



New Paraguay-Paraná Waterway: A comprehensive analysis

Analysing the political, economic, social, and environmental
conjuncture and feasibility of the "new" proposal
for the Paraguay-Paraná Waterway



Wetlands
INTERNATIONAL



New Paraguay-Paraná Waterway: A comprehensive analysis

Analysing the political, economic, social, and environmental
conjuncture and feasibility of the “new” proposal for the
Paraguay-Paraná Waterway

Wilson Cabral de Sousa Júnior
Demerval Aparecido Gonçalves
Thiago Carlos Lopes Ribeiro
Mayara Camila Scur

2019



Wetlands
INTERNATIONAL



This publication was conducted within the framework of the Corredor Azul Programme of Wetlands International, funded by

club ecology

© 2019 Wetlands International Brazil

The contents of this publication may be freely reproduced for educational, promotional and other non-commercial purposes. Prior permission is required for other forms of reproduction.

ISBN 978-85-69786-05-4

This publication can be cited as: SOUSA JÚNIOR, Wilson Cabral de; GONÇALVES, Demerval Aparecido; RIBEIRO, Thiago Carlos Lopes; SCUR, Mayara Camilla. New Paraguay-Paraná waterway: a comprehensive analysis: an analysis of the political, economic, social and environmental conjuncture and feasibility of the "new" proposal for the Paraguay-Paraná waterway. Campo Grande, MS: Mupan, 2019. Corredor Azul Programme. Wetlands International. Brazil.

Wetlands International

Brazil

+55 67 3045 5456

contato@wetlands-brazil.org

wetlands-brasil.org

The material presented in this publication and the geographical designations employed do not imply the expression of any opinion whatsoever on the part of Wetlands International Brasil concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or borders.

International Cataloging in Publication Data (CIP)

New Paraguay-Paraná Waterway [electronic resource] : A comprehensive analysis : analysing the political, economic, social, and environmental conjuncture and feasibility of the "new" proposal for the Paraguay-Paraná waterway / Wilson Cabral de Sousa Júnior ... [et al.]. -- Campo Grande, MS: Mupan, 2019.
1 online resource (20 p. : il. color., photos., maps)

Access mode: <http://wetlands-brasil.org>

Also published in print.

Bibliography: p. 20.

ISBN 978-85-69786-05-4

1. Waterways – Paraguay, River, Basin. 2. Waterways – Paraná, River, Basin. 3. Waterway Paraguay-Paraná (Brazil-Uruguay). I. Sousa Junior, Wilson Cabral de.

CDD (23) 386.30981

Librarian in charge: Wanderlice da Silva Assis – CRB 1/1279

Summary

| | |
|---|----|
| Presentation..... | 4 |
| Introduction..... | 5 |
| 1. Analysed Aspects..... | 5 |
| 2. An account of the historical significance of the Paraguay-Paraná waterway..... | 7 |
| 3. A waterway in the Pantanal: Uncovering the region..... | 9 |
| 4. Is the waterway important? The Water Resources Plan for the Hydrographic Region of the Paraguay River... | 11 |
| 5. The HPP's analyses elucidated..... | 13 |
| 6. Climate change as a factor of uncertainty in the HPP scenario..... | 15 |
| 7. Institutional aspects of society and the waterway..... | 17 |
| Establishing Infrastructures in the HPP Context..... | 18 |
| 8. Final considerations..... | 18 |
| References..... | 20 |



Presentation

Corredor Azul is a Wetlands International program that aims to safeguard the health and connectivity of the wetlands of the Paraná-Paraguay System. Coordinated by the Latin America and Caribbean office in Argentina, the program is carried out in three iconic wetlands of the systems: Pantanal, in Brazil, and Esteros de Iberá and Delta do Paraná, in Argentina. The Corredor Azul Programme is supported by DOB Ecology.

The Program's actions are concentrated in four major axes: knowledge generation, field actions, mobilization and impact on policies and investments. In the area of knowledge generation, a component of the program seeks to provide new information and evidence on the values and threats related to wetlands, in order to encourage targeted policies and decision-making.

The proposals and projects that permeate the Paraguay-Paraná Waterway cannot go unnoticed, as the debates have recently been revived. Some of the issues contemplated in the studies by the Corredor Azul consultants were organized in this document. They deal with the environmental impacts associated with the use of the waterway: regional characterization, construction of scenarios and interrelationship with existing studies.

Introduction

The Paraguay-Paraná river system permeates five countries in the southern cone of South America: Bolivia, Brazil, Paraguay, Uruguay and Argentina. This system, belonging to the La Plata River drainage basin, covers an area of about 1.75 million square kilometers. Its water axis forms a pathway of almost 3,500 kilometers, of navigable conditions. Beginning in the Brazilian municipality of Cáceres (MT), the Paraguay River is a tributary of the Paraná River, which, in turn, flows to the border region between Uruguay and Argentina joining other rivers. They all embody the La Plata River to, finally, reach the Atlantic Ocean.

This river system has been one of the oldest routes of transport in the region. Historically used by population along its axis. It has become an important strategic element since the creation of the Southern Common Market (Mercosur) in the early 1990s. Since then, projects have been presented in order to expand the navigation structure for the consolidation of the Paraguay-Paraná Waterway (HPP).

In general, HPP projects tend to underestimate the social and environmental impacts and overestimate possible economic benefits of the waterway structuring. A substantial deficiency of these studies is the difficulty

of incorporating socio-environmental aspects given the eco-systemic complexity of the region, especially in the context of the Upper Paraguay Basin (BAP). These rivers run through large extensions of floodable environments, and the Pantanal – considered a World Natural Heritage and a Biosphere Reserve – is the most significant.

There is a lack of integration of the waterway with other planning factors, both transnational, with other countries involved, as well as regional or national, e.g. plans for water resources and ecological-economic zoning. This circumstance makes it challenging to make decisions on a broader level and in a long-term perspective.

The study presented at this paper aimed at analyzing the most recent HPP proposal: the feasibility study of the Technological Institute of Transportation and Infrastructure of the Federal University of Paraná, commissioned by the National Department of Transport Infrastructure (DNIT), under its socio-environmental and economic aspects, in addition to its interface with other planning instruments, such as the Water Resources Plan for the Paraguay River Basin. It reflects on the waterway on the basis of consultations with civil society organizations and public authorities.

1. Analysed aspects

The main object of analysis in this work was the Technical, Economic and Environmental Feasibility Study (EVTEA) for the Paraná Paraguay Waterway, carried out by the Technological Institute of Transport and Infrastructure (ITTI), presented in 2015. EVTEA's approach to economic and socio-environmental issues focused on the Upper Paraguay Basin (Figure 1, next page). The portion of the HPP inserted in this geographic context is called

Tramo Norte (at the Brazilian section), as it was named by EVTEA.

The analysis extended to other planning documents, especially the Water Resources Plan for the Paraguay Hydrographic Region, in order to verify the interfaces and integration of the waterway with the basin planning. The study also intailed a survey of expectations of actors and representative institutions in the context of the HPP and its interfaces.



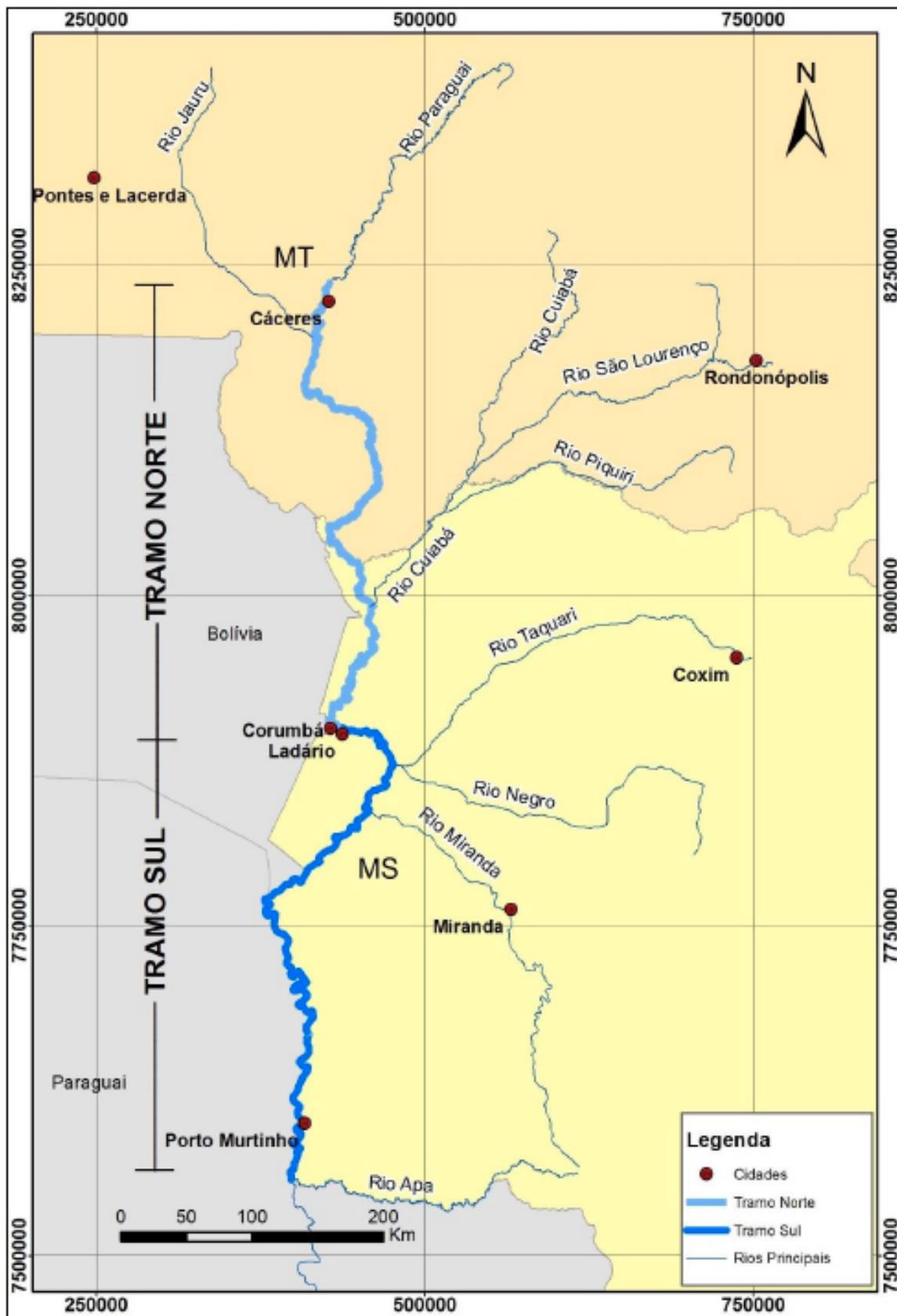


Figure 1.- Paraguayan-Paraná Waterway – Brazilian Section (Cáceres – Porto Murtinho)

Source: UFPR/ITTI (2015)

2. An account of the historical significance of the Paraguay-Paraná waterway

O The Paraguay River, the connection it provides to the south region of the continent has , over the years, been explored in several ways for the transport of people and goods. The most accurate historical records date from the 18th century, when Portuguese and Spanish explorers roamed its waters in search of strategic routes for gold and stone transport and exploitation. Later, for occupation of the land and its defense. At that time, explorations began with the aim of expanding knowledge of the river and the region. In the early 19th century, tasks such as cartographic recording were expanded with the intensification of conflicts over border recognition which led to the 1864 war in Paraguay.

One of the main scenarios of the dispute between Brazil and Paraguay, the region around the city of Corumbá, was partially occupied by Paraguayan forces, given its strategic characteristics in terms of transport system and the borders. They were later repelled at the end of the conflict. It was only in 1870, after the war ended, that international trade intensified in the southern region of Mato Grosso. In addition to the trade routes, the Port of Corumbá provided an important connection to the headquarters of the Empire. It was one of the busiest ports of its time. Yet, its dynamics gradually lost force with the increasing implementation of railroads and highways in the country.

Although navigation along the Paraguay and Paraná rivers goes back to the history of occupation of the terri-

tory since centuries ago, It was only in 1969, that efforts to establish a waterway capable of transporting the economic production of the five countries on its axis reached a milestone.

In that year, the five countries holding territory in the basin (Brazil, Bolivia, Paraguay, Uruguay and Argentina) signed the Plata Basin Treaty, initiating government negotiations that involved the adoption of river mode of transport in their common infrastructure. However, only 20 years later, the "First International Meeting for the Development of the Paraguay-Paraná Waterway" was held with the objective of identifying options for the development of the HPP, publicized as a regional transport corridor and the backbone of future integration. The following year, the Intergovernmental Committee for the Paraguay-Paraná Waterway (CIHPP) was created.

In 1991, a parallel economic integration effort, carried out at the same time by Brazil, Argentina, Paraguay and Uruguay, gave rise to the Southern Common Market (the Mercosur). Given this association, the HPP was promoted as an axis of the Mercosur transport integration.

Since the institution of the CIHPP, study and project fronts have been aimed at making the decisions on the implementation of the HPP. Table 1 presents these milestones, with comments on their approach and results.

Table 1.- Time frames of HPP studies and projects (1988 to 2018)

| Year | Study/Project | Approach | Comments |
|--------------|---|---|--|
| 1988 | HPP Pre-Feasibility Studies. (CIH, 1988) | Undertaking initial studies, concentrating on each country's conceptions in regards to PPH, to provide direction for future studies | The Economic Feasibility Study incorporated the findings of the introductory research from the five countries. It was an exploratory document, not intended to be utilized as a foundation for decision-making. |
| 1990 | Economic Feasibility Study. (INTERNAVE ENGENHARIA, 1990) | The objective was "to assess the possibilities of full use of the Hidrovia as a factor for the development and economic integration of the Region". The study indicated economic viability, in addition to recommending studies of environmental impacts and even the development of own project for vessels to operate in the HPP. | Partial analysis, centered almost exclusively on geoeconomic aspects: activities that generate demand for HPP. |
| 1991 to 1994 | Independent environmental studies. (CE BRAC, ICV, WWF (eds.) et al. | Answering Internave's feasibility study, third party organizations in the sector expressed their opinion. | The preliminary independent survey on socio-environmental impacts would indicate elements of unfeasibility of the HPP project. Faced with this scenario, the international development organizations archived the studies and recommended new analyzes to the CIHPP. |

| Year | Study/Project | Approach | Comments |
|------|--|---|---|
| 1993 | Initial environmental assessment study of the Paraguay-Paraná Waterway impacts (BUCHER et al., 1993) | In 1993, Wetlands for the Americas (Wetlands International) published the first independent assessment of the environmental impacts that the Paraguay-Paraná Waterway project could generate (Bucher et al. 1993). This assessment warned that the Hidrovia project would accelerate the trend of environmental degradation that would affect the region, causing new impacts that would be added to the existing ones, such as those related to deforestation, soil erosion, overexploitation of fauna and flora, in addition to industrial, agricultural and urban pollution. | This work already indicated the Pantanal as the area of greatest concern, given its hydrological complexity and its exceptional biodiversity. The stretch between Cáceres and Corumbá, which includes the Pantanal, was indicated as the most ecologically sensitive sector of the Waterway. The writers highlighted the potentially damaging effects the project could cause in the area, noting that it would be hard to create countermeasures due to the far-reaching implications of changing the hydrological cycle. The potential for disastrous flooding in the river was foreseen. |
| 1997 | Technical-Economic Feasibility Study. Realization: HLBE Consortium. | Conventional technical-economic feasibility analysis. | The study indicated technical-economic feasibility although, it presented important caveats on two fronts; being one, related to physical and climatological aspects, especially in the stretch between Cáceres and Corumbá, where prolonged drought events could make transportation unfeasible; and, another, associated with the precariousness of the economic study by not considering potential competing modes. |
| 1998 | Environmental Impact Studies (Module B2). Realization: TGCC Consortium. | Feasibility analysis of proposed agreements regarding its environmental impacts and proposed mitigation and/or control measures for the most relevant impacts. | The study indicated environmental feasibility of the project, and the impacts were generally considered to be of low intensity, with local and short-term effects. It did not consider a change in hydrological conditions or a loss of the Pantanal, for example. Ibamas pointed out the failure of the study in identifying and assessing the physical, the biotic, and the socio-economic environment. |
| 1999 | Independent study on the evaluations of the HLBE and TGCC consortia. | Commissioned by the World Wildlife Fund (WWF) with a focus on the potential environmental impacts of HPP on the Pantanal. | The study highlighted the disparity between technical-economic and environmental examination. The initial assessment of the magnitude of the work was substantial, but the second assessment underestimated the socio-environmental impacts. These were based on an analysis restricted to the modifications and signaling of the river channel to be used for transport, without involving other impact vectors, such as port works. Based on the studies, the suspension of large-scale dredging activities on the Paraguay River in the stretch (North Section) was requested and the elaboration of a more comprehensive EIA was recommended. |

| Year | Study/Project | Approach | Comments |
|------|---|---|--|
| 2004 | Institutional Legal, Engineering Environmental and Economic-Financial Complementary – Section between Puerto Quijarro (Tamengo Canal), Corumbá and Santa Fé. (COINHI, 2004) | The central objective was to propose institutional mechanisms for carrying out works to improve navigation, in addition to updating and complementing engineering, environmental and economic-financial studies previously performed. | An evaluation carried out by the Ministries of Transport and the Environment highlighted the presence of gaps and omissions, some already identified in previous studies, indicating the need for an Environmental Impact Study (EIA) with the complete process of environmental censusing. |
| 2006 | Independent Study: HPP Environmental Economic Analysis. (CARDOSO et al., 2006) | Analysis of extended costs and benefits from a social perspective. The authors worked on four scenarios in which implementation and maintenance costs, benefits in terms of freight reduction and socio-environmental impacts, were varied. | The study pointed out the road-railway as the preferential axis with the lowest cost, with the option of the BR-364 highway and the Ferronorte railroad (of the five producing regions of MT, only the western region of the state used the road-waterway modal, via the BR-364 and waterway from Madeira/Amazonas to the port of Itacoatiara/AM), indicating that the HPP is unfeasible within the framework of the analysis. |
| 2015 | Technical, Economic and Environmental Feasibility Study - EVTEA. (UFPR/ITTI, 2015) | Study indicated technical, economic and environmental viability. With regard to the environmental plan, it analyzed potential impacts from dredging and the operation of the HPP. | This is a preliminary environmental study, with limited analysis and inadequate methodology, with a considerable degree of subjectivity. The final result of the environmental study is not consistent with the objects and contexts. |

Source: Compilation by the author based on EDF/CEBRAC (1997), Huszar (1999), Zugaib (2006) and UFPR/ITTI (2015).

As evidenced, there is a repetition of deficiencies and shortcomings in the approach of the official studies that advocate the installation of a project for the HPP development. The motivation for these studies explains such deficiencies. Instead of being instruments for effective decision-making, these works were used with the aim to raise awareness, so that actors at different levels, both

local and international, could position themselves in favor of the interventions.

The last one of them, the EVTEA carried out by the Technological Institute of Transport and Infrastructure (ITTI), of the Federal University of Paraná (UFPR), repeats this pattern and is the present work's object of analysis, especially with regard to the HPP environmental analysis.

3. A waterway in the Pantanal: Uncovering the region

The upper part of the HPP, called Tramo Norte (the North Section), is located entirely in the Upper Paraguay Basin (BAP), in the Pantanal region. The BAP has an approximate area of 600,000 km² (larger than the total area of France), covering parts of Brazil, Paraguay and Bolivia (Figure 2, next page). This region has a unique importance in the context of water management, as it includes one of the largest extensions of wetlands on the planet: the Pantanal, declared a National Heritage Site by the Brazilian Constitution of 1988, a site designated as an area of relevant international importance by the Ramsar Wetlands Convention, in 1993, and a Biosphere Reserve by Unesco, in 2000.

The Pantanal represents about 40% of the BAP. The rest of the area is a plateau region, the scenery of the main anthropic interventions with relevance to the Pantanal landscape. The landscape, composed of plateau and plain in addition to other relief and hydrology characteristics, defines a wetland environment, as it conditions the use of natural resources and land occupation. The relief is marked by sig-

nificant contrasts between the lowlands and periodically flooded plains of the Pantanal of Mato-Grosso, and the non-floodable surrounding lands located in the plateaus, mountains and depressions.

Among the issues arising from the plateau and that impact the Pantanal plain, the following stand out; soil compaction and erosion due to inadequate use; deforestation and destruction of riparian forests; pollution of rivers by domestic sewage from cities and agro-industries, mining and agricultural inputs. The consequent alterations in water levels and the silting up of rivers cause changes in the bed of water bodies and increase the flooding period in areas.

In the basin, there is a clear division of the rainfall regime: it rains more on the plateau. An area where soils are more prone to erosion and greater agricultural use. This fact implies a high production of sediments that are carried by the watercourses to the lower regions and are deposited in the plain.

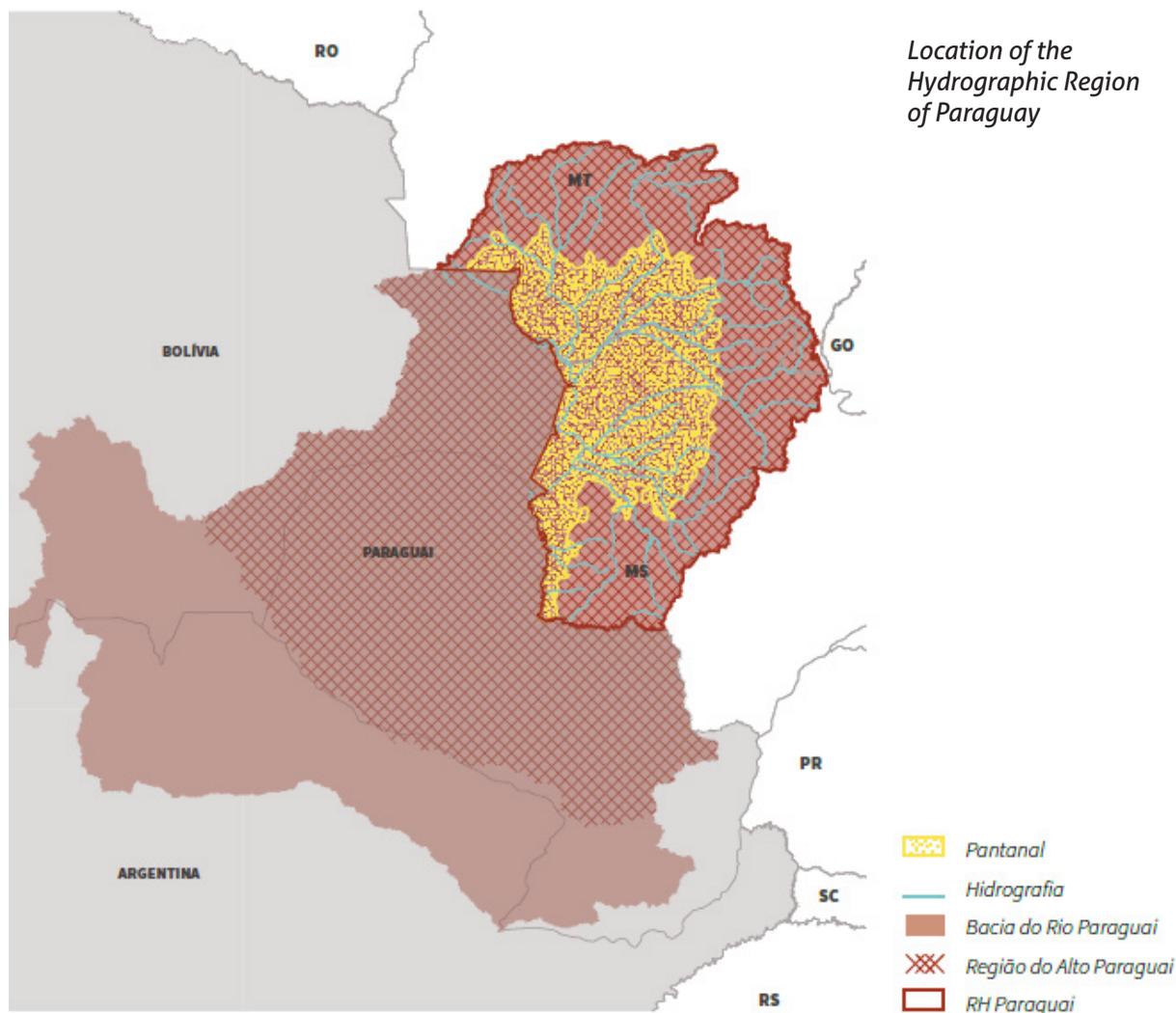


Figure 2.- Upper Paraguay Basin. Source: ANA (2018)

Noteworthy is the Guarani Aquifer System, one of the largest aquifers in South America, with interstate and cross-border boundaries between the states of Mato Grosso, Mato Grosso do Sul, Goiás, Minas Gerais, São Paulo, Paraná, Santa Catarina and Rio Grande do Sul, in Brazil, as well as Uruguay, Paraguay and Argentina.

Elements of three Brazilian biomes can be identified in the region: the Amazon, Cerrado and Pantanal. It hosts great climate, relief and soil variability. The Pantanal holds a rich diversity of flora and fauna, originating from the Amazon, Cerrado and Atlantic Forest regions, a scenario that gives it a strong vocation for conservation activities and contemplative tourism. On the other hand, it is also the region that would most suffer the impacts of the HPP implementation.

BAP hosts 120 Conservation Units, at federal, state or municipal levels. The number, although seemingly substantial, only accounts for 2% of the area as strict protection units and 5% as sustainable development units. Most conservation units are Environmental Protection Areas (APA), less restrictive, and most of these are in conditions of environmental degradation.

There are also 29 Indigenous Lands in the region, home to a population of more than 22,000 indigenous people from 11 different peoples (Guató, Pareci, Bororo, Umutina, Nambiquara, Bakairi, Chiquitano, Terena, Kadiwéu, Kiniknau and Guarani-Kaiowá) occupying an area equivalent to 2.3% of the hydrographic region (ANA, 2015).

4. Is the waterway important? The Water Resources Plan for the Hydrographic Region of the Paraguay River

The National Council for Water Resources (CNRH) proposed the Water Resources Plan for the Hydrographic Region of the Paraguay River (PRH Paraguay) citing the pressing importance of environmental concerns, their relationship to hydric resources, and potential conflict stemming from the use of water. The Plan aims to ensure the sustainable use of water, reconciling existing demands with the need to conserve the Pantanal.

The PRH Paraguay was prepared between 2014 and 2017, based on a broad diagnosis carried out by the National Water Agency (ANA) and other collaborating institutions. Taking into account the various activities and water user agents, in addition to the conservation matter.

Among the contemplated activities, the following stand out; agriculture, practiced in the plateau region of the basin; livestock, with occupation on the plateau and also in the Pantanal; industry and mining, in specific locations; electricity generation (small, medium and large hydroelectric plants); fishing and tourism, practiced especially in the Pantanal; basic sanitation (water and sewage services to municipalities in the basin); and navigation, performed at the HPP.

PRH Paraguay works with six agendas of activities related to water use. In some way, all these agendas are related to HPP. The indications in Table 2 illustrate this relationship.

Table 2.- Agendas related to water and relationship with the HPP

| HRP schedule | HPP relationship |
|---|---|
| Farming | It is related to HPP's transport demand, for the purpose of production flow. Depending on its scale and conservation practices, it can influence the release of sediments, which competes with the maintenance of ideal operational conditions for the HPP. |
| Environmental Conservation | It is characterized as a recipient of the impacts of the HPP and, also, as a vector of operational restrictions, especially with regard to the demands of dredging, construction of ports, rectification of channels and increased water flows. |
| Basic sanitation | It contends with the HPP in terms of upholding water purity and demands for abstraction for utilization in urban areas, on one hand, should there be alterations in hydrological conditions that impact water supply, concerning amounts. |
| Industry (and mining), Transport and Energy | Mining and industry demand HPP for the purpose of production flow. The generation of electricity, on the other hand, contributes to the conservation of the quantity and quality of water, especially in the flow of water and sediments altered by hydroelectric plants. |
| Fishing and Tourism | They compete with the HPP in terms of maintaining ideal characteristics for fishing and tourism, especially if there are changes in the hydrodynamic regime of the Pantanal. |
| Hydric resources | The implementation and operation of the HPP can generate impacts on the water environment, affecting quantitative aspects (water flows) and qualitative aspects (resuspension of sediments, risk of cargo spillage and emission of pollutants). |

Traditional Populations

According to the diagnosis of PRH Paraguay (ANA, 2015), the traditional populations of the basin, including riverside dwellers, artisanal fishermen, indigenous populations and quilombolas, experience a symbiotic and interdependent relationship with water and natural resources. Nature, in a way, shapes and provides the elements for their income, subsistence and culture, in addition to providing means of transportation. Thus, waterways serve a fundamental purpose in the livelihoods,

social and symbolic production and reproduction of these populations.

In this sense, any significant changes in environmental conditions have a direct or indirect impact on these *modus vivendi* and such issues should be the subject of a comprehensive analysis in view of the insertion of infrastructure elements, as the HPP. Such influence would be exercised from changes in the hydrological regime, changes in water turbidity and in the habitat of species related to the culture and subsistence of these traditional populations.

Conflicts over economic uses

As the PRH Paraguay (ANA, 2015) emphasizes, flood pulses are vital for the economic activity of riverside communities, who live by collecting live bait, followed by fishing, extracting wild rice, and raising livestock in native pastures, and small-scale agriculture. Thus, impacts caused by upstream activities that interfere with the flood pulse will have potential consequences on the plain, both for ecosystems and for the population.

The PRH Paraguay points out two other elements of conflict: 1) the replacement of natural pastures by forages that are not suitable for the flood pulses regimes, with the consequent increase in the density of cattle, subsequently overburdening the region's capacity to support it; and 2) the insertion of other productive modes and infrastructure (roads, agricultural and industrial hubs, and mineral and plant extraction) is increasing the fragmentation of native vegetation and the resulting edge effects, potentially leading to gradual impacts on the dynamics of fragmented landscapes on wildlife. The additional consequence of these two anthropization aspects is an escalation in soil losses due to erosion, a problem already severely impacting the basin and which could have a negative affect on the waterway activity and its economic-financial balance.

Predictions

Despite the broad range of topics covered in the Water Resources Plan for the Paraguay River Basin presenting an interface with the Waterway, with potential effects on the latter, the Plan does not mention conflicts associated with the HPP. Alternatively, the document emphasizes the need for actions to conserve water resources in the basin, which could be in conflict with the possible implementation of the HPP.

The HPP is only mentioned when the subject of granting and charging for water use is presented, recommending the inclusion of the Navigation segment. For the Plan, payment for the use of water by shipping and port companies can facilitate reconciliation of conflicts with other users.

With regard to the hydric situation, the PRH Paraguay emphasizes the severity of the issue in both quality and quantity. The projection for 2031, based only on the current rates of growth in water demand (without the effects of climate change), carried out within the scope of the PRH Paraguay, reveals a situation of water stress in some regions of the plateau and downstream from the Pantanal plain (Figure 3).

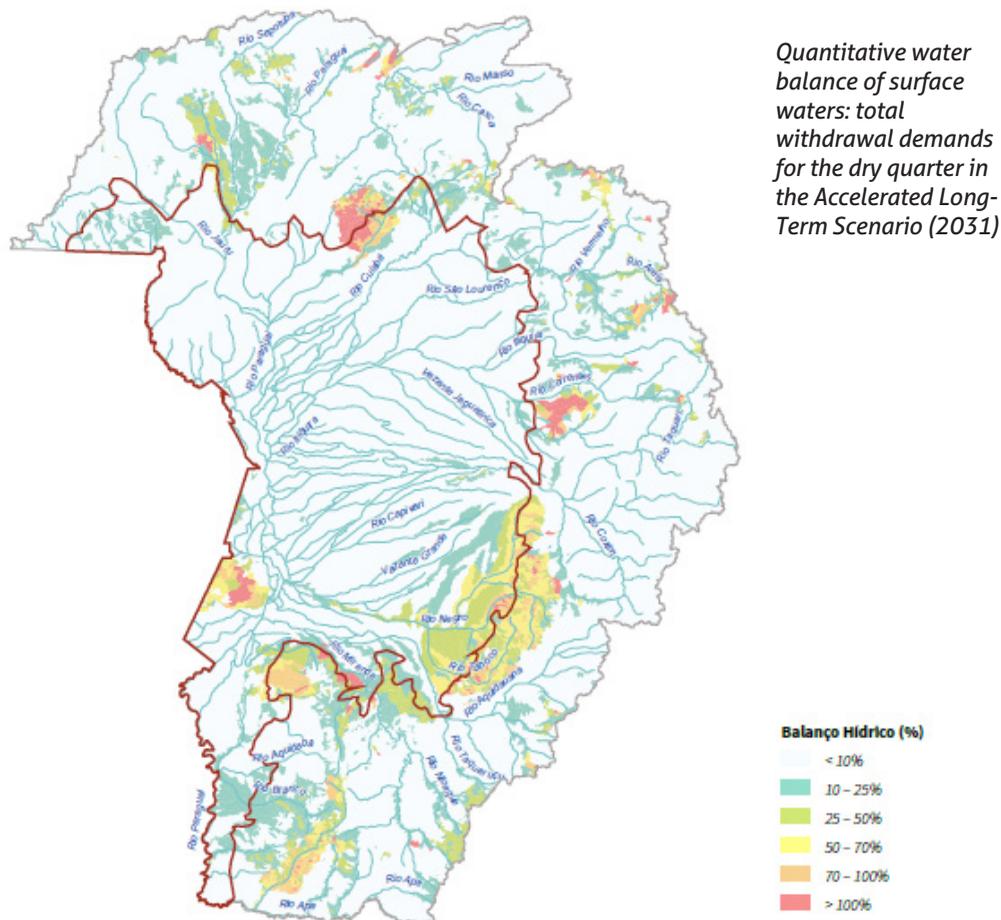


Figure 3.- Quantitative water balance 2031 - Paraguay River Basin. Source: ANA (2018).

The pressures occur predominantly in the region of the plateau surrounding the Pantanal plain, which can be observed. However, there is a critical area in the Corumbá region (MS) located in the most downstream portion of the Tramo Norte (North Section) of the HPP. It is essen-

tial to reflect on the potential impacts of the activities associated to the implementation and maintenance of the waterway, which could affect the quality of the water. This should be the object of analysis in HPP's environmental studies.

5. The HPP's analyses elucidated

A study carried out on a previous HPP project by a group of independent researchers (Cardoso et al., 2006) analyzed the increased costs and benefits from a social perspective. The work pointed to the unfeasibility of the HPP given the preference for the lower cost road-railway modal. Presenting the option of the BR-364 road / Ferronorte Railroad for most of the grain flow, which is the primary transportation item projected for the waterway at that time. The previous HPP project is considered similar to the current one in many aspects. However, it presented a massive investment in waterway adaptation works (alteration of riverbeds, rectification of stretches, demolition, dredging and other engineering works). It tended to make the waterway navigable on a daily and yearly basis, with a minimum draft of three meters, from Cáceres, in the state of Mato Grosso in Brazil, to the port of Nueva Palmira, in Uruguay, along 3,303 km.

In the current context, in order to assess the feasibility of the HPP, it is important to know the possible dependency relationships of the main economic products in those regions close to the waterway and the logistical routes used for their outflow. Although, there is an important foreign trade movement from Brazil to the other Mercosur coun-

tries, most of it is carried out by modes of transportation that are distinct from the HPP. Whereas the products from the states of MT and MS in Brazil concentrate, and the port infrastructure associated with HPP is located. Currently, most of this transport is carried out from the state of MS, in the stretches located in Corumbá and downstream.

The limited interest of MT's main exporters, especially soy, corn, cotton and meat producers in relation to Mercosur, has caused other logistic routes to be privileged, especially the already consolidated route to the ports of Santos (SP), Paranaguá (PR) and Rio Grande (RS), serviced by rail transfer. Furthermore, with new options arising from the so-called Arco Norte*, (North arch) as well as the recent resumption of plans for the Ferrogão Railroad.

The HPP's Technical, Economic and Environmental Feasibility Study (EVTEA) carried out an analysis of macroeconomic scenarios and future market prospects for the main products produced in the states of MT and MS, especially soy, corn and iron ore, in addition to a survey of the list of imports from these states, in order to seek subsidies for return transport via HPP. Table 3 shows the premises of the study analysis.

* This option arose after successive public investments in waterway infrastructure and private investments in port infrastructure at the end of the 1990s for the consolidation of transport along the Madeira River, from Porto Velho (RO), making it possible to convey soybeans from the state of Mato Grosso through the northern region of the country. More recently, other options in the north have been added to the intermodal highway BR-364/Rio Madeira, involving the ports of Itacoatiara (AM), Santarém and Barcarena (PA), Santana (AP), São Luís (MA), Salvador and Ilhéus (BA). Such logistical infrastructure points make up the so-called Arco Norte.

Table 3.- Assumptions of the economic analysis of the EVTEA/HPP

| Analysis elements | Scope and points considered |
|--|--|
| Study of demand for good for exportation | Production of soy and corn for export by municipalities in the states of Mato Grosso and Mato Grosso do Sul. Export of ores and other miscellaneous products through the state of Mato Grosso do Sul. |
| Infrastructure and transport costs | Costs for carrying out final projects and environmental studies (EIA/RIMA); Implementation of terminals including access roads; Waterway maintenance costs including dredging and signaling; Conveyance costs according to distances by road, rail, waterway and long distance (sea) modes. |

| Analysis elements | Scope and points considered |
|-----------------------|---|
| Influence area | <p>Analysis of the exported production of the municipalities, contemplating the exit routes, considering the current situation and the future with greater use of the Waterway:</p> <p>Definition of road, rail, waterway and long-haul (sea) distances for the export of cargo from municipalities in the states of Mato Grosso and Mato Grosso do Sul to the main defined destinations;</p> <p>Calculation of the equivalent total road distance for the loads of the municipalities according to the alternatives of exits used;</p> <p>Definition of the municipalities in the area of influence according to the existing and proposed waterway terminals.</p> |
| Economic viability | <p>Reduction of equivalent total road distances according to the alternatives of waterway terminals studied;</p> <p>Reduction of transport times (tx km) for export by municipalities according to each proposed terminal alternative;</p> <p>Elaboration of the economic viability indicators of the alternatives for the pessimistic, intermediate and optimistic scenarios.</p> |
| Analytical parameters | <p>Term: 30 years;</p> <p>Minimum Attractive Rate (Discount Rate): 12% pa;</p> <p>Projected annual demand growth: 2% (pessimistic), 2.5% (intermediate) and 3% (optimistic).</p> |

Source: (UFPR/ITTI, 2015).

The scenarios were evaluated by state and logistic terminal implemented according to Table 4.

Table 4.- Scenarios evaluated in the HPP EVTEA, carried out by ITTI.

| Status/Alternative | Terminals |
|--------------------|--|
| MT – Alternative 1 | Implementation of the Santo Antônio das Lendas Terminal and Porto Cercado |
| MT – Alternative 2 | Implementation of the Santo Antônio das Lendas Terminal |
| MT – Alternative 3 | Implementation of the Porto Cercado Terminal |
| MT – Alternative 4 | Reactivation and expansion of the Cáceres Terminal |
| MT – Alternative 5 | Implementation of the Santo Antônio das Lendas Terminal and Porto Cercado and reactivation and expansion of the Cáceres Terminal |
| MS – Alternative 6 | Reactivation and expansion of the Porto Murtinho Terminal |

Source: (UFPR/ITTI, 2015).

A summary of the analysis is presented in Table 5.

Table 5.- Summary results of the analysis: alternatives and scenarios – EVTEA/ITTI

| Alternative | Pessimistic Scenario | | Intermediate Scenario | | Optimistic Scenario | |
|---------------|----------------------|--------------------------|-----------------------|--------------------------|---------------------|--------------------------|
| | IRR (%) | NPV (R\$ $\times 10^6$) | IRR (%) | NPV (R\$ $\times 10^6$) | IRR (%) | NPV (R\$ $\times 10^6$) |
| Alternative 1 | 13,37 | 57,80 | 21,91 | 439,21 | 27,91 | 738,53 |
| Alternative 2 | 14,63 | 56,15 | 21,42 | 219,93 | 26,25 | 354,68 |
| Alternative 3 | 16,12 | 91,78 | 27,19 | 360,63 | 35,08 | 568,53 |
| Alternative 4 | 50,29 | 416,47 | 69,70 | 682,97 | 83,52 | 903,55 |
| Alternative 5 | 17,84 | 52,02 | 27,70 | 150,72 | 34,72 | 229,32 |
| Alternative 6 | 28,88 | 30,43 | 39,10 | 53,62 | 46,36 | 73,15 |

Source: (UFPR/ITTI, 2015).

IRR - Internal Rate of Return | NPV - Net Present Value

While, the results seem satisfactory the deficiencies in the analysis should be brought to light.

- The study considered the return cost for comparative road freight assuming the trucks return empty. In fact, that does not occur in reality. Trucks return with half a load, on average. In addition to the apparently overestimated cost of the freight itself. Traffic conversion was carried out in each and every municipality. Considering only freight costs. Disregarding other factors that also influence the producer's decision-making when choosing the route: The modal availability. And the total freight time. Nor did it consider the scale of traffic operations, as if, given a relatively lower price, all cargo in a municipality would be automatically converted to the waterway transport.
- The study does not analyze the effects of the Arco Norte* routes (see p. 13), since these routes are more recent than the database used. Such factors overestimate the benefit of the waterway while compromising the results.
- Costs, especially for dredging, seem to be underestimated for the region. (numbers reflect average costs indicated by ANTAQ, similar to those in coastal port activities).
- Variations in traffic flow due to meteorological restrictions (example: severe droughts that would affect navigation were not Taken into account).

When considering the values used; the pessimistic scenario (table 5) of the ITTI study is what could be charac-

terized as the most realistic scenario for the assessed parameters.

Externalities

The ITTI EVTEA analysis did not incorporate any of the socio- environmental costs and benefits (including both positive and negative externalities). Moreover, the discount rate of 12% per year applied would not be appropriate for the evaluation of environmental costs, which are usually discounted over a medium to long-term period.

The findings emphasize the precariousness of the HPP insertion in the current economic context, indicating the need to expand the portfolio of products conveyed by the waterway. In order to make it viable, despite the limited assumptions of analysis. As an example, the projections consider the full return freight on the waterway from the traffic of products that are not in the export basket of the countries of the southern portion, in the case of agricultural inputs, such as, potassium chloride.

The relative increase in waterway freight resulted from the improvement of infrastructure is another unexplored aspect. Since public-private partnerships are predicted to carry out these works. This factor can contribute to reducing the flow of products currently conveyed. And it would represent risk for the investment. The ITTI's Technical, Economic and Environmental Feasibility Study (EVTEA) documents a decrease in waterway conveyance. When the cost of waterway freight increases due to infrastructure improvements carried out to adapt the conveyance of iron ore.

6. Climate change as a factor of uncertainty in the HPP scenario

The Intergovernmental Panel on Climate Change (IPCC) has highlighted the climate threat to sustainable development in its reports drawing attention to the impacts of considerable magnitude in South America, especially, on water resources and related economic sectors. Imposing on the public authorities the need to formulation, planning and implementation of adaptation measures with a view to managing climate risks and responding in a timely manner to the likely impacts arising from global climate change.

Especially in the case of the Paraguay River Basin (BAP), where two factors may impose a critical adaptation agen-

da in the near future: the temperature increase and precipitation reduction.

The pioneering work in Brazil carried out by Chou et al. (2014), based on the execution of regionalized global climate models, point to trends of average temperature increase above 2° Celsius and precipitation reduction of around 15% for the period 2011-2040 (Figure 4, see following page), considering the IPCC* RCP 4.5 scenario, using the British Had GEM2 global model. In summary, the operations of a possible waterway could be compromised, especially in times of water criticality.

* RCP or Representative Concentration Pathway: Scenarios in which different concentrations of greenhouse gases are projected for future climate simulation. The RCP 4.5 scenario is one of the four established in the last IPCC communication (2014) and represents increases in the concentration of greenhouse gases with a peak in 2040 with a decline after this date. It is considered one of the most realistic scenarios given the current trajectory of emissions.

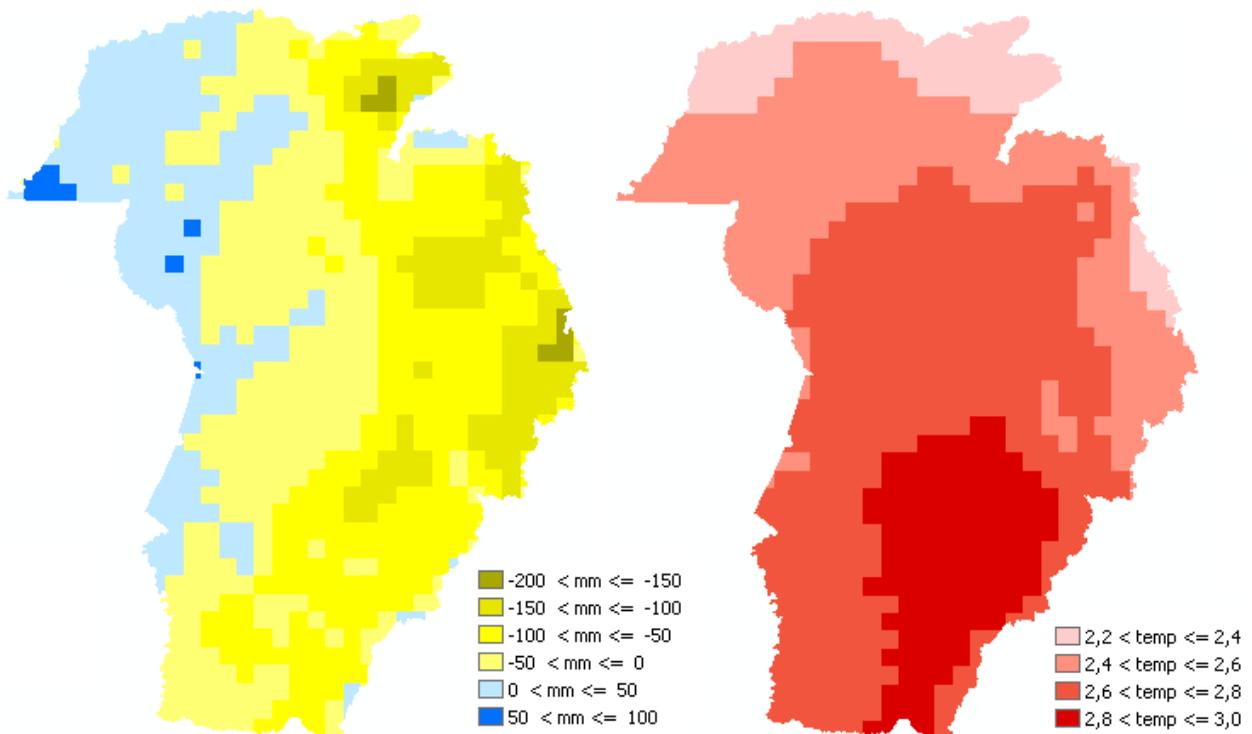


Figure 4.- HadGEM RCP 4.5 IPCC projection. Precipitation (left) and temperature (right) anomalies.
Source: adapted from Chou (2014).

A simulation was built for the Paraguay River region upstream from Cáceres based on future precipitation projections performed by Chou et al. (2014) as a means to analyze the impact of climate change on the flow regime at that point.

For this simulation, the SMAP (Soil Moisture Accounting Procedure) model was used, a conceptual hydrological model developed to simulate the hydrological cycle and obtain flow estimates from rainfall data.

The monthly flow results were divided into two parts, considering the group of driest months (April to September) and rainiest (October to March). The simulation results for precipitation and flow (dry and rainy season, respectively)

until the year 2030 can be visualized in the graphs of Figures 5 and 6.

The averages for the dry period — more sensitive for the purposes of analyzing the navigability of the waterway — point to a flow reduction of around 11% in the decade of 2021-30, compared to current values.

The averages for the rainy season point to a flow reduction of around 13% in the 2021-30 decade, compared to current values.

Such flow reductions, even though arising from a preliminary analysis, indicate a potential vulnerability for assessments of the waterway's feasibility.

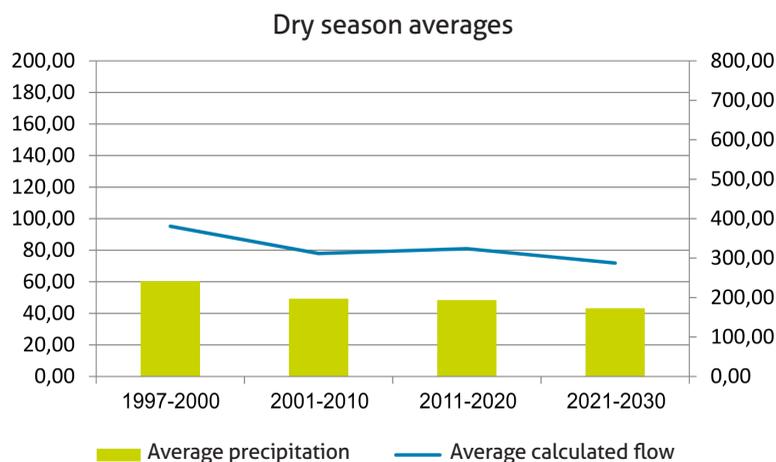


Figure 5.- Precipitation and flow projection graph in the Paraguay Basin, in Cáceres (flow in m3/s and precipitation in mm).

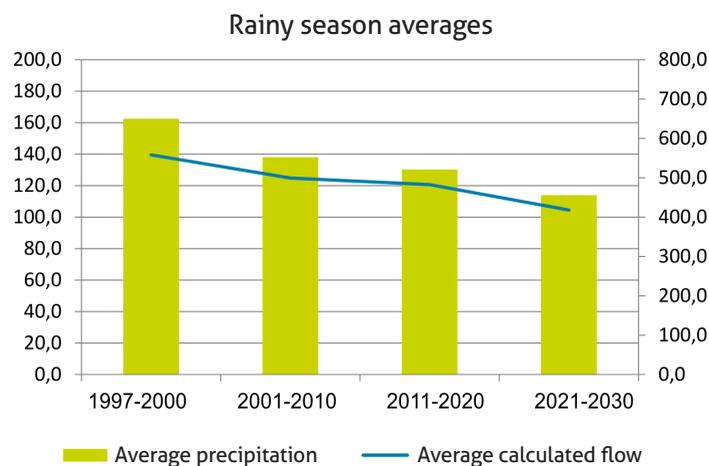


Figure 6.- Precipitation and flow projection graph in the Paraguay Basin, in Cáceres (flow in m³/s and precipitation in mm).

7. The institutional aspects of society and the waterway

Throughout recent history, the various initiatives around a HPP project started from antagonistic positions which were softened overtime. The last study (EVTEA - UFPR/ITTI, 2015), discussed here, indicated as the best cost/benefit solution for HPP the option with the lowest impact and engineering costs, among those analyzed, limiting the necessary interventions for its insertion to dredging works and port facilities. This fact seems to assume a convergence with environmental demands. Although, a consensus has not been established.

Semi-structured interviews were carried out with institutions operating locally and regionally as a means to map and understand the positions of actors with some intersection with the HPP, as well as, its positive and negative externalities. Which content is presented below.

In general, two camps are still perceived with a certain antagonism of views; those who unequivocally defend the implementation of the HP, a group composed essentially of state authorities and private initiative; and those who stand in opposition to the implementation, especially from the part of the waterway in the Tramo Norte (North Section), with a direct relationship with the Pantanal. However, if in the past the polarization was greater, today the discourse seems to accommodate a conciliation, based on the reduction of the scale and impacts of the project and at the same time the imposition of some socio-environmental safeguards in relation to the Pantanal.

In this context, the absence of negative impacts is mentioned, though, limited to certain favorable official

declarations, however, there are still impacts including on riverside transport modes, caused by the waves generated by large cargo vessels. Attention is drawn to reports of natural barriers to transportation, such as, the banks of vegetation (solms, Eichhornia crassipes) that form during the dry season and are released during the ebb. In addition to oscillations in relation to the transport of sediments originating on the plateau and which can silting up channels and thalwegs, with impacts on navigation.

On the other hand, there is ample evidence of economic decay in the key regions for the waterway, especially around the municipalities of Corumbá and Ladário. It is important to note that most of the interviewees with a pro HPP view emphasize the need to work on strategic issues in the eventual implementation, in order to prevent the region from becoming just a route point for the traffic of commodities, with very low repercussions on the local economic development.

A strong finding is the low level of information in local society about the HPP, its projects and impacts. It is estimated that part of this demand is due to absence of data and information, and part is due to lack of access and dissemination of the existing data and information. Considering this, the great demand for data and information of a scientific nature is pertinent, As it enables a more comprehensive assessment of the impacts of large-scale transport in the Tramo Norte (North Section), especially in terms of its implications for the Pantanal.

Establishing Infrastructures in the HPP Context

In the North Section: 1) Implementation of the Santo Antônio das Lendas Cargo Transshipment Station. 2) Pavement of BR 174 connecting Cáceres and Santo Antônio das Lendas (which cost R\$26,824,686.80 by the Brazilian federal government, according to process number 50611.004522/2016-36/DNIT).

In the South Section: 1) Navios South American Logistics Group's plan to invest R\$110 million towards the development of a waterway terminal in the municipa-

lity. 2) PV Cereals group has invested R\$ 50 million to construct a port terminal AGD and PTP have both acquired land along the Paraguay River, with the potential to construct waterway terminals, and the latter has indicated their intention to invest US\$76 million in the municipality. 4) The state government has dedicated R\$ 30 million, as reported by local and national news outlets, to the construction of support facilities for access to the newly constructed BR-267 terminals.



Figure 7.- RILA - Latin American Integration Route
Source: Prepared by Pedro Cristofori.

8. Final considerations

The most recent feasibility study for the Paraguay-Paraná Waterway (EVTEA - UFPR/ITTI, 2015) presents an economic analysis with questionable presumptions, which compromise the result, underestimating costs and overestimating the benefits of the waterway. Its environmental chapter is superficial, minimizing dredging impacts on bottom substrate and benthic organisms, as well as impacts of dredging on river stretches. Nor does it address relevant issues such as the possible impact of dredging on the hydrodynamics and consequences for the Pantanal environment.

EVTEA also ignores climate change scenarios and possible impacts on sediment production (from seasonal dredging

orders) and waterway operation, especially in dry periods. It ignores a possible increase in the frequency of extreme precipitation events and the consequences of the upstream sediment carrying, on these occasions, to channels and thalwegs. It is curious to note that PRH Paraguay did not directly incorporate the HPP into its studies and guidelines, although it did mention water transport as a user when discussing grants and charges for water usage. It is essential to create updates to the PRH that accurately include the HPP, with its impacts and effects on other activities, in addition to their inter dependency. These are vital elements in the basin scenario.

Although it is possible to find some recent reference articles on the hydrology and morphodynamics of the Paraguay River (Paz et al., 2010, Bravo et al., 2012, Paz et al., 2014, Assine et al., 2015), a consensus has been established with respect to the absence of conclusive studies that guarantee a comprehensive grasp of behavior, allowing for predictions to be made in the basin. The most pressing deficiency is a lack of methodical, long-term examination of hydro-sedimentology and morphodynamic changes. Furthermore, it is imperative to analyze the hydrological regimes of the river and the floodplain in order to anticipate the possible implications of the waterway's construction and functioning on the physical environment and associated ecosystems. Moreover, in the opposite direction, it is necessary to extend knowledge about climate models and projections for regions of influence of the upper Paraguay basin in order to evaluate the susceptibility of waterway transport in the context of climate change scenarios.

The numbers for waterway transport in the North have not been documented yet, but it appears that the proposed solution from the EVTEA is gaining momentum. This fact is corroborated by the increase in the volumes dredged in the channel of the Paraguay River (Northern Section) in the last two years, as well as the advancement of public infrastructure (paving the BR 174 between Cáceres and Santo Antônio das Lendas, and Cargo Transshipment Sta-

tions in Cáceres) and private infrastructure (ports in Baranco Vermelho and Paratudal). When confirming these investments, it is therefore necessary to ask why there is no public discussion on transport of large cargoes in the north section of the HPP, which can start immediately after the consolidation of such infrastructure.

There are elements so that a debate on the subject does not incur the polarization of yore. Especially if the option for an alternative of lesser impact of the HPP in the Northern Section is confirmed. However, it is necessary to establish some safeguards in advance. Aiming to guarantee the minimization of impacts until critical data and information is available for decision-making.

It is critical to consider HPP from a broader, more strategic standpoint, looking at it within the context of development. In this regard, the following questions are pertinent: What is the purpose of the waterway? Who is the waterway serving? What is the development model? Are there any vision of alternatives? Are there any winners and losers? Who are they?

Still, in order to meet the pressing demand for information about the HPP, it is important to invest in communication initiatives and grant access to data and information to the social actors implicated, either directly or indirectly, with the issue.



References

- Bravo, JM; Allasia, D.; Peace, AR; Collischonn, W.; Tucci, CEM 2012. Coupled Hydrologic-Hydraulic Modeling of the Upper Paraguay River Basin. *Journal of Hydrologic Engineering*, v. 17, p. 635-646.
- Brazilian Center for Reference and Cultural Support, CEBRAC. 1997. The HPP Navigation Project – Report of a independent analysis. Brasilia: EDF/CEBRAC.
- Bucher, EH, A. Bonetto, TP Boyle, P. Canevari, G. Castro, P. Huszar Y T. Stone. 1993. Hidrovía: An Initial Environmental Examination of the Paraguay-Parana Waterway. *Wetlands for the Americas*, Manomet, Massachusetts, USA, and Buenos Aires, Argentina.
- Cardoso, ER; Sousa Junior, WC; Lopez, E.; Amend, MR 2006. Considerations on economic-environmental viability of the Paraguay-Paraná Waterway. *Megadiversity*, v. 2 (1-2), p. 50-59.
- CEBRAC, ICV, WWD (eds.) et al. 1994. Who pays the bill? Analysis of the economic and financial viability of the project Paraguay-Paraná Waterway. Brazil: WWF.
- Chou, SC; Lyra, A.; Mourao, C.; Dereczynski, C.; and others. 2014. Assessment of climate change over South America under RCP 4.5 and 8.5 downscaling scenarios. *Am J ClimChange* 3: 512-525.
- CIH. 1988. "Ad Hoc" Working Group of the Countries of Cuenca del Plata. Paraguay-Paraná Waterway. pre studio Feasibility.
- COINHI. 2004. Complementary Institutional-Legal, Engineering, Technical and Economic Study for the Development of Works in Hydrovia Paraguay-Paraná between Puerto Quijarro (Canal Tamengo), Corumbá and Santa Fe.
- Federal University of Paraná, UFPR; Technological Institute of Transport and Infrastructure, ITTI. 2015. Paraguay River Waterway: Technical, Economic and Environmental Feasibility Study – EVTEA. Curitiba: UFPR/ITTI.
- Huszar, P.; Petermann, P.; Milk, A.; Resende, E.; Schnack, E.; Schneider, E.; Francesco, F.; Rast, G.; Schnack, J.; Wasson, J.; Garcia, LL; Dantas, M.; Obrdlík, P.; Pedroni, R. 1999. Reality or Fiction: A Review of the Official Studies of the Paraguay-Paraná Waterway. Toronto, Canada: WWF, 46 p.
- Internave Engineering. 1990. Economic Feasibility Study. Final report. Argentina, Bolivia, Brazil, Paraguay, Uruguay. São Paulo, Feb, 3 vols.
- National Water Agency, ANA, 2018. Water Resources Plan for the Hydrographic Region of Paraguay – PRH Paraguay: Executive Summary/National Water Agency. Brasilia: ANA. 180p.
- Peace, AR; Collischonn, W.; Bravo, JM; Bates, PD; Baugh, C. 2014. The influence of vertical water balance on modeling Pantanal (Brazil) spatio-temporal inundation dynamics. *Hydrological Processes*, v. 28, no. 10.
- Peace, AR; Collischonn, W.; Tucci, CEM; Padovani, CR 2010. Large-scale modeling of channel flow and floodplain inundation dynamics and its application to the Pantanal (Brazil). *Hydrological Processes*, v. 25, p. 1498-1516.
- Sign ML; Macedo HA; Stevaux JC; Bergier I.; Padovani CR; Silva A. 2015. Avulsive rivers in the hydrology of the Pantanal Wetland. In: Bergier I., Sign M. (eds) *Dynamics of the Pantanal Wetland in South America. The Handbook of Environmental Chemistry*, vol 37. Springer, Cham.
- Willink, PW; Chernoff, B.; Alonso, LE; Montambault, JL; Lourival, R. (eds.). 2000 A biological assessment of the aquatic ecosystems of the Pantanal, Mato Grosso do Sul, Brazil. *RAP Bulletin of Biological Assessment* 18. Washington, DC: Conservation International.
- Zugaib, E. 2006. The Paraguay-Paraná Waterway. Brasilia: Funag, 438 p.



Wetlands
INTERNATIONAL



**Wetlands International
Brazil**

Rua Giocondo Orsi, 591, vila Vilas Boas
CEP 79.050-270
Campo Grande - MS - Brazil
+55 67 3045 5456
contato@wetlands-brazil.org
wetlands-brazil.org

ISBN 978-85-69786-05-4

This publication was conducted within the framework of the Corredor Azul Programme of Wetlands International, funded by

clw ecology

