

**Baía do Castelo: Local Community Participation in
the Upper Paraguay River Basin, Pantanal Wetland,
Mato grosso do Sul State**

Debora F. Calheiros
Center for Agricultural Research in the Pantanal (CPAP)
Brazilian Corporation for Agricultural Research (EMBRAPA)

INTRODUCTION

In the Pantanal wetland in Brazil (140,000 km²) there are only two protected areas: Taiamã Ecological Station (11,200 ha) and National Park of Pantanal Mato-Grossense (135,000 ha); the last one is in the Ramsar list of wetlands of international importance, especially as waterfowl habitat (30/06/95).

The community of Baía do Castelo (Castelo lake, Mato Grosso do Sul State, Brazil) is a community of local people that have lived there for about 150 years. The area considered under influence of this lake is 12,800 ha, representing only 9 % of all Pantanal area. In this region there aren't any more indigenous communities like in the past. Only one community that lives in the North Pantanal, in Ínsua Island in the Paraguay river. The name of this tribe is Guató. There are 19 families, with a population of nearly 130 inhabitants. The families form groups but are independent, with independent crops. They have plantation of manioc and banana to commercial trade. The crops for livelihood are sugar cane, papaya, bean, corn and pumpkin; they have also 30 cattle. With a little boat they do livelihood and commercial fishing (mostly pacu and piranha) at Corumbá city. They change fruits and vegetables for rice, salt, wheat, coffee and cigarette with the people of a small village (Porto Índio) near to them. They use the exchange system between themselves and maintain a community organization (Araujo, R. M. P., pers. com).

Ecological Profile of the Area

Covering an area close to 140 thousand km², the Brazilian Pantanal is an extensive alluvial plain considered the largest freshwater wetland in the world. The Pantanal is generally defined as the floodplains of the Upper Paraguay River Basin (UPRB) near the geographical center of South America, mostly within the Brazilian territory, with smaller areas in the north-east of Paraguay and south-east of Bolivia.

As in the other tropical wetlands, annual flooding (the flood pulse) is the most important ecological phenomenon, resulting in seasonal inundation and desiccation of extensive floodplains. In the Pantanal, besides of annual flooding there is a high interannual variability in the flooding regime, where there is a period of drought years followed by a period of high water years.

The upland drainage basin surrounding the Pantanal occupies 359,000 km² and consists of elevated plateaus and low mountains. The land subject to inundation is low lying (80-150 m), and much of it is composed of alluvial fans as a vast complex of internal deltas. (Welcomme 1985, EDIBAP 1979)

**Commissioned for the
Project in Response to Ramsar Recommendation 6.3**

The drainage of Pantanal (tributaries and rain water) floodplain is complex. It is constituted by small streams, drainage lines, drainage lines with deeper channel, lakes, lagoons (marginal or oxbow) and rivers. The Paraguay river is the principal drainage system of this Basin. The major tributaries are the rivers: Jauru, Cabaçal, Sepotuba, Cuiabá, Taquari, Negro, Miranda and Apa.

The Pantanal is characterized by a very slight rate of declination, with small inclination from east to west (30 a 50 cm/km) and even smaller from north to south (3 a 15 cm/km) through the region (Brazil 1992) and has rivers with very sinuous slope.

Significant portions (about 70%) of the Pantanal are submerged from four to eight months per year by water depths varying from a few centimeters to more than some meters (Brazil 1979). The Paraguay river floodplain is one of the most deeply inundated parts of the region, but outside of river channels depths do not usually exceed 6 m and are in general around 1-2 m (Calheiros; Hamilton, in press).

The fluctuation in Paraguay river level is unimodal and ranges 2-5 m over the course of year, typically peaking in April-July in the region of Ladário station. This peak in the river level occurs a few months after the peak rainfall (November-March) because the extensive floodplains delay the progress of flood wave that takes about six months to pass through the Brazilian territory (Calheiros; Hamilton in press; Carvalho 1986).

The rivers, coming from the uplands, generally draining thick sandy soils, deposit a lot of sediments when they reach the plain. After the entry in the Pantanal, most of tributary rivers lose water to the floodplain through distributaries and overbank flow and form a very extensive inundated area.

Besides the tributaries there is along the right margin of Paraguay river and hydrologically linked to it several large lakes nominated regionally “baías”: Uberaba, Gaíva, Mandioré, Vermelha, Castelo and Cáceres (inside bolivian territory). The flux direction in the marginal lakes depends on the hydrological phase: from the lake to the river in the falling and dry phases, it turns in the flooding phase and in general, after reaching certain levels returning to the river, now in the flood phase, after the junction with all the system.

The climate is tropical with a marked wet and dry seasons. It is hot and humid in the summer and cold and dry in the winter. The annual average temperature is 25°C, occurring maximal absolute temperatures in the period between September to December with more than 40°C. Between may and July, the temperature fall and the minimal average temperature reach bellow 20°C and the minimal absolute can arrive at 0°C.

Rainfall and potential evapotranspiration show a pronounced seasonal cycle with excesses from November to March. The mean annual rainfall and potential evapotranspiration during non-drought years were 1,295 and 1,471 mm, respectively. Most of the uplands areas surrounding the Pantanal show a similar seasonal cycle, although rainfall is significantly higher in some parts of surroundings uplands, particularly in the north (EDIBAP 1979, Brazil 1992).

The vegetation on the basin includes cerrado savanna, semideciduous forest, xeric scrub and

Commissioned for the Project in Response to Ramsar Recommendation 6.3

gallery forest along rivers. Trees and shrubs are often present but usually have sparse canopies in areas subject to inundation, allowing herbaceous plants to coexist in the understory. Extensive stands of trees dominated by a single species are common. The most important of these species include the Cambará (*Vochysia spp.*), which often grows in dense patches throughout the region, and the Carandá palm (*Copernicia alba*) and Paratudo (*Tabebuia aurea*), which commonly occur as more open stands in the southern Pantanal (Hamilton et al. 1996).

On the floodplains, aquatic or semi-aquatic vascular plants grow profusely during the flood season and are dominated by floating and rooted emergent forms that can tolerate fluctuating water levels and often covers much of water surface (Prance; Schaller 1982). The most abundant species include *Scirpus cubensis*, *Eichhornia azurea*, *E. crassipes* and *Salvinia spp.* in more deeply flooded environments. Rooted emergent species with more vertical, erect stems colonize areas of shallower water, and sometimes develop extensive stands of one or a few species, including *Cyperus giganteus*, *Thalia geniculata*, *Typha domingensis*, *Pontederia cordata* var. *lanciofolia*, *Ipomoea sp.*, *Oryza sp.*, *Paspalum spp.* and *Polygonum spp.* (Calheiros; Hamilton in press; Hamilton et al. 1996).

The Pantanal supports a great diversity and abundance of wildlife. Over 650 species of birds have been identified. The region is one of the world largest breeding grounds for wading birds, an important migratory bird stopover point, and probably the most important area in South America for wetland birds. Over 260 species of fish have been identified (Britski et al., in press) with about 10 species caught for commercial purposes. Large numbers of other species of wildlife exist in the region, encompassing approximately 90 mammal species, 50 species of reptiles and over 1,000 species of butterflies (Brown, 1984). Some of the most unique animals in the world inhabit the Pantanal, including the giant anteater (*Myrmecophaga tridactyla*), giant river otter (*Pteronura brasiliensis*), maned wolf (*Chrysocyon brachyurus*), capybara (*Hydrochoerus hydrochaeris*), tapir (*Tapirus terrestris*), jaguar (*Panthera onca palustris*), puma (*Felis concolor*), caiman or jacare (*Caiman crocodilus yacare*), marsh deer (*Blastocerus dichotomus*), howler monkey (*Alouatta caraya*), blue hyacinth macaw (*Anodorhynchus hyacinthinus*), jabiru stork (*Jabiru mycteria*) greater rhea (*Rhea americana*) and woodstork (*Mycteria americana*) (Resende 1995).

Baia do Castelo

The Baía do Castelo (Castle lake) is a marginal lake in the floodplain of the Paraguay river north of the city of Corumbá (18° 34' 38'' S, 57° 34' 00'' W), located on the Bolivian-Brazilian frontier. Its area is nearly 12,800 ha (lake, floodplain and upland).

As a part of these floodplain it has the most common ecological characteristics of it. Vegetation in the floodplain surrounding Castelo lake is a mixture of savanna and woodland, with extensive stands of palms (*Copernicia alba*). During inundation, emergent aquatic and semi-aquatic plants colonize most of the floodplain.

The wetland type, in according of the Ramsar categories is Inland Wetlands, and includes the following types:

- Riverine floodplains, includes river flats, flooded river basins, seasonally flooded grassland, savanna and palm savanna;
- Permanent freshwater lakes (over 8 ha), includes large oxbow lakes and Seasonal

**Commissioned for the
Project in Response to Ramsar Recommendation 6.3**

freshwater lakes (over 8 ha), floodplain lakes.

Major Value of Wetland

In the UPRB, the concentration of rain in the summer (Brazil, 1992), associated with a regular relief, little inclination and predominance of thick recent alluvial sediments make the flood wave move slowly by the Paraguay river in south direction.

The Pantanal functions as a big water buffer system, releasing very slowly the water accumulated during the rainy/flood season, behaving as a water regulator for the Pantanal itself as well as downstream, maintaining inundated area and navigation conditions even during the dry season. The annual and pluriannual cycles of flooding of the UPRB rivers are the region's most important ecological phenomena. Practically, all aquatic and terrestrial life within the Pantanal depends upon the timing and magnitude of the floods. Plant and animal behavior, including that of humans, is influenced, if not dictated, by the annual hydrologic cycle of the region.

Wetlands are considered "ecotonal communities" because are transitional zones between aquatic environment (lotic and lentic) and terrestrial one. This transitional environment presents high biodiversity and productivity (Petts, 1990). The extension of the inundation area and the period of permanence of waters in the inundated fields determine the availability of the habitats and extremely promote the high primary and secondary production in the aquatic system.

Fish migration, plant flourishing, birds breeding, caiman nesting are strongly regulated and dependent on water level. When water level begins to decrease, migratory fishes starts to shoal, and by the end of the dry season, generally by September/October, all of them are migrating upstream, forming spectacular shoals. After breeding on the upper reaches of the rivers, they move again downstream, by January/February and enter to the flooded areas and marginal lakes to feed. Similar process occurs to alewives carried passively by the river currents into the flooded areas, in which they find food and shelter. They stay there until water begins to lower, when adults return to the main channel by June/July, beginning another upstream migration (Resende 1995).

Species almost extinct in other parts of Brazil have vigorous populations in the Pantanal region like marsh deer, pampas deer (*Ozotocerus bezoarticus*), blue hyacinth macaw, jabiru stork and capybara (Resende 1995). Through aerial census, Mauro (1993) and Brazil (1997) estimated likely 36,000 marsh deer population and 3 millions of caimans, respectively.

The following are considered endangered species in Brazil, that live relatively safe in the Pantanal: giant anteater, giant river otter, maned wolf, tapir, jaguar, puma, neotropical river otter (*Lutra longicaudis*) and bush dog (*Speothos venaticus*) (Resende 1995).

In the period of May/1994 to April/1995 was obtained officially 1,434 tons. of fishes, of which 28.1% corresponds to professional fisheries and 72% to sport fisheries in the Mato Grosso do Sul State (Catella et al. 1996). This estimate is true underestimated, because not all fish are officially recorded. The area of maximum inundation of the Pantanal is 43,850 km² (Cadavid-Garcia 1986). Considering that a tropical floodplain may generate catches from 17 to 60 kg ha⁻¹ year⁻¹ of fish (Welcomme 1985), the potential catch in the Pantanal ranges from

**Commissioned for the
Project in Response to Ramsar Recommendation 6.3**

74,500 and 263,000 t. year⁻¹ (Catella et al. 1996).

Once entering the inundated field, going far way from the principal channel, the diversity of habitats, and therefore the diversity of species, increase. Little variations in the water level and enlargement of dry periods could take irreversible consequences in the organic matter availability and therefore in the primary and secondary productivity.

The maintenance of water quality in the Paraguay river system is related with the maintenance of hydrodynamic and geomorphologic characteristics of all the system. The Paraguay river shows stronger floodplain effects than most other rivers because of the high degree of river-floodplain contact (Hamilton et al. 1997). For example, the nutrient retention in the floodplain, due to these characteristics have great importance in the productivity of the system, and consequently in the sustenance of biodiversity, as an area of food and refuge to many aquatic organisms, like fish (Oliveira; Calheiros, in press a, b).

The biodiversity in the Pantanal region is high, and the species survey studies are yet incipient (Calheiros; Oliveira, in press).

The floodplain modulates the discharges regime, promote the stability of river hydrochemistry and significantly reduce the superficial drainage (runoff) by increasing evaporation losses (Brazil, 1979).

In the Pantanal, nearly 262 fish species were described (Britski et al. in press) what is higher than the Paraná river (Middle and Lower regions) where 161 species were found (Cordivola de Yuan 1992). Neiff (1990), affirms that the greater richness of fish species in the UPRB would have relation with the unimodal slope of its hydrological regime characterizing a high level of environmental stability. Thus, this kind of environment presents a bigger development of inundated areas (19-24 % of total area).

Human Environment Relationship

The hydrology and hydrochemistry of the upper Paraguay river and its adjacent floodplains remain little affected by human activities. Human impact has been mainly through the introduction of cattle and the increased use of fire during the last 200 yr., which have influenced the vegetation throughout the region (Prance; Schaller 1982). A substantial fraction of the upland basin has recently been deforested for grazing or agricultural purposes (4.98% of total area of Pantanal, and 16.6% of forested areas, in according of Silva; Abdon - in press), but the floodplains are used mainly for cattle grazing during dry season.

The river system is largely unregulated, with the only significant dam located on a tributary of Cuiabá river. Water pollution probably has little effect on the hydrochemistry of the rivers within the Pantanal, although increased soil erosion resulting of recent agricultural development of the uplands may be significant (Hamilton et al. 1997).

An improved understanding of river-floodplain interactions is important for the Paraguay river in particular because a major navigation project known as the Paraguay-Parana Waterway or Hidrovia is currently under consideration. This project may require channel modifications that could alter natural hydrological dynamics of the region and consequently the extension of inundated area (Ponce 1995).

Commissioned for the Project in Response to Ramsar Recommendation 6.3

The Tourism Industry is recent in the Pantanal. It is taking a great dimension, been the sport fishery the most important. The main threats are the increase of garbage, the action of ship waves on the river banks increasing erosion, the potential over-fishing on baits (fish and crabs) and, by other hand, social problems (sexual tourism).

The flooding is a special problem to the cattle farmers since 1974. The very dry period of 1964-73 corresponded with expansion of cattle reaching within the Pantanal, and the unforeseen return of high floods in 1974 resulted in large losses of cattle and since then this problem repeated many times.

Socio-Economic Profile of the Area

Human population density is low in the Pantanal and is most of the surrounding uplands (<2/km²: IBGE 1989). Cattle ranching is the main economic activity. Of the a total of approximately 4,000 farms, 3,000 have up to 1000 ha. The tradition of cattle ranching in the Pantanal goes back to approximately 200 years. The cattle is raised in a very extensive system (1 animal/3.6 ha), based on native pastures. The flood brings nutrients to the terrestrial system and functions like a environmental pressure to maintain the plain in the firsts steps of succession process maintaining the grasses vigorous. Both crop and cattle farmers make use of fire to make manage the land. However, in the last two decades this use is intensified and uncontrolled, despite of prohibited legislation.

Fishing is a traditional activity performed nowadays by 3,000 fishermen. As said before, Tourism is an increasing activity in the Pantanal, mainly for fishing.

Potential uses of the Pantanal resources are caiman natural population management for leather, meat and other products, capybara for meat and leather, and feral pig for meat production, now under research.

There are a few human settlements in the Pantanal with the characteristics of Baía do Castelo. These are different within the region due to its small property size (10 to 500 ha, generally), and forming little villages with local community closely integrated with ecosystems. The access and transport in the lake is done by boat. The nearest city is Corumbá at three hours by 25 Hp motorboat and 12 hours by 9 Hp.

Approximately thirty families live in Baía do Castelo. The village is arranged in a single line along the edge of the lake and has a small Protestant church, a public primary school, and a hotel catering to fishing tourism; there aren't health centers. They commonly get married between themselves.

The state of environmental conservation is good within the locale, where we have: small cattle farms, subsistence fishing and a little fishing tourism and trade.

The house's orientation facilitates access to the water for drinking, cooking, cleaning and fishing for food and recreation. They grow manioc (preparing manioc flour), bean, corn, watermelon, pumpkin, bananas and other fruits and vegetables and raise a few cattle. Crops and cattle have both domestic and commercial uses and are sailing at the markets of Corumbá. There is no disparities in relation to education and health, but there are about 5 families with more assets. There is a family of the wood craftsman.

**Commissioned for the
Project in Response to Ramsar Recommendation 6.3**

Baians primarily fish only a few species for personal consumption (pacu, *Piaractus mesopotamicus*; pacu-peva, *Metynnis maculatus* and piranha, *Pygocentrus nattereri*) and a few species of fish and crab to sport fishers as bait (e.g. tuvira, *Gymnotus carapo*).

The state of the local natural resource stocks and flows permeates practically all aspects of local life. Local people depend upon the quality of environmental services (water and fish) derived from this lake-river system for their survival. The local population has a good life quality and well-being, because there are health and good quality/quantity of food.

History of Land Ownership and Management Practices in the Area

The legal status of the land is the private property. The main threats to the natural environment of Baía do Castelo, and, thus, to the well-being of Baians include deforestation on the adjacent lands (Bolivian frontier and some farms); the Paraguay-Parana waterway project; agrochemical use, deforestation, increased erosion and sediments transport in/from the highlands and mercury use in gold mining operations at north of Pantanal.

The Baía do Castelo is a very small subsystem of the Upper Paraguay River Basin. As such, the people of the Baía have little control over the quality and quantity of water and water borne goods and services that reach them. Commercial and sport fishing are, largely, managed at the municipal or state level. Baians are not commonly consulted in such matters. However, Baians are highly dependent upon what they can harvest from the land and the water.

They do manage their small plots of land (the most is 10-100 ha) and make ample use of forest products, however. They use wood from the forest to make their boats and their homes; they use forest products for medicinal purposes and raw materials for crafts. Access or local management of these forest resources is unknown at this time, but could be investigated.

The management of their wetland has been sustainable up to now. However some areas in the larger properties suffer a higher degree of deforestation action to enhance cattle production, probably since the last two decades of high inundation. Some of the inhabitants of Baía do Castelo have a smaller portion of land in the upper side of the lake. In the other side of their remainder land, which is plain, the cattle grazes in the dry season, being necessary to cross the lake with the animals. In the high water period this inundated area remain without use.

Political-Governance Context

In Brazil the government system is democracy with emphasis on direct citizen participation. But the level of popular participation is little expressive because this chance of participation is recent, around 10 years, after a period of successive dictatorships. The education level and the political participation are still low and promote little involvement and interest of community in political and ecological aspects.

In the region of Baía do Castelo, there are two major leader families that centralize the organization of the community, but not the decisions, that are taken in assembly. The community enforce State and Municipal laws, besides Federal laws.

Commissioned for the Project in Response to Ramsar Recommendation 6.3

Nowadays the involvement of local people in wetland conservation is low, because the quality of the environment is still good. An example, is the question of the waterway project in the Paraguay river, with consequences in all floodplain area of Pantanal including Baía do Castelo. They don't have a critical opinion about this because they don't have any information, although some of them have access to television and radio. A strong campaign of environmental education is necessary there.

At present, the Mayor of Corumbá City has demonstrated a great interest about environmental questions using it as a slogan, but in relation to the waterway project, for example, has given way to political pressures.

There aren't official policies to facilitate the involvement of local and indigenous communities in wetland management. There is only a recent project with Guató tribe by non-governmental organization (Ecologia & Ação - ECOA, International Rivers Network - IRN) and Federal University of Mato Grosso do Sul State (UFMS). There is also a ecological research by Center for Agricultural Research in the Pantanal (CPAP).

Involvement of Stakeholders

The groups concerned about management of the Pantanal wetland at present are only the governmental institutions cited ECOA and IRN besides WWF and Conservation International. But, specifically, in Castelo lake just CPAP has maintained ecological research activities.

The historic occupants of this lake, in the last 150 years, are long-term settlers from north region, belonging to Mato Grosso State now. Commercial users of resources (wood from Bolivia), professional fishermen and tourists are frequent in this area; only two absentee landlords maintain their farms with a responsible manager.

As said before, the people of Baía do Castelo have a relation of subsistence with the wetland and therefore the maintenance of its environmental quality is primordial. The different stakeholders are: the hotel owner, a rich family, the trade/transport boats owners, the professional/sports fishermen, the Bolivians wood's explorer and the Navigation's Company owners. Only this last category and the professional fishermen are well organized in a form of association and business.

The waterway project is a development initiative that will be promoting the navigation's company at short and middle-term, but under long-term perspectives the previsions are pessimist due to the great environmental impacts in the wetland functioning and hindering the livelihood of local communities.

People/Institutions with an Active Role in Management

In the region of Baía do Castelo, besides the traditional local community management there aren't any other people involved in wetland management.

Crucial Factors that Promoted the Involvement of Local Community

Commissioned for the Project in Response to Ramsar Recommendation 6.3

The abundance of natural resources; a satisfactory level of local welfare and a relative development; a relative effective enforcement (including gradual sanctions about fire use and deforested areas) and, finally, the existence of dedicated ecological projects of a research institution (CPAP) are the factors that promoted or are promoting the involvement of local community in wetland management. It's better to say not necessarily "involvement", but, at least, woke them to become conscious of the necessity of taking care of wetland uses.

Results

The main result (costs and benefits) of local participation for the wetland ecosystem is the success in maintaining the ecosystem functions and protecting biodiversity. In true, as there is a use of low proportions in the wetland of the Castelo lake area due to a small population size (about 200 inhabitants) a sound management is still made. Only small impacting actions of deforestation, fire use and flood control have been made in this area.

The government authority involved in wetland management that actually acts on the Baía do Castelo region is the CPAP, through ecological research. The local community knowledge of the lake-river system and of a natural phenomenon of fish kills was very important to this ecological research study (Calheiros; Hamilton in press; Calheiros; Ferreira 1996; Calheiros et al. in press). This study project involves improving the understanding of complex ecosystem functions and depends upon local information for both its methodological approach and future management efforts. We demonstrated the high quality of local knowledge of locally observable natural phenomena and considered the appropriate applicability of these knowledge in natural scientific research.

At present, there isn't a wetland management plan, but it's extremely necessary to do a deeper social and ecological research in this community, including environmental education programs based in local experience. The aim would be to recuperate the local information and knowledge of this community that has lived for a long time in Pantanal wetland.

The young people are uninterested about the way of life of elderly relatives because the attraction of urban life is strong. Thus, they are losing the deeper relation with environment of the old generations.

It's necessary to strengthen and to value the knowledge of this community that detain much comprehension of system functioning and thus obtain more subsidies to management actions.

RECOMMENDATIONS

Based on the experience of this case study, the local community, and the indigenous community mentioned above, must be involved in wetlands management decisions and actions. The active involvement of these communities would be the base to further a future wise use of wetlands. In fact, the most of local residents depend on wetland resources for their immediate survival.

The environmental education using the local knowledge could be a form to involve local residents to maintain sustainable uses of natural resources but now, in a more conscious way based in ecological and conservationists ideas.

**Commissioned for the
Project in Response to Ramsar Recommendation 6.3**

The achievement of the ecological and social projects based in Ramsar guidelines seems to be the better form to involve this local community. They are very accessible to the information but maybe they can have difficulties to incorporate new ideas. It's necessary a long-term work of consciousness.

The first step in order to advance the negotiation process, would be a informal agreement with stakeholders. In this way, proposals to alter their uses of nature resources would be assimilated more easily. After this phase, formal agreements including procedures to enforce might be signed.

The social and environmental NGOs and the CPAP (to provide ecological scientific basis) could be charged for the implantation of Ramsar based projects. The monitoring and evaluation procedures would be done by the same institutions, through a specific projects or by the Universities through the social/ecological academic studies.

ACKNOWLEDGMENTS

To Andrew Seidl (CSU - USA) to his suggestions in the first steps of this case study and to Leonardo H. L. Borges to the English revision.