SPATIAL PLANNING

for Restoration of the Pantanal Headwaters with focus on Water Resources


© André Dib / WWF-Brazil

HIGH LIGHTS

PRIORITY LANDSCAPES FOR CONSERVATION AND RESTORATION WERE IDENTIFIED THROUGH RIOS

IN COMPARISON, FOR AN INCREASE IN THE AMOUNT OF WATER, IT IS NECESSARY TO IMPLEMENT SUSTAINABLE ACTIONS IN AT LEAST 20 TO 25% OF THE TOTAL LANDSCAPE AREA

IMPROVEMENT IN WATER QUALITY BEGINS TO BE PERCEIVED IN SCENARIOS WHERE 5% OF THE LANDSCAPE HAVE SUSTAINABLE FARMING PRACTICES AND RESTORATION IMPLEMENTATION

WE USE INVEST, RIOS AND TRADE-OFF ASSESSMENTS TO IDENTIFY AREAS FOR IMPLEMENTING RESTORATION AND SUSTAINABLE PRACTICES IN THE PANTANAL HEADWATERS FOCUSING ON TWO ECOSYSTEM SERVICES: EROSION CONTROL AND WATER REGULATION

AN ANALYSIS OF THE WATER GOVERNANCE SYSTEM WAS ALSO CARRIED OUT IN THE PRIORITY SUB-BASINS ON THE PANTANAL HEADWATERS

THE ALLIANCE FOR WATER STEWARDSHIP (AWS) ASSESSMENT INDICATED MAIN PROBLEMS IN THE WATER GOVERNANCE OF THE JAURU AND MIRANDA SUB-BASINS, SUCH AS LACK OF FINANCIAL AND HUMAN RESOURCES FOR PLANNING AND IMPLEMENTING PROJECTS, STUDIES AND/OR ACTIONS. WHILE THE MICRO-BASIN OF GUARIROBA WAS BETTER ASSESSED DUE TO THE HISTORY OF RESTORING SPRINGS AND PASTURE REHABILITATION IN RECENT YEARS

RESTORING VEGETATION AND WATER QUANTITY HAD POSITIVE LONG-TERM RELATIONS, BECAUSE THE INTERVENTION CHANGED THE LOCAL WATER BALANCE. WHILE THE IMPLEMENTATION OF BEST FARMING PRACTICES HAD A DIRECT SHORT-TERM IMPACT ON IMPROVING WATER QUALITY, BECAUSE IT REDUCES SOIL LOSS AND EROSION PROCESSES THAT TRANSPORT SEDIMENTS TO RIVERS AND STREAMS

THE 1% LANDSCAPE PRIORITIZATION SCENARIOS INDICATE THE MOST ESSENTIAL AREAS TO IMPLEMENT RESTORATION AND SUSTAINABLE FARMING PRACTICES. THESE SCENARIOS ARE THE MOST SUITABLE IN CASE OF RESOURCE AND TIME RESTRICTIONS, ALTHOUGH HAVING REDUCE RETURNS IN TERMS OF WATER QUANTITY AND QUALITY

1.

EXECUTIVE SUMMARY

The Upper Paraguay Basin (UPB) has approximately 36 million hectares in Brazilian territory and occupies 4.3% of the country. For about a decade, it has been considered a priority area for WWF-Brazil. Just over 58% of UPB is formed by the plateau region we call Pantanal Headwaters, encompassing part of the states of Mato Grosso (MT) and Mato Grosso do Sul (MS), and presenting 84% of Cerrado and 16% of Amazon Forest coverage **(Figure 1)**.

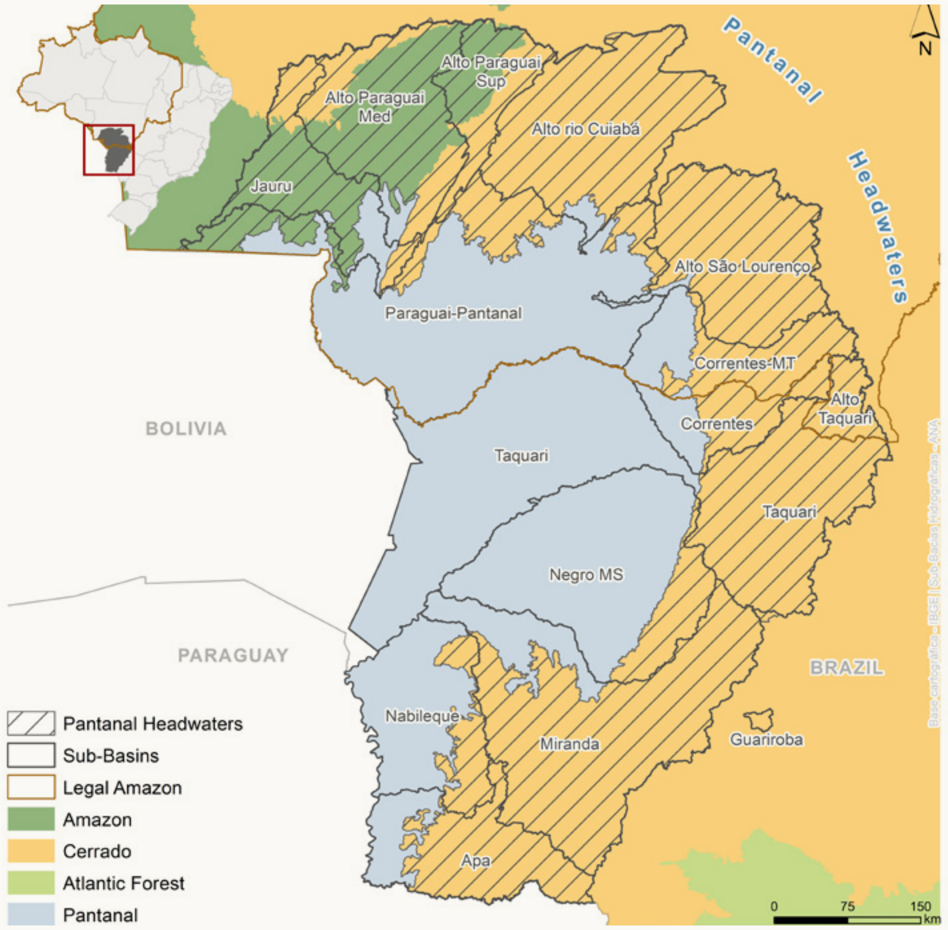
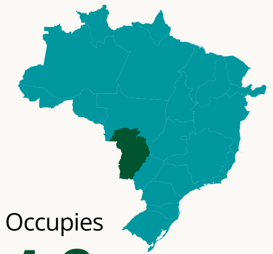


Figure 1. Upper Paraguay River Basin encompassing the Pantanal and Pantanal Headwaters, featuring the Cerrado and Amazon biomes.

UPPER PARAGUAY BASIN

36 million hectares in Brazilian territory



Occupies **4,3%** of the country

58% of UPB is formed by the plateau region we call Pantanal Headwaters

The Pantanal Headwaters region provides 80% of the water flow that maintains the flood pulses of the Pantanal. Such an important landscape for the water balance of the region, it is also the target of rapid land use changes by humans. **From almost 22 million hectares of the Headwaters, about 58% has been converted, 42% into pasture alone. The lack of maintenance or degradation of Permanent Preservation Areas (PPAs) along watercourses and the inadequate pasture management negatively impact the water resources in the landscape.** The vegetation covering PPAs (riparian vegetation that includes riparian forests, gallery forests and veredas, for example) works as a protective belt for the rivers, because the roots retain soil sediment, increase the infiltration, and percolation of water into the soil. In addition, the maintenance and fencing of riparian forests is essential for the preservation of the physical structure of the streams, for example, preventing erosion caused by cattle trampling.

Preserving the integrity of PPAs is, thus, crucial for water security, ensuring sustainable access to water for agricultural productivity, conservation of natural ecosystems, as well as for the well-being of local and regional populations.

WWF-Brazil, in partnership with the sanitation company AEGEA, and other collaborators, has developed the "Water for All" project, preparing studies on the water resources of the Pantanal Headwaters and priority sub-basins for the implementation of landscape conservation and restoration actions. **This document presents the main results obtained by the assessments of ecosystem services related to the increase in water quality and quantity.** These results include the diagnosis of the landscape, the preparation of priority areas scenarios, as well as the indication of the best activities to be implemented in each location, so as to achieve a cost- benefit balance for the activities.

2.

GEOGRAPHICAL SCOPE: Pantanal headwaters and priority sub-basins

The Pantanal Headwaters are composed of 16 sub-basins, 85 municipalities within part of Mato Grosso and Mato Grosso do Sul, with about 3.6 million inhabitants (IBGE, 2021). In the last 10 years (2012-2021), there was a decrease of over 26% of the wetlands mapped in the Headwaters (MapBiomas, 2021).

WWF-Brazil and AEGEA selected three priority sub-basins for project actions (Jauru, Miranda and Guariroba) based on their water contributions and ecological risks (TNC & WWF, 2011), in addition to AEGEA's collection and/or treatment sites for water (WTP) and sewage (STP) (Figure 2). The sub-basin of the Guariroba River, although technically outside of the Headwaters, was selected as priority due to the history of implementation of best agricultural and environmental practices by WWF-Brazil, in addition as being the main source of water supplying the populous city of Campo Grande. In addition to the three priority sub-basins, the Poconé micro-basin was inserted in part of the analyzes at the request of AEGEA, due to the severe water crisis in recent years.

PANTANAL HEADWATERS

85
municipalities

16
sub-basins

3,6
million inhabitants

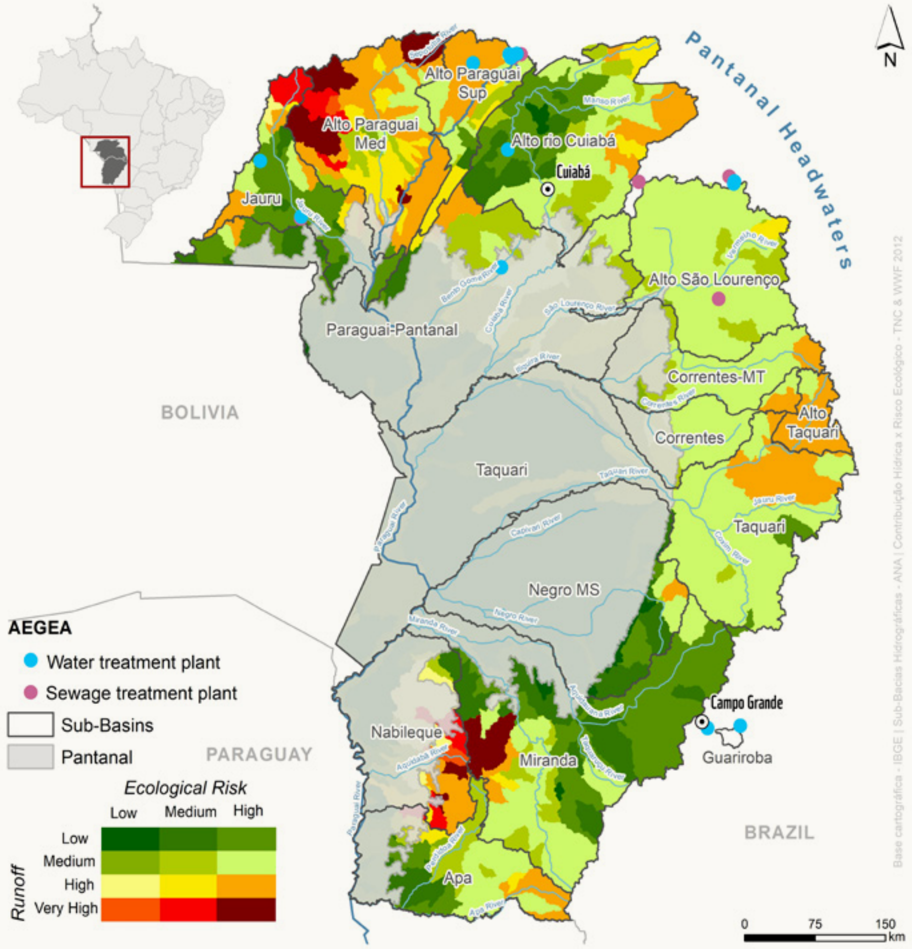
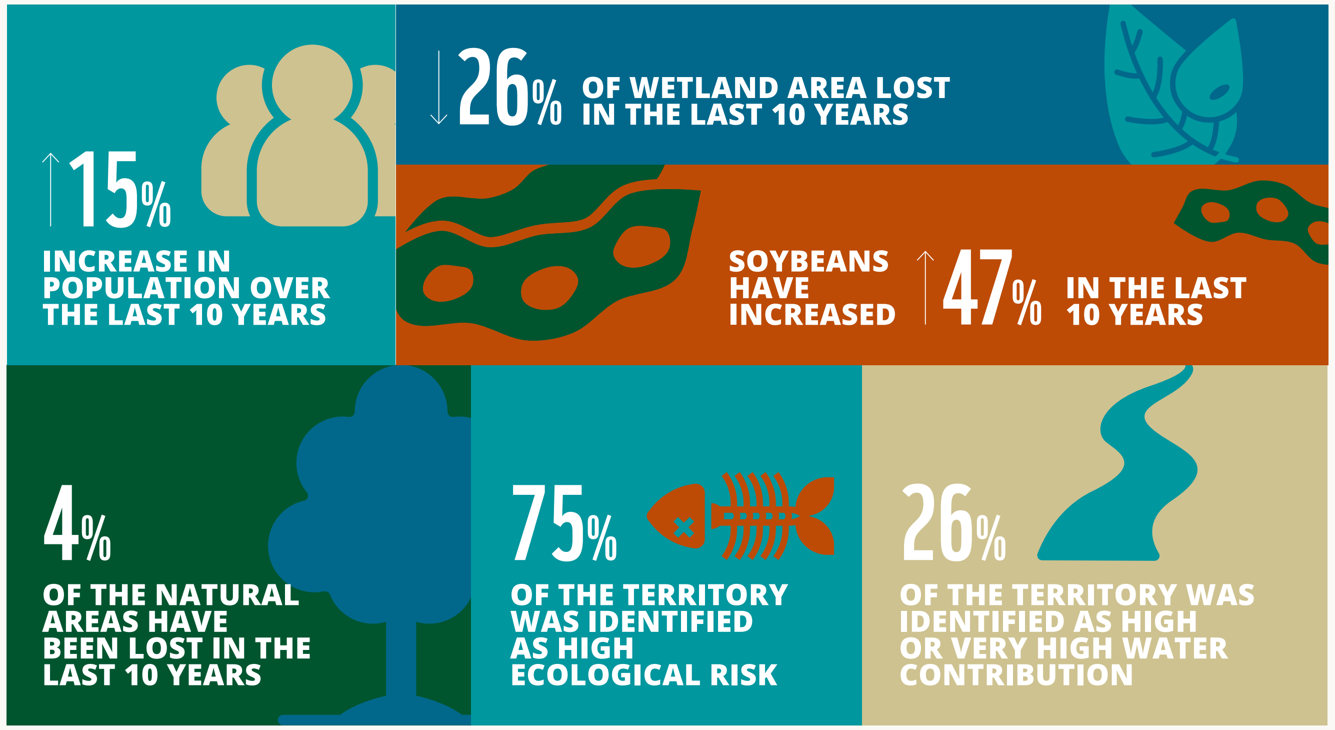


Figure 2. Water contribution study (runoff) X Ecological Risk (ERI) of the Pantanal Headwaters sub-basins vs. water and sewage treatment sites of AEGEA.



3.

ECOSYSTEM SERVICES ASSESSMENT

Ecosystem Services (ESs) are benefits derived from nature and essential for the well-being and survival of society and biodiversity. They can be divided into four categories: **provision, regulation, support** and **cultural services** (MEA, 2005). Water, as a basic element for life, is present in all of them.

The quantification and valuation of ESs are important measures to identify areas in which there is a reduction in offered resources and in need of intervention. Collecting these measures and identifying the places with the greatest water and soil oss is essential to guide decision making and strategic planning towards directing resources (material, human and financial) and focus intervention on places where the return of ecosystem services **(erosion control and water regulation)** are greater.

PROVISION
(water, raw material, agriculture, genetic resources...)

REGULATION
(carbon sequestration, climate adaptation, water regulation...)

SUPPORT
(water cycle and nutrients, air purification, erosion control...)

CULTURAL
(tourism, recreation, spiritual expression...)

WATER REGULATION

(water quantity)

- **Flow** (water availability)
- **Surface runoff** (water that does not infiltrate the soil is lost)

EROSION CONTROL

(water quality)

- **Sediment export** (soil loss due to rainfall flow)

To estimate the impact of activities on the Headwaters we used InVEST, a free software designed to manage natural resources,focusing on the quantification of two ESs: water regulation and erosion control. Thus, we generated the water regulation data based on the quantification of water baseflow **(Figure 3)** and surface runoff **(Figure 4)**, while the erosion control data was based on the sediment export rates **(Figure 5)** of the region (check the QRcode for further details on the methodology).

Figure 3. Map indicating the base flow quantification by microbasin in the Pantanal Headwaters.

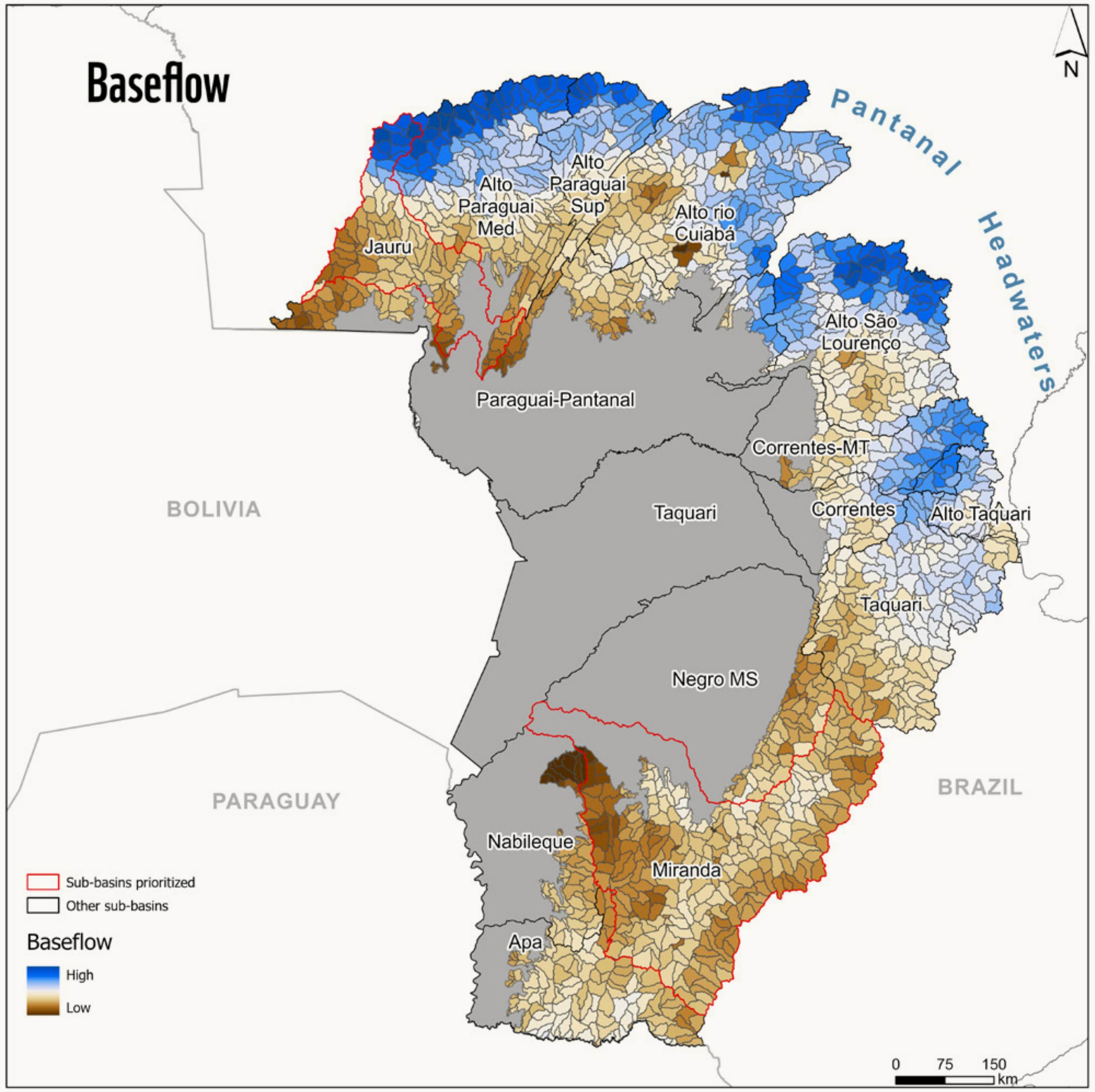


Figure 4. Map indicating the surface water runoff quantification by microbasin in the Pantanal Headwaters.

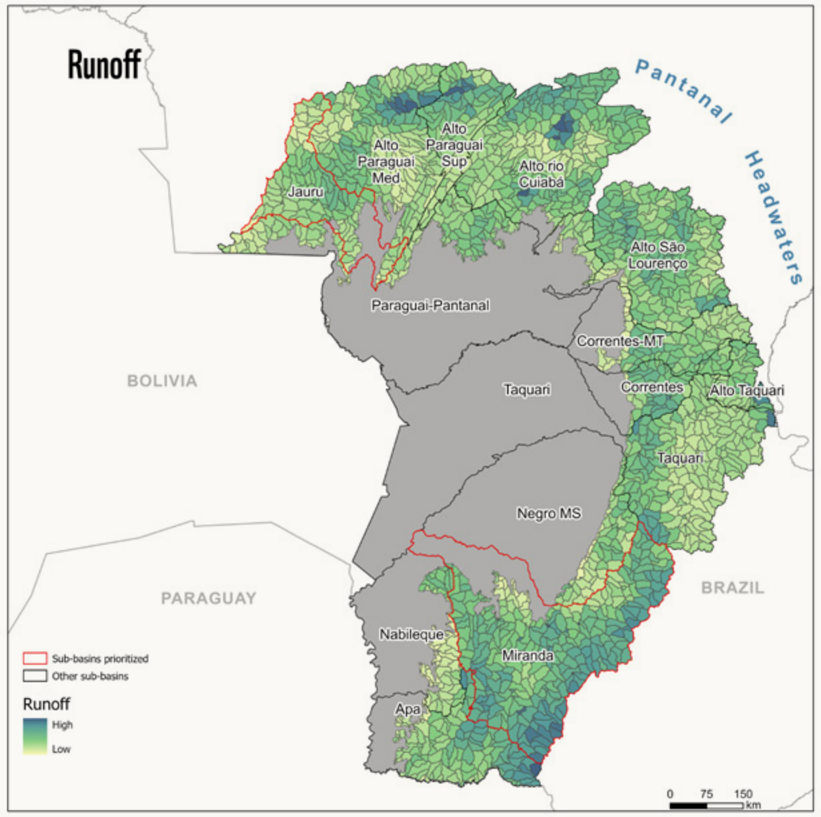
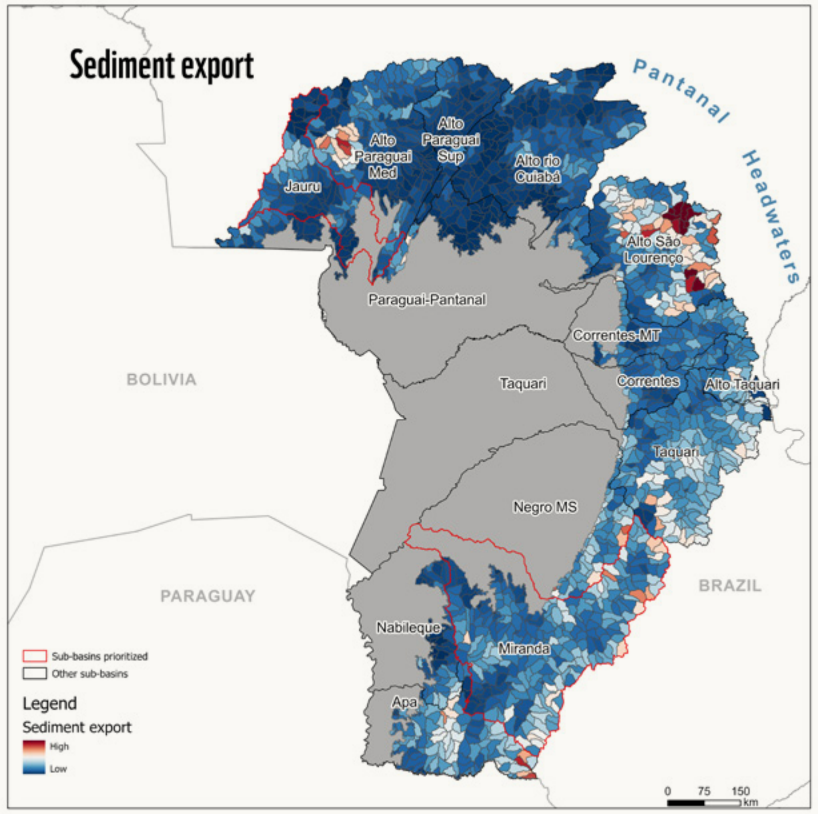


Figure 5. Map indicating the sediments export quantification by microbasin in the Pantanal Headwaters.



© André Dib / WWF-Brazil

4.

SCENARIOS FOR PRIORITIZATION OF AREAS AND CONSERVATION AND RESTORATION ACTIONS

The InVEST and the RIOS software, designed for watersheds management, were used to generate scenarios of priority areas focusing on the optimization of resources and maximization of ecosystem returns. The most recent MapBiomas (2021) land use mapping was used as input with a resolution of 90m to run the model for the Headwaters. This model prioritizes the areas that most need intervention to

i) maximize the reduction of sediment exports, thus controlling erosion processes, and

ii) increase the baseflow, with a decrease in surface runoff, and increase water infiltration into the soil.

Finally, RIOS simulates the modification of each pixel (90 m x 90 m) according to the indicated intervention activity, aiming at the highest potential return of ecosystem services.

To explore different possibilities of action, five scenarios were generated by varying the target implementation area at 1%, 2.5%, 5%, 10% and 20% of the study area, considering the Headwaters landscape, and also the priority sub-basins individually. The scenarios also varied regarding the inclusion of biophysical aspects alone, or considering the human population and its geographical distribution.

The selection of areas by RIOS is based on the cross-referencing of area maps (for example: land use, quantifications resulting from InVEST and hydrological information) and the hydrographic network. Due to its ecological importance, degraded PPAs were defined as maximum priority. After the selection of PPAs, areas with the greatest ES return contributions were added sequentially, until reaching the goal stipulated by each scenario.

For each selected area, RIOS indicates one of three possible activities for intervention in its portfolio: conservation, best farming practices (BFPs) and restoration, and each activity is exclusively assigned to a certain type of land use.

The areas covered by natural vegetation are directed to conservation, areas of high value crops, such as soybeans, are directed to BFPs, maintaining their current use, but suggesting measures to control erosion and runoff, and to increase water infiltration in the soil, such as terracing and level curves. Other anthropized areas, such as pastures, non-vegetated areas or mining areas, are assigned to restoration.

This document presents three scenarios for the Headwaters: implementation in 1% of the landscape **(Figure 6)**, 20% of the landscape **(Figure 7)**, and another scenario for 20%, but considering the demographic density **(Figure 8)**.

PROCESSING OF INPUT DATA

- Data generated by InVEST models enter as baseline for portfolio generation
- 90m spatial resolution

DEFINITION OF RELATIONSHIP BETWEEN LAND USE AND ACTIVITIES

Three activities were considered:

CONSERVATION: areas with natural vegetation

BEST AGRICULTURAL PRACTICES (BAPS): planting areas

RESTORATION: anthropized areas with no record of high-value cultivation

PORTFOLIO GENERATION

Prioritization of

1% of the total area (210,384 ha)

20% of the total area (4,207,680 ha)

20% of the total area considering the geographical distribution of the population

Figure 6. Spatial priority considering the implementation scenario in 1% of the Pantanal Headwaters area.

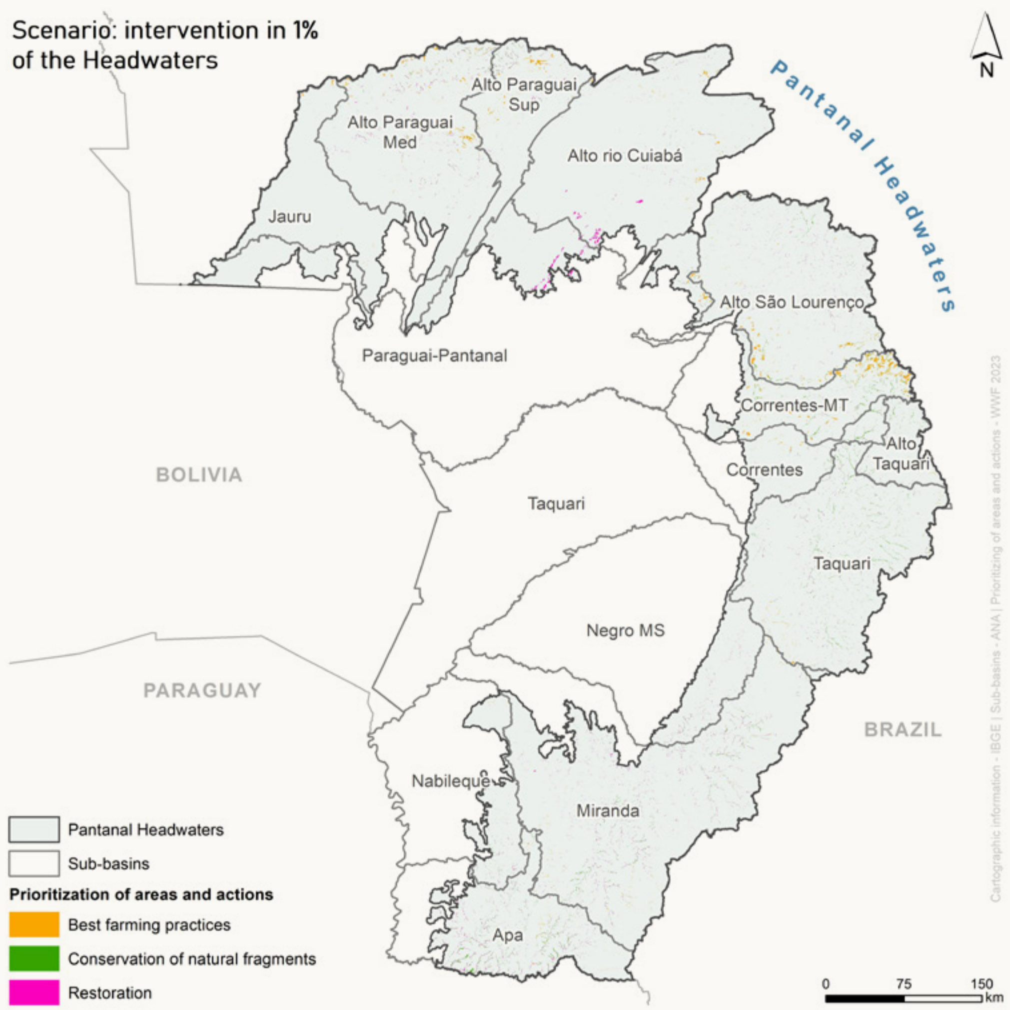


Figure 7. Spatial priority considering the implementation scenario in 20% of the Pantanal Headwaters area.

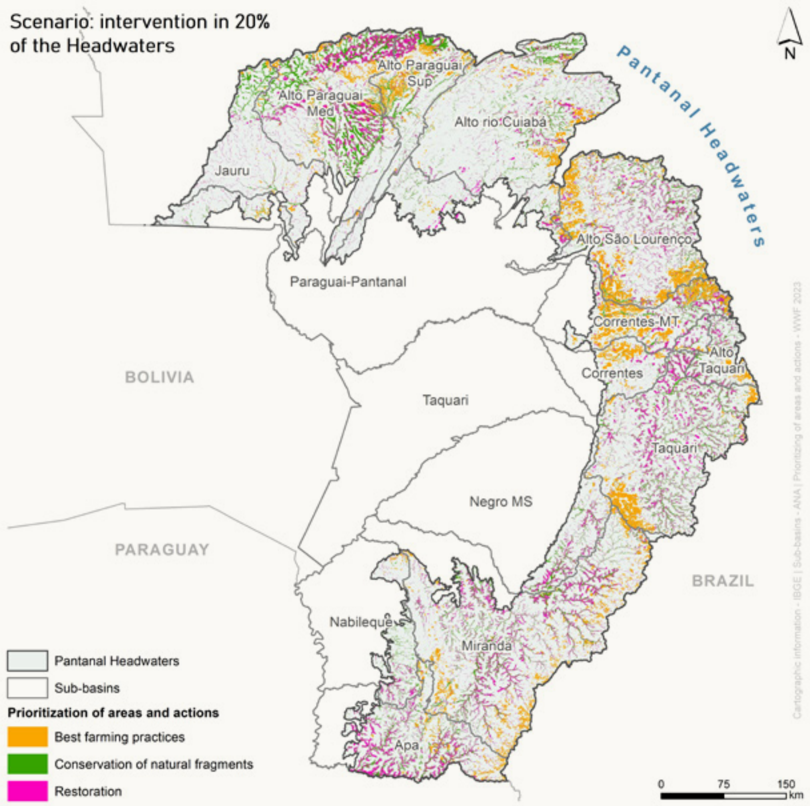
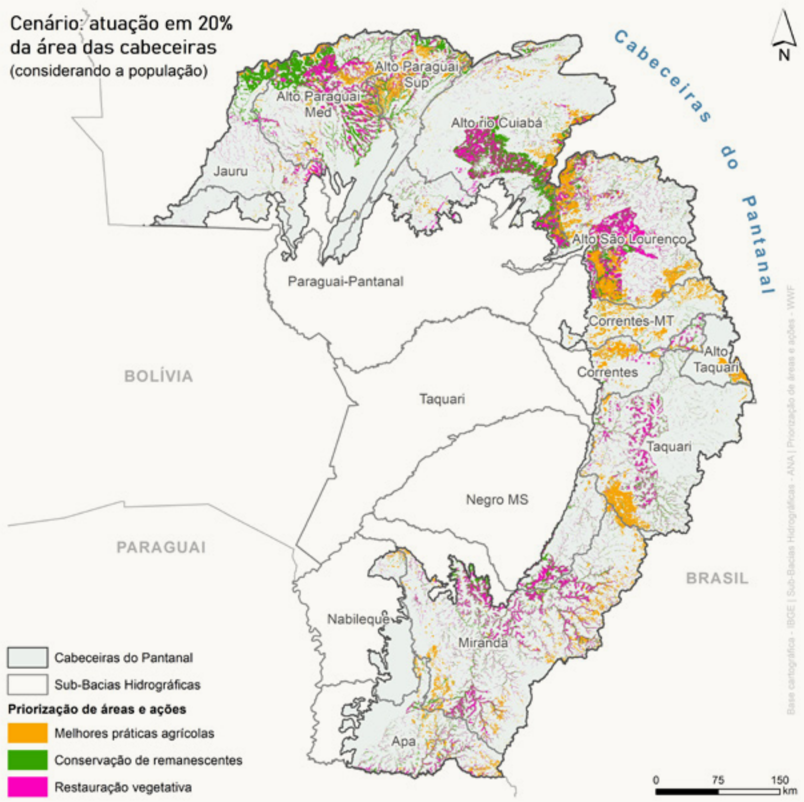
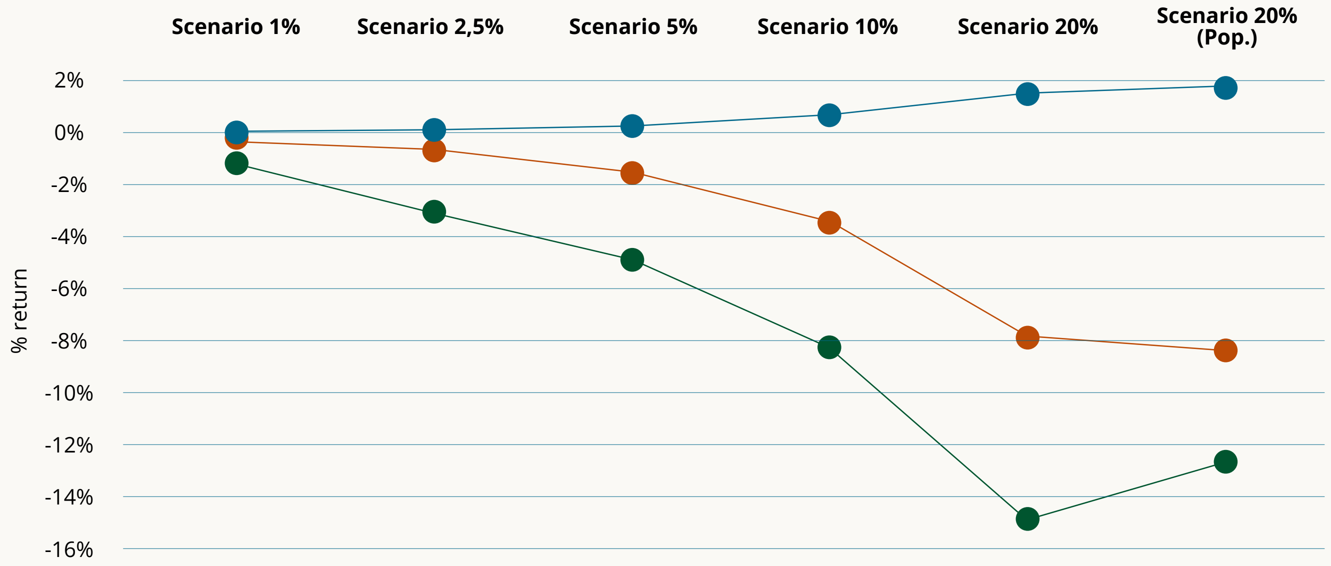


Figure 8. Spatial priority considering the implementation scenario in 20% of the Pantanal Headwaters area and considering the demographic density.



The 1% scenario for the Pantanal Headwaters considers implementation of 210,384 hectares, a higher value than the deficit of degraded PPAs mapped for the landscape (almost 141 thousand hectares) (FBDS and MapBiomas 2021). The two scenarios considering implementation in 20% of the landscape (only biophysical effects, and biophysical effects + population) presented similar results regarding ES return. However, in the scenario considering the human population, the model selected areas in more densely populated regions, such as Alto Rio Cuiabá and Alto São Lourenço, in detriment of those with lower density, such as Nabileque (the territorial fraction located in the Headwaters), Guariroba and Alto Taquari.

Figure 9. Graph showing the return behavior of the ecosystem service parameters studied according to the scenarios for the Pantanal Headwaters landscape.



Erosion control (exported sediments) were more sensitive to local interventions and the geographical distribution of the areas (Figure 9). This means that implementing restoration or BFPs actions on a small scale would already provide an improvement in local water quality.

The 20% scenario was best for water regulation, with baseflow increase and reduction in surface runoff with 8% return , considering (or not) the population. Unlike erosion control, the results showed that the water regulation service is not very sensitive to local changes, and that large-scale interventions are necessary to obtain positive impacts on ESs.

It is noteworthy that the intervention efforts of landscape activities (BFPs, restoration) are not directly related to the size of the analyzed area , which means that the cost-benefit of landscape interventions is not linear (1:1 or 1:2) and can vary between scenarios.

That is, for every 1% of implemented activity, there will not necessarily be 1% in ES return. The model indicates scenarios where the trade-off is higher in terms of cost-benefit: lower intervention efforts resulting in higher ES benefits return.

5.

REGIONALIZATION OF ANALYSES FOR PRIORITY SUB-BASINS

To focus on the priority sub-basins (Jauru, Poconé, Miranda and Guariroba) it was necessary to adapt the previous landscape level analysis (Pantanal Headwaters) to a local scale, at the property level analysis. In addition to increasing the spatial resolution from 90 to 30 m, the delimitation of the sub-basins would follow the catchment areas of AEGEAs' WTPs. For more specific results, we established that:

1
implementation activities would be reduced to BFPs and restoration (excluding conservation);

2
all scenarios must present results with and without considering the demographic density;

3
mining areas, previously indicated for restoration, were removed from processing, while pasture areas were included as being subject to BFPs or even restoration; and

4
inclusion of a new scenario with 25% of prioritized territory.

As it was for the Headwaters analysis, the sub-basins scenarios of 1-10% presented the best trade-off between cost-benefit for erosion control (water quality), while the scenarios 20-25% were better for water regulation (amount of water). The amount of prioritized areas (in hectares) analyzed in each scenario can be seen in **Table 1**.

Table 1. Amount of area considered in each priority scenario by landscape.

Landscape	Total area to be implemented by each scenario (ha)			
	1%	5%	10%	25%
Jauru Microbasin (Jauru)	14	70	140	350
Porto Esperidião Microbasin (Jauru)	5,633	28,166	56,332	140,831
Poconé sub-basin	2,737	13,683	27,366	68,415
Miranda Sub-basin	36,337	181,683	363,366	908,415
Guariroba Microbasin	357	1,787	3,575	8,936

5.1 JAURU - MATO GROSSO

The sub-basin of the Jauru River has 85% of its area within the Headwaters (about 1,235,000 hectares) and has a third of its territory covered by natural vegetation, containing phyto physiognomies of the Amazon Forest and Cerrado. Despite the diverse landscape, 73% of the basin presents high ecological risk (TNC & WWF, 2011), and had a 40% increase in the soybean planting area in the last ten years (MapBiomas, 2021). **Jauru is the fifth basin of the Headwaters with the largest degraded PPA area (about 15,450 hectares) and, of the 100 mapped springs, only five are under restoration process (direct communication with the basin committee).**

The analysis carried out were focused exclusively on the WTP catchment microbasins of AEGEA in Jauru (1,400 hectares) and Porto Esperidião (563,323 hectares), precisely the most populous areas of the region. Because of this, the results between scenarios, whether or not considering the population, did not differ much. Of all the sub-basins analyzed for the Headwaters, Jauru had the greatest response towards the implementation of BAPs and restoration for the increasing water quality (reduction of soil loss). The 5% scenario was the best in terms of cost-benefit for erosion control for the Jauru microbasin, and 1% for the Porto Esperidião microbasin **(Figure 12)**.

SUB-BASIN OF THE JAURU RIVER

85% of its area within the Headwaters

73% of the basin presents high ecological risk

40% increase in the soybean planting area in the last ten years

Figure 10. Spatial priority considering the implementation scenario in 1% of the Jauru sub-basin area.

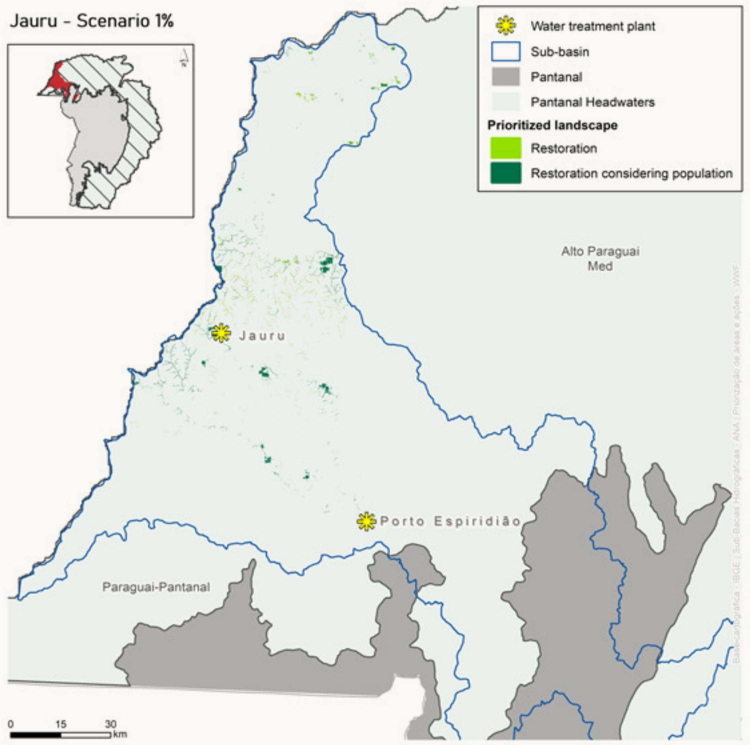
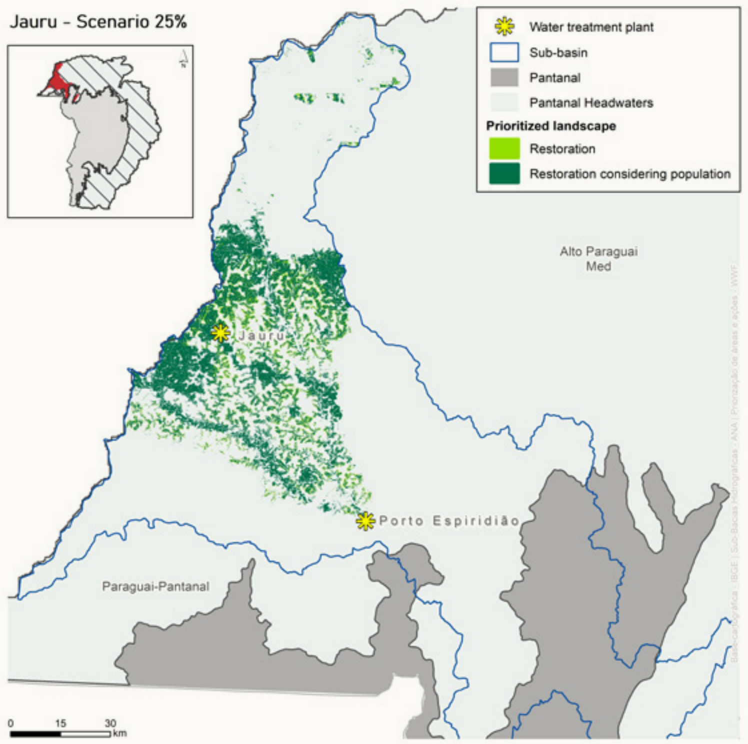
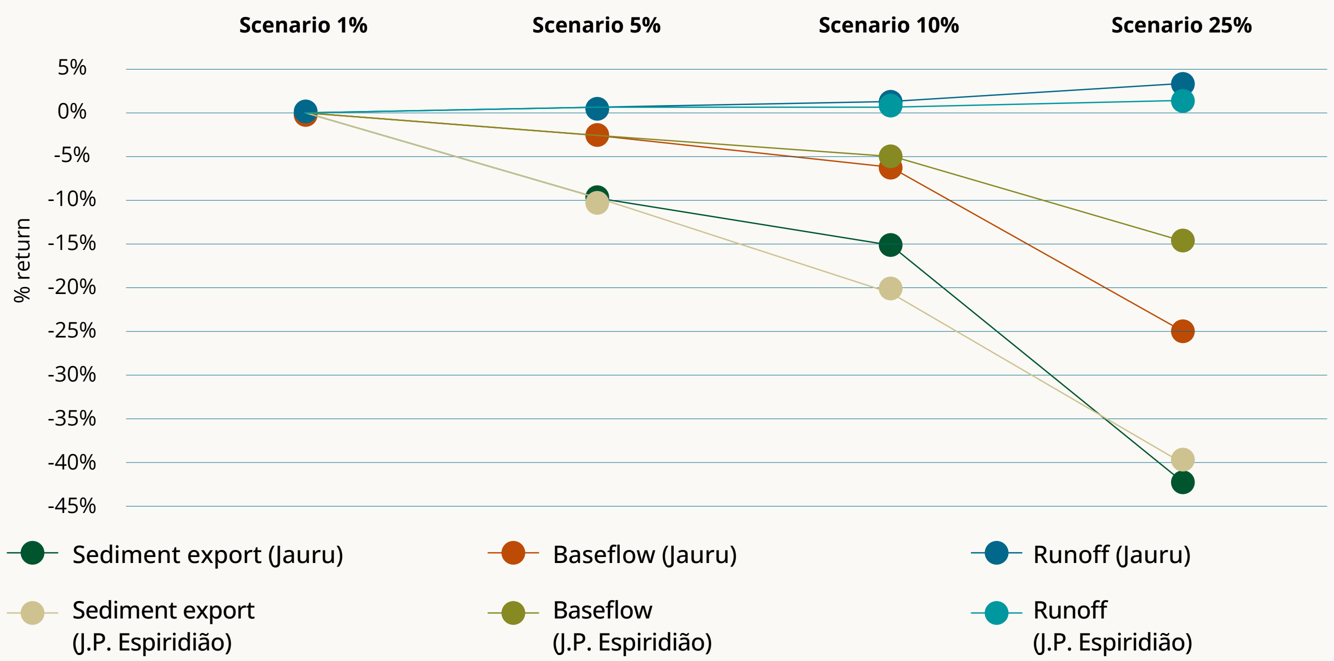


Figure 11. Spatial priority considering the implementation scenario in 25% of the Jauru sub-basin area.



For increment of baseflow (available water) and reduction of surface runoff, the 25% scenario presented the highest return values. Consequently, it is the basin with the best response in relation to the water regulation (amount of water).

Figure 12. Graph showing the return behavior of the ecosystem service parameters studied according to the scenarios.



5.2 POCONÉ - MATO GROSSO

The Poconé WTP catchment microbasin has about 282 thousand hectares and belongs to the Paraguay-Pantanal sub-basin. Of these, 82% are located in the Pantanal Headwaters and, according to a TNC & WWF study (2011), are classified as medium ecological risk and medium water contribution.

Regarding the scenarios analysis, this region presents lower ecosystem returns compared to the Jauru sub-basin . This may be due to the presence of large mining areas and other landscape anthropization activities, which are not analyzed by the model. **The 5% scenario had the best result in terms of cost-benefit, probably due to the land use and occupation context of this region.** In this scenario, for every 1% of implemented area, it is estimated twice as much in sediment retention for the entire sub-basin (2%), which is not always the case. As mentioned, the trade-off between the implementation effort and the benefit return is not linear (1:1 or 1:2). As an example, in the 10% and 25% scenarios, the return is 17% and 31%, respectively, and is not twice as much as invested (20% and 50%, respectively), as in the 5% scenario **(Figure 15)**.

POCONÉ WTP CATCHMENT MICROBASIN

82%
are located in the Pantanal Headwaters

Medium ecological risk

Medium water contribution

Figure 13. Spatial priority considering the implementation scenario in 1% of the Poconé microbasin area.

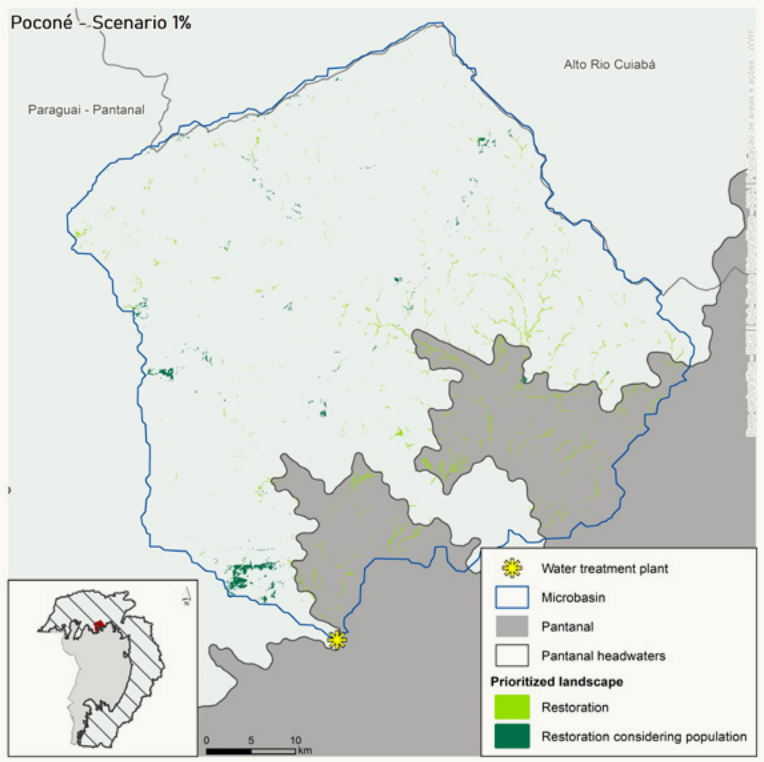
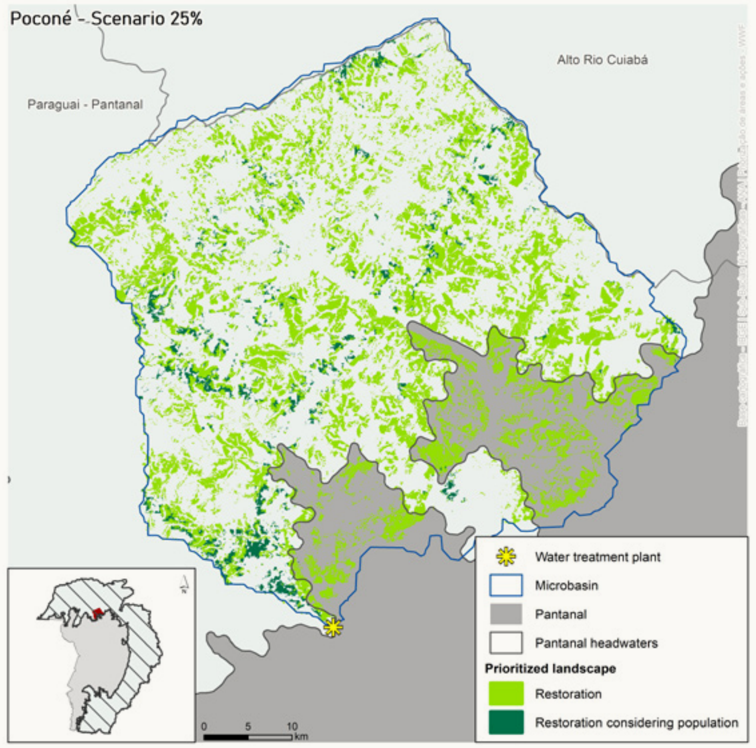
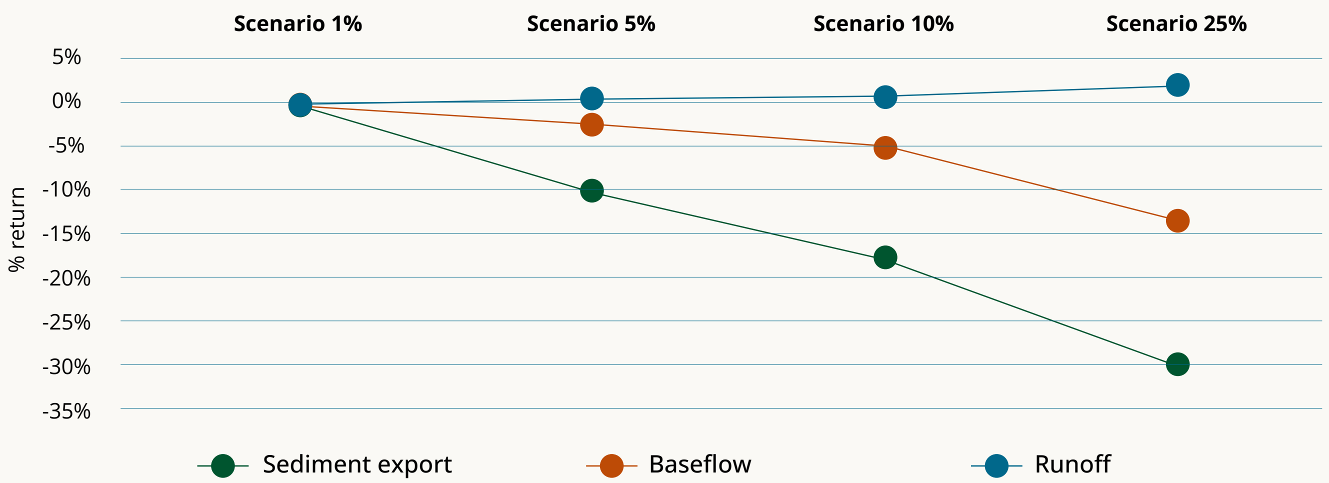


Figure 14. Spatial priority considering the implementation scenario in 25% of the Poconé microbasin area.



For water regulation (amount of water), the results show a positive increase in ES return between the 10 and 25% scenarios, where there is a 2.4% increase in the base flow (water availability) and 13% reduction in the surface runoff (water loss).

Figure 15. Graph showing the return behavior of the ecosystem service parameters studied according to the scenarios.



5.3 MIRANDA - MATO GROSSO DO SUL

The Miranda River sub-basin has 85% of its total area (4,295,100 hectares) inserted in the Pantanal Headwaters landscape. Despite its scenic beauty, Miranda is a basin with high PPA deficit values (24,083 ha), equivalent to 17% of the total deficit of Headwaters, and threatened by the increase in soybean production (170% between 2012 to 2021). Today, only 33% of its Headwaters territory is covered with natural vegetation.

As it is a very large basin, with a heterogeneous population distribution and without the presence of any AEGEA catchment, all landscape prioritization scenarios consider the maximization of ES return with benefits to the population. In terms of erosion control (water quality), the 5% scenario presents the best trade-off: almost 10% retention of sediments generated in the sub-basin (1:2). The impact on the water balance (amount of water) of the sub-basin will require an intervention in at least 25% of the total area for a 2% increase in the base flow (water availability) and an 8% reduction in water loss from surface runoff **(Figure 18)**.

MIRANDA RIVER SUB-BASIN

85%
of its total area inserted in the Pantanal Headwaters

33%
of its Headwaters territory is covered with natural vegetation

170%
increase in soybean production between 2012 to 2021

Figure 16. Spatial priority considering the implementation scenario in 1% of the Miranda sub-basin area.

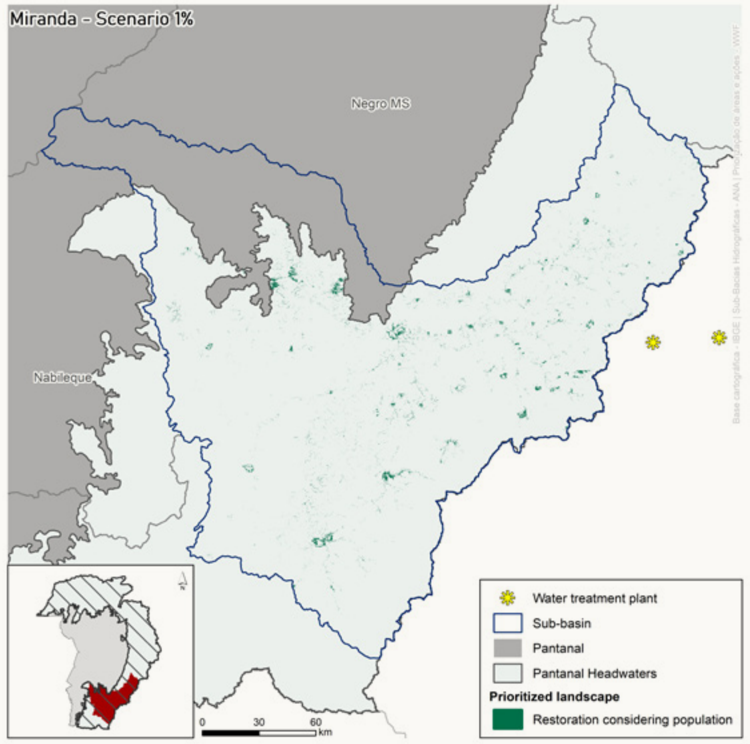


Figure 17. Spatial priority considering the implementation scenario in 25% of the Miranda sub-basin area.

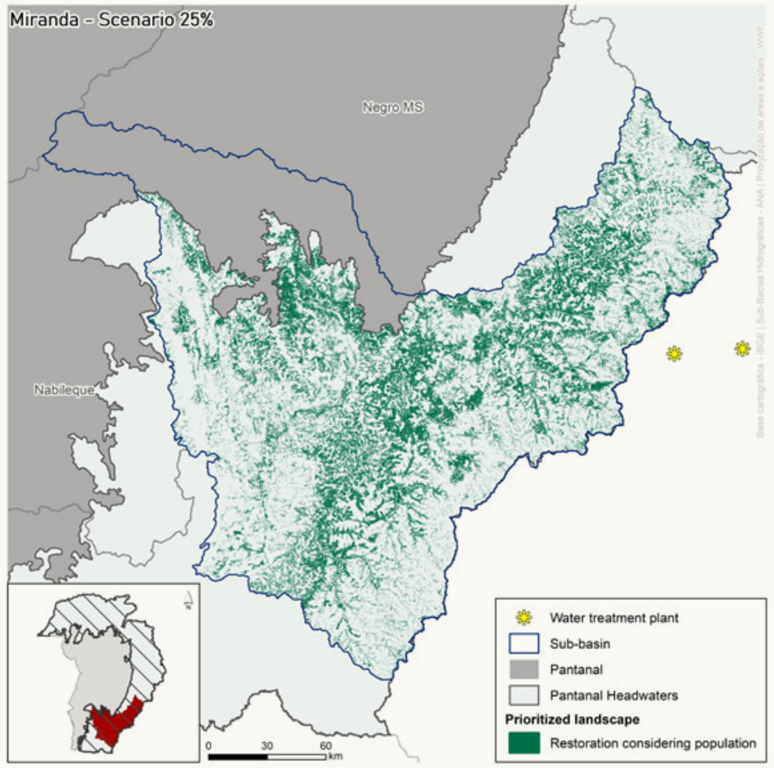
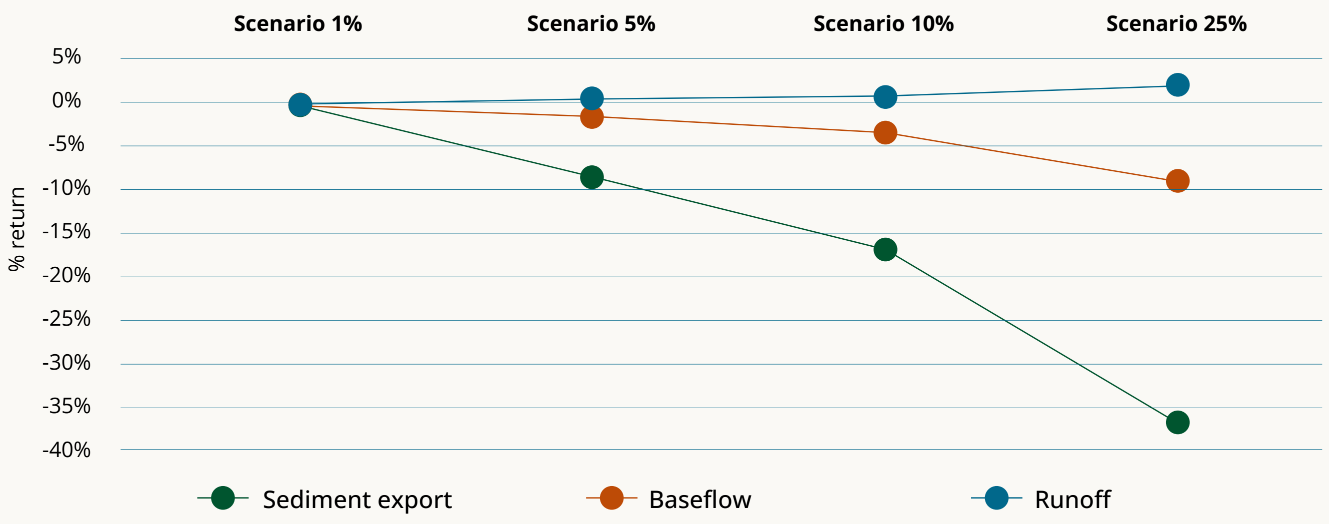


Figure 18. Graph showing the return behavior of the ecosystem service parameters studied according to the scenarios.



5.4 GUARIROBA - MATO GROSSO DO SUL

The sub-basin of the Guariroba stream has about 36,150 hectares, where more than 85% of the area has been converted for anthropic use, which 72% only for pastures. The sub-basin has a PPA debit of 683 hectares, but unlike the other sub-basins, **this region was the target of several conservation projects, with restoration actions in degraded PPAs and pasture management, fencing and other soil conservation practices.**

Because it is a small sub-basin, the analysis showed that the ecosystem return related to erosion control (water quality) presents good results already in the 1% scenario. However, to improve water regulation, at least 25% of the territory should be intervened, achieving a reduction of only 15% of water loss from runoff, and 1.7% increase in base flow (water availability). That is, less than 1:1, suggesting that scenarios over 25% should be considered for increasing the trade-off (Figure 21). In this case, the 25% scenario indicates intervention in 9,037.5 hectares, a much higher value than the PPA debit of the sub-basin (683 ha).

SUB-BASIN OF THE GUARIROBA

36,150
hectares

PPA debit of
683
hectares

85%
of the area has been converted for anthropic use

Figure 19. Spatial priority considering the implementation scenario in 1% of the Guariroba microbasin area.

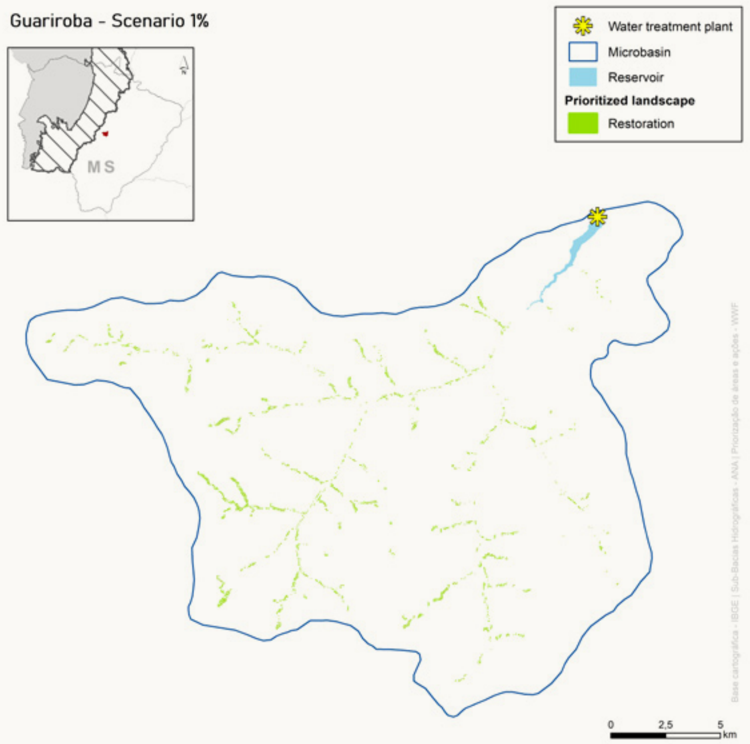


Figure 20. Spatial priority considering the implementation scenario in 25% of the Guariroba microbasin area.

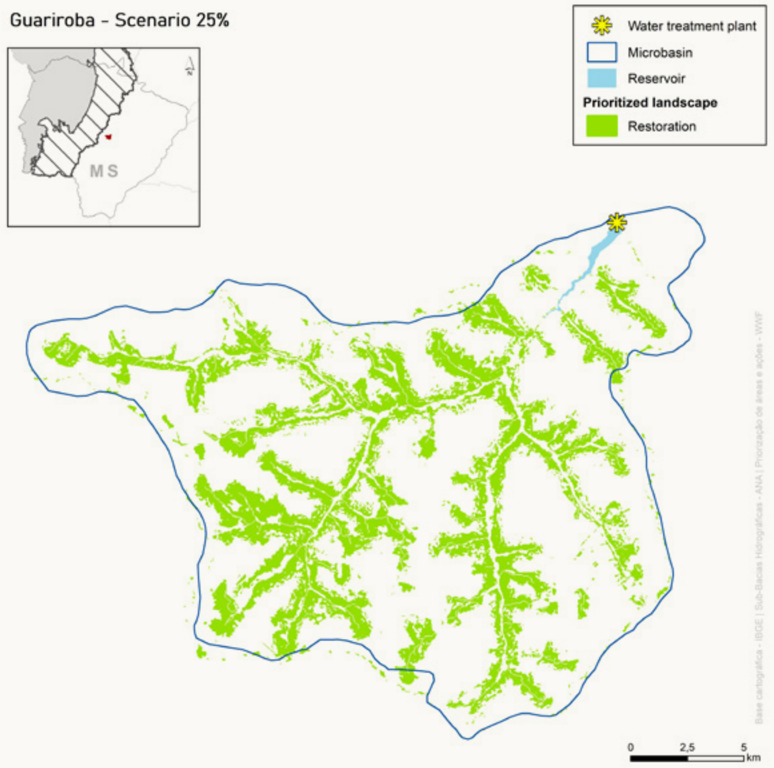
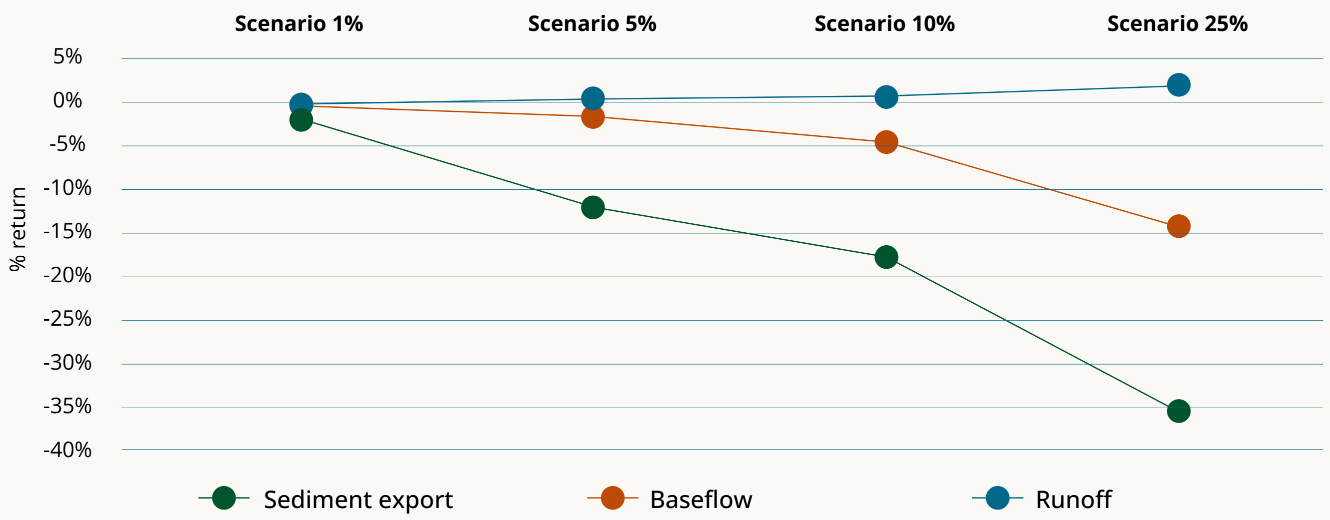


Figure 21. Graph showing the return behavior of the ecosystem service parameters studied according to the scenarios.



6.

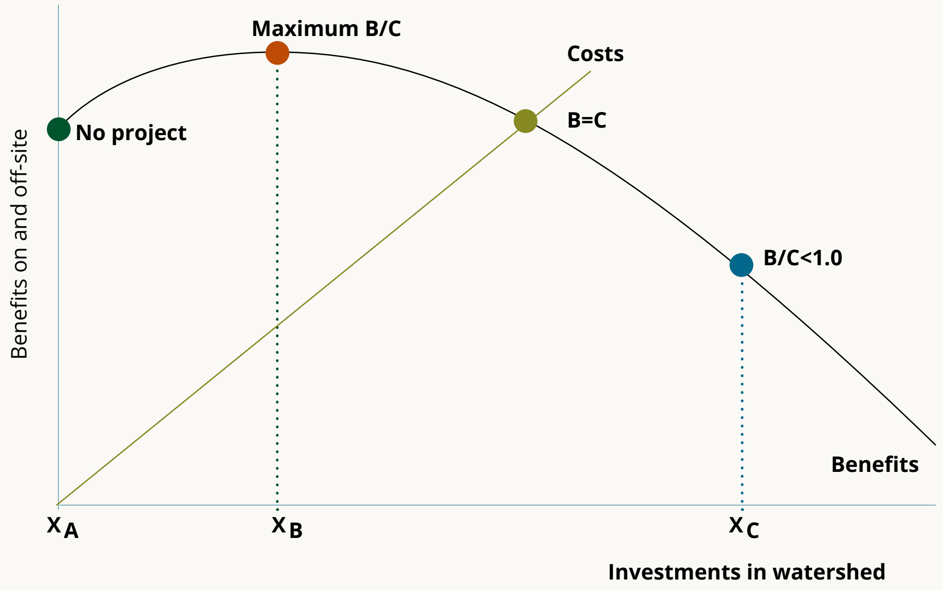
CONSERVATION ACTIONS IMPLEMENTATION TRADE-OFF

According to the "Law of Diminishing Returns", it is possible to calculate the best scenario of intervention in a landscape to obtain the maximization of the cost-benefit ratio, or trade-off, according to the marginal returns of ecosystem services. This law explains the non-linear behavior of the relationship between investment and benefit, unlike the relationship between cost and investment, as shown in **Figure 22**. At a given point, the benefit decreases and becomes negative in relation to the investment, although it can continue to grow when looking at absolute values (McNall, 1933; Brooks & Gregersen, 2014). **This moment is called the point of maximum return, or optimum point, which also represents the inflection point of this curve.** In this case, the investment (horizontal axis) is represented by the percentage of area implemented in the landscape (scenarios), and the benefit (vertical axis) is represented by the marginal return values of the variables studied (sediment export, baseflow and surface runoff).

O return marginal é a quantificação do return dos SE com base na adição de uma unidade de investimento.

As we assessed this analysis for each studied landscape, we identified the optimal point of intervention to maximize the return of both ecosystem services, aiming at increasing the quality and quantity of water, according to the studied scenarios (1 to 25% of the landscape). **The association of the modeling data with the optimum point calculation indicates the optimal implementation value in each landscape, taking into account the maximum return of each ES (Figure 22)**.

Figure 22. Application of the Benefit/Cost ratio in drainage basin management. Adapted from Brooks & Gregersen (2014).



To better understand the relationship between benefits and beneficiaries, see **Table 2**.

Table 2. Description of studied benefits and beneficiaries.

Result	Who benefits?	Benefit	Context
Reduction of soil erosion	Sanitation company, agricultural productive sector, local biodiversity, water consuming population, tourism and leisure activities	Reduced soil loss and increased agricultural productivity	The implementation of restoration and BAP actions decreases leaching and soil loss. Soil vegetation protects the process of disaggregation and transport of soil particles by rainwater that, at a given moment, takes the sediments to riverbeds causing their silting.
Increased amount of water	Sanitation company, agricultural productive sector, local biodiversity, water consuming population, tourism and leisure activities	Increased water supply, especially in periods of drought	Restoration actions and best farming practices (BFPs) for soil conservation in the basin should increase infiltration and decrease water runoff on soil surface. Thus, it increases the recharge of local groundwater, which changes the flow of rivers, especially in drought periods.
Improvement of water quality	Sanitation company, agricultural productive sector, local biodiversity, water consuming population, tourism and leisure activities	Reduction of sediment accumulated by erosion and reduction of expenses with chemical water treatment	The improvement of water quality happens with the reduction of sedimentation caused by erosion in watercourses. Thus, the turbidity of the water decreases, even in rainy seasons, causing fewer interruptions in the supply and decreasing WTP treatment costs.

Table 3. Indication of scenarios with maximum return of ecosystem services and the optimum point of intervention for the Pantanal Headwaters and priority sub-basins.

	Maximum ratio return of erosion control	Maximum ratio return of water regulation	Optimum point for intervention
PANTANAL HEADWATERS	scenario of 2.5%	scenario of 20%	**11% of the landscape**
Jauru	scenario of 5%	scenario of 25%	**14% of the microbasin**
P. Esperidião	scenario of 1%	scenario of 25%	**18% of the microbasin**
Guariroba	scenario of 1%	scenario of 25%	**14% of the microbasin**
Poconé	scenario of 1%	scenario of 25%	**14% of the microbasin**
Miranda	scenario of 5%	scenario of 25%	**10% of the subbasin**

7.

WATER STEWARDSHIP IN SUB-BASINS

Water resources impact several (if not all) aspects of a landscape: from biodiversity, human occupation, and farming activities, for example. It is common for a drainage basin to be under different jurisdictions depending on its political boundaries (such as state and municipal divisions, and different land categories), which do not always communicate, and therefore have decentralized management.

Thus, the conception of an integrated basin management, which we call water stewardship, is the understanding that all actors present in the landscape (from small rural owners to regulatory agencies and different industrial sectors) are also managers of the resources of this landscape (Brooks et al., 2003), and therefore, key actors to ensure water security in the basin (WWF, 2013). The competence in the implementation of the Water Resources Policy belongs to the Executive Branch which, through the implementation of the National Water Resources Management System, composed of the National Water Agency (ANA), state councils and river basin committees, for example, must promote the environmental management integration (MMA, 2006). The river basin committees have the duty to promote debate, mediate conflicts, approve action plans and take responsibility for any changes necessary for the improvement of water governance.

A survey carried out by WWF-Brazil (2023) sought to identify the main problems in water stewardship from research and meetings with relevant actors from the three priority sub-basins, in order to indicate possible actions to mitigate water risks.

To this end, the Alliance for Water Stewardship (AWS) methodology was used, which proposes a standard for evaluating the effort and impact of actions to implement or improve a water governance system, and is based on four major results:

i) good water governance,

ii) sustainable water balance,

iii) good water quality and

iv) protected water importance areas.

To achieve these results, the AWS has a 6-step protocol **(Figure 23)**, of which we will address only the first two:

COMMIT

when local actors come to understand the importance of water governance and engage in collective actions and/ or projects for the conservation of local water resources (mapping of relevant actors)

GATHER AND UNDERSTAND

when actors start to learn about the risks, challenges and opportunities for intervention associated with the regulation and water security of the basin (diagnosis of the governance system).

Figure 23. Six steps of the Alliance for Water Stewardship (AWS) water governance methodology.

The AWS protocol provides a questionnaire that should be applied to actors relevant to the water governance system of each basin. Thus, if the actor is interested in committing to this theme and methodology, depending on his final score, he will receive a seal indicating the effort and impact of his actions on the landscape. In addition, the protocol can help the actor identify where the biggest challenge is for complying with the methodology. See the main information collected in **Table 3**.

Table 3. Result of the analysis using the Alliance for Water Stewardship (AWS) methodology.

Sub-Basin	Diagnosis of governance situation and environmental challenges	Indicated mitigation and governance improvement actions	AWS Score
Jauru (MT)	• **Inoperative** basin committee; • No record of other projects funding restoration activities in the basin; • Lack of financial and human resources to implement water PPA recovery actions; • No participation in projects with financial return to the owner (examples: PES, PRS) • No studies for monitoring water quality or flow, except in AEGEA catchments; • No access to regular hydrological data; • Reduction in rainfall levels between 1971 and 2021;	• The basin committee must start hiring **studies** to carry out the Basin Recovery Plan; • The basin committee must commit to produce, acquire and/or support the generation of **hydrological data** for monitoring the basin; • **Engagement** of city halls and SEMA to support and supervise actions to recompose PPAs and LRs; • Fencing of PPAs and LRs; • Incentive to **level no-till farming**; • Construction of **broad-based terraces** in agricultural and livestock area;	• **Basin Committee:** 0 (zero) *The Committee was represented by the current president Ademir Patrick de Moura.*
Miranda (MS)	• The basin committee is in the **initial phase** of organization, no activities implemented yet, but meeting regularly; • PES implemented and active in the micro-basin of the Mimoso River, with an expectation of expansion to the micro-basin of the Rio do Prata; • The inspection of properties participating in the PES has been carried out by the IASB, an institute that facilitates contact between state and municipal agencies, nurseries, owners and seed collectors. • No quality and water flow monitoring studies; • Increased agricultural activities and contamination of water bodies by chemicals; • Reduction in aquifer recharge due to water in soil infiltration deficit; • Reduction in rainfall levels between 2008 and 2022;	• The basin committee must commit to produce, acquire and/or support the generation of **hydrological data** for monitoring the basin; • **Engagement** of city halls, SEINFRA and AGRAER to implement actions to minimize environmental impact (terracing, construction of level curves in cultivation areas and maintenance of rural roads); • Incentive to **level no-till farming**; • Fencing of PPAs and LRs; • Construction of **broad-based terraces** in agricultural and livestock areas;	• **Basin Committee:** 78 (Gold Seal) *The Committee was represented by the current president Eduardo Coelho.*
Guariroba (MS)	• Committee in the **initial phase** of organization; • Association for the Recovery, Conservation and Preservation of the Guariroba EPA (ARCP), very active in the implementation of restoration and BFPs in associated properties; • Hydrological data periodically monitored by UFMS (state university) • Reservoir spillway water quality and flow periodically monitored by Águas Guariroba (AEGEA); • Most of the basin's landowners are engaged and partner with ARCP for restoration or better soil management practices; • PES in the second public notice; • Água Brasil program investing in conservation actions since 2012;	• **Fundraising** by the management body to continue the current PPA recovery actions (e.g. banks, foundations and environmental agencies) • Construction of **terraces** in the missing areas • Establishment of a mechanism to **perpetuate the PES** along the municipality of Campo Grande	• **Association for the Recovery, Conservation and Preservation of the Guariroba EPA (ARCP):** 113 (Platinum Seal) *ARCP was represented by the current Vice President Claudinei.* **AEGEA Company:** *AEGEA was represented by its Environment and Quality Manager, Fernando Garayo.*

8.

CLOSING MESSAGE

- Spatial planning and area prioritization help decision-makers to direct implementations of sustainable activities where they are most needed, and where the cost-benefits are greater.

- With the scarcity of time and resources (human and financial) decision makers can focus actions in the 1% scenarios, as they are the most priority areas for maximizing the return of the two assessed ES (erosion control and water regulation).

- According to the models, restoration actions should be accompanied by conservation activities and sustainable soil management practices to ensure increased water quantity and quality.

- To change the water balance of the Pantanal Headwaters or their sub-basins, it will be necessary to implement actions in at least 20 to 25% of the landscape area.

- To improve water quality in the Pantanal Headwaters or its sub-basins, implementing actions in 1% of the landscape area will already present positive returns in relation to on-site sediment retention.

- The methodology for calculating the optimum point and the spatial modeling results differ and complement each other, as they bring additional information relevant to decision makers, indicating ideal quantities and areas of intervention for maximizing the return of the two ecosystem services analyzed in the landscape (erosion control and water regulation).

- Greater integration between landowners and rural producers, Environment Secretariats, City Halls, Basin Committees, among others, is suggested to improve the water management of the sub-basins analyzed.


© André Dib / WWF-Brazil

TECHNICAL INFORMATION

“Water for all” project – restoration and water benefits in the Pantanal Headwaters

WWF-BRAZIL

Maria Eduarda Coelho | Veronica Maioli | Laís Cunha | George Mendes | Rodrigo Rodrigues | Laura Silva | Breno Melo

Collaborators: ATA Consultoria | Jorge Eduardo Leon Sarmiento

Proofreading: Bem-comunicar

Visual identity and editorial design: Laboota

Citation: Coelho, M.E. & Maioli, V. (Org.). 2023. Spatial Planning for Restoration of the Pantanal Headwaters with a focus on Water Resources WWF-Brazil & AEGEA.
ISBN: 978-65-89267-05-8

WWF

aegea

FOR FURTHER INFORMATION AND REFERENCES