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CLIMATE EMERGENCY: A PROPOSAL FOR A SOCIO-PARTICIPATORY CONSERVATION UNIT FOR WATER RESTORATION IN THE PANTANAL

EMERGÊNCIA CLIMÁTICA: UMA PROPOSTA DE UNIDADE DE CONSERVAÇÃO SOCIOPARTICIPATÓRIA PARA RESTAURAÇÃO HÍDRICA NO PANTANAL

EMERGENCIA CLIMÁTICA: UNA PROPUESTA PARA UNA UNIDAD DE CONSERVACIÓN SOCIOPARTICIPATIVA PARA LA RESTAURACIÓN DEL AGUA EN EL PANTANAL

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ABSTRACT

The Pantanal, the largest continuous floodplain in the world, depends on the flood pulse to maintain its hydrological connectivity and biodiversity. Climate change affects the aquatic ecosystem, altering rainfall patterns and increasing the frequency of droughts, which impacts water availability and ecosystem services. The creation of conservation units (CUs) is proposed as an adaptation strategy to mitigate these impacts, particularly in sensitive areas such as the Chacororé–Sinhá Mariana Lake System, which suffered significant damage from the 2020 drought and extensive fires. The proposal to create a CU aims to protect water, biodiversity, and local culture, thereby ensuring the maintenance of the living conditions of traditional communities. The proposed area covers 63,990 hectares and includes several geomorphological units and soil types, with the flood pulse regulating ecological processes. Changes in land cover, such as the conversion of native vegetation into anthropogenic areas, represent a threat to the sustainability of the Pantanal. Creating the CU is seen as a way to promote the sustainable use of natural resources and ensure the resilience of the Pantanal in the face of the challenges imposed by climate change and human activities. The proposal is based on studies of the area's physical, biotic, and socio-environmental aspects, aiming at the long-term protection of this important biome.

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Keywords: Flood Pulse. Ecosystem Services. Traditional Communities. Land Use. Biodiversity.

RESUMO
O Pantanal, a maior planície de inundação contínua do mundo, depende do pulso de inundação para manter sua conectividade hidrológica e biodiversidade. As mudanças climáticas afetam o ecossistema aquático, alterando os padrões de precipitação e aumentando a frequência de secas, o que impacta a disponibilidade hídrica e os serviços ecossistêmicos. A criação de unidades de conservação (UCs) é proposta como estratégia de adaptação para mitigar esses impactos, particularmente em áreas sensíveis como o Sistema Lacustre Chacororé–Sinhá Mariana, que sofreu danos significativos com a seca de 2020 e incêndios de grande porte. A proposta de criação de uma UC visa proteger a água, a biodiversidade e a cultura local, garantindo assim a manutenção das condições de vida das comunidades tradicionais. A área proposta abrange 63.990 hectares e inclui diversas unidades geomorfológicas e tipos de solo, com o pulso de inundação regulando os processos ecológicos. Mudanças na cobertura do solo, como a conversão de vegetação nativa em áreas antrópicas, representam uma ameaça à sustentabilidade do Pantanal. A criação da UC é vista como uma forma de promover o uso sustentável dos recursos naturais e garantir a resiliência do Pantanal diante dos desafios impostos pelas mudanças climáticas e pelas atividades humanas. A proposta se baseia em estudos dos aspectos físicos, bióticos e socioambientais da área, visando à proteção a longo prazo deste importante bioma.

Palavras-chave: Pulso de Inundação. Serviços Ecossistêmicos. Comunidades Tradicionais. Uso da Terra. Biodiversidade.

RESUMEN
El Pantanal, una mayor planificación de inundaciones continuas del mundo, depende del pulso de inundaciones para mantener su conectividad hidrológica y biodiversidad. As mudanças climáticas afetam o ecossistema acuático, alterando os padrões de precipitação e incrementando a frequência de secas, o que impacta a disponibilidade hídrica e os serviços ecossistêmicos. La creación de unidades de conservación (UC) se propone como estrategia de adaptación para mitigar estos impactos, particularmente en áreas sensibles como el Sistema Lacustre Chacororé–Sinhá Mariana, que sofreu daños significativos con la sequía de 2020 e incendios de gran puerta. La propuesta de crianza de una visa UC proteger el agua, la biodiversidad y la cultura local, garantizando así la manutenção de las condiciones de vida de las comunidades tradicionales. Un área propuesta abarca 63.990 hectáreas e incluye diversas unidades geomorfológicas y tipos de solo, con el pulso de inundación que regula los procesos ecológicos. Mudanças na cobertura do solo, como una conversación de vegetación nativa en áreas antrópicas, representam uma ameaça à sustentabilidade do Pantanal. La creación de la UC es vista como una forma de promover el uso sustentable de los recursos naturales y garantizar la resiliencia del Pantanal frente a los desafíos impuestos por las mudanzas climáticas y las atividades humanas. A proposta se baseia em estudos dos aspectos físicos, bióticos y socioambientais da área, visando à proteção a longo prazo deste importante bioma.

Palabras clave: Pulso de Inundaciones. Servicios Ecosistémicos. Comunidades Tradicionales. Uso del Suelo. Biodiversidad.

1 INTRODUCTION

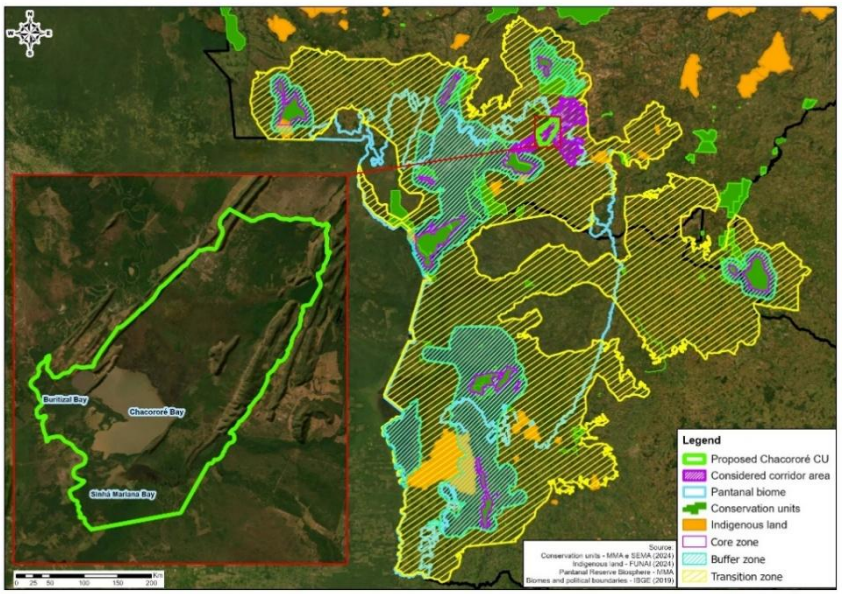
The Pantanal, the largest continuous floodplain in the world and one of the richest biomes in Brazil, is characterized by its main regulatory ecosystem service, which is defined by the dynamics of flood-pulse waters. This pulse, characterized by four hydrological phases (flood/full water and ebb/drought), promotes water and biodiversity connectivity between the plain and the rivers (DA SILVA et al 2015; NUNES et al 2020, 2021, 2023, 2025; DA SILVA et al 2012; JUNK & DA SILVA 1999). The waters of the Pantanal originate from the recycling of local precipitation and the transport of moisture from the Amazon Rainforest (the "flying rivers"), which influence precipitation in several regions of Brazil and South America (ROCHA 2015; FEARNSIDE 2004, ZEMP et al 2014, LOVEJOY e NOBRE 2018, RIOS VOADORES 2024).

Research in the Pantanal highlights the implications of climate change on the aquatic ecosystem, including the temporal shift in rainfall (DA SILVA et al 2022; DALBORTELLI 2015) and the tendency for drought (MAPBIOMAS 2022; LAZARO et al 2021; MORAES et al 2022). Water availability, affected by climate change and other factors (MARENGO et al, 2017), is a crucial resource for resilience, adaptation, and adaptive capacity, which are key concepts of Sustainable Development Goal 13.

The 2020 drought in the Chacororé–Sinhá Mariana Lake system, with a 59% reduction in water coverage (ICV 2021), and the extensive fires (SEMA) highlighted the need for conservation measures. The proposal to create a conservation unit aims to protect water, biodiversity, and culture, maintaining the living conditions of traditional peoples and communities (Da Silva; Figueiredo; Vacchiano, 2021). The proposed area, located between Barão de Melgaço and Santo Antônio do Leverger, covers 63,990 hectares in the Pantanal biome. The proposal was drawn up based on the analysis of studies and documents on the physical, biotic, and socio-environmental aspects of the area (Figure 1).

Figure 1

*Location map of the proposed area for the creation of the Conservation Unit for the Chacororé–Sinhá Mariana lake system in the Pantanal of Mato Grosso*1



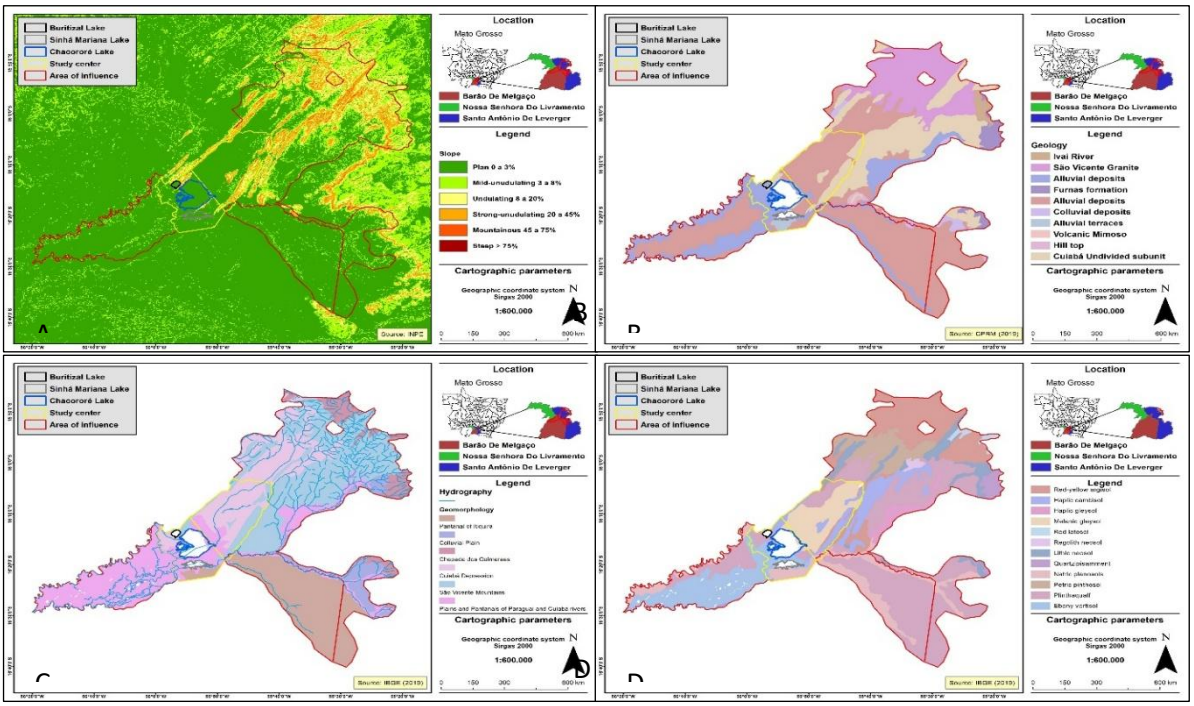
2 GEOENVIRONMENTAL CHARACTERIZATION

The climate in Mato Grosso is predominantly monsoon super-humid tropical and tropical with summer rains and dry winters, whereas in the Cuiabá River Basin, the Sub-Humid Megathermal Tropical climate predominates, characterized by high temperatures and losses through evapotranspiration, resulting in water deficiency. Temperatures in the Pantanal (25 to 26 ºC, with maximums of 34 ºC) are higher than the state's annual average (21 to 26 ºC). The average annual rainfall in Mato Grosso varies from 1,500 to 2,000 mm, but in the Barão de Melgaço region, it is lower, between 1,100 and 1,300 mm, with a period of water deficiency of 7 to 8 months, generally from April to October/November.

In the Chacororé–Sinhá Mariana Lake System, the Pantanal formation predominates as a geological unit—alluvial deposit facies, with sandy sediments and porous gravels, which favor the formation of superficial aquifers (Figure 2B). The predominant slope is flat (52.37%) and gently undulating (25.09%), which facilitates the recharge of aquifers (Figure 2A).

Figure 2

(A) slope, (B) geology, (C) geomorphological units and (D) soil types in the area of influence of the Chacororé–Sinhá Mariana lake system in the Pantanal of Mato Grosso2



The geomorphology of the Pantanal is diverse, with terrains at different flood levels and both Pleistocene and Holocene sediments. The drainage network is formed by the Cuiabá and São Lourenço rivers and their tributaries, including tributary channels with high erosive power. The Chacororé and Sinhá Mariana lakes hold water from the tributaries and the Cuiabá River, located in the northern portion of the Paraguay River depression, surrounded by high terrain (Serrana Province, Guimarães and Taquari-Itiquira plateaus). The study area presents several geomorphological units (Figure 2C) according to IBGE (2019), including Chapada dos Guimarães (17.73%), Cuiabana Depression (27.66%), and the Itiquira-São Lourenço Pantanal (5.64%).

The Pantanal is the largest seasonally flooded plain in the world, with the flood pulse regulating ecological processes. The soils in the area influenced by the Chacororé–Sinhá Mariana Lake System are mainly Red-Yellow Argisol, Plinthaqualf, Petric Pinthosol, Melanic Gleysol, and Ebony Vertisol, according to Embrapa (2018) (Figure 2D). Land cover change, especially the conversion of native vegetation to anthropogenic areas, poses a threat to sustainability, with impacts such as landscape fragmentation, biodiversity loss, and water pollution.

3 CHARACTERIZATION OF THE HYDROGRAPHIC BASIN AND LIMNOLOGICAL VARIABLES

3.1 HYDROGRAPHIC CONTEXT

The Chacororé—Sinhá Mariana lake system is part of the Cuiabá River Basin, located in the south-central part of the state of Mato Grosso, with an area of 22,851.1 km². The Cuiabá River, the main watercourse, receives tributaries on the right bank (Chiqueirão, Jangada, and Espinheiro) and left bank (Marzagão, Manso, Acorizal, Coxipó, and Coxipó-Açu) (CHIARANDA et al., 2016). The lakes are located in the Pantanal plain, the lower part of the basin.

Chacororé Lake has a semicircular shape and turbid, whitish waters (SILVEIRA; DA SILVA 2000; PINTO-SILVA 1980, 1991), altitude of 125.20 m, length of 10.18 km, maximum width of 9.88 km, average depth of 2.75 m, volume of 178.6 × 10^6 m^3 and area of 64.92 km^2 (SILVEIRA, DA SILVA 2000). Sinhá Mariana Lake is elongated, with a length of 8.75 km, a maximum width of 2.67 km, an average depth of 3.58 m, a volume of 40.40 × 10^6 m^3, and an area of 11.25 km^2 (PINTO-SILVA 1980; NUNES, DA SILVA 2005, 2008).

The system is strongly influenced by the hydrological regime of the Cuiabá River. During the rainy season, the lakes become a single body of water supplied by *corixos*. Chacororé is supplied by the Cupim, Capão do Acori, Estiva, and Água Branca rivers, and Sinhá Mariana by the Mutum river. Both form extensive wetlands around (VACCHIANO et al. 2024).

Wetlands provide essential ecosystem services such as storage and gradual release of water, aquifer recharge, sediment retention, irrigation, biodiversity preservation, and support for traditional populations (JUNK et al. 2011).

3.2 LIMNOLOGY

The limnology of the lakes varies seasonally, depending on the time of year—which influences the greater or lesser connection with the Cuiabá River and other smaller rivers—and the morphology and depth of each lake.

Chacororé Lake is strongly influenced by the Cuiabá River, especially during floods, when its low average depth (0.74 m in the dry season, 2.47 m in the flood season) and morphology favor the river's entry and sediment retention (FIGUEIREDO, DA SILVA 1997). During the dry season, the wind increases turbidity, reducing transparency (average of 0.07 m), but favors oxygenation (up to 10 mg/l), while during the flood season, the average

transparency is 1.4 m and oxygen is 5.44 mg/l. Electrical conductivity varies between 20 µS/cm (flood) and 88 µS/cm (dry season), but pH remained stable (7.48 in flood, 7.29 in dry season) (FIGUEIREDO, DA SILVA 1997).

The limnological conditions of Sinhá Mariana Lake are influenced by the Mutum (acidic waters, poor in nutrients, transparent, rich in humic acids) and Cuiabá rivers. During the dry season, the flow is from the Mutum River to the Lake and the Cuiabá River. In the rainy season, the Cuiabá River reverses the flow, also connecting with Chacororé. Its elongated morphology and connections give it a greater average depth (1.8 m in the dry season, 3.0 m in the flood season). The lake has two distinct compartments: the one influenced by the Mutum River—with a pH of 5.33 to 7.55, high transparency, conductivity between 18 and 29 µS/cm and oxygen of 2.85 to 9.68m/l (NUNES, DA SILVA 2005; FIGUEIREDO, DA SILVA 1997) and the one influenced by the Cuiabá River with higher pH and conductivity and lower transparency, similar to Chacororé.

Thermal stratification only occurs in Sinhá Mariana due to the greater depth and lower wind during flooding. Studies on planktonic communities are scarce, but 77 zooplankton taxa were identified in Sinhá Mariana (LIMA et al., 2012). They are important bioindicators, as physical-chemical changes impact this community, affecting aquatic productivity and the food chain, especially for fry and small fish (LUCINDA, 2007). The limnological heterogeneity of the Chacororé–Sinhá Mariana system highlights the importance of protecting this system.

4 BIODIVERSITY

The Pantanal has valuable biodiversity for the economy, culture, science, and recreation, although it is threatened by unsustainable uses (ALHO; SABINO, 2011; ALHO et al., 2019). In the Chacororé–Sinhá Mariana lake system, habitat loss has affected hydrology, biodiversity, and the relationship of local communities with the environment (SPANHOLI et al., 2020).

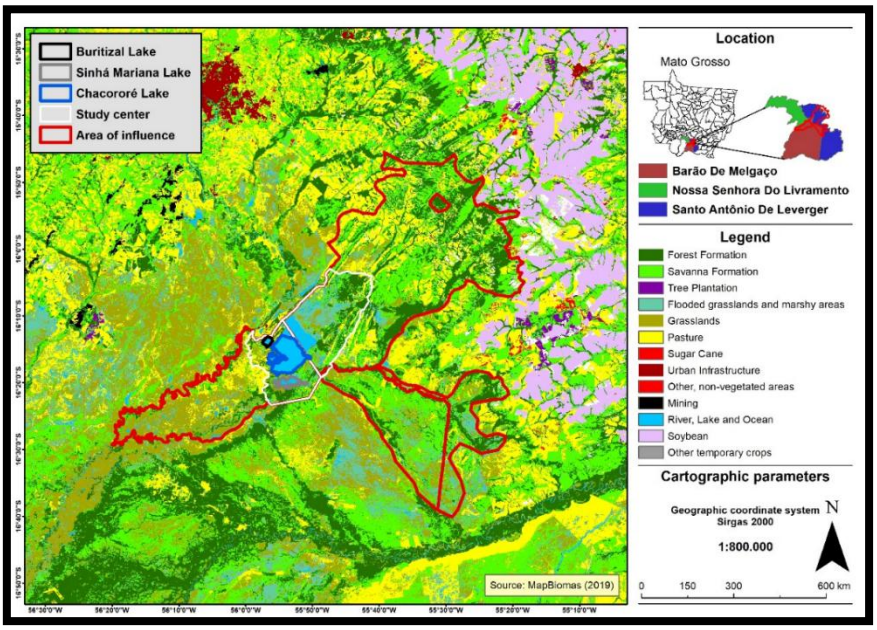
The removal of aquatic macrophytes for navigation resulted in the drying out of 40% of the area (NUNES, DA SILVA, ABDO 2012). These plants are essential for retaining water, sheltering fish and insects, and attracting piscivorous and insectivorous birds (PACHECO, DA SILVA 2009; NUNES et al. 2012). Macrophyte banks favor resident and migratory fish and integrate diverse landscapes.

Aquatic vegetation predominates around lakes and flooded roadsides, benefiting aquatic fauna and contributing to the landscape and ecosystem services, such as providing

resources for bees. The lakes function as fish nurseries, foraging areas for migratory and resident birds, and support practices such as artisanal fishing and birdwatching tourism (Figure 3). Figure 4 illustrates fish species recorded in the system.

Figure 3

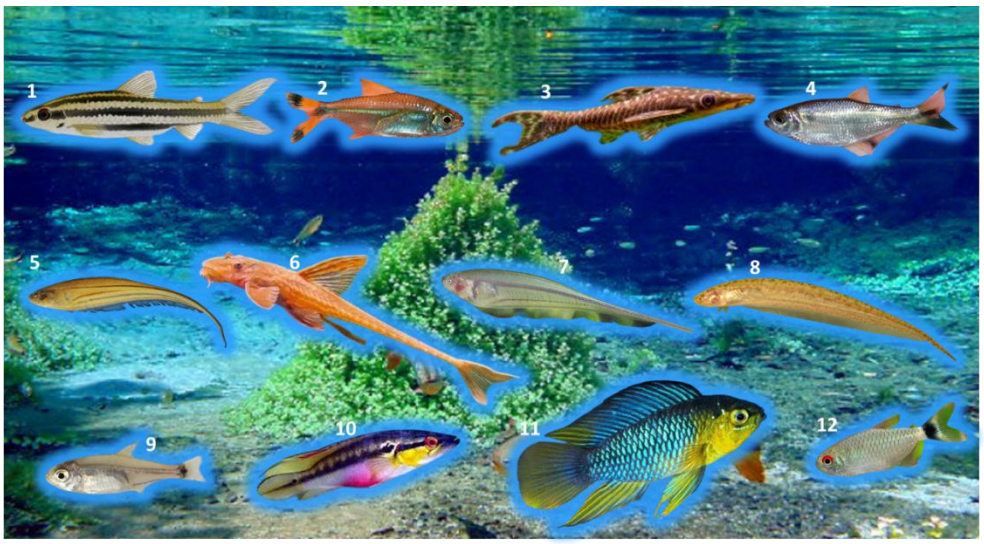
Vegetation Map of the area of influence of the Chacororé–Sinhá Mariana lake system in the Pantanal of Mato Grosso



The Pantanal is also home to a rich bird life, with resident and migratory species using the region for breeding and feeding (NUNES et al., 2012; OLIVEIRA et al., 2016). Their presence indicates environmental quality and contributes to seed dispersal. Studies show that the abundance and richness of water birds increase with the reduction in water levels: from 10 to 30 species and from 40 to 936 individuals during the low water period (NUNES et al., 2012; NUNES et al., 2020).

Figure 4

Fish species found in the Chacororé—Sinhá Mariana Lake System: 1 Piau - Leporellus striatus; 2 Lambari or pequira - Moenkhausia intermedia; 3 Cascudo - Hypoptopoma inexpectatum; 4 Lambari - Bryconamericus sp.; 5 Tuvira - Eigenmannia trilineata; 6 Cascudo - Rineloricaria sp.; 7 Eigenmannia virescens; 8 Brachyhypopomus sp.; 9 Lambari or pequira - Odontostilbe pequira; 10 Joanaguensa - Crenecicla lepidota; 11 Cará or carazinho - Apistograma Borelli; 12 Lambari or pequira - Moenkhausia sanctaefilomenae. Source: fishbase.com



We conclude that this lake system represents a diverse ecological mosaic. quatic macrophytes and riparian vegetation are essential in connecting aquatic and terrestrial environments and sheltering diverse species, including threatened ones. Local biodiversity also supports the way of life of human communities, from fishing to the cultural use of birds.

5 ECONOMIC ACTIVITIES

The municipalities of Barão de Melgaço and Santo Antônio de Leverger have a territorial extension of 11,373.79 km² (SEPLAN, 2015) and 11,753.6 km² (IBGE, 2010), respectively. Their populations are estimated at 8,564 and 16,628 inhabitants, respectively (IBGE, 2020). The Municipal Human Development Index (MHDI) in 2010 was 0.60 and 0.69, respectively (SEPLAN, 2010).

Between 2010 and 2015, Barão de Melgaço increased formal jobs from 513 to 538, while Santo Antônio de Leverger saw a reduction from 3,473 to 2,511. The average incomes were R$1,516.34 and R$1,816.52, respectively (RAIS, 2015).

Tax collection increased: Barão de Melgaço collected R$24,176,229.23 in 2019 (35% higher than 2017) and Santo Antônio de Leverger R$57,336,089.89 (34% higher) (TRIBUNAL DE CONTAS MT, 2021).

The main source of wealth is the agricultural sector. In Barão de Melgaço, it represents 22% of the GDP; in Santo Antônio, 50%. The former has 822 properties on 630,495 ha; the latter, 2,282 properties on 925,050 ha. Both prioritize pastures and have more than 630 thousand head of cattle (IBGE, 2017).

According to IPEA (2021), formal jobs have increased in sectors such as food and accommodation. The annual flow is 657 tourists and R$98,454.00 in Barão de Melgaço, and 183 tourists and R$41,175.00 in Santo Antônio do Leverger (ANA, 2020).

Fishing, observation of fauna and flora, and the natural landscape stand out as tourist attractions. A hotel boat costs around R$1,000.00 per day, and riverside inns cost R$150.00. Regional cuisine is also a differentiator.

Since 2002, municipalities have received ecological ICMS for Conservation Units. In 2019, Barão de Melgaço obtained 17% of the total ICMS (R$ 800,000.00) from this source.

The creation of a new Conservation Unit (UC) in the form of a Sustainable Development Reserve can increase revenue and generate jobs with minimal economic impact. Visitation is an activity compatible with conservation and can generate income as per Table 1.

Table 1

Simulation of the economic impact of tourism with the creation of a Conservation Unit in the Chacororé–Sinhá Mariana lake system1

Visitors/year	Conservative	Optimistic
2,000	R$ 555,958.00	R$ 1,569,512.20
4,000	R$ 1,111,916.00	R$ 3,139,024.40
6,000	R$ 1,667,874.00	R$ 4,708,536.60
8,000	R$ 2,223,832.00	R$ 6,278,048.80

Source: Own work based on Medeiros and Young (2011) and Nereus (2021).

In the conservative scenario, with 2,000 visitors/year, municipalities would collect more than R$ 16,600 in Services Taxes; in the optimistic scenario, R$ 47,000. With 8,000 visitors, this value would rise to R$ 66,700 and R$ 188,300, respectively.

Creating this CU can maintain 20,804 ha of forest remnants, avoiding the emission of 600 thousand tons of CO_2. This represents R$ 13,800,000 in carbon credits (Alvarenga Júnior et al., 2018).

The UC would prevent the silting of rivers, reducing soil loss by 28,204 tons and saving R$ 423,300 annually in cleaning (Alvarenga Júnior et al., 2018).

6 LAND USES IN THE CONTEXT OF PROPOSING A CONSERVATION UNIT

The Chacororé–Sinhá Mariana lake system has suffered a series of disturbances in recent decades, such as fires, deforestation, poorly managed livestock farming, mining, road construction, drains in wetlands, damming and filling of watercourses, and damming of the Cuiabá River and tributaries for the generation of electricity, as is the case with the dam in the Manso Springwater Protection Area. These disturbances have caused negative environmental impacts and threatened the existence of the lake system. Local residents report some streams not having had any water running through them for three years. In 2020, the drought in Chacororé Lake attracted great attention, with at least 30% of the biome's territory located in the Brazilian portion targeted by forest fires that year (Shimabukuro et al, 2023).

6.1 LAND USE, LAND PROFILE, DEFORESTATION, AND FIRES

For this theme, a study was carried out using data from Collection 5 of the MapBiomas project, from the State Secretariat for the Environment (SEMA/MT), the National Institute for Colonization and Agrarian Reform (INCRA), and the National Foundation for Indigenous Peoples (FUNAI). Considering the area proposed for the conservation unit, the results showed that 89% are located in the Pantanal biome and 11% in the Cerrado biome (Figure 5a).

Regarding land use and coverage, of the 63,990 hectares included in the area proposed for the creation of the UC, 93% are natural formations, 13.5% of which are lakes, rivers and lakes, 32.5% forest formations, 23.9% flooded grasslands and marshy areas, 19.1% grassland formations, 3.7% savanna formations and 7% are areas of human use (most of which correspond to pasture and small temporary crops) (Figure 5b).

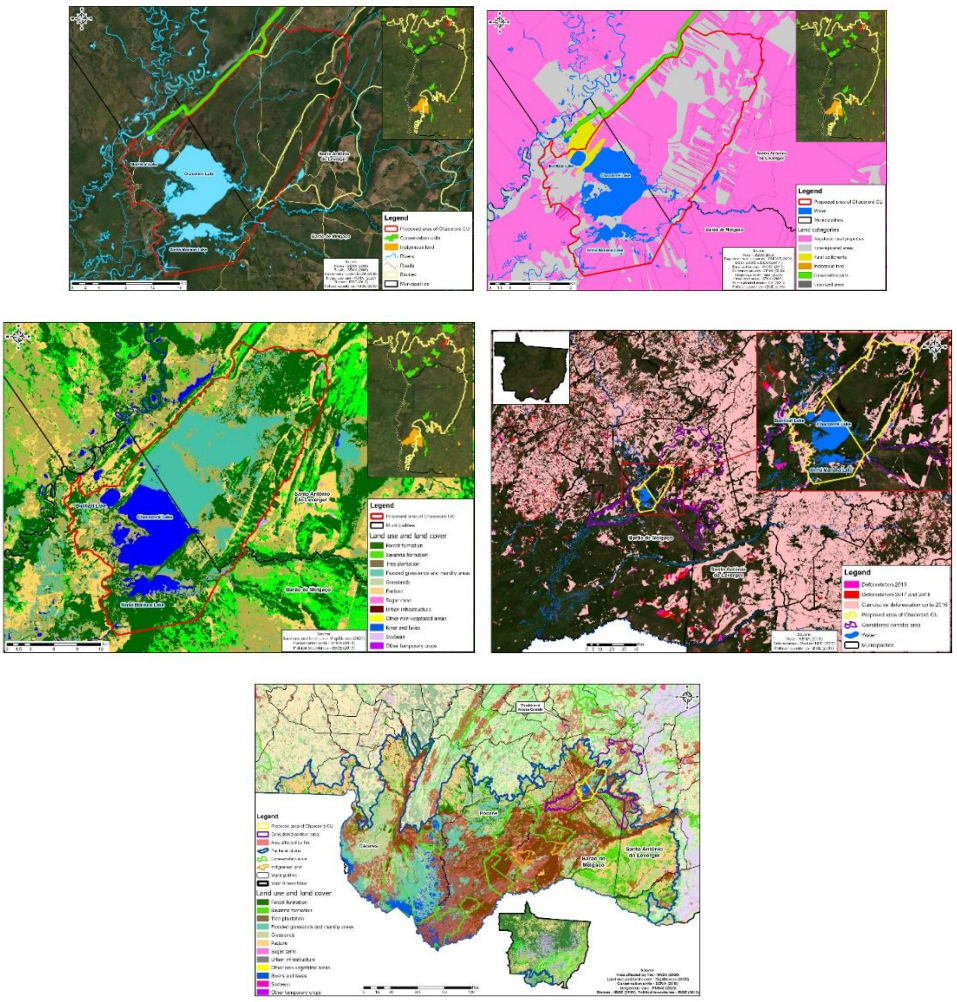
Considering the area of the proposed CU, based on data from the National Institute for Space Research (INPE) for the Pantanal Biome, 5,863 ha of accumulated deforestation

were identified up to 2019, which represents 9% of the area (Figure 5c). Of this total deforestation in the proposed area, 98% occurred up until 2016.

Regarding the land profile, the analysis of the data indicates the existence of 373 private rural properties registered in the Rural Environmental Registry (CAR) and/or the Land Management System (SIGEF), which occupy 53% of the proposed CU's area. Of this total, 264 are in Santo Antônio do Leverger and 109 in Barão de Melgaço, with 90% of them having an area of up to 100 hectares (Figure 5d).

Figure 5

Map of the area proposed for the creation of the Conservation Unit for the Chacororé–Sinhá Mariana lake system, ***(A)*** *boundaries of the Pantanal and Cerrado biomes, (B): land use and cover,* ***(C)****: deforestation, between 2016 and 2019, in the area of influence of the proposed Conservation Unit, (D): land profile of the proposed area and* ***(E)****: areas affected by fire in 2020 in the area of influence of the proposed Conservation Unit*



Regarding the areas affected by fires in 2020, in the proposed CU area, 26,806 hectares were affected, which corresponds to 42% of the proposed area (Figure 5e).

6.2 WATER USE

The Chacororé and Sinhá Mariana lake system constitutes an important natural nursery, supporting subsistence fishing (the main source of local protein), besides sporting and tourist activities. Its water is also vital for agriculture and navigation (BORGES, 2004). According to Reis (2000), traffic in the Pantanal region depends on the “bocas”, used as access routes between Mimoso and the capital.

Traditionally, communities fished during the low water, but today many work as pilots throughout the year. However, changes in water flow have caused severe impacts on lakes, threatening both ecosystems and local livelihoods.

6.3 SOCIAL GROUPS

The Chacororé and Sinhá Mariana lakes are historically occupied by traditional peoples and communities, such as the Guató, Bororo, Cuiabá Mirim, Porto Brandão, and Estirão Comprido. According to Silveira and Da Silva, several social actors operate locally in the system, including pilots, tour guides, tourists, hotel owners, fishermen (professional, amateur, and sport), traditional communities, farmers, researchers, government agents, NGOs, and the press.

7 LEGAL ASPECTS

Brazil has robust environmental legislation, based on the Federal Constitution, which aims to preserve essential ecological processes and ecologically manage species and ecosystems. The protection of territorial spaces is determined, prohibiting uses that compromise their attributes (BRASIL, 1988), without, however, preventing traditional, tourist, or subsistence activities.

The Pantanal of Mato Grosso is recognized as a National and World Heritage Site, as well as a Biosphere Reserve by UNESCO. In Mato Grosso, four areas are Ramsar Sites: Pantanal Mato-Grossense National Park, Private Natural Heritage Reserves (including SESC Pantanal), and Taiamã Ecological Station (BRASIL, 1996). However, federal legislation is limited, restricting itself to classifying it as an area of restricted use (BRASIL, 2012).

The State Constitution (MATO GROSSO, 1989) establishes that the Pantanal constitutes a priority center for environmental protection. State Law No. 8.830, which establishes the State Policy for Management and Protection of the Upper Paraguay Basin (MATO GROSSO, 2008), together with all existing protection systems, has not been effective in overcoming the problems reported in these studies.

However, this lack of legislative concreteness can be overcome, at least in the portion of the Pantanal that is the subject of these studies, with the institute called Conservation Unit.

Conservation Units are territorial spaces to be created by Law or an act of the Chief Executive, with conservation objectives, for which adequate protection guarantees apply (BRASIL, 2000). These protected spaces can be created without harming the maintenance of economic activities developed in the region since the beginning of its occupation, as long as the category allowing this goal is chosen.

Despite the maintenance of traditional communities and other people who occupy the territory in the Chacororé–Sinhá Mariana lake system, including the possibility of maintaining its sustainable exploitation, the legislation provides for the possibility of creating a type of Conservation Unit allowing economic exploitation, without the need for expropriation, and able to generate economic resources for the municipality, such as greater promotion of tourism and receipt of the Ecological Tax on Movement of Goods and Services until it is extinguished. It is therefore suggested that a Sustainable Development Reserve (SDR) be established, as it is a category of conservation unit for sustainable use, as established by Law No. 9.985 of July 18, 2000 (BRASIL, 2000). SDRs are designed to preserve nature while allowing the sustainable use of natural resources by traditional populations inhabiting the area. SDRs may include public and private areas, not requiring the expropriation of private lands, as long as the activities follow the management plan. The management of SDRs is carried out with broad participation of local communities, promoting sustainability and biodiversity conservation, Table 2.

Table 2

Main features of an RDS

01	Objective	Conserving nature and ensuring the livelihoods and culture of traditional populations, in addition to sustainably exploiting the area's natural resources.

02	**Traditional Population**	Includes the presence of traditional populations using natural resources sustainably, ensuring that their cultural and economic practices are maintained and encouraged.
03	**Sustainable Use**	Activities within an SDR must promote the sustainability of natural resources, allowing practices that do not compromise the integrity of ecosystems.
04	**Property**	SDRs can include public and private areas. In the case of private areas, expropriation is not necessary, as long as the activities carried out follow the reserve management plan.
05	**Management Plan**	The management of an SDR is guided by a management plan, which establishes the guidelines and regulations for the sustainable use and protection of natural resources, ensuring that the economic and cultural activities of traditional populations are maintained.
06	**Community Participation**	The SDR is managed with broad participation from local communities, promoting involvement and collaboration in the sustainable management of resources.
07	**Usage categories**	I - direct use of renewable natural resources by traditional populations, if sustainability criteria are observed; II - scientific research aimed at developing sustainable technologies for the exploitation of natural resources; III - ecotourism.
08	**Legal basis**	Law No. 9.985/2000, Decree No. 4.340/2000, Normative Instruction No. 7/2007 – ICMBio, Normative Instruction No. 5/2008 – ICMBio

The areas requiring the creation of a Sustainable Development Reserve are those with relevant characteristics such as forest remnants in good condition, presence of threatened, rare, migratory, or endemic species, scenic beauty or potential for ecological tourism, rich in biodiversity and water resources, availability for sustainable use of their natural resources, used by traditional communities, and having populations residing in the area (BRASIL, 2019).

The creation must observe the principle of democratic participation, so that all potential interested or impacted parties are consulted, thus avoiding the overlapping of interests in the area and possible underlying and yet unidentified conflicts. To this end, it is necessary to indicate, in a clear and accessible manner, the implications for residents inside and around the area to be established as a Sustainable Development Reserve. At this point, the accuracy of the polygon boundaries and the type of Conservation Unit suggested can be assessed.

The creation may occur by Decree of the Executive Branch or by drafting a Bill of Law to be sent for analysis and approval by the Legislative Assembly of the State of Mato Grosso,

expanding, in this case, popular participation through their legitimate representatives in Parliament.

After its creation, it is necessary to register it in the National Registry of Conservation Units, so that it can access resources from environmental compensation (BRASIL, CONAMA, 2006)

8 FINAL CONSIDERATIONS

The Chacororé–Sinhá Mariana lake system is of significant ecological interest due to its biodiversity, with a substantial variety of habitats, high richness of fauna and flora species, a great variety of fish and birds, in addition to the cultural richness of traditional communities, the Pantanal people. Added to this are its scenic beauty and exceptional tourism potential, which can contribute significantly not only to the local economy but to the economy of Mato Grosso.

However, this potential for economic exploitation is threatened, both by climate change and by environmental impacts in the lake region and in the drainage areas of the rivers that supply it.

All this natural richness of the lake system depends on the characteristic water pulse of the Pantanal biome, requiring the full functioning of the complex local water network. This network is made up of rivers, such as the Cuiabá and the Mutum, besides several streams connecting the water system. This system has already been severely impacted, so that the supply to the lake is insufficient and even interrupted at certain points and times of the year.

It is therefore necessary to urgently adopt measures for the conservation and restoration of the Chacororé–Sinhá Mariana lake system, to reestablish the full performance of its ecosystem functions and a satisfactory quality of life for traditional communities and other inhabitants of the region.

The Sustainable Development Reserve is a category of Conservation Unit whose basic objective is to preserve nature and, at the same time, ensure the conditions and means necessary for the reproduction and improvement of ways and quality of life and exploitation of natural resources, as well as to value, conserve, and improve the knowledge and techniques of environmental management developed by traditional populations. It is a way of valuing and maintaining the natural areas that shelter these populations, with environmental management based on sustainable systems and the exploitation of natural resources.

Through document analysis, bibliographic research, and field interviews, we evaluated the area in question. We characterized the biotic, physical, and socioeconomic environments. We reported the main pressures resulting from undue anthropogenic interventions. We recognized the presence of demand calling for the establishment of a Conservation Unit so that the important existing water resources and remaining vegetation still in good condition are not lost. We conclude that there is demand and convenience in establishing a Sustainable Development Reserve conservation unit as a response to be given by the State to address the environmental problems identified, without this resulting in expropriations, large public investments, or the removal of populations from the spaces they occupy, maintaining their productive sources and respecting their ways of life.

New studies and surveys will be necessary, including those related to cartographic representation and descriptive memorial, without forgetting land surveys and the extraction of detailed information from the Rural Environmental Registry to identify who occupies the region. The public hearings to be held will ensure that the creation process is as democratic as possible, with broad access to free, conscious, and informed information.

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