RESTORATION PLAN

for the Pantanal Headwaters Landscape

Cerrado de pé/WWF-Brazil

1.

INTRODUCTION

The Upper Paraguay River Basin (BAP) is formed by the Pantanal plains and its plateau areas, also known as Pantanal Headwaters. The Headwaters occupy 58% of the BAP, are mostly covered by characteristic vegetation of the Cerrado Biome, such as grassland, savannas and forests, **responsible for 80% of the water flow that feeds the flood pulses of the Pantanal.** This landscape has incredible scenic beauty, high biodiversity, and is home to millions of people, including hundreds of traditional communities. Despite that, the landscape is under intense anthropogenic pressure, mainly due to the growth of unsustainable agriculture and livestock farming, activities driven by the global demand for food, fiber and biofuels..

UPPER PARAGUAY RIVER BASIN (BAP)

58%

Pantanal Headwaters

The land use change, associated with climate change, has impacted the natural resources on which agriculture also depends, with more extreme droughts and shrinking water resources.

Driven by this threat scenario, in association with the richness of local initiatives and power of resources that can be transformed into institutional and financial arrangements, WWF-Brazil select the Pantanal Headwaters as a priority landscape, being the focus of environmental conservation activities, strengthening of socio-biodiversity chains and improving best agricultural practices. In this context, the partnership with the sanitation company AEGEA stands out in a project that aims to understand the context and impacts of water resources on the Pantanal Headwaters, as well as encourage the adoption of best practices in the region, having the **LANDSCAPE RESTORATION*** as central strategy.

LANDSCAPE RESTORATION consists of the recovery of ecological processes of a deforested or degraded area, restoring its functionality. This concept goes beyond planting species in a given location, as it considers the landscape as a whole, including different land use mosaics and local communities, thus offering more productive spaces and multiple benefits for people and nature.

Restoration activities are crucial to reverse and transform the current vulnerability scenario of the landscape, promoting the environmental, social and economic restoration of the Headwaters, with the improvement of water and soil resources, employment and income generation. In addition, there are positive effects on food security by boosting the production and trade of native products. However, for restoration to happen and succeed, many barriers and difficulties need to be overcome through actions ranging from governance arrangements to practical information on what to do, where to do it and why. This is what this document was built for.

PURPOSE OF THE PLAN

This Pantanal Headwaters Restoration Plan was developed to assist the decision-making of different stakeholders and institutions involved with the restoration chain in this landscape. It brings together the state of the art of knowledge on the subject, generated by different people and institutions, as well as new unpublished data. Throughout the next pages, several analyzes are (briefly) presented and the areas prioritized according to the different restauration objectives, as well as mapped stakeholders, techniques and main species indicated for planting, in addition to bottlenecks and opportunities for future interventions and projects.

The full restoration plan document is available on the QRcode

TARGET AUDIENCE

People or organizations interested in restoration, including: companies, government members, research centers and institutes, universities, associations and local institutions.


Laís Cunha/WWF-Brazil

2.

THE HEADWATERS

The landscape known as Pantanal Headwaters is composed of 16 hidrographic sub-basins and has an intense economic activity aimed at extensive beef cattle farming and agriculture (e.g. soybeans, corn and sugarcane) **(figure 1)**. **Most of the Headwaters is inserted in the Cerrado biome (84%) and a smaller portion in the Amazon biome (16%) (figure 2)**. Deforestation rates in the Headwaters have been falling in the last 10 years (2012-2022), but from 2021 to 2022 there was an increase of 25.5% in MT (INPE, 2023).

PANTANAL HEADWATERS

16
sub-basins

84% Cerrado biome

16% Amazon biome

Figure 1. Location of the Cerrado and Pantanal Headwaters in Brazil.

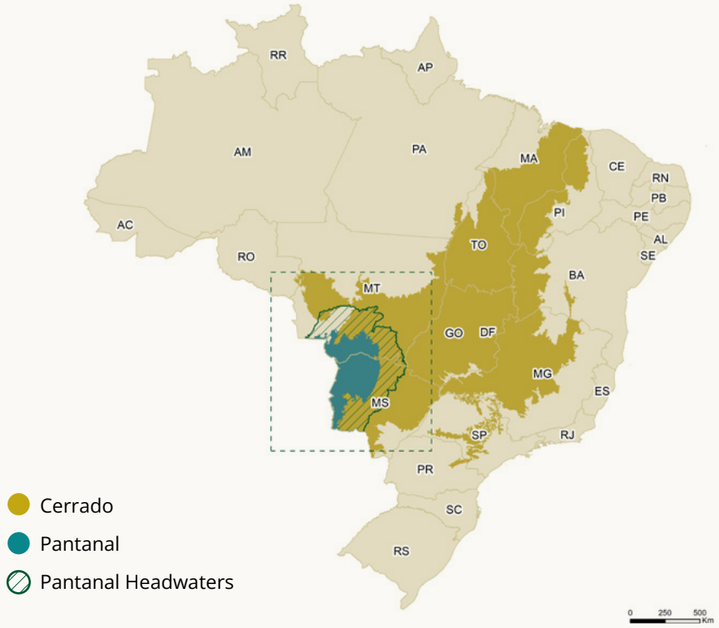
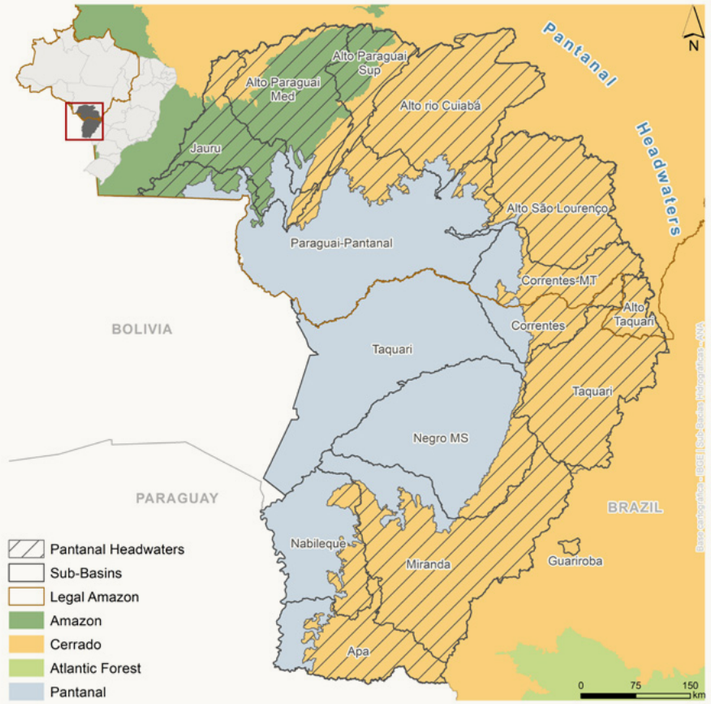


Figure 2. Biomes in the Pantanal Headwaters.



PANTANAL HEADWATERS

Area (ha)
21,100,000 ha

The Headwaters encompass parts of 2 states: **Mato Grosso** (MT) (13.4%) and **Mato Grosso do Sul** (MS) (25.3%)

Municipalities
85

Biodiversity
34 endangered fauna species (EN/CN)

Indigenous lands
26

Land uses

42% de **Pasture**

42% de **Native vegetation**

6% de **Conservation Units in the territory**

Human population
estimated at **3.6 million** inhabitants

3.

PREPARING THE PLAN

3.1. METHODOLOGY

The Pantanal Headwaters Restoration Plan was built based on secondary and primary data. WWF-Brazil carried out bibliographic assessment to survey the state of the art on spatial data available for the Headwaters, including mappings and territorial analyzes, definition of priority areas for restoration, ecological corridors, etc. Agroicone, the company contracted for the project, collected secondary data to identify stakeholders working in the landscape restoration chain, as well as information on techniques and models associated with implementation. In a second moment, new analyses and mappings were carried out with the participation of several local stakeholders from Mato Grosso do Sul and Mato Grosso in face-to-face workshops **(figure 3)**.

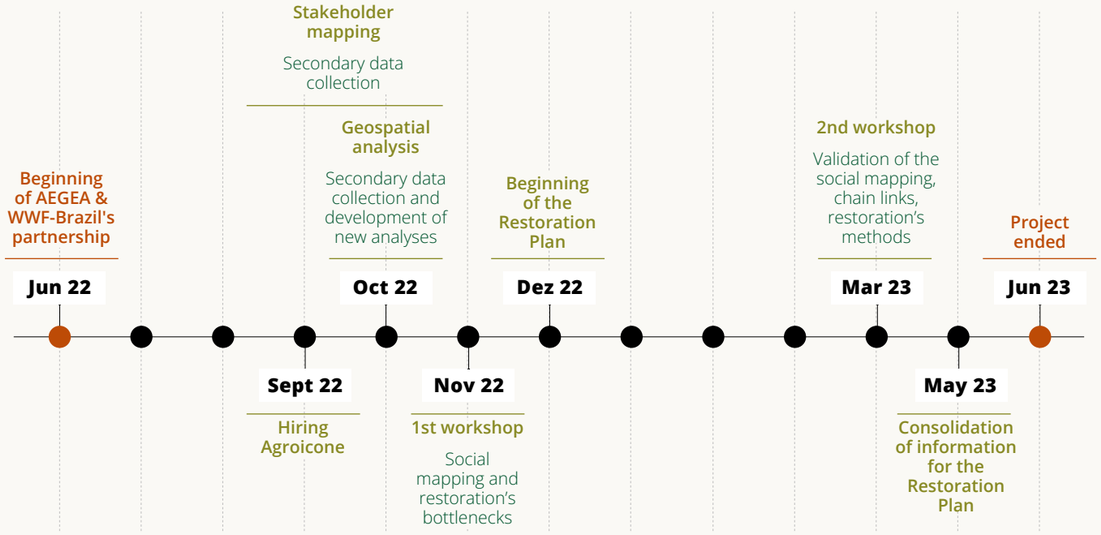


Figure 3. Timeline for the elaboration of the Pantanal Headwaters restoration plan.

PARTICIPATORY PREPARATION

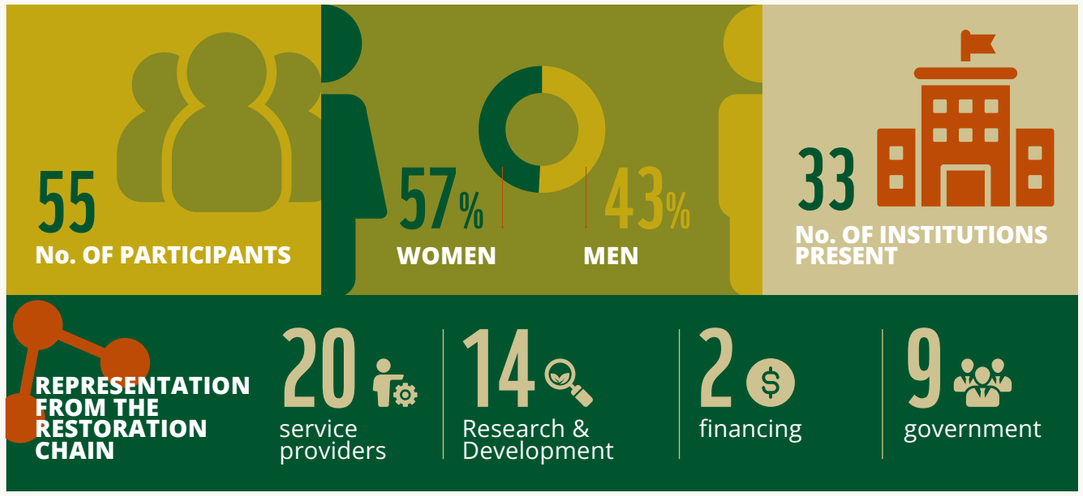
Two face-to-face workshops were held in Campo Grande (in November 2022 and April 2023) with the presence of 55 stakeholders involved in the restoration chain of the Headwaters **(figure 4)**. Both workshops were practical, using focus group and dynamic methodologies, maps, post its and tables for greater dynamism and incentive to discussion and data collection*.

The methodology applied in the workshop is available in the annex of the Restoration plan report on the QRcode.

The first workshop focused on mapping stakeholders and identifying bottlenecks to scale up restoration. In the second workshop, the stakeholders' mapping was validated and expanded; recommendations were prepared to overcome the bottlenecks pointed out in the first workshop and the locations of the implemented restoration were identified. The techniques, models and costs associated with the restoration of the Headwaters were also discussed, based on the results of the GEF Project for the Cerrado*. The information about the stakeholders's mapping was later inserted in Kumu, a mapping tool for networks and systems, in order to analyze the connections and networks between them.

This work was coordinated by the Empresa Brasileira de Pesquisa Agropecuária - Embrapa and carried out under the Conservation, Restoration and Management Strategies Project for the Biodiversity of the Caatinga, Pampa and Pantanal - GEF Terrestre, coordinated by the Ministry of Environment and Climate Change (MMA) and financed with resources from the Global Environment Facility (GEF). GEF Terrestre has the Inter-American Bank of Development (IDB) as an implementer agency, in addition to the Brazilian Fund for Biodiversity (FUNBIO) as executing agency.

Figure 4. Result of workshops participation.



Ana Lorete/Agroicone

TWO FACE-TO-FACE WORKSHOPS WERE HELD IN CAMPO GRANDE (IN NOVEMBER 2022 AND APRIL 2023) WITH THE PRESENCE OF 55 STAKEHOLDERS INVOLVED IN THE RESTORATION CHAIN OF THE HEADWATERS

Veronica Maioli/WWF-Brazil

4.

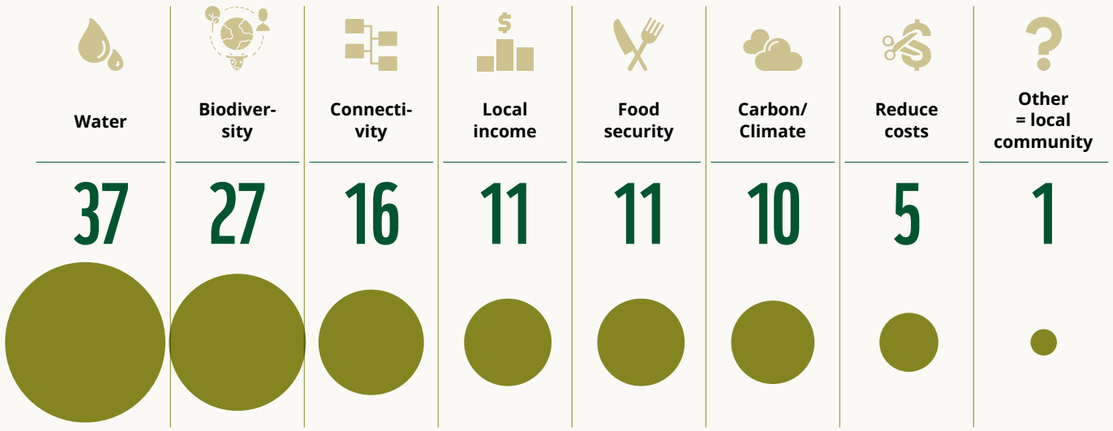
MAIN FINDINGS

4.1. OBJECTIVES OF RESTORATION - WHY RESTORE?

Landscape restoration can positively impact various ecosystem services and have different aims: **reducing restoration costs, increasing biodiversity, improving water resources, contributing to food security, among others.** The selection of one or another aim can direct actions to one place or another, changing spatial planning, influencing the type or model of restoration (full planting, agroforestry systems, etc.) and the species to be implemented (useful species, attractive to fauna, wetlands species, etc.).

In the second workshop, participants were asked to reflect on the main objectives for the Headwaters restoration. 40 participants voted on water, biodiversity and connectivity as the priority strategies targets for the Pantanal Headwaters restoration **(figure 5)**.

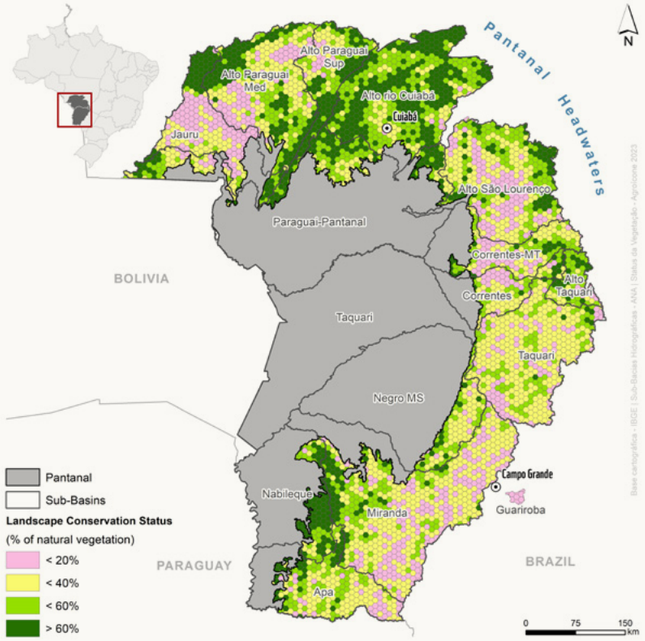
Figure 5. What restoration aims should be prioritized in the Pantanal Headwaters?



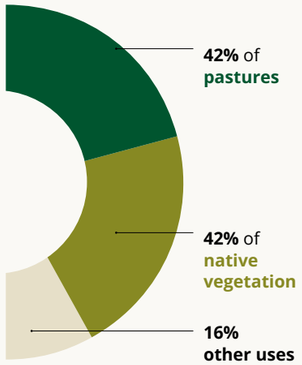
4.2. LANDSCAPE ANALYSIS - WHY RESTORE?

Once the focus and aim of the restoration actions have been chosen, it is necessary to know the different aspects of the target landscape (land use history and aptitude, social characteristics, etc.). Spatial analyses are excellent for guiding planning and subsequent implementation and monitoring of restoration actions. In the Pantanal Headwaters, pastures (42%) and native vegetation (42%) are the predominant land uses, with 58% of the landscape already anthropized **(figures 6-11)**. There is still a large environmental liability of areas to be restored and, in the last ten years (2012-2022), there was an increase in the suppression of native vegetation (+4%) and soybean cultivation (+47%), and a decrease in water bodies (-26%) (Mapbiomas, 2022).

Figure 6. Landscape conservation status.



PREDOMINANT LAND USES



LANDSCAPE CONSERVATION STATUS

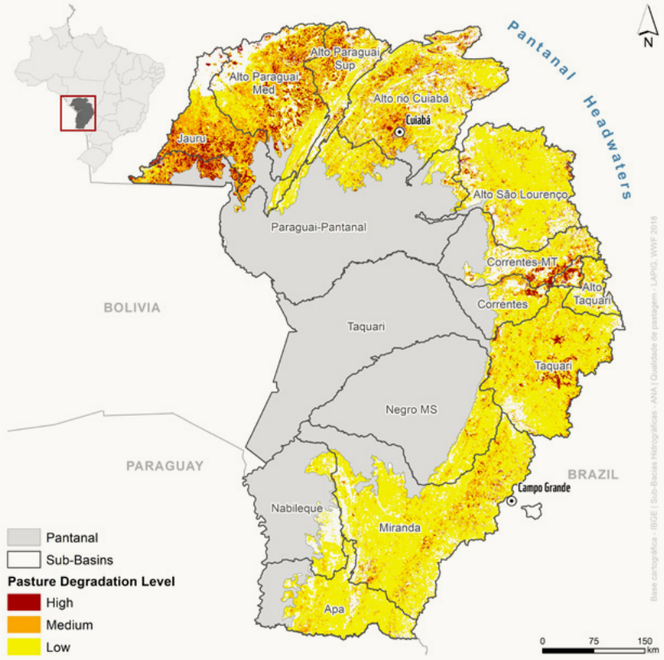
Class < 20% =
3,843,158.41 hectares
18,21%

Class < 40% =
7,615,264.96 hectares
36,1%

Class >60% =
4,526,934.77 hectares
21,45%

According to the Native Vegetation Protection Law (Law 12.651/2012), also known as the Forest Code, Permanent Preservation Areas (PPA) are marginal areas to watercourses, whether springs, paths, artificial reservoirs, etc., and also hilltops. Legal Reserve (LR) is an area of the property that must be maintained with vegetation, partial management being allowed. In the Cerrado biome, the LR area corresponds to 20% of the property; in the Legal Amazon, the LR goes to 35%.

Figure 7. Pasture quality.



PASTURE QUALITY

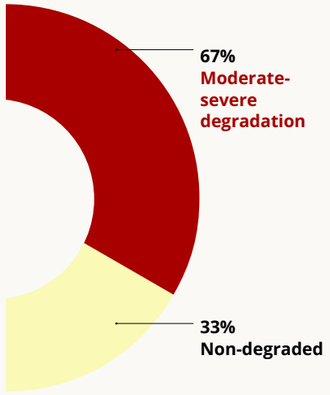


Figure 8. Deficit of Permanent Preservation Areas (PPA).

PPA DEBIT

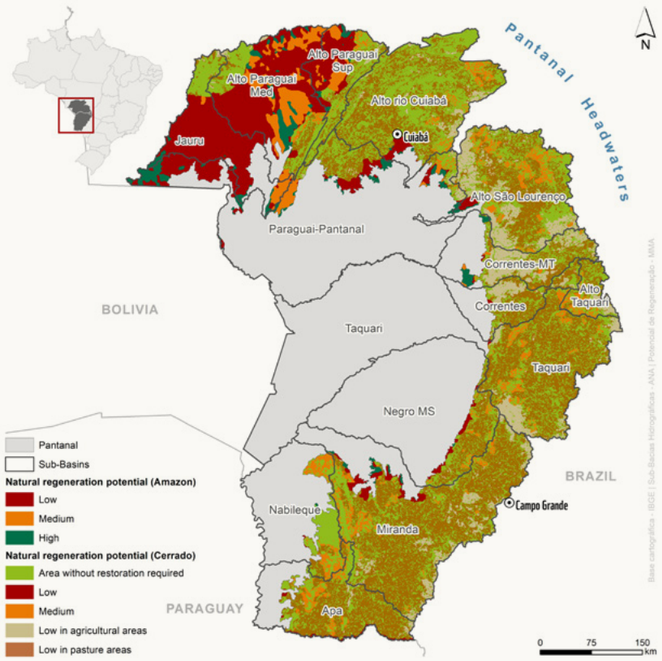
141,000ha

Figure 9. Deficit of Legal Reserve areas (LR).

LR DEBIT

771,155.35ha

Figure 10. Natural Regeneration Potential.



NATURAL REGENERATION POTENTIAL

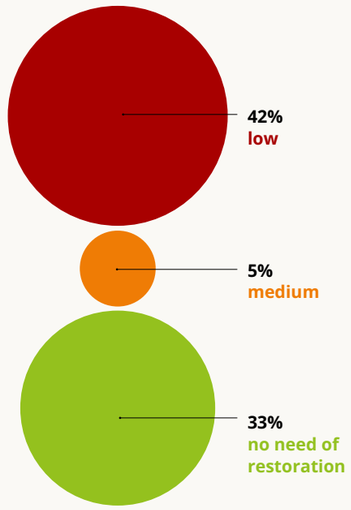
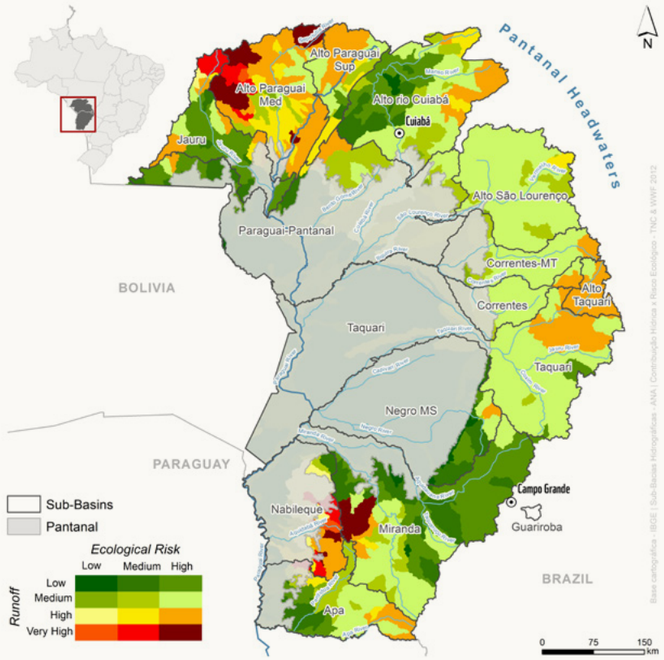


Figure 11. Water contribution (runoff) x Ecological risk (ERI) of the Headwaters sub-basins.



WATER CONTRIBUTION X ECOLOGICAL RISK

Low contribution

25%

High-very high contribution

26%

High risk

75%

Low risk

2%

4.3. STRATEGIC AREAS FOR RESTORATION - WHERE TO START?

As time and resources (human and financial) are commonly scarce, the use of strategies that guide priority action areas is suggested. Several institutions have been developing analysis and modeling with current and/or predictive scenarios to assist in the selection of priority areas for restoration. **Some works are highlighted here (figure 12-16)* in terms of prioritization aimed at improving water resources, biodiversity and connectivity, the most important aims according to workshop participants:**

For details regarding the work cited here, see the QRcode at the end of this document.

Figure 12. Multicriteria modeling for the Headwaters (IIS, 2022) indicates the best places for restoration regarding carbon sequestration, lower costs, increased biodiversity, water and socioeconomic aspects (commitment scenario).

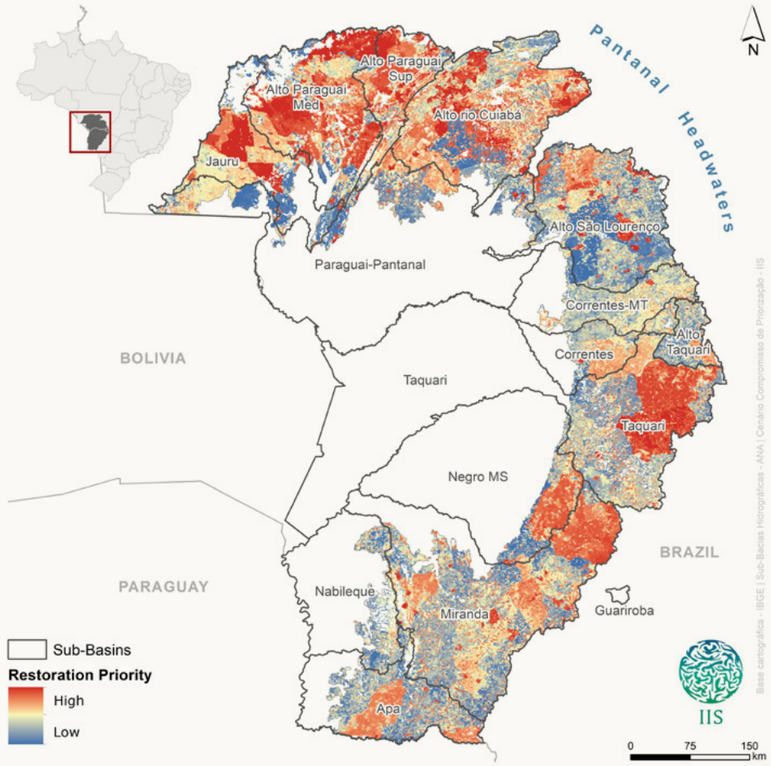


Figure 13. Future projections (until 2040) demonstrating the impact of climate change on 7,000 native plants in the Cerrado, optimistic (< 1.5oC) and pessimistic (>4oC) scenarios for the Headwaters (Silva et al., in prep.).

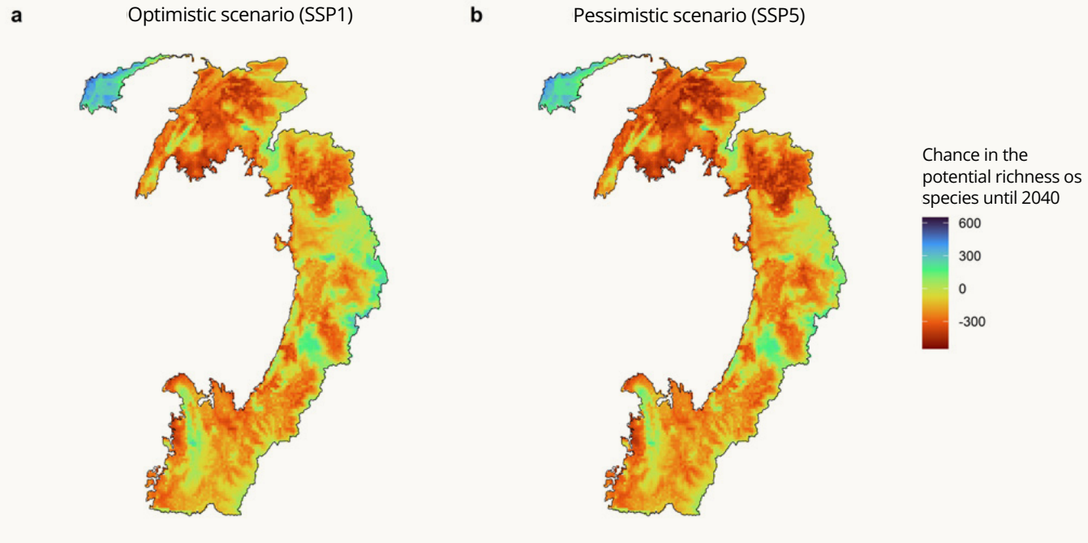


Figure 14. Distribution analysis indicating the priority areas for jaguar conservation (*Panthera onca*) in BAP (WWF, 2020). It's also noteworthy the works of the *Center for Large Landscape Conservation in the Pantanal-Chaco* (PACHA) regarding the jaguar.

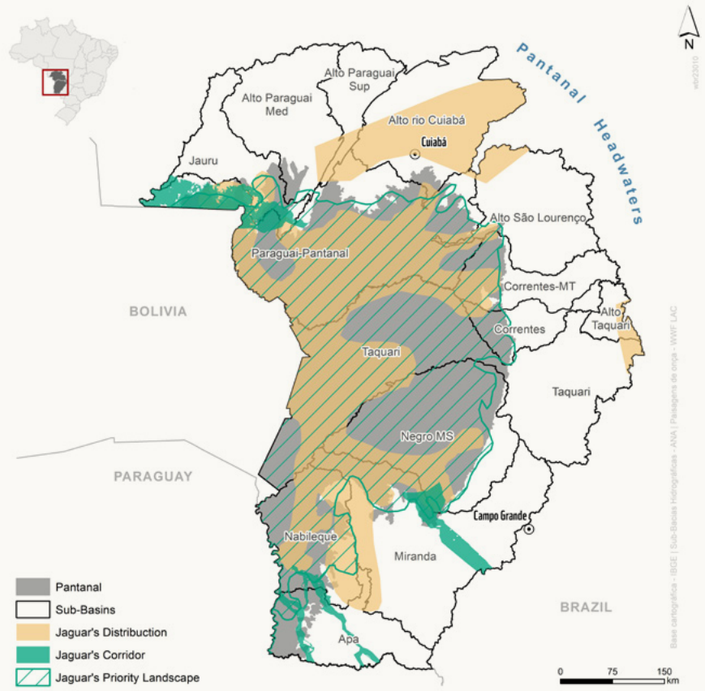


Figure 15. Multi-species modeling for BAP (in Brazil, Bolivia and Paraguay) identifing 649 target fragments to be connected by 3012 forest and savannah corridors. Many of these corridors are PPAs and the remaining areas can be used for LR prioritization, for example (Tomas et al. 2022).

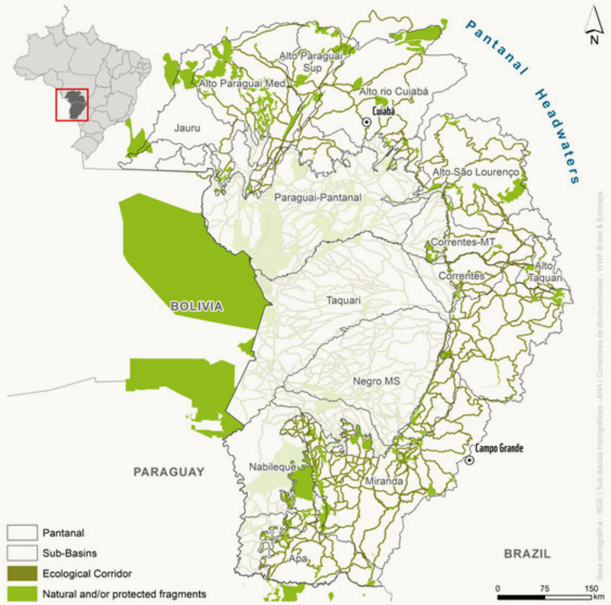
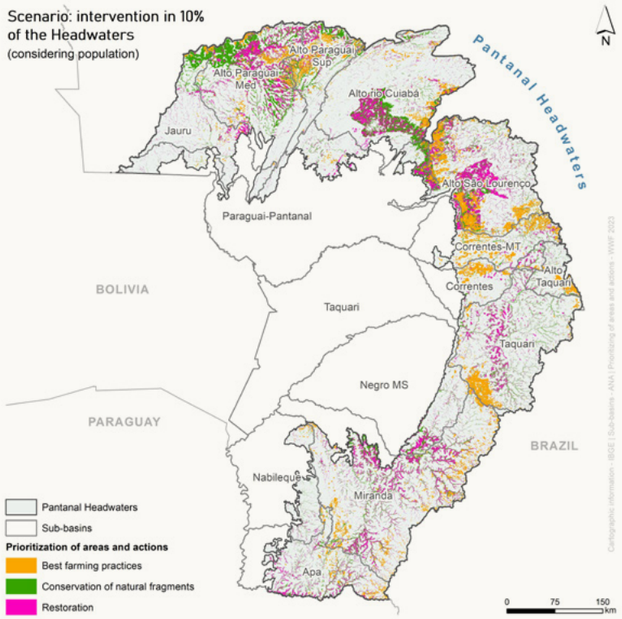


Figure 16. Spatial analysis indicating the best practices to be applied in the 20% of the landscape considered as highest priority for erosion control and water resources quality and quantity in the Headwaters, considering more populated places (WWF, 2023).



As previously mentioned, the areas considered as priority may change according to the purpose of the restoration, as can be seen in figures 12 to 16.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4.4 RESTORATION PRODUCTION CHAIN AND ITS ACTORS

The restoration production chain is composed of different links that encompass both the agents directly involved in restoration actions (from planning to trading products) and those that are part of the "surrounding environment", whose activities directly and indirectly impact the chain **(figure 17)**. And, **for the restoration to succeed and gain scale, it is necessary to strengthen these actors and their dynamics in an integrated governance structure.** The secondary survey indicated about 254 stakeholders and organizations that operate in the Headwaters' restoration chain, and the links of inputs, markets and producers were the least representative **(figure 18)**.

The stakeholders' network allows us to analyze the connections between them and the links in the restoration chain, providing a strategic look at their relationships, indicating which connections or links can be

Figure 17. Restoration chain, its links and steps.

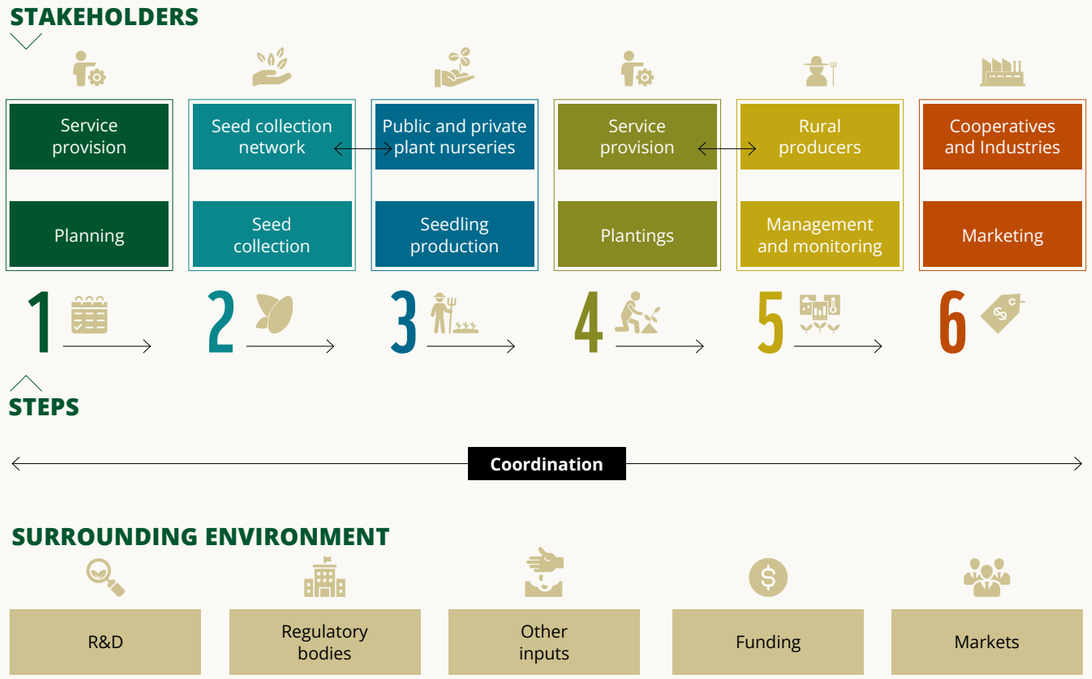
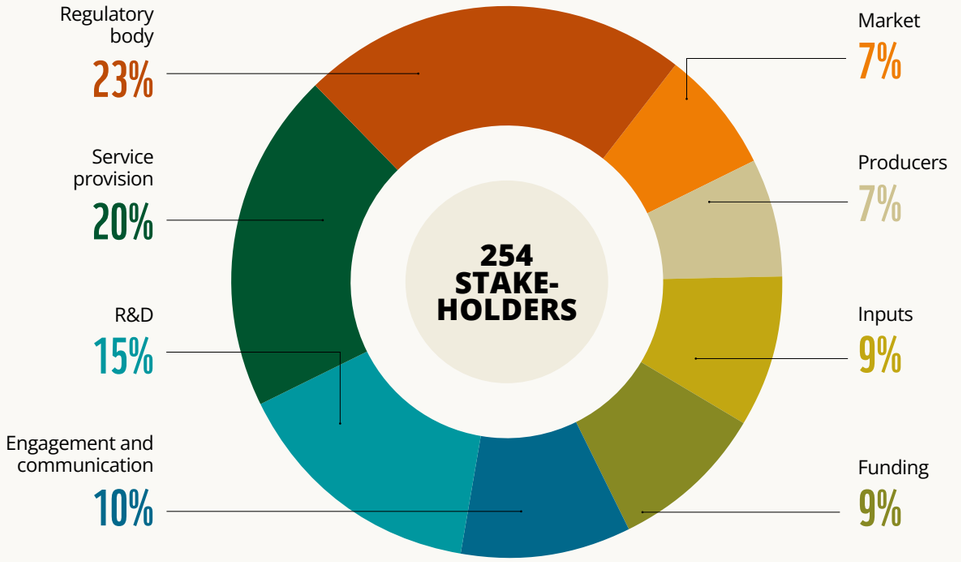


Figure 18. Representativity of the restoration chain's links, from secondary data.



strengthened, as well as which actors or links are key to having a greater impact on the landscape. **The mapping elaborated in the workshops indicated 188 actors and institutions with 731 connections between them, and the links of inputs and service providers were the most representative for the Headwaters* (figure 19).**

It´s important to emphasize that this stakeholders mapping is a direct reflection of the workshop participants' perceptions. Possibly there are other institutions/actors in the landscape.

The participants of the second workshop also indicated where the restoration is being implemented and by whom (which service provider) and where there is seed collection, nurseries and training taking place **(figure 20)**. This analysis was carried out mainly in the three priority sub-basins for the project with AEGEA, whose objective was the improvement of water resources.

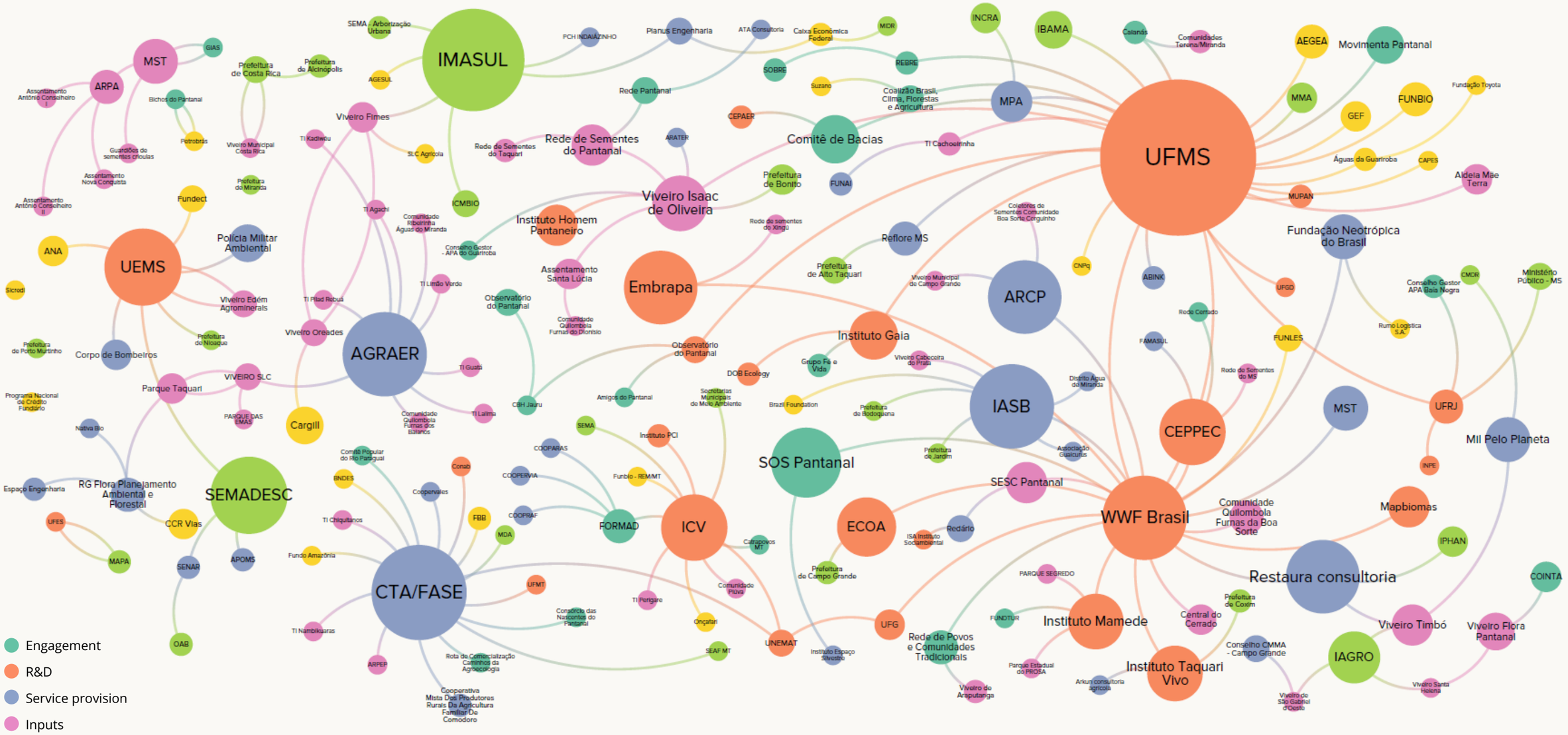
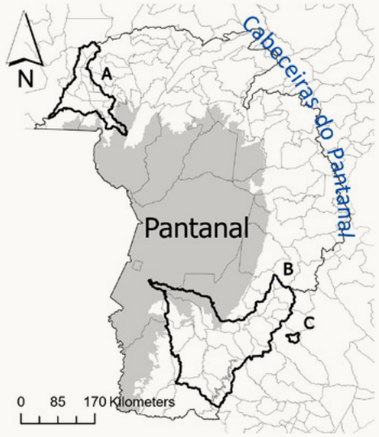


Figure 19. Mapping of stakeholders working in the restoration chain at the Pantanal Headwaters. Colors indicate the link categories and circle sizes indicate the amount of connections.



Restoration Links

- Capacitation (8)
- Seed collection (11)
- Planting (49)
- Service providers (implementors): (34)
- Plant nurseries (27)

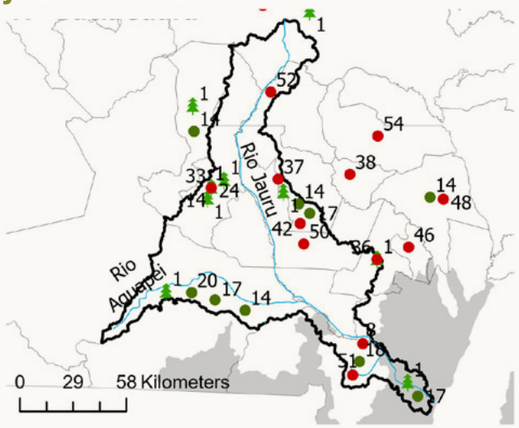
Delimitations

- Sub-basins' limits
- Pantanal headwaters
- Pantanal
- Municipality
- Rivers

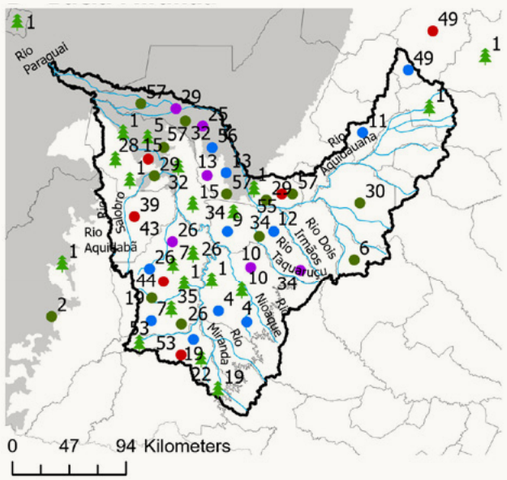
Figure 20. Mapping of the restoration activities and their actors in 3 sub-basins from Pantanal Headwaters.

*Important to emphasize that these maps are a direct reflection of the workshop participants' perceptions. Possibly there are other institutions/ actors in the landscape.

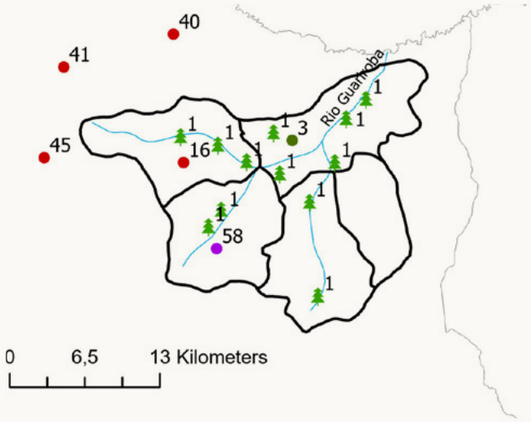
Jauru sub-basin



Miranda Sub-basin



Guariroba sub-basin



DISTRIBUTION OF RESTORATION CHAIN IN THE LANDSCAPE

1,Not identified
2,ABINK
3,ARCP
4,Settlement Andalucia
5,Settlement Bandeirantes
6,Settlement El dourado
7,Settlement Santa Lúcia
8,Cáceres Florestal
9,CEBRAF - UEMS
10,CEPPEC
11,Seed collector Boa sorte & Corguinho community
12,Comunidade Camisão
13,Comunidade Terena
14,CTA
15,ECOA
16,Ecoplantar
17,FASE
18,GAEA
19,IASB
19,IASB
20,ICV
21,IHP
22,Instituto Amigos do Rio da Prata
23,Instituto Taqueri Vivo
24,Ipê Ambiental
25,LEI/UFMS
26,Mil pelo Planeta
27,MST
28,Neotrópica
29,PREVFOGO
30,Samuel
31,SESC Pantanal
32,SOS Pantanal
33,Sumaúma Nursery and Environmental Consultancy
34,UEMS
35,UFGD
36,ARPA Seedling Nursery
37,Araputanga Seedling Nursery
38,Senttlement Rio Branco Seedling Nursery
39,Edem Agrominerais Seedling Nursery
40,Flora Pantanal Seedling Nursery
41,Isaac de Oliveira Seedling Nursery
42,Municipal Araputanga Seedling Nursery
43,Municipal de Bodoquena Seedling Nursery
44,Municipal de Bonito Seedling Nursery
45,Municipal de Campo Grande Seedling Nursery
46,Municipal de Cuverlândia Seedling Nursery
47,Municipal de Tangará da Serra Seedling Nursery
48,Municipal Lambari D'Oeste Seedling Nursery
49,Municipal São Gabriel do Oeste Seedling Nursery
50,Municipal São José dos Quatro Marcos Seedling Nursery
51,Pasadia Seedling Nursery
52,Reserva do Cabaçal Seedling Nursery
53,RPPN Cabeceiras do Prata Seedling Nursery
54,Salto do Céu Seedling Nursery
55,UEMS Seedling Nursery
56,Not identified
57,Restaura
58,Not identified

INFORMATION MAPPED IN THE WORKSHOPS

Mapped nurseries
27

Mapped seed collectors
11

Implemented restoration
49

Service providers (implementors)
34

4.5 RESTORATION TECHNIQUES AND MODELS - HOW TO RESTORE?

Several techniques, models and species can be used in the Headwaters' restoration, considering the history of land use, climate, soil type, phytophysiognomy and potential for natural regeneration of the landscape.

The first step should be the control of external degradation factors (e.g. fencing of the area, removal of livestock, control of ants, fire, invasive species, etc.). Depending on the analysis and diagnosis of the area, more than one restoration technique may be applied, always according to the legislation (Law 12.651/2012, Decree 7.830/2012). Regarding the models for restoration, based on the work carried out by the GEF Terrestrial Project, the participants of the second workshop suggested some adaptations and the use of five models in the Headwaters, emphasizing the importance of those with economic potential, especially for small rural properties (<4MF) **(table 1)**. **The species selection is directly related to the type of area to be restored and the chosen model, whether productive or not*.**

For more information regarding species and integrated models see Ribeiro et al. 2022, availble at the QRcode.

Table 1. Restoration models and its characteristics for the Pantanal Headwaters, elaborated based on the workshop discussions.

Objective	Landscape restoration with or without economic purpose				
Areas features	Agriculture/Pastures				
Models	**Natural regeneration**	**Agrocerrado Systems** With economic purpose	**Livestock + Forest Integration** With economic purpose	**Direct Seeding** With/without economic purpose	**Full-area seedling planting** With/without economic purpose
Indicated Areas	LR and PPA	LR and PPA < 4FM (4 fiscal modules)	Degraded pastures	Without economic purpose: LR and PPA With economic purpose: LR and PPA < 4FM	Without economic purpose: LR and PPA With economic purpose: LR and PPA < 4FM
Strategies and recommendations	Fencing the area, and if necessary, enrichment with native species. Highlight about the importance of planting herbaceous species for savanna woodlands and grassland vegetation. The management of exotic species is suggested.	Planting agronomic species combined with native shrub-tree species. In SACIs, the use of native species of the Cerrado is encouraged, considering potential consumer markets and the different functions within the system. Highlight the importance of not mischaracterizing wetlands (PPAs) and performing phytosociological diagnosis to identify the local vegetation that will direct the selection of "diversity" species.	Planting seedlings and/or seeds of native tree species with potential consumer markets, with or without native grass management, plus livestock. Evaluate the shading potential of the species selected for cattle and the adaptation of native grasses. Tree planting precedes the entry of cattle (2- 3 years).	It is suggested a phytosociological diagnosis to identify the local vegetation that will direct the selection of "diversity" species. The species composition may vary according to the availability of seeds in the region.	It is suggested a phytosociological diagnosis to identify the local vegetation that will direct the selection of "diversity" species. Value the species diversity and favor the growth of spontaneous species (natural regeneration). For economic purposes - prioritize species with an established or potential production chain and market.

A recent study revealed that the supply of tree species is disproportionately greater than the supply of grasses and herbs in the main seed networks operating in the Cerrado Biome

(Silva et al. 2022). The herbaceous vegetation protects the soil, facilitates water infiltration into the soil, recharges groundwater and houses most of the Cerrado biodiversity. Since there is a movement to form a seed network (supported by WWF-Brazil, Instituto Taquari Vivo, ARCP and CEPPEC), there is a unique opportunity to foster species diversification in the market.

Models	Natural regeneration	Agrocerrado Systems With economic purpose	Livestock + Forest Integration With economic purpose	Direct Seeding With/without economic purpose	Full-area seedling planting With/without economic purpose
Techniques	Used mainly in springs, but there is little monitoring in Headwaters to be able to measure its success in the restoration and which species have returned. Ecological enrichment: technique can be applied to increase species diversity. ** use of tree pruning in the implemented area to attract birds.*	**In line:** easier to maintain. It is suggested 1 line of agricultural, 1 line of native, 1 line of biodiversity- 70% being native. Corn can be planted at the beginning and end of each line to aid marking and management. Planting of sesame and crotalaria to control ants. **Agroforestry backyards:** cultivation of agronomic and native forest species, aligning extractivism within their own backyards. **Management:** intense, varies according to the model.	**Agrosilvopastoral System:** first planting native forestry species in a rows, followed by the entry of dairy or beef cattle. The spacing of the trees should be > 3x3 m, and in the case of planting baru, it is recommended >3x5m. It is suggested the initial planting of the key species in consortium with another support species (sorghum, banana, corn), to accelerate growth and protection (e.g. baru breaks with the wind if it is isolated), followed by the removal of the support species, once key species are stablished. **Natural regeneration:** conduction of natural regeneration species associated with tree planting with pasture. **Management:** periodic, varies according to the key species and focuses on the control of invasive species (e.g. *Brachiaria* spp.)	**Technique of Muvuca/Direct seeding -** **Use:** mechanized or manual, in lines, nucleation or entire area. **Quantity:** Use of ca. 80kg/ha+ green fertilization, depending on the purpose of the restoration. **In agrocerratenses systems:** it is a strategy for green fertilization, and cultivation of initial cycles. **Management:** intense, varies according to the amount of invasive species (e.g. *Brachiaria* spp.) ** use of tree pruning in the implemented area to attract birds, and cardboard to shade Brachiaria spp.*	**In line:** facilitates maintenance, 2x3m spacing, densify seedlings to increase shading and curb *Brachiaria* growth. **Nucleation:** technique with little representation in Headwaters, but with good results in the Guariroba region (3250 seedlings/ha). **Management:** intense, varies according to the amount of invasive species (e.g. *Brachiaria* spp.) ** use of tree pruning in the implemented area to attract birds, and cardboard to shade Brachiaria spp.*
Key species (*)	In this model, naturally occurring native species are prioritized. Ecological enrichment: perform phytosociological diagnosis to identify the local vegetation that will direct the selection of "diversity" species.	**Agronomic:** cassava, pumpkin, corn, okra, sesame, peanuts, watermelon, sweet potato, cucumber, banana. **Forestry (fruits):** guavira (*Campomaneasia velutina* (Cambess.)O.Berg, (*Dipteryx alata* Vogel), jatobá (*Hymenaea courbaril* L.), pequi (*Caryocar brasiliense* Cambess.), cajuzinho (*Anarcadium humile* A. St-Hill), jenipapo (*Tocoyena formosa* (Cham, e Schltdl.) KSchum., araticum (*Annona montana*), cagaita (*Eugenia dysenterica* (Mart.) DC.) (with consumer market); **(wood):** aroeira (*Astronium urundeuva* (MAllemão)Engl, gonçalo-alves (*Astronium flaxinifolium* Schott), angico-branco (*Anadenanthera colubrina* (Vell.), pau-d'óleo (*Copaifera langsdorffii* Desf.). **Melliferous species can be used*	**Main species:** Bocaiuva (*Acrocomia aculeata* (Jacq)Lodd.ex Mart.), baru (*Dipteryx alata* Vogel), faveiro (*Dimorphandra mollis* Benth.) **More tests with the implementation of native grasses*	**Green fertilization + ant control:** pigeon-peas, crotalaria, pumpkin, peanuts, sesame. **corn to mark the beginning/ end of the lines.* **Florestry:** caju (*Anarcadium humile* A. St-Hill), guavira (*Campomaneasia velutina* (Cambess.)O.Berg,, baru (*Dipteryx alata* Vogel), jatobá (*Hymenaea courbaril* L.), pequi (*Caryocar brasiliense* Cambess.), caja-mirim (*Spondia mombin* L.), jenipapo (*Tocoyena formosa* (Cham. e Schltdl.) KSchum., angico-branco (*Anadenanthera colubrina* (Vell.) Brenan), araticum (*Annona montana*), pau-d´oleo (*Copaifera langsdorffii* Desf.), cagaita (*Eugenia dysenterica* (Mart.) DC.) .	**Species selection:** prioritize biodiverse arrangements and use of native species. **Green fertilizatione + ant control:** pigeon-peas, crotalaria, pumpkin, peanuts, sesame. **corn to mark the beginning/end of the lines* **Forestry:** angico-branco (*Anadenanthera colubrina* (Vell.) Brenan), gonçalo-alves (*Astronium flaxinifolium* Schott), pata-de- vaca (*Bauhinia dumosa* Benth.), baru (*Dipteryx alata* Vogel), ipê-rosa (*Handroanthus heptaphyllus* (Vell.) Mattos), ipê-roxo (*Handroanthus impetiginosus* (Mart. Ex DC.) Mattos), jatobá-do-cerrado (*Hymenaea stigonocarpa* Mart. Ex Hayne).
Challenges in adopting the model	Low species diversity, longer time to return to a mature ecosystem, herbaceous species cannot regenerate naturally when the area has been detouched (roots removed) in soil preparation. There may be regrowth of exotic trees. **absence of known successful models in the Headwaters.*	High maintenance cost, absence of skilled labor for biodiverse plantations, absence of market for native products, lack of aptitude for agriculture by medium/large landowners. AFS/SACIs in PPA may not be rewarded if the rivers are far from the houses. Legal uncertainty for managing trees within restoration projects.	Longer time for catle insertion. Cost and time with maintenance and monitoring the restoration after planting.	Lack of knowledge about the technique in the Headwaters, need for a large volume of seeds adapted to the region, difficulty of mechanized maintenance in the post-planting if the entire area was planted. **absence of known successful models in the Headwaters.*	Low diversity of seedlings in the region, longer planting time (if compared to direct seeding), higher high cost with transportation, labor and planting inputs (e.g. fertilizers, seeds, etc).
Benefits of adopting the model	Low cost	Economic return, income diversification, associates extractivism and conservation. Model most practiced by small producers and traditional communities.	Economic return, income diversification, can be associated with recovery of degraded pastures, increases animal welfare.	Lower time and implementation costs when compared to other models, greater species diversity, direct insertion and economic return for local/traditional communities (e.g. seeds collection and sale).	Greater number of nurseries in the Headwaters (if compared to seeds collection), producers are more accustomed to this technique.

(*) Most cited species in the groups during the second workshop

4.6 BOTTLENECKS AND OPPORTUNITIES

The participants of the two workshops indicated the main bottlenecks and opportunities existing in the Pantanal Headwaters restoration chain **(figure 21)**. Although stakeholders have specific demands related to the restoration chain links', there is a set of challenges that appeared transversely to all links.

Figure 21. Main bottlenecks identified during the workshops.

In order to scale up restoration and be implemented successfully and sustainably, it is necessary to make a joint effort to carry out concrete and integrated actions, such as those pointed out by the workshop participants **(table 2)**. These alternatives are mainly associated with the engagement of beneficiary producers, new financing for maintenance and/or expansion of the areas, skilled labor for the activities and acquisition of inputs close to the restored areas.

Tabela 2. Opportunities to overcome the bottlenecks identified during workshops.

Bottlenecks	Practical actions	Actors/links
Engagement of producers	**1.** Include economic and socio-environmental diagnoses during the planning of actions; **2.** Involve local communities in the planning and development of proposals, valuing traditional and field knowledge; **3.** Prioritize stages of mobilization and awareness raising prior to the start of activities, having key actors/organizations dialoguing with producers/communities involved with the actions, based on previously built trust relationships.	Service providers, regulatory agencies, R&D, financers.
Low supply of inputs	**4.** Formalize nursery collectors and seed collectors; **5.** Search for regional seed collector network; **6.** Promote actions (resources and/or training) for producers/owners to have their own matrices; **7.** Disseminate and implement 'agrocerratense' systems, less dependent on external inputs.	Regulatory agencies, service providers, R&D.
Lack of skilled labor	**8.** Promote experience exchanges between beneficiaries of the actions; **9.** Have producers as technical training agents in the different links; **10.** Apply research results in the scope of technical and institutional training; **11.** Establish institutional partnerships with universities and research agencies to carry out the actions.	Service providers, regulatory agencies, R&D, financers, producers.
Discontinuity of financing	**12.** Ensure resources for the monitoring and maintenance stage; **13.** Increase value of forests with models of productive restoration of non-timber natives ('agrocerratense' systems); **14.** Ensure restauration ecological and environmental function through models that have research results; **15.** Expand demonstrative units of restoration models; **16.** Establish partnerships with credit institutions that support and structure the forestry business.	Service providers, regulatory agencies, R&D, financers.
Lack of monitoring and maintenance of areas	**17.** Adopt models that ensure the ecological and environmental functions of restoration; **18.** Acknowledge that the adoption of simplified monitoring processes and methods is important to reduce costs and facilitate procedures; **19.** Raise awareness and train producers for participatory monitoring as a possible strategy for cost reduction; **20.** From experiments already carried out, use planting techniques that do not hinder monitoring.	Service providers, regulatory agencies, R&D, financers.

5.

FINAL MESSAGE

The Plan shows the broad social capital and the amount of qualified information available for the Headwaters, as well as highlights the economic, environmental and social importance of this landscape. It is noteworthy that this document is only the first version of a Restoration Plan, and more details and analysis should be added to capture the complex interactions and variables associated with the restoration of this landscape. Some highlight issues are:

- Restoration is a key strategy for the Pantanal Headwaters due to its transversal character, multiple benefits and possibility of association with other approaches (e.g. degraded pastures, socio-biodiversity chains, traditional peoples, etc.);

- The deficit of vegetation coverage of the Headwaters (LRs and PPAs) is a great challenge and an excellent opportunity for institutional arrangements and connections of different sectors in favor of a common goal;

- There are places in the Headwaters where the restoration chain can be strengthened, and others where it should be created. The selection will depend on the scope of action and objective of the project to be implemented;

- It is necessary to involve local actors in decision-making, from producers and landowners to traditional and rural communities, in order to expand their engagement and create a "bank of areas" for restoration;

- Foster more spaces for exchange between local stakeholders and institutions active in the Headwaters restoration chain to improve engagement and landscape strategic planning;

- To improve the quality of the restoration currently carried out, as well as gain scale in the landscape, it will be essential to create and strengthen local/regional seed networks and nurseries, aiming at diversifying the inputs for restoration;

- The association of universities, technical assistance centers and local/regional organizations is a crucial strategy for dissemination of technical information in the different links of the restoration chain;

- Taking advantage of the political moment, international movements (UN Restoration Decade-2021-2030), national movements (REBRE and SOBRE) and coalitions (Araticum) to organize and integrate databases and support actions at local level;

- Expand the engagement of companies and the private sector to attract investments and access to funds, integrate public policies and support projects with better agricultural and environmental practices (e.g. Payment for Environmental Services, carbon, restoration, integrated systems, etc.) and strengthening of existing policies that can assist in the flow of restoration products (e.g. National Program for food in schools, etc.), in addition to financial mechanisms to enable the development of actions;

- Carry out communication actions on the benefits of restoration, publicize the work already done and the actors involved, aiming to give visibility to the links and actions of the restoration chain, engaging people and future markets.

TECHNICAL INFORMATION

Project "Water for all" – restoration and water benefits in the Pantanal Headwaters

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