villagers were giving up in exchange for the largesse. As it stands, the document has the appearance of buying acquiescence. The issue is made even more problematic by the involvement of Paranatinga Energia and Blairo Maggi, governor of Mato Grosso, who are heavily invested in the dam project as interested principles. Maggi, the owner of the Maggi group, is himself the largest private producer of soy in Mato Grosso. Presumably the Maggi Group has an interest in the development of Mato Grosso and the availability of low cost energy.

The impact of the dam is surely of considerable concern. A number of the Xingu fish are migratory, and others move substantial distances in pursuit of migratory species. Fish ladders are not necessarily efficient (in one study only 2% of fish entering the ladder system reached the top step; see FAO paper which references a number of studies, section 3.4.1, [http://www.fao.org/documents/show\\_cdr.asp?url\\_file=/DOCREP/004/Y2785E/y2785e02a.htm](http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/004/Y2785E/y2785e02a.htm)), and also a detailed examination of the problem in "Efficiency of fish ladders for neotropical ichthyofauna" (<http://www3.interscience.wiley.com/cgi->

[bin/abstract/93520267/ABSTRACT?CRETRY=1&SRETRY=0](http://bin/abstract/93520267/ABSTRACT?CRETRY=1&SRETRY=0)). There are many other environmental questions as well, including the impact of the dam on the volume of water in the Culuene and the possible eutrophication of the water behind the dam.

**Monitoring the Xingu Ecosystem.** One of the major goals of AquaBio is to monitor riverine ecosystems, including the headwaters of the Xingu. The Culiseu, reaching as it does to the South and East, is exceptionally situated for monitoring. It drains newly developing agricultural regions, including the new municipality of Gaucha do Norte, and is one of the major rivers forming the Xingu. The Mehinaku, with two communities on the Culiseu, including Utawana at the very Southeastern corner of the indigenous reserve, are ideally located for such a project. Specifically, it could be facilitated by Tamalui Mehinaku (see Figure 14) who is deeply concerned about the ecosystem. He is a resident of Utawana, and an elected *vereador* of Gaucha do Norte. He works closely with Edson Wegner, the mayor of Gaucha, who is himself very supportive of the Mehinaku and concerned about the environmental impact of the town and the surrounding agricultural enterprises on the ecology of the region.

### Conclusions

In failing to protect the headwaters of the Xingu, Brazil has placed the indigenous peoples of the region at substantial risk. The newly drilled wells are an essential protective step, but ultimately the quality of fish, soil, manioc and other staples of life depend on the rivers in the region. The pace of agricultural activity is intense, and the economies of two new frontier cities (Canarana and Gaucha do Norte) now service and depend on the large farms and ranches in the region. These changes can hardly be reversed, in that they are themselves tied into global markets and political decisions beyond the reach of the Xinguanos, or for that matter, in all probability, the World Bank. Each rainy season will bring a new torrent of water, mud and pollutants from farms, ranches and cities through the river systems, across the flood plains and into the forests. The burning of the surrounding forests carries its own risk of air borne toxic compounds which augment the contamination of the rivers.

Although the pattern can not be reversed it surely can be monitored and perhaps mitigated. Below are summary conclusions and respectful suggestions for Bank efforts:

1. Water is central not only to Xinguano subsistence, but also to their ritual culture, their diet, their concept of purity and their mythology.
2. Substantial changes are underway in the Culiseu ecosystem caused by deforestation and runoff from the fazendas and ranches in the area. The results of relatively simple field analysis of the river performed for this report should be followed up with more sophisticated technical monitoring, for Atrazine, Simazine and similar pesticides and fertilizers, but also for methyl mercury, which would be an extraordinarily dangerous contaminant in the Upper Xingu.
3. Water quality has unquestionably been affected as evidenced by the need for wells in the villages and positive tests for e-coli at two locations. Fish were apparently abundant during the time of my field trip, but there are reports of fish kills associated with the advent of the rains.

4. The Xinguano dependence on fish, manioc, salt and other products processed with water make them uniquely vulnerable to pollution. As such, attention to the Xinguanos may be a reasonable priority for Aquabio, particularly in that they have been good stewards of their lands, which in contrast to the surrounding area, remain forested.
5. The location of the Mehinaku in two communities at the very Southeastern corner of the PIX make them especially suitable for a monitoring or demonstration project in the southern headwaters of the upper Xingu region. There is a built in political structure with willing and highly placed participants should AquaBio wish to become engaged in the region.
6. The dam currently under construction on the Culiseu demonstrates the political complexity and multiple interests engaged in the development (and ecological degradation) of the Xingu region. It is also clear, however, that the Xinguanos also have considerable political impact, in that they may yet be able to annul an agreement which seemed irreversible. The support of the Xinguanos is likely to be crucial to any project AquaBio initiates in the Xingu headwaters.