THE SERRA DO AMOLAR REDD+ PROJECT

Document prepared by:

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Project title	The Serra do Amolar REDD+ project
Version	2
Date of issue	31 March 2022
Project location	Municipality of Corumbá, Mato Grasso do Sul (Brazil)
Project proponent(s)	Instituto Homem Pantaneiro Leticia Larcher leticia@institutohomempantaneiro.org.br Tel: (+55) 67 99688 3814
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Project lifetime	July 1, 2016 – June 30, 2045; crediting period of 30 years
GHG accounting period	July 1, 2016 – June 30, 2046; crediting period of 30 years
History of CCB status	Validation
Gold level criteria	**Biodiversity** The Serra do Amolar REDD+ project has an important role in conserving biodiversity and meets the 'GL3 Gold Level' criteria, whereby exceptional benefits to biodiversity, according to the vulnerability criterion described by CCB, includes presenting critically threatened species (IUCN Red List) as one endangered species – the giant otter (*Pteronura brasiliensis*) – and five vulnerable species: the lowland tapir (*Tapirus terrestris*), the white-lipped peccary, (*Tayassu pecari*), the giant armadillo (*Priodontes maximus*), giant anteater (*Myrmecophaga tridactyla*) and the bare-faced curassow (*Crax fasciolata*). The project area also has a well-documented population of the near-threatened jaguar (*Panthera onca*).
Expected verification schedule	October 31, 2021

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1 SUMMARY OF PROJECT BENEFITS

The Serra do Amolar REDD+ project by Instituto Homem Pantaneiro is part of the Agriculture, Forestry and Other Land Use (AFOLU) sector, under the 'Reducing Emissions from Deforestation and Degradation' (REDD) project category. Specifically, the project is part of the 'Avoided Unplanned Deforestation & Degradation' (AUDD) project category.

The Serra do Amolar REDD+ project aims to preserve and conserve the Pantanal ecosystem, which covers approximately 135,060.62 hectares (ha) located in the strategic region of Mato Grosso do Sul (MS) and Mato Grosso (MT).[1] This region has high levels of deforestation risk caused by land speculation, which is associated with livestock and agricultural activities. The project has quantifiable climate, community and biodiversity (CCB) benefits because it provides full-time employment, training and access for families that live in and around the project area, enabling self-empowerment in a region where there are very few job opportunities. The project also seeks to improve activities in seven strategic lines such as: management, monitoring, control and inspection, communication, and develop new efforts in ecotourism, research, and fire prevention.

This project is a milestone for global climate action, with an emphasis on conservation and mitigating harmful concentrations of greenhouse gases (GHGs) in the atmosphere. It also protects and supports the wetland's rich biodiversity, unseen anywhere else in the world. Furthermore, the socio-economic co-benefits promote positive sustainable development. The project drives poverty reduction and empowers the local community, by strengthening local governance and providing long-term employment opportunities which render it beneficial to work with nature rather than against it.

The Serra do Amolar project has an important role in conserving biodiversity by monitoring mammals and other incentives which enable necessary scientific research to be carried out. The project also meets the 'GL3 Gold Level' criteria, whereby exceptional benefits to biodiversity, according to the vulnerability criterion described by CCB, includes presenting critically threatened species (IUCN Red List) as one endangered species – the giant otter (*Pteronura brasiliensis*) – and five vulnerable species: the lowland tapir (*Tapirus terrestris*), the white-lipped peccary (*Tayassu pecari*), the giant armadillo (*Priodontes maximus*), the giant anteater (*Myrmecophaga tridactyla*) and the bare-faced curassow (*Crax fasciolata*). The project area also has a well-documented population of the near-threatened jaguar (*Panthera onca*).

[1] Maria Tereza et al., *MATO GROSSO PANTANAL: A SANCTUARY FOR HUMANITY. The History of the Creation of the Complex of Preservation Units of the Region of Serra Do Amolar (Upper Paraguai River Basin) and Its Breakdown* (Rede Nacional Pró Unidades de Conservação, 2018).

1.1 Unique project benefits

Outcome or impact estimated by the end of project lifetime	Section reference
1) The permanent protection and conservation of 135,060 ha in the Pantanal biome, as well as actions in the Alto Pantanal.	3
2) Protection of a high-risk forest area to allow a natural refuge for the following populations to grow jaguars (*Panthera onca*), giant otters (*Pteronura brasiliensis*), giant anteaters (*Myrmecophaga tridactyla*), giant armadillos (*Priodontes maximus*) and the South American tapir (*Tapirus terrestris*).	5
3) Avoided unplanned deforestation and enhanced ecosystem functionality by allowing patched deforestation to regenerate, thus reducing ecosystem fragmentation.	3
4) Increase the amount of carbon sequestered in the forest.	3
5) Strengthen local governance and management of protected wetland areas at the biome level.	4
6) Economic empowerment of community groups and increased job opportunities.	4

1.2 Standardized benefit metrics

Category	Metric	Estimated by the end of project lifetime	Section reference
GHG emission reductions or removals	Net estimated emission removals in the project area, measured against the without-project scenario.	Not applicable.	
	Net estimated emission reductions in the project area, measured against the without-project scenario.	2,837,764 tons of carbon dioxide equivalent (tCO_2e)	3
Forest[2] cover	For REDD[3] projects: estimated number of hectares of reduced	Reduce at least 90% of the deforestation baseline	3

[2] Land with woody vegetation that meets an internationally accepted definition (e.g., UNFCCC, FAO or IPCC) of what constitutes a forest, which includes threshold parameters, such as minimum forest area, tree height and level of crown cover, and may include mature, secondary, degraded and wetland forests (*VCS Program Definitions*).
[3] Reduced emissions from deforestation and forest degradation (REDD) - activities that reduce GHG emissions by slowing or stopping conversion of forests to non-forest land and/or reduce the degradation of forest land where forest biomass is lost (*VCS Program Definitions*).

Category	Metric	Estimated by the end of project lifetime	Section reference
	forest loss in the project area when measured against the without-project scenario.	scenario, as well as taking into consideration non-prescribed fires.	
	For ARR[4] projects: estimated number of hectares of forest cover increased in the project area when measured against the without-project scenario.	Not applicable.	
Improved land management	Number of hectares of existing forest land in which IFM[5] practices are expected to occur as a result of project activities, measured against the without-project scenario.	Not applicable.	
	Number of hectares of non-forest land in which improved land management practices are expected to occur as a result of project activities, measured against the without-project scenario.	Not applicable.	
Training	Total number of community members who are expected to have improved skills and/or knowledge as a result of training, as part of the project activities.	Increasing by at least 25%, the number of community members involved in training activities.	4
	Number of female community members who are expected to have improved skills and/or knowledge as a result of training, as part of the project activities.	15 women are expected to have improved skills from training as part of the project activities.	4
Employment	Total number of people expected to be employed in project	Increase by at least 50%, the number of full-time jobs	4

[4] Afforestation, reforestation and revegetation (ARR) - activities that increase carbon stocks in woody biomass (and in some cases soils) by establishing, increasing and/or restoring vegetative cover through the planting, sowing and/or human-assisted natural regeneration of woody vegetation (*VCS Program Definitions*).
[5] Improved forest management (IFM) - activities that change forest management practices and increase carbon stock on forest lands managed for wood products such as saw timber, pulpwood and fuelwood (*VCS Program Definitions*).

Category	Metric	Estimated by the end of project lifetime	Section reference
	activities,[6] expressed as the number of full-time employees[7].	at the end of the project's lifetime.	
	Number of women expected to be employed as a result of project activities, expressed as the number of full-time employees.	25 full time jobs.	4
Livelihoods	Total number of people expected to have improved livelihoods[8] or income generated as a result of project activities.	Not applicable.	
	Number of women expected to have improved livelihoods or income generated as a result of project activities.	Not applicable.	
Health	Total number of people for whom health services are expected to improve as a result of project activities, measured against the without-project scenario.	Not applicable.	
	Number of women for whom health services are expected to improve as a result of project activities, measured against the without-project scenario.	Not applicable.	
Education	Total number of people for whom access to, or quality of, education is expected to improve as result of	Not applicable.	

[6] Employed in project activities means people directly working on project activities in return for compensation (financial or otherwise), including employees, contracted workers, sub-contracted workers and community members that are paid to carry out project-related work.
[7] Full time equivalency is calculated as the total number of hours worked (by full-time, part-time, temporary and/or seasonal staff) divided by the average number of hours worked in full-time jobs within the country, region or economic territory (adapted from the UN System of National Accounts (1993) paragraphs 17.14[15.102]; [17.28]).
[8] Livelihoods are the capabilities, assets (including material and social resources) and activities required for a means of living (Krantz, Lasse, 2001. *The Sustainable Livelihood Approach to Poverty Reduction*. SIDA). Livelihood benefits may include benefits reported in the Employment metrics of this table.

Category	Metric	Estimated by the end of project lifetime	Section reference
	project activities, measured against the without-project scenario.		
	Number of women and girls for whom access to, or quality of, education is expected to improve as result of project activities, measured against the without-project scenario.	Not applicable.	
Water	Total number of people who are expected to experience increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario.	Not applicable.	
	Number of women who are expected to experience increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario.	Not applicable.	
Well-being	Total number of community members whose well-being[9] is expected to improve as a result of project activities.	10 people to be employed full time in ecotourism activities (which will improve their income).	4
	Number of women whose well-being is expected to improve as a result of project activities.	Five women to be employed full time in ecotourism activities (which will improve their income).	4

[9] Well-being is people's experience of the quality of their lives. Well-being benefits may include benefits reported in other metrics of this table (e.g., training, employment, livelihoods, health, education and water), and may also include other benefits such as strengthened legal rights to resources, increased food security, conservation of access to areas of cultural significance, etc.

Category	Metric	Estimated by the end of project lifetime	Section reference
Biodiversity conservation	Expected change in the number of hectares managed, significantly better, by the project for biodiversity conservation,[10] measured against the without-project scenario.	Improve the management of 302,910 ha of the Amolar network.	5
	Expected number of globally critically endangered or endangered species[11] benefiting from reduced threats as a result of project activities,[12] measured against the without-project scenario.	Increase the functional connectivity of species in critical categories (habitat and populations) by at least 5%. Expand the monitored area for the implementation of conservation strategies for vulnerable species by 25%.	5

[10] Managed for biodiversity conservation in this context means areas where specific management measures are being implemented as a part of project activities with an objective of enhancing biodiversity conservation, e.g., enhancing the status of endangered species.
[11] Per IUCN's Red List of Threatened Species.
[12] In the absence of direct population or occupancy measures, measurement of reduced threats may be used as evidence of benefit.

2 GENERAL

2.1 Project goals, design and long-term viability

2.1.1 Summary description of the project (G1.2)

The Serra do Amolar REDD+ project by Instituto Homem Pantaneiro for scaling up the Serra do Amolar Protection and Preservation Network (*Rede de Proteção e Conservação da Serra do Amolar* [RPCSA] in Portuguese) is part of the Agriculture, Forestry and Other Land Use (AFOLU) sector under the 'Reducing Emissions from Deforestation and Degradation' (REDD) project category. Specifically, the project is part of the 'Avoided Unplanned Deforestation and Degradation' (AUDD) project category.

The Serra do Amolar REDD+ project aims to preserve and conserve the Pantanal ecosystem, which covers approximately 135,060 ha located in the strategic region of the Mato Grosso do Sul and Mato Grosso.[13] This region has high levels of deforestation risk caused by land speculation, which is associated with livestock and agricultural activities. The project has quantifiable climate, community and biodiversity (CCB) benefits because it provides full-time employment, training and access for families that live in and around the project area, enabling self-empowerment in a region where there are very few job opportunities. The project also seeks to improve activities in seven strategic lines such as: management, monitoring, control and inspection, communication, and develop new efforts in ecotourism, research, and fire prevention.

The alternative scenarios of land use, livestock (grassland) and agriculture (mainly soy) have been the most widespread in the reference region. Those land uses are carried out, without exception, in almost the entire territory. The project activities aim to protect land use and, therefore, generate a less negative impact that will allow the recovery of the natural environment and connectivity between ecosystems in the region.

Communities living around the project area have a high economic dependence on all of the resources (land and water). They have historically been articulated with practices and activities developed by IHP, which reinforces the aim to improve their economic welfare and maintain the environmental quality of the ecosystem.

Climate benefits:

- Integrity of forest land and savanna forest protection in Pantanal's ecosystem.
- Fire prevention and integrated management.
- Estimated annual GHG reductions are 94,592 tCO_2e per year from avoiding deforestation over the lifetime of the project.

[13] Maria Tereza et al., *MATO GROSSO PANTANAL: A SANCTUARY FOR HUMANITY. The history of the creation of the complex of preservation units of the region of Serra Do Amolar (Upper Paraguai River Basin) and its breakdown* (Rede Nacional Pró Unidades de Conservação, 2018).

Community benefits:

- Employment opportunities in the area. In addition, provide qualified training, social assistance and labor rights, and better living conditions.
- Promotion of applied scientific research that is focused on biodiversity and the efficient use of natural resources, and the inclusion of riverine communities.
- Involve prominent stakeholders, focusing on sustainable business chains (ecotourism) and generating income and well-being for local communities.
- Environmental education of families surrounding the project area, focusing on different age groups, aiming to improve the quality of life of this population and the dissemination of local knowledge, best practices, rights and well-being.

Biodiversity benefits:

- In terms of biodiversity, the project aims to protect the region's biological diversity, specifically, felines such as jaguars (*Panthera onca*) and pumas (*Puma concolor*)), that are near threatened (NT) and of least concern (LC) respectively, but also species like the giant otter (*Pteronura brasiliensis*), which are classified as endangered (EN) by the IUCN; the giant armadillo (*Priodontes maximus*), the white-lipped peccary (Tayassu pecari) and the lowland tapir (*Tapirus terrestris*), among others under the IUCN's vulnerable (VU) category, due to the expansion of anthropogenic agricultural and livestock activities.
- Monitoring dense Ombrophylous forest and the Savanna forest.

2.1.2 Project scale

Project scale	
Project	X
Large project	

2.1.3 Project proponent (G1.1)

Organization name	Instituto Homem Pantaneiro (IHP)
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2.1.4 Other entities involved in the project

Organization name	South Pole Carbon Asset Management S.A.S.
Role in the project	South Pole plans and oversees the development of appropriate project design and monitoring techniques in line with VCS and CCBS guidelines
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Organization name	Interconexión Eléctrica S.A. E.S.P ISA
Role in the project	Financier of the Project Document and Monitoring Report
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Organization name	Panthera Colombia
Role in the project	Biodiversity study and support of monitoring activities
Contact person	Jeronimo Rodríguez
Title	Country Director
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2.1.5 Physical parameters (G1.3)

The Serra do Amolar REDD+ project is located in the municipality of Poconé, Mato Grosso state, and in the municipality of Corumbá, Mato Grosso do Sul state, in the central-western region of Brazil. The project area is located in the Pantanal biome, one of the largest tropical wetlands in the world, which covers an area of approximately 135,060 ha in the Paraná River basin, with centrical geographic coordinates of 17°58'2.72'' S and 57°30'31.58'' W (Figure 1).

One of the main characteristics of the region is the extensive exploitation of agricultural and livestock activities, which result in the conversion of natural areas into human areas. This causes physical processes such as erosion, over enrichment of rivers through nutrient pollution (eutrophication), as well as contamination through agrochemicals.

Due to the predominance of these characteristics, alongside the loss of forest and an increase in anthropic intensification in the region, there is an urgent challenge to reconcile economic activities with the promotion of conservation and biodiversity, and thus maintain ecological processes. To this end, the government sector is seeking to prioritize an ecologically sustainable economy; this consists of regulations, compensation programs, and defined intervention limits regarding the suppression, substitution and change of native vegetation as proposed by the Pantanal Law.

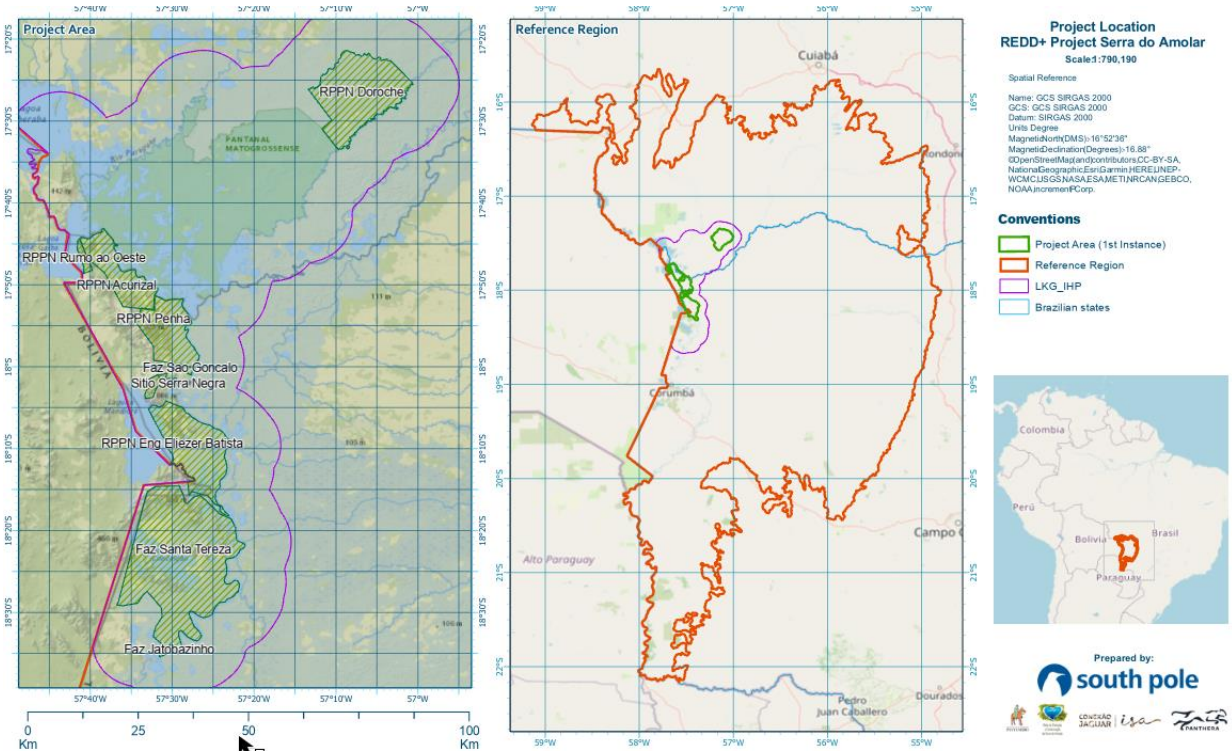
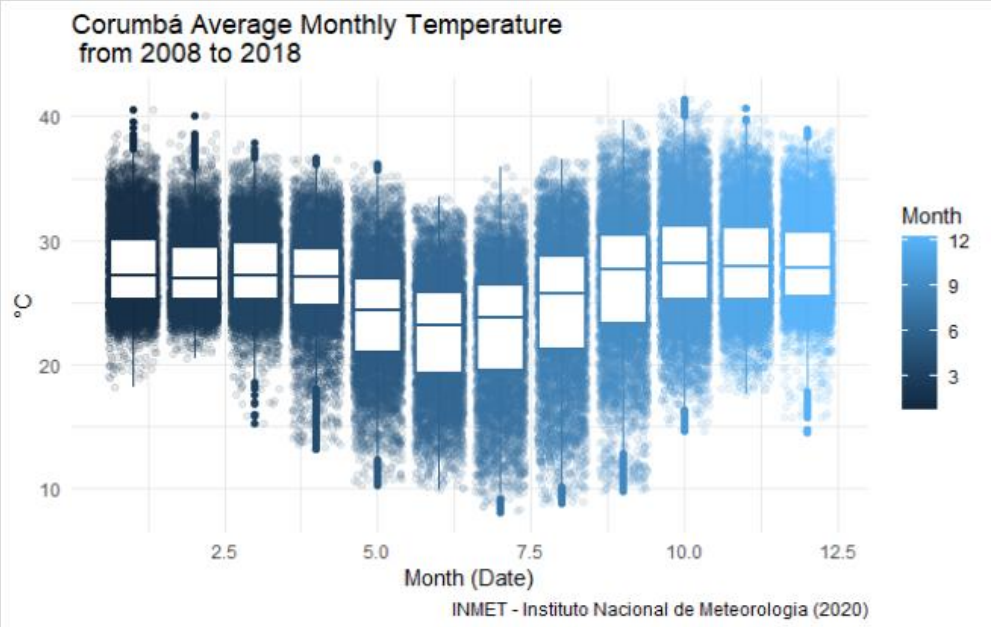


Figure 1. Project location map

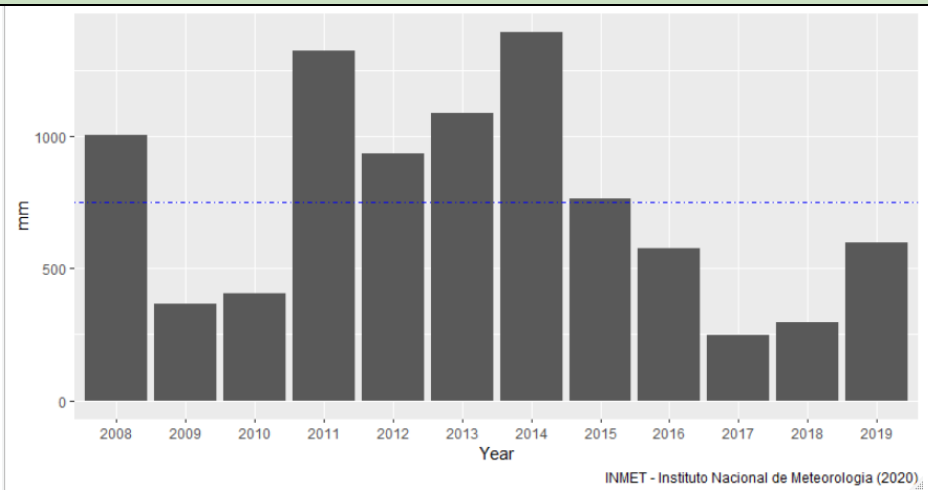
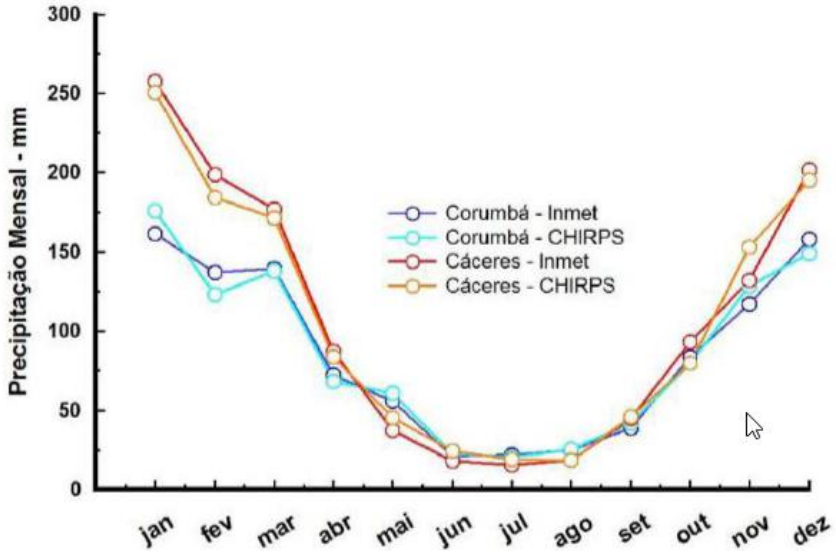
(Source: South Pole, 2022)

The general environmental conditions of the project area and its surroundings are presented as follows (see Table 1)

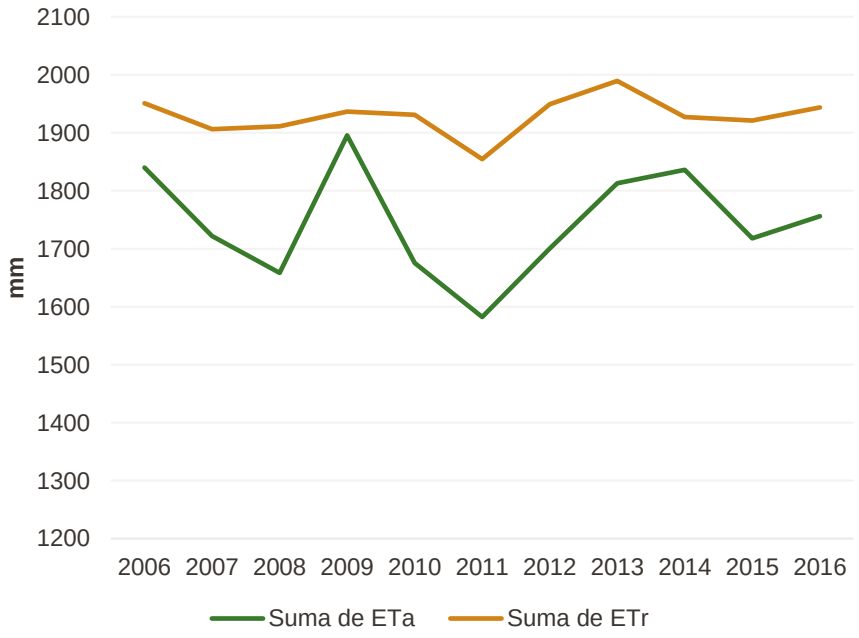
Table 1. Physical and environmental conditions of the project area

Physical condition	Description
Climate	The Pantanal biome has a typical wet-dry climate and is a semi-arid region.[14] The average annual temperature varies between 21 degrees Celsius (°C) and 27°C.[15] The hottest months are October and November, and the coolest ones are June and July (see Figure 2).  *Figure 2. Corumbá average monthly temperature* (Source: INMET, 2020)[16] The rainy season lasts from October until March, and the dry season from May to September. Rainfall is seasonal, with average annual precipitation ranging from 748 millimeters (mm), and the lowest annual precipitation being 250.75 mm (see Figure 3).

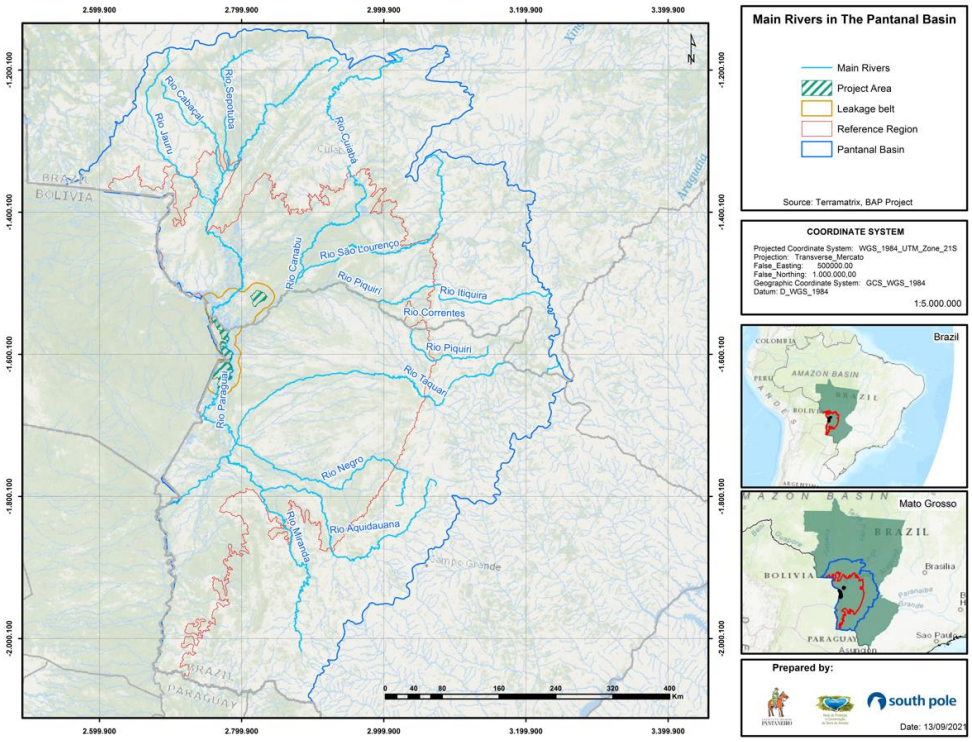
[14] Jose A. Marengo, Gilvan S. Oliveira, y Lincoln M. Alves, "Climate change scenarios in the pantanal", in *Handbook of Environmental Chemistry*, vol. 37 (Springer Verlag, 2016), 227-38, https://doi.org/10.1007/698_2015_357; Mario Luis Assine et al., "The Quaternary alluvial systems tract of the Pantanal Basin", *Brazilian Journal of Geology* (Sociedade Brasileira de Geologia, 1 de septiembre de 2015), https://doi.org/10.1590/2317-4889201520150014.
[15] Assine et al., "The Quaternary alluvial systems tract of the Pantanal Basin"; H C Gonçalves, M A Mercante, y E T Santos, «Hydrological cycle», *Braz. J. Biol*, vol. 71, 2011.
[16] Inistituto Nacional de Metereologia - INMET, "Dados Metereológicos do Tempo / Corumbá", 2020, https://tempo.inmet.gov.br/TabelaEstacoes/A724.

Physical condition	Description
	 *Figure 3. Average annual precipitation in reference region from 2008–2018*[17] (Source: INMET, 2020)  *Figure 4. Average monthly precipitation in reference region from 2008–2018* (Source: INMET, 2020)

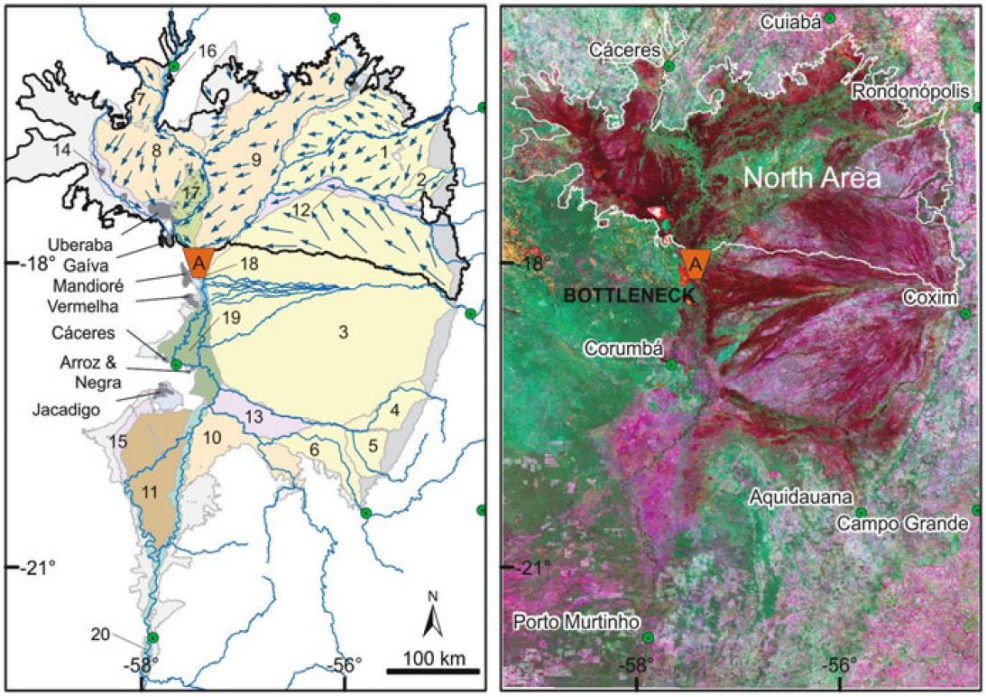
[17] Ibid.

Physical condition	Description
	The precipitation in the Pantanal is influenced by large-scale climate phenomena such as El Niño Southern Oscillation and La Niña.[18] Evapotranspiration is high in the Pantanal due to its high water level during the year, generating water loss through evaporation rather than water drainage through the soil. However, factors such as altitude and hydrology are directly related to the radiation received in the Pantanal basin, influencing climate parameters such as temperature, evapotranspiration and precipitation.[19] The average annual evapotranspiration (Figure 5) in the project area is 1,745 mm. On average, annual evapotranspiration is 48% less than annual precipitation; annual discharge is 91% and 82% less than precipitation and evapotranspiration respectively.[20]  *Figure 5. Map of potential evapotranspiration (Eta) of forest in Corumbá*

[18] Marengo, Oliveira, y Alves, "Climate change scenarios in the pantanal".
[19] Pinto, V. R. Caracterização morfométrica e capacidade de uso da terra da Bacia Hidrográfica do rio Sararé, sudoeste do Estado do Mato Grosso. 2015. 87p. Dissertação (Mestrado em Ciências Ambientais) – Universidade do Estado de Mato Grosso, Cáceres, 2015.
[20] Atena Editora, *Pantanal: O Espaço Geográfico e as Tecnologias Em Análise* (Antonella Carvalho de Oliveira, 2019), https://doi.org/10.22533/at.ed.227192903.

Physical condition	Description
Hydrology	The Pantanal biome basin is contained within the upper Paraguay River basin, where the Paraguay River is the trunk river system that drains water and sediments.[21] It is considered to be the largest continuous floodplain in the world[22] and has several bedrock rivers (Figure 6) in the catchment area, due to the formation of the watercourses by erosion processes.[23] The sedimentation and bifurcation of the channels leads to changes in the rivers' courses, generating shifts in the watercourses to areas far from the active main channel.[24]  *Figure 6. Main rivers in the project area and reference region* (Source: IBGE, 2019) The project area is located in the upper Paraguay River basin, Amolar zone, which is a narrow floodplain, with mainland forest limited by the Amolar Mountain Range and the

[21] Mario Luis Assine et al., "Avulsive rivers in the hydrology of the pantanal wetland", in Handbook of Environmental Chemistry, vol. 37 (Springer Verlag, 2016), 83-110, https://doi.org/10.1007/698_2015_351
[22] André Augusto et al., "Geography of the Physical Environment The Physical Geography of Brazil Environment, Vegetation and Landscape", s. f., http://www.springer.com/series/15117
[23] Assine et al., "Avulsive rivers in the hydrology of the pantanal wetland".
[24] Natasha Costa Penatti et al., "Satellite-Based Hydrological Dynamics of the World's Largest Continuous Wetland," *Remote Sensing of Environment* 170 (2015): 1–13, https://doi.org/10.1016/j.rse.2015.08.031.

Physical condition	Description
	Cuiabá and Taquari fans rivers, that acts as a bottleneck for the flow of the Paraguay River, which causes flow constriction and backwater flooding upstream.[25] The bottleneck of Serra do Amolar is located in X: -57.553251 and Y: -17.916694 (Figure 7).  *Figure 7. Location of the Serra do Amolar bottleneck[26]* (Source: Pennati et al, 2015) During the rainy season (October to April), the rivers flood the lowlands, inundating as much as 70% of the floodplain, with areas submerged from 0.5 m to 4 m (6 m has been the maximum high registered), as well as forming swamps, marshes and shallow lakes.[27] In the drier season (May to September), the rivers withdraw to their banks, but the lowlands are only partially drained.[28]
Relevant historic conditions	The process of occupation of the Pantanal region – population growth, expanding economic activities and the birth of cities in the upper Paraguay River basin – is as old as the expansion of western Brazil. The region had a strategic role in defining the

[25] Assine et al., “Avulsive Rivers in the Hydrology of the Pantanal Wetland.”
[26] Ibid.
[27] Marengo, Oliveira, and Alves, “Climate Change Scenarios in the Pantanal.”
[28] Gonçalves, Mercante, y Santos, "Hydrological cycle".

Physical condition	Description
	boundaries of Brazilian territory, when the border with the Spanish domain was configured during the colonial period (Paraguay and Bolivia).[29] As a result, from that socio-political configuration, the first "sesmarias" of the region were granted, generating the first cattle breeders, and the origin of the Pantanal land use. The system of sesmarias enabled people to possess large areas of land – free of charge to anyone who could prove financial conditions to exploit them. The climatic seasonality, together with the landscape conditions that impose the flooding regime experienced in parts of the properties during certain times of the year, influenced the size of the areas and legitimized the large extension of the farms in the Pantanal.[30] All of the human activities in the region such as navigation, cattle ranching and farming, are strongly regulated by the hydrological regime. For instance, the available land for cattle ranching and farming is dependent on the extent of the flooding area during each wet season.[31] Thus, flooding determines the human occupation and the productive activities. Once the flood is over, fertile arable lands and grasslands are available for use in cattle ranching and farming activities. Nevertheless, natural areas are also converted into productive land, which increases the occurrence of erosive processes, overflowing of river courses and eutrophication of the water sources.[32] Although most of the productive activities take place in the plateau of the upper Paraguay River basin, the negative effects of these activities are present in the Pantanal basin, especially in relation to deforestation: mainly the transport and input of sediments into the rivers of the Pantanal. Deforestation in the plateau for livestock and/or cultivation of grains (soybeans, maize) causes erosive processes on the soil, which increase the sediments going into the Pantanal, causing siltation of rivers, inundations and loss of habitats.[33] On the other hand, cattle farming is the primary activity for income generation inside the Pantanal. Cattle were introduced in the Pantanal about 300 years ago, with a recent intensification during the 1990–2011 period.[34] Consequently, the land tenure of the Brazilian Pantanal consists of 95% privately-owned ranches called "Fazendas." Please refer to section 2.4 for further information about the historical conditions of the zone.

[29] Tereza et al., *MATO GROSSO PANTANAL: A SANCTUARY FOR HUMANITY. The history of the creation of the complex of preservation units of the region of Serra Do Amolar (Upper Paraguai River Basin) and its breakdown*.
[30] Ibid.
[31] Marengo, Oliveira, y Alves, "Climate change scenarios in the pantanal".
[32] Sandra Mara Alves Da Silva y Juliano Aquino De Moraes, "EVOLUTION OF DEFORESTATION IN THE BRAZILIAN PANTANAL AND SURROUNDINGS IN THE TIMEFRAME 1976-2008 João dos Santos Vila da SILVA 1 Myrian de Moura ABDON 2", Geografia 36 (2011): 35-55.
[33] Ibid.
[34] David M. Lapola et al., "Pervasive transition of the Brazilian land-use system", *Nature Climate Change*, enero de 2014, https://doi.org/10.1038/nclimate2056.

Geology, geomorphology and soils

The Pantanal is located in a tectonic depression as a consequence of the last Andean compressive event at 2.5 Ma. The geological formations in the project area and reference region are the Urucum formation, the Fluvial formation and the Pantanal formation (Quaternary), with the dominance of sandy and clayey sediments from Holocene, Tertiary and present days. These are presented by main geology categories by project area and reference region (see Table 2).

Table 2. Geology typologies for reference region and project area

Reference region				Project area			
Name (Era)	Class	Area (ha)	%	Name (Era)	Class	Area (ha)	%
Total general		15,053,982	100%	Total general		133,027*	100%
Phanerozoic Cenozoic Quaternary	Q1Q2p	5,914,916	39%	Water and others	-	15,616	12%
	Q1Q2pa	3,854,050	26%	Phanerozoic Neoproterozoica	NPu	20,068	15%
	Q2a	2,269,735	15%	Phanerozoic Cenozoic Quaternary	Q1Q2p	10,424	8%
	Q1Q2pt	1,614,295	11%		Q2a	70,491	53%
	NQdl	301,583	2%		Q2t	16,428	12%

*

(Source: SGB, 2019)

The reference region is a recognized complex sedimentary wetland originating from different flooding dynamics and geomorphological characteristics, leading to diverse subdivisions based on landscape features, flooding dynamics and hydrology.

The soils of the Brazilian Pantanal in the upper Paraguay River basin are divided into Litolic neosols, Spodosols and Gleysols.[35] Although the conditions are favorable for the formation of Spodosols, there is still a lack of research on this soil type in the project area.[36] [37] [38]

The Brazilian System of Soil Classification (SiBCS) (Embrapa, 2006) divides the order of Spodosols into Espodossolo Humilúvicos, with a predominance of organic carbon (OC) accumulated in the spodic horizon (Bh and/or Bhm); Espodossolos Ferrilúvicos, with the accumulation of aluminum (Al) that may or may not contain iron (Fe) in the spodic horizon (Bs and/or Bsm); and Espodossolos Ferrihumilúvicos, with the

[35] Assine et al., "The Quaternary Alluvial Systems Tract of the Pantanal Basin."
[36] Ibid.
[37] Jolimar Schiavo et al., "Characterization and Classification of Soils in the Taquari CharaCterization and ClassifiCation of Soils in the Taquari River Basin-Pantanal Region, State of Mato Grosso Do Sul, Brazil," *R. Bras. Ci. Solo* 36 (2012).
[38] Eduardo Guimarães Couto and Virlei Oliverira, "The Soil Diversity of the Pantanal," 2010.

accumulation of OC, Fe and Al in the spodic horizon (Bhs and/or Bhsm). However, due to the Spodosols at the reference region, it is not possible to determine if the formation of spodic horizons in the project area are associated with high levels of OC.[39]

Table 3. Soil classification in reference region and project area

Reference region				Project area			
Name	Class	Area (ha)	%	Name	Class	Area (ha)	%
Total general		14,016,939	100 %	Total general		119,735	100 %
	Espodossolo Ferrocárbico	2,864,555	20%		Gleissolo Háplico	41,538	35%
	Plintossolo Háplico	2,729,427	19%		Plintossolo Háplico	26,862	22%
	Planossolo Háplico	2,335,068	17%		Argilossolo Vermelho-Amarelo	26,831	22%
	Planossolo Nátrico	1,533,208	11%		Massa d´Água	24,505	20%

(Source: Embrapa, 2006)

Topography

The Pantanal is located in a plain with most of the relief ranging from 29 meters above sea level (masl) to 1,089 masl. Serra do Amolar reaches high elevations, around 940 masl (Figure 8).[40] The elevation gradients vary within the flood plains: from 25 cm km^{-1} from east to west and 2 cm km^{-1} from north to south along the Paraguay River[41] (with almost zero inclination at the large slopes close to surrounding mountain escarpments).

Due to these characteristics, the flooding periods range from four months in weak flooding areas to up to nine months in strong flooding areas, and there are still places which remain flooded all year long.[42]

[39] Ibid.
[40] Assine et al., "The Quaternary alluvial systems tract of the Pantanal Basin".
[41] Stephen K Hamilton, "HYDROLOGICAL CONTROLS OF ECOLOGICAL STRUCTURE AND FUNCTION IN THE PANTANAL WETLAND (BRAZIL)", *The Ecohydrology of South American Rivers and Wetlands. IAHS Special Publication*, 2002.
[42] MA Mercante, SC Rodrigues, y JLS Ross, "Geomorphology and habitat diversity in the Pantanal Mercante", *Brazilian Journal of Biology* 71, n.º 1 (2011): 233-40.

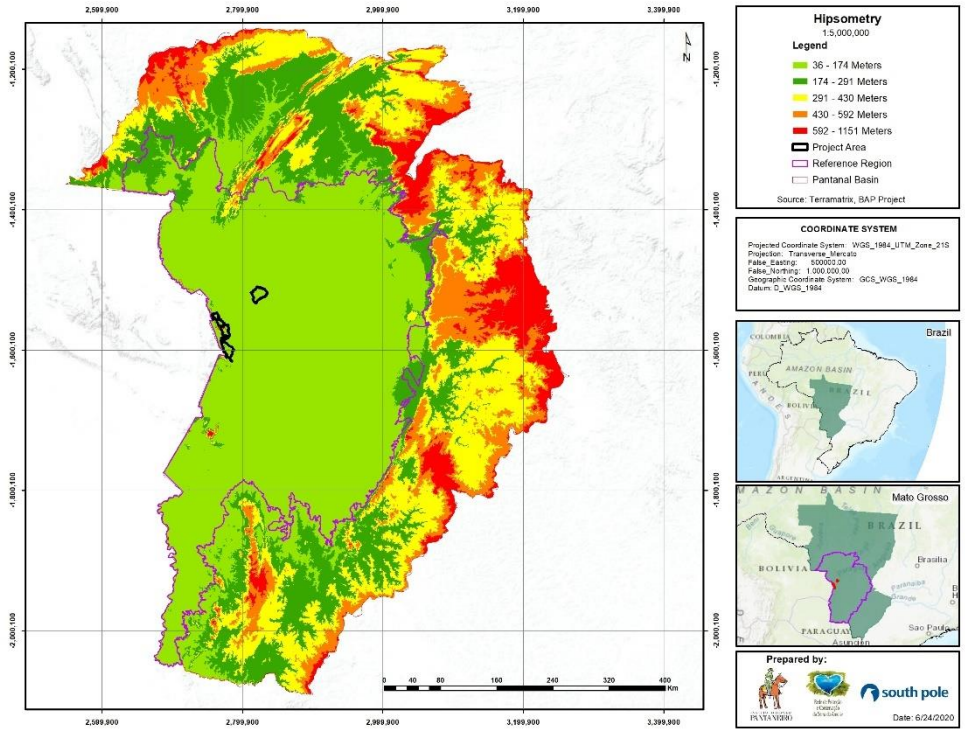


Figure 8. Hypsometry (altitude in masl) of the reference region and project area[43]

(Source: BAP Project, 2018)

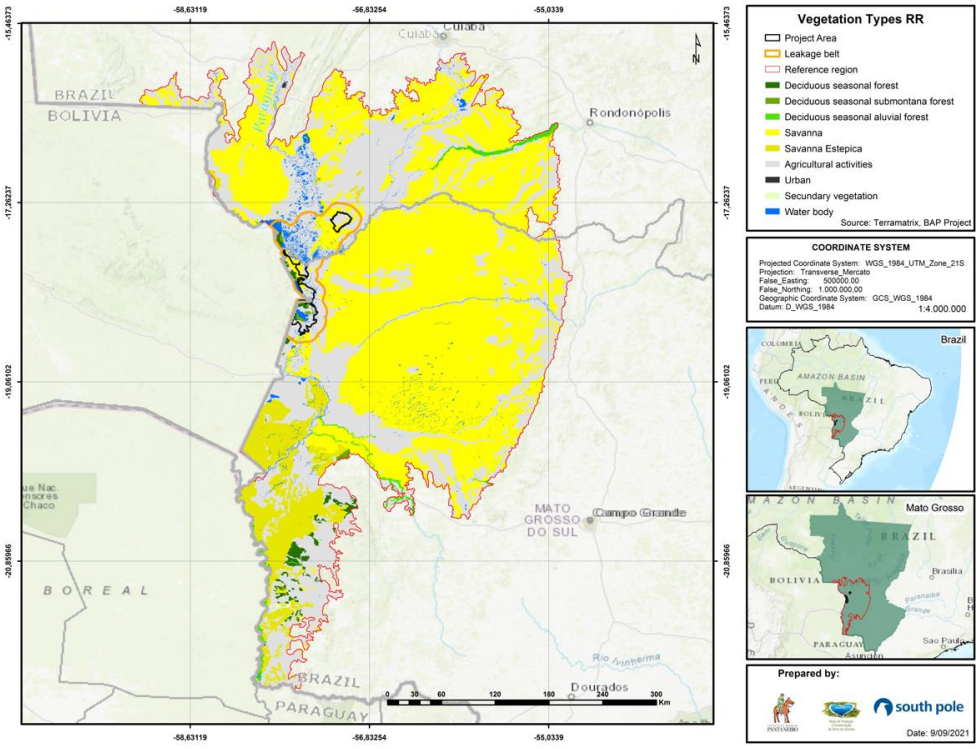
Table 4. Classes of altitude within reference region and project area

Class (masl)	Reference region		Project area	
	Area (ha)	%	Area (ha)	%
36–174	14,436,583	96%	116,214	86%
174–291	608,619	4%	11,039	8%
291–430	22,693	0%	5,358	4%
430–592	12,207	0%	1,651	1%
592–1151	7,870	0%	795	1%
Total general	**15,087,972**	**100%**	**135,059***	**100%**

* Difference compared to the total project area due to the edge effects in which pixel is highly likely to be unaccounted using two or more sources (i.e., raster and shapefile).

(Source: BAP Project, 2018)

[43] Info available on Geopantanal Platform: https://ihp.agrotools.com.br/MapPage.aspx

Vegetation and ecosystems	The project is located in the Pantanal biome, which is one of the world's largest tropical wetlands and is classified by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as a Biosphere Reserve and World Heritage Site.[44] The vegetation of Pantanal is related to the communities from the surrounding biomes: Amazon basin, the Cerrado Savannas and the Chaco Savannas, and to the seasonal flooding effects. According to the Brazilian Institute of Geography and Statistics (IBGE), the main vegetation types in the reference region are seasonal semi-deciduous forest, seasonal deciduous forest, savanna and transitional areas between savanna and forest (Figure 9).  *Figure 9. Vegetation types in the reference region* (Source: IBGE, 2019) The seasonal semi-deciduous forest and the savanna are the most common formations in the project area too (Figure 10); the gallery forests can be found in the

[44] Hamilton, "HYDROLOGICAL CONTROLS OF ECOLOGICAL STRUCTURE AND FUNCTION IN THE PANTANAL WETLAND (BRAZIL)".

more elevated ground along the major rivers.[45] The Pantanal biome has different kinds of woody vegetation that are subjected to inundation.[46]

However, the grasslands and floating vegetation cover areas are subject to seasonal flooding. The most common floating plants are the Cuban bulrush (*Oxycaryum cubense*) and the rooted water-hyacinth (*Pontederia azurea*), while the most abundant rooted emergent species are the piripiri (*Cyperus giganteus*), the fire-flag (*Thalia geniculata*) and the southern cattail (*Typha domingensis*).[47]

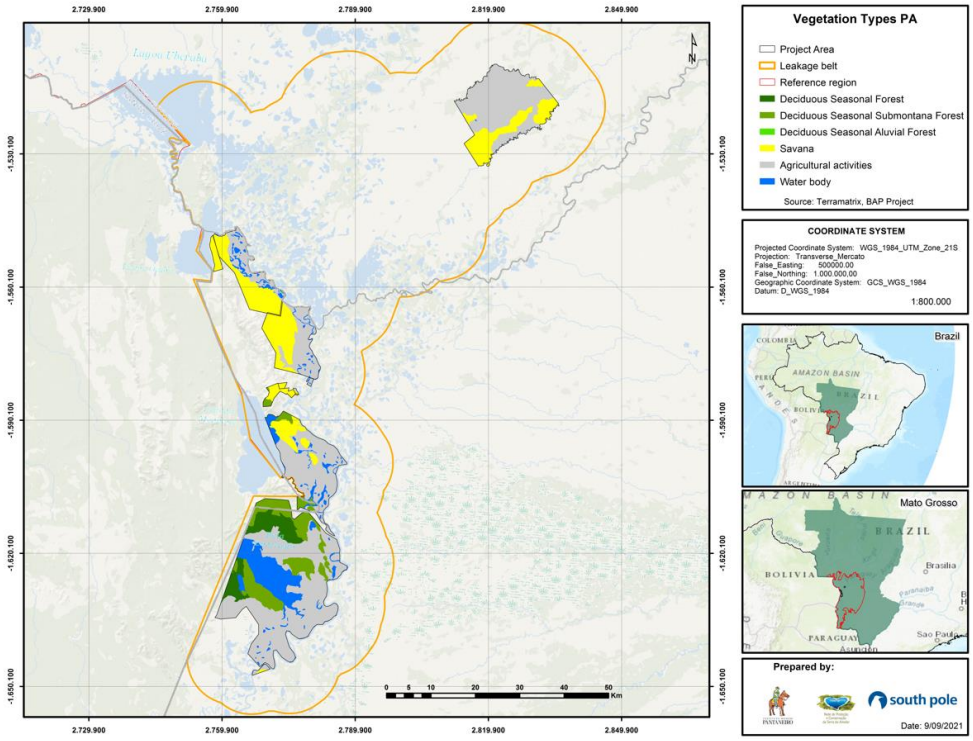


Figure 10. Vegetation types in the Serra do Amolar project area

A summary of the vegetation cover present in the project area and the region of reference can be found in Table 5.

Table 5. Presence of vegetation types

Types of vegetation	Reference region	Project area
Forest		
Submontane deciduous Seasonal Forest (Cs)	X	X

[45] Ibid.
[46] Geraldo Alves Damasceno et al., "Structure, distribution of species and inundation in a riparian forest of Rio Paraguai, Pantanal, Brazil", *Flora* 200, n. 2 (2 de mayo de 2005): 119-35, https://doi.org/10.1016/j.flora.2004.09.002.
[47] Ibid.

	Alluvial Semi deciduous Seasonal Forest (Fa)	X	X
	Lowland Semi deciduous Seasonal Forest (Fb)	X	X
	Wooded Steppe Savannah (Ta)	X	X
	Non-forest		
	Savannah-park without riparian forests	X	X
	Wooded Steppe Savannah without riparian forests	X	X
	Wooded Savanna without riparian forests	X	X
	Savanna	X	X
	(Source: IBGE, 2019)		

2.1.6 Social parameters (G1.3)

The Pantanal is a complex area formed by the Pantaneira Plain and the Serra do Amolar, and is one of the greatest biological diversity patrimonies in Brazil. It combines the richness of species and ecological processes of the Pantanal – one of the largest areas of savanna in the world – with the Serra do Amolar, comprising of a biological and geographical corridor inhabited by *pantaneiros* (i.e., landowners), peons (i.e., farm workers), and *ribeirinhos* (i.e., those who live on the riverbanks).[48]

Extensive cattle ranching has been the main reason for people occupying this region, but more recently other economic activities have been developed, including ecological fishing and rural tourism, mining and border trade. Some enterprises have already been set up in the region, including the Bolivia-Brazil Gas Pipeline, the Paraguay-Parana Waterway and the Corumbá Mining and Siderurgical Center.

In the last decade, upon the initiative of the IHP, the organizations that work in this region (including Acaia Pantanal, the Ecotrópica Foundation, and ICMBio, by means of the Pantanal Matogrossense National Park) formed a partnership and established the Serra do Amolar Protection and Preservation Network (RPCSA). Their goal is to share the management of the conservation units[49] of the region, whose objective is to carry out integrated management actions for preservation, as well as contributing to the protection of the Pantanal Matogrossense National Park and surrounding areas. Such actions will help

[48] Pierre Girard, "The Pantaneiros, Perceptions and Conflicts Abouth the Environment in the Pantanal," in *Tropical Wetland Management: The South-American Pantanal and International Experience*, ed. Antonio Augusto Rossotto Ioris, 2012, 376.
[49] The concept of conservation units (CUs) evolved notions of preservation of historic heritage, protected natural area and biodiversity conservation. according to SNUC – Sistema Nacional de Unidades de Conservação da Natureza (National System of Nature Conservation Units) CUs may be classified in two big groups according to the form of use of natural resources: 1- Full Protection Units – Ecological Station, Biological Reserve, National Park, Natural Monument and Wildlife Refuge; and 2- Sustainable Use Units – Environmental Protection Area, Area of Relevant Ecological Interest, National Forest, Extractive Reserve, Fauna Reserve, Sustainable Development Reserve and Private Reserve of Natural Heritage.

protect a large mosaic of natural areas, with the aim of maximizing the local means as well as optimizing financial, technical and logistical resources for the preservation of the Pantanal.[50]

To reduce the effects of fragmentation on biodiversity, efforts were made, and new areas were added, to the four existing CUs.[51] For instance:

- In 2005, a private natural heritage reserve ("*Reserva Particular do Patrimônio Natural"*, RPPN) Rumo Oeste, added 9.9 km^2 to the Pantanal protected area complex, located in Gaiva Lagoon, at the northwest limit of the RPPN Acurizal. The State Department of Environment and Water Resources (SEMA/MS) recognized it by deliberation No. 22. CECA/MS, on June 8, 2005.
- In 2008, upon suggestion by Angelo Rabelo, founder and then president of the IHP, to the EBX group, by means of Ordinance No. 51, dated June 24, the Engineer Eliezer Batista Natural Reserve was created in an area of 13,323.44 ha, located in the municipality of Corumbá, Mato Grosso do Sul, owned by MMX Corumbá Mineração Ltda. Subsequently, the RPPN formed a partnership with the IHP, which undertook responsibility for the administration of the area.
- The two new RPPNs were also added to Fazenda Santa Tereza, situated to the south of RPPN Engineer Eliezer Batista. With 630 km^2, the area was acquired between 2005 and 2006 by Teresa Bracher, director of Acaia Pantanal. The owner, who already saw potential for the preservation of biodiversity in the area when acquiring the farm, adhered to the preservation purposes of the Protection and Preservation Network of Serra do Amolar. Fazenda Santa Tereza is a private rural property with livestock breeding activity and a preservation purpose. There are 63,000 ha: 10,000 ha are used for cattle breeding and 53,000 ha are dedicated to preservation.

The creation of the new RPPN characterized a new era for the preservation actions of Serra do Amolar.

Currently, Serra do Amolar Protection and Preservation Network is a model of shared management of UCs and is virtually unique in Brazil, involving three sectors of society; the third sector is represented by non-governmental organizations; the second sector is financing companies and individuals; and the first sector is the Chico Mendes Institute for Biodiversity Preservation (ICMBio), emphasizing that the main supporter of the Network so far has been the private sector.[52]

Table 6 outlines the most important social parameters for the project in relation to historical events, settlements and demographics of the reference region. Other important elements such as traditional communities are described in section 2.1.9 (Stakeholder Description).

[50] Viviane Fonseca Moreira, "Rede de Proteção e Conservação da Serra do Amolar: Rompendo Fronteiras para a Conservação do Pantanal" (Universidade Federal de Mato Grosso do Sul, Mestrado em Estudos Fronteiriços, 2011).
[51] Maria Tereza et al., "MATO GROSSO PANTANAL: A SANCTUARY FOR HUMANITY THE HISTORY OF THE CREATION OF THE COMPLEX OF PRESERVATION UNITS OF THE REGION OF SERRA DO AMOLAR (UPPER PARAGUAI RIVER BASIN) AND ITS BREAKDOWN Realization: Rede Nacional Pró Unidades de Conservação", 2018.
[52] Moreira, "Rede de Proteção e Conservação da Serra do Amolar: Rompendo Fronteiras para a Conservação do Pantanal".

Table 6. Main social parameters of the project area

Social parameters	Description
Historic conditions	The process of occupation of this region is as old as the expansion of western Brazil itself. It started in the 17th century, with the São Paulo expeditions, whose initial objective was the capture of native people for commercialization in São Paulo.[53] In the 18th century, upon discovery of gold, a new cycle began, intensifying migration from all parts and contributing to occupation of the territory, that later gave rise to the cities of Cuiabá (1719), Cáceres and Corumbá (1778), and Poconé (1781).[54] Years later, when the gold cycle declined in the region, mine explorers started looking for other locations and activities, among them, cattle breeding. As they went from Cuiabá to the south, these miners, in addition to their own herds, tried to capture the cattle that had been in the area since the time of the flag expeditions. The natural grass meadows, characteristics of the vegetation of the biome, were a guarantee of fertile pastures for all kind of livestock. Thus, the historic cattle herd of Pantanal was formed, with an extensive livestock breeding mode as its main characteristic, something established in the 18th century as a parallel activity to the mining of gold and precious stones. During the Paraguayan War in the 19th century, because of an order from Don Pedro II, the area became more occupied so as to contain the possible advances of the Spanish domain into Brazilian territory, specifically from Paraguay and Bolivia (Higa, 2005). By the end of this period and at the beginning of the 20th century, the extraction of mate herb and poaia, a native plant widely used in the pharmaceutical industry, were added to cattle breeding and the dry meat industry as main economic activities of the region.[55] From the 20th century onwards, driven by the agricultural expansion policies of the Brazilian government, extensive cattle breeding leveraged a new occupation front in Pantanal, causing tremendous economic and population growth through the implantation of different official and private agricultural colonies in the upper Paraguay River basin and the surroundings.[56] Other policies directly and indirectly affect the Pantanal, such as, the National Integration Plan (PIN), the Program for Land Redistribution and Stimulus to Agribusiness in the North and the Northeastern Regions (Proterra), the Center-West Development Program (Prodeste), the Program for Agricultural and Agro-mining Centers in Amazon (Polo Amazônia), the Program for the Development of Cerrado (Polo Center) and the Special Program for Development of Pantanal (Prodepan).

[53] Tereza et al., *MATO GROSSO PANTANAL: A SANCTUARY FOR HUMANITY. The History of the Creation of the Complex of Preservation Units of the Region of Serra Do Amolar (Upper Paraguai River Basin) and Its Breakdown*.
[54] Ibid.
[55] Ibid.
[56] Ibid.

Social parameters	Description
	The latter is intended to create a development center in Pantanal Mato Grosso and implement new industrial activities such as the manufacture of broth and meat extract, as well as leather tanning (Moreno, 2005; Kmitta & Calheiros, 2014).
Main settlements	The reference region covers the municipalities of Aquidauana, Corumbá, Cáceres, Poconé, Santo Antõnio do Leverger and Barão do Melgaço. In the north of the Pantanal are the municipalities of Poconé, Cáceres and Barão do Melgaço, and in the south are Aquidauana and Corumbá (see Figure 11).

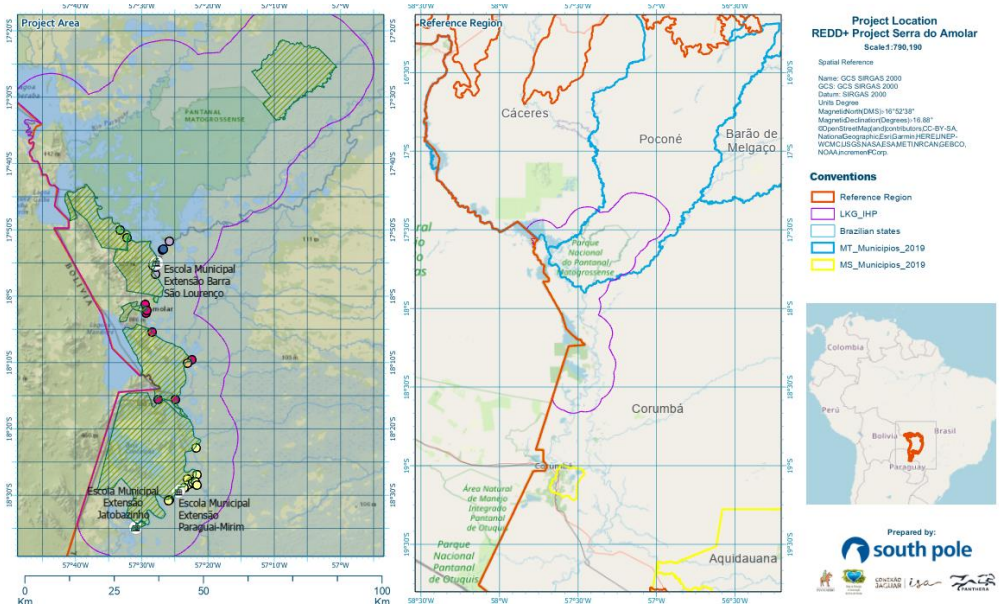


Figure 11. Main settlements and municipalities in the reference region and project area

(Source: IBGE, 2019)

The local population in the Pantanal are named *pantaneiros*, being composed of mixed Indigenous groups and foreigners. The simplest way to define *pantaneiro* is as a person who lives in the Pantanal. However, this territory is vast and, in fact, there are many landscapes and people within it. Usually, the *pantaneiros* are associated with cattle ranching, but they are also peons, farmers, landowners and *ribeirinhos* (who live on the river side), who are the main stakeholders in the Pantanal, and Serra do Amolar project.[57] [58]

[57] Walfrido M. Tomas et al., "Sustainability Agenda for the Pantanal Wetland: Perspectives on a Collaborative Interface for Science, Policy, and Decision-Making", *Tropical Conservation Science* (SAGE Publications Inc., 2019), https://doi.org/10.1177/1940082919872634.
[58] Girard, "The Pantaneiros, perceptions and conflicts abouth the environment in the Pantanal".

<table>
<tr><th>Social parameters</th><th>Description</th></tr>
<tr><td></td><td>Despite the recognition of most communities in the Pantanal, there are still invisible communities to policymakers due to the historical conditions of isolation, oppression and displacement.[59] The IBGE indicates the existence of 27 local communities (see Table 7).

Table 7. List of settlements in the Pantanal[60]
<table>
<tr><th>State</th><th>Municipality</th><th>Settlement</th></tr>
<tr><td rowspan="20">Mato Grosso (MT)</td><td rowspan="2">Barão do Melgaço</td><td>Barão De Melgão</td></tr>
<tr><td>Joselândia</td></tr>
<tr><td rowspan="5">Cáceres</td><td>Caramujo</td></tr>
<tr><td>Clarinpolis</td></tr>
<tr><td>Horizonte Do Oeste</td></tr>
<tr><td>Nova Cáceres</td></tr>
<tr><td>Soteco</td></tr>
<tr><td rowspan="2">Curvelandia</td><td>Curvelândia</td></tr>
<tr><td>Santa Rita</td></tr>
<tr><td>Nossa Senhora do Livramento</td><td>Pirizal</td></tr>
<tr><td rowspan="2">Poconé</td><td>Poconé</td></tr>
<tr><td>Cangas</td></tr>
<tr><td rowspan="3">Porto Esperidião</td><td>Porto Esperidião</td></tr>
<tr><td>Bocaiuval</td></tr>
<tr><td>Pedro Neca</td></tr>
<tr><td rowspan="3">Santo Antônio do Leverger</td><td>Aldeia Indígena Tereza Cristina</td></tr>
<tr><td>Santo Antônio do Leverger</td></tr>
<tr><td>Caité</td></tr>
</table></td></tr>
</table>

[59] Rafael Chiaravalloti, "The Displacement of Insufficiently 'Traditional' Communities: Local Fisheries in the Pantanal", *Conservation and Society* 17, n.º 2 (1 de abril de 2019): 173-83, https://doi.org/10.4103/cs.cs_18_58.
[60] IBGE, "Localidades Brasil 2010", 2020, https://www.ibge.gov.br/geociencias/downloads-geociencias.html.

Social parameters	Description

		Mimoso
Mato Grosso do Sul (MS)	Corumbá	Corumbá
		Albuquerque
		Amolar
		Coimbra
		Porto Esperança
	Ladário	Ladário
	Miranda	Salobra
	Porto Murtinho	Porto Murtinho
Total		27

(Source: IBGE, 2019)

Localization of communities

For the Sierra do Amolar project, IHP has recorded five regions and more than 36 settlements in the project area that may be characterized as traditional populations and compounds the main community scope (see Table 8).

Table 8. Settlements in the project area[61]

Region in project area	**Settlements (*ribeirinhos*)**
Acurizal	Ecotropica/Acurizal
	RPPN- Acurizal
Barra do São Lourenço	Barra do São Lourenço
	Canãa
	Ilha do Paraiso
	Porto Bons Amigos
	Porto Celebridade
	Porto Feliz Natal
	Porto Jardim do Eder

[61] Instituto Homem Pantaneiro, “Ribeirinhos - Rede de Proteção e Conservação Da Serra,” 2018.

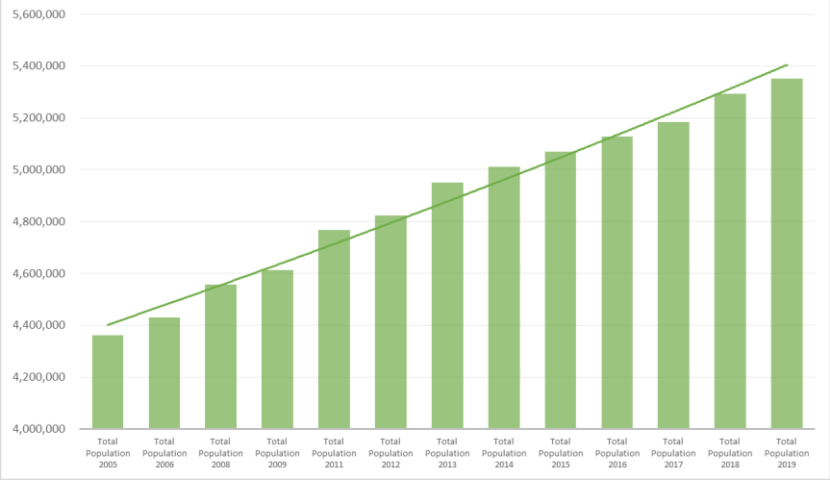
Social parameters	Description	
		Porto Paraiso
		Porto Reconto Celeste
		Porto São João
		Recanto Paraiso
		Rio São Lourenço
	Bomfim	Porto São Pedro
	Paraguai Mirim	Ilha da Sorte
		Ilha Santa Catarina
		Ilha Verde
		Instancia
		Nova Instancia
		Parada Dura
		Paraguai Mirim
		Porto 05 de Março
		Porto 15 de Março
		Porto 5 de Julho
		Porto das Pedreiras
		Porto Manduví
		Porto Oito Irmãos
		Porto Santa Catarina
		Porto São Francisco
	Serra do Amolar	RPPN EEB
		Porto Divino
		São Pedro
		Serra Negra
	(Source: IBGE, 2019)	

<table>
<tr><th>Social parameters</th><th>Description</th></tr>
<tr><td>Demography</td><td>
The demographic scenario shows a population of 296,665 inhabitants in 2010, with 75% residing in urban areas and 25% in rural areas. There is a population of 10.2% in the northern part and 23% in the south.

The reference region population growth in the period 2005–2011 was 8%, with the main areas of growth being Barão de Melgaço and Santo Antônio do Leverger, with rates above 20% in the period of 2010–2015 and 2% in 2015–2019, with the main areas of growth being Barão de Melgaço, Cáceres and Corumbá as well (see Table 9).

Table 9. Population of municipalities in the reference region[62]
<table>
<tr><th rowspan="2">UF</th><th rowspan="2">Municipality</th><th colspan="4">Total population</th><th colspan="3">Growth rate (%)</th></tr>
<tr><th>2005</th><th>2011</th><th>2015</th><th>2019</th><th>2005 – 2010</th><th>2010 – 2015</th><th>2015 – 2019</th></tr>
<tr><td>MS</td><td>Aquidauana</td><td>46,007</td><td>45,781</td><td>47,162</td><td>47,871</td><td>0%</td><td>3%</td><td>2%</td></tr>
<tr><td>MS</td><td>Corumbá</td><td>100,268</td><td>104,318</td><td>108,656</td><td>111,435</td><td>4%</td><td>4%</td><td>3%</td></tr>
<tr><td>MT</td><td>Barão de Melgaço</td><td>6,319</td><td>7,58</td><td>7,526</td><td>8,564</td><td>20%</td><td>-1%</td><td>14%</td></tr>
<tr><td>MT</td><td>Cáceres</td><td>89,054</td><td>88,428</td><td>90,518</td><td>94,376</td><td>-1%</td><td>2%</td><td>4%</td></tr>
<tr><td>MT</td><td>Poconé</td><td>31,348</td><td>31,857</td><td>32,131</td><td>32,843</td><td>2%</td><td>1%</td><td>2%</td></tr>
<tr><td>MT</td><td>Santo Antônio do Leverger</td><td>15,464</td><td>18,696</td><td>19,257</td><td>16,628</td><td>21%</td><td>3%</td><td>-14%</td></tr>
<tr><td colspan="2">Total</td><td>4,361,192</td><td>4,768,748</td><td>5,069,826</td><td>5,352,382</td><td>8%</td><td>2%</td><td>2%</td></tr>
</table>
(Source: IBGE, 2020)
</td></tr>
</table>

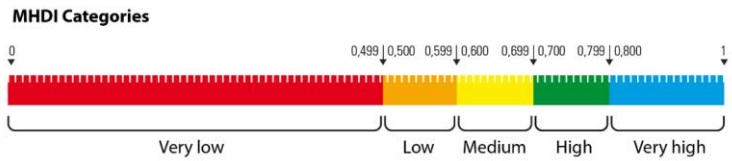
[62] IBGE, "Estimativas de População 2020 - Tabela 6579 - População residente estimada", 2020, https://sidra.ibge.gov.br/tabela/6579.

Social parameters	Description
	 *Figure 12. Total population of municipalities in the reference region 2005–2019*[63] (Source: IBGE, 2020)
Land use and economic activities	Until the 1960s, the dominant land use in the Pantanal and Cerrado was pasture for cattle ranching. During the 1970s, agricultural expansion also became important; then, in the 1980s, a more intense occupation was initiated, leading to the large-scale farming of commodity crops, which greatly expanded from the 1990s, all at the expense of native vegetation.[64] Over the last three decades, human intervention in the Pantanal's highlands for agricultural expansion has suppressed large areas of native vegetation, including riparian and gallery forests. A great deal of literature indicates a relative land cover increase in soybean/corn cropland from 25% to 30% and pasture from 17% to 41%, while highlighting a decrease in the native forest from 57% to 28%. These land-use changes significantly affect several economic indexes, such as the per capita gross domestic product (GDP), which was 48% higher than that of Brazil. The total GDP increased by 259% from 1999 to 2011. In addition, in 2010, the Human Development Index (HDI) of the reference region was 0.729, the same as Brazil's average HDI[65] (see Table 10).

[63] Ibid.
[64] Ivan Bergier, Mario Luis, y Assine Editors, "Dynamics of the Pantanal Wetland in South America The Handbook of Environmental Chemistry 37 Series Editors: Damià Barceló · Andrey G. Kostianoy" s. f., http://www.springer.com/series/698.
[65] Ibid.

Table 10. HDI categories in the reference region and Brazil

States	Municipalities	MHDI 200066	MHDI 201067	MHDI 201568
All	Brazil	0.61	0.73	0.76
Project	Reference region	0.53	0.66	0.76
MS	Aquidauana	0.56	0.69	0.76
MS	Corumbá	0.58	0.70	0.76
MS	Miranda	0.50	0.63	0.76
MT	Barão de Melgaço	0.45	0.60	0.76
MT	Cáceres	0.59	0.71	0.76
MT	Poconé	0.53	0.65	0.76
MT	Santo Antônio do Leverger	0.53	0.66	0.76



(Source: PNUD, 2013)

The main economic activities in the Pantanal are raising beef cattle, fishing and tourism.

Extensive livestock farming started at least 250 years ago, being the most traditional economic activity in the Pantanal region since the beginning of its colonization. But it has become more important with the development of cattle farming and the introduction of slaughterhouses in São Paulo as well. Market conditions meant there was an increased demand in productivity and the option of natural pastures with low animal support capacity (heads/ha) was determined to the best option. Thus, the feasibility of this type of occupation was supported by the constitution of large farms.[69]

The tables below determine how the initial conditions show an increase in the production, livestock effect.

Social parameters	Description

Table 11. Production of livestock and heads within the reference region (2010–2014)

Descrição	2010	2011	2012	2013	2014
Rebanhos (cabeças)					
Bovinos	22.354.077	21.553.851	21.498.382	21.047.274	21.003.830
Bubalinos	16.811	15.277	15.141	14.582	14.445
Equinos	344.589	339.136	338.093	337.124	337.185
Muares	47.213	46.268	46.046	-	-
Suínos	1.062.035	1.328.251	1.205.455	1.159.632	1.217.651
Asininos	4.014	3.960	3.947	-	-
Galináceos (1)	25.760.402	25.238.634	25.263.806	24.458.357	25.311.665
Ovinos	497.102	497.631	498.064	500.509	502.678
Caprinos	31.716	39.556	37.927	36.239	36.099
Codornas	108.919	135.478	115.116	122.922	124.920
Coelhos	843	859	724	-	-
Produção					
Leite (mil litros)	511.270	521.832	524.719	523.347	528.738
Vacas ordenhadas (cabeças)	528.011	530.463	532.061	529.651	517.385
Ovinos tosquiados (cabeças)	64.075	63.575	63.411	63.651	63.256
Lã (kg)	104.680	103.914	103.571	103.997	103.604
Casulo Bicho-da-Seda (kg)	138.499	99.540	75.313	100.016	110.139
Mel de Abelhas (kg)	512.417	686.486	821.961	769.261	837.099
Ovos de codorna (mil dúzias)	2.160	2.692	2.425	2.646	2.647
Ovos de galinha (mil dúzias)	40.184	40.301	40.974	41.795	41.833

Fonte: IBGE - Pesquisa Pecuária Municipal. Disponível em:
<http://www.sidra.ibge.gov.br/bda/acervo/acervo2.asp?ti=1&tf=99999&e=c&p=PP&v=105&z=t&o=24>. Acesso em: Abril 2015.
(1) Galinhas, galos, frangas (os) e pintos.

(Source: IBGE, 2015)

Fishing is an important sector in the region as well, thanks to preservation and the water quality. The fishing production potential can be estimated as being between 14,000 and 263,000 t/year, depending on 43,850 km^2 of floodable areas, which is considered to be of importance for ichthyofauna (Catella; Petrere, 1996). This activity employs about 96,356 professional and subsistence fishermen in 1,947 sites, in addition to boosting tourism through sport fishing.[70]

Tourism started in the early 20th century due to the scenic beauty of the region and the very high biodiversity, making tourism an activity of economic and social importance. The municipalities of the project area are the gateway to the Pantanal; there are many inns and hotels along the *Transpantaneira* highway and a large ecological resort, which receives an intense flow of tourists from various parts of Brazil and around the world.[71]

[66] PNUD, IPEA, y FJP, "O Índice de Desenvolvimento Humano Municipal Brasileiro (2000–2010)", 2013, http://atlasbrasil.org.br/2013/pt/download/publication/.
[67] Ibid.
[68] PNUD, IPEA, y FJP, "Desenvolvimento Humano - Análise de Resultados para Brasil - (2011–2015)", 2015.
[69] Jose Melo, "Qual é o determinante da expansão da fronteira agrícola matogrossense, no período de 2001/2007: Produção Agrícola ou Pecuária?" (2009), Universidade Federal do Pernambuco (UFPE).
[70] Maiara Thaisa Oliveira, "Percepção dos atores sociais do turismo no Pantanal de Poconé/MT sobre o pulso de inundação" (Universidade Federal de Mato Grosso, 2017).
[71] Ibid.

2.1.7 Project zone map (G1.4-7, G1.13, CM1.2, B1.2)

The project zone is the area in which communities and biodiversity is potentially impacted by REDD+ project activities, including the potential project instances which could be included in the future. The Serra do Amolar REDD+ also includes areas which are defined as having a potentially high conservation value (HCV) described in Section 4.1.3 Community High conservation values (CM1.2) and Section 5.1.2 Biodiverity High conservation values (B1.2).

Following are the project zone boundaries composed of main areas where project activities aims to generate net benefits and impacts:

- the project area;
- the potential project instances;
- the Hight conservation values; such as:
- Paraguay River and its tributaries,
- the Pantanal biome,
- conservation units of the Pantanal Matogrossense National Park – World Heritage Site – UNESCO Biosphere Reserve – Ramsar site,
- the jaguar conservation units for Brazil, and
- the communities or settlements surrounding the project area

2.1.7.1 Project area

Serra do Amolar is located in the Pantanal, in the sub-region of Paraguay, near the border with Bolivia, between the municipalities of Cáceres (MT) and Corumbá (MS). The RPCSA, which in the area mentioned above as project area for REDD+ activities, included: RPPN Estância Dorochê (W 17°27´08" S, 57°01´28") with about 33,200 ha; the RPPNs Acurizal (W 57°33'13" , S 17°49'52") with about 13,600 ha, Penha (W 57° 30'09" , S 17°54'34") with about 13,400 ha, Rumo ao Oeste (W 57°38'35", S 17°49'52") with about 900 ha, Engineer Eliezer Batista (W 57°28'29", S 18°05'26") with about 20,400 ha, and Santa Tereza Farm (W 57º30'10", S 18º18'38") with about 55,000 ha; Fazenda Jatobazinho (W 57° 29’ 10.5”, S 18° 36' 18.2”) with about 360 ha, and other small properties such as Serra Negra, Santa Rosa, Sao Goncalo (W 57° 29’ 22.7”, S 18° 2' 21.2”) with about 2000 hectares. All are about 180 km from the urban centers where the managing institutions are located (Cuiabá – MT and Corumbá – MS)

According to methodology applicability conditions the project area shall include only land qualifying as “forest” for a minimum of 10 years prior to the project start date. To prove this, an eligibility analysis was performed. The eligibility analysis was performed based on cartographic information from the MapBiomas Collection 6 1985–2020.

In summary and according to the results of the eligibility analysis, 64,442.97 ha of the project area were forest land for more than 10 years prior to the project start date, and thus meets that eligibility criteria. Figure 13 shows the eligible area.

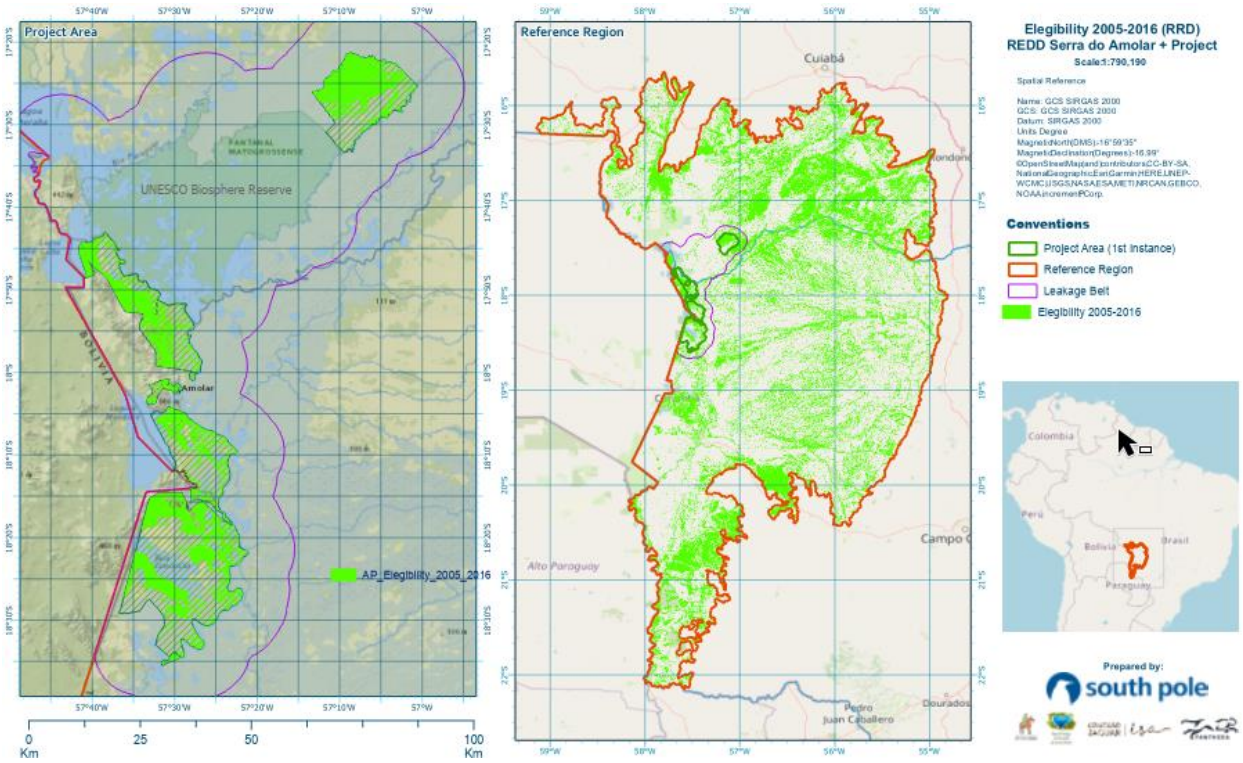


Figure 13. Project eligibility 2005-2016

(Source: South Pole , 2022)

2.1.7.2 Potential project instances

Potential project areas for grouped projects are show Figure 14. Communities that may be included in the project at a future verification and their boundaries are presented in section 2.1.6 (see Table 8).[72]

The definition target of new instances will restore connectivity including new protected areas management and RPPNs to maintain hydric pulse, reduce human pressure and increase the efficiency of responses to new opportunities and threats at site level.

The potential of the e biodiversity corridor approach is also supporting local municipalities' planning, building local capacity.

[72] Information is available in GIS/Boundaries folder

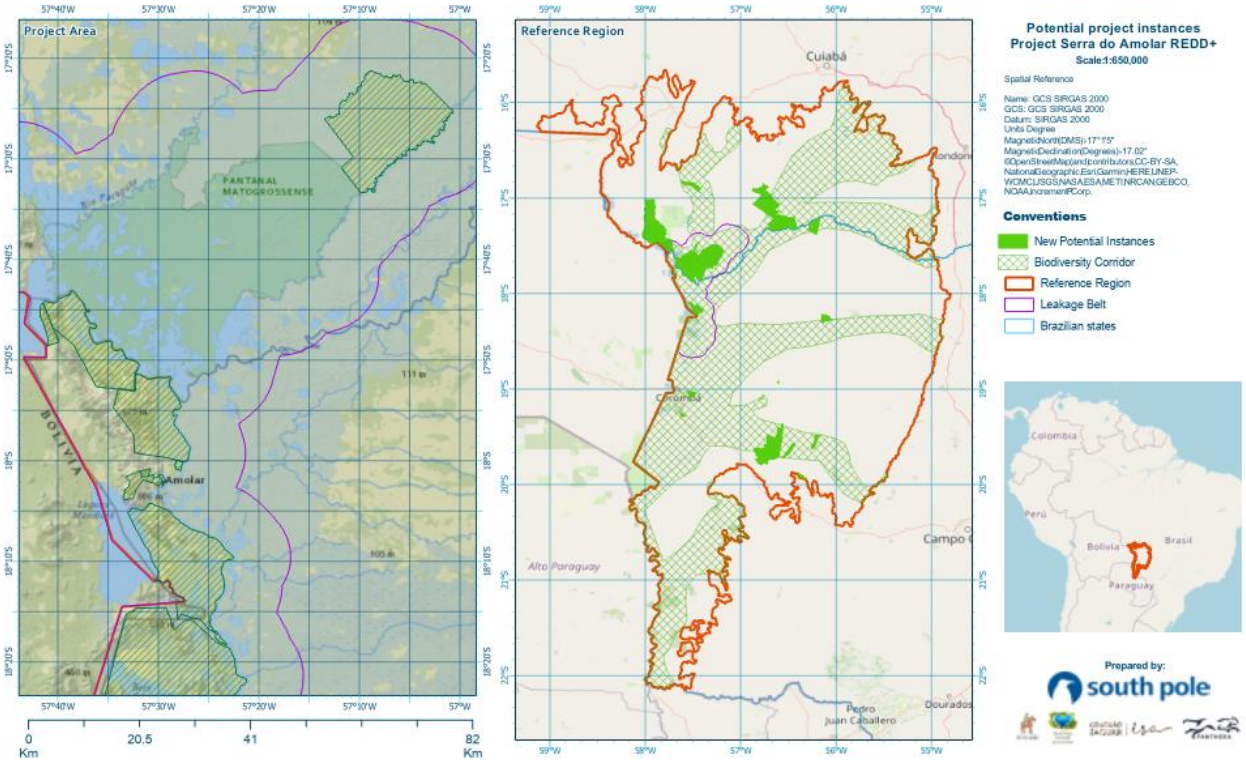


Figure 14. Potential project instances

(Source: South Pole, 2022)

2.1.7.3 Paraguay river its tributaries and other water bodies

The Paraguay-Paraná River system is another conservation target for the Serra do Amolar REDD+ project which is an important ecological corridor across South America. The Figure 15 present has a physical structure with aquatic habitats along the main channel a 200-km long section of the Upper Paraguay River between Cáceres city and Taiama island (Mato Grosso, Brazil). Along 1873 km, it has several tributaries the largest being the Sepotuba, Cabaçal, Jauru, Cuiabá, Taquari, and Miranda rivers. Its basin covers about 496 000 km2 of Brazil, Bolivia, and Paraguay (14°-23° S and 53°- 60° W).

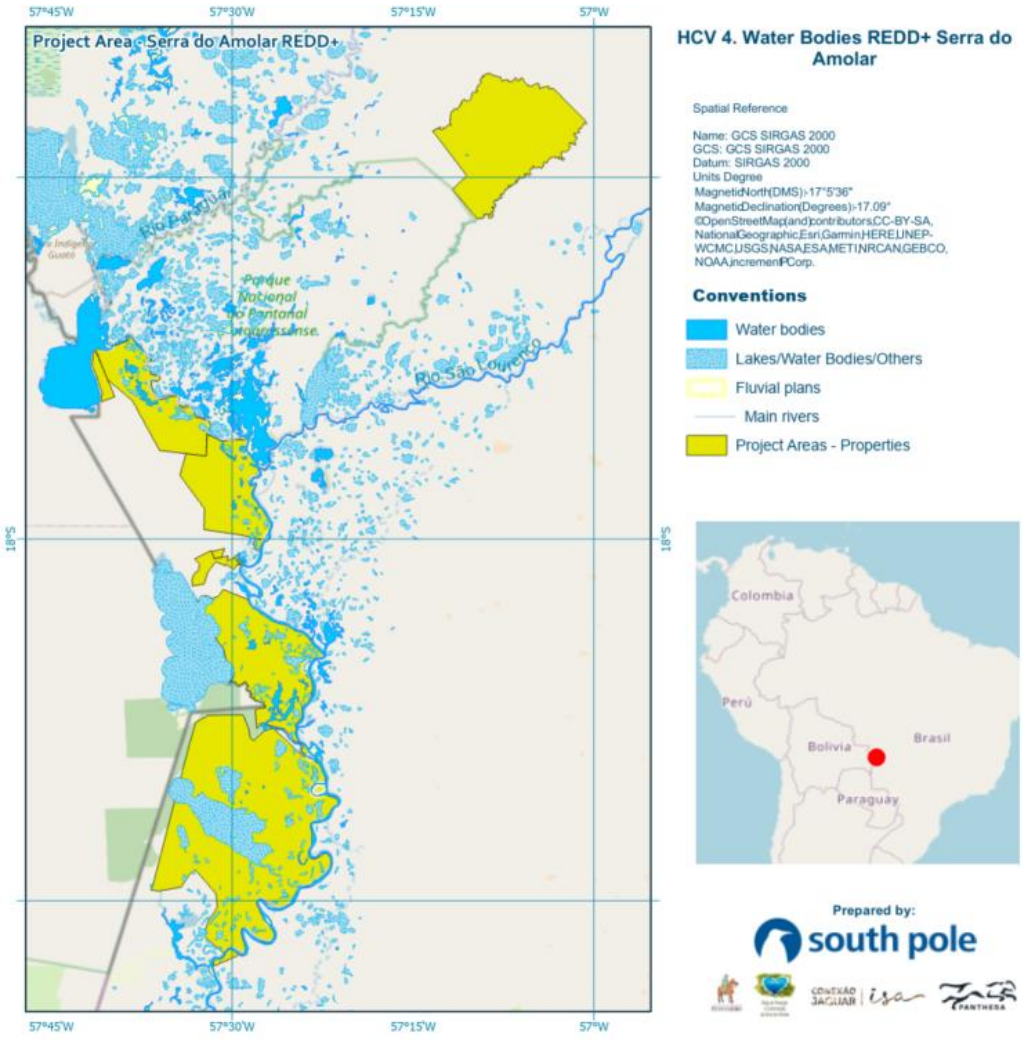


Figure 15 Paraguay river and water bodies offsite the Serra do Amolar REDD+ project

(Source: South Pole, 2022)

2.1.7.4 Pantanal biome

, which is situated in the depression of the upper Paraguay River 16–20° S and 55–58° W that extends between the old crystalline shield of central Brazil and its transition zone to the foothills of the geologically young Andes.

In Brazil, the Pantanal covers the states of Mato Grosso and Mato Grosso do Sul, being considered an Ecosystem Complex, with landscapes characterized by forest and savanna forest in periodic inundations, floodable fields and aquatic environments, such as freshwater or brackish lagoons, rivers, ebb, and corixos, all that is the Pantanal biome that extends for 160 km².

The Brazilian Pantanal was mapped as a result of improvements in the investigation, bibliographic revision and inter-institutional contacts, as well as of the verification and consolidation of field surveying, which, along the boundaries between the environments under analysis, confirmed both the physical-biotic environment and pieces of evidence of the previous vegetation performed by IBGE[73].

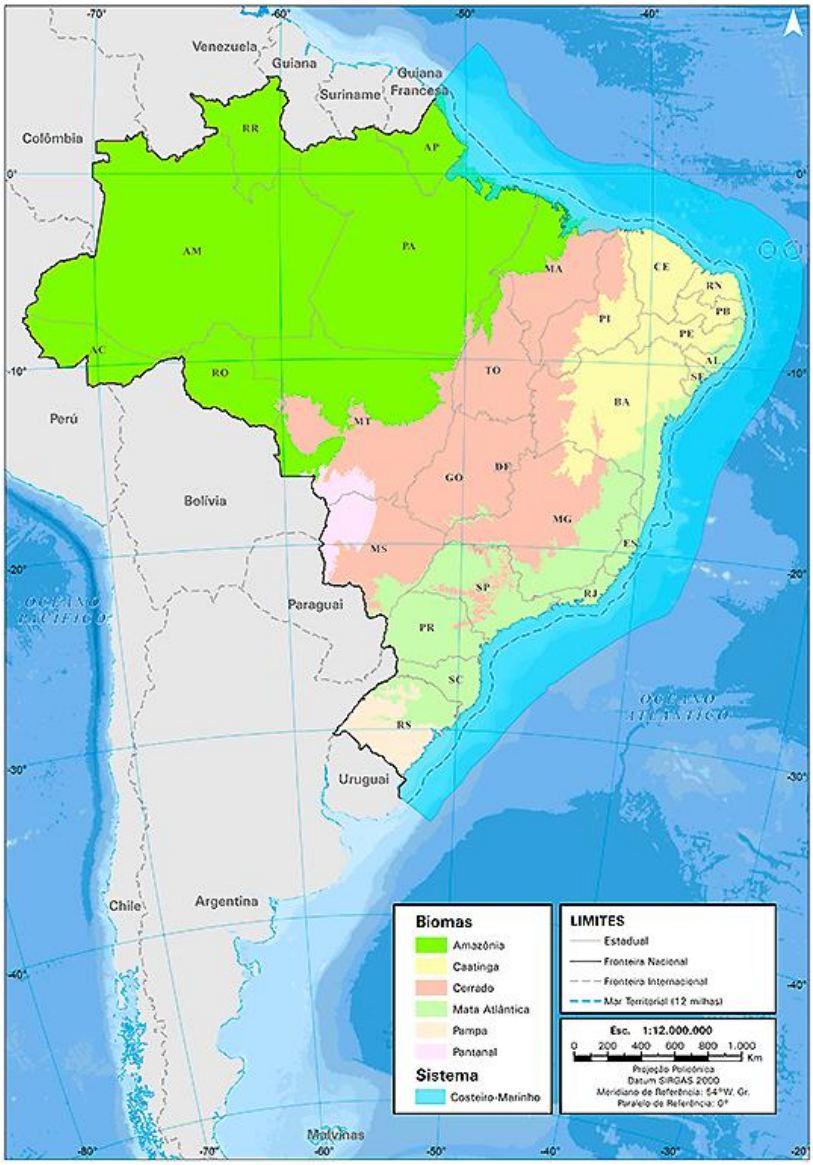


Figure 16 Map of Biomes of Brazil (1:250.000)

(Source: IBGE, 2022)

[73] IBGE launches unprecedented map of Biomes and Coastal-Marine System | News Agency

2.1.7.5 Conservation units of the Pantanal Matogrossense National Park – World Heritage Site – UNESCO Biosphere Reserve – Ramsar site

The Pantanal conservation area comprise a total of 187,818 ha distributed in four protected areas: Pantanal Matogrossense National Park, and Acurizal, Penha and Doroche special reserves (World Heritage Convention, 2022). Due to its landscapes of wetlands and the Amolar mountain chain, the hydrological process there are unique, generating abundance in biodiversity and representative habitats for different species. Furthermore, the area is recognized as a Ramsar site in Brazil.

The Pantanal National Park is under the management of the Chico Mendes Institute for Biodiversity Conservation (ICMBio) since 2007, who is also responsible for the establishment of the RPPNs. The advantage of having all these areas under a continuous corridor is that all of the key biological and geographical elements of the Pantanal can be represented and conserved in one area (see section 5.2.1).

2.1.7.6 Jaguar conservation units for Brazil

Due to the wide distribution of the jaguar (Panthera onca), spanning from the north of Mexico to the north of Argentina, conservation units were prioritized in major habitats in order to protect the species (Sanderson, 2002). In 1999 the Jaguar Conservation Units (JCU) were defined as areas with a stable prey community, currently know or believed to contain a population of resident jaguars large enough to be potentially self-sustaining or areas containing fewer jaguars but with adequate habitat and stable diverse prey base (Nijhawan, 2012).

JCU should have a strategic location important for connectivity within or between the biomes. In Brazil, 20 conservation units were identified across five biomes. The jaguar conservation units in the Pantanal according to Cavalcanti et al. (2012), have about 63% of the Pantanal biome occupied by jaguars. Specifically in Pantanal, the JCU number 18 (see figure 15 and 49 in section 5.1.2) is located in the project area, near to a research JCU, therefore, this location is very important for the conservation of jaguars.

Following on from that, Figure 17 presents the boundaries of the project zone, as well as the areas with importance in project expansion, and target areas for new instances, such as: jaguar conservation unit, the UNESCO biosphere reserve; and the Pantanal Matogrossense National Park.

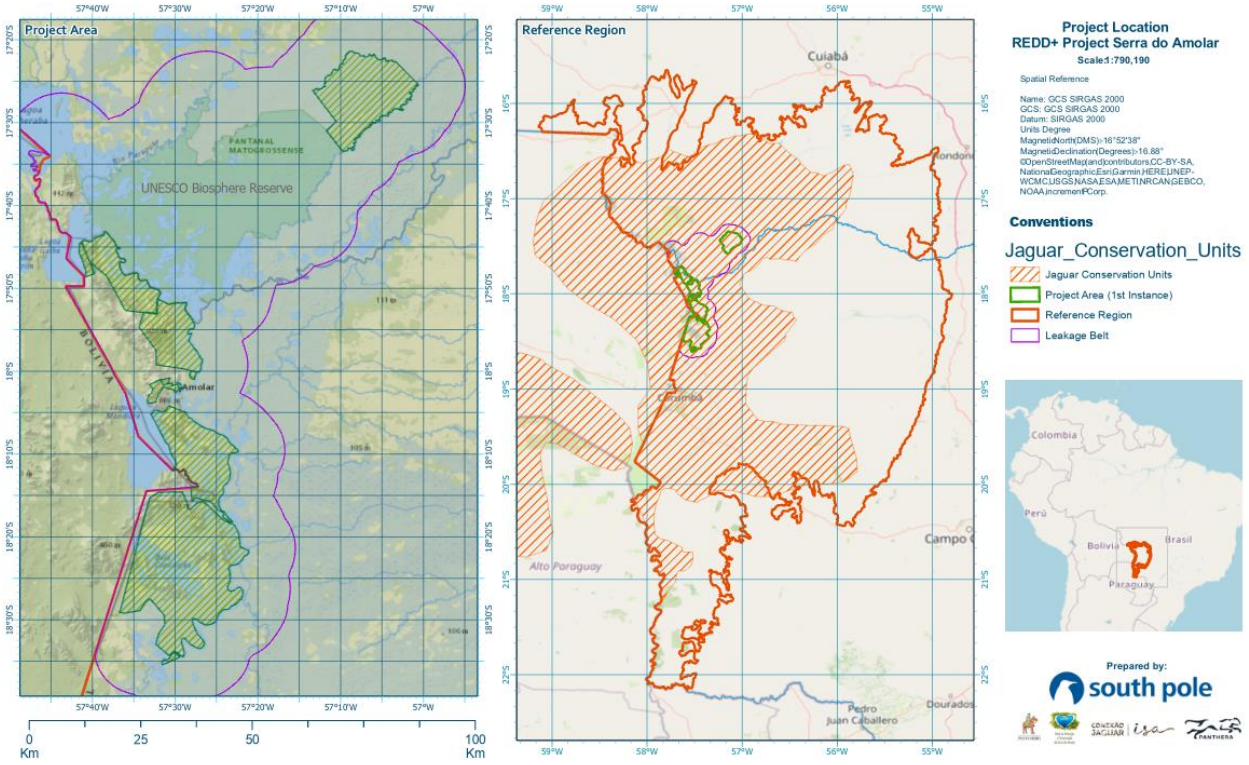


Figure 17. Areas of the project zone

(Source: South Pole,2022)

2.1.7.7 communities or settlements surrounding the project area

The "ribeirinhos" surrounding the project area are another conservation target. The "ribeirinhos" (mestizos, pantaneiros or river dwellers) are the largest contingent in the Serra do Amolar REDD+ project, which has remained virtually invisible and unrecognized in spite of being a living and diversified cultural entity.

During the past decades, many pantaneiros households from rural communities located in the Upper Paraguay River between Cáceres city and Taiama island (Mato Grosso, Brazil) have left behind their subsistence grounds and moved to the nearest towns in what seems to be an anomalous phenomenon of rural-to-urban migration.

The observed migrations have brought land grabs in third parties or land speculators, loss of ecosystem services, and forced displacements due to common pull factors, such as access to urban-based public services and job market.

The Serra do Amolar REDD+ project has mapped seven communities in the Serra do Amoalr region. (Please see Figure 19, and section 4.1.3) Where initiatives in preservation and production activities help them to maintain their land rights and have access to a permanent income from tourism and research visitors.

2.1.8 Stakeholder identification (G1.5)

For stakeholder identification, the project's area of influence was established, including the focus groups that will be directly or indirectly impacted (positively or negatively) by the project. The general objective of this identification was to generate a bridge between organizations, groups and individuals with similar visions and interests. Also, it was required to cover mitigation proposals to familiarize them with the most relevant aspects of the project, inviting them to participate in decision making.

This identification process – basically collecting information – was carried out in two regions by the IHP and its partners in Corumbá and the Pantanal. As a result, the IHP produced two databases with information recognizing settlements and other kinds of stakeholders in the area.

In 2019, before the planned REDD+ project gatherings, a second stage was developed which stressed the importance of communicating the project to community leaders, government and regional environmental entities, project workers and the wider community, who may be impacted by the activities. At this stage, the forest carbon certification process, the Jaguar Connection Program, and the role of organizations such as ISA, Panthera, South Pole and the IHP, were also presented and explained.

The identification of stakeholders took place in five stages according to the characteristics of each actor (see Table 12) and in three focal groups, according to role and geographical distribution, as well as facilities to define a time and location for the consultation (see Figure 18).

Table 12. Types of stakeholders[74]

Level	Type or category
A	i. Local people who are directly or indirectly affected by the carbon project and their representatives or proponents. All stakeholders with land tenure rights within or adjacent to the project area must be contacted, e.g., dwellers of informal settlements/slum dwellers.
	ii. Other affected stakeholders outside the project area, for example, those in line-of-sight REDD+ projects in Brazil.
	iii. Businesses/institutions operating in the area that could be affected by, or who may also be supporting local initiatives.
B	i. Local policymakers and representatives of local authorities.
	ii. Any regional authorities such as parks authorities.
C	National government officials or National Focal Point.

[74] Source: South Pole, 2020: based on Gold Standard.

D	Local non-governmental organizations (NGOs) or international governmental organizations working on topics relevant to REDD+.
E	Any institution/person representative of any carbon standard, Gold Standard (GS, VCS).

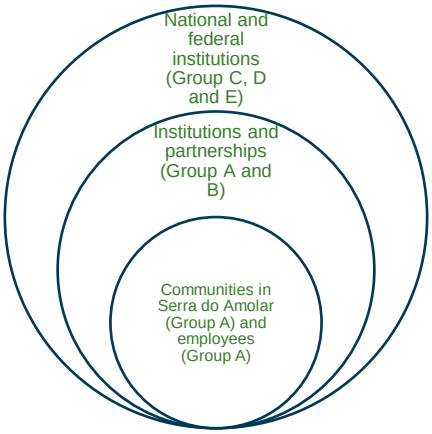


Figure 18. Focal groups for the local stakeholder consultation (LSC)[75]

2.1.9 Stakeholder descriptions (G1.6, G1.13)

An extra explanation accompanied stakeholders' identification as to why they were selected as relevant actors to the project, with details of their location and their invitation mode. To create a complete database, the IHP used the spreadsheet recommended by South Pole (see Annex 1).

Listed below are all the stakeholders, focus groups and other institutions in the reference region and a brief description of their role/relevance to the project activities (Table 13). All these stakeholders were invited to participate in the projects local stakeholder consultation (LSC) in 2019 (section 2.3).

Table 13. Stakeholder description to LSC

Category	Type	Organization (if relevant)	Role/relevance
A	Local communities and IHP employees	*Pantaneiros* or *ribeirinhos*	Local people directly affected (positively or negatively) by the project and their representatives or proponents. All stakeholders with land tenure rights surrounding the project area were contacted.

[75] Source: South Pole, 2020: based on Gold Standard.

Category	Type	Organization (if relevant)	Role/relevance
B	Large or small businesses operating in the area	Associação Corumbaense das Empresas de Turismo (ACERT)	Association that brings together tourism entrepreneurs who are implementing ecotourism in the region.
		Vale SA	Other organizations or companies that may be interested in offsetting carbon credits due to mining activity.
		Caimasul	Small business that may have an interest in offsetting carbon credits due to alligator breeding activities.
	Representatives of local authorities	Fundação de Meio Ambiente de Corumbá	The municipality's representative in the management of natural resources.
		Fundação de Turismo de Corumbá	The municipality's representative in the management of tourism-related strategies.
		Conselho Municipal de Meio Ambiente	The council division which takes decisions on the actions of the Fundação de Meio Ambiente de Corumbá.
		Sindicato Rural	Representative of the rural farmers of Corumbá who play a historical role in society.
C	National government officials or National Focal Points	Embrapa	A Brazilian public agricultural research corporation. It works to ensure sustainable development in the Pantanal biome.
		Universidade Federal da Grande Dourados (UFGD)	A Brazilian university whose researchers have already developed activities in line with carbon credits in the Pantanal biome.
		IMASUL	The representative body of the state managing protected areas.
		IBAMA	The representative body of the federal government inspecting activity in protected areas.

Category	Type	Organization (if relevant)	Role/relevance
		Policia Militar Ambiental	Military government agency responsible for the command and control of activities (supervision) of natural resources in Mato Grosso do Sul (MS) state.
		Exercito	Military government agency responsible for border surveillance, with a military base neighboring the reserve in the Serra do Amolar region.
		Marinha	Military government agency responsible for monitoring federal rivers.
		SESAI	Social government agency responsible for relations concerning the health of the indigenous community, such as the Guató, neighboring Serra do Amolar.
		ICMBio	Environmental government agency responsible for the management of conservation units, such as the Pantanal Matogrossense National Park, which is part of RPCSA.
		IBAMA	Brazilian Institute of the Environment and Renewable Natural Resources (in Portuguese: Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis, (IBAMA)), which supports anti-deforestation of all biomes in Brazil and implements laws against deforestation.
		Câmara Consultiva Temática sobre Salvaguardas (CCT-Salv)	National administrative body that develops inputs to support the decision making of the National REDD+ commission (CONAREDD+) on issues related to the follow up of how the Cancun Safeguards (Decision 1/CP.16) are being addressed and respected in the implementation of REDD+ by Brazil.

Category	Type	Organization (if relevant)	Role/relevance
		Ministry of Science, Technology, Innovations and Communications	Designated national entity for technology development and transfer. They also act as focal points for interaction with climate, innovations and communications.
		Secretaria Executiva da CONAREDD+ Departamento de Florestas Secretaria de Florestas e Desenvolvimento Sustentável	National administrative body created by Decree No. 8.576 of November 26, 2015, responsible for coordinating, monitoring and controlling the implementation of Brazil's National REDD+ strategy.
D	Local non-governmental organizations	MUPAN	Working in the Pantanal and have projects related to the protection of springs and deforestation, with a social bias.
		SOS Pantanal	Working in the Pantanal and have an updated deforestation study on the plain.
		REPAMS	Association of owners of RPPNs, can be a disseminator of results.

(Source: South Pole, 2020)

2.1.9.1 Traditional communities

The socio-economic characterization developed by the IHP in 2016 identified stakeholders that make direct or indirect use of natural resources, or benefit from them. Those stakeholders included traditional communities. Listed below are stakeholders identified who live within the project area and leakage management area (Table 8, Figure 19). They are described as traditional people in Brazil and are all characterized as Riverine people (Riberinhos in portuguese).

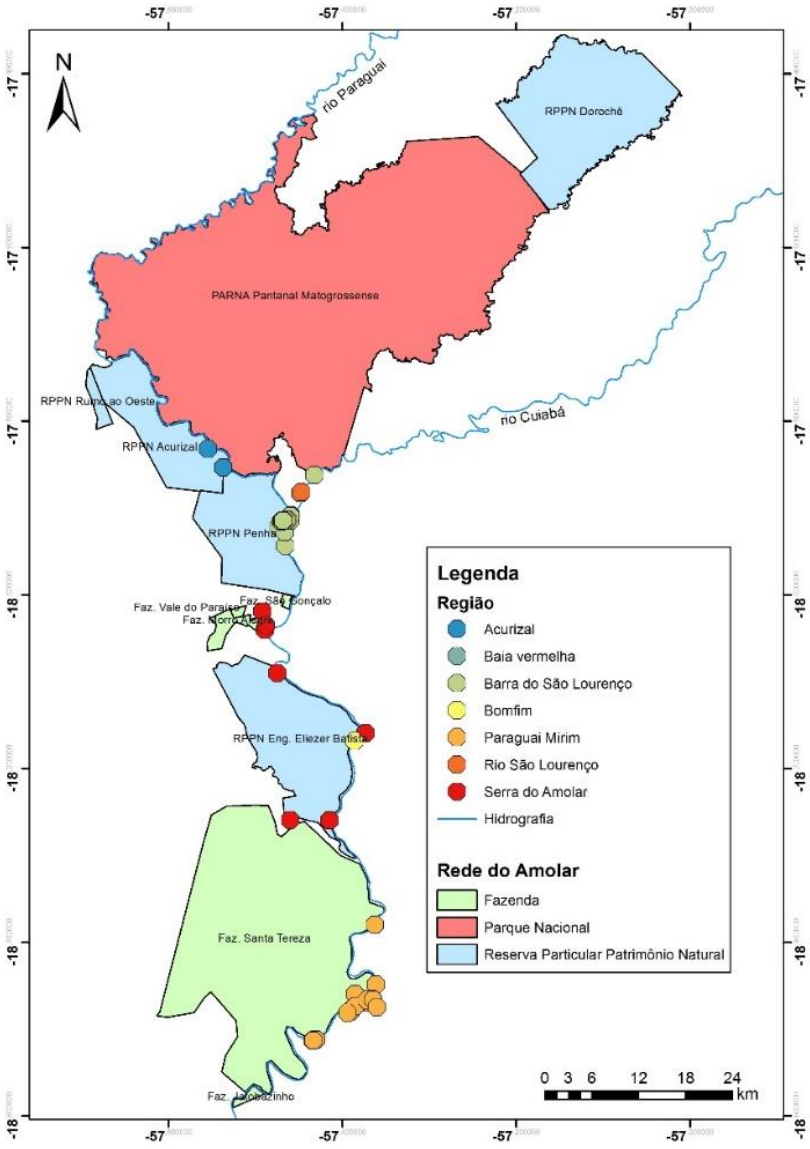


Figure 19. Settlements location within the project area and leakage management area

(Source: Instituto Homem Pantaneiro, 2018)

In terms of distribution of work based on gender, women raise the children, cook the food and take care of the household. They are usually the leader of the family. While men fish, tend cattle, work in traditional agriculture and offer services likes peons or being guides to tourists. Therefore, two distinct community subgroups, with mostly separate participatory roles, were part of the project.

Despite the Riverine population having an above-average human rights situation compared to other regions in Brazil, there is a lack of economic stability to their general income. That is one reason why the project introduced initiatives in preservation and production, offering training and widespread support. As a result, the *ribeirinhos* are a human fence between the external land invaders (deforestation and

degradation activities), in addition to their role in fire monitoring, and preservation activities as well. If local Riverine people maintain their land rights and have access to a permanent income, they are less likely to move away and will continue their presence in the territory.

Table 14 and Figure 20 show the population of all of the settlements, by gender, within the project zone, created made by IHP in 2016.

Table 14. Total population of all settlements in Serra do Amolar regions

Region	Community	Gender		Total
		Female	Male	
Acurizal	Ecotropica/Acurizal		1	**1**
	RPPN- Acurizal		3	**3**
Barra do São Lourenço	Barra do São Lourenço	6	12	**18**
	Canãa		1	**1**
	Ilha do Paraiso		1	**1**
	Porto Bons Amigos		1	**1**
	Porto Celebridade		1	**1**
	Porto Feliz Natal		1	**1**
	Porto Jardim do Eder		1	**1**
	Porto Paraiso		1	**1**
	Porto Reconto Celeste	1		**1**
	Porto São João		1	**1**
	Porto São João – Barra de São Lourenço		1	**1**
	Recanto Paraiso		2	**2**
	Rio São Lourenço	1	1	**2**
Bomfim	Porto São Pedro		1	**1**
Paraguai Mirim	Ilha da Sorte		3	**3**
	Ilha Santa Catarina		1	**1**
	Ilha Verde	1	1	**2**
	Instancia		1	**1**
	Nova Instancia		2	**2**

Region	Community	Gender		Total
		Female	Male	
	Parada Dura		4	**4**
	Paraguai Mirim		3	**3**
	Porto 05 de Março		1	**1**
	Porto 15 de Março		1	**1**
	Porto 5 de Julho		1	**1**
	Porto das Pedreiras		1	**1**
	Porto Manduví		2	**2**
	Porto Oito Irmãos		1	**1**
	Porto Santa Catarina		2	**2**
	Porto São Francisco		1	**1**
Rio São Lourenço	Divisa Corumbá/Poconé		1	**1**
Serra do Amolar	Bomfim	1	2	**3**
	Porto Divino	1		**1**
	São Pedro		2	**2**
	Serra Negra		1	**1**
	RPPN-EEB		1	**1**
Total		**11**	**61**	**72**

(Source: South Pole, 2020)

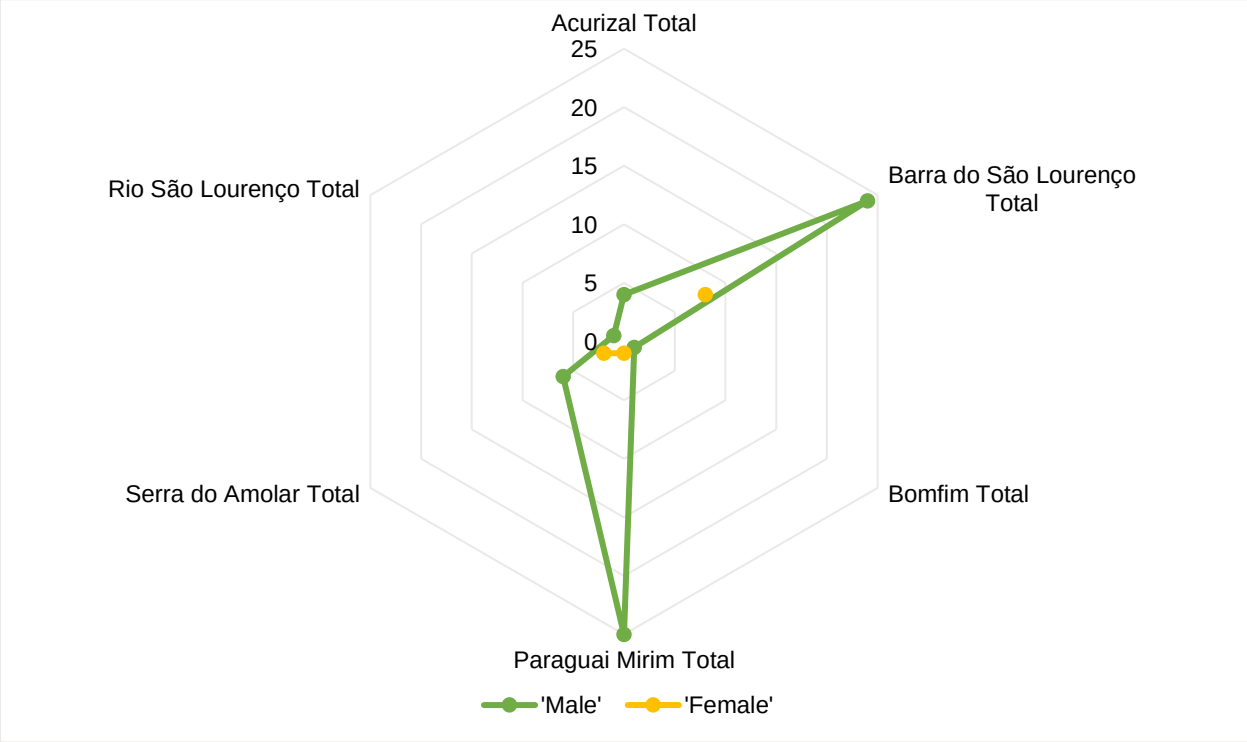


Figure 20. Gender distribution by communities in the project area and leakage management area[76]

2.1.9.2 Employees

Project staff believe it is better to communicate with households with a bright, open-mind, so as to understand local needs and later shape the activities based on the results.

Table 15 shows the project staff inside and outside the project area. The project aims to increase the number of staff to involve more people as *pantaneiros* well-being managers.

Table 15. Project staff

N	Complete name	Role	Municipality	Gender	Term
0	Angelo Rabelo	Institutional relations and CEO	Corumbá	M	O
1	Carlos Adriano	Reserve operational assistant	Corumbá	M	C
2	Angélica Guerra	Project coordinator	Campo Grande	F	H
3	Bárbara Banega	Intern	Corumbá	F	C
4	Bruno Agueda	Firefighter project coordinator	Corumbá	M	H

[76] Instituto Homem Pantaneiro. Diagnóstico social comunidades ribeirinhas, 2016.

N	Complete name	Role	Municipality	Gender	Term
5	Cleyton Alves Varela	Brigadista	Corumbá	M	H
6	Diego Viana	Project coordinator "Biodiversity"	Corumbá	M	H
7	Eliana Magalhães	General services	Corumbá	F	C
8	Elvis Oliveira Alves	Assistant	Corumbá	M	C
9	Isabelle Bueno	Administrative and financial coordinator	Corumbá	F	C
10	Joana Alpaza	Reserve operational assistant	Corumbá	F	C
11	Joelson Soares	General secretary	Corumbá	M	C
12	Josiel de Oliveira Coelho	Assistant	Corumbá	M	C
13	Kelli Monique	Reserve operational assistant	Corumbá	F	C
14	Letícia Larcher	Executive secretary	Corumbá	F	C
15	Luiz Ricardo Rocha	Tourism manager	Corumbá	M	C
16	Manoel Garcia da Silva	Brigadista	Corumbá	M	H
17	Marcia Mendes	General services	Corumbá	F	C
18	Marcos Antonio Gonçalves	Reserve operational assistant	Corumbá	M	C
19	Otavio Henrique Ximenes Fabrão	Reserve operational assistant	Corumbá	M	C
20	Renato Gonçalves de	Brigadista	Corumbá	M	H
21	Sérgio Barreto	Biologist	Corumbá	M	C
22	Thalita Oyos	Accounting analyst	Corumbá	F	C
23	Vanessa Moraes	Area manager	Corumbá	F	H
24	Wagner Tolone	Geoprocessing analyst	Corumbá	M	C
25	Washigton Gonçalves	Brigadista	Corumbá	M	H
26	Welington Fernandes	Administrative assistant	Corumbá	M	C
27	Welvyn Maciel	Intern	Corumbá	M	H
28	Wilson Malheiros	Reserve operational assistant	Corumbá	M	C

M: Male F: Female C: Consultant H: Hired O: Other

(Source: South Pole, 2022)

2.1.10 Sectoral scope and project type

The project comes under scope 14 in the AFOLU category of REDD, 'Avoided Unplanned Deforestation and Degradation' (AUDD). The project is a grouped one that aims to set up a financing framework for activities proposed by the NPCSA to protect and conserve the region's biodiversity. Specifically, the project seeks to promote and improve activities in four strategic areas, such as ecotourism, scientific research, fire prevention, and governance and administration. In addition, the project was designed under the Climate, Community & Biodiversity Standards (Version 3).

2.1.11 Project activities and Theory of Change (G1.8)

The Serra do Amolar REDD+ project is not covered by a jurisdictional REDD+ program. Under the direction of the IHP,[77] the project aims to combine its efforts in relation to the conservation and sustainability of the Pantanal as a biological corridor and source of well-being for its traditional communities. To maximize its means and optimize the financial, technical and logistical resources in partnership with the Ecotrópica Foundation and ICMBio, the REDD+ project has a gradual implementation of activities following a technically-oriented strategic plan, based on the RPCSA lines.

The Serra do Amolar REDD+ project is subdivided into seven strategic lines which include interactions between the IHP, local communities and other institutions in the Pantanal that have worked together to achieve its conservation, constructing community and biodiversity objectives. These strategic lines will provide stakeholders with an income flow to promote poverty reduction in associated communities, especially as governance is strengthened, projects are implemented, and activities are developed for Pantanal monitoring.

A description of each project activity – and the expected outputs, outcomes and impacts of each activity – are presented in Table 16. Regarding the construction of the scopes by project activity, the Theory of Change (ToC) approach was used to explain how these activities will achieve the expected benefits for climate, community and biodiversity (CCB).

With the ToC analysis, it is concluded that project activities in their current situation (activities or initiatives already implemented in the project area), with the help of the multiple institutions involved in the project, will achieve their goals in the short (2016–2025), medium (2026–2035) and long term (2036–2045).

The strategic activities will be revised throughout the crediting period by the executive committee of IHP, as more data becomes available about the necessary resources and the results of the implementation.

The following provides a detailed description of the project's GHG emission reduction activities.

2.1.11.1 Management area

Strengthening area management aims to build technical, administrative and institutional capacities which will promote new agreements and implement the best practices related to the protection of the Pantanal

[77] IHP acts as an administrator for the RPCSA and as a political-institutional articulator with the municipal, state and federal powers, according to the terms of the IHP agreement signed with the other areas of the Network (Available on: Annex/Agreements).

ecosystem. Strengthening at both institutional and community levels promotes the harmonization of environmental management, which aims to reduce deforestation by reducing the risk of fires and improving the relationship between conservation and production, as well as humans and jaguars.

This strategic line aims to contribute to the objectives of the project through events, projects and training workshops, with stakeholders and communities being involved in the reference region. The IHP's creation of strategic alliances with entities interested in the conservation of natural resources will help reduce the project's financial barriers and be the main parameter or indicator.

The expected impacts in terms of CCB are:

- Climate: reduce Pantanal threats and prevent conversion to grassland through actions that increase the capacity to manage programs, projects or plans focused on human-jaguar cohabitation.
- Community: improve the well-being of the communities associated with the project through managing the ecosystem and its associated services, such as tourism, fishing and scenic beauty.
- Biodiversity: encourage harmonious integration between conservation and human development.

2.1.11.2 Environmental monitoring

The objective of the monitoring line is to generate a balance between control and inspection activities, with a continuous diagnosis of the current state of the ecosystem. Tools for monitoring all project activities and their accountability will be included, providing useful knowledge to implement actions in the medium and long term. Monitoring and reporting also generate community capacity.

The expected impacts in terms of CCB are:

- Climate: diagnose the current state of the ecosystem and generate actions that allow an orderly and planned management.
- Community: create capacities in the communities with respect to community monitoring.
- Biodiversity: monitor and report the presence or absence of fauna and flora species that are considered to be of high conservation value in the ecosystem.

2.1.11.3 Environmental control and inspection

This line aims to build technical, administrative and institutional capacities to promote the strengthening of interest groups, including the formulation and adoption of management measures. This strategic line is expected to contribute to the objectives of the project by creating patrol groups and uniting partners that have similar priorities and interests. This can help improve networking with field staff and neighboring traditional communities; raise awareness of the REDD+ project and REDD+ activities; and strengthen community forest-tenure rights through management agreements, mapping and boundary demarcation.

The expected impacts in terms of CCB are:

- Climate: reduce Pantanal threats and prevent conversion to grassland through actions that increase the capacity to manage programs, projects or plans focused on human-jaguar cohabitation.

- Community: strengthen the community through management agreements, mapping and boundary demarcation.
- Biodiversity: strengthen monitoring and reporting through volunteer patrols and forest watchers.

2.1.11.4 Communication

The creation of effective communication and dissemination channels within communities and other interested parties will also be sought, as well as the availability of, and access to, information about REDD+ concepts and components that will be vital to communities, employees and marginalized groups.

This strategic line is expected to contribute to the objectives of the project through regularly raising awareness and creating outreach activities with stakeholders which relate to gender and community inclusion. This can help create a safe environment for them and enable them to create a collective and unified voice, as well as develop the confidence and skills to strategically outline projects and access influential decision-making processes.

The expected impacts in terms of CCB are:

- Climate: accumulate management knowledge about the importance of the ecosystem and avoid many land-use changes.
- Community: improve the communities' training associated with the project through access to information about REDD+ concepts and REDD+ activities.
- Biodiversity: improve fishing schemes, community patrolling and the monitoring of species of high conservation value.

2.1.11.5 Fire prevention

This line aims to reduce the number of threats to fauna and flora in the Pantanal by natural or anthropogenic fires, as a measure of adaptation to climate change. Fire prevention activities will focus on the exchange of experiences and an increase in knowledge focused on integrated fire management (IFM) at both the community and technical level.

This strategic line is expected to contribute to the objectives of the project through community capacities regarding fire management, fire prevention, post-fire restoration and fire suppression. This should be achieved by strengthening the management of any burning that takes place when any cleaning and renewing of pasture is required. Alongside this, future conflicts related to firefighter plans will be identified.

The expected impacts in terms of CCB are:

- Climate: maintain functional ecology of the Pantanal, both in its floristic composition and structure, as well as its water flows, alongside introducing measures for adapting to climate change at the ecosystem level.
- Community: create spaces for the exchange of experiences, including training and environmental education associated with fire prevention practices.
- Biodiversity: engage firefighters in the Pantanal at the local level, protecting the habitat of vulnerable flora and fauna species.

2.1.11.6 Environmental education and capacity building

The development of an environmental education and capacity building line will help gain a better understanding of the conditions required for the communities associated with the project, promote the preservation of the ecosystem and strengthen collective work.

This strategic line is expected to contribute to the objectives of the project through climate change training, offering sustainable productive activities, ecotourism practices and the establishment and management of the ecosystem. The project will seek to support capacity building in training prior to the implementation of the activities and through research to promote future innovative solutions that are imperative to the social challenges.

The expected impacts in terms of CCB are:

- Climate: develop collective actions among women, employees and researchers, to increase the effective management of the ecosystem and increase its value in terms of social capital (social interactions).
- Community: where possible involve research centers and small businesses who can build multisectoral and multistakeholder solutions related to the environment, and seek gender equality, improve employee conditions, and avoid any form of discrimination when developing new relationships and meanings.
- Biodiversity: prioritize or streamline access to public and private research activities and assessments that document and analyze new knowledge or data, whilst avoiding incorporating unsustainable activities.

2.1.11.7 Strategic actions

The objective of strategic actions are to generate a balance between the priorities of stakeholders and potential public or private funding when developing projects in the region. By implementing other actions that are not included in the strategic lines presented above, there will hopefully be opportunities to include ecotourism actions that will directly relate to conservation and the community.

In the medium and long term, such actions will hopefully help to solve problems and offer new solutions for conservation and communities. This strategic line is expected to integrate all of the objective lines of this project through meetings, new projects and new financial sources, with the main parameter or indicator being strategic alliances with entities.

The expected impacts in terms of CCB are:

- Climate: new projects and alliances which aim to reduce deforestation and reduce institutional barriers related to the installed capacity.
- Community: where possible, involve research centers and small businesses in building multisectoral and multistakeholder solutions, seek gender equality and create local employment through the implementation of project activities.
- Biodiversity: promote the protection and conservation of strategic ecosystems and their services by diversifying the sources of income in the territory.

Table 16. Activities and Theory of Change in the short-, medium- and long-term scopes of the strategic lines of the project

Strategic lines	Output	Climate, community and biodiversity			Relevance to project objectives
		Short-term outcomes	Medium-term results	Long-term impacts	
 **Area management**	Manage economic resources which are self-sufficient during the implementation of project activities. Provide and participate in events, projects and training workshops with multisector and multiple stakeholders who act inside the reference region and its surrounding area. Promote ecotourism (sustainable and differential tourism) in the project area.	Increase the number of resources for the implementation of activities. Create and generate strategic alliances with entities interested in the conservation of the Pantanal. Identify conflicts and overlaps of land-use rights within the project area and collect baseline social information. Develop general guidelines for managing and conserving the Serra do Amolar area.	Strengthen area management. Build technical, administrative and institutional capacities to promote new agreements and implement best practices related to the protection of the Pantanal ecosystem. Design strategies for resolving conflicts over land tenure and land tenure speculation in the Serra do Amolar area.	Generate actions that help resolve socio-environmental conflicts and promote the protection and production of the ecosystem. Self-management and sustainability for the implementation of project activities.	• Climate: reduce Pantanal threats and prevent conversion to grassland through actions that increase the capacity to manage programs, projects or plans focused on human-jaguar cohabitation. • Community: improve the well-being of the communities associated with the project, by managing the ecosystem and its associated services, such as tourism, fishing and scenic beauty. • Community: increase the number of people or communities participating in the implementation of activities and decrease the number of social barriers related to poverty. • Biodiversity: encourage harmonious integration

Strategic lines	Output	Climate, community and biodiversity			Relevance to project objectives
		Short-term outcomes	Medium-term results	Long-term impacts	
					between conservation and human development.
 **Environmental monitoring**	Generate a balance between control and inspection activities, with a continuous diagnosis of the current state of the ecosystem, which will help with decisions.	Develop tools and plans for monitoring the area and project activities, as well as their accountability.	Adapt new tools, new technologies, and the background knowledge used to implement proper mitigation actions in the medium and long term.	Increase capacity for local territorial control, governance and natural resource management.	• Climate: diagnose the current state of the ecosystem and generate actions that allow orderly and planned management. • Community: create capacities in the communities with respect to community monitoring. • Community: increase the number of people or communities participating in the implementation of activities and reduce the number of social barriers related to skilled labor. • Biodiversity: diagnose and monitor vulnerable species and high conservation values.
	This line aims to build technical, administrative and institutional capacities to help	Support and strengthen monitoring and report through volunteer patrols,	Raise awareness of the REDD+ project and REDD+ activities; and strengthen	Create patrol groups and unite partners with similar priorities and interests.	• Climate: reduce Pantanal threats and prevent conversion to grassland through actions that increase the capacity to manage

Strategic lines	Output	Climate, community and biodiversity			Relevance to project objectives
		Short-term outcomes	Medium-term results	Long-term impacts	
Environmental control and inspection	promote the strengthening of interest groups, including the formulation and adoption of management measures.	policemen and forest watchers.	community forest-tenure rights through management agreements, mapping and boundary demarcation.		programs, projects or plans focused on human-jaguar cohabitation. • Community: strengthen the community through management agreements, mapping and Rural Environmental Registry (CAR in Portuguese) boundary demarcation for private properties. • Biodiversity: strengthen monitoring and reporting through volunteer patrols and forest watchers.
 **Communication**	Create communication and information dissemination channels between project implementers and communities in highly influential project areas.	Design and implement strategies to disseminate information about the project and sensitize the community on the importance of the Pantanal.	Effective and voluntary community participation in the implementation and monitoring of project activities. Communities have transparent, accessible and timely information related to the project	Increase transparency and access to information for all stakeholders. Increase capacity for integration of all sectors under a common conservation objective.	• Climate: increase knowledge about the importance of the ecosystem and avoid unexpected land-use changes. • Community: improve communities well-being associated with the project through access to information and knowledge on REDD+ concepts and REDD+ activities.

Strategic lines	Output	Climate, community and biodiversity			Relevance to project objectives
		Short-term outcomes	Medium-term results	Long-term impacts	
			in the platforms or media.		• Biodiversity: improve fishing schemes, community patrolling and the monitoring of species with a high conservation value.
 **Fire prevention**	Reduce threats to fauna and flora in the Pantanal from natural or anthropogenic fires, as part of measures for adapting to climate change.	Implement actions, training and workshops to combat wildfires and reduce human-induced fires.	Create spaces for the exchange of experiences, including training and environmental education associated with fire prevention practices.	Generate community capacities regarding fire, strengthen the management of any burning that takes place when cleaning and renew any pasture when required. Also, identify any future conflicts related to firefighter plans.	• Climate: maintain the ecological dynamics of the Pantanal, both in its floristic composition and structure, as well as its water flows. Introduce measures for adapting to climate change at the local level. • Community: create spaces for the exchange of experiences, which includes training and environmental education associated with fire prevention practices. • Biodiversity: engage firefighters in the Pantanal at the local level. Protect the habitat of vulnerable flora and fauna species.

Strategic lines	Output	Climate, community and biodiversity			Relevance to project objectives
		Short-term outcomes	Medium-term results	Long-term impacts	
 **Environmental education and capacity building**	Build an environmental education and awareness strategy to improve technical, legal and regulatory capacities about REDD+ and the Upper Paraguay Basin (BAP), which includes multiple sectors and multiple stakeholders.	Conduct training and workshops to improve the skills and knowledge of communities involved in ecotourism activities. Develop theoretical-practical workshops and implement awareness-raising campaigns about REDD+. Diagnose the current state of the ecosystem and formulate actions that allow the construction and planning of action. Monitor and report the presence or absence of fauna and flora species that add conservation value	Design and implement an education program and pilot training spaces with the community. Conduct participatory monitoring. Build capacity in traditional communities for community monitoring, including training and environmental education.	Increase communities' perception of natural resource conservation and strengthen communities' skills in natural resource management and monitoring. Support capacity building in training prior to the implementation of activities, and research to promote future innovative solutions that are imperative to solving the social challenges.	• Climate: form a collective perspective (e.g., women, employees, researchers) analysis of the benefits, potential ecosystem goods and services that can increase the value of the natural capital. • Community: where possible, improve employee conditions, avoid any form of discrimination, and develop technical capacities that will help manage the project and the areas related to the ecosystem. • Biodiversity: prioritize or streamline land access to public and private research activities and assessments that document and analyze new knowledge or data, and avoid unsustainable activities. Form a habitat of species that have a high conservation value.

Strategic lines	Output	Climate, community and biodiversity			Relevance to project objectives
		Short-term outcomes	Medium-term results	Long-term impacts	
		to the Pantanal ecosystem.			
 **Strategic actions**	Generate a balance between the priorities of stakeholders and potential public or private funding to develop activities that will help manage the Serra do Amolar region.	Closely follow the design process, the implementation and strengthening of laws, decrees and agreements established with public and private national institutions.	Integrate all scope lines involved in the REDD+ project through meetings, new projects, and new financial sources.	Create actions that will help resolve socio-environmental conflicts and promote the protection and production of the ecosystem. Self-management and sustainability are essential for the implementation of project activities.	• Climate: reduce the number of risks and provide tools to improve actions. • Climate: new projects and alliances which aim to reduce deforestation and reduce institutional barriers related to installed capacity. • Community: where possible, involve research centers and small businesses in helping to build multisectoral and multistakeholder solutions, seek gender equality and create local employment through the implementation of project activities. • Community: reduce the number of social barriers related to poverty (improve livelihood or income and reduce economic inequality) and reduce the number of barriers related to economic

Strategic lines	Output	Climate, community and biodiversity			Relevance to project objectives
		Short-term outcomes	Medium-term results	Long-term impacts	
					dependence on logging activities. • Biodiversity: promote the protection and conservation of strategic ecosystems and their services by diversifying the sources of income in the territory.

(Source: South Pole, 2020)

2.1.12 Sustainable development

Sustainable Development Goals (SDGs) are central to the 2030 Agenda in Brazil; their implementation will take place in the period 2016–2030, and poverty may be the main mandate for all internal or external initiatives, programs, projects and activities, including REDD+ projects.

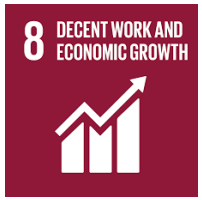
In September 2015, the conclusion of negotiations in relation to the 2030 Agenda culminated in an ambitious outcome for Brazil which was the proposal for 17 SDGs and 231 associated targets. The SDGs are the core of the 2030 Agenda and their implementation will take place within the 2016–2030 period. Brazil has highlighted this as a huge opportunity for eradicating poverty, that may be within the mandate of this new Agenda.

In 2017, the first "Voluntary National Reviews" by the Brazilian government, focusing on institutional structures, were put into operation to incorporate SDGs into public policies. In terms of conservation and sustainable use of natural resources, environmental sustainability is not only based on the reduction of damage to the environment, but also on efficient management of ecosystem services, which favors human development by increasing economic opportunities as well as social and ecological resilience.

The management of ecosystem goods and services is represented in SDGs associated with water, climate, biodiversity and the oceans. These generate a series of interactions that address other major global goals, such as the eradication of hunger, poverty reduction and the quality of health services, among others.

After taking into consideration the national sustainable development targets and indicators, the Serra do Amolar REDD+ project has aligned its activities in such a way that, at the local level, progress is being made towards meeting the targets for each of the following SDGs of the 2030 Agenda: decent work and economic growth, sustainable cities and communities, responsible production and consumption, climate action, underwater life and life in terrestrial ecosystems. These SDGs and indicators, that the project seeks to target with its activities, are presented in Table 17.

Table 17. Objectives and indicators of sustainable development considered by the project[78]

SDG	SDG indicator	Indicator type	Unit	Value/adjusted unit (if applicable)
	5.1 End all forms of discrimination against women and girls everywhere. 5.5 Ensure women's full and effective participation, with equal opportunities for leadership at all levels of decision-making in political, economic and public life.	Growth and development	%	Increase proportion of women in managerial and operative positions to 50%.
	8.4 Improve global resource efficiency in consumption and production, and endeavor to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programs on sustainable consumption and production, with developed countries taking the lead. 8.5 By 2030, achieve full and productive employment and decent work for all women and men, including young people and people who have disabilities, and equal pay for work of equal value. 8.9 By 2030, implement policies that promote sustainable tourism which creates jobs and promotes local culture and products.	Economic	Number of people. Proportion of jobs in tourism activities.	Increase employment rate by sex, age and people with disabilities. Increase the number of jobs in the sustainable tourism sector to 20%.

[78] Other indicators that the project contribute to the stated national level, but not monitored, are available at: in SDG Tool: https://sdgtool.com/scripts/present_project.php?proj=77b13d9a.

SDG	SDG indicator	Indicator type	Unit	Value/adjusted unit (if applicable)
	11.4 Strengthen efforts to protect and safeguard the world's cultural and natural heritage.	Economic	BRL	Increase total expenditure on the preservation, protection and conservation of all cultural and natural heritage by 150,000 BRL each year (using public and private funds).
	12.2 By 2030, achieve sustainable management and the efficient use of natural resources. 12.8 By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and that their lifestyles are in harmony with nature. 12.b Develop and implement tools to monitor sustainable development impacts for sustainable tourism, which creates jobs and promotes local culture and products.	Social	Number of activities	Number of sustainable tourism strategies or policies and the number of implemented action plans with agreed monitoring and evaluation tools.
	13.2 Integrate climate change measures into national policies, strategies and planning. 13.3 Improve education, awareness raising, and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.	Environment	Tons of carbon dioxide	Reduce the number of tons of carbon dioxide: target is 30,000 tCO_2e per year.

SDG	SDG indicator	Indicator type	Unit	Value/adjusted unit (if applicable)
	15.1 By 2020, ensure that the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, are in accordance with the obligations stipulated in international agreements. 15.2 By 2020, promote the implementation of the sustainable management of all types of forests, halt deforestation, restore degraded forests and increase afforestation and reforestation globally. 15.5 Take urgent action to reduce the degradation of natural habitats, prevent the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species. 15.a Mobilize and increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems.	Environment	Percentage of area of forest under sustainable management. Number of red list species benefited.	Forest area as a proportion of the total Amolar network area: expected to be 140,506 ha. IUCN Red List index of species. Number of biological and botanical activities implemented.

(Source: South Pole, 2020)

2.1.13 Implementation schedule (G1.9)

The goals for activities and the relevance of these goals to achieve the project's objectives concerning CCB were established, and the implementation schedule per activity in the project's crediting period was agreed.

Table 18 presents key dates and milestones during the project development and implementation, such as introductory meeting dates, start and end dates of each project activity, start and end dates of the GHG accounting period, monitoring program, verification program, etc.

Table 18. Implementation schedule

Milestone	Date	Strategic lines	Milestone(s) in the project's development and implementation	Support Information[79]
1	2016	Area management	Construction of the ecotourism plan in areas under the management and administration of the IHP, in which research, learning and adventure are allowed.	Community/Ecotourism/
2	2016–2020	Environmental monitoring	Developing and release of a spatial (Geoservice) platform as a management tool for the IHP and other stakeholders.	Activities/Monitoring/
3	2016	Socio-educational	Strengthening of two schools (Jatobazinho and Barra do São Lourenço).	Activities/Annual Reports/
4	2016	Socio-educational	Conducting trainings and workshops to improve the skills and knowledge of communities through 'Strategies for the Conservation of Nature Course (Edition XIII)'.	Activities/Annual Reports/
5	2016–2017	Environmental monitoring	Monitoring maps of degradation and baseline fire time series of the Upper Paraguay Basin (BAP). Social mapping of traditional communities (*ribeirinhos*). Mapping of ecological and	Activities/Annual Reports/

[79] Support information from 2016-2020 period is available on: Monitoring Report/Support Information CCB/; Summary is available on: Main Activities and Schedule.xlsx

Milestone	Date	Strategic lines	Milestone(s) in the project's development and implementation	Support Information[79]
			economic zoning of the project area.	
6	2016–end of crediting period	Environmental monitoring	Mapping and maintenance of roads and land routes.	Activities/Annual Reports/
7	Once every two years from 2016 onwards	Communication	Maintenance of the cable network and internet in the project area. Also including new strategies to improve the cover in Serra do Amolar region.	Activities/Annual Reports/
8	2016–end of crediting period	Communication	Implementation and adaptive management of communication and information dissemination channels with home visits and informative activities in which diverse material on the Pantanal and the IHP's actions was provided.	Activities/Annual Reports/
9	2016–end of crediting period	Strategic actions	Development of multi-sector and multi-stakeholder events, workshops and meetings between the IHP and other NGOs and companies that aim to find solutions for the conservation and development needs in Corumbá.	Activities/Annual Reports/
10	2016–end of crediting period	Strategic actions	Creation of agreements and signature for the execution of projects in the IHP's areas.	Activities/StrategicActions/
11	2016–end of crediting period	Socio-educational	Support and collaborate with researchers and investigators in carrying out their research and participation in symposiums, congresses and other scientific dissemination activities, in aspects related to the social and	Activities/Annual Reports/

Milestone	Date	Strategic lines	Milestone(s) in the project's development and implementation	Support Information[79]
			ecosystem characteristics of the Pantanal.	
12	2016–end of crediting period	Environmental monitoring	Carry out aquatic and terrestrial trips for environmental monitoring and control and surveillance activities.	Activities/Annual Reports/
13	At least once before every verification	Environmental monitoring	Updating, monitoring and mapping fauna parameters.	Activities/StrategicActions/
14	2015–2018*	Environmental monitoring	Mapping and collecting water points for the identification of water quality (physical and chemical). Measuring the water pulse of rivers.	Activities/Annual Reports/
15	At least once before every verification	Fire prevention	Fire monitoring via satellite.	Activities/Fire Prevention
16	2015–2018	Fire prevention	Meetings with PREVFOGO and the forest firefighting committee.	Activities/Fire Prevention
17	2015–2018	Fire prevention	Design, implement and strengthen firefighting actions in the project area.	Activities/Fire Prevention
18	2015–2018	Area management	Identification of the type and number of boats on the waterways.	Activities/Annual Reports/
19	2016–2018*	Strategic actions	Partnership agreement with a commercial agency for tourism and the preparation of advertising material.	Activities/Annual Reports/

Milestone	Date	Strategic lines	Milestone(s) in the project's development and implementation	Support Information[79]
20	2017	Strategic actions	Participation in market fairs for ecotourism projects.	Activities/Annual Reports/
21	One year prior to every verification	Area management	Monitoring of deforestation and quantification of emission reductions.	Climate/Estimations
22	At least one time prior to every verification	Area management	Monitoring of community impact and biodiversity indicators.	Activities/
23	At least every five years from 2020 onwards	Area management	Verifications	-

(Source: South Pole, 2020)

2.1.14 Project start date

The project began on July 1, 2016. This is when the first effort was made to implement ecotourism and scientific research as the main objectives to access carbon credits, reduce deforestation and increase incomes hand in hand with *ribeirinhas* populations and public and private institutions.[80]

2.1.15 Benefits assessment and crediting period (G1.9)

The crediting period is from July 1, 2016 to Junio 30, 2046, and expects to take a duration of 30 years.

2.1.16 Differences in assessment/project crediting periods (G1.9)

There is no difference between the GHG emission accounting period and the community and biodiversity benefits assessment periods.

[80] In July 2016, IHP hired an ecotourism consultancy for the planning and survey of potential areas, analysis of the structure and financial viability for Serra do Amolar, description of the attractions, the definition of short-, medium- and long-term actions.
Also made some improvements to facilities for the tourism component: kitchen equipment, customer service at meals, mattresses, pillows, bed and bath linens, air conditioning for all rooms, decorative items, pool chairs, umbrellas, and tour support and safety equipment.
Evidence information is available on: Supporting Information/Starting Date

2.1.17 Estimated GHG emission reductions or removals

The crediting period during which GHG emission reductions (ERs) for the Serra do Amolar REDD+ project will be generated is 30 years, with a minimum of three baseline revalidations, occurring every 10 years according to VCS Standard v4.2 requirements. However, considering that the deforestation model was performed for 15 years, five additional years to the first term of the baseline (i.e., to the first 10 years of its crediting period) are presented in the ex-ante calculations in this document.

The project is not presenting emission reductions for the last 20 years due to high uncertainty in the estimations and spatially explicit models, but it is concluded that the project's activities will rely on a long duration.

Following the total emission reduction for the 30-year crediting period is presented using the first 15-year average in Table 19 below.

Table 19. Estimated GHG reductions ERs for the Serra do Amolar REDD+

Year	Estimated GHG ERs (tCO_2e)
2016	33,926
2017	63,180
2018	64,378
2019	55,117
2020	115,109
2021	97,673
2022	50,724
2023	58,984
2024	179,983
2025	120,890
2026	116,442
2027	77,188
2028	136,344
2029	108,943
2030	140,001
Total estimated ERs (30-year crediting period)	**2,848,249**
Total number of crediting years	**30**
Average annual ERs	**94,592**

(Source: South Pole, 2022)

2.1.18 Risks to the project (G1.10)

The project risk analysis was carried out using the guidelines of the 'Non-Permanence Risk Tool', version 3.3. The risk ratings were based on an assessment of the risk factors that are added together to determine the total risk rating.

The risk factors were classified into three categories: internal risks, external risks and natural risks, and later into subcategories such as project management, financial viability and community engagement. The project was evaluated considering each of the risk factors suggested by the tool. A description was made of the applicability of the risk factor and a score was assigned to each factor by category and subcategory.

Where applicable, risk factor mitigation activities or plans were presented to lower the assigned risk score. These activities or plans were presented considering the strategic lines and activities of the project (see section 2.1.11). Detailed information on the risk analysis can be found in the 'VCS AFOLU Non-Permanence Risk Tool Version 4.0' and 'Non-Permanence Risk Analysis'.[81]

Summarizing all expected risks to occur to the climate, community, and biodiversity benefits during the project lifetime have corresponding measures taken to mitigate the risk, as presented in Table 20. Those items will be revised along the project lifetime, at each monitoring period, in accordance with renewed assessments of each factor.

Table 20. Main project risk factors and actions to mitigate them

Strategic lines	Identified risk	Potential impact of risk on climate, community and/or biodiversity benefits	Actions needed and designed to mitigate the risk
Area management	Increase disputes over access/use rights (or overlapping rights)	Illegal activities can impact management and thus impact biodiversity and the community.	Maintain environmental control and inspection activities. Strengthen articulation measures so that activities can take place with all stakeholders.
Environmental monitoring	Increase of illegal activities inside the	Illegal activities can impact management and thus	Maintained articulation measures to develop all activities with all

[81] Available in Annex 2 – AFOLU_NonPermanence_Risk_Tool.

Strategic lines	Identified risk	Potential impact of risk on climate, community and/or biodiversity benefits	Actions needed and designed to mitigate the risk
	project area and its surroundings	impact biodiversity and the community.	stakeholders, ensuring the permanence of activities and perpetuity for conservation agreements.
Environmental control and inspection	Changes in policies and laws governing external actors.	Political scenarios can change the rules, even of environmental policies or other sectors.	Maintain environmental control and inspection activities. Strengthen articulation measures so that activities can take place with all stakeholders to ensure the permanence of activities and perpetuity for conservation agreements.
Communication	Access or connectivity open disputes related to communication system extension, social and cultural changes; claims for prioritization areas.	Describing, explaining, informing; in the absence of this strategic line, the effect is negative for conservation in general and creates disputes over control of the media.	Develop a community integration plan to improve hiring conditions, working conditions and remuneration.
Fire prevention	Increase of non-prescribed fires vs. low capacities to prevention, control, and the monitoring of them.	Species are affected by habitat burning, in terms of biodiversity; birds and mammals are burned as well.	Develop a firefighting plan as a fire prevention mitigation measure to avoid both community and biodiversity impacts.
Environmental education and capacity building	Disputes with other priorities of the project – educational actions will not be considered.	Disintegration and social disarticulation around the marshland ecosystem	Develop a community integration plan to improve hiring conditions, working conditions and remuneration.

Strategic lines	Identified risk	Potential impact of risk on climate, community and/or biodiversity benefits	Actions needed and designed to mitigate the risk
Strategic actions	Disputes with other economic- financial priorities of the project – legal actions will not be considered.		

(Source: South Pole, 2020)

2.1.19 Benefit permanence (G1.11)

The project activities described in section 2.1.1 aim to shift the cost/opportunity of the land use, from livestock and extensive agriculture to activities which do not have such a negative impact on the land, allow the protection of the natural environment and connectivity between forest cover and wildlife.

With respect to the financial and opportunity cost risks, the project hopes to ensure the permanence of the activities through the "Management of economic resources for the implementation of project activities" under the strategic line of area management (see section 2.1.11); in addition to the commercialization of carbon credits derived from the reduction of emissions generated by it and the continuity of donations by other institutions.

The project will also ensure the permanence of the activities and their associated benefits by mitigating possible conflicts over land tenure, training and through the implementation of seven strategic lines.

Throughout the crediting period, the project will maintain an active processes of socialization, consultation and adaptive management with stakeholders. The aim is to disseminate project information, especially any decisions made by steering and technical committees, through agreed communication channels. In addition, there will be strategies for the resolution of petitions, complaints, claims, suggestions and denunciations.

Finally, to mitigate risks focused on the cluster approach, the executive committee will ensure that proposed project activities for the new areas (i.e., new instances; see section 2.1.21) will be led by entities directly involved in the management and administration of areas in their jurisdiction (see section 2.1.4).

2.1.20 Financial sustainability (G1.12)

The financial viability of the Serra do Amolar REDD+ project is based on the number of years until cash flow breakeven is reached, the funding that is needed to implement and operate the project until reaching the cash flow breakeven, and the IHP’s capacity for managing financial and technical resources.

Three financial mechanisms are in place to ensure the project's long-term objectives become sustainable over time:

- First, the extensive experience of the IHP as a developer, its operational and management capacity to manage financial resources which are contributed by both private and public institutions and donors, such as the State or Brazilian national institutions, which are part of the project leverage.
- Second, the legal statutes and liabilities remark that all funds raised by the IHP must be invested in project implementation activities, including community capacity building on technical issues, monitoring and technical follow up.
- Finally, the financial analysis forecasts that project revenues from GHG emission reductions and other resources will provide a flow of funds for the project's growth (addition of new instances) and increase climate, community and biodiversity benefits (see Figure 21 and section 3.1.5).

Thus, the project will allow activities to be subsequently transferred to new landowners or stakeholders involved around the project area. In addition, the climate, community and biodiversity benefits can be achieved without depending on additional funds that might be obtained in the future.

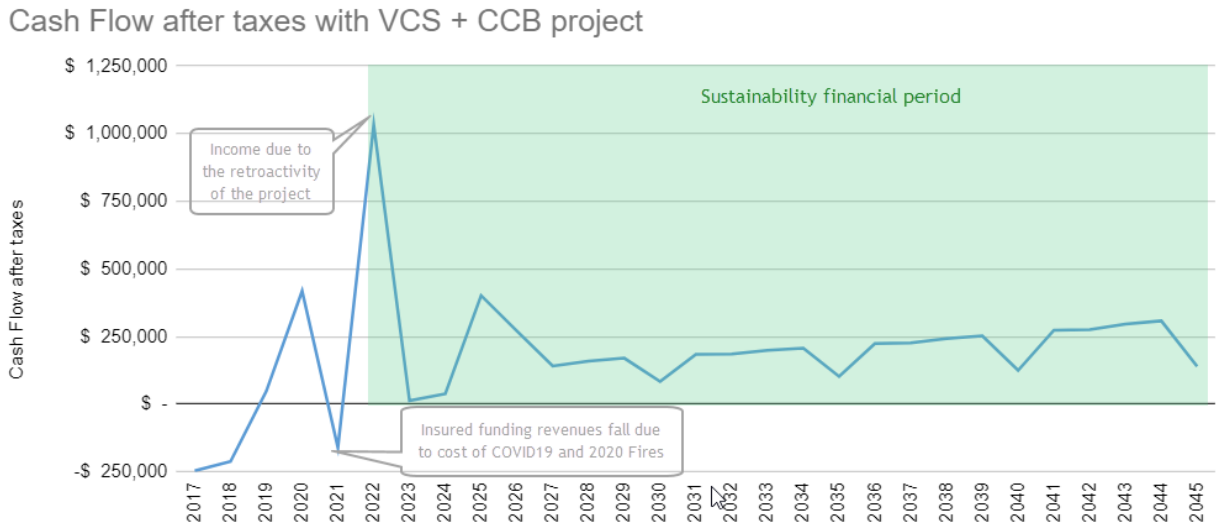


Figure 21. Financial project sustainability since 2022 calculated with VCS + CCB Project

(Source: South Pole, 2022)

2.1.21 Grouped projects

2.1.22 Eligibility criteria for grouped projects (G1.14)

The project will include further project activity areas after their initial validation; the definition target of new instances will restore connectivity including new protected area management and RPPNs to maintain hydric pulse, reduce human pressures and increase the efficiency of site-level responses to new opportunities and threats.

New areas, called ‘new instances’, must adopt and apply the project activities, technologies and/or measures in the same manner as specified in the project description documentation. The Serra do

Amolar REDD+ project set more than one eligibility criteria for the inclusion of new areas. The criteria for new instances to be eligible are as follows:

1.1.1.1 Expansion area

The areas which will scale up the project activities are grouped into two categories: (1) areas inside of the RPCSA (Amolar Network), and (2) RPPNs surrounding the project area and inside the reference region. 'There are also public areas such as Parque Natural Matogroensse and private areas such as RPPN Neivo Pires II and RPPN Fazenda Cabeceira do Prata. Figure 20 and Table 21 show the spatial distribution and size of potential new instances.

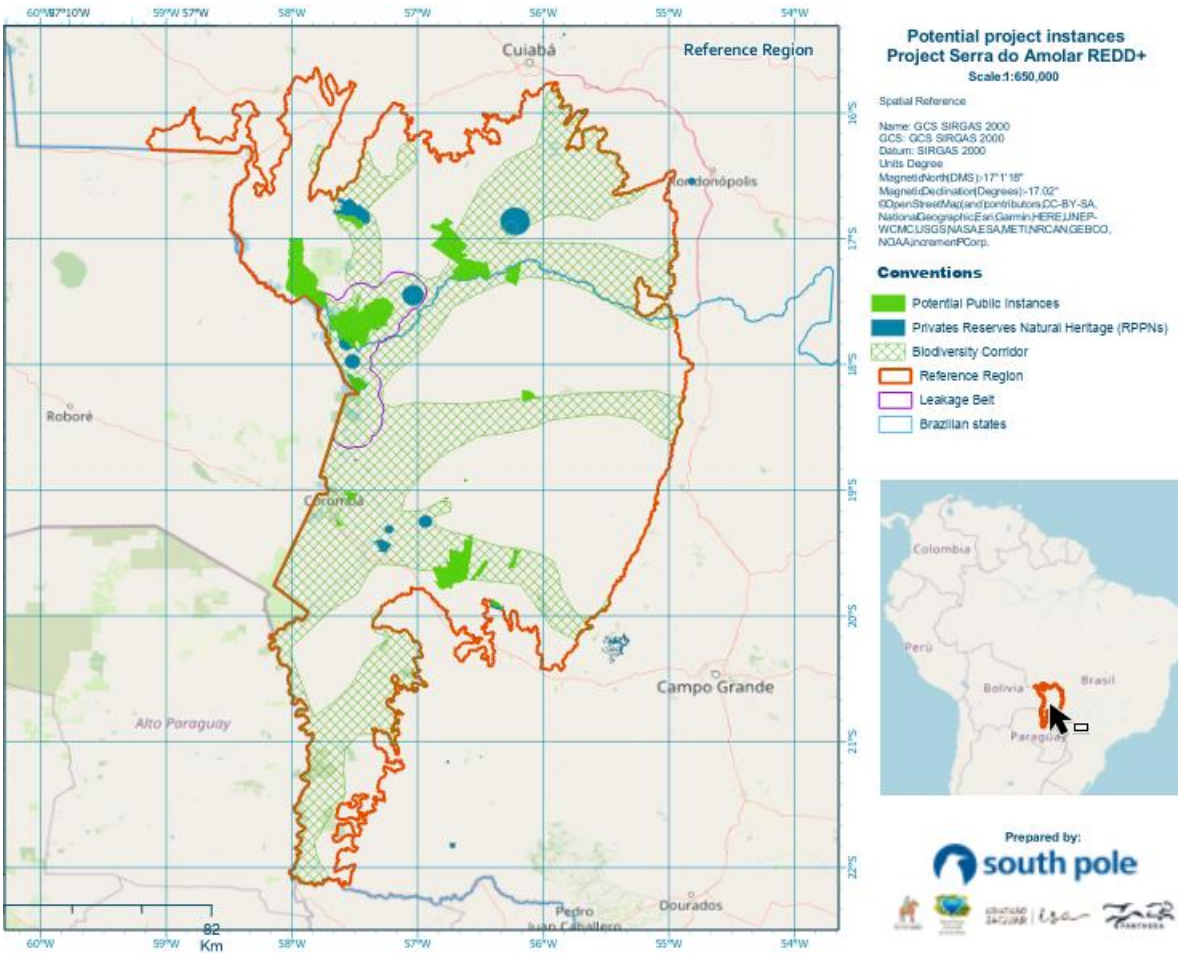


Figure 22. Spatial distribution boundaries for the new instances in the grouped project

(Source: South Pole, 2022)

The private areas to potentially be included are a category of conservation units recognized by the Brazilian Government. These RPPNs have owners who recognize the ecological importance of the reserves, effectively engage in nature and biodiversity conservation efforts and acts, and are committed to protecting the area.

Table 21 presents an indicative list of potential instances of project area expansion. A total of 490,468 ha of new areas could be included at the end of 30-year crediting period.

Table 21. Size areas within the reference region as new facilities (project expansion areas)[82] [83]

Federal unit	Municipality	New instance name	Area (ha)
MS	Jardin	RPPN Fazenda Cabeceira do Prata	295,048
MT	Barão de Melgaço	RPPN Estância Ecológica SESC Pantanal I	49,485
MT	Barão de Melgaço	RPPN Estância Ecológica SESC Pantanal II	38,385
MT	Cáceres	RPPN Reserva Jubran	35,531
MS	Corumbá	RPPN Poleiro Grande	16,530
MS	Aquidauana	RPPN Fazendinha	9,619
MS	Corumbá	RPPN Santa Cecilia II	8,729
MS	Corumbá	RPPN Paculândia	8,232
MS	Aquidauana	RPPN Pata da Onça (Fazenda Santa Sophia)	7,387
MS	Aquidauana	RPPN Fazenda Rio Negro	7,000
MS	Miranda	RPPN Dona Aracy – Fazenda Caiman	5,603
MS	Corumbá	RPPN Fazenda Santa Helena	4,295
MS	Corumbá	RPPN Arara Azul	2,000
MS	Corumbá	RPPN Alegria	1,128
MS	Corumbá	RPPN Nhumirim	862
MS	Miranda	RPPN Neivo Pires II	320
MS	Corumbá	RPPN Pioneira do Rio Piquiri	195
MS	Miranda	RPPN Neivo Pires I	119.49
Total			**490,468**

[82] ICMBio, "Sistema Informatizado de Monitoria de RPPN (SIMRPPN)", 2020, https://sistemas.icmbio.gov.br/simrppn/publico/.
[83] CNRPPN, "Painel de Indicadores da Confederação Nacional de RPPN", 2020, https://datastudio.google.com/reporting/0B_Gpf05aV2RrNHRvR3kwX2ppSUE/page/jGXB.

Methodological criteria

New instances must be aligned with the proposed activities in the project description, including agreeing with the monitoring plan and activities (see section 2.4.1). New instances must also:

- meet the applicability conditions set out in the methodology, which means they must develop the same activities, include the same phytophysiology of vegetation, develop a local stakeholder consultation to evaluate risk and design mitigation measures, and develop or have data for wildlife monitoring (more details in section 3.1.2);
- be subject to the same community and biodiversity without-project scenarios as determined by the project. (section 2.2);
- be situated within the specified expansion area;
- have characteristics, with respect to additionality, that are consistent with the initial instances for the specified project activity and geographic area; and finally
- be subject to the same processes for stakeholder engagement described in G3 and regarding rights to lands, territories and resources, including free, prior and informed consent described in G5.

Administrative criteria

New instances must be aligned with the proposed governance structure for the project, including agreeing to be represented by the IHP (see section 2.4.1). New instances must also:

- have the same baseline scenario defined in the project description (see sections 2.2.2 and 3.1.4);
- have similar characteristics to the initial instance in terms of additionalities (see section 3.1.5);
- be subject to consultation processes similar to those carried out in the first instance in terms of respect for land tenure and rights of use, such as compliance with the free and informed prior consultation process (see sections 2.3.7 and 2.5.3);
- have enough information to implement the monitoring plans proposed for each of the components of the project, i.e., climate, community and biodiversity (see sections 3.3, 4.4 and 5.4);
- not be retroactive and be validated within the framework of one of the first instance verifications; and
- provide enough information to meet the eligibility criteria mentioned above.

2.1.23 Scalability limits for the grouped projects (G1.15)

The Amolar Network led by the IHP, represents the main area for scalability of the Serra do Amolar REDD+ project activities, that aim to join forces for the conservation of the whole Pantanal as a biological corridor.

The IHP acts as the manager of the RPCSA and as a political-institutional articulator with the municipal, state and federal institutions;[84] it also has extensive experience as a developer, and operational and management capacity to bring financial resources. Based on the IHP's experience, initial efforts of expansion should be limited to 200,000 ha. However, the scalability limits (see Figure 22) of the project are set by the Pantanal biome demarcation by IBGE in 2019 (1:250.000).

[84] According to the terms of the IHP agreement with the other areas of the RPCSA.

2.1.24 Risk mitigation approach for grouped projects (G1.15)

The risks associated with the non-continuity of benefits is reduced, given that the project activities proposed for the new instances will be led by the owners of the new instances, and they are directly involved in the management and administration of the RPPNs (as special units of conservation) and supported by all institutions cited in section 2.1.4. These entities carry out activities in an articulated manner with local actors and have local and regional recognition for their conservation work in this region.

2.2 Without-project land use scenario and additionality

2.2.1 Land use scenarios without the project (G2.1)

For determining the land use scenario in the absence of the project (baseline scenario), the 'VCS Methodology VM0015, version 1.1' was used in conjunction with the 'VCS approved tool VT0001 – Tool for the Demonstration and Assessment of Additionality in VCS' (see section 3.1.5).[85]

Considering that the Serra de Amolar protection network is composed of private landowners with conservation interest, it is expected that forest land will be converted to non-forest land in the baseline scenario under the mechanism of unplanned avoided deforestation (AUD). Landowners are expected not to afford the efforts and costs of maintaining long-term monitoring of project boundaries to avoid unplanned land use change through encroachment and uncontrolled deforestation without carbon credit revenues.

The analysis of deforestation, vector agents and underlying causes, and the likely scenarios of land use in the absence of the project were performed, based on the baseline scenario and detailed in section 3.1.4.

The range of potential forest to non-forest hanges most likely to occur within the project zone in the absence of the project are:

- deforestation for expansion of livestock and agricultural activities; and
- deforestation through forest fires used to clear forests.

Without the project scenario, the Amolar network would not gain biodiversity benefits and would not be able to increase benefits for surrounding communities. In the baseline scenario, landowners would not develop preservation and conservation strategies protecting the Pantanal against unorganized anthropic activities and the advancement of agribusiness; non-improvement of the management conditions in the area, no promotion of sustainable ecotourism, and increasing social conflicts.

For communities, the without-project scenario would only reinforce the communities' dependence on the intermediaries for selling fish bait or fish, and getting supplies from the city of Corumbá. Thus, communities' dependence would likely rise because of an increase in debts over time, which would not

[85] VT0001 - Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities", version 3.0.

improve their well-being. In contrast, the scenario with the project's development will be environmentally, socially and economically positive, and will improve the environmental monitoring system, communication between the implementers and communities, fire prevention and socio-educational programs.

For the biodiversity without-project scenario, few financial resources are available to biodiversity monitoring and jaguar conservationists, and non-additional funding and financial support will not be available to protect the Serra do Amolar Network.

As a result, it would be more challenging to generate trickle-down benefits, such as jobs and economical alternatives for traditional knowledge, importance or threatened species and the monitoring actions which guarantee the permanence of the forest and savanna forest, protecting the biodiversity and maintaining the ecosystem services in the Pantanal. Financial and political barriers will also be reduced with the implementation of any conservation project, and other stakeholders will be come to implement other economic alternatives.

2.2.2 Most-likely scenario justification (G2.1)

The most likely land use scenario in the project's absence is the continuation and expansion of livestock and agricultural activities, including forest fires used to clear the forest. See section 3.1.4 for further information.

2.2.3 Community and biodiversity additionality (G2.2)

In the current scenario, without the project, IHP would not develop preservation and conservation strategies protecting the Pantanal against unorganized anthropic activities and the advancement of agribusiness. Considering current agreements, the Amolar network would not gain biodiversity benefits and would not be able to increase benefits for climate as well as community.[86]

As mentioned before, the most likely land use scenario in the project's absence is the continuation and expansion of livestock and agricultural activities, resulting in forest fires. Although the IHP and the landowners are responsible for the maintenance of the reserve and are expected to cover all costs associated with its protection and management,[87] these areas depend on the will of the owners and private economic resources, without support from any government initiative. This puts them at a disadvantage with respect to other land uses.

Therefore, the project seeks to improve the management conditions in the area, promote sustainable ecotourism and reduce conflicts and the overlapping of land use. In addition, the scenario with the development of the project, will be environmentally, socially and economically positive, and will improve the environmental monitoring system, communication between the implementers and communities, fire prevention and socio-educational programs.

[86] Instituto Homem Pantaneiro, "Rede de Proteção e Conservação da Serra do Amolar", 2020, https://www.institutohomempantaneiro.org.br/rpcsa.
[87] Fernanda de Vasconcellos Pegas y J. Guy Castley, "Ecotourism as a conservation tool and its adoption by private protected areas in Brazil", *Journal of Sustainable Tourism*, 2014, https://doi.org/10.1080/09669582.2013.875550.

Building technical and administrative capacity for the control and inspection of the area, where local people have an important role as forest watchers, will also reduce the impact on the forests, including both natural or anthropogenic fires. As for the socio-educational program, training and workshops will be provided to educate the local communities in topics such as monitoring and reporting on fauna and flora, as well as capacities for implementing ecotourism programs.

All these actions guarantee the permanence of the forest, protecting the biodiversity and maintaining the ecosystem services in the Pantanal. Financial and political barriers will be reduced with the implementation of the project, and with the inclusion of the community, generate jobs and economic alternatives to improve people's quality of life in the area.

Further details on project additionality for community and biodiversity can be found in sections 4.1.4 and 5.1.3.

2.2.4 Benefits to be used as offsets (G2.2)

There are no distinct benefits for climate, community or biodiversity to be used as an offset.

2.3 Stakeholder engagement

2.3.1 Stakeholder access to project documents (G3.1)

The project documents, such as the project description documentation and monitoring report, will be available online through the VERRA webpage and made publicly available. Before the audit process, stakeholders were invited to participate in the public comment period and provided with the project documents. For stakeholders who do not have access to the project documentation via the internet, especially those living in the project area, hard copies were printed and made available in locations like schools and clinics, so that all stakeholders could have access to this documentation.

2.3.2 Dissemination of summary project documents (G3.1)

Summaries of the project documents, including the information for G1.1-9, were provided online via the VERRA webpage. The stakeholders were invited to review and send their comments. For the stakeholders who do not have access to the project documentation via the internet, especially those living in the project area, hard copies were printed and made available in locations like schools and clinics, so that all stakeholders could have access to this documentation.

2.3.3 Informational meetings with stakeholders (G3.1)

The informational meetings with communities and local stakeholders were carried out from December 3 until December 6 of 2019. The meetings were publicized via invitations sent by the Instituto Homem Pantaneiro to the stakeholders. Physical invitations were sent (Figure 21) , and stakeholders who were not initially interested in the project were contacted by phone. The project team invited stakeholders living in the project area during the monitoring activities that preceded the consultation meetings visit.

All stakeholders were contacted 20 days prior to the scheduled meeting date, and contacts were followed up using a follow-up form with telephone and email information.

This meeting was fundamental for the population around the project area, employees and all different groups of stakeholders to understand more about the project, for those who don't know about Instituto Homem Pantaneiro, ISA-CETP, South Pole and Panthera the meeting answered the questions regarding the role as well as raised up challenges that they have.

Some guiding questions on the process of preparation for the consultation, as well as photos, list of attendees and minutes of these meetings; please refer to the Local Stakeholder Consultation report which is available in the supporting documents.[88]

[88] Available on Annex 3 – Local Stakeholder Consultation/Report

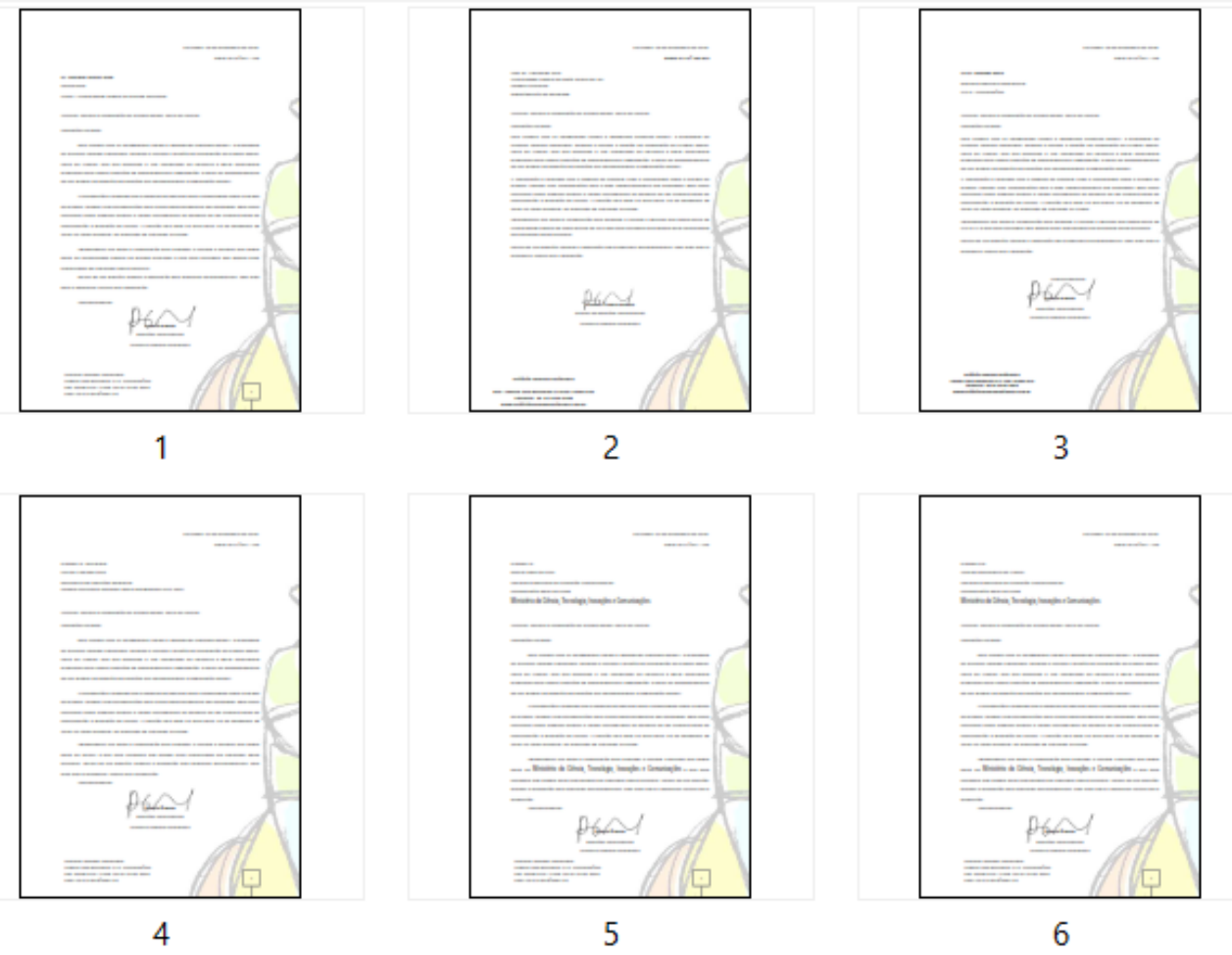


Figure 23. Example of invitation letters sent to the stakeholders

(Source: South Pole, 2020)

2.3.4 Community costs, risks and benefits (G3.2)

Throughout the life crediting period, the project will maintain active consultation processes and adaptive management with stakeholders. The objective is to disseminate project information, especially decisions made by the steering and technical committees, through agreed communication channels. In addition, there will be strategies for the resolution of requests or complaints. Furthermore, the project proponent develops an annual independent audit for the demonstration of transparency in which the project's financial expenditures and resource execution are presented.[89]

[89] Available on statements and transparency report: https://www.institutohomempantaneiro.org.br/transparencia. Also see Support_information/Financial Statement.

During the LSC[90] in December 2019, the potential risks and benefits of implementing the project activities were openly and publicly discussed with the stakeholders. At the end of the meetings, the stakeholders had the opportunity to recreate future scenarios under the assumptions of the project activities. No negative opinions and perceptions about the project were raised regarding to development activities in the region; they did not identify the project activities as a potential risk to them. Indeed, on the contrary, the stakeholders perceived that the project activities would help to develop the region, including the city of Corumbá and the surrounding villages while protecting the Serra do Amolar REDD+ areas. The communities which live surrounding the project cannot relate the implementation of the REDD+ activities to potential risks, even if potential risks exist.

Overall, the benefits of the project implementation overcome the risks, especially due to the presence of IHP in the area and the advanced implementation status of the project.

Regarding the cost, the project activities has not potential costs to communities, because IHP's team has a financial sourcing structure for activities and any complementary operation of the REDD+ commitments. During the LSC in December of 2019. it was discussed and explained that the carbon project will not cost the community anything; it was explained that the project is 100% intended to benefit the local population in a no-harm situation. Finally was explained the verification/validation costs are covered until the first verification through financial support from the Jaguar program, and carbon credits will be cover future verificationsDue to the constant presence of HP in the area, the team members of the project have a close relationship with the families and communities surrounding the project that allows a face-to-face management of the risks, conflicts, and benefits. Other meetings and conversations with families and communities are reported and published on the IHP Instagram account: https://www.instagram.com/ihp_pantanal_/?hl=en.

Finally, the verification/validation costs are covered until the first verification through financial support from the Jaguar program, but the project proponent is in charge of future verifications.

2.3.5 Information to stakeholders on validation and verification process (G3.3)

First, the stakeholders and communities were invited to participate in the LSC process, aiming to inform, socialize and receive feedback from the participants on the project certification process, including the VCS and CCB Standards.

Also, before CCB validation and verification, the project went through a public comment period of one month (from 11 October 2021- 11 November 2021), in which the main project documents and their summaries were available to the stakeholders to review and send their comments back to the project proponent. The documents were available on the Verra landpage[91].

For stakeholders who do not have access to the internet and for the community members, the project proponent printed and place information in strategic places for the communities people, for example schools, and community centers. Flyers inviting the stakeholder to review the documents and informing

[90] Annex 3 –Local stakeholder consultation report
[91] https://registry.verra.org/app/projectDetail/CCB/2566

community members and stakeholders about the CCB validation and verification process were printed and posted by the community members.

In November 2021, once the public comment period was closed, Verra informed that no comments were received[92].

2.3.6 Site visit information and opportunities to communicate with auditor (G3.3)

Before validation/verification site visit, dates will be communicated along with invitations to stakeholders to comment the project documentation available on the online public consultation period (Verra pipeline). How the communities will be informed is achieved, initially, through Whatsapp message contact with specific stakeholders (academics, NGOs, policymakers, and the community surrounding the project area) who have this capability and who are capacities to pass the message on.

This will be normally carried out at least one month before the site visit, to achieve all stakeholder (including whom don't have permanent access to internet) and to enable stakeholders to plan ahead and be available during this visit. The results of the communication between communities and the auditor will defined on the audit plan, where the stakeholders who will be interviewed should be defined. The project aims those interviews between the community members, other stakeholders and the auditor will be face to face.

2.3.7 Stakeholder consultations (G3.4)

During the stakeholder consultation meetings, there was no comment that would lead to any change in project design. The IHP referred to the importance of stakeholder participation at all stages of the project's certification, including the design of activities and implementation. The IHP also has a strong presence in the project area, enhanced by monthly visits for monitoring purposes, which makes stakeholder participation and interaction with the IHP easier and more natural. Therefore, the current project setting guarantees a close relationship between the project owner and community members from different communities.

Overall, the comments were encouraging to the development of the project activities as planned, and the stakeholders also wanted to participate as much as possible in the project implementation. The consultations were documented and are available in the Local Stakeholder Consultation report (see supporting documents in Annex 3). No changes to the project design occurred after this consultation due to the fact the stakeholders were mainly supportive about the project activities and willing to participate in the activities.

[92] Copy of the e-mail sent by Verra was shared with the VVB.

Regarding the strategy to influence the project design, employees involved in the Serra do Amolar REDD+ Project's decision-making processes were involved and had full and effective participation in the process.

The Amolar Network annuals reports, and the main demands of the communities surrounding the project area were took prioritizing the project Activities and Theory of Change, where clearly and inclusively the project draw their objectives in short-, medium- and long-term solutions, thus contributing to the design of the project activities.

2.3.8 Continued consultation and adaptive management (G3.4)

The project has ongoing communication channels between the project proponent and the stakeholders and communities. The communication mechanism was suggested by the IHP according to the capabilities of the interested parties and tools that are easily accessible to them. The first channel is direct contact with the project team, both in the field and in the main office in Corumbá. The other two channels are via telephone calls and emails.

Previous to Stakeholder consultation meeting in December of 2019, IHP identified some gaps and weaknesses in social impact that should be taken into the project. These include gaps in the community employment environment and the measurement and setting of project impacts within the community, as:

- Improve effectiveness of the communication mechanism that IHP has set up with the people surrounding Serra do Amolar Network.
- Monitoring workers' information: number of workers, job description. Identify how many employees are from the local community and how many are from urban areas. How do you ensure that women are involved in job opportunities? What is the process for hiring and making selections for vacancies?
- Ensuring a job training program in place to involve more people from the community and others.

In order to resolve those doubts or present complaints that may result from the implementation of the project. The project defines and present a mechanism or channel of communication between the project proponent and the interested parties throughout the project lifetime. The communication mechanism between the parties is presented below:

Figure 24 Communication mechanism for the Serra do Amolar REDD+ project. Further information is available in the LSC report[93] and section 3.3.

Depending on the type of concern raised by the stakeholders and the communities, those will be included in the adaptive management process and will be taken into account in the development of the project activities and project operation.

2.3.9 Stakeholder consultation channels (G3.5)

The stakeholders and communities, as well as the community groups, were directly invited to participate in the consultation process. Several consultation meetings were conducted, not only in Corumbá, but also in the project area with local communities to make sure that all the stakeholders had the chance to attend the meetings. An adequate level of information was shared with the stakeholders following the VCS standard rules and requirements. Further details on the level of information shared is provided in the LSC report, section 4 'Stakeholder consultation development'. Detailed information for each specific meeting is included in the same document, Annex III.

2.3.10 Stakeholder participation in decision making and implementation (G3.6)

To ensure the inclusion and participation of all communities in decision making and implementation, the project proponent identified the stakeholders that should be invited to participate before sending out the invitations. The correct type of communication channels such as face-to-face invitation, anticipated notifications to leads, and other methods based on the targeted stakeholders, as well as the location of the LSC or other meetings, also took into account the mobility of the stakeholders. This was necessary to enable effective participation from all interested stakeholders and communities.

[93] Available on Annex 3 – Local Stakeholder Consultation/ Report.

Culture and gender-sensitive information was also taken into account, as this is part of the project proponent's practices. More detailed information on this is provided in the LSC report, section 2 'Preparation of the local stakeholder consultation (LSC)'.

2.3.11 Anti-discrimination assurance (G3.7)

The project proponent, the IHP, is an institution with principles of legality, impartiality and morality, which enshrines the principles of anti-discrimination on the basis of race, color, gender or religion. In addition, the project proponent complies with the International Labor Organization Convention No. 111 of 1958, ratified by Brazil on March 1, 1965, which provides assistance for anti-discrimination matters in relation to employment and occupation. Implementation reports are used to ensure transparency and to avoid any form of discrimination. Communication channels were also presented during the stakeholder meetings and should be used for any grievances from any stakeholder to assure that the project is not involved, or complicit in, any form of discrimination or sexual harassment.

2.3.12 Feedback and grievance redress procedure (G3.8)

The feedback and grievance mechanisms are ongoing throughout the project lifetime. Details of the process and communication channels can be found in the LSC report, section 3.3 'Setting up a communication mechanism'. If any grievances or conflicts arise, the project proponent will attempt to provide an answer or solve the existing conflict. If the issue were to persist, mediation will be necessary, and only if the listed options are not satisfactory, arbitration or courts should be the last option.

The IHP is in the process of formalizing a complaint mechanism under Decree Law No. 8.078 of September 11, 1990, which establishes general rules on Consumer Service (SAC). The time limit for any request within Brazilian law is a maximum of 60 days per request.

2.3.13 Accessibility of the feedback and grievance redress procedure (G3.8)

The feedback and grievance procedure were publicized during the LSC meetings. Also, during the meetings with the communities, the project team made themselves available at any time in case the community members had any feedback, grievances or complaints. Further information on the grievance process and communication channels can be found in the LSC report, section 3.3 'Setting up a communication mechanism'.

2.3.14 Worker training (G3.9)

The project proponent is responsible for training its own staff to make sure they have the capacity to carry out the project activities. Also, the community members involved in the project activities must be trained by the project proponent team so as to improve their skills on monitoring and tourism. Increasing local community skills guarantees that knowledge is built locally and also increases local participation in the project development.

2.3.15 Community employment opportunities (G3.10)

Gender equality and community employment opportunities are extremely important topics for the project proponent. That is why equal opportunities are given to people from the communities when trying to fill any work positions. A clear example is Joelson Soares, a young employee that works for the project. Mr. Soares is from one of the small communities near the project area and his contribution to the development of the project has been crucial to the success of the activities developed, especially because of his knowledge of the riparian communities.

Women and young people have priority and will be offered different opportunities to foster gender equality within the community in the long term. Other examples are the IHP's president and executive secretary, high-level positions occupied by women, and which are important for decision making and implementation. An important ratio of women (eight out of nineteen workers) is employed by the project proponent and no distinction is made between genders, which corroborates the idea that gender equality and equal opportunities are very important topics and are taken into consideration throughout the project's implementation. Within the communities, women are encouraged to participate in training and project activities, with gender equality also being bolstered through community initiatives. In addition, gender equality is secured via the publication of progress reports that present the data monitored and aim to make this public and transparent.

2.3.16 Relevant laws and regulations related to worker's rights (G3.11)

In 1930, the Brazilian president and a group of lawyers and legislators elaborated the Consolidation of Labor Laws (CLT) that sought to guarantee a series of securities and regulations in the relationship between employers and employees. Since then, the CLT has undergone a series of modifications and improvements. The following are the main Brazilian labor laws and regulations:

- Decree-Law No. 5,452 of May 1, 1943: approves the CLT.
- Law No. 6,514 of December 22, 1977: amendments to Chapter V of Title II of CLT, on occupational safety, medicine and other measures.

The project proponent complies with all laws and regulations that cover worker's rights and do not have any claims against them.

2.3.17 Occupational safety assessment (G3.12)

The following is presented the risk analysis of each strategic line with the possible scenarios and hazards identified considering the type of transportation used to internal displacement and the other physical, biological or organizational agents to which the worker may be exposed.

For management, the hazards were categorized as (S) Safety and Health, (O) organizational, (P) physical, and (E) ergonomic. The frequency or severity was evaluated to show five levels of likelihood of happening (0-100%). The higher risk is considering prevention or mitigation actions (Table 22).

Table 22 Qualitative severity and exposure assessment for strategic lines

Strategic lines	Hazard	Risk or Severity
Area management	(S) (P)	10-35 %
Environmental monitoring	(S) (P) (O) (E)	> 35%
Environmental control and inspection	(S) (P) (O) (E)	> 50%
Communication	(S) (P) (O) (E)	35 - 50%
Fire prevention	(S) (P) (O) (E)	> 80%
Environmental education and capacity building	(O) (E)	0-25%
Strategic actions	(O) (E)	0-25%

(Source: South Pole, 2022)

The table shows that the highest risk area is fire prevention. It has a probability of more than 80%. Environmental control and inspection also have a probability of more than 50% occurrence.

The strategic lines of area management and environmental monitoring have a moderate likelihood of occurrence, ranging from 10-35% and more than 35%, respectively. Communication, environmental education and capacity building also have a moderate likelihood of occurrence, ranging from more than 35% to 0-25%. Finally, the category of strategic actions has the lowest probability of occurrence. It ranges from 0 to 25%.

Mitigation actions will always depend on the ability to implement administrative controls and the economic resources to provide personal protective equipment (PPE) to reduce the likelihood of a hazard occurring. Based on the experience of the management of the Instituto Homem Pantaneiro, the following actions are considered, depending on the risk:

- High risks (fire prevention activities): Training the brigade, meeting before each operation, and preparing a safety manual for management.
- Moderate risk (environmental inspection, environmental surveillance, and communication activities): Harmonisation of safety procedures with other organizations, meetings before each field trip and maintenance of adequate communication systems.
- Low risks (staff training and skills, ergonomics, and strategic actions): PPEs, furniture adequacy, creating a health, safety and quality of life plan, and ongoing meetings.

From 2016 to 2020, the project has undertaken several necessary actions, which are presented in the table below.

Strategic lines	Action needed and designed to mitigate the risk	Evidence[94]
Area Management	Staff training and qualification (Ongoing process)	Safety and Health_Sesi 2019 commercial proposal

[94] Info available on Annex 3 – Local Stakeholder Consultation/Mitigation measures evidences.

Strategic lines	Action needed and designed to mitigate the risk	Evidence[94]
	Creation of the PA Management Manual with safety procedures in equipment management, instruction, and maintenance of equipment (Ongoing process) Meeting before each field trip with general instructions and travel insurance (Ongoing process) Adequacy of furniture to favor the ergonomics of activities (Ongoing process) A consulting quotation was carried out on "Health, Safety and quality of life at work" (2019) - Suspended in February 2020 due to the arrival of the pandemic and start of the fires (date given)	Insurance receipt 2019 and 2020 Protected Areas Management Manual 2019 Adaptation of furniture and structure of new headquarters (chairs, supports, cabinets, structuring of new headquarters). PPE in equipment maintenance - Photo report 2019
Environmental monitoring	Meeting that precedes each field trip with general instructions (Ongoing process) Creation of the PA Management Manual with safety procedures in equipment management, instruction, and maintenance of equipment (Ongoing process) Guide accompaniment and travel insurance (Ongoing process) Hiring a professional with an active class record, qualified to pilot vessels and adequate first aid training (Administrative process)	2019 and 2020 Insurance Voucher 2019 Protected Areas Management Manual 2016 Boat Pilot's License of Sérgio Barreto
Enviromental control and inspection	Environmental control and inspection in the region is carried out by the Environmental Military Police and they have their own safety procedures. (2018-2020)	Amolar Network annual reports. E.g. 2018 and 2020
Communication	Meeting before each field trip with general instructions and travel insurance. (Ongoing process) Maintenance activities and adequacy of the communication system were all carried out by contracting service providers with adequate training. (2016)	2019 and 2020 Insurance Voucher 2016 Tower maintenance photo - Amolar Network Annual Report
Fire prevention	Brigade Training: meeting that precedes each operation (2020) Creation of the PA Management Manual with safety procedures in equipment management, instruction, and maintenance of equipment (Ongoing process)	2019 and 2020 Insurance Voucher Brigade training course in Serra Negra – Photo September 2020 and Amolar Netwrok Annual Report 2020 – page 29.

Strategic lines	Action needed and designed to mitigate the risk	Evidence[94]
	Most fire prevention actions between 2016 and 2020 were carried out by Ibama/PrevFogo Brigade members, who have their own safety and insurance procedures.	
Environmental education and capacity building	Meeting before each field trip with general instructions and travel insurance	2019 and 2020 insurance voucher and 2019 Protected Areas Management Manual
Strategic Actions	Meeting before each field trip with general instructions and travel insurance. (Ongoing process) Safety procedures in the management, instruction and maintenance of equipment and travel insurance (Ongoing process)	2019 and 2020 insurance voucher and 2019 Protected Areas Management Manual

Additionally, the Brazilian Regulatory Standards (also known as NR) regulate and provide guidance on mandatory procedures related to occupational safety and health. The standards, which are cited in Chapter V, Title II, of CLT were approved by Ordinance No. 3214 in June 1978.

Regarding the activities of the project, the proponent is obliged with all laws and regulations, and more specifically, provided adequate protective equipment to employees doing forest monitoring activities. Also, monitoring staff are equipped with first aid kits.

The following are the main NR regulations for the project:

- NR 4 – Specialized Services in Occupational Safety and Health (last update: MTPS Ordinance no. 510 of April 29th, 2016).
- NR 5 – Internal Commission on Accident Prevention (last update: SIT Ordinance no. 247 of July 12th, 2011).
- NR6 – Personal Protective Equipment – PPE.
- NR23 – Fire Protection.
- NR31 – Safety and Health at Work in Agriculture, Livestock Forestry, Forestry and Aquaculture.

2.4 Management capacity

2.4.1 Project governance structures (G4.1)

The governance structure of the project has two components. The first is an executive committee which involves all of the partners of the RPCSA; this body makes decisions about project activities and funds. The second is the technical committee (exclusively a body of the IHP), who are responsible for coordinating the activities and providing logistical and technical support. Further details on project management capacity can be found in Support Information.[95]

[95] Support_information/Non Permanence Risk Tool/Management_Capacity.

2.4.1.1 Executive committee

The executive committee is made up of an internal and external body, and is responsible for approving the annual activities report, monitoring plan and others project products, as well as balancing and approving the project's financial resources to ensure the successful implementation of the project's activities.

The executive committee is in charge of any statutory alterations of the institute and the execution of the project activities. The committee is also in charge of establishing cooperation policies with public, private, national and international institutions involved in the project. The executive committee acts according to the statute of the IHP Chapter V and in accordance with art. 34, VI of Law No. 13.019/2014.

Figure 25. Executive commite for the Serra do Amolar REDD+ project

(Source: Instituto Homem Pantaneiro, 2021)

2.4.1.2 Technical committee

The technical committee (exclusively a body of the IHP), is responsible for coordinating the activities and providing logistical and technical support (the organization chart is presented below). All members have the relevant experience to implement the activities, including, biologists, vets, accountants, IT consultants, firefighters and geographers.

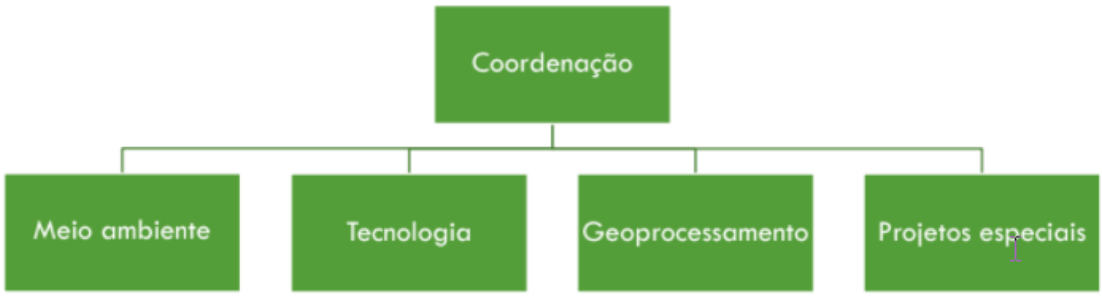


Figure 26. Instituto Homem Pantaneiro – technical chart

- Coordination – Letícia Larcher
- Environment – Sergio Barreto
- Technology – Josiel Coelho
- GIS – Angélica Guerra
- Biodiversity projects – Diego Viana (*Projeto Felinos Pantaneiros*)
- Technical advisory from Santa Tereza Farm – Renato Roscoe

2.4.2 Required technical skills (G4.2)

The project proponent carries out all the project and monitoring activities. In addition, South Pole, Panthera and ISA, are supporting them in the validation and verification stages of the project.

South Pole will be present for the entire formulation of the project document (PD) and will continue to be present during the validation, monitoring and verification of the climate, and the community and biodiversity benefits generated by the project. Also, South Pole will support the auditing processes, respond to corrective actions, as well as project registration and clarifications requested by the standards.

Ecotropica Foundation, Acaia Pantanal and other stakeholders are partners who will be consulted and be part of the decision-making process made by the steering and technical committees, regarding the project. This is to establish strategies of sharing information, implementation and joint construction, thus ensuring their participation in project design and decision-making.

2.4.3 Management team experience (G4.2)

The project team implementing the project activities have extensive experience working on land management, especially conservation projects (see profiles and curriculums in Non-Permanence Risk Tool/Management Capacity).

2.4.4 Project management partnerships/team development (G4.2)

South Pole, a carbon project developer, works and will work together with the project proponent in the validation, monitoring and verification of the project benefits. South Pole has extensive technical expertise in developing AFOLU projects, as well as in-depth knowledge of national and international carbon markets. This team continuously manages the monitoring, reporting and verification (MRV) of GHG benefits of land use projects, including ARR and REDD+ worldwide. More information about the project developer is available at https://www.southpole.com.

Additionally, for the biodiversity activities, Panthera designed the monitoring plan and will work closely with the project proponent during training, when necessary, and in some aspects of monitoring (use of cameras, collection of samples, etc.).

For other capacities necessary for project implementation, no technical or administrative gaps have so far been identified which need to be filled by any other entity other than the project participants mentioned in section 2.4.3. However, if during the monitoring work, independent professionals or companies need to

be hired to carry out any work, the project team will take the necessary steps to find, contract and then manage any subcontractors. In addition, the project team will determine the time, resources and level of participation of any external entities who provide services to the project in accordance with the internal processes.

2.4.5 Financial health of implementing organization(s) (G4.3)

The IHP is an NGO with more than 12 years of experience in the environmental assets and the protection and conservation of the Pantanal biome, having a diversified line of projects, and investors who support the strategic lines described in section 2.1.11.

The supporting documents show the financial health of IHP has already been analyzed in the financial structure of the additionality (section 3.1.5.2) and in the Non-Permanence Risk Tool (Annex 2).

2.4.6 Avoidance of corruption and other unethical behavior (G4.3)

IHP has an internal statute in place to guarantee ethical and transparent actions. The statute describes IHP's role, the purpose of the activities, all goods constituting patrimony and rights and duties.

The following are in Portuguese:

- Statute: https://institutohomempantaneiro.org.br/wp-content/uploads/2021/10/ESTATUTO-IHP.pdf
- Minutes No 15 and 16: https://institutohomempantaneiro.org.br/transparencia/

South Pole has a code of conduct in place to ensure that there is no involvement with corruption. ISA also has a Code of Ethics and Conduct in place to guarantee ethical actions based on the highest principles and values of all stakeholders.

2.4.7 Commercially sensitive information (*Rules* 3.5.13 – 3.5.14)

Some information required by the VCS and/or CCB Standards is considered confidential or commercially sensitive, and cannot be made public by the project proponent. This information will be supplied, in full, to the VVB during the validation process, attached to this PD document, but is not included in the public version. Below is a list of the information that will only be made available to VVB:

- agreements and contracts between the parties involved;
- trade agreements, and;
- legal status and property right documents.

The financial reports are not commercially sensitive information, because all has been available at https://institutohomempantaneiro.org.br.

2.5 Legal status and property rights

2.5.1 Statutory and customary property rights (G5.1)

2.5.1.1 Ownership and control of land, soil and resources

Rural land rights are governed by the Constitution, the Land Statute, and the Civil Code of 2002 (Law No. 10.406), and deal with family rights, inheritance, possession and property rights. In Brazil, land can be acquired through purchase, transfer of ownership (e.g., through inheritance), and government allocations. The right to acquisition land through long occupation (usucapion) has existed in rural Brazil since 1916. Adverse possession under the current law allows the legal transfer of land to the occupant after uninterrupted and undisputed occupation for a specified number of years (Constitution 1988, Art. 191; Civil Code 1916, Art. 1240).

The ownership and property rights of the project area correspond to the three following entities and an agreement of management:

- RPPN Rumo Oeste, RPPN Acurizal, and RPPN Dorochë; registered and established by IBAMA Ordinance No. 7, on February 19, 1997, belonging to the Fundação de Apoio a Vida nos Trópicos (Ecotrópica).
- RPPN Engineer Eliezer Batista, and RPPN Penha; created by ICMBio Ordinance No. 51, July 24, 2008, and owned and managed by the IHP.
- The voluntary conservation areas (not legally established as conservation units [UCs]) are Fazenda Sao Goncalo, Fazenda Santa Rosa, Fazenda Morro Alegre, Fazenda Vale do Paraíso, Sítio Serra Negra (under the direction of the IHP) and Fazenda Jatobazinho (under the direction of the Acaia Pantanal Institute).

These areas, although small, are located between the Acurizal and Eliezer Batista RPPNs and, therefore, have enormous importance as a biodiversity corridor between the conservation units. The Santa Tereza Farm, which has 63,000 ha of surface area, of which only 3% is used for cattle raising, is adjacent to the RPPN Engineer Eliezer Batista.

Excluding Fazenda St. Tereza, all the project areas are private natural heritage reserves (RPPNs). The Sustainable Use Conservation Unit foreseen in Federal Law 9.985 of 2000, established the National System of Conservation Units (SNUC). This means the project area has both a federal sphere and a state sphere recognition model for conservation of eco-resources on private lands. These areas were clearly identified before INCRA/MDA's Sistema de Gestión Fundaría (SIGEF)[96] and the Sistema Nacional de Cadastro Ambiental Rural (SICAR).[97]

Table 23 shows the relevant information for the properties in terms of legal security of ownership and the SICAR registration code.

[96]Available on the MS layer: http://certificacao.incra.gov.br/csv_shp/export_shp.py and in the report at: https://sncr.serpro.gov.br/sncr-web/consultaPublica.jsf;jsessionid=ZEuprugd8OhO+D+VM744vuYj.sncr-web2?windowId=4fd.
[97] Available at: www.car.gov.br/publico/imoveis/index.

Table 23. Basic information on land ownership with auto declarative registration

No	Property name	Landowner	Area (ha)	Environmental rural register (Code)	Legal tenure state	Legal tenure	Type
1	Faz Jatobazinho	Acaia Pantanal	360	MS-5003207-67B0B862F0CB4DF5BC202A32E473D3E5	MS	yes	IRU
2	RPPN Engineer Eliezer Batista	IHP	13.323	MS-5003207-25BEEC2A4EF242D7A04A2926A4523CB6	MS	yes	IRU
3	RPPN Penha	Fundação Ecotropica/ IHP	13.409	MS-5003207-0AFDB43C1D9F44F1A1A169EEECF3E69B	MS	yes	IRU
4	Faz Morro Alegre	Alexandre Bossi/IHP	1.351	MS-5003207-73734B50586A4D18A1D063CCDE9E5D05	MS	yes	IRU
5	Faz Vale do Paraíso	Alexandre Bossi/IHP	184		MS	yes	IRU
6	Faz Santa Rosa	IHP	78,9	MS-5003207-A3A4568DB0DD45F5A244E61377C1E518	MS	yes	IRU
7	Faz Sao Gonçalo	IHP	180,9	MS-5003207-C0B2C21F40DB467C89E623DD1A94867F	MS	yes	IRU
8	Sitio Serra Negra	IHP	16,7	MS-5003207-82620C9690F74D8794FD8CB643A7E1D8	MS	yes	IRU
9	RPPN Acurizal	Fundação Ecotrópica/ IHP	13.665	MS-5003207-0AFDB43C1D9F44F1A1A169EEECF3E69B	MS	yes	IRU
10	RPPN Rumo ao Oeste	Fundação Ecotrópica/ IHP	990	MS-5003207-06A447C3D265436DB91754A29FCDE5E2	MS	yes	IRU
11	RPPN Doroche	Fundação Ecotrópica/ IHP	32406	MT-5106505-8EAE1D24761A465E94035345E6ACF36C	MT	yes	IRU
12	Faz Santa Tereza	Teresa Bracher	55,194	MS-5003207-1B4C085E5E8C452A9708585194C7BFC1	MS	yes	IRU

IRU: Rural Land

(Source: South Pole, 2022)

2.5.2 Recognition of property rights (G5.1)

The project proponent recognizes and respects all property rights for each area. Properties involved in the project either have property titles or equivalent documents to certify and assure rights over the land. Additionally, the project has all documentation relating to CAR, RPPNs and conservation agreements.

All supportive information is available in Annex 4 and section 2.5.1. Also, it should be noted that there are no communities of Brazilian or indigenous heritage with collective property titles in the project area.

2.5.3 Free, prior and informed consent (G5.2)

Considering the information presented in sections 2.5.1 and 2.5.2, the project will not affect third-party property rights, community property or government property.

Interested parties have been consulted and duly informed about the impact of the project regarding their rights. The project proponent was authorized through the LSC mechanism (see sections 2.3.3 and 2.3.7).

2.5.4 Property rights protection (G5.3)

The implementation and development of the project shall not lead to the involuntary removal or relocation of any stakeholder. The conservation agreements freely signed by all the partners in the RPCSA are the result of previous socialization and the commitment of both parties to identify and define the activities that will be developed in each one of the farms. This ensures that they have not been forced to relocate activities important to their culture and livelihood. At the same time, one of the mitigation measures implemented by the project proponent is to keep in constant communication with the partners and all stakeholders around the project area and project expansion area.

2.5.5 Illegal activity identification (G5.4)

In the baseline scenario (see section 3.1.4), illegal deforestation, forest fires and the speculation of land tenure in the project area generate problems relating to a scenario without the project, which aims to prevent these illegal practices by means of a set of activities oriented to the conservation of the forest.

The illegal activities threatening the project area are related to the Planalto's deforestation and degradation, including illegal loggers and trespassers, infrastructure such as fluvial highways, hydroelectric projects, bad practices in ecotourism, and increasing pasture and grassland in protected areas.

To reduce these activities, the project will implement programs for environmental monitoring and environmental control and inspection, generating a diagnosis of the current state of the ecosystems and building technical, administrative and institutional capacities to promote and strengthen community forest-tenure rights. Moreover, socio-educational actions, including environmental education and awareness, will be carried out with the community to reduce the overall impact on the forests.

2.5.6 Ongoing disputes (G5.5)

In the project area, there are no conflicts, current or unresolved disputes over land rights, use of real estate or access to natural resources, nor are there any disputes with traditional third parties or squatters that can revoke the right to property of the IHP, as already detailed above.

2.5.7 National and local laws (G5.6)

Brazil is one of the most advanced countries in the world in REDD+ planning. As Brazil began to crack down on deforestation, between 2005–2006, the national government created climate change policy and reduction of deforestation targets; subsequently, they announced the Amazon Fund to help finance these programs and compensate for lost economic development. That fund is a voluntary project set up in 2008 to receive compensation for the reduction of deforestation; it is directed by the Brazilian Development Bank and manages donations to implement national climate change and forest governance policies and mechanisms. The major donor to this fund is the Norwegian government, and smaller donors include the government of Germany and Brazilian oil company PetroBras.

Despite the existence of early commitments from Brazil and the Amazon Fund, there is officially nothing establishing or regulating any legislation related to the private sector or private initiatives under single REDD+ projects at the present moment.

Below is a brief review of risks under international climate agreements, which could lead to the possible development of REDD+ initiatives in the country (Table 24). In addition, the main relevant laws and regulations at the federal and state levels are listed and detailed.

Table 24. Screening topic for single REDD+ projects in Brazil

Screening topic	Description
Host country position on accounting ERs in national GHG inventory	One of the main issues, which was a roadblock to a satisfactory conclusion in the Art. 6 rulebook in Katowice (Poland) at COP 24, was the treatment of the first transfer for A6.4U (article 6.4 units) regarding corresponding adjustment (CA). The concern is that the treatment proposed by Brazil (and supported by other parties) could lead to double-counting and has become a highly charged political issue.
Country, policy, regulatory and political risks – both generic and forestry-related, such as baseline level change, JNR, etc.	According to World Aware, Brazil's security assessment is high. Political and economic uncertainties, and an occasionally difficult business environment, can affect corporate payment behavior. Corporate default probability is appreciable. The business environment is acceptable. Corporate financial information is sometimes neither readily available nor sufficiently reliable. Debt collection is not always efficient and the institutional framework has shortcomings.

Screening topic	Description
Carbon market risk	In the NDC, Brazil states that it reserves its position in relation to the possible use of any market mechanisms that may be established under the Paris Agreement. It is unclear how a potential engagement would occur. Six Brazilian states – Acre, Amapa, Amazonas, Mato Grosso, Para and Tocantins – participate in the Governors' Climate and Forests Task Force (GCF), which is a multi-jurisdictional collaborative effort. The Pantanal will depend on whether the Brazilian federal government has no objection if any standard, this don't representa a risk for the project.
Management of double counting risk	Double-counting is mainly a risk for Article 6.4 transactions, and when used in accordance with ITMOs by another country so they can meet NDC targets. In voluntary carbon markets (VCM), there is an ongoing debate on whether transactions should be accompanied by corresponding adjustments for any claim regardless of whether the buyer is a part of the UNFCCC or a private entity. No decision has been made so far, but some standards are moving in that direction.

(Source: South Pole, 2020)

2.5.7.1 International agreements

Some policies, following further construction and negotiation through agreements and meetings in the United Nations Framework Convention on Climate Change (UNFCCC), are:

- **FCCC/CP/2005/Misc. 1:** Reducing emissions from deforestation in developing countries: approaches to stimulate action. Submission from Parties (in Portuguese: *Reduzindo emissões de desmatamento em países em desenvolvimento: abordagem para estimular ação. Submissão das partes.* COP 11, Montreal, 2005).

- **FCCC/CP/2007/6/Add. 1:** Report of the Conference of the Parties on its 13th session, held in Bali from December 3 to 15, 2007. Addendum. Part Two: Action taken by the Conference of the Parties at its 13th session (in Portuguese*: Relatório da Conferência das Partes sobre sua décima terceira sessão, ocorrida em Bali de 3 a 5 de dezembro de 2007. Addendum. Part Two: Ação tomada pela Conferência das Partes em sua décima terceira sessão ou "Action Bali Plan."* COP 13, Bali, 2007).

- **FCCC/CP/2009/Add. 1:** Report of the Conference of the Parties on its 15th session, held in Copenhagen from December 7 to 19, 2009. Addendum. Part Two: Action taken by the Conference of the Parties at its 15th session (in Portuguese: *Relatório da Conferência das Partes sobre sua décima quinta sessão, ocorrida em Copenhagem de 7 a 19 de dezembro de 2009. Addendum. Part Two: Ação tomada pela Conferência das Partes na sua décima quinta sessão ou "Copenhagem Accord."* COP 15, Copenhagen, 2009).

- **FCCC/CP/2010/7/Add. 1:** Report of the Conference of the Parties on its 16th session, held in Cancun from November 29, to December 10, 2010. Addendum. Part Two: Action taken by the Conference of the Parties at its 16th session (in Portuguese: *Relatório da Conferência das Partes sobre sua décima sexta sessão, ocorrida em Cancun de 19 de novembro a 10 de dezembro de 2010. Addendum. Parte Dois: Ação tomada pela Conferência das Partes na sua décima sexta sessão ou "Cancun Agreement."* COP 16, Cancun, 2010).

- **FCCC/CP/2011/9/Add. 1:** Report of the Conference of the Parties on its 17th session, held in Durban from November 28, to December 11, 2011. Addendum. Part Two: Action taken by the Conference of the Parties at its 17th session (in Portuguese: *Relatório da Conferência das Partes sobre sua décima sétima sessão, ocorrida em Durban de 28 de novembro a 11 de dezembro de 2011. Addendum. Parte Dois: Ação tomada pela Conferência das Partes em sua décima sétima sessão.* COP 17, Durban, 2011).

- **FCCC/CP/2012/8/Add. 1:** Report of the Conference of the Parties on its 18th session, held in Doha from November 26, to December 8, 2012. Addendum. Part Two: Action taken by the Conference of the Parties at its 18th session (in Portuguese: *Relatório de Conferência das Partes sobre sua décima oitava sessão, ocorrida em Doha de 26 de novembro a 8 de dezembro. Addendum. Parte Dois: Ação tomada pela Conferência das Partes em sua décima oitava sessão*).

- **FCCC/CP/2013/10/Add. 1:** Warsaw Framework for REDDplus, held in Warsaw, Poland, from November 11 to 22, 2013 (in Portuguese: *Pacote de Varsóvia para REDD+, ocorrida em Varsóvia, Polônia, de 11 a 22 de Novembro de 2013*). In particular, the following decisions:

- **Decision 9/CP. 19:** Work program on results based finance to progress the full implementation of the activities referred to in decision 1/CP. 16, paragraph 70 (in Portuguese*: Programa de trabalho em financiamento baseados em resultados para o progresso da implementação completa das atividades referidas na decisão 1/CP*. 16, parágrafo 70).

- **Decision 10/CP. 19:** Coordination of support for the implementation of activities in relation to mitigation actions in the forest sector by developing countries, including institutional arrangements (in Portuguese: *Coordenação do suporte para a implementação de atividades relacionadas a ações de mitigação no setor florestal por países em desenvolvimento, incluindo arranjos institucionais*).

- **Decision 12/CP. 19:** The timing and the frequency of presentations of the summary of information on how all the safeguards referred to in decision 1/CP. 16, appendix I, are being addressed and respected (in Portuguese: *O tempo e a frequência na qual são apresentadas as informações resumidas de como todas as salvaguardas referidas na dicisão 1/CP. 16, apêndice I, estão sendo abordadas e respeitadas*).

- **Decision 13/CP. 19:** Guidelines and procedures for the technical assessment of submissions from Parties on proposed forest reference emission levels and/or forest reference levels (in Portuguese: *Guia e procedimentos para avaliação técnica das submissões das Partes em propostas de níveis de referência em emissões florestais e/ou níveis de referência florestal*).

- **Decision 14/CP. 19:** Modalities for measuring, reporting and verifying (in Portuguese: *Modalidades para medir, reportar e verificar*).

- **Decision 15/CP. 19:** Addressing the drivers of deforestation and forest degradation (approach of deforestation and forest degradation drivers).

- **FCCC/CP/2015/10/Add. 1:** Report of the Conference of the Parties on its 21st session, held in Paris from November 30, to December 13, 2015. Addendum. Part Two: Action taken by the Conference of the Parties at its 21st session (in Portuguese: *Relatório de Conferência das Partes sobre sua vigésima primeira sessão, ocorrida em Paris de 30 de novembro a 13 de dezembro. Addendum. Parte Dois: Ação tomada pela Conferência das Partes em sua vigésima primeira sessão*).

- **FCCC/CP/2016/10/Add. 1:** Report of the Conference of the Parties on its 22nd session, held in Marrakech from November 7 to 18, 2016. Addendum: Part two: Action taken by the Conference of the Parties at its 22nd session (in Portuguese: *Relatório de Conferência das Partes sobre sua vigésima segunda sessão, ocorrida em Marrakech desde o 7 de novembro a 18 de vovembro. Addendum. Parte Dois: Ação tomada pela Conferência das Partes em sua vigésima segunda sessão*).

- **FCCC/CP/2017/11/Add. 1:** Report of the Conference of the Parties on its 23rd session, held in Bonn from November 6 to 18, 2017. Addendum: Part two: Action taken by the Conference of the Parties at its 23rd session (in Portuguese: *Relatório de Conferência das Partes sobre sua vigésima terceira sessão, ocorrida em Bonn desde o 6 de novembro até o 18 de novembro de 2017. Addendum. Parte Dois: Ação tomada pela Conferência das Partes em sua vigésima terceira sessão*).

- **FCCC/CP/2018/10/Add. 1**: Report of the Conference of the Parties on its 24th session, held in Katowice from December 2 to 15, 2018 Addendum: Part two: Action taken by the Conference of the Parties at its 24th session (in Portuguese*: Relatório de Conferência das Partes sobre sua vigésima quarta sessão, ocorrida em Katowice desde o 2 de dezembro até o 18 de dezembro de 2018. Addendum. Parte Dois: Ação tomada pela Conferência das Partes em sua vigésima quarta sessão*).

2.5.7.2 National level

At the national level, the National Policy on Climate Change (PNMC, Law No. 12.187/2009)[98] outlined the objectives and guidelines for addressing climate change in Brazil, providing that the national voluntary commitment to reduce GHG emissions from 36.1% to 38.9% in relation to the projected emissions until 2020. With regards to specific REDD+ actions, Brazil committed to achieving, in 2020, a reduction of 80% in the rate of deforestation in the Amazon biome, to be measured against the historical average between 1996 and 2005 (19,625 km^2), and 40% in the Cerrado biome, to be measured against the average between 1999 and 2008 (15,700 km^2). For the other biomes, it should seek to stabilize emissions at 2005 levels[99]; however, this was not part of the country's direct commitments. In addition, the National Policy and the National Plan on Climate Change intend to promote measures to reduce the adverse effects of climate change and the vulnerability of environmental, social and economic systems, thus, contributing to adaptation. The coordination, supervision and impact monitoring of the National Policy and the National Plan are the responsibility of the Interministerial Committee on Climate Change (CIM) and its Executive Group on Climate Change (GEx), in accordance with Decree No. 6.263/2007.[100] Brazil´s sovereign

[98] Available at (Portuguese only): <http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2009/lei/l12187.htm>.
[99] Available at (Portuguese only): http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2010/Decreto/D7390.htm.
[100] Available at (Portuguese only): <http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2007/Decreto/D6263.htm>.

commitment for the protection of native vegetation and the integrity of the climate system for the well-being of present and future generations was reiterated by Law No. 12.651/2012 (Forest Code).[101] It also established restrictions on the use of certain areas of private property, which should be covered by native vegetation as Permanent Preservation Areas (APP) and Legal Reserves (RL), and as defined by law, must be maintained by the landholders.

Other environmental policies and laws regarding project activities:

- Law of Environmental Crimes (Law No. 9.605/1998);[102]
- National System of Conservation Units (Law No. 9.985/2000);[103]
- Law on Data and Information of the National Environment System (Law No. 10.650/2003);[104]
- Priority Areas for Conservation, Sustainable Use and Biodiversity Benefits Sharing (Decree No. 5.902/2004 and MMA's Ordinance No. 09/2007);[105]
- Atlantic Forest Law (Law No. 11.428/2006);[106]
- Public Forests Management Law (Law No. 11.284/2006);[107] and
- National Policy for Environmental and Territorial Management of Indigenous Lands (Decree No. 7.747/2012).[108]

At the tactical-operational level, Brazil has developed biome-wide action plans for the prevention and control of deforestation, which are, at present, the main instruments for promoting integration and coordination of REDD+ initiatives. The Amazon and the Cerrado are the biomes that have action plans.[109]

The national and state plans feature analyses on land tenure issues, forest governance, deforestation dynamics and its main drivers, as well as the situation of indigenous peoples and traditional communities. The plans also present a logical framework that guides the design and prioritizes actions to address the drivers identified: a detailed operational plan, assigning whichever body is responsible for each action; and the necessary resources for its implementation. The plans are reviewed and updated periodically. Due to their relevance, Brazil has only developed the Action Plan for the Prevention and Control of Deforestation in the Amazon (PPCDAm) and the Action Plan for the Prevention and Control of Deforestation and Forest Fires in the Cerrado (PPCerrado);[110] which were incorporated as instruments in the PNMC.

The Action plans and the Sectorial Plans: Climate Change Mitigation and Adaption to Establish a Low-Carbon Economy in Agriculture (ABC Plan), and Steel Sector Emission Reductions (Charcoal Plan). Together, these plans form the pillars of the PNMC for mitigation in the LULUCF sector, contributing directly to REDD+.

[101] Available at (Portuguese only): http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12651.htm.
[102] Available at (Portuguese only): http://www.planalto.gov.br/ccivil_03/leis/l9605.htm.
[103] Available at (Portuguese only): http://www.planalto.gov.br/ccivil_03/leis/l9985.htm.
[104] Available at (Portuguese only): <http://www.planalto.gov.br/ccivil_03/Leis/2003/L10.650.htm>.
[105] Available at (Portuguese only): <http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2004/decreto/d5092.htm>.
[106] Available at (Portuguese only): <http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2006/lei/l11428.htm>.
[107] Available at (Portuguese only): <http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2006/lei/l11284.htm>.
[108] Available at (Portuguese only): <http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/decreto/d7747.htm>.
[109] https://www.mma.gov.br/clima/politica-nacional-sobre-mudanca-do-clima/planos-setoriais-de-mitigacao-e-adaptacao.
[110] Available at http://combateaodesmatamento.mma.gov.br/images/conteudo/Planos_ultima_fase.pdf

In addition, Federal Decree No. 8,576/2015 established an Environmental Commission to coordinate and monitor the implementation of the so-called National Strategy on REDD+.[111] The major objective of this strategy is to enhance the monitoring and the analysis of the impacts of public policies for the achievement of REDD+ results, and to comply with the National Policy on Climate Change, among other things.

Similarly, the Ministry of Environment created multidisciplinary focal groups of discussions to elaborate on major aspects of REDD+. A specific chamber called "Safeguard Chamber" was created to assist the National Committee on REDD+ with the range of guidelines, rules and criteria related to safeguard matters within the national strategy on REDD+.

Below is a brief review of the main relevant laws and regulations at the CONAREDD+:

- Resolutions Nos. 1, 2, 3, and 4 of July 11, 2016, establish guidelines and create thematic advisory chambers on safeguards, federative pact and non-reimbursable fundraising and distribution.[112]

- Resolution No. 5 of December 16, 2016, establishes the general principles for the implementation of the National Strategy for REDD+ through the National Commission for REDD+ and its Thematic Consultative Chambers.[113]

- Resolution No. 6 of July 6, 2017, defines the distribution of limits for capturing payments due to the reduction of emissions from deforestation in the Amazon biome.[114]

- Resolution No. 7 of July 6, 2017, defines the rules for the eligibility of Amazonian states and federal entities to access and attract payments for results of reducing emissions from deforestation in the Amazon biome.[115]

- Resolution No. 8 of December 7, 2017, defines the guidelines for the use of resources and the monitoring of REDD+ results-based payment agreements.[116]

- Resolution No. 9 of December 7, 2017, adopts the interpretation of Cancun's safeguards in the Brazilian context and gives other measures to CCT-Safeguards.[117]

- Resolution No. 10 of December 7, 2017, approves the eligibility of federal and state entities to access and capture payments for the results of reducing emissions from deforestation in the Amazon biome.

[111] Available in https://redd.unfccc.int/files/brazil_national_redd__strategy.pdf
[112] Available in http://redd.mma.gov.br/images/publicacoes/conaredd_res01a04_2016.pdf
[113] Available in http://redd.mma.gov.br/images/conaredd/conaredd-resolucao5-principiosgerais.pdf
[114] Available in http://redd.mma.gov.br/images/central-de-midia/pdf/Documentos/conaredd-resolucao-no6-20170621-final.pdf
[115] Available in http://redd.mma.gov.br/images/central-de-midia/pdf/Documentos/conaredd-resolucao-no7-elegibilidade-20170719-final.pdf
[116] Available in http://redd.mma.gov.br/images/conaredd/SEI_MMA---0160805---Resoluo-8.pdf
[117] Available in http://redd.mma.gov.br/images/conaredd/SEI_MMA---0160864---Resoluo-9.pdf

- Resolution No. 11 of December 7, 2017, extends the term of operation of the Thematic Advisory Chamber on Safeguards (CCT) Safeguards and reestablishes the Thematic Advisory Chamber on Federative Pact (CCT) Federative Pact.

- Resolution No. 12 of April 24, 2018, defines the distribution of limits for capturing payments for the results of reducing emissions from deforestation in the Amazon biome for the year 2016.

- Resolution No. 13 of September 27, 2018, defines elements for the monitoring report on the implementation of the REDD+ results-based payment agreements.

- Resolution No. 14 of September 27, 2018, defines the distribution of the limits for capturing payments due to the reduction of emissions from deforestation in the Amazon biome for the year 2017 and amends the single annex to Resolution No. 12 of April 24, 2018 (see above).

- Resolution No. 15 of September 27, 2018, amends the sole annex of Resolution No. 9 of December 7, 2017 (see above).[118]

- Resolution No. 1 of July 22, 2020, creates the technical working group on Safeguards.

- Resolution No. 2 of July 22, 2020, creates the technical working group on Measurement, Reporting and Verification of REDD+ results.[119]

- Resolution No. 3 of July 22, 2020, recognizes the voluntary forest carbon market.[120]

Relevant and important regulations regarding biodiversity:

- **Law No. 13,123 of May 20, 2015:** regulates item II of § 1 and § 4 of art. 225 of the Federal Constitution, Articles 1, 8 (j), 10 (c), 15, and 16, Paragraphs 3 and 4 of the Convention on Biological Diversity, promulgated by Decree No. 2,519 of March 16, 1998. Also, this provides access to genetic heritage and protection, access to associated traditional knowledge and benefit sharing for conservation and sustainable use of biodiversity; it repeals Provisional Measure No. 2. 18616 of August 23, 2001; and makes other arrangements.

- **Law No. 12,651 of May 25, 2012:** provides for the protection of native vegetation and amends Laws 6,938 of August 31, 1981; 9,393 of December 19, 1996; and 11,428 of December 22, 2006. In addition, it revokes Laws 4,771 of September 15, 1965, and 7,754 of April 14, 1989; and Provisional Measure No. 2 – 16667 of August 24, 2001; and other measures.

- **Decree No. 58,054 of March 23, 1966:** promulgates the convention for the protection of flora, fauna and the scenic beauties of the countries of America.

[118] http://redd.mma.gov.br/images/conaredd/SEI_MMA---0335920---Resoluo-15.pdf
[119] Available in http://redd.mma.gov.br/images/publicacoes/Resolucoes/Resoluo-n-1-de-22-de-Julho-de-2020.pdf
[120] Available in http://redd.mma.gov.br/images/publicacoes/Resolucoes/Resolu%C3%A7%C3%A3o%20n%C2%BA%203%20de%2022%20de%20Julho%20de%202020%20-%20Mercado%20Voluntario%20de%20Carbono%20Florestal.pdf

- **IBAMA Ordinance No. 37N of March 4, 1992:** recognizes the Official List of Species of the Brazilian Flora Threatened of Extinction, which is presented in the Ordinance.

Conclusion

Considering the legal framework above, one of the challenges facing REDD+, which remains in Brazil and biomes outside Amazon and Cerrado, is the need to create opportunities for the projects developed prior to 2020, by addressing the legal uncertainties connected to REDD+ and attracting governmental and private investments. In this sense, the National Fund on Climate Change and the Brazilian Carbon Market established by the National Policy on Climate Change could increase the amount of funds available to help control deforestation, as well as contribute to the modernization and competitiveness of the industry.[121]

In summary, Brazil currently lacks specific laws and regulations that govern REDD+ initiatives and private carbon projects. However, there is a movement towards developing a national policy framework for climate change and REDD+ in Brazil, which has the potential to impact the rights of the project to generate VCUs and sell them offshore to voluntary carbon markets. Finally, as a result of the Paris Agreement, the global business environment is already changing, and companies that succeed in contemplating the policy measures proposed in the National Policy on Climate Change and implementing their own strategies accordingly will be at an advantage.

2.5.8 Approvals (G5.7)

Project proponents have achieved recognition and approval of project implementation through meetings between employees, communities around the project consultation, as well as consultation with partners (see section 2.3). The project proponent is always present in federal and state government discussion forums to contribute to the formulation of these policies and regulations, being promptly available to adapt the project to any new officially established law, decrees or rules.

2.5.9 Project ownership (G5.8)

The IHP is a civil, private not-for-profit organization, register No. 4 Corumba-MS.[122] It is a legitimate owner and manager where the Serra do Amolar REDD+ project is being implemented and developed (see section 2.5 – Statutory and Customary Property Rights).

2.5.10 Management of double counting risk (G5.9)

The project has not received any environmental or social credit, including certificates related to GHG emissions reduction or renewable energy. The reduction or removal of emissions resulting from the implementation of these project activities will not be used to meet the emission reduction targets of any

[121] https://www.environmentlawinsights.com/2017/05/16/redd-in-brazil-the-right-moment-to-attend-discussions-and-seek-opportunities/
[122] Proof of Registration and Registration status available at: https://servicos.receita.fazenda.gov.br/Servicos/cnpjreva/cnpjreva_solicitacao.asp consulting CNPJ No: CNPJ:16.575.853/0001-91

other REDD+ program or mechanism. For further information on strategies to help eliminate double counting in the project crediting period, see section 2.5.15.

2.5.11 Emissions trading programs and other binding limits

The emissions reduction, as a result of this project, will not be used for compliance under any other trading program or mechanism. The current VCS and CCB project is entirely independent of any other carbon project or payment of ecosystem service scheme being developed in the states of Mato Grosso do Sul and Mato Grosso, or even in Brazil.

2.5.12 Other forms of environmental credit

The project has not sought nor received any other form of GHG-related environmental credit.

2.5.13 Participation under other GHG programs

The project has not been registered and is not seeking registration under any other GHG program.

2.5.14 Projects rejected by other GHG programs

No other GHG program has rejected the project.

2.5.15 Double counting (G5.9)

The project does not attempt to generate, nor has it received any other form of environmental or social credit, including any tradable climate, community or biodiversity unit. To avoid possible double-counting of mitigation results at the national level, particularly for credits sold as offsets in the voluntary market and those generated for commercialization, the project proponent will take the necessary actions to register and share information of the initiative to the National Commission for Reducing Emissions of Greenhouse Gases from Deforestation and Forest Degradation (CONAREDD).

3 CLIMATE

3.1 Application of methodology

3.1.1 Title and reference of methodology

- 'VCS Methodology VM0015 – Methodology for Avoided Unplanned Deforestation, version 1.1', December 3, 2012.
- 'VT0001 – Tool for the Demonstration and Assessment of Additionality in VCS AFOLU Project Activities, version 3.0', February 2012.
- 'AFOLU Non-Permanence Risk Tool, version 3', October 19, 2016.

3.1.2 Applicability of methodology

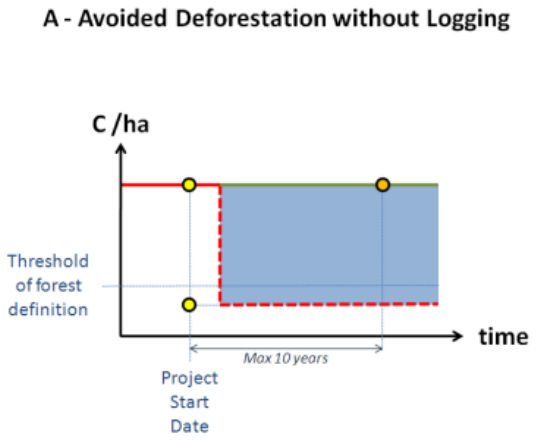
The VCS and CCB voluntary market standard have several methodologies applicable to Agriculture, Forestry and Other Land Use (AFOLU). Due to the characteristics of the activities developed by the Serra do Amolar REDD+ project, the most applicable categories to its conservation objectives and future

expectations are Reduction of Emissions from Deforestation and Degradation (REDD) and Wetland Conservation and Restoration (WRC).

According to the analysis of applicability conditions, the available information and the activities developed by the proponent, the 'VCS Methodology VM0015 – Avoided Unplanned Deforestation'[123] was chosen. Due to the gaps in information needed for the WRC applicability conditions, the conservation of wetland areas has been discarded for the project.

According to the applicability conditions stated in the VM0015 methodology and Nature,[124] the methodology has no geographic restrictions and is applicable globally under the following conditions:

Table 25. Analysis of applicability conditions for the VM0015 methodology

Applicability conditions	Applicability of the project
Baseline activities may include planned or unplanned logging for timber, fuel wood collection, charcoal production and agricultural and grazing activities, as long as the category is unplanned deforestation according to the most recent VCS AFOLU guidelines.	The RPCSA REDD+ project's baseline scenario encompasses unplanned deforestation, with native vegetation loss for cattle ranching, and temporary agriculture purposes, as well as fuel wood. For more information, please refer to sections 2.4 and 2.5.
Project activities may include one or a combination of the eligible categories defined in the description of the scope of the methodology (see Table 1 and Figure 2).	The RPCSA REDD+ is eligible with scenario A: Avoid deforestation without logging with controlled activities of logging, fuel wood collection or other activities related to charcoal production. 

[123] VM0015 Methodology for Avoided Unplanned Deforestation, v1.1 – Verified Carbon Standard (VCS). Available in
[124] REDD+ standard and methodology analyzed for the project, also https://www.nature.org/content/dam/tnc/nature/en/documents/EligibilityRequirementsforREDDPlus_Financing_2021.pdf.

Applicability conditions	Applicability of the project
The project area can include different types of forest such as, but not limited to, old-growth forest, degraded forest, secondary forests, planted forests and agro-forestry systems meeting the definition of "forest".	The project area encompasses three types of old-growth forest: • alluvial semi-deciduous seasonal forest (Fa); • lowland semi-deciduous seasonal forest (Fb); and • wooded steppe savannah (Ta). These meet the definition of forest and are monitored as forest according to Brazil's official submission to the UNFCCC.
At project commencement, the project area shall include only land qualifying as forest for a minimum of 10 years prior to the project start date.	For baseline modeling and climate benefits (VCUs), Brazil considers land categorized as forest under the Food and Agriculture Organization (FAO) and UNFCCC definition: "Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use"[125]
The project area can include forested wetlands (such as bottomland forests, floodplain forests, mangrove forests) as long as they do not grow on peat. Peat shall be defined as organic soils with at least 65% organic matter and a minimum thickness of 50 cm. If the project area includes a forested wetland growing on peat (e.g., peat swamp forests), this methodology is not applicable.	Despite the project area including lowland semi-deciduous seasonal forests (Fb) as wetland, they do not grow on peat, nor are they depreciable in terms of area.

(Source: prepared by South Pole, based on the VM0015 methodology guidelines)

On the other hand, according to the applicability conditions stated in the 'VT0001 – Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities, v3.0', the tool is applicable under the following conditions:

[125] Please see: Box 10: https://redd.unfccc.int/files/frelc_modifiedversion_correction2019.pdf.

Table 26. Applicability conditions module 'VT0001 – Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities, v3.0'

Applicability conditions	Applicability of the project
AFOLU activities are the same as or similar to the proposed project activity on the land within the proposed project boundary performed with or without being registered as the VCS AFOLU project shall not lead to violation of any applicable law even if the law is not enforced.	The project activities are based on a conservation plan for strategy areas (RPPNs) that include monitoring against forest degradation and deforestation and sustainable income generation, such as sustainable fishing and non-timber forest production. Neither of these activities has led to a violation of any applicable law, because all activities are already approved by Federal law No. 9.985/2000 issued by the SNUC.
The use of this tool to determine additionality requires the baseline methodology to provide a stepwise approach justifying the determination of the most plausible baseline scenario. Project proponent(s) proposing new baseline methodologies shall ensure consistency between the determination of a baseline scenario and the determination of additionality of a project activity.	This document includes all the steps used to define the most plausible baseline scenario (section 3.1.4.).

(Source: prepared by South Pole, based on the VT0001 methodology)

3.1.3 Project boundary

According to the VM0015 methodology, four types of boundaries must be defined:

- spatial boundaries;
- temporal boundaries;
- carbon pools; and
- sources of emissions of GHG (other than carbon stock changes).

3.1.3.1 Spatial boundaries

The spatial boundaries of the project are divided into reference region, project area or forest; leakage belt and leakage management areas.

3.1.3.1.1 Reference region

The reference region is the Pantanal biome, which corresponds to an area of 15,087,973 ha, about 100 times the size of the project area, located in the federal states of Mato Grosso do Sul and Mato Grosso in Brazil. The reference region had a deforestation rate of 48,465 ha per year (1%) during the period 2006–2016.

The reference region contains the same baseline conditions as the project area (see Table 27). It has experienced a typical deforestation and degradation pattern, and faces threats such as mining, cattle raising, asphalted roads, agricultural settlement and new pasture areas.[126] These activities were taking place inside and outside of the project area, according to the methodology requirements, prior to the start date of the proposed AUD project activity. In addition, such activities are expected to occur within the project area without the project activities.

Threats in the reference region and the project area.

Mining is the most impactful activity in the western part of the reference region, an elevated region locally known as 'Morraria' in Portuguese. In the last 15 years, four mining companies have exploited iron and gold resources: MMX, EBX, Piramide, and Vale. Although these companies have made environmental commitments to the government to recover and protect natural and native landscape, mining activities still occur in the reference region and near to the project area.

Historical and new pasture areas associated with cattle raising also represent a significant threat, causing degradation, soil compaction and creating routes and grooves favorable to water discharge. The expansion and introduction of exotic pastures and new pasture areas also increases the vulnerability of forests and other native ecosystems.

Finally, there is the threat of agricultural settlements, where seasonal logging and clearings are made and the soil is exposed throughout the year.

To determine whether the conditions of the reference region are similar to that of the project area, the following are considered:

1) summary threats for the reference region and the project area (above)
2) agents' groups and causes of deforestation expected to influence the project area (Section 3.2.1.3 regarding to analysis of agents and drivers; (Table 26.a and Table 40),
3) landscape configuration and ecological conditions (Table 26 and section 2.1.5)
4) socio-economic and cultural conditions (section 4.1.1).

Table 26 and Table 26.a compares the reference region and the project area. It shows that 100% of the project area has the same vegetation classes found throughout the reference region; 100% of the project area is within the elevation range of the reference region (29 meters – 1,089 meters above sea level); and that 100% of the project area has the annual precipitation and temperature found throughout the reference region (1000 mm).

[126] Zalles, V., Hansen, M. C., Potapov, P. V., Stehman, S. V., Tyukavina, A., Pickens, A., … Chavez, S. (2019). Near doubling of Brazil's intensive row crop area since 2000. Proceedings of the National Academy of Sciences, 116(2), 428–435. https://doi.org/10.1073/PNAS.1810301115
Prager, A. (2019). Brazil's key deforestation drivers: Pasture, cropland, land speculation. Retrieved from https://news.mongabay.com/2019/03/brazils-key-deforestation-drivers-pasture-cropland-land-speculation/
Cavalcanti, S. M. C., de Azevedo, F. C. C., Tomas, W. M., Boulhosa, R. L. P., & Crawshaw JR., P. G. (2012). The status of the jaguar in the Pantanal. CATnews Special Issue, 7(January), 29–34.

Table 27. Comparison of reference region (RR) and project area (PA)

Class	Reference region	Project area
Forest		
Submontane Deciduous Seasonal Forest (Cs)	Yes	Yes
Alluvial Semi deciduous Seasonal Forest (Fa)	Yes	Yes
Lowland Semi deciduous Seasonal Forest (Fb)	Yes	Yes
Wooded Steppe Savannah (Ta)	Yes	Yes
Non-forest		
Savannah-park without riparian forests	Yes	Yes
Wooded Steppe Savannah without riparian forests	Yes	Yes
Wooded Savanna without riparian forests	Yes	Yes
Savanna	Yes	Yes
Elevation range (meters a.s.l)	29–1,089	29–1,089
Average slope (%)	0–8	0–8
Annual average rainfall (mm)	1000	1000

Table 26a. Comparison of agents and causes of deforestation expected on the reference region (RR) and project area (PA)

Class of agent, cause of deforestation expected		Reference region	Project area
Underlying causes	Increasing the number of cattle heads	In the last 20 years, families who had been raising cattle in the region are increasing the number of heads per hectare due to low productivity. The 2017 Census shows an annual increase of 1.5% for the state of Mato Grosso do Sul.[127]	Many landowners around the project are increasing the number of heads. Corumbá municipality where is the project hold the second ranking with more cattle heads in Brazil. [128]

[127] Source: https://censoagro2017.ibge.gov.br/en/2185-news-agency/releases-en/31738-ppm-2020-cattle-herd-is-1-5-bigger-and-amounts-to-218-2-million-head.html
[128] IBGE, 2019. Source: https://censos.ibge.gov.br/en/2184-news-agency/news/29177-cattle-herd-records-slight-increase-in-2019-after-two-straight-years-of-decrease.html

Class of agent, cause of deforestation expected		Reference region	Project area
	Land policies and other economic forces	Land-use policies threaten the reference region by accelerating the growth of agribusiness, weaking federal authority and granting immunity from prosecution for deforestation.[129]	The Brazilian code has accelerating small landing in the region without environmental commitments.
Agents of deforestation	Ranchers and local communities	Locally known as “pantaneiros” and “riberinhos”, the cowboys that work here have a culture deeply rooted in rural traditions and been here more than 200 years ago.	The project area located to 180 km to Corumbá (one of the cultural city reference for the Pantanero culture).Until last decade It was inhabited by Pantaneros,
	Farmers and agribusiness	Farmers and agribusiness increasing productive areas each year in the reference region.	The agricultural expansion areas near to the project area represent a second corn, sugar and soy production in Brazil.

(Source: South Pole, 2022)

3.1.3.1.2 Project area

The Serra do Amolar REDD+ project has an area of 135,061 ha under the control of IHP. The carbon accounting area has an extension of 64,443 ha, where the proposed conservation activities will be carried out. This was defined as the area of existing forest within the limits of the project in 2016, when tourism, research and other activities began to take place (Figure 27).

[129] Jeff Tollefson, “Brazil Revisits Forest Code,” *Nature* 476, no. 7360 (2011): 259–60, https://doi.org/10.1038/476259a.

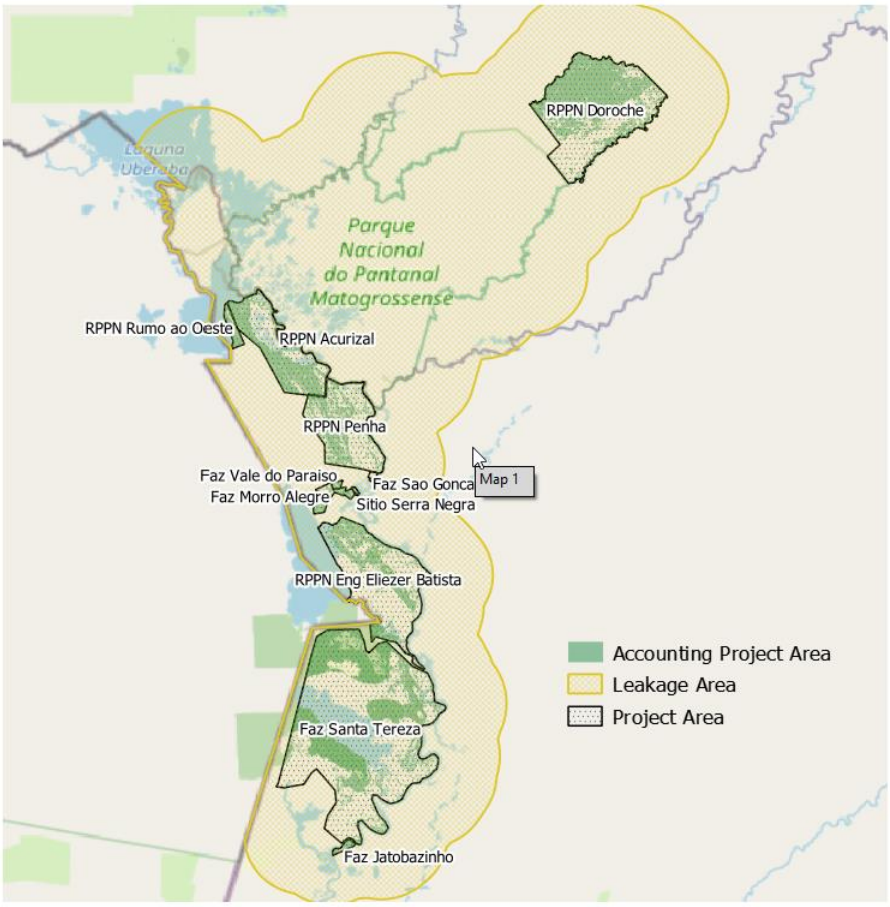


Figure 27. Location of the project area

(Source: IBGE, 2015; IHP, 2019)

3.1.3.1.3 Forest definition

The Pantanal ecosystem contains a large diversity of forest types. The forest definition applicable to Brazil is that provided by the Food and Agriculture Organization of the United Nations (FAO) for the Global Forest Resources Assessments (FRA):

“Forest is defined as land spanning more than 0.5 hectare with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. Land not classified as “Forest”, spanning more than 0.5 hectare; with trees higher than 5 meters and a canopy cover of 5–10 percent, or trees able to reach these thresholds in situ; or with a combined cover of shrubs, bushes and trees above 10 percentage classified as “Other Wooded Land.”

The classification of vegetation typologies into the categories of “Forest” and “Other Wooded Land”, used by FAO include:

- submontane deciduous seasonal forest (Cs);

- alluvial semi-deciduous seasonal forest (Fa);
- lowland semi-deciduous seasonal forest (Fb); and
- wooded steppe savannah (Ta).

3.1.3.1.4 Leakage belt and leakage management areas

The leakage belt corresponds to those areas of forest located around the project areas, in which deforestation could be displaced by implementing the project activity within the boundaries of the project area. The leakage belt was designed using Option II of the VM0015 methodology, which is based on a "Mobility Analysis".

The section 1.1.3 of the of the methodological document VM0015 indicates that an analysis of the potential mobility of deforestation agents should be carried out and evaluated via multi-criteria analysis.

For the multi-criteria analysis, the following weights were assigned taking into account that the objective is based on determining adjacent areas where the deforestation that would be avoided in the project area would be displaced and must be contained within the reference region (see Table 3). To assign these weights, the Weighted Sum tool on ArcGIS was used.

Table 28 Variables and spatial data used as inputs for multi-criteria analysis

Variable input	Description	Source	Weighted Sum
Distance to previous deforestation	Euclidean distance to previous deforestation (2006-2016)	Mapbiomas Collection 6	15%
Distance to rivers	Euclidean distance to rivers	Calculated from national information (IBGE, 2020)	15%
Distance to roads	Euclidean distance to roads	Calculated from national information (IBGE, 2020)	10%
Distance to settlements	Euclidean distance to river communities, reclassify in quantiles	Calculated from Alto Paraguay Basin (BAP) (WWF, 2018)	10%
Distance to Project area	Euclidean distance to project area (buffer of 10km)	Landowner	50%

(Source: South Pole, 2022)

It should be clarified that Option I: Opportunity cost analysis has not been able to demonstrate through the literature and other sources of secondary information, and no evidence of another AUD project present within 50km of the project area. Therefore the use of Option II (mobility analysis) was considered for greater consistency with the context of the territory.

Following are the Euclidean distances for each parameter used in the multi-criteria analysis.

Distance to rivers	Distance to previous deforestation

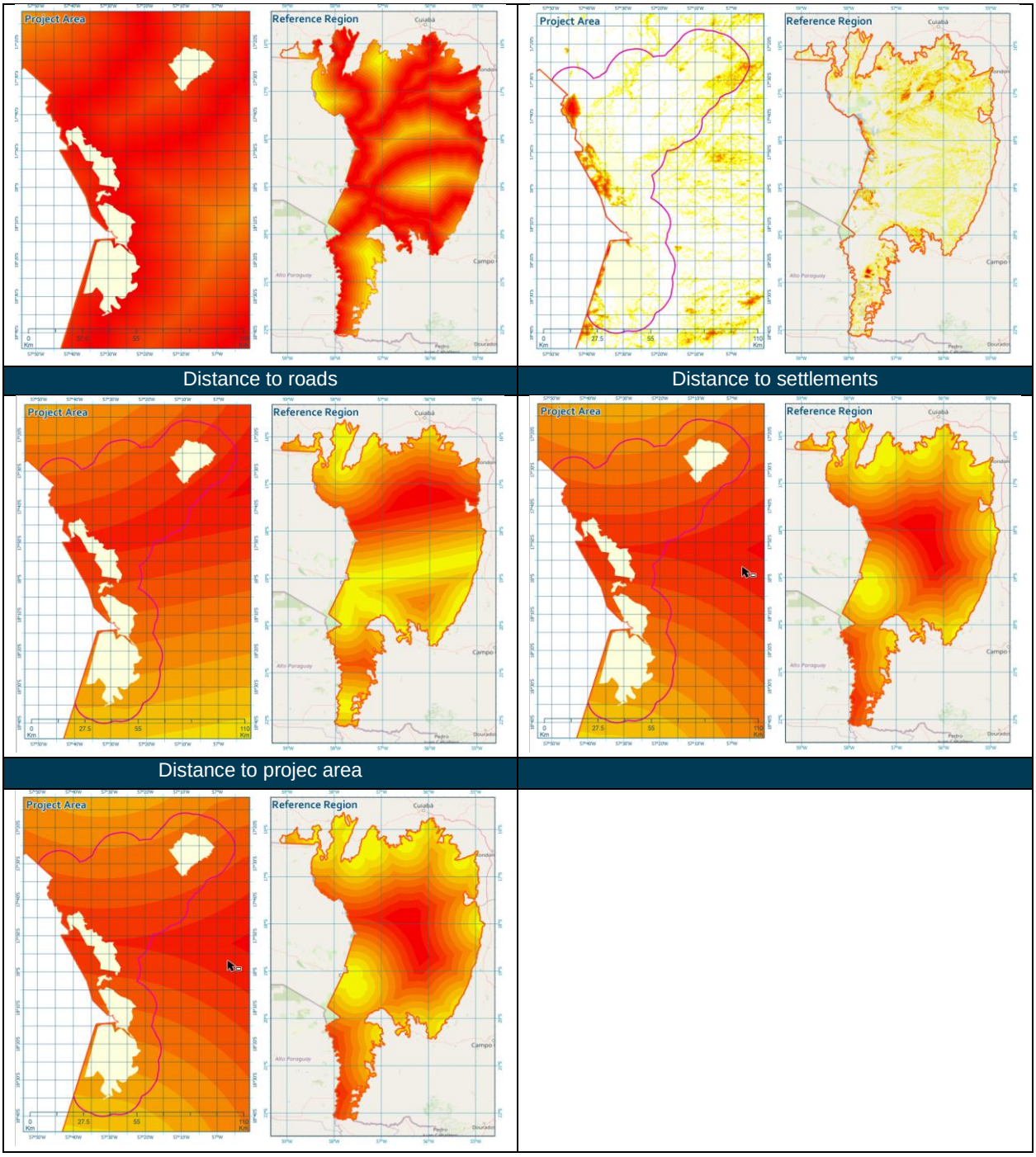


Figure 28 Euclidian distances for parameters within multi-criteria analysis

(Source: South Pole, 2022)

For Serra do Amolar REDD+ project assigning these weights, we obtained a raster map showing near areas to the project area where the leakage belt should be located, this result was refined with the 10km vector to the project area.

In order to, the leakage belt corresponds to the near-forests areas to the project area, and the leakage management area corresponds to the non-forest area surrounding the project area that were not defined as a project area, according to the eligibility criteria.

For new instances, the boundaries of the leakage belt must be adhere to the following criteria:

- The leakage belt corresponds to areas closest to the project area and with the maximum amount of forest that is like the project area, with respect to landscape factors (see section 2.1.5), and social factors (see section 2.1.6). In addition, the policies and regulations that have an impact on land use are the same as those for the project area.
- The leakage belt is not spatially biased in terms of the distance between its edge and the edge of the project area.
- The leakage belt is accessible and reachable by the deforestation agents of the project baseline.

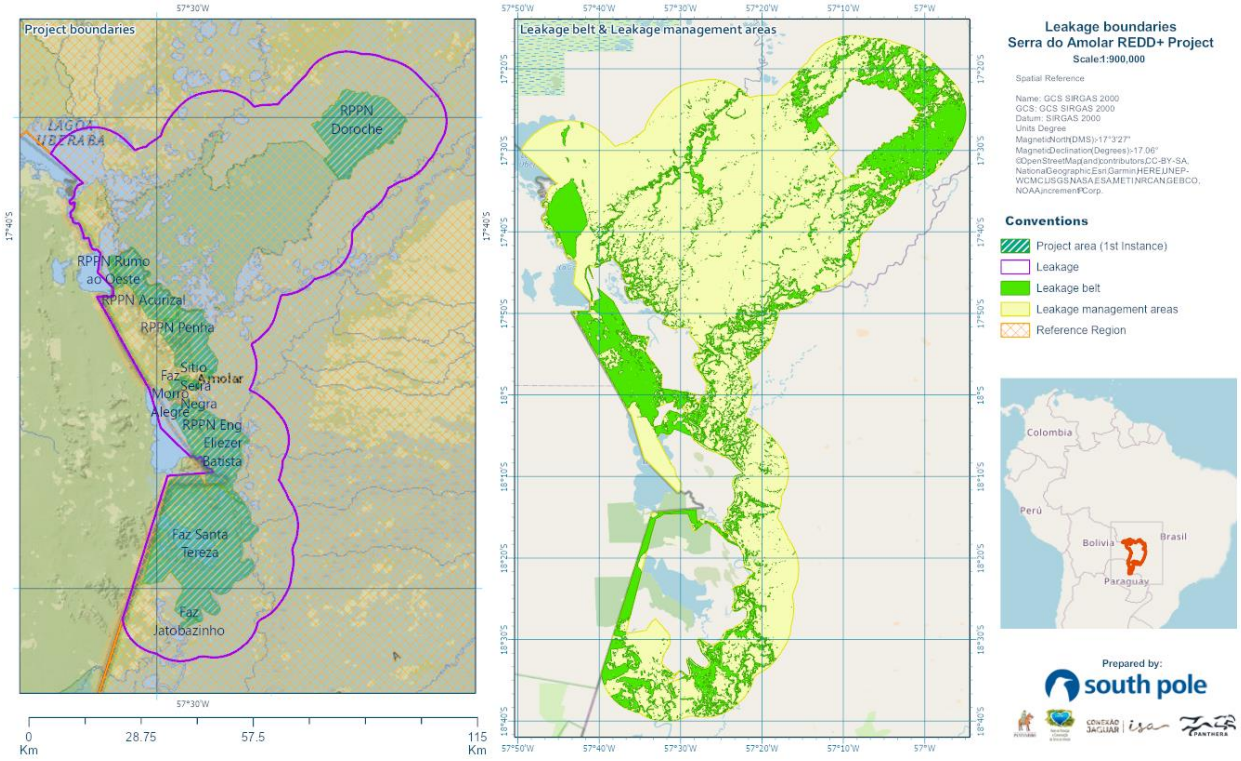


Figure 29. Delimitation of leakage belt and leakage management area

(Source: South Pole, 2020)

3.1.3.2 Temporal boundaries

In accordance with the selected methodology, the following temporary limits were considered:

- Historic reference period: for the projection of the deforestation under the historic approach, the reference period corresponds to all the years that have passed between three spatial data points. Considering the availability of land use cover, the historic reference period is 2006–2016 (10 years to the past regarding the start date of the project).

- Period of certification of the REDD+ project: the selected certification period was 2016–2045; 30 years from the start date of the project.

- Date for the revalidation of the baseline: considering that the baseline must be renovated every 10 years after the start date of the project, the date for this revalidation is 2026.

- Monitoring period: the monitoring period/verification process will be every three to five years. It will depend on the income managed by the IHP and the cost-benefit analysis for the optimal verification period (amount of expected carbon credits).

3.1.3.3 Carbon pools

The carbon pools analyzed in the Serra do Amolar REDD+ project are listed in Table 29.

Table 29. Carbon reservoirs included in the Serra do Amolar REDD+ project

Carbon pool	Included/excluded	Justification/explanation of choice
Above ground	Tree: included	Change in carbon stocks in this pool is significant.
	Non-tree: excluded	It should be included in categories in which the final class of land cover is perennial crops. This pool does not apply to the project.
Below ground	Included	The pool represents 21% of the expected emissions in the baseline scenario, according to Miranda *et al.*, 2014.
Dead wood	Excluded	The changes in carbon stocks for this pool are considered a significant proportion (>10%) of the total carbon stock change attributable.
Wood products	Excluded	Not included: the pool of wood products in the baseline scenario is low and insignificant due to remoteness (distance from markets); lack of infrastructure (transportation of raw product, timber industry); and the slow rate of growth of many of the tree species with potential markets relative to the opportunity cost of capital (Seidl, et al., 2000).
Litter	Excluded	It should not be inventoried according to the 'VCS Methodology Requirements 4.0', updated on September 19, 2019. Not applicable to the project.

Organic carbon in soil	Excluded	Should not be inventoried in conversion to pasture and perennial crops according to 'VCS Methodology Requirements 4.0', updated on September 19, 2019. Not applicable to the project.

(Source: Table 3 of VM0015 methodology)

3.1.3.4 Sources of GHG emissions

GHG sources and sinks in the baseline scenario are presented in Table 30:

Table 30. GHG sources and sinks in the baseline scenario

Source		Gas	Included/excluded	Justification/explanation of choice
Baseline	Biomass burning	CO_2	Excluded	Registered as changes in carbon stocks.
		CH_4	Included	Considered because emissions from fires are used to clear forests. Sufficient data is available to determine the occurrence of natural fire. The project also includes fire management activities related to human occupation and natural circumstances.
		N_2O	Included	Considered because the emissions from fires are used to clear forests.
	Cattle emissions	CO_2	Excluded	Not a significant source.
		CH_4	Excluded	Excluded for simplification. The project does not include livestock activities, so it is conservative to exclude such emissions once they are present in the baseline scenario.
		N_2O	Excluded	Excluded for simplification. The project does not include livestock activities, so it is conservative to exclude such emissions once they are present in the baseline scenario.
Project scenario	Biomass burning	CO_2	Excluded	Registered as changes in carbon stocks.
		CH_4	Included	Considered because emissions from fires are used to clear forests. Sufficient data is available to determine the occurrence of natural fire. The project also includes fire management activities related to human occupation and natural circumstances.
		N_2O	Included	Considered because the emissions from fires are used to clear forests.
	Cattle emissions	CO_2	Excluded	Not a significant source.
		CH_4	Excluded	Not a significant source. No livestock increase is predicted to occur in the project scenario compared to the baseline case. Therefore, the relative contribution according to Tool for testing

Source		Gas	Included/excluded	Justification/explanation of choice
				significance of GHG emissions in A/R CDM project activities 0%
		N_2O	Excluded	Not a significant source. No livestock increase is predicted to occur in the project scenario compared to the baseline case. Therefore, the relative contribution according to Tool for testing significance of GHG emissions in A/R CDM project activities 0%
Leakage	Biomass burning	CO_2	Excluded	Registered as changes in carbon stocks.
		CH_4	Included	Considered because emissions from fires are used to clear forests. Sufficient data is available to determine the occurrence of natural fire. The project also includes fire management activities related to human occupation and natural circumstances.
		N_2O	Included	Considered because the emissions from fires are used to clear forests.
	Cattle emissions	CO_2	Excluded	Not a significant source.
		CH_4	Excluded	Not a significant source.
		N_2O	Excluded	Not a significant source.

(Source: Table 4 of VM0015 methodology, page 28)

3.1.4 Baseline scenario

According to the VCS definition, the baseline scenario is the expected change in land use and land cover in the absence of any project activity designed to reduce emissions from deforestation, forest degradation, or enhance carbon stocks. The baseline scenarios in this project set the historical land use and land cover change that is explained in section 3.1.5.1

The result of the historical deforestation analysis yields the forest and non-forest areas (agroculture, pastures and other uses) at the beginning and end of the historical period. From these values, baseline scenario demonstrates that the forest formation will be lost at a rate of -1% each year in reference region, -0.86% in the leakage belt, and 0.49% in the project area. This analysis considered a gross land cover change between forest and non-forest. Where the non forest is mainly represented by plantation forestry, mining, pastures and agriculture.

Multi-temporal results between the maps for the historical periods, for the different non-forest land cover classes within the reference region are presented below:

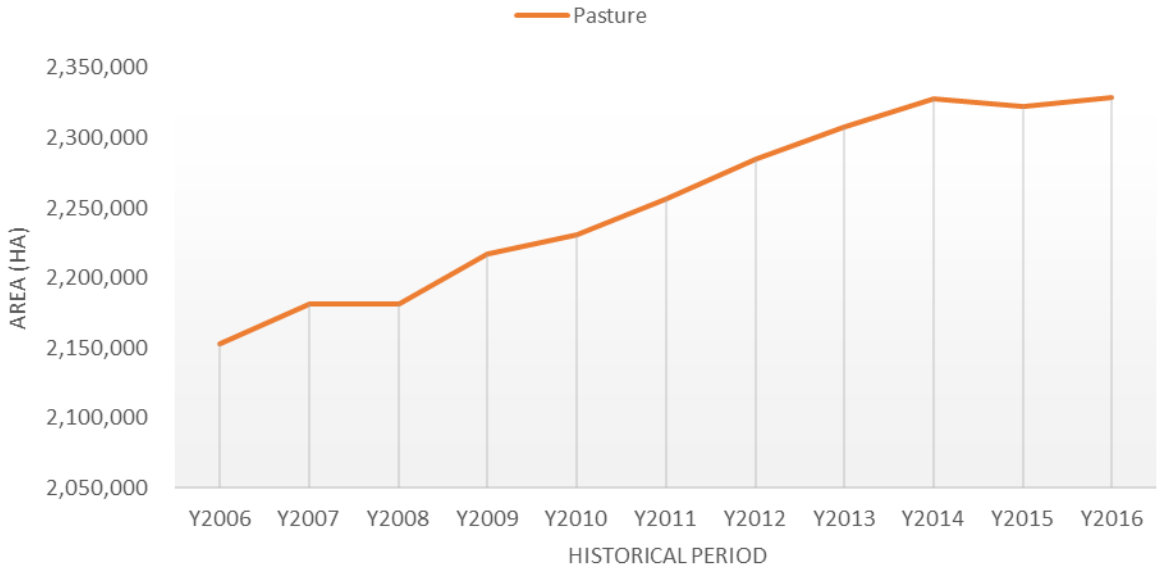


Figure 30. Annual areas of pastures within the Pantanal biome of Brazil

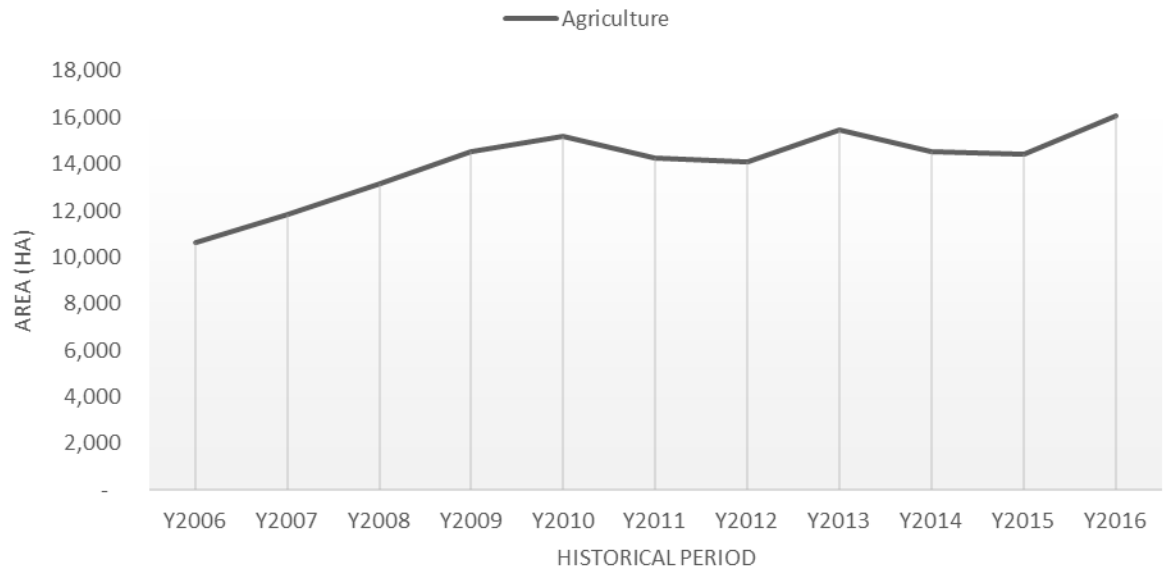


Figure 31. Annual areas of agriculture activities within the Pantanal biome of Brazil.

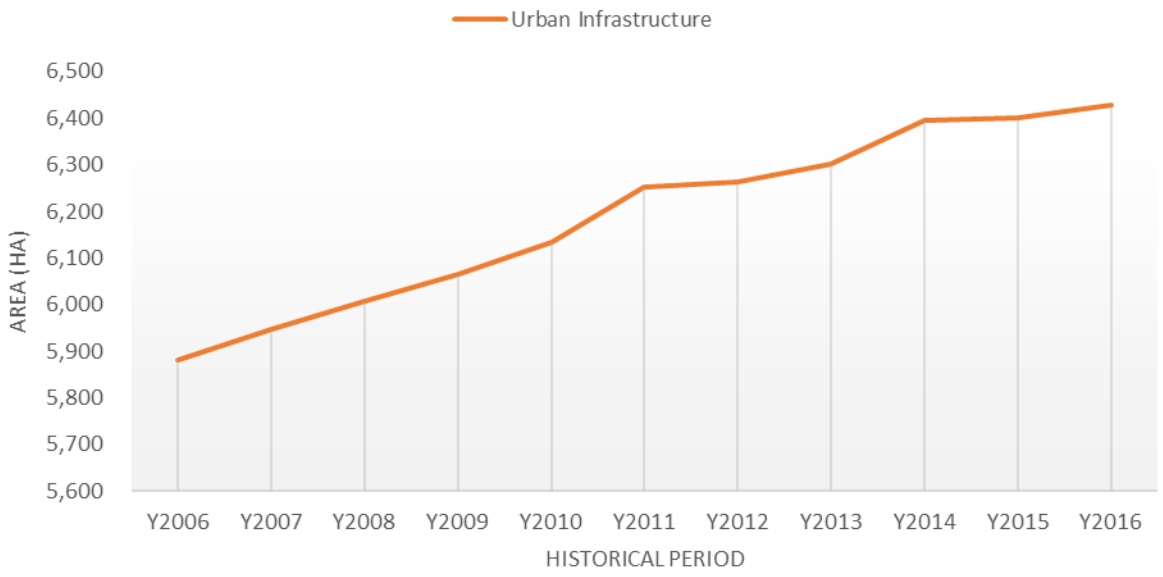


Figure 32. Annual areas of urban infrastructure within the Pantanal biome of Brazil.

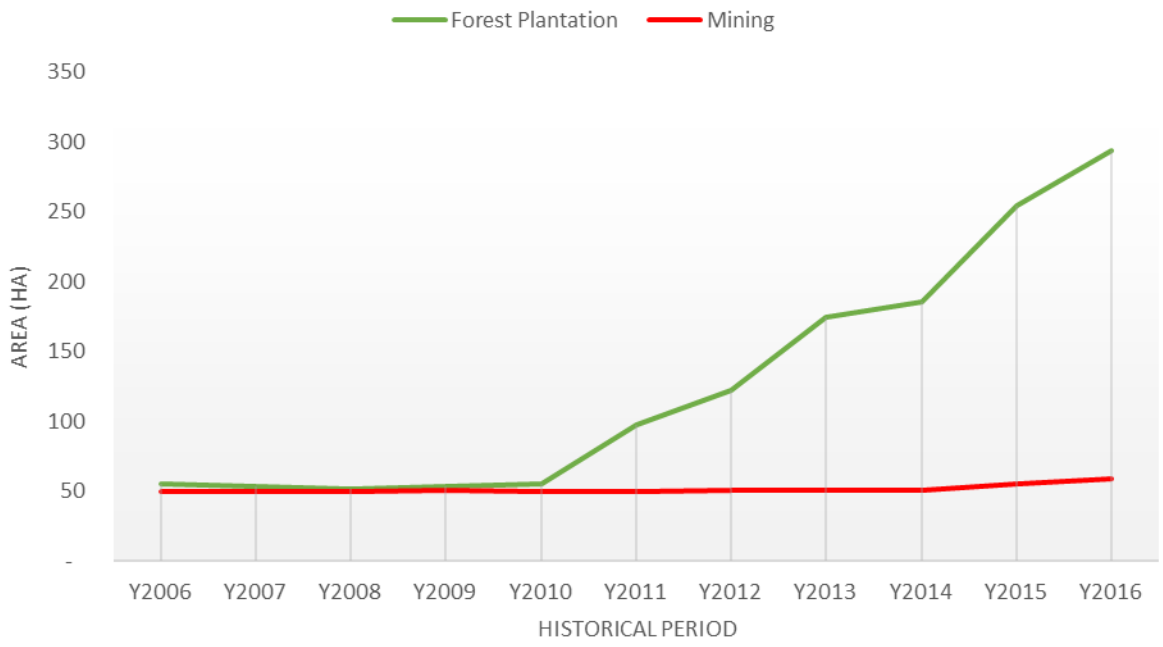


Figure 33. Annual areas of forest plantation and mining within the Pantanal biome of Brazil.

Considering the scenario above, it is expected that forest land will be converted to non-forest land in the reference scenario, without the mechanism of unplanned avoided deforestation (AUD), it is expected that landowners cannot afford the efforts and costs of maintaining long-term monitoring of project boundaries to avoid unplanned land use change through encroachment and uncontrolled deforestation, without carbon credit revenues.

3.1.5 Additionality

Additionality was analyzed following the methodological tool VT0001, version 3.0, for the demonstration and assessment of additionality in VCS AFOLU project activities. The following steps were developed to demonstrate additionality:

- Step 1. Identification of alternative land use scenarios to the proposed VCS AFOLU project activity.
- Step 2. Investment analysis.
- Step 3. Barrier analysis.
- Step 4. Common practice analysis.

3.1.5.1 Step 1. Identification of alternative land use scenarios to the proposed VCS AFOLU project activity

This step serves to identify alternative land-use scenarios to the proposed VCS AFOLU project activity that could be the baseline scenario, through the following sub-steps:

3.1.5.1.1 Sub-Step 1a. Identify credible alternative land use scenarios to the proposed VCS AFOLU project activity

The scenarios described here are based on secondary information (literature review) and local information provided by experts at IHP.

Among the alternative scenarios for realistic and credible land use occurring within the project boundary, in the absence of an AFOLU project activity registered with the VCS, the following was considered:

- continuation of land use activities prior to the project activities, which includes deforestation for the expansion of cattle ranching and agriculture, which has been occurring outside the project boundaries; and
- forest management activities without registration as a VCS AFOLU project.

Alternative 1: Expansion of cattle ranching

Brazil is currently the second largest producer of beef (16% of the total production) and the biggest exporter (USDA, 2019; Gonçalves, et al., 2015) (Figure 34). With an estimated herd of 22 million cattle heads in the upper Paraguay River basin, cattle ranching has a significant presence in the reference region, accounting for about 65% of economic activity in the states of Mato Grosso and Mato Grosso do Sul (WWF Brazil, 2019). Therefore, cattle ranching is by far the main land use in the Cerrado and Pantanal ecosystems (Buller *et al.*, 2014; Assine, 2015).

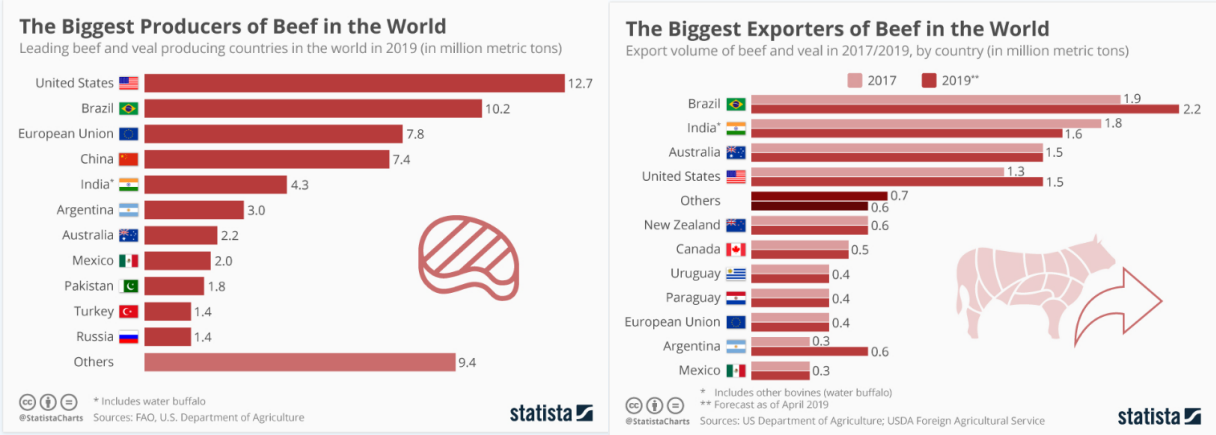


Figure 34. Largest producers and biggest exporters of beef in the world

(Source: USDA, 2019)

Cattle were introduced into the Pantanal about 300 years ago, making them a tradition in the area. Moreover, the Pantanal wetland, which is under an annual flood pulse, physically limits the expansion of crop farming and favors extensive cattle ranching on native grasslands (Junk *et al.*, 2006).

In addition, the municipality of Corumbá is characterized by large cattle ranches; in fact, it had the largest cattle herd in the country, with 1.99 million heads in 2007 (Zucco *et al*. 2011). The cattle herd of Corumbá has grown annually since 2001, with an increase of 1.9% between 2005 and 2006, the year in which there was a fall of 0.6% in the size of the national herd (Zucco *et al*., 2011).

Moreover, 95% of the Brazilian Pantanal land consists of privately-owned ranches called “fazendas”, which, in order to produce more cattle, have included harmful ranching practices, most significantly deforestation, the conversion of natural habitat to planted pasture, and the subsequent intensification of cattle operations (Eaton, 2016).

Although there was an intensification of cattle ranching, inefficiency[130] in many regions (mean cattle density ≈ one head per hectare) generated an increase in the stocking density of Brazilian pastures (~45%) during the 1990–2011 period (Lapola *et al*., 2013) (Figure 35). Due to this, an estimated 15% of Pantanal has already been deforested and it is expected that the trend will continue to affect the native vegetation (Michelaina, 2018).

[130] Inefficiency of cattle grazing is due to the low productivity of the pastures (Sparovek et al., 2018. http://doi.org/10.1525/elementa.187: approximately 30% of the grasslands in Brazil have low productivity); to compensate for this, the number of cattle per area is increased.

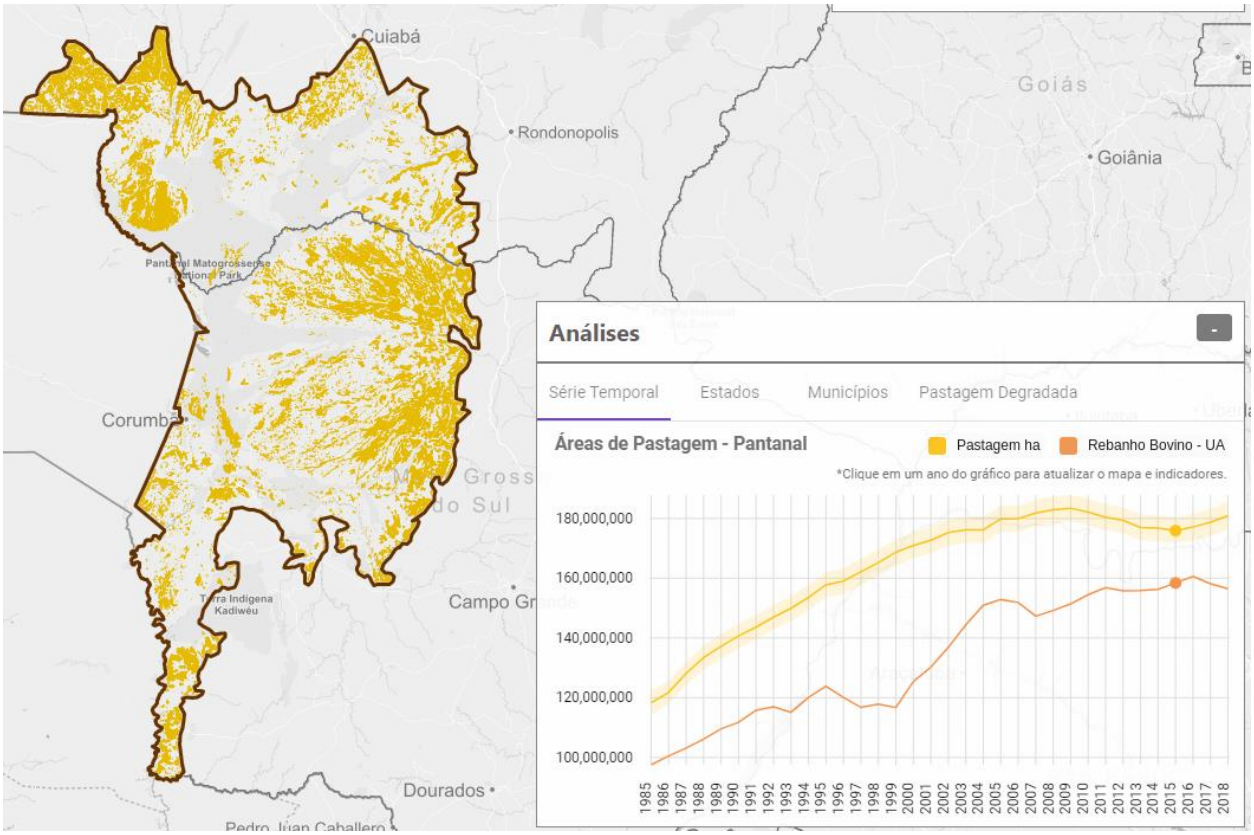


Figure 35. Spatial distribution of pastures[131] in Brazilian biomes in 2016

(Source: Lapola et al, 2013)

Alternative 2: Expansion of agriculture

Wetlands such as the Pantanal are being converted into anthropized areas to meet the growing demand for food production. Such land use changes have a significant impact on the hydrologic processes, affecting the energy and water balances, and the flood pulse in the Brazilian Pantanal wetland (Miranda, 2018).

In fact, the growing demand of uses for production and infrastructure generates pressure on the Pantanal, allowing land use occupation to become a fragmented form by public policies for both Mato Grosso and Mato Grosso do Sul states, without the fulfillment of the legislation (da Silva, 2011). This is due to the lack of a unified and strong land tenure system, which results in areas being undesignated or classified under any official land tenure registration, generating difficulties in territorial planning, legal compliance and illegal occupation of land (Sparovek *et al*., 2019).

[131] The Atlas of Pastures, open to the public, was developed by the Image Processing and Geoprocessing Laboratory of the Federal University of Goiás (Lapig/UFG) Website: Atlas das Pastagens (pastagem.org)

This has implications for Brazil's Forest Code compliance, which stipulates that landowners in the Cerrado biome should conserve between 20% and 35% of the native vegetation (Azevedo *et al*., 2017). Nevertheless, the clearing of small areas (<10 ha) in the properties is taking place due to the difficulty of detecting or prosecuting by the control agencies (Azevedo *et al*., 2017). Although strategies like the CAR formulated in the Brazilian Forest Code have helped ease this problem, there are still inconsistent monitoring programs, and the state and municipal managers are reluctant to punish landowners, which results in a perception of impunity that weakens compliance with the laws (Azevedo *et al*., 2017).

According to Zalles *et al*. (2018), there has been a significant expansion of cropland in the Cerrado biome in Mato Grosso and Mato Grosso du Sol (an 81% increase in the cropland area in 2014 vs. 2000). Although crops and agriculture are not common in the Pantanal due to the natural conditions, some crops of soybean, corn, cotton and rice are growing in the plateau areas (Zucco *et al*. 2011). The soybean is the main crop, with an estimated area of 1.9 million ha of plantations in the plateau, and 200,000 ha in the plain areas (Zucco *et al*. 2011).

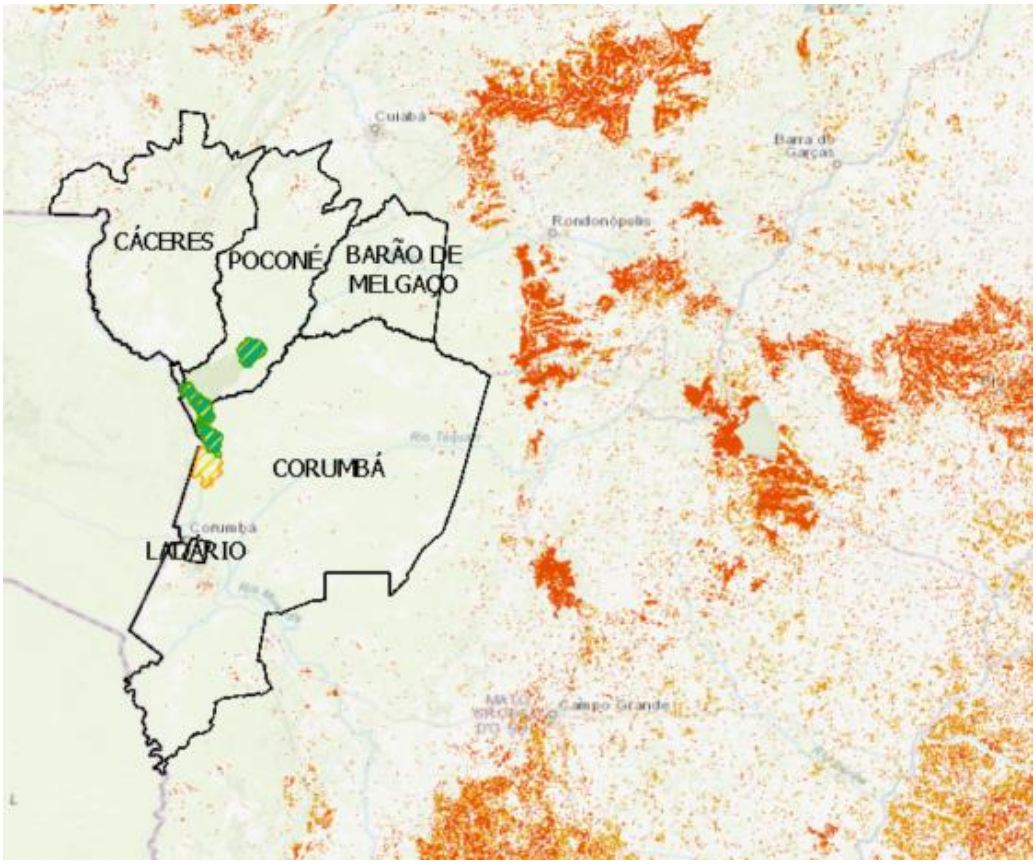


Figure 36. Colored red, cropland extent in the year 2001. In blue, cropland expansion through 2014

(Source: Zalles et al., 2018)

On the other hand, sugarcane is currently forbidden in the Pantanal (in the state of Mato Grosso do Sul). Irrigation is also strictly controlled and permitted only for rice fields inside the plain (Pott & Da Silva,

2015). Decree No. 6.964/2009, which established the sugarcane zones for cultivation, was recently replaced with a new National Decree No. 10.084/2019 that established rules for financing operations and allowing the cultivation of sugarcane without land cover restrictions; for example, in the Amazon rainforest, the Pantanal, indigenous and reforested areas; putting ecosystems at risk (Grizzi *et al*., 2019).

Finally, despite what has been said above, due to the characteristics of the Pantanal's hydrologic regime, cultivation in the area will continue to be low, affecting mostly the plateau areas and hills (Pott & Da Silva, 2015).

Alternative 3: Forest management for conservation without registration as a VCS AFOLU project

The Pantanal biome has been declared a National Heritage site by the Brazilian constitution, and a Biosphere Reserve and a Natural Humanity Heritage by UNESCO (Pott & Da Silva). There are two protected areas under federal administration, the National Park of Pantanal, which is also a Ramsar site, and the State Park of Rio Negro (Junk *et al*. 2006). In addition, some private reserves have been created on ranches; however, the rest of Pantanal is still a wild place (Pott & Da Silva, 2015) (Figure 37).

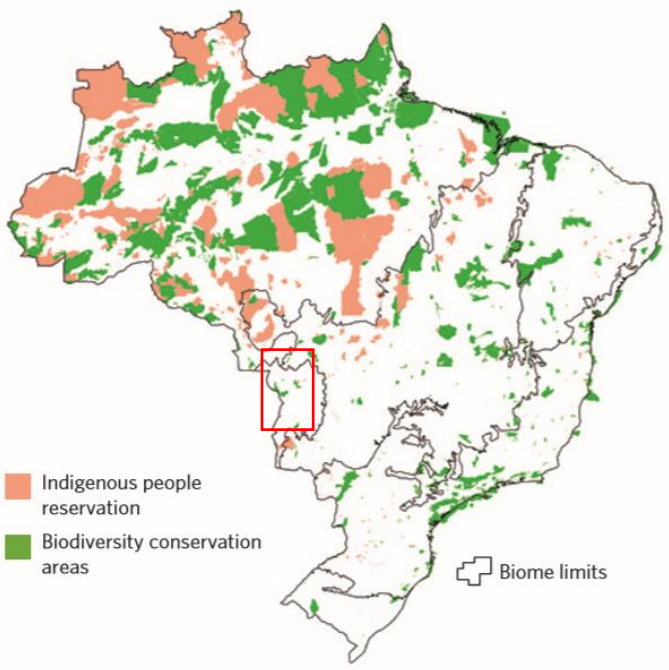


Figure 37. Protected areas in Brazilian biomes

(Source: Lapola *et al*, 2013)

The IHP is one of the organizations in charge of the private reserves. The private natural heritage reserves (RPPN) are part of the sustainable use area categories established by Brazilian Law (Schiavetti *et al*., 2010). IHP directly manages 138,978 ha of the Amolar Protection and Conservation Network (RPCSA), where it develops preservation and conservation strategies to protect the Pantanal, which is threatened by disorganized anthropic activities and the advancement of agribusinesses (IHP, 2019).

The RPCSA includes the RPPNs Engineer Eliezer Batista, Penha, Acurizal, Dorochê and Rumo Oeste; in addition to the fazendas Morro Alegre and Fazenda Santa Tereza Sapezal (IHP, 2019). The IHP has two lodging centers that offer research, environmental education and ecotourism activities. Through these, the IHP seeks to contribute to improving the communities' quality of life as well as protect and conserve these areas.

In Brazil, a management plan is required for the establishment of RPPNs, which must be approved by the associated environmental government agency. In addition, landowners are also responsible for the protection of the reserve (e.g., fencing off the reserve) and are expected to cover all costs associated with its protection and management (Pegas & Castley, 2014).

Obtaining additional funding is vital to ensure the conservation of the Pantanal biome and to continue managing the protected areas. The financial support provided by carbon credits can be an ideal strategy for securing the future of these areas (see Step 2, Investment analysis).

3.1.5.1.2 Sub-step 1b. Consistency of credible land-use scenarios with enforced mandatory applicable laws and regulations

The proposed scenarios are in compliance with the applicable legal and regulatory requirements.

RPPN is one of the types of conservation units (CU) provided for by Law No. 9.985/2000; inside a RPPN, the only activities allowed are scientific research, conservation and tourism. Furthermore, there are more than 120 laws on environmental issues connected with the conservation of the Pantanal ecosystem, but there are no specific prohibitions on cattle ranching activities in the Pantanal areas (IIoris, 2013).

3.1.5.1.3 Sub-step 1c. Selection of the baseline scenario

In the absence of the project, the most probable scenario is the continuation of deforestation via the conversion of forests and native floodplain vegetation into other land uses, primarily into artificial pastures for livestock (Estevam *et al*., 2017). This is due to:

- environmental degradation, due to a lack of legal structures and the absence of the institutions in charge of limiting the environmental impacts of rapid development and land use change (IIoris, 2013);
- law enforcement not being strong enough: if a violation is detected, the penalty is not sufficient to act as a deterrent against non-compliance (IIoris, 2013);
- there are no other productive activities in the area like cattle ranching that can adapt to the flooding regimes; and
- the difficulty of creating new protected areas because 95% of the land is privately owned (Chiaravalloti *et al*., 2017).

Therefore, the selected baseline scenario highlights the continuation of deforestation to implement cattle-ranching activities.

3.1.5.2 Step 2. Investment analysis

IHP has shared its financial structure for the RPCSA, which brings together several institutions, including the Instituto Acaia Pantanal, Fazenda Santa Tereza, Fundação Ecotrópica, Pantanal Matogrossense National Park/Chico Mendes Institute for Biodiversity Preservation and the Environmental Military Police. The financial structure is a document that shows the costs incurred to implement the different REDD+ activities, and the different income sources. The REDD+ project activities aim to establish a funding framework for activities proposed by the RPCSA to protect and conserve the region's biodiversity. Specifically, the project seeks to promote and increase activities in five strategic areas, such as ecotourism, scientific research, fire prevention, governance and environmental management.

Currently, funding for the RPCSA comes from different strategic actions and projects including the Cabeceiras project, Vale SA project resources, IBICT, and the river and cat monitoring project – BRPEC. Other sources include international donations (specific destination), ecotourism, revenues (of which there is no precise estimate), and other similar national sources.

The investment analysis presented in this section aims to highlight the difficulties of financing REDD+ activities when there is no income from carbon credits traded (VCUs when issued in the international VCS+CCB Standards). The idea is to compare two scenarios, one of which will account for income from the carbon scheme.

3.1.5.2.1 Determining an appropriate analysis method

According to the additionality tool, the next criterion should be used to determine the type of analysis which should be applied: if the project does not generate financial benefits, apart from the carbon credits-related revenue, a simple cost analysis should be applied (Option I). Otherwise, the analysis should be conducted through the investment analysis (Option II) or the baseline analysis (Option III). Options I, II and III are mutually exclusive; therefore, only one of them can be applied.

According to this, Option I does not apply to the proposed project, as the project will generate other financial benefits, derived from the budget management of protected areas, ecotourism rents and donations, all of which do not constitute income related to carbon credits. Therefore, the investment comparison analysis (Option II) is applied for the demonstration of the financial barrier for the proposed project.

3.1.5.2.2 Apply investment comparison analysis

The valuation methodology implemented in this analysis was Free Cash Flow, which is based on the idea that the value of an investment is the present value of its future flows. Taking this into account, the net present value (NPV) financial indicator for the project was calculated under two scenarios:

- Scenario 1: The proposed project activity, without the proceeds from the sale of carbon credits, is financially viable.
- Scenario 2: The proposed project activity requires proceeds from the sale of carbon credits to be a financially viable alternative.

3.1.5.2.3 Calculation and comparison of financial indicators (only applicable to Options II and III)

Financial Scenario 1 (project without carbon credits)

Cost structure

For this scenario, two main cost categories, described below, were considered:

Project activities are those carried out to meet the preservation objectives in the area. These activities include the protection of forests and biodiversity associated with forest enrichment or reforestation, and which have the potential for being conserved in the future through sustainable forest management; economic activities that supplement the opportunity cost of not taking advantage of forest resources (one of these activities is ecotourism); and management of forest fires, among others.

These activities should involve the entire community in the project and are key to its success. These activities encourage innovation since they do not restrict access to forests to make use of non-timber products. It is important to emphasize that the certification of the project under the VCS and CCB Standards implies carrying out project activities to conserve biodiversity and to maintain links with the community, with an emphasis on sustainability.

Operation: these are the costs that the project operator must cover in order to coordinate the activities.

Income structure

The income considered in this analysis is the available annual budget from different contributions to the project activities, which is close to USD 392,769.

Cash flow analysis

Three financial indicators were selected and calculated for Scenario 1 in order to determine its feasibility: net present value (NPV), cost-benefit ratio and payback period. The following were considered:

- This analysis was based on the estimation of future financial sources provided by RPCSA, the Cabeceiras project, Vale SA, IBICT and BRPEC, as well as the estimated cost of ecotourism activities, scientific research, fire management, community governance, protected area management, administrative costs, environmental monitoring (Serra do Amolar), supervisory support, communication (radio and internet), and planning and management.
- The discount rate is assumed constant for the time horizon of the project (10%).
- The evaluation period of the financial model is 2016–2045.

The results show an NPV of USD -1,802, or 114, or an NPV <0 was obtained; therefore, the project is not financially viable since discounting cash inflow at the present value does not even cover the cost of the initial investments. Therefore, we can reject the hypothesis of Scenario 1 (see Table 31).

Table 31. NPV under financial Scenario 1

Financial indicator	Value
Net present value (USD)	-597,834

Financial indicator	Value
Cost-benefit ratio	0.92
Payback period (year)	Never

(Source: South Pole, 2022)

Financial Scenario 2 (project with carbon credits)

Cost structure

Project development costs: includes the writing of the project document, detailing all aspects of the project, the scope, activities, methodologies and formats for monitoring and verification, among others.

Standard fees: generally, the standard under which a project is registered collects the fees to which it is entitled. These costs depend on the standard to which the project is presented, as shown in Table 32.

Project activities: the same costs considered for Scenario 1.

Operation: the same costs considered for Scenario 1.

Table 32. Costs structure for financial Scenario 2

Project development	Cost type	Metric	Cost/metric in VCS+CCB (USD)	Quantity of metric	Total cost (USD)	When
PD	One-off	Project	53,000	1	53,000	Y1
Monitoring report	Recurring	Project	47,000	1	47,000	Each verification
Validation	One-off	Project	42,065	1	42,065	Y1
DOE	One-off	Project	28,422			
Support	One-off	Project	*13,643*			
Verification	Recurring	Project	33,879	1	33,879	Every five years
DOE	Recurring	Project	*25,011*			
Support	Recurring	Project	*8,868*			
Validation and verification at the same time	Recurring	Project	68,895	1	68,895	
DOE	Recurring	Project	47,408			

Support	Recurring	Project	21,487			
Standard fees	Cost type	Metric	Cost/metric	Quantity of metric	Total cost	When
Registration fee (VCS)	One-off	Commission/ bonus	0.1			Y1
VCS issuance levy (VCS)	Recurring	Commission/ bonus	0.1			All
Registration fee (CCB)	Recurring	Commission/ bonus	10000			All
VCS issuance levy (CCB)	Recurring	Commission/ bonus	0.05			All
Operational fees (Markit)	Recurring	Commission/ bonus	1200			All
Opening account (Markit)	One-off	Commission/ bonus	600			Y1
Certificates (Markit)	Recurring	Commission/ bonus	0.1			Every five years
Project activities	Cost type	Metric	Cost/metric (USD)	Quantity of metric	Total cost (USD)	When
Ecotourism	Recurring	Project	41,266	1	41,266	All
Scientific research	Recurring	Project	-	1	-	All
Fire management	Recurring	Project	62,135	1	62,135	All
Community government	Recurring	Project	16,959	1	16,959	All
Management of protected areas	Recurring	Project	98,000	1	98,000	All
Administrative costs	Recurring	Project	83,488	1	83,488	All
Environmental monitoring (Serra do Amolar)	Recurring	Project	41,852	1	41,852	All
Supervision support	Recurring	Project	11,456	1	11,456	All

Communication (radio and internet)	Recurring	Project	6,272	1	6,272	All
Planning and management	Recurring	Project	23,198	1	23,198	All
Operation and marketing	Cost type	Metric	Cost/metric (USD)	Quantity of metric	Total cost (USD)	When
Operation team	Recurring	Project	128,500	1	128,500	All

(Source: South Pole, 2021)

Income structure

The income considered in this analysis is composed of two sources: an annual IHP budget of roughly USD 392,000, and the income derived from the sale of 87,639 VCUs (annual average).[132]

Cash flow analysis

Three financial indicators were selected and calculated for Scenario 1 in order to determine their feasibility: net present value (NPV), cost-benefit ratio and payback period. The following were considered:

- the assumptions of Scenario 1; and
- the price of the carbon credit was estimated at USD 4.0 in 2019.

The results under Scenario 2 show a NPV >0 when a discount rate of 10% is applied to the cash flows. The NPV obtained is USD 3,019,374 (Table 33).

In conclusion, the project is financially feasible given that the cash flows cover the initial investment and generate positive results. Scenario 2 shows that the project requires the economic benefits from the sale of carbon credits to be a financially viable alternative.

[132] More details are available on NonPermanenceRiskTool/CashFlow-Seera do Amolar REDD+ Project

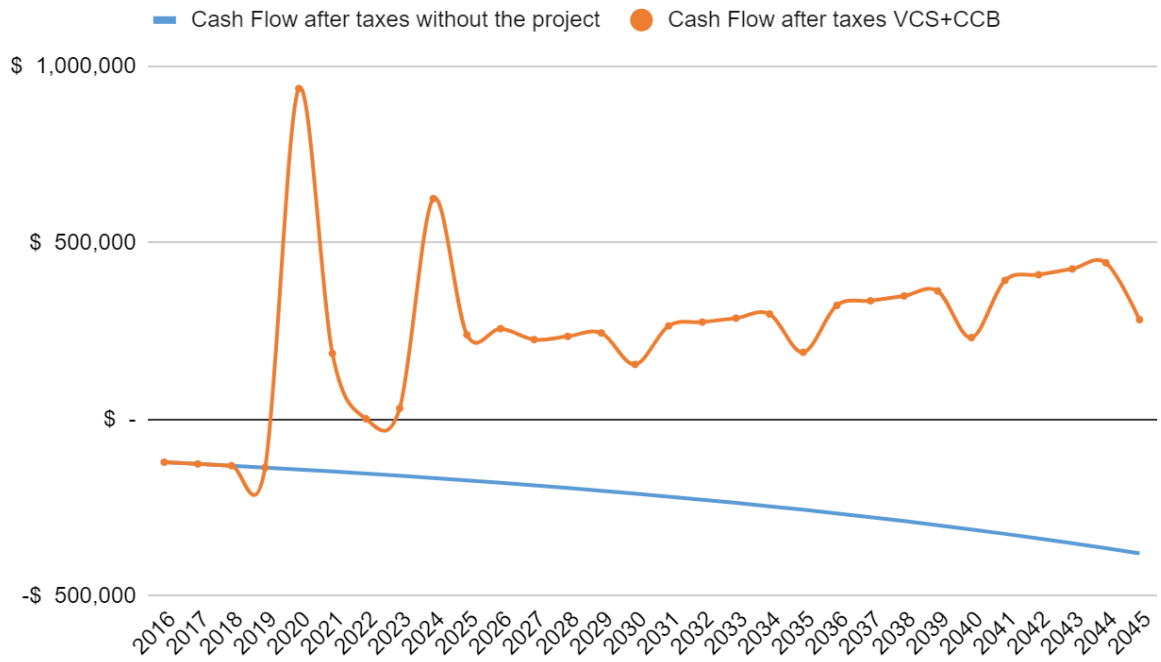


Figure 38. Comparison cash flow both Scenario 1 and 2

(Source: South Pole, 2021)

Table 33. NPV under financial Scenario 2

Financial indicator	Value
Net present value (USD)	3,019,374
Internal rate return	24.84%
Cost-benefit ratio	1.35
Payback period (year)	2022

(Source: South Pole, 2021)

Sensitivity analysis

The objective of the sensitivity analysis is to show whether the conclusions of the investment analysis for Scenarios 1 and 2 are resilient to reasonable variations in the critical assumptions. The investment analysis provides a valid argument for additionality, only if it consistently supports (for a realistic range of assumptions) the conclusion that the project is not viable without the financial benefits associated with VCUs.

For the sensitivity analysis of the project in Scenario 1, the total incomes were increased by 20%, and the results showed that the NPV is negative.

On the other hand, for Scenario 2, percentage variations were established on two parameters: the price of each VCU and the amount of CO_2 sequestered (implicitly, it corresponds to the number of VCUs). Table 34 shows the variations (%) in each parameter, reductions in the reference value of 5%, 10% and 20%, and increases of 5%, 10% and 20%.

Table 34. Parameters subject to sensitivity analysis under Scenario 2

Parameter	Reference value	Variations					
		-20%	-10%	-5%	5%	10%	20%
Estimated annual VCUs (average)	33,926	27,141	30,533	32,230	35,622	37,319	40,711
Carbon price (USD/VCU)	4.00	3.2	3.6	3.8	4.2	4.4	4.8

(Source: South Pole, 2021)

The results of the comparison between the reference value and the Scenario 2 variations in parameters are listed in Table 35.

Table 35. Results of sensitivity analysis under Scenario 2

Parameter	Reference value	NPV of scenario 2 (USD)					
		-20%	-10%	-5%	5%	10%	20%
Estimated annual VCUs (average)	33,926	885,503	1,332,583	1,552,247	1,991,441	2,211,105	2,650,366
Carbon price (USD/VCU)	4.00	2,101,587	2,720,954	3,030,638	3,646,956	3,954,566	4,569,786

(Source: South Pole, 2021)

It is generally observed that the NPV under Scenario 1 (without the sale of VCUs) never exceeds Scenario 2, even when the price of carbon credits and annual VCU sales vary within the range of plus 20%.

Consistency of analysis

In order to demonstrate to what extent the NPV of Scenario 1 (without carbon credits) can reach that of Scenario 2 (with carbon credits and NPV = 250,044), the variation of the income parameter was analyzed under the premise of *ceteris paribus,* and the following results were obtained.

Only when the total revenues of Scenario 1 have a variation greater than 37% can this scenario surpass Scenario 2 (see Table 36). However, this would mean a substantial increase in project funding sources, which is unlikely, given the difficulties of securing the necessary budget for protected areas in Brazil (see below: Financial Barriers).

Table 36. Comparison of financial indicators in Scenario 1 and 2

Indicators	Scenario 1: cashflow without VCUs	Scenario 2: cashflow with VCUs
Net present value (USD)	USD -597,834	USD 3,019,374
Internal rate return (%)	N/A	24.84%
Cost-benefit ratio	0.92	1.35
Payback period (year)	Never	2022

(Source: South Pole 2021)

Project NPV Scenario 1 is always less than the NPV Scenario 2, when variations in the price of carbon credits or variations in the total amount of VCUs emitted are taken into consideration. In addition, it confirms that NPV Scenario 1 requires the revenues from the sale of carbon credits in order to be a financially viable alternative. Also, the prospects of a project that will generate carbon credits may be attractive for attracting greater investment to protected areas.

3.1.5.3 Step 3. Barrier analysis

The 'VT001 – Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU)' requires the investment analysis (Step 2) or barrier analysis (Step 3). In this case, we opted for the investment analysis, which has already been described in Step 2, and also included some financial, macroeconomic, political and institutional barriers as part of a complementary and complete approach.

3.1.5.3.1 Sub-step 3a. Identify barriers that would prevent the implementation of the type of proposed project activity

Financial barriers

The project area covers 66,398 ha of RPPNs, which are a permanent conservation feature created as an efficient and economical measure to promote biodiversity conservation. However, because RPPNs in the Cerrado and Pantanal biome are less financed than protected areas in other biomes, such as the Amazon, these areas depend on the owners for their conservation, on private economic resources, and have no support from any government initiative.[133]

[133] Oliveira, U., Soares-Filho, B. S., Paglia, A. P., Brescovit, A. D., De Carvalho, C. J. B., Silva, D. P., … Santos, A. J. (2017). Biodiversity conservation gaps in the Brazilian protected areas. Scientific Reports, 7(1), 1–9. https://doi.org/10.1038/s41598-017-08707-2

According to de Oliveira and Bernard (2017)[134], in situ conservation is an effective strategy to protect biodiversity, and Brazil has one of the largest protected area systems in the world. However, the distribution of Brazilian protected areas is uneven. This study analyzes the necessary funding to manage more conservation areas, considering this zone as a significant sample of biodiversity financing in Brazil, and lands are poorly protected. The government's budget allocated 20 federal project areas between 2008 and 2014, with funding ranging from USD 231,575 in 2008 to USD 13.5 million in 2011. The budget was not homogeneous among protected areas, or throughout the years, as shown in Figure 39 and Figure 40. Land acquisition in a single protected area consumed around 75% of the budget, and the two smallest protected areas received, proportionally, the most money. Excluding land acquisition, the 20 protected areas received USD 0.50 ha/year. Therefore, is concluded how bigger are the financial barriers in terms of any government support, and for any conservation initiative such as RPPN or REDD+ project in the Brazilian context.

There is an important financial barrier regarding funds allocated, not to biodiversity conservation per se, but mainly to securing offices, cars and equipment (there is a fixed cost for operations, but not for implementing activities in the field). From 2012 onwards, the protected areas budget was reduced. This included salaries too; the budget allocated to these protected areas is around 13 times lower than what the Ministry of the Environment declared necessary for the basic operation of protected areas in Brazil; 1.5 times lower than the value spent worldwide; up to five times lower than that spent in Latin American and African parks; and up to 72 times lower than that spent in the European Union, exposing one reason behind the precarious situation of the protected areas in Brazil, including RPPNs and conservation initiatives such as the Serra do Amolar REDD+ project.

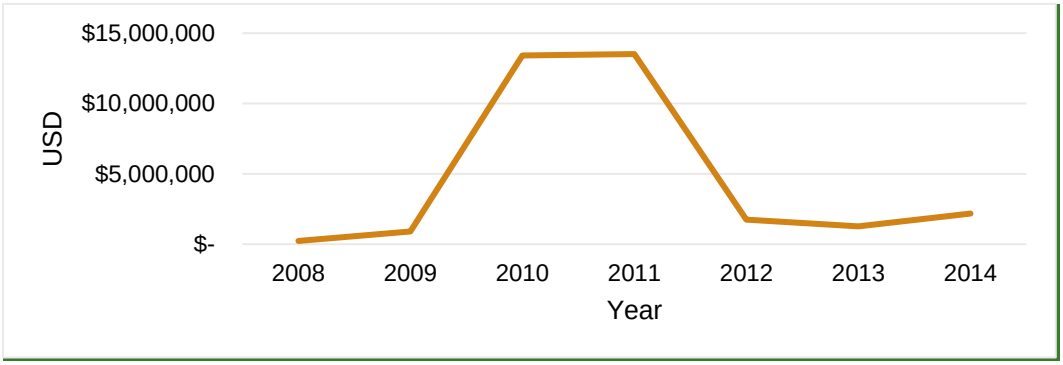


Figure 39. Annual budget for 20 protected areas in the region analyzed by the literature (case Caatinga biome), 2008–2014 (USD/ha/year)

(Source: Oliveira and Bernard, 2017)

[134] de Oliveira, A. P. C., & Bernard, E. (2017). The financial needs vs. the realities of in situ conservation: an analysis of federal funding for protected areas in Brazil's Caatinga. Biotropica, 49(5), 745–752. https://doi.org/10.1111/btp.12456

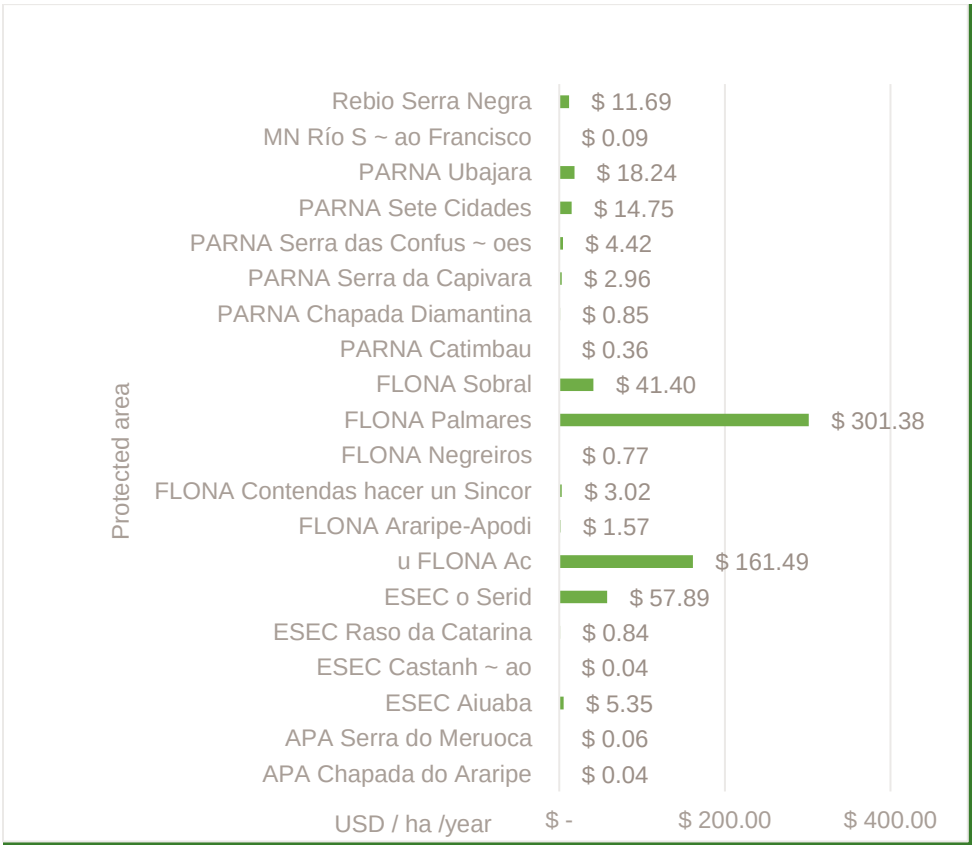


Figure 40. Budget per ha in 20 protected areas in the region analyzed by the literature (case Caatinga biome), (average 2008–2014)

(Source: Oliveira and Bernard, 2017)

Macroeconomic conditions

The influence of macroeconomics and macroeconomic policies on protected areas is unquestionably important, but it often takes subtle forms that are difficult to identify or measure. Recessionary economies, on the one hand, dismiss the risks posed by development, such as transport and energy infrastructures, and the expansion of the agricultural frontier; however, minimizing public expenditure on the environment and protected areas, and increasing poverty, often exacerbate protected area conflicts with neighbors, such as poor rural populations. The worst impacts on biodiversity and protected areas tend to occur at times of relative prosperity and expansion of the economy, due to economic pressure on resources (Dourojeanni and Quiroga, 2006).

Also, in these periods of rapid economic development, governments seek to accelerate investments, especially those aimed at increasing energy supplies, as well as attacking their own environmental licensing system, and responding to pressures and complaints from the private sector. The analysis of the supposed slowness of environmental licensing shows that it is almost always motivated by the poor quality of the environmental impact studies presented and by the insistence of businessmen on not complying with the requirements demanded. This issue is extremely relevant in Brazil, where the private

sector has the support of the energy and mining sector to accuse the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) of delays and, ultimately, of making the environmental area responsible for an eventual national energy crisis. The acceleration and simplification of licensing processes creates a great risk for existing protected areas, which can suffer severe impacts and limit the use of environmental compensation mechanisms, something that companies try to avoid (Dourojeanni and Quiroga, 2006).

Political barriers

The lack of political prioritization of protected areas always appears at the top of the list of national problems related to sectoral environmental policies. This seems to be a consequence of public opinion, and decision-makers are unaware of the functions and economic potential of these protected territories. The main problem lies with the economic and financial sector of the legislative and executive branches, that neither allocate nor release resources that could even meet the minimum needs of protected areas.

The main problems regarding protected areas legislation in Brazil are:

- financial mechanisms and clarity are insufficient during their application;
- existence of protected areas categories of little value for biodiversity conservation;
- excessive number of protected areas categories with inconsistent definitions;
- lack of administrative autonomy for protected areas;
- treatment of buffer zones;
- management of prior consultations for the creation of protected areas; and
- unequal treatment of international categories.

Table 37. Frequency of perceived problems in the areas of governance, institutionality and administration in relation to protected areas in Brazil

Issues	%
Bureaucracy (slow decisions, the low capacity of execution of budgetary funds, concentration of staff at headquarters)	100
Lack of effective control of the project area due to non-regularized land tenure (IBAMA without legal land possession).	95
Poorly prepared staff at headquarters (managerial capacity) and in the field, and lack of field staff	67
Laws are inapplicable without regulations and complementary measures, and are always complex and debatable	57
Discontinuity of actions from government to government, with changes in the local authority	52
Lack of effective communication with society (people do not know what a protected area is or what it is for)	48

Issues	%
Challenges in effective civil society participation	38
Excess of studies and meetings that lengthen decisions	33
Political interference (in decisions, appointment of staff, etc.)	33
Corruption	24

(Source: Dourojeanni & Quiroga, 2006)

Article 36 of Brazil's SNUC law determines a clear source of funding for protected areas. This article provides that no less than 0.5% of the total anticipated cost, as established during the environmental licensing process for works with significant environmental impact, shall be destined for an existing protected area or a new protected area to be created. This has been beneficial for protected areas, as it can be seen above in the financial barriers, but it has a greater impact on aspects of protected area investment (the purchase of land, infrastructure and equipment) than on the annual maintenance cost. Article 34 of the same law also refers to financing, but states only that protected areas can receive donations of any nature. Article 35 provides for the distribution of protected area's own income (Dourojeanni & Quiroga, 2006).

1.1.1.2 Step 4. Common practice analysis

As mentioned above, IHP is in charge of the protection and conservation of the Serra do Amolar in the Pantanal biome. The IHP model is based on the promotion and implementation of four strategic lines: ecotourism, scientific research, fire prevention, and governance and administration.

As shown in the investment analysis, in the actual financial scenario, the successful protection of these areas is not viable in the future, even though the RPCSA has several institutions working together. In addition, there is no evidence in the protected areas of the Pantanal of the use of funding from carbon credits as a strategy to deal with financial gaps.

In terms of conservation, Brazil is known for the protection of the Amazon rainforest, which generates resources from private, national and international sources. However, the Pantanal does not receive the same attention, especially because there has been an inherent lack of research on the area, and its dynamics and ecosystem services are not well understood yet. This produces a lot of pressure on the Pantanal, especially in the use of land for production instead of protection and conservation.

The most common practice would be to attempt to acquire a license to deforest part of the land and seek valuation of the property leading to the land sale. Other common practices are invasions by third parties for crops, pastures and land speculation. Overall, forest management is weak, although there are some actions for forest management and forest conservation strategies in the Pantanal

Moreover, in the upper Paraguay River basin, where the project is located, more than 40% of the area is at high ecological risk. This is the main region in which the enormous quantities of water that make Pantanal a wetland are concentrated.

On the other hand, less than 1% of the basin is protected in conservation sites, with 55% having already suffered deforestation (WWF, 2018), and currently, in the state of Mato Grosso alone, there is an estimated deficit in legal reserves of 392,000 ha (WWF, 2018). Additionally, landowners receive negligible economic benefits from the establishment of RPPNs, which is primarily an exemption from paying rural property taxes (Pegas & Castley, 2014). Furthermore, RPPNs can only be used for scientific environmental research, ecotourism and educational purposes, with extractive uses (e.g., fishing, harvesting of forest products, hunting) being prohibited (Pegas & Castley, 2014).

Considering that one of the financial barriers is that the funds received for the project area, under the conservation agreement, are used mainly for administrative functions, there is a need for extra funding to implement ecotourism activities, scientific research and mitigation actions to prevent fires. Moreover, regarding ecotourism activities, according to Brazilian law (CONSEMA resolution – 85/11), the protected areas can only offer ecotourism services if they have a management plan (Tortato & Izzo, 2017), which is an advantage for the areas in the RPCSA.

Thus, if the project does not take place, IHP will not be able to achieve its goals regarding the conservation of the Pantanal and the practices of cattle ranching and agriculture will continue to reduce and degrade the forest and the Pantanal biome, affecting the biodiversity, ecotourism and provision of ecosystem services.

3.1.6 Methodology deviations

Not applicable.

3.2 Quantification of GHG Emission Reductions and Removals

3.2.1 Baseline emissions

The quantification of emission reductions associated with changes in carbon values within the project area for year t was done following the guidelines in section 6.1.3 of the VM0015 methodology.

The methodology used for the quantification of the baseline emissions was divided into the following steps:

- Step 1. Definition of the boundaries of the proposed AUD project activity: spatial boundaries, temporal boundaries, carbon pools and sources of GHG.
- Step 2. Analysis of historical land use and land cover (LU/LC) changes in the reference region, going back about 10–15 years from the present.
- Step 3. Analysis of agents, drivers and underlying causes of deforestation, and sequencing of the typical chain of events leading to land use and land cover change.
- Step 4. Projection of the annual areas and location of deforestation in the reference region in the without-project case.
- Step 5. Identification of forest classes in areas that will be deforested under the baseline scenario, and of post-deforestation land use classes in the project area.
- Step 6. Estimation of baseline carbon stock changes and, where forest fires are included in the baseline assessment, of non-CO_2 emissions from biomass burning.

- Step 7. Ex ante estimation of actual carbon stock changes and non-CO_2 emissions under the project scenario.
- Step 8. Ex ante estimation of leakage associated with leakage prevention measures and activity displacement.
- Step 9. Ex ante calculation of net anthropogenic GHG emission reductions.

3.2.1.1 Step 1. Definition of the boundaries of the proposed AUD project activity

Please see section 3.13 Project boundary

3.2.1.2 Step 2. Analysis of historical land use and land cover changes in the reference region going back about 10–15 years from the present

This step consisted of quantifying the historical deforestation rate during the historical reference period (2006–2016) within the selected RR.

The goal of this step is to collect and analyze spatial data in order to identify current land use and landcover conditions, and to analyze LU/LC changes during the historical reference period within the reference region and project area. The tasks to be accomplished include:

- 2.1 collection of appropriate data sources;
- 2.2 definition of classes of land use and land cover;
- 2.3 definition of categories of land use and land cover change;
- 2.4 analysis of historical land use and land cover change; and
- 2.5 map accuracy assessment.

3.2.1.2.1 Collection of appropriate data sources

The images used for the analysis of historical deforestation between 2006–2016 are Landsat 5 Thematic Mapper (TM), Landsat 7 Enhanced Thematic Mapper Plus (ETM+), and Landsat 8 Operational Land Imager (OLI). The process is performed by MapBiomas[135] Collection 6 and the process flow used for the Reference Region is described in the Pantanal Appendix[136].

For each year Mapbiomas used images from the best Landsat surface reflectance (SR) available:

- 2003 to 2011 – Landsat 5
- 2012 – Landsat 7
- 2013 to 2019 – Landsat 8

Mapbiomas creates a mosaic of images consists of a composition of the best pixels that are extracted from all the images available in a defined period within a year. Once the initial and final dates of this period were defined, the median pixel from that period was calculated, generating one median image with

[135] MapBiomas initiative was formed in 2015 by universities, NGOs and companies to develop a fast, reliable, collaborative and low-cost method to produce an annual time series of land cover and land use maps of Brazil from 1985 to 2020.
[136] Information available on: SupportInformation_CCB\Climate\Classification in the MapBiomas

several bands. The aggregation of these composed pixels was conducted for each year, producing the annual Landsat mosaics, which were then submitted to classification.

Following the requirements of the methodology, the analyzed historical series considered a reference period of more than 12 years. The years were selected taking into consideration data availability and quality.

Deforestation was mapped by detecting changes from forest and savanna forest to non-forest in the period 2006–2016, classifying the images into three phases: pre-processing, interpretation and classification, and post-processing.

The process flow used for achieving a consistent time-series of LU/LC-change data from Mapbiomas Collection 6 is described in in the Pantanal Appendix[137]. The Pantanal Appendix include detailed methodological procedures used in pre-processing, classification.

The post classification processing and accuracy assessment procedures are available in the GIS Serra do Amolar GIS Procedure[138].

3.2.1.2.2 Definition of classes and categories of land use and land cover[139]

[137] Information available on: SupportInformation_CCB\Climate\Classification in the MapBiomas
[138] Information available on: Support Information CCB\Climate\ Serra do Amolar REDD+ GIS_Procedures
[139] More information available on: https://mapbiomas-br-site.s3.amazonaws.com/downloads/Colecction%206/Cod_Class_legenda_Col6_MapBiomas_BR.pdf.

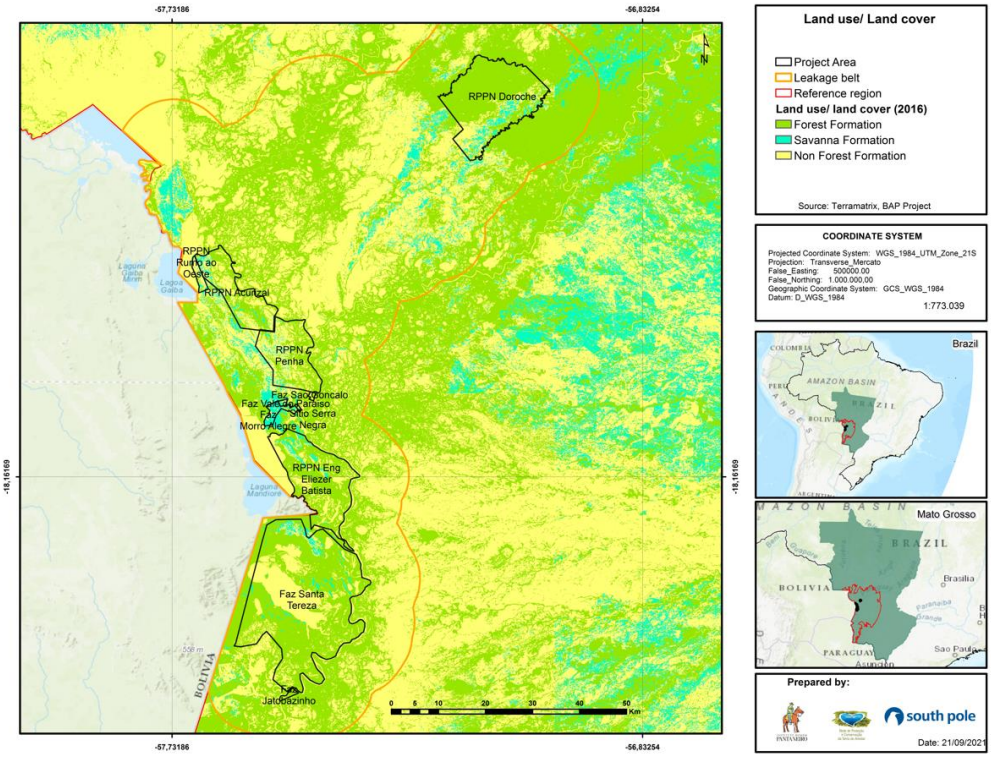


Table 38 and Figure 41 reveal the classes of land use and land cover within the project area, leakage belt and reference region.

Table 38. Land-cover types in the project Reference Region and project area

Class	Brief description	IBGE (1999–2012)	FAO (2012)	GHG national inventory (2015)
Forest formation	Tall trees and shrubs in the lower stratum: deciduous and semi-deciduous seasonal forest, wooded savanna, wooded steppe savanna, and fluvial and/or lacustrine-influenced pioneer formations.	Ca, Cb, Cs, Fa, Fb, Fs, SN, Sd, Td, Pa	FEP, FSP	FMN, FM
Savanna formation	Small tree species, sparsely arranged in the shrub and herbaceous continuous vegetation. The herbaceous vegetation mixes with erect and decumbent shrubs.	Sa, Sp, Sa, Sg, Td, Ta, Tp	FDP, FSP, WS	FMN, FM

Class	Brief description	IBGE (1999–2012)	FAO (2012)	GHG national inventory (2015)
Non-forest	Non-forest natural formation, farming areas, pasture and agriculture, and other non-vegetated areas.	Tg, Sp, Pa, Tp, Sg, Sp, AP, PE, PS, ATp, Atc, Dn, Ar, MCA	WG, OCA, OCM, OP, OG, OQ	GNM, GM, Gsec

(Source: South Pole, 2021)

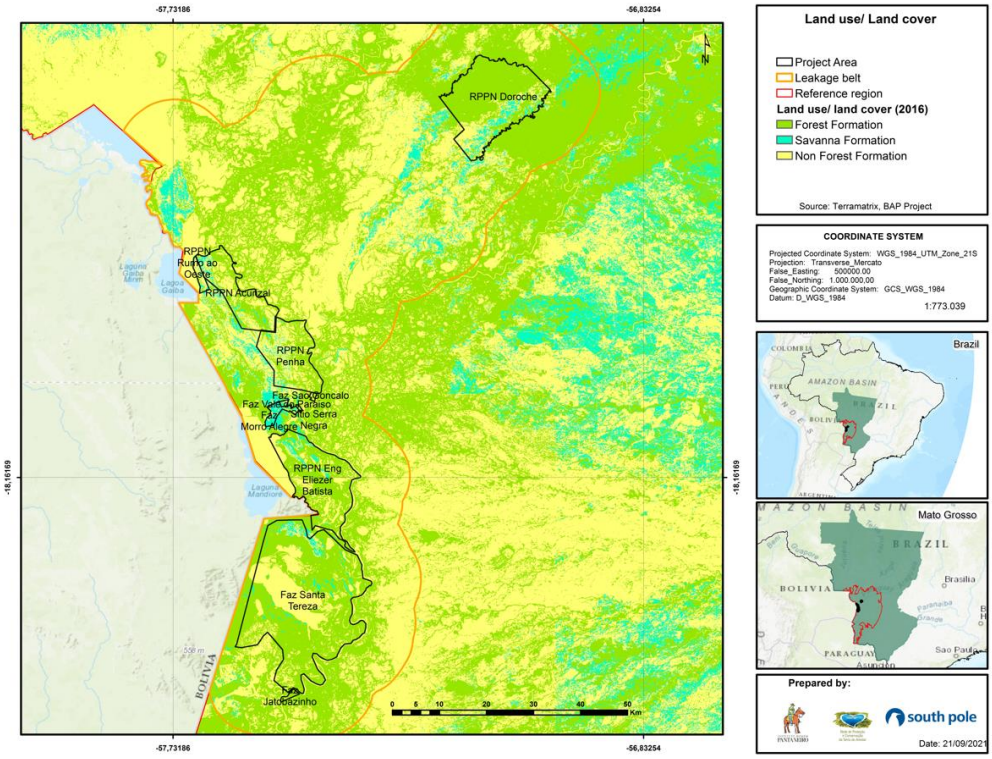


Figure 41. Land use and land cover in the project reference region and project area

(Source: South Pole, 2022)

For Serra do Amolar REDD+ project LU/LC class relevant are “Forest Land” and “Non-Forest Land”. Criteria are aligned with the forest definition of the Brazilian government under UNFCC. Below the list of land use and land cover classes existing with their description according to methodology (Table 6 of Methodology VM0015).

Class Identifier		Trend in Carbon stock (“decreasing”,”constant”,”increasing”)	Presence in (Reference region, leakage belt, leakage management areas,	Baseline activity			Description(including criteria for unambiguous boundary definition)
ID (unique identifier)	Name			Logging	Fuel-wood collection	Charcoal Production	

			project area)				
1	Forest formation	Decreasing	RR, LK, PA		Yes	Yes	Tall trees and shrubs in the lower stratum: deciduous and semi-deciduous seasonal forest, wooded savanna, wooded steppe savanna, and fluvial and/or lacustrine-influenced pioneer formations. Also include, small tree species, sparsely arranged in the shrub and herbaceous continuous vegetation
2	Non-forest formation	Increasing	RR, LK, PA				Non-forest natural formation, farming areas, pasture and agriculture, and other non-vegetated areas.

3.2.1.2.3 Categories of land-use and land-cover change

The list of land-use and land-cover change categories are presented below (Table 7b of Methodology VM0015). The project scenario anticipates reducing transitions, but probably not fully closing all baseline transitions, thus repeating the categories.

Idcl	Name	Trend in Carbon stock	Presence in	Activity in the baseline case			Name	Trend in carbon stock	Presence in	Activity in the project case		
				LG	FW	CP				LG	FW	CP
Forest/Forest	Stable forest	Constant	PA, LK, RR				Stable forest	Constant	PA, LK, RR			
Forest/Non Forest	Deforestation	Decreasing	PA, LK, RR	X	X	X	Deforestation	Decreasing	PA, LK, RR	X	X	X

3.2.1.2.4 Analysis of historical land use and land cover change

Change detection was performed after the re-classification of land use categories. To locate changes in the historical period analyzed, basic cross tabulation techniques were used to identify changes in proportion and location between forest and non-forest cover. Cross-tabulation represents the occurrence of deforestation for the project area and the reference area.

The analysis of LU/LC-changes involved the following post-processing task:

- Reclassification of annual land use cover layer 2006-2016 to obtain layers of forest and No Forest.
- Thus, the non-forest forest layers were obtained for the years 2006 and 2016.

Using the Forest-Non-Forest layers (2006 and 2016), a cartographic cross-over of both periods was made for the delimitation of the eligible areas and the information was reclassified considering eligible areas as those areas that were maintained as stable forest in the period 2006-2016 on a scale of 1: 100,000. On the other hand, non-eligible areas were those with a non-stable forest or with losses of forest cover over the same period.

Finally, with the resulting raster information, a post-processing was carried out, which consisted of changing the projection system of the WGS84 geographic coordinate system to the flat WGS84-UTM 21S system, transforming the resulting layer (raster) to vector format, eliminating isolated polygons smaller than 1 ha, construction of table of attributes with categories: eligible (Forest) and non-eligible (Non Forest), and cut of the layer with the boundaries of the project area and reference region.

The process flow used for achieving a consistent time-series of LU/LC-change data from Mapbiomas Collection 6 is described in in the Pantanal Appendix[140]. The Pantanal Appendix include detailed methodological procedures used in pre-processing, classification.

The post classification processing and accuracy assessment procedures are available in the GIS Serra do Amolar GIS Procedure[141].

The change matrices calculated for the periods 2006–2016 in the reference region are summarized in Table 39, Table 40 and Table 41. Where initial refer to 2005 and final refer to 2016.

Table 39. Land-use and land-cover change matrix with reference region (Table 7a of Methodology VM0015)

		Final LU/LC class		
	IDcl	Forest	Non-forest	Sum initial LU/LC
Initial LU/LC class	Forest	4,770,787	484,654	5,255,441
	Non-forest	-	6,714,155	6,714,155
	Sum final LU/LC	4,770,787	7,198,809	11,969,596*

Table 40. Land use and land cover change matrix with leakage area (Table 7a of Methodology VM0015)

		Final LU/LC class		
	IDcl	Forest	Non-forest	Sum initial LU/LC
Initial LU/LC class	Forest	129,228	2,441	131,669
	Non-forest	-	65,729	65,729
	Sum final LU/LC	129,228	68,170	197,398*

Table 41. Land use and land cover change matrix with project area (Table 7a of Methodology VM0015)

		Final LU/LC class		
	IDcl	Forest	Non-forest	Sum initial LU/LC
Initial LU/LC class	Forest	64,443	1,218	65,661
	Non-forest	-	20,878	20,878
	Sum final LU/LC	64,443	22,096	86,539*

* Horizontal sum of forest and non-forest in 2016

[140] Information available on: SupportInformation_CCB\Climate\Classification in the MapBiomas
[141] Information available on: Support Information CCB\Climate\ Serra do Amolar REDD+ GIS_Procedures

The result of the historical deforestation analysis yields the forest and non-forest areas (pastures and other uses) at the beginning and end of the historical period (2006 and 2016, respectively). From these values, the annual deforestation rate for the 2006–2016 period (based on a multi-step matrix) demonstrates that the forest formation is being lost at a rate of -1% each year in reference region, -0.86% in the leakage belt, and 0.49% in the project area. This analysis considered gross deforestation in the cover in terms of two land cover classes: forest and non-forest.

In summary and according to with the results of the eligibility analysis and land use and land cover change.

Figure 42, Figure 43, Figure 44 shows the eligible area i.e. the land area that has been non-forest for more than 10 years prior to the project start date. Also, the area deforested for the 2006–2016 period.

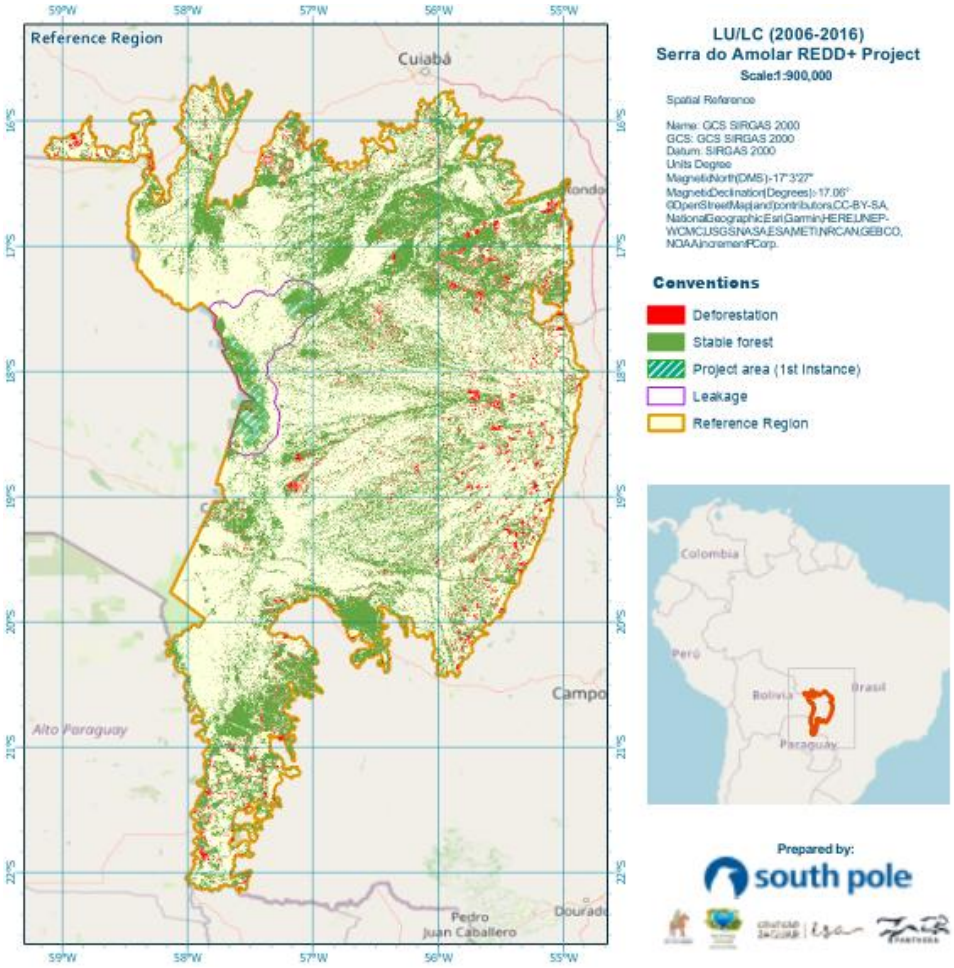


Figure 42 Land-use and land-cover change map for the Serra do Amolar REDD+ reference region.

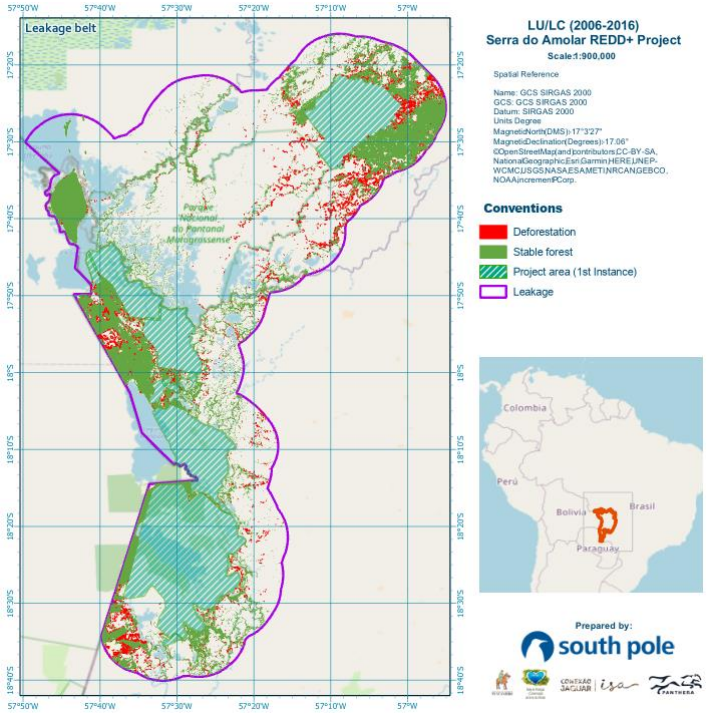


Figure 43 Land-use and land-cover change map for the Serra do Amolar REDD+ in the leakage belt.

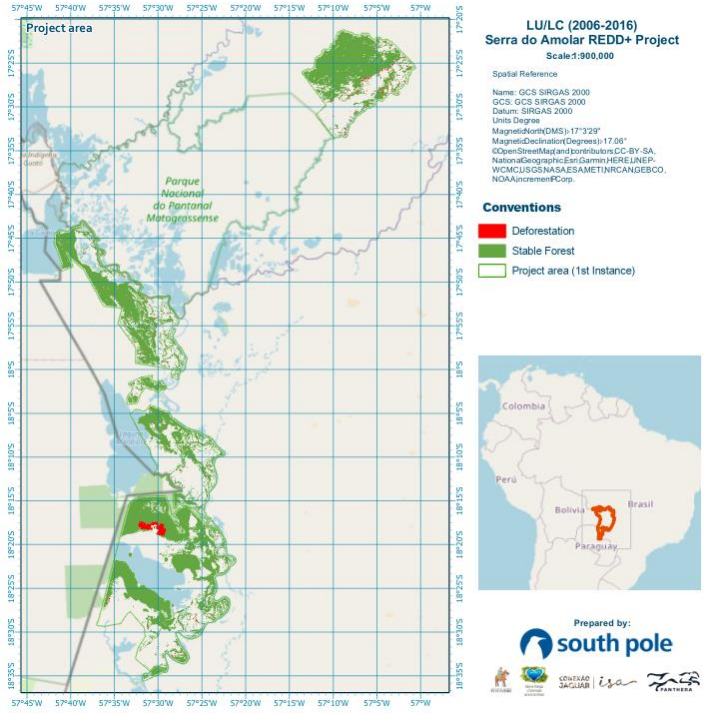


Figure 44 Land-use and land-cover change map for the Serra do Amolar REDD+ in the project area.

For further information regarding the historical deforestation analysis and land use cover change, see Support_Information/Climate/Baseline data and GIS Eligibility.

The process for consistent maps from Mapbiomas Collection 6 is described in in the Pantanal Appendix[142]. The Pantanal Appendix include detailed methodological procedures used in pre-processing, classification, and post classification processing.

3.2.1.2.5 Map accuracy assessment

Accuracy analysis is the main way of assessing the quality of mapping performed by MapBiomas. In addition to detailing the overall classification accuracy, the analysis also reveals the accuracy and error rate for each classified class. MapBiomas evaluated global and per-class classification accuracy for each year between 1985 and 2018.

Accuracy estimates were based on the evaluation of a pixel sample, which are called the reference database, consisting of ~ 75,000 samples. The number of pixels in the reference database was predetermined by statistical sampling techniques. Each year, each pixel from the reference database was evaluated by technicians trained in visual interpretation of Landsat images. Accuracy was assessed using metrics that compare the mapped class with the class evaluated by the technicians in the reference database.

For the Serra do Amolar REDD+ project, the accuracy throughout the MapBiomas collection in the version 6 for the reference region (Pantanal biome) at level 2 (including different types of forest vegetation) is 73,5%, and at level 1 (forest and non-forest categories) as shown in Figure 33 and Figure 34 is above 81.6%

Each year, the accuracy analysis is done by cross-tabulating the sample frequencies of the mapped and real classes and is publicly reported on: https://mapbiomas.org/en/analise-de-acuracia?cama_set_language=en.

The accuracy for each class is the estimate of the overall hit rate. It estimation is given by the sum of the main diagonal of a proportions matrix and then is decomposed into area disagreement and allocation disagreement [143]

[142] Information available on: SupportInformation_CCB\Climate\Classification in the MapBiomas
[143] Pontius Jr, R. G., & Millones, M. (2011). Death to Kappa: birth of quantity disagreement and allocation disagreement for accuracy assessment. International Journal of Remote Sensing, 32(15), 4407-4429.

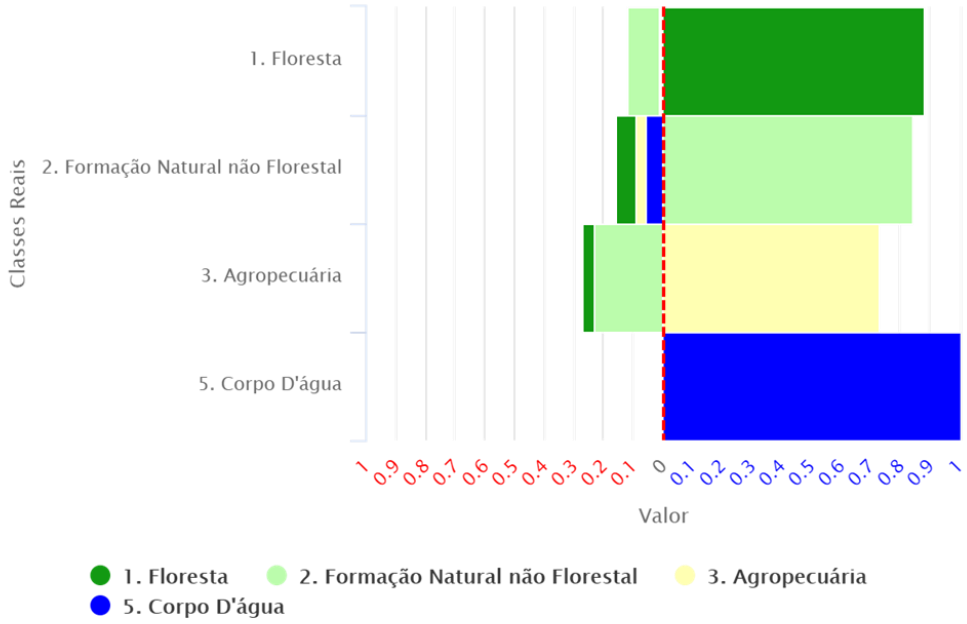


Figure 45. Omission (non detection) error by class (English: Forest, Non-forest, Agriculture, Water)

(Source: MapBiomas 2021)

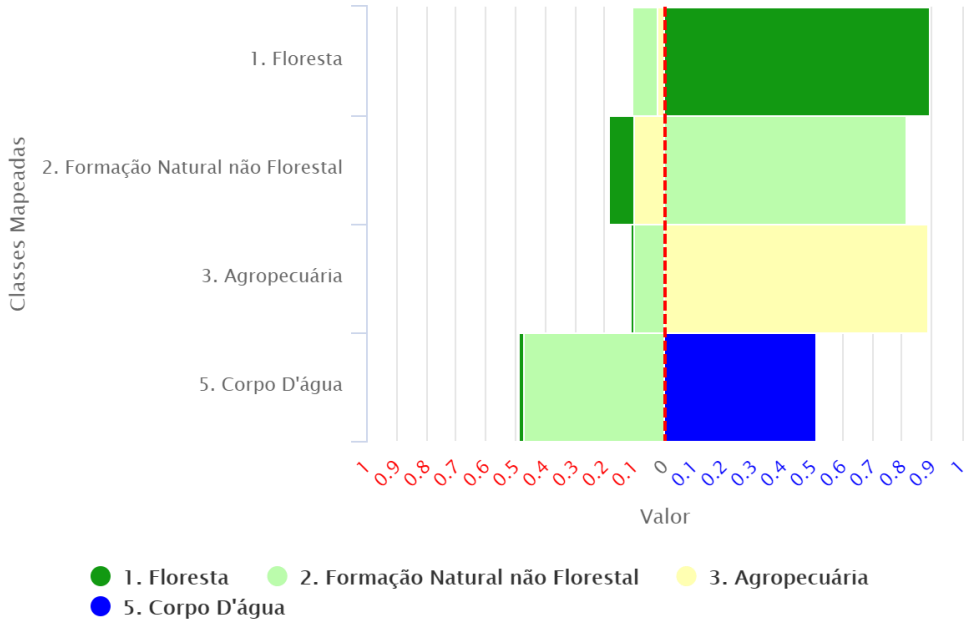


Figure 46. Inclusion (false detection) error by class (English: Forest, Non-forest, Agriculture, Water)

(Source: MapBiomas 2021)

3.2.1.3 Step 3. Analysis of agents, drivers and underlying causes of deforestation, and sequencing of the typical chain of events leading to land use and land cover change

This section refers to a highly detailed description of the agents of deforestation according to the guidelines of the VM0015 methodology.

The analysis of agents, drivers and underlying causes of deforestation, and the likely scenarios of land use in the absence of the project were performed based on the baseline scenario and detailed in section 3.1.4.

The potential land use scenarios and the associated drivers of land use changes most likely to occur within the project zone in the absence of the project are:

- deforestation for expansion of livestock and agricultural activities; and
- deforestation through dry season, forest fires used to clear, and other ecosystem dynamics.

These have been suggested as the main drivers of Pantanal deforestation and degradation by local experts and knowledgeable groups.[144]

3.2.1.3.1 Identification of agents, drivers and underlying causes of deforestation

Identification of agents

The agents of deforestation for the Serra do Amolar REDD+ project are external ranchers, squatters and small farmers, who seek a valuation of the lands, selling them to third-party agents for crops, pastures and other land uses. The agents are dispersed across the main settlements and can be characterized as having isolated occupations and possessing lands with agricultural potential along the Paraguay River.

The identified agents, drivers and underlying causes of deforestation have a relative importance because they account for 95% of the unplanned deforestation observed in the reference region, whereas 5% is related to fires, with these being naturally occurring fires (see section 3.1.5.1.1 regarding scenarios of additionality).

The agents are historically attracted to the region by opportunity/cost from cattle ranching and agricultural expansion, who originated from other cities in the center of Brazil.

Squatters clean up areas, aim to take ownership, build improvements, and initiate small-scale plantations and small-scale animal husbandry. Through these activities, which impact and change the forest cover, the squatters seek to legitimize their occupation and take advantage of the Native Vegetation Protection Law (NPVL) of Brazil, popularly known as the “New Forest Code” in 2009 vs 2012, allowing for new legal land use conversions.

[144] C.S. Miranda, R.M. Gamarra, C.L. Mioto, N.M. Silva, A.P. Conceição Filho, A. Pott Analysis of the landscape complexity and heterogeneity of the Pantanal wetland Braz. J. Biol., 78 (2018), pp. 318-327, 10.1590/1519-6984.08816.

3.2.1.3.2 Drivers of deforestation

Causes of drivers of deforestation in the reference region are cattle ranching and agriculture activities, which among the most important sources of income in the region.

3.2.1.3.3 Underlying causes of deforestation

A combined analysis of the agents, determinants shows that the main factors which constitute the causes underlying deforestation are related to: lacks of economic opportunities and lacks of laws and enforcement capacities.

Experts have suggested that President Jair Bolsonaro's policies are directly to blame for the destruction of the Brazilian Pantanal and other critical ecosystems. Bolsonaro's administration has actively pursued the economic development of the Pantanal, prioritized agribusiness and mining interests, encouraged a culture of impunity which empowers illegal agricultural expansion against conservation and indigenous rights, and weakened the institutions of the Brazilian government responsible for protecting the environment and indigenous peoples.[145]

Spatial analysis shows land use change for cattle and agricultural intensification directly threatens the Pantanal wetlands. Over 12% of Pantanal forest cover has already been lost due to the growth of ranching and agricultural activities, If the current rate of deforestation persists, the Pantanal as an ecosystem will effectively disappear by 2050.[146]

Figure 47 represents the probability of ecosystem change according to a spatial model from the literature for 2050.

[145] Environmental Justice Foundation, "Paradise Lost? Protecting the Pantanal, a Precious Ecosystem in Crisis," 2020, 1–18, https://ejfoundation.org/resources/downloads/EJF-Pantanal-Briefing-2020-Final.pdf.
[146] Angélica Guerra et al., "Drivers and Projections of Vegetation Loss in the Pantanal and Surrounding Ecosystems," *Land Use Policy* 91 (February 1, 2020), https://doi.org/10.1016/j.landusepol.2019.104388.

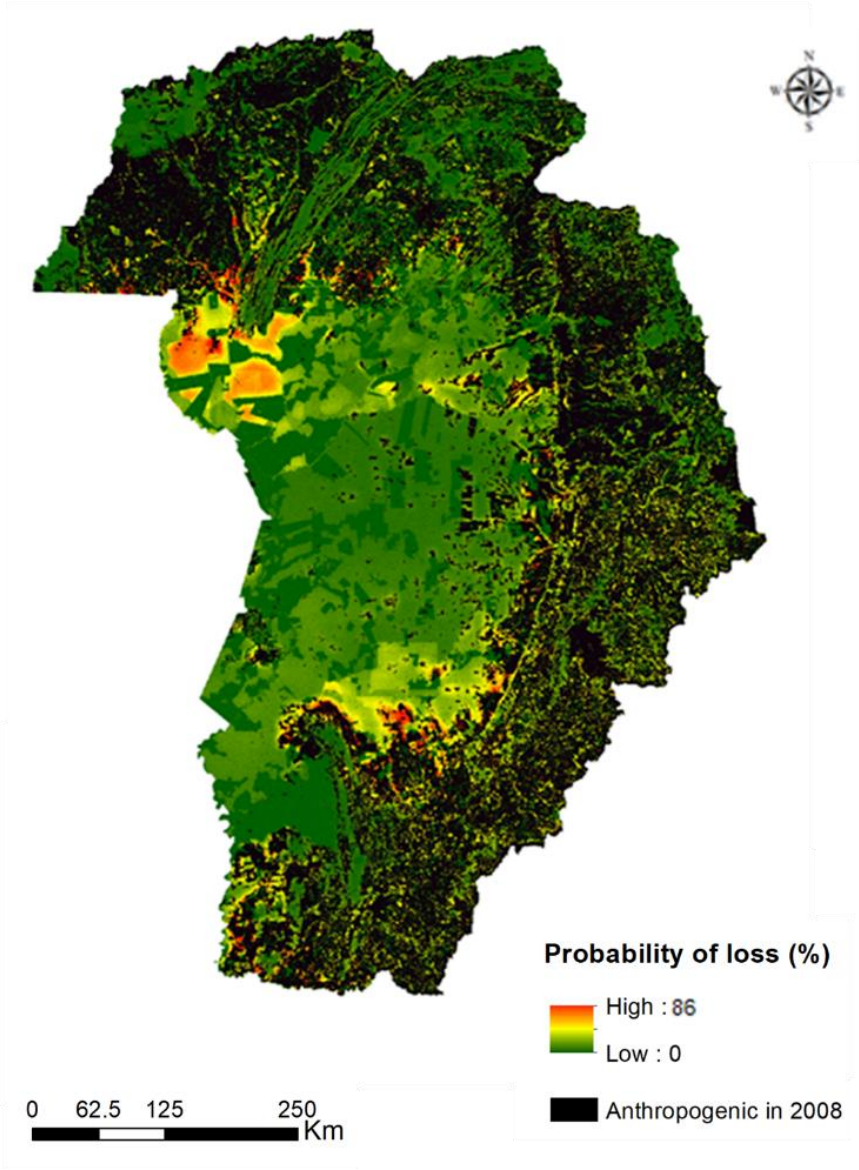


Figure 47. Native vegetation loss predictions (in %) for the UPRB (upper Paraguay River basin) model accumulated by 2050

(Source: Guerra et al, 2020)[147]

Table 42 summarizes the main agents, drivers and underlying causes of deforestation.

[147] Ibid.

Table 42. Summary of main agents, drivers and underlying causes of deforestation

Distribution (presence-absence)		Reference region	Project area
Underlying causes	Historically, cattle ranching in the Pantanal was characterized by extremely low stocking rates and low environmental impact. As a result, the activity has become uncompetitive, and in the last 20 years, families who had been raising cattle in the region are increasing the number of heads per hectare due to low productivity.	X	X
	Land-use policies and other economic forces, such as revisions to Brazil's Forest Code, threaten the Pantanal by accelerating the growth of agribusiness and small landowners, weaking federal authority and granting immunity from prosecution for deforestation.[148]	X	X
Agents of deforestation	Ranchers and local communities	X	X
	Farmers and agribusiness	X	X
Drivers of deforestation	Cattle ranching focusing on beef production since 1975 [149]	X	X
	Agricultural expansion	X	X

(Source: South Pole, 2020)

[148] Jeff Tollefson, "Brazil Revisits Forest Code," *Nature* 476, no. 7360 (2011): 259–60, https://doi.org/10.1038/476259a.
[149] WWF-Brasil, 10 Years of Sustainable Beef Production in the Pantanal, 2015.

3.2.1.3.4 Analysis of chain of events leading to deforestation

Taking into account the socio-economic activities of the region, the main productive activities are cattle ranching and agriculture.

One of the main drivers of deforestation in the Pantanal is cattle ranching activities, which is among the most important sources of income in the region. Due to an increase in the domestic and international demand for beef, livestock dynamics have shown a cattle herd increase from around 185 million heads in 2002 to 215 million heads in 2015 (Lapola *et al*., 2013; Sparovek *et al*., 2018). Due to the requirements of land for grazing activities, biomes like the Amazon, Cerrado, and now the Pantanal, have been degraded and converted into pastures for beef production. With the creation of new laws and international pressures over the Brazilian government, deforestation rates in the Amazon have been decreasing in recent years, with 65% of the deforested land having been occupied by pastures (Sparovek et al., 2018).

Nevertheless, these decreases encourage land use changes in the adjacent biomes such us Cerrado and Pantanal. It is estimated that 60% of the plateau surrounding the Pantanal is deforested for cattle ranching and agricultural activities (Michelaina, 2018). Cattle ranching in these areas is pasture dependent and is performed with low levels of technology; in addition, around 30% of all pastures in Brazil have low productivity (Sparovek *et al*., 2018). Furthermore, it is estimated that about 20% of the land used for grazing is degraded due to inappropriate pasture management (Elias *et al*., 2018). Despite this, cattle ranching activities have been increasing in the Pantanal, where 15% of the land has already been deforested (Elias *et al*., 2018).

Although cattle ranching is considered to be a traditional practice in the Pantanal, the land available for cattle ranching depends on the extent of flooding levels during the wet season and the vegetation cover. Due to these conditions, ranchers have included detrimental practices, primarily deforestation and the conversion of natural vegetation to pastures (Marengo et al., 2014; Eaton, 2016), generating an intensification of cattle ranching.

Regarding agribusiness, Brazil is one of the world's major agricultural producers. Agribusiness represents around 25% of the country's economy (Sparovek *et al*., 2018), and over the last four decades there has been an increasing trend of land area used for cropping, especially for large-scale farming of soybean, sugarcane and maize. These crops represented 83% of the country's gross crop production by 2011 (USD 84 billion) (Lapola *et al*., 2013). One of the strongest factors driving the increase in agriculture was the political power of the sector at state and municipal levels, which generates new subsidies for the agro-industry (Lapola et al., 2013). Nevertheless, these increases in production and subsidies have been associated with the conversion of natural vegetation, deforestation, cropland establishment in pastures, and social and other environmental impacts, especially in the Amazon and Cerrado biomes (Sparovek et al., 2018).

Although new policies and international pressures slowed the cropland expansion in the Amazon, the Cerrado was exposed to the needs of suitable land for agriculture, and, therefore, experienced a conversion of savannas to croplands two and a half times that of the Amazon Rainforest (Zalles et al., 2018). In terms of cropland, the state of Mato Grosso increase of 26%, and a 99% increase in Mato Grosso do Sul, which occurred through the conversion of pastures (Zalles et al., 2018). The Cerrado

biome has experienced significant land use changes, with 50% of its original area transformed by agriculture. This is due to the characteristics of its topography and soils, which facilitated the mechanization processes.

This situation has expanded into the Pantanal, which is the most intact biome in Brazil, with a 15% transformation of its area. Although agricultural expansion is not as significant in the Pantanal, the consequences of this activity in the plateau could be severe for the ecosystem. The Pantanal depends on the hydrologic regime which has its origins in the plateau; therefore, agricultural activities could alter the hydrological flows, increase the runoff of fertilizers and sediments, and the water discharge (Guerra et al., 2020). This affects the native vegetation of the Pantanal and the livelihoods of people (fishing, ranching, or agriculture), mainly due to changes in the flood dynamics and river avulsions (Guerra et al., 2020; Michelaina, 2018).

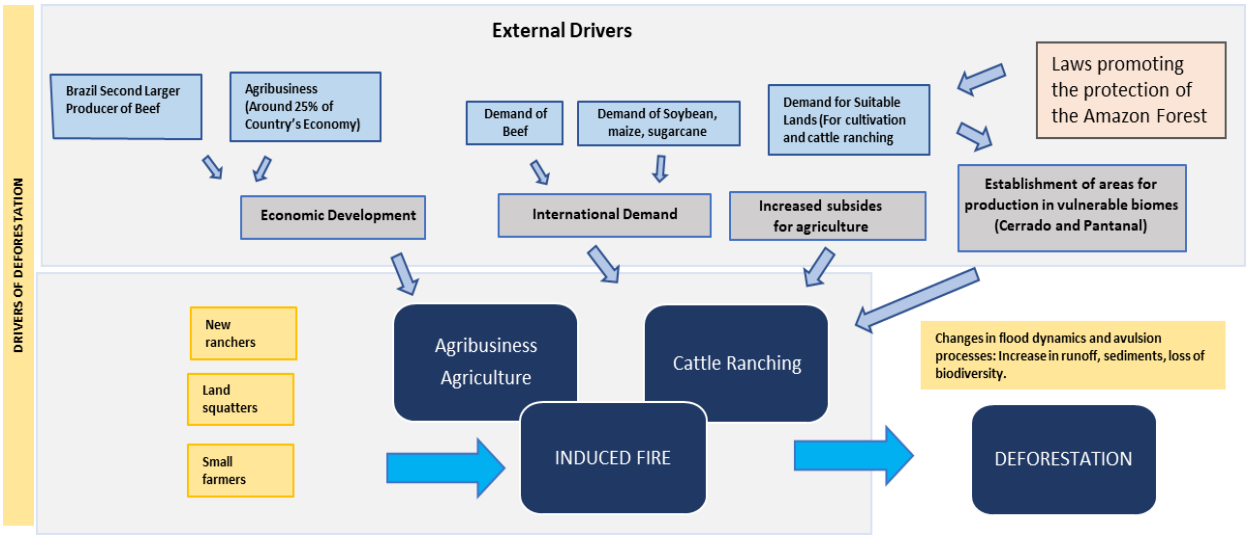


Figure 48. Drivers of deforestation

(Source: South Pole, 2020)

3.2.1.3.5 Conclusion

Based on the data and information presented above, it is possible to find conclusive evidence of the relationship between agents, drivers, underlying causes and the deforestation pressure, as presented in Figure 48.

Thus, the hypothesis presented is that occupational growth influenced by agribusiness and major land projects and public policy, coupled with the inefficiency of the government in the regularization and monitoring of rural properties, the precariousness of public services and the weak performance of the state to curb illegal activities, all contribute to the deforestation scenario observed during the period analyzed. Taking this into consideration, the tendency for the baseline in the future, is to maintain the influence of the agents, drivers and underlying causes shown in the historical period analyzed.

3.2.1.4 Step 4. Projection of the annual areas and location of deforestation in the reference region in the without-project case

3.2.1.4.1 Step 4.1. Projection of the quantity of future deforestation

The reference region was not stratified in terms of land cover. To predict the amount of future deforestation, an analysis of agents and causes of deforestation was considered, alongside historical deforestation trends in the project reference region.

Step 4.1.1. Selection of the baseline approach

Section 4.1.1 of the VM0015 methodology dictates that if the deforestation rates in the reference region reveal a clear trend for different periods (decreasing); and, in addition, there is conclusive evidence that the agents and drivers explain predictable changes in the deforestation, which means at least one variable that can be used to model deforestation; then baseline approach "C" should be employed as a conservative procedure to quantify future deforestation.

The location of future deforestation was modeled according to approach C, which estimates the annual area of deforestation using a model that expresses future deforestation as a function of the variables mentioned in the supporting document 'Modelling future deforestation in Serra do Amolar using Dinamica EGO'.[150]

The process used is outlines in a flow diagram (Figure 45), related to the corresponding section of the methodology in section 4.2.

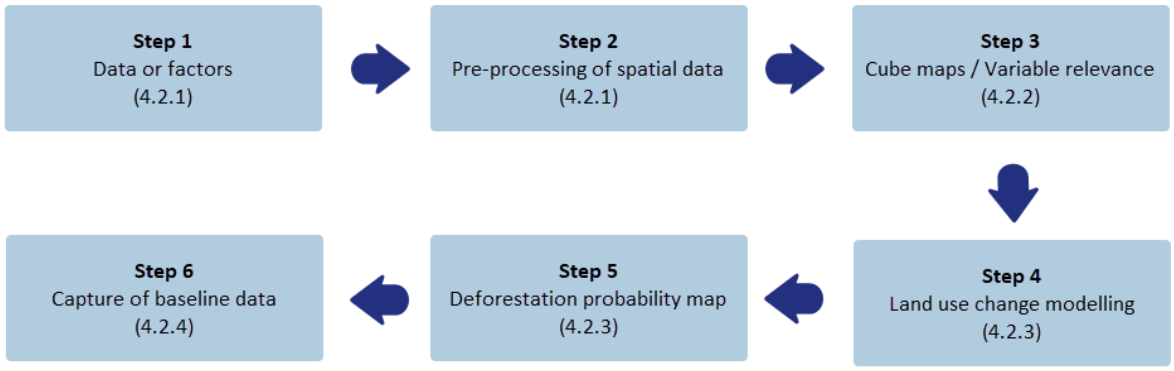


Figure 49 Process for simulating the location of future deforestation with DinamicaEGO.

(Source: South Pole, 2022)

[150] Document available on Support Information /Climate/Deforestation Drivers and Model

The final forest area for the historical analysis period was used as a reference point for the baseline deforestation model; however, it was compared with the average annual rate for the historical period to maintain conservative principle.

Step 4.1.2. Quantitative projection of future deforestation

As Step 4.1.1 in the Annex describes, the annual deforestation rate of -1.10% could be applied to the analysis boundary using approach "a", the historical average approach. On the other hand, an annual deforestation rate decreasing trend in the inter-annual data set with a coefficient of determination r2 at 90%, using approach "b", could be applied. However, both do not reveal the latest policies and causes and drivers of the deforestation driving land use change in the project reference region.

Therefore, the most appropriate baseline approach is Approach “c” because it represents the most complete, consistent, robust, and conservative approach, which includes non-homogenous deforestation risk maps and other factor maps.

- Complete and robust: because more steps and data are included in this approach;
- Consistent: a spatial model implies a spatial distribution of the deforestation rate at the level of variables used; and consistence criteria compliance with section 4.1.1 regarding a decrease of the deforestation rate but even a emergence evidence that the decreasing trend will change in the future without project scenario.
- Conservative: comparative analysis between Approach A (Historical Average) and Approach C (Modelling) is below historical trend and most appropriate to explain the drivers.

Approach “C”: Modelling

Finally, the annual of baseline deforestation that applies within the project area and leakage belt projection were analyzed using a spatially explicit model which included multiple regression of factors using DinamicaEGO (model performed by South Pole, available in Annex[151]). Presented in Table 44, Table 45, and Table 46.

3.2.1.4.2 Step 4.2 Projection of the location of future deforestation

Based on there are more than one fine-scale detail of landscapes and spatially dependent biological, economic, and social processes that can explain the deforestation phenomena in the reference region, the project area, and the leakage belt. According to Step 4.2.1 of VCS Methodology VM0015, all following sub-steps were performed and described deeply in Annex ‘Modelling future deforestation in Serra do Amolar using Dinamica EGO’.[152]

- 4.2.1 Preparation of factor maps;
- 4.2.2 Preparation of risk maps for deforestation;
- 4.2.3 Selection of the most accurate deforestation risk;

[151] Support Information CCB/Climate/Deforestation Drivers and Model
[152] Document available on Support Information /Climate/Deforestation Drivers and Model

- 4.2.4 Mapping of the locations of future deforestation.

4.2.2 Preparation of deforestation risk maps

As required by Section 4.2.1 of VCS Methodology VM0015, spatial variables associated with deforestation were used to prepare factor maps. An empirical approach using distance maps was chosen for projecting deforestation as preferred by the methodology. Variables considered for modeling future deforestation were “spatial driver variables” associated with the agents and drivers of deforestation. Dinamica EGO supports data in raster format. Therefore, each of the variables was converted into a raster file (TIFF) aligned to the spatial characteristics of the forest cover data, which had the finest spatial resolution.

The predictors maps used were sourced from different entities such as WWF, INPE, SOS Pantanal, and IBGE. Population Density 2015 maps was derived from the European Commission’s Joint Research Centre and Columbia University’s Center for International Earth Science Information Network (CIESIN (2015). (Please see details available in: Support Information CCB/Climate/Deforestation Drivers and Model).

4.2.3 Selection of the most accurate deforestation risk map

In preparing the deforestation risk maps, a statistical method was used to relate each spatial driver variable and its factor map to probability of deforestation. Prepared factor maps are listed in Table 44

To determine the level of influence of each variables in the deforestation processes, the geostatistical method of weights of evidence was used in Dinamica EGO. This process analyzes the relationship between each factor map and observed deforestation during the historic baseline period to determine the importance of each range of values for each variable (weight) and the nature of its relationship with deforestation (i.e., positive, negative, or neutral). Once the coefficients of the weights of evidence have been established, the factor maps are combined to generates the deforestation risk map, a raster of transition probabilities.

A Bayesian method was used in the calculation of the weights of evidence, in which the effect of a spatial variable on a transition was calculated independently of a combined solution. Therefore, it was necessary to analyze the correlation between variables and ensure that the assumption of independence was met.The variables which may influence the occurrence of deforestation within the reference region were identified. Six variables considered to be factor variables in the deforestation risk parsimonious model were included (see Table 43).

Table 43. List of variables, maps and factor maps (Table 10 of Methodology VM0015)

Factor map		Source	Variable represented	
ID	File name		Unit	Description
1	Distance to rivers and body water	IBGE	meters	Euclidean distance

2	Distance to ports	IBGE	meters	Euclidean distance
3	Distance to settlements	IBGE	meters	Euclidean distance
4	Property land area	IBGE	hectares	Categorical average
5	Distance to conservation units	IBGE	meters	Euclidean distance
6	Distance to previous deforestation	MapBiomas	meters	Euclidean distance

(Source: South Pole, 2022)

4.2.4 Mapping of the locations of future deforestation

As required by Section 4.2.3, multiple deforestation risk maps (i.e., transition probability maps) were prepared and used for simulations select the most accurate map. Model selection was done using the results of the validation approach used with Dinamica EGO. The final model was chosen to maximize the minimum similarity in the multiple windows constant decay validation process, discussed in later sections.

After running validation on all the model variations, Dinamica EGO maps the location of future deforestation following the approach as described in Section 4.2.4 of the methodology. For each simulation year, the model:

1. Recalculated distance to deforestation based on deforestation occurring during previous simulation years and updated the deforestation risk map accordingly;
2. Calculated total area to be deforested based on the deforestation rate (i.e., the transition matrix) and determined the number of pixel transitions from forest to non-forest
3. Allocated deforestation transitions by selecting pixels for which deforestation would occur based on the probability of deforestation (deforestation risk map) and model parameters (i.e., proportion of new deforestation patches vs. expansion of existing patches, patch shape and size)

presents the landscapes (forest and non-forest) simulated by Dinamica EGO for Pantanal biome from 2017 to 2032.

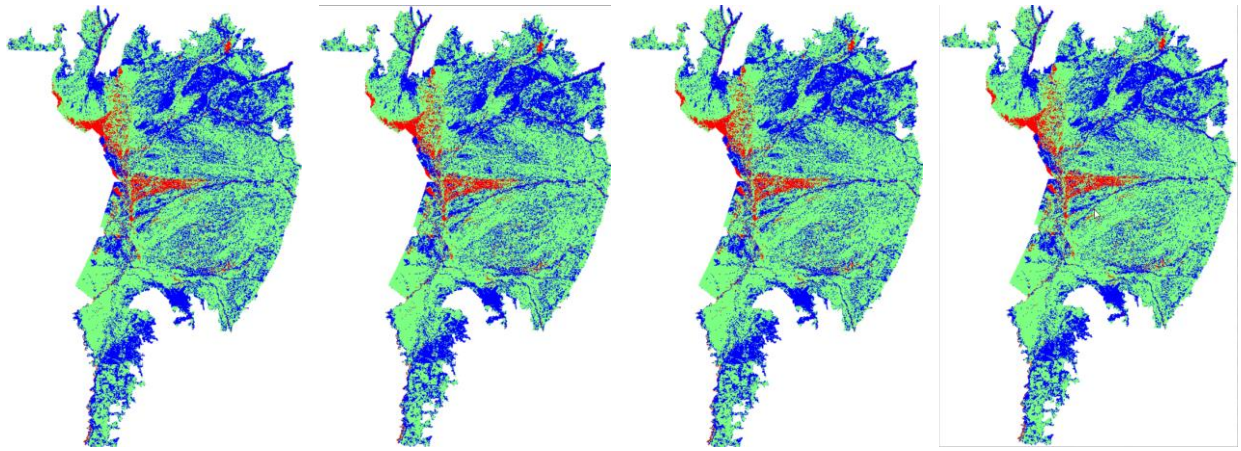


Figure 50 Simulated landscapes (Forest and Non-Forest) map for Pantanal biome for 2017, 2022, 2027 and 2032

Figure 47 presents the simulated annual deforestation probability map by Dinamica EGO for Pantanal biome from 2017 to 2032

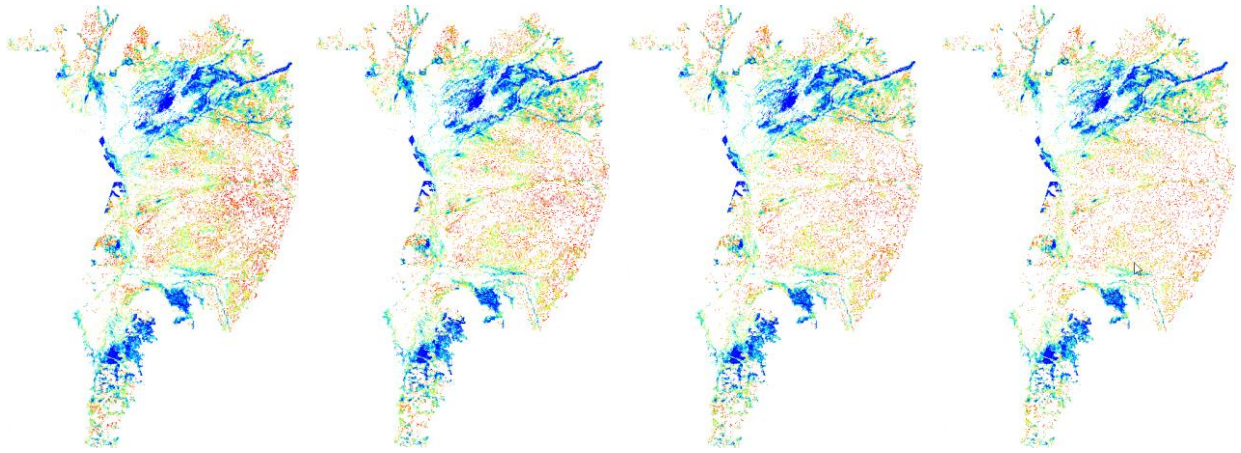


Figure 51. Simulated probability deforestation map for Pantanal biome for 2017, 2022,2027 and 2032

The total increase in deforestation projected for the first 15 years of the crediting period was 584,707 ha, with an annual average of 38,980 ha (see Table 44).

Table 44. Annual areas of baseline deforestation in the reference region (Table 9.a of Methodology VM0015)

Project year (t)	Stratum I in the reference region	Total	
	1	Annual	Cumulative
	ABSLRRi,t	ABSLRRt (Annual area of baseline deforestation in the reference region at year t)	ABSLRR (cumulative area of baseline deforestation in the reference region at year t)
	ha	ha	ha
1	41,163.62	41,163.62	41,163.62
2	40,840.99	40,840.99	82,004.61
3	40,520.96	40,520.96	122,525.57
4	40,203.45	40,203.45	162,729.02
5	39,888.36	39,888.36	202,617.38
6	39,575.80	39,575.80	242,193.18
7	39,265.65	39,265.65	281,458.83
8	38,957.94	38,957.94	320,416.77
9	38,652.66	38,652.66	359,069.43
10	38,349.80	38,349.80	397,419.23
11	38,049.28	38,049.28	435,468.50
12	37,751.09	37,751.09	473,219.59
13	37,455.24	37,455.24	510,674.84
14	37,161.73	37,161.73	547,836.57
15	36,870.56	36,870.56	584,707.13

(Source: South Pole, 2022)

In the project area, the projected deforestation is also decreasing, estimated to be 4,364 ha between 2016 and 2031, with an average of 290 ha per year (see Table 45).

Table 45. Annual areas of baseline deforestation in the project area until 2035 (Table 9.b of Methodology VM0015)

Project year (t)	Stratum I of the reference region in the project area	Total	
	1	Annual	Cumulative
	ABSLPAi,t (Annual area of baseline deforestation in sratum i within the project area at year t)	ABSLPAt (Annual area of baseline deforestation in the project area at year t)	ABSLPA (Cumulative area of baseline deforestation in the project area at year t)
	ha	ha	ha
1	313.11	313.11	313.11
2	384.39	384.39	697.50
3	276.43	276.43	973.93
4	188.60	188.60	1162.53
5	407.68	407.68	1570.21
6	301.69	301.69	1871.90
7	98.80	98.80	1970.69
8	120.55	120.55	2091.24
9	553.85	553.85	2645.09
10	303.94	303.94	2949.03
11	284.97	284.97	3234.00
12	147.97	147.97	3381.97
13	360.93	360.93	3742.90
14	253.06	253.06	3995.96
15	368.21	368.21	4364.17

(Source: South Pole, 2022)

In the leakage belt, the projected deforestation (Table 46) is also simulated by a spatial model, with a cumulative estimation of 3,825 ha between 2016 and 2031, with an average of 400 ha per year.

Table 46. Annual areas of baseline deforestation in the leakage belt until 2035 (Table 9c of Methodology VM0015)

Project year (t)	Stratum I of the reference region in the leakage belt	Total	
	1	Annual	Cumulative
	ABSLLKi,t (Annual area of baseline deforestation in stratum i within the leakage belt at year t)	ABSLLKt (Annual area of baseline deforestation within the leakage belt at year t)	ABSLLK (Cumulative area of baseline deforestation within the leakage belt at year t)
	ha	ha	ha
1	248.02	248.02	248.02
2	212.15	212.15	460.18
3	512.86	512.86	973.03
4	198.40	198.40	1,171.43
5	210.99	210.99	1,382.42
6	397.16	397.16	1,779.58
7	584.95	584.95	2,364.53
8	531.64	531.64	2,896.17
9	559.51	559.51	3,455.68
10	370.10	370.10	3,825.78
11	259.80	259.80	4,085.58
12	482.74	482.74	4,568.32
13	461.97	461.97	5,030.30
14	451.73	451.73	5,482.02
15	519.78	519.78	6,001.80

(Source: South Pole, 2022)

3.2.1.5 Step 5. Definition of the land use and land cover change component of the baseline

The goal of this step is to calculate activity data (hectares per year) of the initial forest classes (icl) that will be deforested, and activity data of the post-deforestation classes (fcl) that will replace them in the baseline case.

3.2.1.5.1 Step 5.1. Calculation of baseline activity data per forest class

This calculation combined the estimations based on maps of annual baseline deforestation of each future year produced with the land use and land cover map created for the initial landscape (2016).[153]

The number of hectares of each forest class that would be deforested were extracted from these maps, and the results of the baseline projections were compared with linear models to demonstrate consistency. The average results were: 38,980 ha in the reference region between 2017 and 2026 (Table 47), 400 ha in the leakage belt ((Source: South Pole, 2022)

Table 48), and 290 ha in the project area ((Source: South Pole, 2022)

Table 49).

Table 47. Annual areas deforested per forest class icl within the reference region in the baseline case (Table 11a of Methodology VM0015)

Area deforested per forest class icl within the reference region		Total baseline deforestation in the reference region	
IDicl >	1		
Name >	1.1 Forest	ABSLRRt annual	ABSLRR cumulative
Project year t	ha	ha	ha
2017	41,164	41,164	41,164
2018	40,841	40,841	82,005
2019	40,521	40,521	122,526
2020	40,203	40,203	162,729
2021	39,888	39,888	202,617
2022	39,576	39,576	242,193
2023	39,266	39,266	281,459

[153] All maps area available in Support_information CCB/Climate/Deforestation Drivers and Model/Dinamica/Results

Area deforested per forest class icl within the reference region		Total baseline deforestation in the reference region	
IDicl >	1		
Name >	1.1 Forest	ABSLRRt annual	ABSLRR cumulative
Project year t	ha	ha	ha
2024	38,958	38,958	320,417
2025	38,653	38,653	359,069
2026	38,350	38,350	397,419
2027	38,049	38,049	435,469
2028	37,751	37,751	473,220
2029	37,455	37,455	510,675
2030	37,162	37,162	547,837
2031	36,871	36,871	584,707

(Source: South Pole, 2022)

Table 48. Annual areas deforested per forest class icl within the leakage belt area in the baseline case (Table 11c of Methodology VM0015)

Area deforested per forest class icl within the leakage belt		Total baseline deforestation in the leakage belt	
IDicl >	1		
Name>	1.1 Forest	ABSLRRt annual	ABSLRR cumulative
Project year (t)	ha	ha	ha
2017	248.02	248.02	248.02
2018	212.15	212.15	460.18
2019	512.86	512.86	973.03
2020	198.40	198.40	1,171.43
2021	210.99	210.99	1,382.42
2022	397.16	397.16	1,779.58

Area deforested per forest class icl within the leakage belt		Total baseline deforestation in the leakage belt	
IDicl >	1		
Name>	1.1 Forest	ABSLRRt annual	ABSLRR cumulative
Project year (t)	ha	ha	ha
2023	584.95	584.95	2,364.53
2024	531.64	531.64	2,896.17
2025	559.51	559.51	3,455.68
2026	370.10	370.10	3,825.78
2027	259.80	259.80	4085.58
2028	482.74	482.74	4568.32
2029	461.97	461.97	5030.30
2030	451.73	451.73	5482.02
2031	519.78	519.78	6001.80

(Source: South Pole, 2022)

Table 49. Annual areas deforested per forest class icl within the project area in the baseline case (Table 11b of Methodology VM0015)

Area deforested per forest class icl within the project area		Total baseline deforestation in the project area	
IDicl >	1		
Name >	1.1 Forest	ABSLRRt annual	ABSLRR cumulative
Project year (t)	ha	ha	ha
2017	313.11	313.11	313.11
2018	384.39	384.39	697.50
2019	276.43	276.43	973.93
2020	188.60	188.60	1,162.53
2021	407.68	407.68	1,570.21

Area deforested per forest class icl within the project area		Total baseline deforestation in the project area	
IDicl >	1		
Name >	1.1 Forest	ABSLRRt annual	ABSLRR cumulative
Project year (t)	ha	ha	ha
2022	301.69	301.69	1,871.90
2023	98.80	98.80	1,970.69
2024	120.55	120.55	2,091.24
2025	553.85	553.85	2,645.09
2026	303.94	303.94	2949.03
2027	284.97	284.97	3234.00
2028	147.97	147.97	3381.97
2029	360.93	360.93	3742.90
2030	253.06	253.06	3995.96

(Source: South Pole, 2022)

3.2.1.5.2 Step 5.2. Calculation of baseline activity data per post-deforestation class

Two methods are available to project the LU/LC classes that will replace forests in the baseline case: (1) “Historical LU/LC-change”, and (2) “Modeling”. The complexity of Method 2 suggests the projection of LU/LC changes, in which new variables could be included in step 4; however, this increases the risk of uncertainty or error.

For the historical scenario (Method 1), this would create a more confident scenario to determine the forest cover trend class in the baseline.

For this calculation, a Pantanal biome statistic was considered, which contained the project area and the leakage management areas, as well as MapBiomas capabilities, which means it is not necessary to divide into zones.

Due to the corresponding areas of forest after deforestation (post-deforestation), based on Method 1 of 1,999,169 ha encompassing a dominant use of grassland (99.8%), and only 0.2% of cropland (Figure 52), a single zone and post-deforestation was considered.

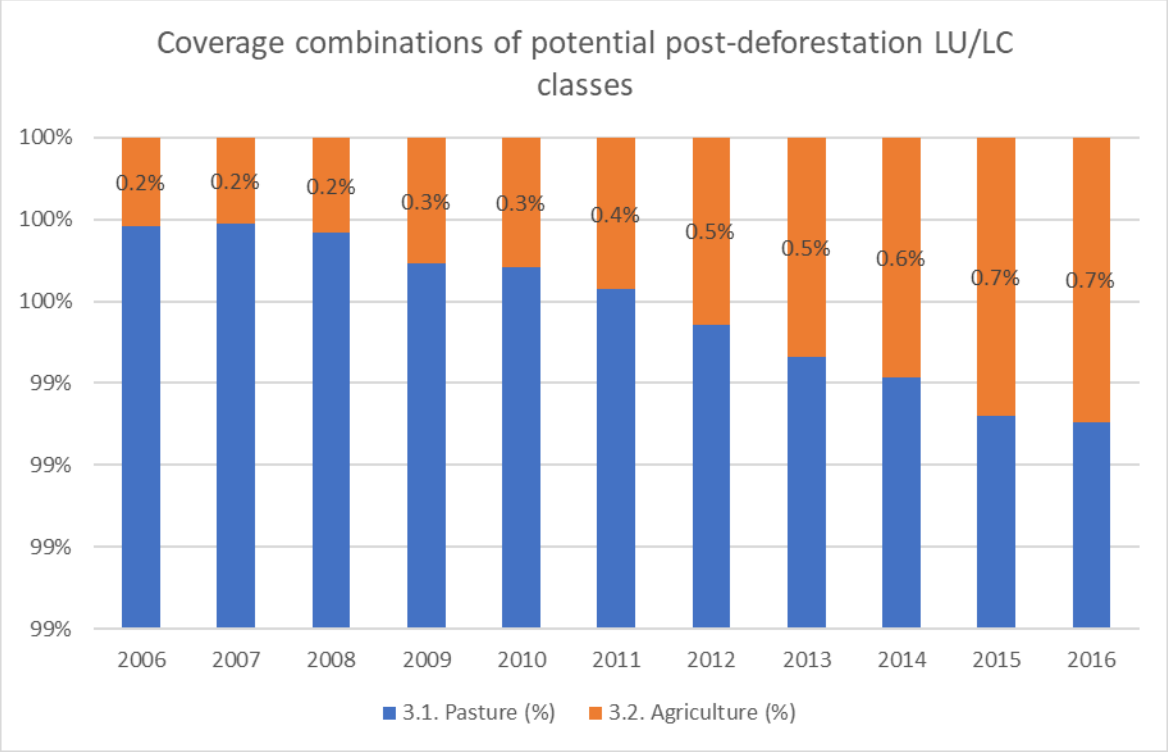


Figure 52. Coverage combinations of potential post-deforestation LU/LC classes

Table 50. Zones of the reference region encompassing different combinations of potential post-deforestation LU/LC classes (Table 12 of Methodology VM0015)

Zone		3.1. Pasture		3.2. Agriculture		Total of all other LU/LC classes present in the zone		Total area of each zone	
		IDfcl	1	IDfcl	2				
		Area	% of zone	Area	% of zone	Area	% of zone %	Area	% of zone
IDz	Name	ha		ha		ha		ha	
1.0	Zone 1	1,940,145	99.7%	6,732	0.3%			1,946,877.5	100%
Total area of each class fcl		1,940,145	99.7%	6,732	0.3%			1,946,877.5	100%

(Source: Mapbiomas, 2021)

Given that the project only considers one zone at a time, the values per zone are identical to Table 47, (Source: South Pole, 2022)

Table 48 and (Source: South Pole, 2022)

Table 49 in step 5.1.

3.2.1.5.3 Step 5.3. Calculation of baseline activity data per land use and land cover change category

This step does not apply for the project, because Method 2 was not applied.

3.2.1.6 Step 6. Estimation of baseline carbon stock changes and non-CO_2 emissions

This step creates the estimation of the baseline stocks by calculating the average carbon stocks of each LU/LC class, determining the carbon stock change factors, and then calculating the baseline carbon stock changes, even when forest fires are included in the baseline assessment, of non-CO_2 emissions from biomass burning.

3.2.1.6.1 Step 6.1. Estimation of baseline carbon stock changes

Step 6.1.1. Estimation of the average carbon stocks of each LU/LC class

The baseline carbon stock changes to estimate the average carbon stock of each LU/LC class are reached through literature estimations. The average includes forest classes within the project area and the leakage belt. Other values were used as vegetation classes as the post-deforestation classes projected to exist in the project area and the leakage belt and the non-forest classes in the leakage management areas.

According to methodology VM0015, existing data that meet the follow criteria shall be applied across the classes from which they were representatively sampled:

- The data are less than 10 years old;
- The data are derived from multiple measurement plots;
- All species above a minimum diameter are included in the inventories;
- The minimum diameter for trees included is 30 cm or less at breast height (DBH);
- Data are sampled from good coverage of the classes over which they will be extrapolated.

Spatial data and data forest inventory for forest classes existing in the reference region, leakage belt and project area are available. Although the spatial data are more recent (from 2016), those data do not present a detailed, robust analysis for forest types, species and diametric classes.

The evaluation criteria for each of the data are presented below:

Table 51 Evaluation criteria for existing carbon stock data

Criteria	Spatial data	Inventory data
Data source:	Soares-Filho BS, Rajão R, Merry F, Rodrigues H, Davis J, Lima L, Macedo M, Coe M, Carneiro A, Santiago L (2016) Brazil's Market for trading forest certificates. Plos One 11(4): e0152311. doi:10.1371/journal.pone.0152311	*Estimativa do Estoque de Carbono Florestal na SESC Pantanal* [154]'
How old are the data?	Spatial data are published by *Soares, et al., 2016.* However, data represent a compilation of secondary information since 2012.	Inventory forest data are obtained by direct estimation in permanent plots (PP) after five years (2007-2012) by *Camargo et al., 2012*
Comparison	Spatial data estimates in the leakage belt, the carbon stock per hectare varied between 161 tCO_2e/ha and 1109.8 tCO_2e/ha in which areas with higher biomass values are located within the project area (see Figure 53).[155]	The available inventory data have a sampling intensity of (1 PP: 500 ha). Allometric equations were developed to estimate biomass as a function of D>30 (diameter greater than 30 cm) and height for each of the 17 area-dominant species. Considering vegetation types and strata of a non-proportional stratified sample, confidence intervals with a probability of 95% were estimated. Data below show a average from good coverages of the classes over which data will be extrapolated for the project used in Table 52

[154] Camargo, G., & Gonçalves, F. H. M. (2012). Estimativa do Estoque de Carbono da RPPN Dona Aracy – Miranda , Mato Grosso do Sul. 1–34.

[155] Soares-Filho BS, Rajão R, Merry F, Rodrigues H, Davis J, Lima L, Macedo M, Coe M, Carneiro A, Santiago L (2016) Brazil's Market for trading forest certificates. Plos One 11(4): e0152311. doi:10.1371/journal.pone.0152311

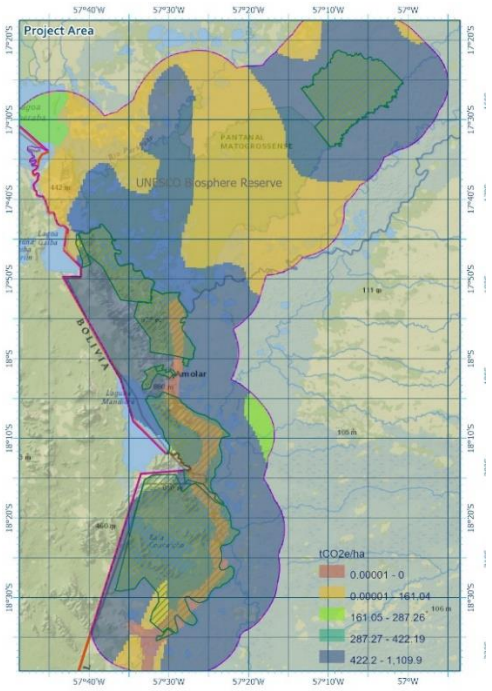


Figure 53. Carbon stocks in the project area and leakage belt

Table 52 Carbon stocks for types of vegetation within the project area

Pool	Average tC/ha	S.	n	Source:
AGB	120.25	319.18	163	(Page 42/145) Table 16[156]'
BGB	68.98	319.18	163	
Total	189.27	329.49	163	

Table 53 presents average carbon stock values per hectare of all LU/LC classes in the baseline scenario, present in the project area, leakage belt and leakage management areas: these values are also conservative in relation to other sources. Additional and methodological details for the construction of biomass estimations for the Serra do Amolar project can be found in the report: '*Estimativa do Estoque de Carbono Florestal na SESC Pantanal*'.

[156] Camargo, G., & Gonçalves, F. H. M. (2012). Estimativa do Estoque de Carbono da RPPN Dona Aracy – Miranda , Mato Grosso do Sul. 1–34.

Table 53. Estimated values of carbon stocks per hectare of initial forest classes icl existing in the project area and leakage belt (Table 15a of Methodology VM0015)

Project year (t)	Name:	1.1.1. Forest formation				
	ID icl	1				
	Average carbon stock per hectare + 90% CI					
	Cab icl (Average carbon stock per hectare in the above-ground biomass carbon pool of initial forest class icl)		Cbb icl (Average carbon stock per hectare in the below-ground biomass carbon pool of initial forest class icl)		Ctot icl (Average carbon stock of all accounted carbon pools in forest class icl)	
	C stock	90% CI	C stock	90% CI	C stock	90% CI
	(tCO_2e*ha^{-1})	(tCO_2e*ha^{-1})	(tCO_2e*ha^{-1})	(tCO_2e*ha^{-1})	(tCO_2e*ha^{-1})	(tCO_2e*ha^{-1})
1	440.92	30.02	252.94	5.72	693.86	34.87

(Based on SESC Pantanal)

Where:

Cab icl — Average equivalent carbon stock per hectare for the above-ground biomass reservoir for the initial forest class.

Cbb icl — Average equivalent carbon stock per hectare for the below-ground biomass reservoir for the initial forest class.

Ctot icl — Average carbon stock per hectare for the total biomass reservoir for the initial forest class.

Step 6.1.2. Calculation of carbon stock change factors

Post-deforestation classes are projected to exist in the project area and leakage belt in the baseline scenario and non-forest classes are expected to exist in the leakage management areas.

The VM0015 methodology allows the use of estimates from local studies, and therefore, values are reported in Table 53, which was taken as reference for the carbon stock in vegetation, the class projected to exist in the project area and the leakage belt in the project scenario.

The baseline scenario of the project considers the changes in forest carbon stock to be replaced by a type of vegetation that may be areas of pasture, and temporary agricultural crops. The VCS AFOLU document requires consideration of the carbon stock decay of carbon pools in organic soil, below-ground biomass, dead wood and timber products.

To calculate this decay, the VM0015 methodology applies a linear function to account for the initial carbon stock decay for the initial forest class (icl) and an increase in the carbon stock in the class after deforestation (fcl). The calculation also includes the new interpretation published by VCS in the 'Errata and Clarifications' (VCS, 2017), with updates to the VM0015 methodology regarding the inventory increase in the post-deforestation class. Table 54 shows how the carbon stock change factor was calculated.

Table 54. Table 20.a. Carbon stock change factors for initial forest classes icl (Table 20a of Methodology VM0015)

Year after deforestation	ΔCab icl,t	ΔCbb icl,t	ΔCdw icl,t	Δ Cl icl,t	ΔCsoc id,t	ΔCtot id,t
1	440.92	25.294	0	0	0	466.2106
2	0	25.294	0	0	0	25.2939
3	0	25.294	0	0	0	25.2939
4	0	25.294	0	0	0	25.2939
5	0	25.294	0	0	0	25.2939
6	0	25.294	0	0	0	25.2939
7	0	25.294	0	0	0	25.2939
8	0	25.294	0	0	0	25.2939
9	0	25.294	0	0	0	25.2939
10	0	25.294	0	0	0	25.2939

(Source: South Pole, 2022)

3.2.1.6.2 Step 6.2. Baseline non-CO2 emissions from forest fires

According to the methodology, emissions from fires used to clear forests in the baseline can always be omitted. However, the conversion of forest to non-forest, involving fires, is a significant source of non-CO_2 gas (methane, CH_4 and nitrous oxide, N_2O) emissions in the Pantanal; sufficient data on such forest fires are available from the historical reference period.

The effect of fire on carbon emissions is counted in the estimation of carbon stock changes; therefore, CO_2 emissions from forest fires should be ignored so as to avoid double counting.

To estimate non-CO_2 emissions from forest fires, it is necessary to estimate the average percentage of the deforested area in which the fire was used, the average proportion of mass burnt in each carbon pool (Pburnt,p), and the average combustion efficiency of each pool (CEp). These average percentage values are estimated for each forest class (icl) and are assumed to remain the same in the future.

Based on the 'Revised 1996 IPCC Guidelines for LULUCF', GHG emissions from biomass burning can be estimated as follows:

$EBBtot_{icl,t} = EBBN2O_{icl,t} + EBBCH4_{icl,t}$ Equation (11)

Where:

EBBtoticl,t Total GHG emission from biomass burning in forest class icl at year t (tCO_2e ha-1)

EBBN2Oicl,t N_2O emission from biomass burning in forest class icl at year t (tCO_2e ha-1)

EBBCH4icl,t CH_4 emission from biomass burning in forest class icl at year t (tCO_2e ha-1)

$EBBN2Oicl,t = EBBCO_2icl,t * 12/44 * NCR*ERN2O*44/28*GWPN2O$ Equation (12)

$EBBCH4icl,t = EBBCO_2icl,t * 12/44 * ERCH4*16/12*GWPCH4$ Equation (13)

Where:

$EBBCO_{2icl,t}$ Per hectare CO_2 emission from biomass burning in slash and burn in forest class icl at year t; tCO_2e ha-1

$EBBN2O_{icl,t}$ Per hectare N2O emission from biomass burning in slash and burn in forest class icl at year t; tCO_2e ha-1

EBBCH4icl,t Per hectare CH4 emission from biomass burning in slash and burn in forest class icl at year t; tCO_2e ha-1

NCR Nitrogen to Carbon Ratio (IPCC default value = 0.01); dimensionless

ERN2O	Emission ratio for N_2O (IPCC default value = 0.007)
ERCH4	Emission ratio for CH_4 (IPCC default value = 0.012)
GWPN2O	Global warming potential for N_2O (IPCC default value = 310 for the first commitment period)
GWPCH4	Global warming potential for CH_4 (IPCC default value = 21 for the first commitment period)

An estimation of non-CO_2 GHG emitted from forest fires for the Serra do Amolar project includes accounting for the area burned because of the role of fire in deforestation, and because ignoring them constitutes a source of emissions that underestimates the baseline emissions for the project.

Fire variability in the project area is high and unpredictable (see Figure 54) with there being an undefined pattern associated with yearly fire events, as well as monthly ones that are not accounted for by deforestation due to their spontaneous occurrence, frequency, scale and ecosystem potential for recovery. However, emissions by forest fires were estimated in fire events and areas burnt for the dry season from the start of the project and for the historical reference period, 10 to 15 years earlier, as required by the methodology. The analyses obtained results that do not negatively affect the principle of the conservativeness of GHG reductions. Therefore, it is considered adequate, given that the estimates have a greater precision of what is happening in terms of the forest degradation process.

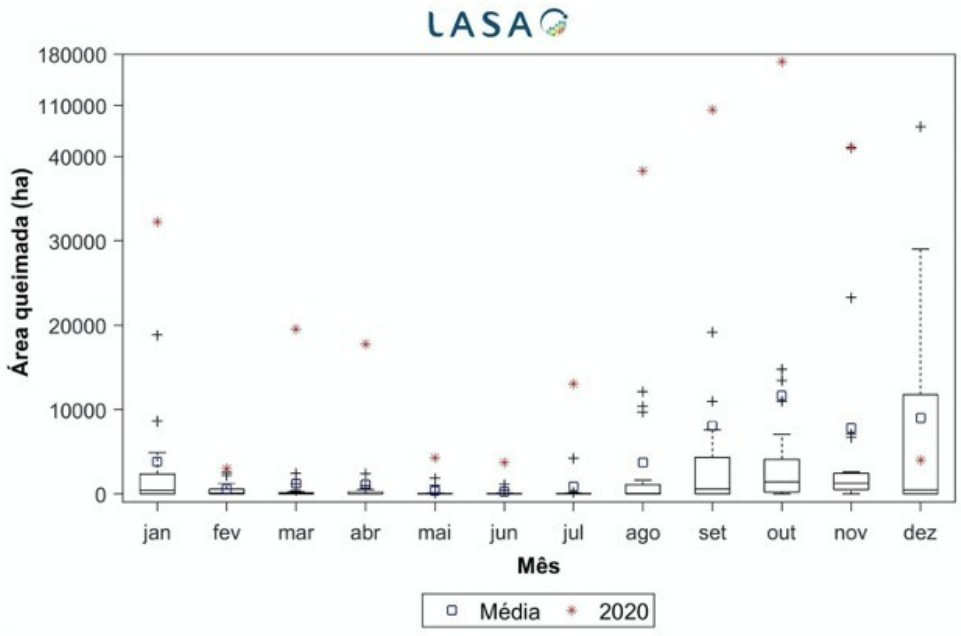


Figure 54. Monthly cycle of burned area in the project area for a historical period of 20 years. Boxplot represents the average and red point extreme events

(Source: LASA, 2021)

However, the El Niño event produced an increase in burned areas in some regions compared to the La Niña years. El Niño, by comparing simulations driven by observations from the year 2015/16, 2004/06, with mean climatological drivers of temperature, precipitation, humidity, wind, air pressure, and short and long-wave radiation, has the largest fire response, with a 70% increase in burned areas and emitted carbon (Figure 55). Therefore, parameters in the monitoring period regarding %Pbumt ab,icl and %Fburnticl should be updated if those events occur.

Table 55. Parameters used to calculate non-CO_2 emissions from forest fires (Table 23 of Methodology VM0015)

Initial forest class		%Fburnticl	tCO_2e/ha Cab	% Pbumt ab,icl	% CEab,icl	tCO_2e/ha ECO_2-ab	tCO_2e/ha $EBBCO_2$-tot	tCO_2e/ha EBBnN2Oicl	tCO_2e/ha EBBCH4icl	tCO_2e/ha EBBtoticl
IDcl	Name									
1	Forest formation	38%	440.92	100%	0.50	220.46	83.77	0.78	7.68	3.21

(Source: South Pole, 2022)

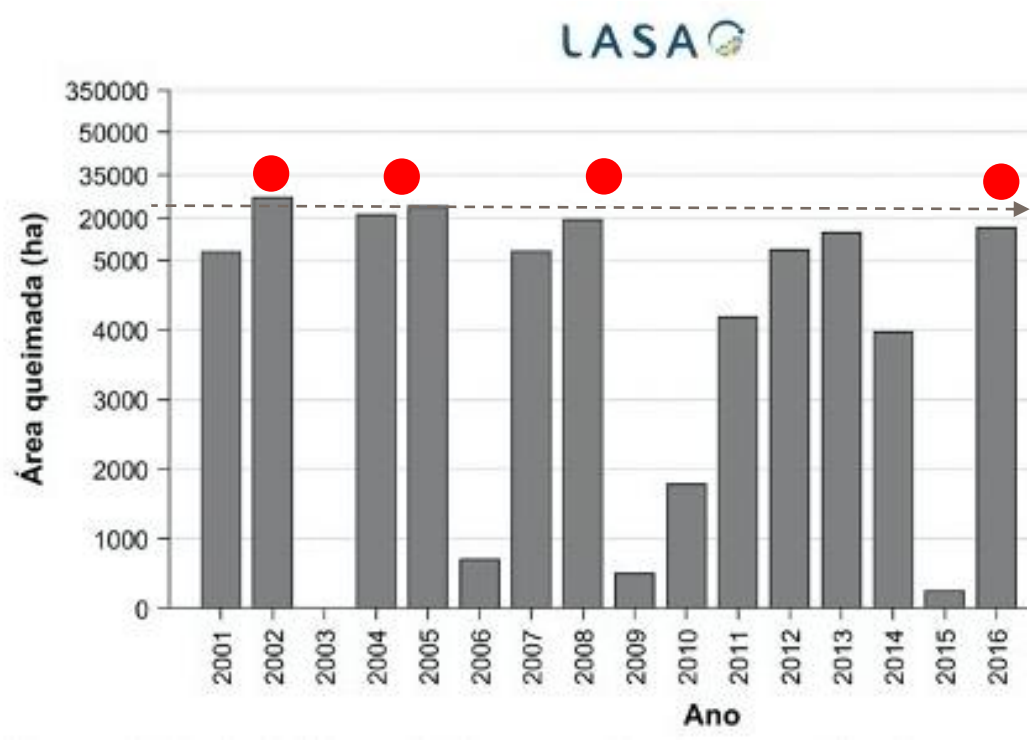


Figure 55. Interannual variation of the burned area in the dry season JJASO within the project area, in the reference period 2001–2016. Points represent ENSO events

(Source: LASA, 2021)

From the number of hectares of each forest class that would be deforested in the project and parameters, the baseline of non-CO_2 emission has been calculated. The average results were: 947,59 tCO_2e per year in the project area (Table 56).

Table 56. Baseline non-CO_2 emissions from forest fires in the project area (Table 24 of Methodology VM0015)

Project year t	Emissions of non-CO_2 gases from baseline forest fires		Total baseline non-CO_2 emissions from forest fires in the project area	
	IDicl = 1		annual	cumulative
	ABSLPA icl,t	EBBBSLtoticl (Sum of (or total) actual non-CO_2 emissions from forest fires at year t in strata i in forest class icl)	EBBBSLPAt (Sum of (or total) baseline non-CO_2 emissions from forest fires at year t in the project area)	EBBBSLPA (Cumulative baseline non-CO_2 emissions from forest fires at year t in the project area)
	ha	tCO_2e ha^-1	tCO_2e	tCO_2e
1	313.11	3.21	1006.08	1,006.08
2	384.39	3.21	1235.15	2,241.23
3	276.43	3.21	888.23	2,123.38
4	188.60	3.21	606.02	1,494.25
5	407.68	3.21	1309.96	1,915.98
6	301.69	3.21	969.40	2,279.36
7	98.80	3.21	317.45	1,286.85
8	120.55	3.21	387.36	704.81
9	553.85	3.21	1779.64	2,166.99
10	303.94	3.21	976.62	2,756.26
11	284.97	3.21	915.67	1,892.29
12	147.97	3.21	475.46	1,391.13
13	360.93	3.21	1159.75	1,635.21
14	253.06	3.21	813.13	1,972.88
15	368.21	3.21	1183.15	1,996.28

(Source: South Pole, 2022)

3.2.2 Project emissions

The goal of this step is to provide an ex ante estimate of future carbon stock changes and non-CO_2 emissions from forest fires under the project scenario ("actual").

3.2.2.1 Step 7. Ex ante estimation of actual carbon stock changes and non-CO2 emissions under the project scenario

3.2.2.1.1 Step 7.1. Ex ante estimation of actual carbon stock changes

No deforestation activities are planned within the project area.

However, some unplanned deforestation may happen in the project area despite the AUD project activity. The level at which deforestation will actually be reduced in the project area depends on the effectiveness of the proposed activities, which cannot be measured ex ante. Ex post measurements of the project results will be important when trying to determine actual emission reductions.

Ex ante estimation of uncontrollable emissions in the project area are only being considered in relation to forest fires. Carbon stock changes, due to possible future catastrophic events, are conservatively predicted and are therefore excluded from the ex ante assessment.

A conservative assumption about the effectiveness of the proposed project activities estimates an effectiveness index (EI) between 0 (no effectiveness) and 1 (maximum effectiveness).

An EI was considered for the project scenario regarding the decrease of deforestation, beginning at 35% and reaching 90%, and it was implemented to the unplanned deforestation from the baseline scenario. This EI was calculated using the relation between the historic annual deforestation 2006–2016 from the project area and the monitoring previous values for the period 2016–2020.

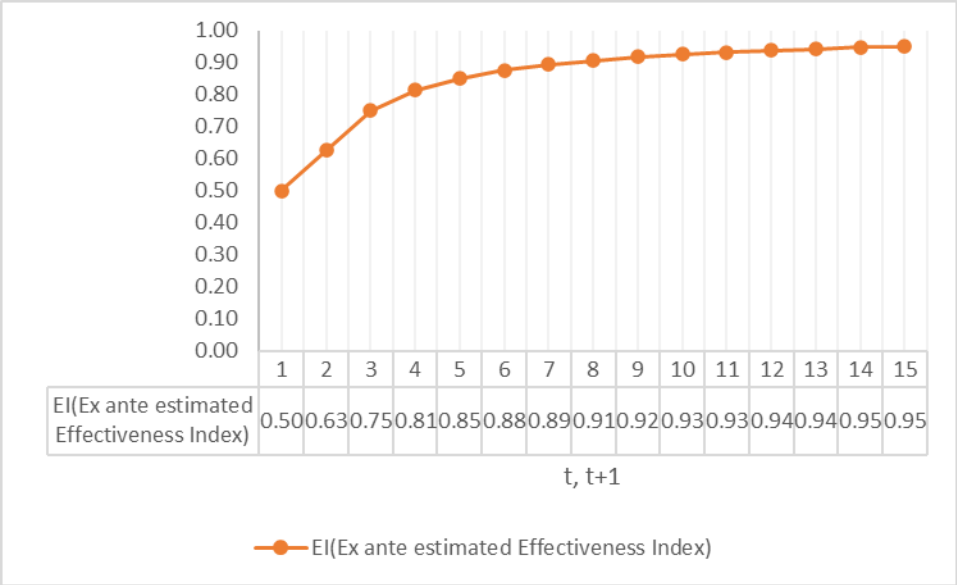


Figure 56. Ex ante estimated effectiveness index (EI)

The ex ante estimated net actual carbon stock changes in the project area, which summarize the result of the previous assessments, are presented in Table 57.

Table 57. Ex ante estimated net carbon stock change (tCO_2e) in the project area under the project scenario (Table 27 of Methodology VM0015)

Project year t	Total carbon stock decreases due to planned activities		Total carbon stock increase due to planned activities		Total carbon stock decreases due to unavoided unplanned deforestation		Total carbon stock change in the project case	
	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative
	ΔCPAdPAt (Total decrease in carbon stock due to all planned activities at year t in the project area)	ΔCPAdPA (Cumulative decrease in carbon stock due to all planned activities at year t in the project area)	ΔCPAdPAt (Total decrease in carbon stock due to all planned activities at year t in the project area)	ΔCPAiPAt Total decrease in carbon stock due to all planned activities at year t in the project area)	ΔCUDdPAt (Total actual carbon stock change due to unavoided unplanned deforestation at year t in the project area)	ΔCUDdPA (Cumulative actual carbon stock change due to unavoided unplanned deforestation at year t in the project area)	ΔCPSPAt (Total project carbon stock change within the project area at year t)	ΔCPSPA (Cumulative project carbon stock change within the project area at year t)
1					72,986.87	72,986.87	72,986.87	72,986.87
2					70,003.93	142,990.80	70,003.93	142,990.80
3					36,377.93	179,368.74	36,377.93	179,368.74
4					20,842.31	200,211.04	20,842.31	200,211.04
5					32,668.98	232,880.02	32,668.98	232,880.02
6					22,263.14	255,143.16	22,263.14	255,143.16
7					9,718.89	264,862.06	9,718.89	264,862.06
8					9,675.80	274,537.86	9,675.80	274,537.86
9					25,674.32	300,212.18	25,674.32	300,212.18
10					15,359.40	315,571.58	15,359.40	315,571.58
11					13,314.48	328,886.06	13,314.48	328,886.06
12					8,058.33	336,944.39	8,058.33	336,944.39
13					12,998.67	349,943.06	12,998.67	349,943.06
14					9,602.95	359,546.02	9,602.95	359,546.02
15					11,446.92	370,992.94	11,446.92	370,992.94

(Source: South Pole, 2022)

3.2.2.1.2 Step 7.2. Ex ante estimation of actual non-CO_2 emissions from forest fires

Where forest fires have been included in the baseline scenario, non-CO_2 emissions from biomass burning must be included in the project scenario. This is done by multiplying the baseline emissions by the factor (1 – EI).

EBBPSPAt = EBBBSPAt* (1 - EI) Equation 14

Where:

EBBPSPAt	Total ex ante actual non-CO_2 emissions from forest fire due to unavoided unplanned deforestation at year t in the project area; tCO_2e
EBBBSPAt	Total non-CO_2 emissions from forest fire at year t in the project area; tCO_2e
EI	Ex ante estimated effectiveness index; %
t 1, 2, 3 …	T a year of the proposed project crediting period; dimensionless

Therefore, details about effectiveness and ex ante estimated actual emissions of non-CO_2 gases due to forest fires in the project area under the project scenario are estimated in relation to deforestation effectiveness (see step 7.1). The efforts in terms of fire management activities are:

- qualified staff to lead fire prevention activities;
- adequate equipment;
- territorial control and accessibility;
- fire integrated management and articulation with other entities; and
- weather and detection system or operational monitoring system.

Total ex ante estimated actual emissions of non-CO_2 gases due to forest fires in the project area are 2,173 tCO_2e for 10 years.

Table 58. Total ex ante estimated actual emissions of non-CO_2 gases due to forest fires in the project area (Table 28 of Methodology VM0015)

Project area t	Total ex ante estimated actual non-CO_2 emissions from forest fires in the project area	
	EBBPSPAt (Sum of (or total) actual non-CO_2 emissions from forest fire at year t in the project area)	EBBPSPA (Cumulative (or total) actual non-CO_2 emissions from forest fire at year t in the project area)
	Annual	Cumulative
	tCO_2e	tCO_2e
1	503.04	503.04
2	463.18	966.22
3	222.06	1188.28
4	113.63	1301.91
5	196.49	1498.40
6	121.17	1619.58
7	34.01	1653.59
8	36.31	1689.90
9	148.30	1838.21
10	73.25	1911.45
11	62.43	1973.89
12	29.72	2003.60
13	66.91	2070.51
14	43.56	2114.07
15	59.16	2173.23

(Source: South Pole, 2022)

Table 59. Total ex ante estimated actual net carbon stock changes and emissions of non-CO_2 gases in the project area (Table 29 of Methodology VM0015)

Project year t	Total ex ante carbon stock decrease due to planned activities		Total ex ante carbon stock increase due to planned activities		Total ex ante carbon stock decrease due to unavoided unplanned deforestation		Total ex ante carbon stock change		Total ex ante estimated actual non-CO_2 emissions from forest fires in the project area	
	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative
	ΔCPAdPAt (Total decrease in carbon stock due to all planned activities at year t in the project area)	ΔCPAdPA (Cumulative decrease in carbon stock due to all planned activities at year t in the project area)	ΔCPAiPAt (Total increase in carbon stock due to all planned activities at year t in the project area)	ΔCPAiPA (Cumulative increase in carbon stock due to all planned activities at year t in the project area)	ΔCUDdPAt (Total actual carbon stock change due to unavoided unplanned deforestation at year t in the project area)	ΔCUDdPA (Cumulative actual carbon stock change due to unavoided unplanned deforestation at year t in the project area)	ΔCPSPAt (Total project carbon stock change within the project area at year t)	ΔCPSPA (Cumulative project carbon stock change within the project area at year t)	EBBPSPAt (Sum of (or total) actual non-CO_2 emissions from forest fire at year t in the project area)	EBBPSPA (Cumulative (or total) actual non-CO_2 emissions from forest fire at year t in the project area)
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
1	0.00	0.00	0.00	0.00	72,986.87	72,986.87	72,986.87	72,986.87	503.04	503.04
2	0.00	0.00	0.00	0.00	69,228.99	142,215.86	69,228.99	142,215.86	463.18	966.22
3	0.00	0.00	0.00	0.00	35,227.06	177,442.92	35,227.06	177,442.92	222.06	1,188.28
4	0.00	0.00	0.00	0.00	19,637.07	197,079.99	19,637.07	197,079.99	113.63	1,301.91
5	0.00	0.00	0.00	0.00	31,518.07	228,598.06	31,518.07	228,598.06	196.49	1,498.40
6	0.00	0.00	0.00	0.00	20,967.72	249,565.78	20,967.72	249,565.78	121.17	1,619.58
7	0.00	0.00	0.00	0.00	8,395.19	257,960.97	8,395.19	257,960.97	34.01	1,653.59
8	0.00	0.00	0.00	0.00	8,456.43	266,417.40	8,456.43	266,417.40	36.31	1,689.90

9	0.00	0.00	0.00	0.00	24,524.14	290,941.54	24,524.14	290,941.54	148.30	1,838.21
10	0.00	0.00	0.00	0.00	14,050.08	304,991.62	14,050.08	304,991.62	73.25	1,911.45
11	0.00	0.00	0.00	0.00	11,987.41	316,979.04	11,987.41	316,979.04	62.43	1,973.89
12	0.00	0.00	0.00	0.00	6,853.47	323,832.50	6,853.47	323,832.50	29.72	2,003.60
13	0.00	0.00	0.00	0.00	11,976.51	335,809.01	11,976.51	335,809.01	66.91	2,070.51
14	0.00	0.00	0.00	0.00	8,623.92	344,432.94	8,623.92	344,432.94	43.56	2,114.07
15	0.00	0.00	0.00	0.00	10,511.89	354,944.83	10,511.89	354,944.83	59.16	2,173.23

(Source: South Pole, 2022)

3.2.3 Leakage

3.2.3.1 Step 8. Ex ante estimation of leakage associated to leakage prevention measures and activity displacement

3.2.3.1.1 Step 8.1. Ex ante estimation of the decrease in carbon stocks and an increase in GHG emissions due to leakage prevention measures

Initially, it is expected that leakage prevention measures will be employed within the limits of Serra do Amolar, addressing all activities described in section 2.1.11. Subsequently, measures will be employed outside the limits of the project (Project Zone), through assistance to other river communities and small farmers. These initiatives will focus not only on training and guidance, but also on raising people's awareness of environmental issues and preserving the forest, protection of the Pantanal and protection of rivers.

As already mentioned in this document, the project is not planning to develop any activity that could lead to the reduction of carbon stocks or an increase of GHG emissions compared to the baseline scenario. If there are significant changes in carbon stock, i.e., forest fires, flooding, etc., it will be monitored, accounted for and reported.

Step 8.1.1. Carbon stock changes due to activities implemented in leakage management areas

Table 30c of the VM0015 methodology is not applicable because no reduction is expected due to the implementation of these activities. If there are significant changes in carbon stock, these activities will be monitored, accounted for and reported

Step 8.1.2. Ex ante estimation of CH_4 and N_2O emissions from grazing animals

According to the above, there are no activities that will lead to a significant increase in CH_4 and N_2O emissions. Therefore, Tables 31 and 32 of the VM0015 methodology were not applied.

Step 8.1.3. Total ex ante estimated carbon stock changes and increases in GHG emissions due to leakage prevention measures

Table 33 of the VM0015 methodology does not apply.

Step 8.2. Ex ante estimation of a decrease in carbon stocks and an increase in GHG emissions due to activity displacement leakage

The calculation of ex ante actual carbon stock change due to unavoided unplanned deforestation used an equation similar to equation 16 of the VM0015 methodology, presented in Step 7.1.2; however, it is by multiplying the estimated baseline carbon stock changes for the project area by a ‘displacement leakage factor' (DLF), representing the percent of deforestation expected to be displaced outside the project boundary, beginning with an index of 19% and continue constant it along the project life-time.

The quantification of DLF is based on Henders & Ostwald (2012)[157] who's estimate an average leakage factor for REDD in 19%. This value is highest than the leakage market impact of agricultural and pasture activities which are displaced outside of the project boundary which showed an increase of 5%[158] in exports from the State of Mato Grosso do Sul in the last years; or 15% according to section 3.14.13 of VCS Standard v4.2 document.

Table 60. Ex ante estimated leakage due to activity displacement (Table 34 of Methodology VM0015)

Project year t	Total ex ante estimated decrease in carbon stocks due to displaced deforestation		Total ex ante estimated increase in GHG emissions due to displaced forest fires	
	Annual	Cumulative	Annual	Cumulative
	ΔCADLK t (Total decrease in carbon stocks due to displaced deforestation at year t)	ΔCADLK (Cumulative total decrease in carbon stocks due to displaced deforestation)	EADLKt (Total ex ante increase in GHG emissions due to displaced forest fires at year t)	EADLK (Cumulative total increase in GHG emissions due to displaced forest fires)
	tCO_2e	tCO_2e	tCO_2e	tCO_2e
1	27,735.01	27,735.01	151.42	151.42
2	35,468.66	63,203.67	129.52	280.94
3	27,647.23	90,850.90	313.10	594.05
4	21,120.20	111,971.10	121.13	715.17
5	41,380.70	153,351.81	128.81	843.98
6	33,839.98	187,191.78	242.47	1,086.45
7	17,234.84	204,426.62	357.12	1,443.58
8	19,609.62	224,036.24	324.58	1,768.15
9	58,537.46	282,573.70	341.59	2,109.74
10	38,910.48	321,484.18	225.95	2,335.69

[157] Henders, S., & Ostwald, M. (2012). Forest carbon leakage quantification methods and their suitability for assessing leakage in REDD. Forests, 3(1), 33–58. https://doi.org/10.3390/f3010033
[158] Brazil: With heated market, Mato Grosso do Sul increased sugar exports fivefold https://www.noticiasagricolas.com.br/noticias/sucroenergetico/277772-com-mercado-aquecido-mato-grosso-do-sul-aumentou-em-cinco-vezes-a-exportacao-de-acucar.html#.Yl3VBYuZNPZ

11	37,103.01	358,587.19	158.61	2,494.30
12	24,497.33	383,084.52	294.72	2,789.02
13	42,808.97	425,893.49	282.04	3,071.06
14	34,058.46	459,951.96	275.78	3,346.85
15	43,498.29	503,450.25	317.33	3,664.18

(Source: South Pole, 2022)

Table 61. Ex ante estimated total leakage (Table 35 of Methodology VM0015)

Project year t	Total ex ante GHG emissions from increased grazing activities		Total ex ante increase in GHG emissions due to displaced forest fires carbon stock increase due to planned activities		Total ex ante decrease in carbon stocks due to displaced deforestation		Carbon stock decrease due to leakage prevention measures		Total net carbon stock change due to leakage		Total net increase in emissions due to leakage	
	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative
	EgLKt (Emissions from grazing animals in leakage management areas at year t)	EgLK (Cumulative Emissions from grazing animals in leakage management areas at year t)	EADLKt	EADLK	ΔCADLKt (Total decrease in carbon stocks due to displaced deforestation at year t)	ΔCADLK (Cumulative total decrease in carbon stocks due to displaced deforestation)	ΔCLPMLKt (Carbon stock decrease due to leakage prevention measures at year t)	ΔCLPMLK (Cumulative carbon stock decrease due to leakage prevention measures)	ΔCLKt	ΔCLK	ELKt (Sum of ex ante estimated leakage emissions at year t)	ELK (Cumulative sum of ex ante estimated leakage emissions at year t)
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
1	0	0	151.42	151.42	27,735	27,735	0	0	27,735	27,735	151	151
2	0	0	129.52	280.94	35,469	63,204	0	0	35,469	63,204	130	281
3	0	0	313.10	594.05	27,647	90,851	0	0	27,647	90,851	313	594
4	0	0	121.13	715.17	21,120	111,971	0	0	21,120	111,971	121	715
5	0	0	128.81	843.98	41,381	153,352	0	0	41,381	153,352	129	844
6	0	0	242.47	1086.45	33,840	187,192	0	0	33,840	187,192	242	1,086
7	0	0	357.12	1443.58	17,235	204,427	0	0	17,235	204,427	357	1,444
8	0	0	324.58	1768.15	19,610	224,036	0	0	19,610	224,036	325	1,768
9	0	0	341.59	2109.74	58,537	282,574	0	0	58,537	282,574	342	2,110

10	0	0	225.95	2335.69	38,910	321,484	0	0	38,910	321,484	226	2,336
11	0	0	158.61	2494.30	37,103	358,587	0	0	37,103	358,587	159	2,494
12	0	0	294.72	2789.02	24,497	383,085	0	0	24,497	383,085	295	2,789
13	0	0	282.04	3071.06	42,809	425,893	0	0	42,809	425,893	282	3,071
14	0	0	275.78	3346.85	34,058	459,952	0	0	34,058	459,952	276	3,347
15	0	0	317.33	3664.18	43,498	503,450	0	0	43,498	503,450	317	3,664

(Source: South Pole, 2022)

3.2.4 Net GHG emission reductions

Step 9. Ex ante calculation of net anthropogenic GHG emission reductions

Step 9.2. Calculation of ex ante estimation of total net GHG emissions reductions

As suggested by the VM0015 methodology, the ex ante estimation of the project emissions reductions within the project area, are presented in Table 58 and Table 60.

Table 62 shows the ex ante estimation of total net GHG emissions based on the below equation:

$\Delta REDD_t = (\Delta CBSLPA_t + EBBBSLPA_t) – (\Delta CPSPA_t + EBBPSPA_t) – (\Delta CLK_t + ELK_t)$

Where:

ΔREDDt	Net ex ante estimated anthropogenic GHG emissions reductions attributable to the AUD project activity at year t; tCO_2e.
ΔCBSLPAt	Sum of baseline carbon stock changes in the project area at year t; tCO_2e. *Note: The absolute value of CBSLPAt shall be used in Equation 19.*
EBBBSLPAt	Sum of baseline emissions from biomass burning in the project area at year t; tCO_2e.
ΔCPSPAt	Sum of ex ante estimated actual carbon stock changes in the project area at year t; tCO_2e. *Note: If CPSPAt represents a net increase in carbon stocks, a negative sign before the absolute value of CPSPAt shall be used. If CPSPAt represents a net decrease, a positive sign shall be used.*
EBBPSPAt	Sum of (ex ante estimated) actual emissions from biomass burning in the project area at year t; tCO_2e.
ΔCLK*t*	Sum of ex ante estimated net carbon stock changes due to leakage at year t; tCO_2e. *Note: If the cumulative sum of CLKt within a fixed baseline period is > 0, CLKt shall be set to zero*.
ELKt	Sum of ex ante estimated leakage emissions in year t; tCO_2e.
t = 1, 2, 3 …	T a year of the proposed project crediting period; dimensionless.

Table 62. Ex ante estimated net anthropogenic GHG emissions reductions (ΔREDDt) (Table 36 of Methodology VM0015)

Project year t	Baseline carbon stock changes		Baseline GHG emissions		Ex ante project carbon stock changes		Ex ante project GHG emissions		Ex ante leakage carbon stock changes		Ex ante leakage GHG emissions	
	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative
	ΔCBSLPAt (Total baseline carbon stock change within the project area at year t)	ΔCBSLPA (Total baseline carbon stock changes in the project area)	EBBBSLPAt (Sum of (or total) baseline non-CO_2 emissions from forest fire at year t in the project area)	EBBBSLPA (Cumulative baseline non-CO_2 emissions from forest fire at year t in the project area)	ΔCBSLPAt	ΔCBSLPAt	$EBBPSPA_t$	EBBPSPA	ΔCLKt (Total decrease in carbon stocks within the leakage belt at year t)	ΔCLK (Total cumulative decrease in carbon stocks within the leakage belt at year t)	ELKt	ELK
	tCO_2e											
1	145,974	145,974	1,006	1,006	72,987	72,987	503	503	27,735	27,735	151	151
2	186,677	332,651	1,235	2,241	70,004	142,991	463	966	35,469	63,204	130	281
3	145,512	478,163	888	3,129	36,378	179,369	222	1,188	27,647	90,851	313	594
4	111,159	589,322	606	3,735	20,842	200,211	114	1,302	21,120	111,971	121	715
5	217,793	807,115	1,310	5,045	32,669	232,880	196	1,498	41,381	153,352	129	844
6	178,105	985,220	969	6,015	22,263	255,143	121	1,620	33,840	187,192	242	1,086
7	90,710	1,075,930	317	6,332	9,719	264,862	34	1,654	17,235	204,427	357	1,444
8	103,209	1,179,138	387	6,720	9,676	274,538	36	1,690	19,610	224,036	325	1,768

9	308,092	1,487,230	1,780	8,499	25,674	300,212	148	1,838	58,537	282,574	342	2,110
10	204,792	1,692,022	977	9,476	15,359	315,572	73	1,911	38,910	321,484	226	2,336
11	195,279	1,887,301	916	10,392	13,314	328,886	62	1,974	37,103	358,587	159	2,494
12	128,933	2,016,234	475	10,867	8,058	336,944	30	2,004	24,497	383,085	295	2,789
13	225,310	2,241,545	1,160	12,027	12,999	349,943	67	2,071	42,809	425,893	282	3,071
14	179,255	2,420,800	813	12,840	9,603	359,546	44	2,114	34,058	459,952	276	3,347
15	228,938	2,649,738	1,183	14,023	11,447	370,993	59	2,173	43,498	503,450	317	3,664

(Source: South Pole, 2022)

Table 63. Verified Carbon Units (VCUs) (Table 36 of Methodology VM0015)

Project year t	Ex ante net anthropogenic GHG emissions reductions		Ex ante buffer credits		Ex ante VCUs tradable	
	Annual	Cumulative	Annual	Cumulative	Annual	Cumulative
	ΔREDDt (Net anthropogenic GHG emission reduction attributable to the AUD project activity at year t)	ΔREDD (Cumulative met anthropogenic GHG emission reduction attributable to the AUD project activity)	Number of buffer credits deposited in the VCS buffer at time t	VBC (Number of buffer credits deposited in the VCS buffer at time t)	VCUt (Number of Verified Carbon Units (VCUs) to be made available for trade at time t)	VCU (Number of Verified Carbon Units (VCUs) to be made available for trade at time t)
	tCO_2e					
2017	45,603	45,603	11,677	11,677	33,926	33,926
2018	81,847	127,450	18,667	30,344	63,180	97,106
2019	81,839	209,289	17,461	47,805	64,378	161,484
2020	69,567	278,856	14,450	62,255	55,117	216,601
2021	144,728	423,584	29,619	91,874	115,109	331,710
2022	122,607	546,191	24,934	116,808	97,673	429,383
2023	63,682	609,873	12,958	129,766	50,724	480,107
2024	73,949	683,822	14,965	144,731	58,984	539,091
2025	225,169	908,991	45,186	189,917	179,983	719,074
2026	151,199	1,060,190	30,309	220,226	120,890	839,964

2027	145,556	1,205,746	29,114	249,340	116,442	956,406
2028	96,528	1,302,274	19,340	268,680	77,188	1,033,594
2029	170,313	1,472,587	33,969	302,649	136,344	1,169,938
2030	136,087	1,608,674	27,144	329,793	108,943	1,278,881
2031	174,799	1,783,473	34,798	364,591	140,001	1,418,882

(Source: South Pole, 2022)

3.3 Monitoring

3.3.1 Data and parameters available at validation

Data/parameter	PA
Data unit	Hectares (ha)
Description	Project area (PA)
Source of data	See section 3.1.3
Value applied	64,443
Justification of choice of data or description of measurement methods and procedures applied	See section 3.1.3 for description of measurement methods and procedures applied
Purpose of data	Calculation of baseline emissions
Comments	Project area is sum of forest formation, which includes some savanna formation

Data/parameter	ABSLPA1,t
Data unit	Hectares per year (ha/year)
Description	Areas of forest cover converted to non-forest cover areas within the project area in year t
Source of data	See section 3.2.1.4.1
Value applied	290.94
Justification of choice of data or description of measurement methods and procedures applied	The methods and procedures applied are detailed in section 3.2.1.4.1
Purpose of data	Calculation of baseline emissions
Comments	N/A

Data/parameter	LK
Data unit	Hectares (ha)
Description	Leakage belt area
Source of data	See section 3.1.3
Value applied	129,228
Justification of choice of data or description of measurement methods and procedures applied	The methods and procedures applied are detailed in section 3.1.3.1
Purpose of data	• Calculation of baseline emissions • Calculation of leakage
Comments	N/A

Data/parameter	ABSLLKicl,t
Data unit	Hectares (ha)
Description	Areas of forest cover converted to non-forest cover areas within the leakage belt of the project
Source of data	See section 3.2.1.4
Value applied	400.12
Justification of choice of data or description of measurement methods and procedures applied	The methods and procedures applied are detailed in section 3.2.1.4
Purpose of data	• Calculation of baseline emissions • Calculation of leakage
Comments	N/A

Data/parameter	Ctot
Data unit	$tCO_2e\ ha^{-1}$
Description	Average carbon stock per hectare in all carbon pools in the forest formation class used in the baseline scenario
Source of data	See section 3.2.1.6
Value applied	See Table 15 VM0015 (Support Information/Estimations)
Justification of choice of data or description of measurement methods and procedures applied	See section 3.2.1.6 for description of measurement methods and procedures applied
Purpose of data	• Determination of baseline scenario • Calculation of baseline emissions • Calculation of project emissions • Calculation of leakage
Comments	Project area is sum of forest formation, which includes some savanna formation

Data/parameter	CAB_treebsl,i
Data unit	tC/ha
Description	Average carbon stock per hectare in the above-ground biomass carbon pool of initial forest formation class
Source of data	See section 3.2.1.6
Value applied	See Table 15 VM0015 (Support Information/Estimations)
Justification of choice of data or description of measurement methods and procedures applied	See section 3.2.1.6 for description of measurement methods and procedures applied

Purpose of data	• Calculation of baseline emissions • Calculation of project emissions • Calculation of leakage
Comments	Project area is sum of forest formation, which includes some savanna formation

Data/parameter	Fburnticl
Data unit	%
Description	Proportion of forest area burned during the historical reference period in the forest class icl
Source of data	The MapBiomas Fogo platform will provide data on fire scars every year. Data on accumulated areas and frequency of scarring are also available for each of the biomes.
Description of measurement methods and procedures to be applied	Raster calculation, interpolation and other methods will be used to estimated burned area within project area. See section 3.2.1.6 for description of measurement methods and procedures applied
Frequency of monitoring/recording	Only once at project start
Value applied	Annual average burned area related to deforestation in the project area during the crediting period: 38%.
Monitoring equipment	GIS procedures
QA/QC procedures to be applied	To be determined depending on the activity.
Purpose of data	• Calculation of baseline emissions • Calculation of project emissions
Comments	NA

3.3.2 Data and parameters monitored

Data/parameter	ABSLRRt
Data unit	Ha
Description	Annual area of baseline deforestation in the reference region at year t
Source of data	Calculated by means of remote sensing imagery together using MapBiomas and procedures to reclass cover maps for each year.
Description of measurement methods and procedures to be applied	PP will be in charged for the climate monitoring according to the methodology VM0015 v1.1. and Table 9a, 11a, 13a of VM0015 Variables and procedures to calculate baseline deforestation are thoroughly explained in the Excel sheet submitted to VVB (Support_Information/Estimations).
Frequency of monitoring/recording	Each re-validation of baseline period (10 years), and annually if it is needed.
Value applied	N/A
Monitoring equipment	GIS procedures
QA/QC procedures to be applied	Accuracy assessment
Purpose of data	Calculation of project emissions Calculation of leakage
Calculation method	If unplanned deforestation areas are detected, the Forest Cover BenchMark Map will be updated using raster calculation.
Comments	N/A

Data/parameter	$ABSLLK_{icl,t}$
Data unit	Hectare (ha)
Description	Areas of forest cover converted into non-forest cover areas within the leakage belt.
Source of data	Calculated by means of remote sensing imagery together using MapBiomas and procedures to reclass cover maps for each year.
Description of measurement methods and procedures to be applied	PP will be in charged for the climate monitoring according to the methodology VM0015 v1.1. and Table 9c, 11c, 13c of VM0015 Variables and procedures to calculate baseline deforestation are thoroughly explained in the Excel sheet submitted to VVB (Support_Information/Estimations).
Frequency of monitoring/recording	Annual average deforestation in the project area during the crediting period: 400 ha. Annually.
Value applied	N/A
Monitoring equipment	GIS procedures
QA/QC procedures to be applied	Accuracy assessment
Purpose of data	Calculation of project emissions Calculation of leakage
Calculation method	If unplanned deforestation areas are detected, the Forest Cover BenchMark Map will be updated using raster calculation.
Comments	N/A

Data/parameter	ABSLPA1
Data unit	Ha
Description	Areas of forest cover converted into non-forest cover areas within the project area at year t.
Source of data	Calculated by means of remote sensing imagery using MapBiomas and procedures to reclass cover maps for each year.
Description of measurement methods and procedures to be applied	PP will be in charged for the climate monitoring according to the methodology VM0015 v1.1. and Table 9b, 11b, 13b of VM0015 Variables and procedures to calculate baseline deforestation are thoroughly explained in the Excel sheet submitted to VVB (Support_Information/Estimations).
Frequency of monitoring/recording	Annually.
Value applied	Annual average deforestation in the project area during the crediting period: 290 ha.
Monitoring equipment	GIS procedures
QA/QC procedures to be applied	Accuracy assessment
Purpose of data	Calculation of project emissions Calculation of leakage
Calculation method	If unplanned deforestation areas are detected, the Forest Cover BenchMark Map will be updated using raster calculation.
Comments	N/A

Data/parameter	RFt
Data unit	%
Description	Risk factor used to calculate VCS buffer credits
Source of data	VCS Non Permanence Risk analysis
Description of measurement methods and procedures to be applied	PP will be in charged for the AFOLU Non permanence Risk Tool v.3.2
Frequency of monitoring/recording	At each verification period
Value applied	N/A
Monitoring equipment	Professional assessment
QA/QC procedures to be applied	N/A
Purpose of data	• Calculation of project emissions
Comments	Calculation of number of Buffer Credits deposited in the VCS Buffer at time t;

3.3.3 Monitoring plan

The monitoring plan provides guidance and describes the operating procedures of the activities in the REDD+ project, which allow for the evaluation of its performance and verification of the elimination of net GHG emissions from anthropogenic sources.

3.3.3.1 Monitoring of project implementation

The reduction of emissions and the environmental and social benefits associated with the implementation of project activities will be monitored through a transparent structure that integrates remote sensing actions and a mechanism of community participation.

The monitoring of the activities basically aims to cover the following:

- monitoring of project activities implemented, and resources invested by strategic lines and project activities (section 2.1.11); and
- monitoring the direct impacts of implemented project activities, according to defined climate, community and biodiversity indicators.

General information

There is an organizational structure between the Project Proponents (Instituto Homem Pantaneiro) and the Project Designer (South Pole) working together to perform the monitoring plan (Please refer to section 2.4.1.1 Executive committee and 2.4.1.2 Technical committee)

Procedure for handling non-conformances with the validated monitoring plan

Existing communication channel with the technical and executive committees will determine the formats and the way the information will be stored so that the same procedure is followed for all activities.

The technical team is responsible for planning the activities and providing guidance. At the same time, the site spokesperson is responsible for executing the project's actions and collecting their respective items of evidence.

3.3.3.1.1 Monitoring of REDD activities

The objective of the monitoring plan is to document and assess the climate impacts of the causal approach to activities in the short and long term.

All methods for measuring, recording, storing, aggregating, collating, and reporting data should be kept in accordance with the Table 64.

Table 64. Activities for monitoring changes in land use

Activity	Frequency/method
Monitoring actual changes in carbon stocks and GHG emissions in the project area	In each monitoring period (at least every five years). Methods according to the VM0015 methodology.
Estimation of the accuracy of coverage maps *t*	In each monitoring period (at least every five years) Methods according to the VM0015 methodology and MapBiomas Accuracy Report.
Identification of significant disturbances (natural events)	In each monitoring period. Events should be reported and identified at the time of monitoring. Includes fires, flooding and other natural events.

Activity	Frequency/method
Identification of fire frequency, cumulative area and annual fire scar map	In each monitoring period. Method implies MapBiomas Fire report or others, using machine learning algorithms (deep learning) through the Google Earth Engine and Google Cloud Storage platform.

(Source: South Pole, 2020)

Monitoring of actual Carbon stock changes and GHG emissions within the Project Area and Leakage Area

Technical description

Monitoring of deforestation-avoidance activities will be performed through Mapbiomas post-processing procedures and satellite imagery to continuously inspect the forest condition within the Project Area, as described in 3.3.2. Data and Parameters Monitored. All images, maps and records generated during project implementation should be conserved and made available to VCS verifiers at verification for inspection to demonstrate that the AUD project activity has actually been implemented.

In addition, Monitoring of land-use and land-cover change within the project area and leakage management area will be performed annually as well as Mapbiomas pst-processing procedure and satellite imagery, referring mainly to the classes "Forest" converted to "Non-Forest". In context, Areas of forest converted to non-forest are an area of forest land undergoing carbon stock decrease and area of non-forest converted to forest are an area of forest land undergoing carbon stock increase.

Quality control and quality assurance procedure

To further security and checks, the project designer (South Pole) keeps all raw images and procedures documentation in a proper data cloud. All maps generated during project implementation will be conserved and made available to VVBs.

Estimation of the accuracy of coverage maps

Technical description

The coverage maps will be assessed using the confusion matrix to calculate the overall index of success by period and by class. Three specific classes will be used: forest, non-forest, and deforestation. With the help of the "Create Random Points" tool, at least 100 random points will be generated for each class/year as samples for evaluation wall to wall, using high-resolution satellite images as reference, making it possible to generate a confusion matrix for calculation of the accuracy indexes, and the Kappa index (indicators for validation of mapping accuracy). Land use classes must have higher values than 80% for accuracy as required in VM0015 methodology.

Quality control and quality assurance procedure

All maps and records generated during the process will be conserved and made available to VCS verifiers at verification for inspection to demonstrate that the AUD project activity is conforming the validated monitoring plan.

All documents and records will be kept in a secure, retrievable manner for at least five years after the project crediting period ends.

Identification of fire data and monitoring of carbon stock changes and non-CO2 emissions from forest fires

Technical description

Decreases in carbon stocks and increases in GHG emissions (e.g., in case of forest fires) due to natural disturbances (such as hurricanes, earthquakes, volcanic eruptions, tsunamis, flooding, drought, fires, tornados or winter storms) or man-made events, including those over which the project proponent has no control (such as acts of terrorism or war), are subject to monitoring and must be accounted under the project scenario, when significant.

Areas subject to unplanned and significant carbon stock decrease, e.g., due to uncontrolled forest fires and other catastrophic events. In these areas, carbon stock losses must be estimated as soon as possible after the catastrophic event.

The results of monitoring activity data and carbon stocks must be reported using the proper parameters and tables used for the ex-ante estimations in VM0015 methodology.

Quality control and quality assurance procedure

The validation will be performed within the Reference Region by using satellite images from Mapbiomas Fires (Landsat 8 TM) and Nasa firms (MODIS). Other optical sensors could be used for accuracy assessment in case of cloud cover such as Sentinel 1 or 2, or CBERS.

All active fire points detected using the MODIS satellite will be filtered to select only fires identified with confidence higher that 90%. Summaries, confusion matrices, and relevant statistics will be generated to evaluate the degree of agreement ("accuracy") between the two burned area datasets as well as the proportion of detected fires that fell within burned areas for each burned area dataset.

All documents and records will be kept in a secure, retrievable manner for at least five years after the project crediting period ends.

3.3.4 Dissemination of monitoring plan and results (CL4.2)

All results will be made publicly available on the internet, with summaries communicated to communities and other interested parties via appropriate means. In addition, all documents and information on the results of monitoring and verification will be published on the VCS and CCB Standards' platforms.

IHP have extensive experience in disseminating information about the Pantanal to communities. The most effective means agreed is the dissemination of periodic information on social media, regarding the progress of the project in all its phases.

Additionally, each verification will have a strategy that proposes a solution to key questions on the dissemination of results, such as:

- What will be done to make the generation and assimilation of knowledge successful?
- What are the barriers to knowledge sharing?
- What is known about what others need to know (e.g., community versus researchers, researchers versus policy makers, politicians versus community, other sectors?
- What tools can be used? And which can be designed to produce more effective products and knowledge pathways?

Dissemination of the monitoring plan for climate benefits will consider what is described in section 0 about the dissemination of project summary documents.

4 COMMUNITY

4.1 Without-project community scenario

4.1.1 Descriptions of communities at project start date (CM1.1)

The project area is characterized by recent historical events, caused by the water regimes in the Pantanal region. Such events also play an important role in defining the way of life of the traditional communities living in or near the region. The biggest recent climate event was the great flood in 1974. After this event, a few big cattle ranches and crop production farms went bankrupt in the region; this caused the expulsion or dispersion of the people living in the former ranches to the outskirts of Ladario and Corumbá, or to the riverbanks of the Paraguay river and its tributaries. Besides the new household locations, the local communities also had to adapt to a new subsistence form of life, including traditional fishing and agriculture, and more recently, around 1980, the collection and sale of live bait. This period also saw an increase in fishing tourism in the region and the establishment of fishing restrictions on commercial fishing in the area, such as the ban on using fishing nets.

4.1.1.1 Well-being

The HDI for the municipalities located in the project and reference region is 0.76 (considered a high score category); however, reality in the project area is a little different. The project is located in the rural portions of the municipalities of Poconé and Corumbá, but the communities living there are isolated from the urban settlements.

During a visit interview by Mato Grosso State University (UNEMAT) to the "*ribeirinhos*", in the communities of Paraguay-Mirim, Serra do Amolar, and Barra do São Lourenço,[159] 62 families, or 90% of the residents, within those three localities were surveyed. As result, 98.4% of respondents said they like living where they live. The advantages identified are many, highlighting the tranquility, peace and freedom that they claim does not exist in the city. In addition, it was mentioned by many respondents that there is a clear advantage to living close to nature, where there is fish, fresh air, water, plants, etc. Some talked about the advantages of not paying for water, rent and electricity; because most families are on low-income, these types of expenses are taken into consideration when choosing a place to live. It can be assessed that the elements representing comfort and quality of life in these localities are associated with nature.

When the communities were asked about the main problems or difficulties they faced, the main issue identified was the accessibility of public and health services, followed by the annual floods. The public and health problems mentioned are caused by the lack of public action in the areas of health, education, transport, supervision and public services (treated water, communication and energy); with the effective actions of the state not reaching those communities. This is caused mainly by the long distances between communities and urban centers, and the precariousness of the waterway transport. There is no treated water supply, nor sewage collection networks; all of the families use water taken directly from the rivers; only 22.6% of respondents' homes have bathrooms, and the deficits in basic sanitation are evident when considering that some diseases that are easy to control are prominent in the area.

The construction pattern of the houses is very simple and precarious; they are built quickly when the family settles in the locality or when the flood makes it impossible to stay in the previous residence. Most families live in houses of inadequate size: 30.6% of the residences have only two rooms; 25.9%, three rooms; 17.7%, one room; and 17.7%, four rooms. Almost half (48.4%) of the families have a television, 27.4% have a fridge and 58.1% have a gas stove; however, energy supply is low. Therefore, the possession of one or more of these items does not mean that the resident has continuous use of them. Due to the long distances and associated costs of installing electricity transmission and distribution networks, the most viable solution for these locations is the adoption of alternative energy sources.

4.1.1.2 Income

Despite the concentration on fishing and bait collection, the families mix different activities, either to increase earnings or to compensate for losses from any of the activities. This is common in contexts where there are seasonal variations, mainly, when they occur due to natural causes. The relationship of the riverine fishermen of the study area, with the commercialization of their products, as in many other places in the country, suffer from onerous intermediary intervention, as the local population does not have direct contact with the tourist buyer, and the income subtracted by the middleman is not invested in improving the quality of life or working conditions of fishermen. Although the most frequent economic activity is fishing and bait collection, it is important to note that more than half of the responding families did not live solely off this income. Another notable aspect is the methods and instruments adopted in

[159] Almeida MA; Da Silva CJ, "As Comunidades Tradicionais Pantaneiras Barra De São Lourenço E Amolar , Pantanal , Brasil .," *História e Diversidade* 1 (2012): 10–31.

these activities: craft techniques and rudimentary tools prevail. The work practices of the population typically involve the entire family group; it could be inferred that the current situation derives from circumstantial factors regardless of personal will or desire, especially when looking at the main economic activity in the area that went out of business before the 1980s: cattle raising.

Bait collection is done primarily by women and children, and since this has to be done in the early hours of the morning, it could be defined as an unhealthy activity, involving long periods of immersion in water and exposure to solar radiation, predators, insects, etc. In addition, prices paid to the community members are low due to the middlemen, whilst the pressure on the natural resource is big, especially as it is focused on a limited number of species and areas. So, this activity can cause dependency and debt with the middlemen.

The agricultural production is aimed primarily at family consumption; the cultivated areas are small and normally the crops are grown in the backyards of the homes. The crop species are those commonly found in the context of family agriculture and riverine populations: cassava, maize, cane, pumpkin and banana; with other fruit plants being seen around the houses: orange, lemon, guava, pineapple, acerola, watermelon and melon. Regarding domestic animal husbandry, chickens are found in 35 households, cattle in nine, and pigs in seven; and these animals are used for family consumption. There is also some exchange of food or other animals with neighbors. Finally, another resource that seems to have a great local demand is wood, which is used for the construction of houses and firewood for cooking, but there is no evidence of wood extraction for commercial purposes. Among the respondents, 39 declared using wood for one or both purposes. There is a constant demand for wood for construction or for the renovation of houses, due to the floods that can damage them.

4.1.1.3 Education

The level of schooling of the riverine communities studied is low. The data shows that most residents have not completed or are still studying at elementary school; high school is a level of instruction almost absent here. When all of the family members are considered, except the respondents, 11.9% of them are illiterate. Part of this precariousness is due to the lack of educational services in the area, and the other part can be attributed to cultural factors and the limited prospects for life improvement, since there are few employment opportunities in these locations that require some level of schooling.

During the same survey, the diversity and socio-economic profile of the local people was assessed. Overall, there is no homogeneity between the characteristics of the material and immaterial culture of localities, communities and families living in the same locality in the project area. Among the surveyed community members, 53% were female and 47% were male. In relation to professional activities and family maintenance, 85.5% of respondents' families collect bait; 74.2% fish; and only 21% practice agriculture. Of the 53 families collecting bait, 42 (80.8%) also collect fish. It was found that there are few working options other than fishing, bait collection and agriculture; only 11.3% of the respondents' family members work in another activity. The occupations mentioned were school lunch lady, boat pilot, driver, manual services in the city (Corumbá) and farm manager.

Around 40% of families reported they received up to half a minimum wage per month. A small group said the family income is more than half and less than a full minimum wage. The second most significant

group are the families that have an income of one minimum wage per month. Adding these three groups together, they represent 74.2% of all households of the respondents. The last group, which forms the highest income stratum, represents 16.1% of the 62 families. Most of this group declared that they earn two minimum wages per month. The income of this population is therefore low, even with the inclusion of retirements and other state benefits; 62.9% of the households' benefit from receiving resources from a direct cash transfer government program.

The distribution of households by number of residents is as follows: 32% of households with 1–3 people, 39% with 4–6 people, and 29% with 7–10 people; the average is 5.1 people per household, which is relatively high when compared to the figures recorded in the country, the state, and the municipality. Census Data Demographic 2010 recorded that the average number of residents per household was 3.3 people in Brazil; in Mato Grosso do Sul, 3.2 people; and in the municipality, 3.7 people. The responses on land ownership, where the families reside, showed that 40% said that they resided in public areas; only 21% owned the land, but they reported that they did not have the necessary supporting documents. The third largest group, accounting for 15%, expressed that their houses stay on land belonging to third parties, who can be farmers or former owners; the other 15% did not know the ownership of the land they resided on. Only 6% lived on their relatives' land. Almost 80% of families live in a fragile situation of dependence regarding land ownership.

Regarding relations with social universes other than those of the communities, this occurs mainly within the urban center of the municipality. Corumbá is the nearest location for shops, resources for health treatment, and banking institutions. That is where these communities buy essential items (mainly food), receive pensions and benefits of social programs, and seek medical and hospital treatment. However, distance, limited availability of transport, long journey time to and from Corumbá (between 3 and 16 hours) and the high prices charged for speedboats, reduce the number of incursions taken to the city. Answers to the question of how often people go to Corumbá varied from once a month to once a year.

The community's relationship with the city is basically instrumental; it is marked by the most basic and immediate needs of the population. Due to these difficulties, many families and external actors have created strategies to keep trade relations with the city. Some families order purchases from neighbors who travel more frequently to Corumbá; there are cases where residents with better financial conditions or who often go to the region for shopping, take other residents with them as a favor. It is common for salesmen (*mascates*) to go up and down the rivers selling food, hygiene and cleaning products, among other things; sometimes, they also act as intermediaries in the commercialization of baits or fish. As families do not always have money, they use barter agreements, exchanging fish for goods. Beyond the higher prices charged by salesmen, this barter generates a relationship of dependency, indebtedness and exploitation, and creates bonds that are difficult to break. There is also bartering with bait businessmen, who offer basic consumer products that bait collectors would only obtain in the city of Corumbá.

4.1.1.4 Culture

In relation to the cultural life and leisure of the populations studied, the main occasions mentioned are community encounters. These tend to rotate around religious life, but respondents also mentioned events linked to schools (parent-teacher conferences), June parties (*festa junina*); local authorities (city hall), like the distribution of food baskets; and festivities, such as birthdays and end of year celebrations (Christmas

and New Year's Eve). Regarding religious practices, there is at least one member linked to some religion in 75.8% of families. Despite the predominance of Catholicism, evangelical denominations are also consolidated in these localities. The respondents highlighted that these religious practices are one of the main components of local sociability, guiding behaviors, defining social ties, and ordering moments of meetings in the localities. In this sense, religion is one of the strongest cultural aspects for these people; it can be characterized as a factor of identification and social belonging.

The communities display high levels of ethnic and cultural mixtures, so, the inhabitants do not keep a homogeneous origin; there are groups that arrived at different times, coming from different places, and groups with unique characteristics. Still, there are recurring aspects that make the general conditions of existence similar, to some degree. Regarding their place of birth, the survey found that 72% of the respondents came from Mato Grosso do Sul itself and 26% came from other states; among the latter, most came from neighboring Mato Grosso. Respondents who came from Mato Grosso do Sul, 44 (of 45) are from Corumbá and only one from Campo Grande. Among those from Mato Grosso do Sul, 64% are from the study area itself; representing 46% of respondents. It was also evidenced that family groups are formed primarily with members from the same or different localities, but primarily belonging to the area of study; however, it is worth highlighting that the exchange of people between the communities is high, and that displacement between communities occurs both from the formation of families and from micro-local migrations. In fact, only 12.9% of the respondents' families declared to have always lived in the same place. The most frequently cited reason why the respondents left their last place of residence was family connections: marriage, invitation of relatives, and accompanying father or mother.

Even though it is possible to find common elements to define the communities in the region, a differentiation was noted that reveals not only variations in purchasing power and capacity to structure daily life, but also aesthetic preferences and tastes. Clothing, building materials, house sizes, household equipment, care and cleaning (of the people, houses and their surroundings), means and instruments of transport and the type of fishing adopted varies greatly from one locality to another (and sometimes from one house to another in the same community). Paraguay-Mirim and a portion of Barra de São Lourenço near the school, are the localities that show the greatest signs of precariousness and need. Regarding housing, the more isolated houses, situated in the secondary channels, are larger and better cared for and are built usually with natural materials; they are, in fact, more harmonious and cozier when it comes to distribution and functionality of its components. It was in these large, articulated houses that our unexpected visits have been received by families of many members, improvised gatherings in large, clean structures. These houses, mostly in the Serra do Amolar region and in some places in Barra do São Lourenço, are generally surrounded by well-kept orchards and vegetable gardens, which may be due to the availability of dry land, allowing agricultural activities and small animal creations. The last is an expression of a better-structured standard of living.

In summary, the situation is of an undiversified, unplanned and subsistence economy based on bait collection and fishing (both seasonal), stimulated by the presence of fishing tourism. These income generating alternatives help many people, but they are not stable or diverse. Beyond their economic fragility, riparian populations lack basic services, such as health and education. The extractive activity, the main source of livelihood, has an impact on ecosystems, which creates tensions and conflicts with the region's vocation for biodiversity conservation. These communities live in relative marginality and poverty, and have little integration with government agencies and basic social services. They have low skills

(education and vocational training) and reduced capacity to generate income within a poorly diversified framework of job opportunities; this implies early school dropouts with serious consequences for the health of young people and women.

4.1.2 Interactions between communities and community groups (CM1.1)

In *"Biodiversidade e Ocupação Humana Do Pantanal Mato-Grossense: Conflitos e Oportunidades*", Franco et al. (2012) carried out research alongside an Amolar network advisor to bring together elements that would allow an informed reflection on the possibilities and difficulties for conservation, which describe interactions between the communities and other stakeholders.[160] During their surveys, respondents positively assessed community relations in the researched locations. Despite the little formal-institutional organization, 4.8% remarked that community relations were great, 77.5% said they were good, 11.3% said they were regular, and only 1.6% responded that they were bad. It is common in these contexts that neighborhood or kinship form strong links of mutual respect, self-help, reciprocal service provision, and solidarity. However, this solid basis of local social relations has not been enough to induce a robust collective action capable of expanding the supply of collective public goods.[161]

In other research, developed by Cristiane Façanha and carried out for the Barra do São Lourenço community, it was revealed that interviewees maintain social relations among themselves, especially professional relations related to fishing. Also, knowledge relating to the place they live, including fauna, flora, and important places for the community, climate and dynamic of changes, have been passed on to generations orally.[162]

4.1.3 High conservation values (CM1.2)

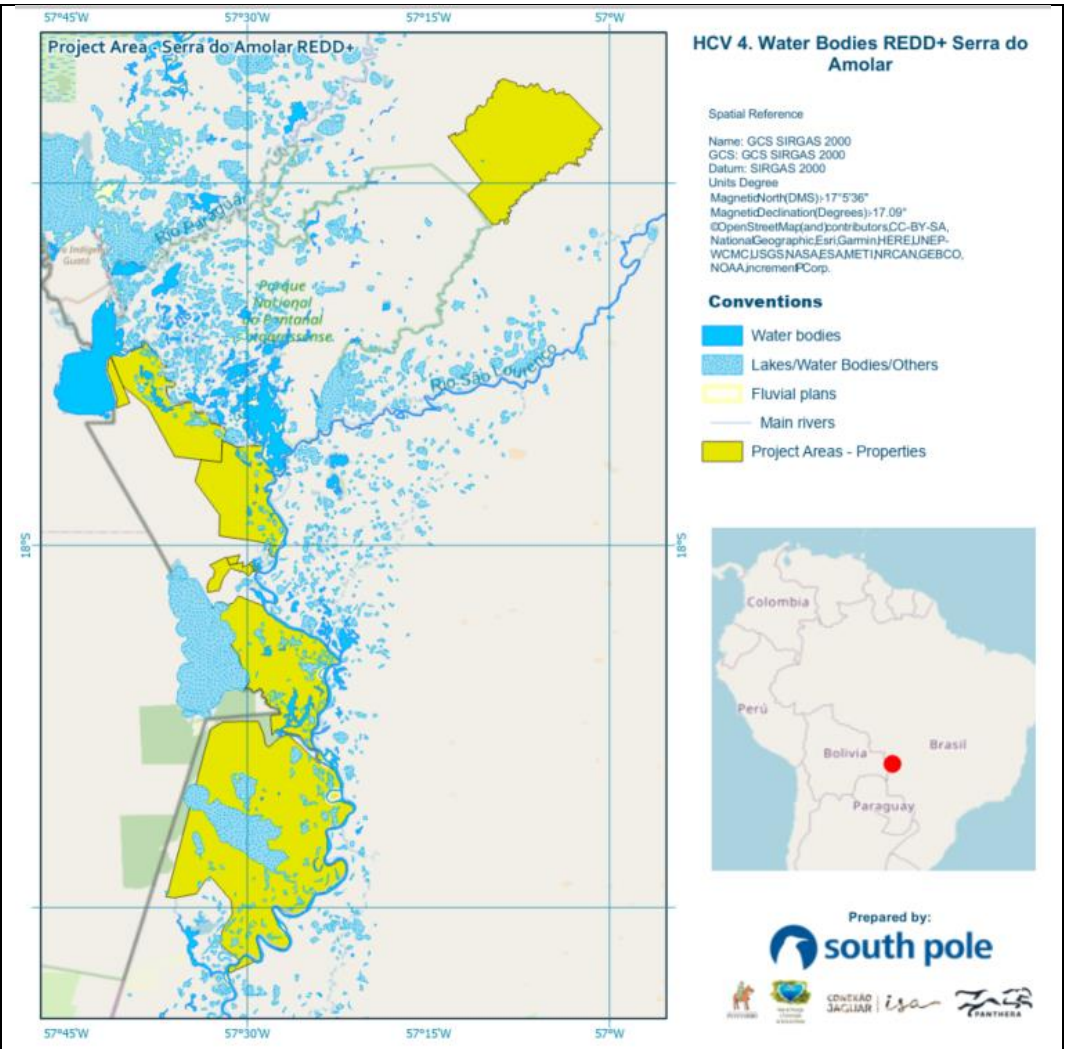
According to the HCV Resource Network's 'Guide for Identifying High Conservation Values', to qualify, an ecosystem service must be presented in a critical situation, which may be the product of one of the following factors:

- Its interruption would have serious negative impacts on the well-being, health, or survival of the communities that depend on them.
- There are no viable, available, or affordable alternatives that can provide support in the absence of the resource.

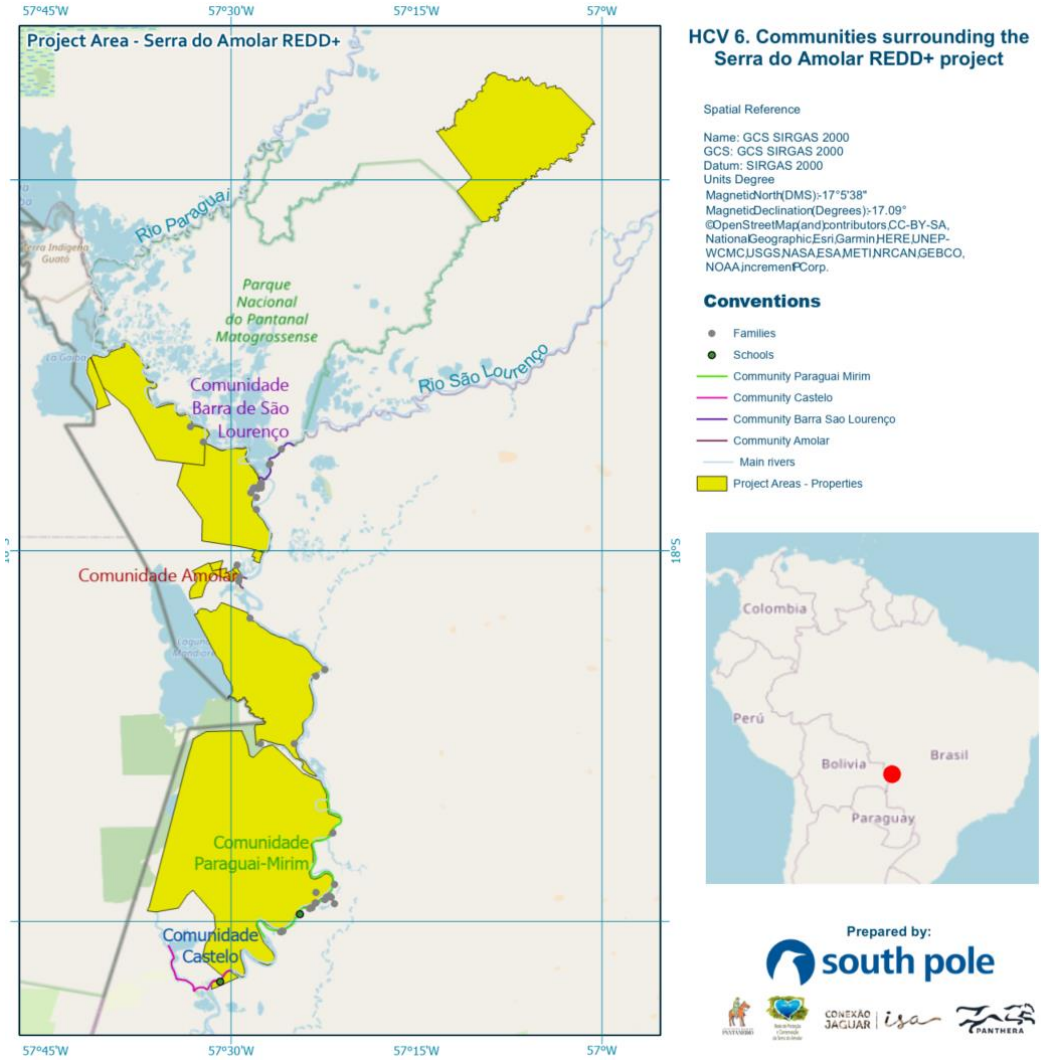
The main objectives of the project are in line with the preservation of the HCVs described below. A further explanation on its impact on community well-being is included in the following tables.

[160] José Luiz de Andrade Franco et al., "Biodiversidade e Ocupação Humana Do Pantanal Mato-Grossense: Conflitos e Oportunidades," no. November (2013): 260.
[161] Ibid.
[162] Cristiane Lima Façanha, "A Educação Ambiental e o Conhecimento Ecológico Tradicional de Comunidades Pantaneiras Como Instrumentos Para o Desenvolvimento Do Turismo Ecológico No Parque Nacional Do Pantanal" (Universidade do Esatdo de Mato Gross, 2011), http://portal.unemat.br/media/oldfiles/ppgca/docs/disseertacao_maria_auxiliadora.pdf.

High Conservation Value	HCV 4: Water bodies, Paraguay River and its tributaries. Water quality, fishery resources, climate regulation.
Qualifying attribute	All of the community members depend on the rivers for basic needs, as well as economic activities such as fishing and bait collection. Therefore, maintaining the quality of the rivers through the conservation of the project area is essential because the rivers are not only a source of food and water for the riverine communities; they also depend on the health conditions of the fisheries for income generation. Worsening water quality and quantity would result in a negative impact on the communities' well-being with no precedents, and no alternative is available in the absence of this HCV. There are numerous water bodies and rivers which, provided by the conservation of the forest in the project area, can impact well-being substantially, but HCV 4 will focus on three of them, as listed below. Water quality: all of the community's source their drinking water from the rivers. No treated water is available for the communities living in the project area; therefore, forest conservation to increase the water quality and quantity is crucial for the well-being of the people living there. Otherwise, this would create a decrease in their quality of life and no alternative resource is available. Fishery resources: the health and amount of fishery resources depend not only on the conservation of the forests, but also the protection of the riparian vegetation on the riverbanks. Respecting the restrictions to fish at certain times of the year, it is important to maintain fishery resources at a healthy level to guarantee a constant level throughout the year. Overfishing or land-use change to an unsustainable use, especially in the riparian zone, could lead to a decrease in fishery resources, jeopardizing the well-being of the communities. This resource, which is so important to the communities, would not have a substitute that would cause further harm to the ecosystem. Therefore, the main goal of the REDD+ project is to mitigate the reduction of fishery resources and prevent the well-being deterioration. Climate regulation: this is probably one of the most important ecosystem services related to the project activities and has an impact not only on the local climate, but also prevents the emission of GHG to the atmosphere, having a global impact. In areas with higher population density, other alternatives, such as clean energy production, could be an option for climate regulation, but due to the low population density in the project area, this alternative would not be viable because of the low demand for electricity in the region. Therefore, the best option, combining not only climate regulation, but also other services (such as water, fauna and flora species, and nutrient cycling), is a conservation project in the area. In the absence of the project activities, the well-being of the communities there and in other parts of the reference region would worsen.

	
Focal area	Project area

High Conservation Value	HCV 6: Cultural values Archaeological or historical significance of “Pantanal” culture
Qualifying attribute	The "*ribeirinhos*" surrounding the project area depend on the small income from tourism and research visitors. Therefore, maintaining the cultural values through the conservation of the project area is essential for the history and culture; elements like the rock art, and "pantaneira" culture are income generators. Worsening cultural values would negatively impact the communities' well-being with no precedents, and no alternative is available in the absence of this HCV.

	There have been several archaeological missions to study the economic, social, cultural and symbolic dimensions of the Pantanal. These studies have examined habitats, settlements and rock-art sites, seeking to better understand the territories and the cultures, past and present, of those inhabiting the Pantanal of Mato Grosso and Mato Grosso do Sul. Surrounding the project area, on the river's right bank, there are river rock-art sites that express a continuity of symbolic, technical, stylistic and thematic features, sustaining this area's rich complexity and originality. 
Focal area	Surroundings of project area

4.1.4 Without-project scenario: Community (CM1.3)

The without-project scenario would only reinforce the dependence of the communities on the middlemen for selling fish bait or fish, and getting supplies from the city of Corumbá. Thus, communities' dependence

would likely rise because of an increase in debts over time, which would not improve their well-being. (See also section 2.2.1)

4.2 Net positive community impacts

4.2.1 Expected community impacts (CM2.1)

This project is generating community impacts related to the strategic lines and project activities of all the groups associated with it. Each of the expected impacts are presented below.

Community group	Overall community
Impact(s)	Provide tools to resolve socio-environmental conflicts and promote protection and production.
Type of benefit/cost/risk	One of the strategic lines of the project is communication (section 2.1.11.4) and its activities include creating communication and information dissemination channels between the project implementer and communities in the project area, to raise awareness and sensitize communities on the care of nature resources. This is an indirect benefit because the effectiveness of this line will therefore improve the quality and increase the quantity of the ecosystem services that the community rely on to maintain and improve their well-being. Another important strategic line having a similar impact is socio-educational (section 2.1.11.6). Here, training on climate change, including REDD+ concepts, and management of the ecosystem as well as environmental education are envisioned. As per communication, the benefit on well-being is indirect; however, it can lead to an increase of quantity and enhance the quality of ecosystem services like water and fishery resources. Impacts and activities described in this table are ongoing as it is in its initial stage. Therefore, more activities are planned on those strategic lines in the future.
Change in well-being	The activities will impact and enhance well-being as follows: • The permanence of activities will guarantee the enhancement of ecosystem services, directly impacting and enhancing food security and access to water with there being a higher quality from the rivers. • The overall satisfaction of the community and better governance and independence from other actors, like the middlemen.

Community group	Overall communities
Impact(s)	Economic empowerment and broader income and job opportunities.
Type of benefit/cost/risk	Direct benefits to some of the community members through the creation of new job opportunities on ecotourism, that could be caused by an increase of tourists visiting the region. Also, artisans would benefit from the sale of their handicrafts to the visitors and increase the household income, reducing their dependency and enhancing well-being. These impacts are directly linked to the socio-educational strategic line (section 2.1.11.6), through training and workshops to improve the skills and knowledge in ecotourism activities, as well as to improve technical, legal and regulatory capacities in the communities. This is an actual benefit; however, it is still in the initial stage, but has great potential to be upscaled.
Change in well-being	The activities will impact and enhance well-being as follows: • The permanence of project activities and an increase in job opportunities and ways to diversify the household income will increase the well-being of the community. • Reduction of dependence from middlemen through the diversification of income opportunities in the project area.

4.2.2 Negative community impact mitigation (CM2.2)

The project activities only intend to increase the positive impacts and reduce any possible negative ones. Also, during the LSC, as part of the validation process, the community groups consulted had a positive impression and feedback. They did not identify the project activities as a potential risk to them; on the contrary, they perceived that the project activities would only help develop the region while protecting the local ecosystems.

Constant communication between the project team and the local community will ensure that any grievances about negative impacts on the communities are identified and mitigated. The feedback from the community members to the project team will guarantee that the project activities only have positive impacts in the community, and if there is a risk to any negative impact, those could be mitigated as soon as they are identified.

The project also has an adaptive management process in charge of the executive committee (section 2.4.1), which is the place to correct any risks or negative community impacts. Any negative impact must be escalated via the communication mechanism (can be found in the LSC report, section 3.3), documented and corrected where needed.

IHP has demonstrated that such plans are in place, and these processes were considered in the realm of potential risks and obstacles related to the project; for instance, during the COVID-19 pandemic and the most recent fire situation in 2020, new priority activities were developed to attend to the community well-being

4.2.3 Net positive community well-being (CM2.3, GL1.4)

The project activities are only designed to bring positive impacts, such as raising more awareness and sensitizing communities to the conservation and care of natural resources, through training on climate change and environmental education, with the same objective: to improve the quality and quantity of the ecosystem services which are the foundation of the communities' well-being. Also, ecotourism training is being planned, and further job opportunities are expected, which also decreases community dependency on the middlemen through the diversification of income opportunities in the project area.

4.2.4 High conservation values protected (CM2.4)

The HCVs related to community well-being will not be negatively impacted by the project activities. On the contrary, the project activities aim to protect the ecosystem and important sites for the communities living in the project area. If any potential negative impact is identified during the project lifetime through the grievance mechanism, a mitigation plan will be put in place to reduce and ideally stop such an impact.

4.3 Other stakeholder impacts

4.3.1 Impacts on other stakeholders (CM3.1)

The other stakeholders identified were also consulted during the LSC. The project activities will likely only bring positive impacts to the community living inside the project area, as well as to the stakeholders mentioned. The activities developed will only bring more awareness to the stakeholders in conservation, improving the quality of fresh water and the health of fisheries, as well as promoting a diversification of economic activities for the stakeholders involved. In addition, these stakeholders perceived the project as positive and there was no mention of negative impacts to their well-being.

4.3.2 Mitigation of negative impacts on other stakeholders (CM3.2)

Although no negative impacts are foreseen, due to the project activities, through the monitoring activities and the constant grievance mechanism in place, combined with the project staff presence in the project area, any negative impact on the stakeholder's well-being will be identified and assessed. This is done through the adaptive management process, to identify any risks or negative impacts on other stakeholders' well-being and to mitigate them.

4.3.3 Net impacts on other stakeholders (CM3.3)

The project predicts only positive impacts on well-being when compared to the without-project scenario, not only for the communities living inside or near the project area, but to all other stakeholders identified and consulted during the LSC. Therefore, no negative impacts on well-being are anticipated to occur. However, as described in the other sections above, mitigation measures will be discussed and

implemented as part of the adaptive management process in case any negative impact is foreseen or identified.

4.4 Community impact monitoring

4.4.1 Community monitoring plan (CM4.1, CM4.2, GL1.4, GL2.2, GL2.3, GL2.5)

The main monitoring method for communities is a survey carried out with different communities and stakeholders. The surveys address: a) the general population in the project area, b) direct beneficiaries of the project, and c) employees of the project. In addition, ongoing records of training sessions and awareness campaigns will indicate the creation and enhancement of local capacity for the management of the ecosystem, for community monitoring and for tourism-related activities.

The communities that will be monitored are Serra Negra, Barra do São Lourenço, Paraguai-Mirim, Serra do Amolar, as well as some families/individuals living along the riverbank, as listed in Table 14. (Section 2.1.9.1)

The IHP has identified the indicators which will be used to measure the impact of the project activities on communities and employees at the local, sub-national and national levels. The project's potential contribution to the UN's Sustainable Development Goals (SDGs) was raised and no changes were made to the scope of the indicators (see SDG model).[163]

Frequency of monitoring: (i) surveys – at least once before the end of each verification, (ii) training and awareness campaign – ongoing effort.

Frequency of reporting: for both the surveys and the training, and awareness campaigns will be reported at least once every verification period.

Methods: (i) survey of a population sample, including women and men from different age groups and community groups; (ii) training and awareness campaigns, consisting of a session prepared to increase the community capacity in a topic related to the project, or to raise awareness of REDD-related topics.

Variables to be monitored for the training and awareness campaigns: names of the people receiving training, identification number, age, gender and a form of contact (telephone or email); topic of the training or awareness campaign as well as the duration and activities developed during the session. The variables to be monitored during the survey are included in section 4.4.1.1 below.

4.4.1.1 SOP community

A sample of households in the project area will be surveyed at least once before every CCB verification. A general questionnaire will be presented to all interviewees; two sections will only apply to direct beneficiaries of the project and employees.

[163] Available on https://sdgtool.com/scripts/present_project.php?proj=77b13d9a

Three distinct groups will be monitored for the social impact assessment:

- general community members;
- direct beneficiaries of the Serra do Amolar REDD+ project involved in the RPCSA initiative; and
- employees of the Serra do Amolar REDD+ project.

4.4.1.1.1 General community members

To identify interview partners representing the general community, settlements across the project area will be randomly selected; within each settlement, households will then be randomly selected (when there is more than one household). This can be done by numbering the households and then randomly selecting a number (e.g., by rolling dice). The head of the household, or another representative, will be interviewed – men and women should be equally distributed in the sampling. If no one is available to be interviewed, another household will be randomly selected following the same procedure; between 5 and 15 households from the project area will be interviewed this way.

4.4.1.1.2 Direct beneficiaries

Interview partners representing the direct beneficiaries are to be randomly selected from the community members that have benefited from the project for at least one year, where possible. To randomize the sampling, beneficiary lists from previous interventions will be used. Roughly one to two beneficiaries per activity are to be interviewed this way, covering beneficiaries of all relevant project activities.

4.4.1.1.3 Employees

Employees to be interviewed are to be randomly selected from the staff of the Serra do Amolar REDD+ project or the RPCSA initiative. This can be done by assigning a number to each staff member and then randomly picking numbers (ensuring that different teams are represented); at least 25% of all employees are to be surveyed using this method.

4.4.1.1.4 Which questions to use?

The questionnaire is shown below. Not all questions are to be used for all participants – depending on the participant, the following sets of questions are used:

Participant is…	Use questionnaire parts
General community member	A
Direct beneficiary	A + B
Employee	A + B + C

4.4.1.1.5 Questionnaire

ID: _____ **(Repeat in top right corner of every relevant sheet)** **Date:** _____ **Project area (community/settlement):**	**Interviewer:** Picture (if possible):
Questions with interview partner	
PART A.	
1. Gender:	2. Age:
3. Marital status: Married | Single | Divorced | Widowed	4. Education: None | Primary | Secondary | Tertiary
5. Employment: None | Part-time | Full-time	6. Are you aware of the Serra do Amolar REDD+ project (IHP or *Rede de Proteção e Conservação da Serra Do Amolar*)? Yes | No
7. Are you satisfied with the project? Very unsatisfied | Unsatisfied | Indifferent | Satisfied | Very satisfied	8. Are you directly involved in the project (direct beneficiary, employee, etc.)? Yes | No
12. Are you the household head? Yes | No	13. Number of household members: ___
14. Most important income source: Fishing | Bait collection | Livestock | Ecotourism | Informal work | Formal employment | Other (please, specify)	15. Monthly household income: ____ RS
16. Do you receive any government support?	
9. Through the project, are you, or members of your household, restricted in collecting, or the use of products, or any kind of ecosystem service? Very restricted | Somewhat restricted | Not restricted 10. If the answer to 9 is “Yes”, did the project provide you with alternative sources to collecting these products in natural forests? Alternatives provided | No alternatives provided	

11. If 9 is yes, are the alternatives provided by the project attractive to you? Not attractive | Somewhat attractive | Very attractive
PART B: Only for employees and direct beneficiaries
17. How is your livelihood impacted by the project? Very negatively | Negatively | No impact | Positively | Very positively 18. How is your food security impacted by the project? Very negatively | Negatively | No impact | Positively | Very positively 19. How is yours or your children's access to education impacted by the project? Very negatively | Negatively | No impact | Positively | Very positively 20. How is your healthcare impacted by the project? Very negatively | Negatively | No impact | Positively | Very positively 21. Do you know whom to address for your grievances? Yes | No 22. How could the project be improved? _____ _____
PART C: Only for employees
23. How long have you been employed by the project? _____ years 24. How has your annual household income been impacted by your employment? Very negatively | Negatively | No impact | Positively | Very positively 25. Are you from the project area? Yes | No 26. Through your employment, did you gain knowledge on sustainable natural resource management? Not at all | Not enough | Sufficient | Good | Very good

27. Did you receive enough training to do your work properly?
Not at all | Not enough | Sufficient | Good | Very good
28. How does your wage compare to your previous jobs?
Much lower | Somewhat lower | About equal | Somewhat higher | Much higher
29. Have you been prepared for dangerous situations in your job?
Not at all | Not enough | Sufficiently | Well | Very well

4.4.2 Monitoring plan dissemination (CM4.3)

The monitoring plan as well as its results have been, and will continue to be, disseminated across the communities and other third parties interested in the project area before each audit process and before the public comment period.

The Serra do Amolar REDD+ project has three methods of communication to guarantee the communities' and other stakeholders' access to all information via oral, written and virtual means.

Instituto Homem Pantaneiro disseminates print versions of the annual results for each of the project's strategic lines, (Please see Amolar Network Reports: https://institutohomempantaneiro.org.br/relatorios/). Furthermore, meetings with the local communities take place before and during the audit process to aligning results of the monitoring and the next monitoring plan (same or including changes).

For current validation and verification, summaries of the project documents were also available online via the Verra and IHP websites, and IHP's Instagram (with information in the local language), to facilitate the communities' access to the monitoring plan and its results. This will ensure the public sharing of project information with the community.

Finally, the monitoring plan and results and benefits of the project were shared with multiple stakeholders during seminar and public events, such as "Semagro – Seminário de Negócios de Carbono e Sustentabilidade"[164]. All the project documents, including the project description document and this monitoring report, will be also shared.

Dissemination is expected to take place in the last year of monitoring period, when there are problems, such as COVID-19 in 2020, the monitoring plan dissemination will take place on year after (2021). Therefore, this dissemination activity will not be considered as a result or included in the subsequent verification period.

4.5 Optional Criterion: Exceptional Community Benefits

Not applicable

[164] Available on: https://www.facebook.com/semagroms/videos/1107367890009238/

5 BIODIVERSITY

5.1 Without-project biodiversity scenario

The description of biodiversity presented in this section corresponds to the flora and fauna that has been reported for the Pantanal, or the reference region. Detailed descriptions are provided of the municipalities in which the project area is located, as well as studies of the RPPNs.

5.1.1 Existing conditions (B1.1)

The project area is composed of a specific ecosystem wetland with predominant subtropical forests in two categories – dense forest and savanna forest – as mentioned in section 2.1.5.

This biome is characterized by a complex mosaic of habitats and is influenced by neighboring biomes like the Cerrado, the Amazon, Atlantic Forest and the Chaco, which contribute to its ecological diversity[165] and abundance of unique wildlife.[166]

5.1.1.1 Major eco-regions in which the project zone is located

Brazil is the most biologically diverse country in the world. It is ranked first among the world's 17 megadiverse countries, and second only to Indonesia in terms of species endemism. Across its six terrestrial eco-regions, Brazil hosts between 15% and 20% of the world's biological diversity, with the greatest number of endemic species on a global scale. Its biodiversity is ever-expanding, with an average of 700 new animal species discovered each year.

One of those eco-regions is the Pantanal, a seasonal wetland in which large parts become completely dry during low water periods and others remain flooded (Junk et al., 2006). These characteristics have created different environments for vegetation and fauna, making it one of the most biodiversity-rich wetlands in the world (Guerra et al., 2020).

Wetlands are among the world's most productive and critical environments, due to the ecosystem services they provide; however, they are also among the most fragile and most threatened by anthropic activities (Ivory et al., 2019; Junk et al., 2006). Located within the upper Paraguay River basin of western Brazil and covering more than 140,000 km^2, the Pantanal is the largest wetland in the world (Guerra et al., 2020; Ivory et al., 2019).

[165] Ministério do Meio Ambiente MMA, *Caderno Da Região Hidrográfica Do Paraguai*, Ministério (Brasília: Ministério do Meio Ambiente, Secretaria de Recursos Hídricos., 2006).
[166] Mogens Trolle, "Mammal Survey in the Southeastern Pantanal, Brazil," *Biodiversity and Conservation* 12 (2003): 823–36.

5.1.1.2 Description of biodiversity in project zone

5.1.1.2.1 Flora

Vegetation within the Pantanal is controlled and determined by climatic patterns, flooding regimes, topography and soil type; therefore, it is very sensitive to flood stage and timing. Depending on the location, it is possible to find specific forms of vegetation; for example, a mixture of Cerrado and semi-deciduous forest can be found away from rivers, aquatic plants and seasonally waterlogged woodlands and grasslands are found in the floodplains, and dense, low-canopy riparian forests border the river channels.[167]

A total of 337 species of algae have been identified in the Pantanal, most of which are common species, though diversity decreases during the rising water period. Regarding the higher plants, a total of 1,656 terrestrial species have been recorded (Figure 57), of which 900 species are grasses and epiphytes and 756 are woody plants.[168]

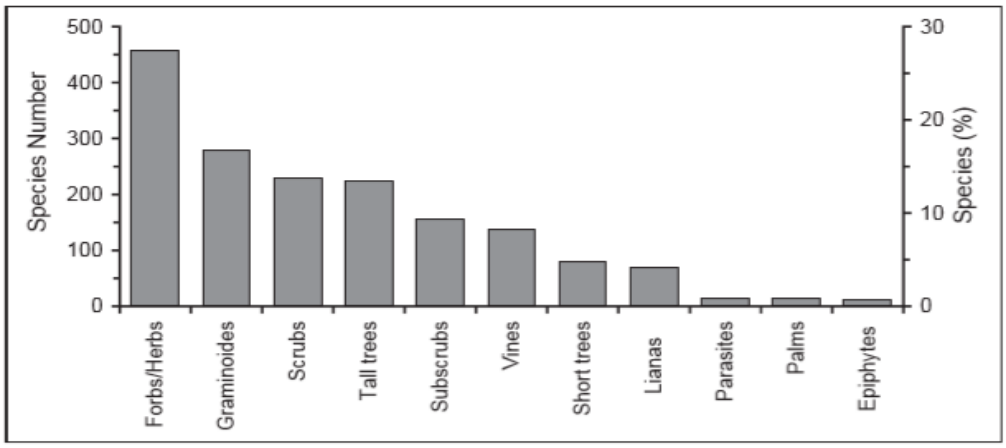


Figure 57. Species number and percentage of terrestrial herbaceous and woody plants in the Pantanal according to growth forms[169]

Woody plants are divided into shrubs, trees, palms and lianas. Of these, 60% are shrubs, subshrubs, and small trees, 29% are tall trees, 9% lianas, and 0.2% palms (see Table 65). Most of these species have some form of resistance to drought conditions, but the number of species that have adapted to long-term flooding periods is small. In addition, tree species in the Pantanal are not endemic because most of them came from adjacent biomes like the Cerrado, the Amazon Rainforest and Chaco.

[167] Sarah J. Ivory et al., Vegetation, rainfall, and pulsing hydrology in the Pantanal, the world's largest tropical wetland, *Environmental Research Letters* 14, n.º 12 (27 de noviembre de 2019), https://doi.org/10.1088/1748-9326/ab4ffe.
[168] Wolfgang J. Junk et al., Biodiversity and its conservation in the Pantanal of Mato Grosso, Brazil, en *Aquatic Sciences*, vol. 68, 2006, 278-309, https://doi.org/10.1007/s00027-006-0851-4.
[169] Ibid.

Table 65. Number of families, genera, and species of woody plants in the Pantanal of Mato Grosso according to growth habits

Growth habit	Families (n)	Genera (n)	Species (n)	Cultivated (n)	Ruderal (n)
Scrubs	43	96	223	3	7
Subscrubs	22	61	149	5	15
Small trees	27	63	83	4	2
Tall trees	43	148	220	12	2
Palms	1	11	13	1	
Lianas	14	36	68		1
Total	70	380	756	25	27

(Source: Junk et al., 2006)

In the RPPN Engineer Eliezer Batista in the Serra do Amolar, a total of 287 plant species – including aquatic plants, algae, and herbaceous and arboreal species – have been cataloged. Of this number, a total of 140 botanical species have been recorded as fertile. The vegetation identified was composed of species from the Cerrado, the Amazon rainforest, the Atlantic Forest and Chaco, as previously mentioned. The collection was made during the dry season and rainy season, determining that 87.14% of the species were fertile (presence of flowers) during the rainy season, 20% were fertile during the dry season and 7.14% were fertile during both expeditions, highlighting that the plant community presents a strong seasonal phenology (Rabelo et al., 2012).

In conclusion, vegetation species of the Pantanal are not exclusive to a single biogeographic biome: species have a wide distribution and present seasonal phenology. Serra do Amolar is composed of two vegetation types: forest and savanna forest formations.

5.1.1.2.2 Fauna

Similarly, most of the Pantanal fauna is widely distributed, with endemic species being rare in the biome (Alho and Sabino, 2011). The great diversity of ecosystems inside the Pantanal contribute to a high diversity of fauna. Furthermore, due to the relatively well-preserved areas in the Pantanal, compared with other biomes in Brazil, it is estimated that species abundance is higher than in the neighboring biomes (Alho et al., 2019).

Species diversity includes 174 mammals, more than 600 species of birds, 85 species of reptiles, 35 amphibians, and more than 260 species of fish (Alho et al., 2019; da Silva, 2011). According to Junk et al. (2006), birds are the best-known taxonomic group in the Pantanal and the total number of species of herpetofauna is almost the same in the Pantanal as in the Cerrado – 91% of the mammals are also found in the Cerrado, 85% in Amazonia, and 84% in the Chaco.

In terms of threatened and endangered species that can be found in the Pantanal, the IUCN listed four species in the category “endangered” (EN), eight “vulnerable” (VU), and 17 “near threatened” (NT) (Alho & Sabino, 2011). Some of the most representative species are the jaguar (*Panthera onca*), marsh deer

(*Blastocerus dichotomus*), giant armadillo (*Priodontes maximus*), giant anteater (*Myrmecophaga tridactyla*), giant otter (*Pteronura brasiliensis*), maned wolf (*Chrysocyon brachyurus*) and hyacinth macaw (*Anodorhynchus hyacinthinus*), which is the world's largest parrot. Based on the research of Rabelo et al. (2012), 33 mammal species have been reported in the RPPN Engineer Eliezer Batista.

Table 66 presents the list of threatened species that can be found in the project area, focusing on groups of mammals and birds as indicators of conservation status.

Table 66. List of threatened or endangered species in the project area

Common name	Family	Species	State of conservation
			Red List of Threatened Species – IUCN
Jaguar	Felidae	*Panthera onca*	NT
Giant armadillo	Dasypodidae	*Priodontes maximus*	VU
White-lipped peccary	Tayassuidae	*Tayassu pecari*	NT
Giant otter	Mustelidae	*Pteronura brasiliensis*	EN
Neotropical otter	Mustelidae	*Lontra longicaudis*	NT
Lowland tapir	Tapiridae	*Tapirus terrestris*	VU
Giant anteater	Myrmecophagidae	*Myrmecophaga tridactyla*	VU
Marsh deer	Cervidae	*Blastocerus dichotomus*	VU
Maned wolf	Canidae	*Chrysocyon brachyurus*	NT
Hyacinth macaw	Psittacidae	*Anodorhynchus hyacinthinus*	VU

(Source: Panthera Colombia, 2020)

5.1.1.2.3 Baseline camera trap study

In December 2019, Panthera Colombia and IHP researchers installed 39 camera trap stations. The study was conducted in the dry season and sampling stations were located in different types of coverage (primary forest, secondary forest and gallery forest) with an operational time of more than 45 days.

A total of 49 different species were identified: 25 mammals, 20 birds and four reptiles (Table 67). Of the mammals, the Carnivora order was the most represented, with four families and nine species, followed by Cetartyodactyla and Rodentia, with four species each. As for birds, order Galliformes, Passeriformes and Pelecaniformes were equally represented, with three species each.

Table 67. List of species record during camera trapping and their threat status according to IUCN

Class	Order	Family	Scientific name	Common name	Regional name	IUCN
Mammalia	Didelphimorphia	Didelphidae		Marsupial	Marsupial	LC
	Cingulata	Chlamyphoridae	*Priodontes maximus* (Kerr, 1792)	Giant armadillo	*Tatu-canastra*	VU
			Euphractus sexcinctus (Linnaeus, 1758)	Yellow armadillo	*Tatu-peba*	LC
		Dasypodidae	*Dasypus novemcinctus* (Linnaeus, 1758)	Nine-banded armadillo	*Tatu-galinha*	LC
	Pilosa	Myrmecophagidae	*Myrmecophaga tridactyla* (Linnaeus, 1758)	Giant anteater	*Tamandu á bandeira*	VU
	Primates	Cebidae	*Sapajus cay* (Illiger, 1815)	Azaras's capuchin	*Macaco-prego-de-Azara*	LC
	Rodentia	Caviidae	*Hydrochoerus hydrochaeris* (Linnaeus, 1766)	Capybara	*Capivara*	LC
		Dasyproctidae	*Dasyprocta azarae* (Lichtenstein, 1823)	Azara's agouti	*Cutia*	DD
		Echimyidae	*Proechimys* sp.	Spiny rat	*Rato-de-espinho*	
		Sciuridae	*Sciurus* sp.	Squirrel	*Esquilo*	
	Chiroptera			Bat	*Morcego*	
		Canidae	*Cerdocyon thous*	Crab-eating fox	*Cachorro-do-mato*	LC

Class	Order	Family	Scientific name	Common name	Regional name	IUCN
			(Linnaeus, 1766)			
		Felidae	*Herpailurus yagouaroundi* (É. Geoffroy Saint-Hilaire, 1803)	Jaguarundi	*Gato mourisco*	LC
			Leopardus pardalis (Linnaeus, 1758)	Ocelot	*Jaguatirica*	LC
			Panthera onca (Linnaeus, 1758)	Jaguar	*Onça-pintada*	NT
			Puma concolor (Linnaeus, 1771)	Puma	*Onça-parda*	LC
		Mustelidae	*Eira barbara* (Linnaeus, 1758)	Tayra	*Irara*	LC
			Pteronura brasiliensis (Gmelin, 1788)	Giant otter	*Ariranha*	EN
		Procyonidae	*Nasua nasua* (Linnaeus, 1766)	South American coati	*Quati*	LC
			Procyon cancrivorus (G. [Baron] Cuvier, 1798)	Crab-eating raccoon	*Mão-pelada*	LC
	Perissodactyla	Tapiridae	*Tapirus terrestris* (Linnaeus, 1758)	Lowland tapir	*Anta*	VU

Class	Order	Family	Scientific name	Common name	Regional name	IUCN
	Cetartiodactyla	Tayassuidae	*Pecari tajacu* (Linnaeus, 1758)	Collared peccary	*Caititu*	LC
			Tayassu pecari (Link, 1795)	White-lipped peccary	*Queixada*	VU
		Cervidae	*Mazama americana* (Erxleben, 1777)	Red brocket	*Veado-mateiro*	DD
			Mazama gouazoubira (G. Fisher [von Waldheim], 1814)	Gray brocket	*Veado-catingueiro*	LC
Aves	Accipitriformes	Accipitridae	*Parabuteo unicinctus* (Temminck, 1824)	Harris's hawk	*Gavião asa de telha*	LC
	Caprimulgiformes	Caprimulgidae	*Nyctidromus albicollis* (Gmelin, 1789)	Pauraque	*Curiango-comum*	LC
	Cariamiformes	Cariamidae	*Cariama cristata* (Linnaeus, 1766)	Red-legged seriema	*Seriema*	LC
	Cathartiformes	Cathartidae	*Cathartes burrovianus* (Cassin, 1845)	Lesser yellow-headed vulture	*Urubu-de-cabeça-preta*	LC
			Coragyps atratus (Bechstein, 1783)	American black vulture	*Urubu-de-cabeça-preta*	LC
	Columbiformes	Columbidae	*Claravis pretiosa* (Ferrari-Pérez, 1886)	Blue ground-dove	*Parari-azul*	LC

Class	Order	Family	Scientific name	Common name	Regional name	IUCN
			Leptotila verreauxi (Bonaparte, 1855)	White-tipped dove	*Juriti-pupu*	LC
	Coraciiformes	Momotidae	*Momotus momota* (Linnaeus, 1766)	Amazonian motmot	*Udu-de-coroa-azul*	LC
	Cuculiformes	Cuculidae	*Crotophaga* sp.	Ani	*Anu*	LC
	Galliformes	Cracidae	*Crax fasciolata* (Spix, 1825)	Bare-faced curassow	*Mutum-de-penacho*	VU
			Ortalis canicollis (Wagler, 1830)	Chaco chachalaca	*Aracuã-do-pantanal*	LC
			Pipile cumanensis (Jacquin, 1784)	Blue-throated piping-guan	*Jacutinga-de-garganta-azul*	LC
	Gruiformes	Aramidae	*Aramides cajaneus* (Müller, 1776)	Gray-cowled wood-rail	*Saracura três-potes*	LC
	Passeriformes	Corvidae	*Cyanocorax cyanomelas* (Vieillot, 1818)	Purplish jay	*Gralha-do-pantanal*	LC
		Furnariidae	*Furnarius figulus* (Lichtenstein, 1823)	Wing-banded hornero	*Casaca-de-couro-da-lama*	LC
		Turdiade	*Turdus leucomelas* (Vieillot, 1818)	Pale-breasted thrush	*Sabiá-barranco*	LC
	Pelecaniformes	Ardeidae	*Ardea cocoi* (Linnaeus, 1766)	Cocoi heron	*Garça-moura*	LC

Class	Order	Family	Scientific name	Common name	Regional name	IUCN
			Tigrisoma lineatum (Boddaert, 1783)	Rufescent tiger-heron	*Socó-boi*	LC
		Threskiornithidae	*Mesembrinibis cayennensis* (Gmelin, 1789)	Green ibis	*Coró-Coró*	LC
	Struthioniformes	Tinamidae	*Crypturellus undulatus* (Hermann, 1783)	Undulated tinamou	*Jaó*	LC
Reptilia	Squamata	Iguanidae	*Iguana iguana* (Linnaeus, 1758)	Common green iguana	*Iguana*	LC
		Teiidae	*Ameiva ameiva* (Linnaeus, 1758)	Giant ameiva	*Ameiva*	LC
			Tupinambis sp.	Tegu	*Teiú*	
	Crocodylia	Alligatoridae	*Caiman yacaré* (Daudin, 1802)	Yacaré	*Jacaré*	LC

The Relative Abundance Index (RAI) was created for large and medium mammals of more than one kilogram (kg), and terrestrial birds. The most abundant species was *Dasyprocta azarae* with 328 records (n) and an RAI of 18,304. Other abundant species were *Crax fasciolata* (n = 311, RAI = 17.168), *Hydrochoerus hydrochaeris* (n = 59, RAI = 10.757), *Ortalis canicollis* (n = 102, RAI = 9,688) and *Mazama americana* (n = 150, RAI = 8.346). Among the less abundant species, we have *Sciurus sp*. (n = 1, RAI = 0.060) and *Pipile cumanensis*, which presented two records and an RAI of 0.097 (Table 68).

Table 68 shows the RAI values of mammals weighing more than one kilogram and birds with terrestrial habits, organized from large to small according to their weight. We can see that large predators, such as *Panthera onca* and *Puma concolor,* present a low abundance; while potential prey, such as *D. azarae* and *Crax fasciolata,* are found in abundance.

Table 68. RAI and number of records of large and medium mammals, and terrestrial birds

Species	n	RAI
Dasyprocta azarae	328	18.304

Species	n	RAI
Crax fasciolata	311	17.168
Hydrochoerus hydrochaeris	59	10.757
Ortalis canicollis	102	9.688
Mazama americana	150	8.346
Pecari tajacu	130	6.655
Tapirus terrestris	100	5.528
Leopardus pardalis	65	3.666
Tayassu pecari	44	3.094
Cerdocyon thous	36	1.784
Pteronura brasiliensis	9	1.481
Puma concolor	28	1.433
Panthera onca	25	1.270
Priodontes maximus	19	0.963
Nasua nasua	15	0.724
Cariama cristata	16	0.691
Dasypus novemcinctus	11	0.636
Procyon cancrivorus	13	0.631
Crypturellus undulatus	11	0.537
Euphractus sexcinctus	9	0.468
Sapajus cay	10	0.445
Mazama gouazoubira	6	0.419
Aramides cajaneus	8	0.392
Myrmecophaga tridactyla	4	0.277
Herpailurus yagouaroundi	2	0.164
Eira barbara	3	0.156
Pipile cumanensis	2	0.097
Sciurus sp.	1	0.052

Figure 58. Large carnivores observed during camera trapping: Panthera onca (left) and Puma concolor (right)

(Source: Panthera Colombia, 2020)

Figure 59. Pardalis (left) and C. thous (right) were the most abundant carnivores

(Source: Panthera Colombia, 2020)

Regarding endangered and rare vertebrates, seven species listed in the risk category of the IUCN's Red List were recorded. Mammals listed as vulnerable (VU) are the giant armadillo (*P. maximus*), giant anteater (*M. tridactyla*), lowland tapir (*T. terrestris*), white-lipped peccary (*T. pecari*) and bare-faced curassow (*C. fasciolata*). The giant otter (*P. brasiliensis*) is listed as an endangered species (EN), while the jaguar (*P. onca*) is near threatened (NT).

The high abundance of *C. fasciolata* (RAI = 18.623) shows the conservation status in the area and that it is a suitable habitat for the presence of other species like its predators. Furthermore, despite being categorized as vulnerable, we observed various couples and hatchlings in the camera trapping study.

Figure 60. A Crax fasciolata family – two adults and two hatchlings

(Source: Panthera Colombia, 2020)

Other important records of rare species that were captured by the camera traps include *Herpailurus yaguarundi*, *Procyon cancrivorous*, *Cerdocyon thous*, and the armadillos *Euphractus sexcinctus* and *Priodontes maximus*. The giant otter (*P. brasiliensis*) is a rare species that is difficult to observe using this method, due to its aquatic habits, but we obtained six records of it during the study and at least five individuals. The presence of these species increases the area's diversity value.

5.1.1.2.4 Threats to biodiversity

Although most of the Pantanal biome is relatively well preserved, it is one of several regions of Brazil that are under pressure, and has experienced the greatest landscape change in recent years (Guerra et al., 2020) due to the expansion of human settlements, unsustainable farming practices, deforestation, agribusiness, dam construction and unregulated tourism.

The Pantanal's major conservation problems occur on the plateau, where only 41% of the original vegetation cover remains, due to deforestation for plantations and cattle ranching activities (Alho et al., 2019). In the agribusiness, there is an increasing trend of large-scale farming of soybean, sugarcane and maize crops. According to Zalles et al., (2018), there has been a significant expansion of cropland in the Cerrado biome in Mato Grosso and Mato Grosso do Sul (81% increase in cropland areas in 2014 vs. 2000).

Although agricultural expansion is not high in the Pantanal, the consequences of this activity on the plateau could severely affect the ecosystem. This is particularly true for soybean plantations, which are a common activity on the plateau, with an estimated total area of 1.9 million ha (Zucco et al., 2011). These plantations lead to increases in erosion, sedimentation and chemical leaching into the Pantanal, which can cause water pollution and changes in the hydrologic regime (Junk et al, 2006; Alho and Sabino, 2011).

Regarding cattle ranching activities, the increase in domestic and international demand for beef has led to a cattle herd increase from around 185 million heads in 2002 to 215 million heads in 2015 (Lapola et al., 2013; Sparovek et al., 2018). Due to the land requirements for grazing activities, large swathes of the

biomes of the Amazonas, Cerrado and Pantanal have been degraded and converted into pasture for beef production.

Other threats that disrupt ecological processes and severely affect the Pantanal's biodiversity include the creation of the Paraguay–Paraná River canal, which has impacted surrounding rivers and streams. This will likely affect the abundance and regularity of the water currents and cause changes in the temporal and spatial patterns of biological communities and ecological processes (Alho, 2011; Calheiros, 2003).

These situations affect the Pantanal's native vegetation and fauna species, due to changes in flood dynamics, habitat loss, fragmentation and river avulsions (Guerra et al., 2020; Michelaina, 2018). This is leading to changes in fauna dynamics, for example, the movement and migration of species can be disrupted due to habitat fragmentation.

The principal threat for wild cats like jaguars (*Panthera onca*) and pumas (*Puma concolor*) is indiscriminate hunting, often justified as a way to prevent or retaliate against livestock predation (Azevedo and Murray, 2007; Cavalcanti et al., 2012). Other threats include hunting and overfishing, with the main species targeted being agouti (*Cuniculus paca*), deer (*Mazama sp*) and armadillo (*Dasypus novemcinctus*) (Junk et al., 2006).

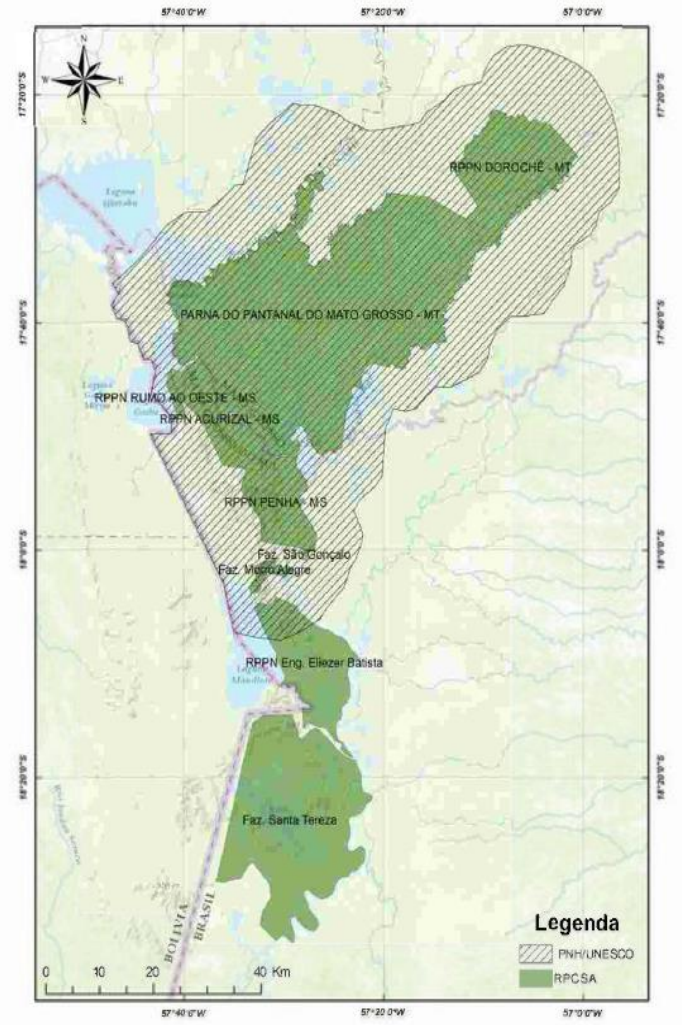
5.1.2 High conservation values (B1.2)

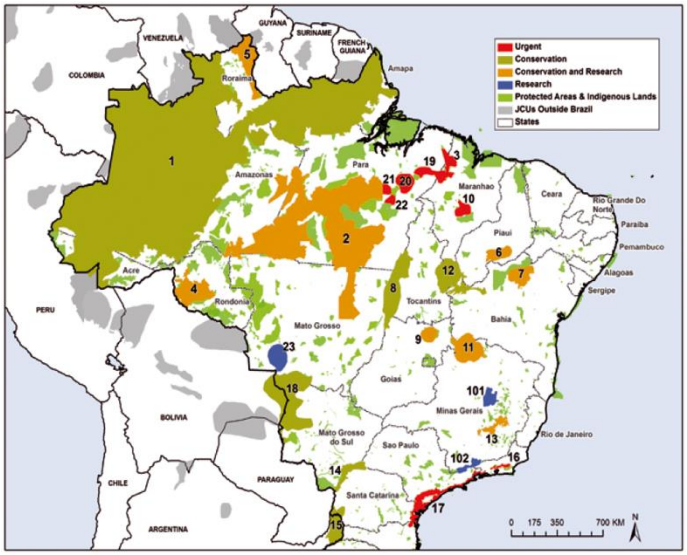
High Conservation Values (HCVs) were defined according to global, regional and national significant concentrations of biodiversity values; protected areas, rare, threatened species, and endemic species and areas that support significant concentrations of a species during any time in the project lifecycle.

High Conservation Value	Focal species for the project area
Qualifying Attribute	Large populations of threatened species like the Jaguar (Panthera onca), Giant armadillo (Priodontes maximus), Giant anteater (Myrmecophaga tridactyla), Giant otter (Pteronura brasiliensis), Lowland tapir (Tapirus terrestris), White-lipped peccary (Tayassu pecari), Bare-faced curassow (Crax fasciolata) are essential to regulate forest ecosystems through balance of the trophic cascades that maintain forest health and structure (Ripple et al., 2014). According to Cavalcanti et al. (2012), about 63% of the Pantanal biome is occupied those species. Nevertheless, due to habitat degradation that increased human presence and the intensification of land use for cattle ranching, those species are important because they live at low densities, and their long-term survival depends on vast connected forested habitats to maintain genetic flow beyond protected areas (Rabinowitz & Zeller, 2010)
Focal Area	Pantanal Matogrossense National Park and project area

High Conservation Value	Pantanal biome
Qualifying attribute	The Pantanal is one of the largest and most biodiversity-rich wetlands on the planet (Harris et al., 2005; Guerra et al., 2020). Although fauna species are not significantly different from neighboring biomes, there are more than 3,000 species of superior plants, 263 species of fish, 85 species of reptiles, more than 600 species of birds, and 175 species of mammals (Alho and Sabino, 2011; Alho et al., 2019). In addition, the local people depend on the land in the Pantanal for farming, fishing and cattle ranching. Due to its environmental and socioeconomic importance, the Pantanal was declared a National Heritage Site by the 1988 Brazilian Constitution (Cowie, 2016; Galdino et al., 2002).
Focal area	Total area of the Pantanal biome

High Conservation Value	Pantanal Matogrossense National Park, World Heritage Site, UNESCO Biosphere Reserve, Ramsar site
Qualifying attribute	The Pantanal conservation area consists of a cluster of four protected areas with a total area of 187,818 ha, and includes the Pantanal Matogrossense National Park (Figure 61). Due to the presence of the Amolar mountains, with a dominant freshwater wetland, a unique ecological gradient is present. Through its hydrologic regime of dry and rainy seasons, it produces temporal lakes and different habitats and ecosystems. These characteristics have made the Pantanal Matogrossense National Park a very important wetland in South America. Its abundant biodiversity includes several populations of capybara (*Hydrochoerus hydrochaeris*), spectacled caiman (*Caiman crocodilus*) and marsh deer (*Blastocerus dichotomus*), alongside large populations of threatened species like the giant otter (*Pteronura brasiliensis*), greater hyacinth macaw (*Anodorhynchus hyacinthinus*), Pampas deer (*Ozotoceros bezoarticus*) and jaguar (*Panthera onca*) (Larcher et al., 2017). Due to its importance, the Pantanal Matogrossense National Park is listed as a World Heritage Site and a Biosphere Reserve.

	 *Figure 61. Location of the RPCSA and UNESCO Reserve* (Source: Lacher et al., 2017)
Focal area	The conservation area of the World Heritage Site comprises of a cluster of four protected areas, but the focal areas are the Pantanal Matogrossense National Park and the buffer zone of the RPCSA (Figure 61).

High Conservation Value	Jaguar conservation – Brazil
Qualifying attribute	The jaguar (*Panthera onca*) is the predator with the greatest distribution, spanning from the north of Mexico to the north of Argentina. Due to this wide distribution, conservation units were prioritized in major habitats in order to protect the species (Sanderson, 2002). In Brazil, 20 conservation units were identified across five biomes. The jaguar conservation units in the Pantanal are the poorest represented within the protected area system in Brazil – as shown in Figure 62 (Nijhawan, 2012). According to Cavalcanti et al. (2012), about 63% of the Pantanal biome is occupied by jaguars, including the area of the RPCSA. Nevertheless, due to habitat loss, increased human presence and the intensification of land use for cattle ranching, this species is considered near threatened in the Pantanal. Conflict between ranchers and jaguars in the Pantanal exists due to livestock predation; however, for Serra do Amolar, most of the community has a good relationship with the jaguar and it is frequently seen in its natural habitat (Porfirio et al., 2016).  *Figure 62. Jaguar conservation units for Brazil. Unit 18 represents the population of the Pantanal biome* (Source: Nijhawan, 2012)
Focal area	Area of occupancy for the jaguar in the Brazilian Pantanal.

5.1.3 Without-project scenario: Biodiversity (B1.3)

Currently the IHP manages 135,061 ha under the RPCSA, where it develops preservation and conservation strategies to protect the Pantanal. This entity is responsible for biodiversity conservation and the development of activities for the monitoring, control, research, preservation and conservation of the forest and the rest of the land within the RPCSA.

The IHP and landowners are responsible for the maintenance of the reserve (e.g., fencing off the reserve), and are expected to cover all costs associated with its protection and management. However, the Pantanal is threatened by land use transformation and degradation,[170] which leads to habitat loss and an increase in deforestation, hunting and retaliation in response to predation events[171] – all of which put various species of fauna and flora at risk, such as jaguars (*Panthera onca*) and pumas (*Puma concolor*), with the other main species targeted being agouti (*Cuniculus paca*), deer (*Mazama sp.*) and armadillo (*Dasypus novemcinctus*).

Carbon credits through REDD+ offer a unique opportunity to positively impact habitat and biodiversity conservation, because few financial resources are available to jaguar conservationists to conserve forest habitats.[172] Without credits, additional funding and financial support will be not available for the protection of the RPCSA.

In addition, it would be more difficult to generate trickle-down benefits, such as jobs and economic alternatives for the community to improve their living conditions and quality of life. (See also section 2.2.1)

[170] Pegas and Castley, "Ecotourism as a Conservation Tool and Its Adoption by Private Protected Areas in Brazil."
[171] Angélica Guerra et al., "Drivers and Projections of Vegetation Loss in the Pantanal and Surrounding Ecosystems," *Land Use Policy* 91 (February 1, 2020): 104388, https://doi.org/10.1016/j.landusepol.2019.104388.
[172] Oscar Sarcinelli, "Valoração Economica Do Serviços Ambientais Prestados Por RPPNs No Estado Do Mato Grosso Do Sul Como Potencial Para Um Programa de Pagamentos Por Serviços Ambientais," no. December (2015), https://doi.org/10.13140/RG.2.1.4615.9444.

5.2 Net positive biodiversity impacts

5.2.1 Expected biodiversity changes (B2.1)

Biodiversity element	Conservation
Estimated change	Positive
Justification of change	Although the Pantanal is the most intact biome of Brazil, the representation of federal conservation units is poor, with only 147,477 ha of the total area of the biome being under the category of National Park or Ecological Station, which is 15,131,385 ha (0.97%).[173] If the other protection and conservation categories are included, a total of 6.1% of the Pantanal biome is covered, as shown in Figure 63 (Larcher et al., 2017). Additionally, one of the most important factors of the Pantanal biome is its hydrological regime, which is threatened by rapid deforestation and land use changes in the upper part of the project area (mostly in the Cerrado biome), for agribusiness and cattle ranching activities. These changes increase sedimentation and soil erosion, which result in changes in the flooding regime. The project area employs a unique conservation strategy that considers the diversity of landscapes, ecosystems and biodiversity of the Pantanal and its hydrologic cycles (IBAMA, 1999). The approach taken to manage this area can be considered to be a smaller scale pilot model for the management of the entire Pantanal hydrographic basin (IBAMA, 1999). Therefore, the project area will contribute to the conservation of the different ecosystems in the Pantanal and the populations of threatened species of fauna, as well as all the resources required for its survival in this area.

[173] Chico Mendes Institute for Biodiversity Conservation. Available on: https://www.icmbio.gov.br/portal/

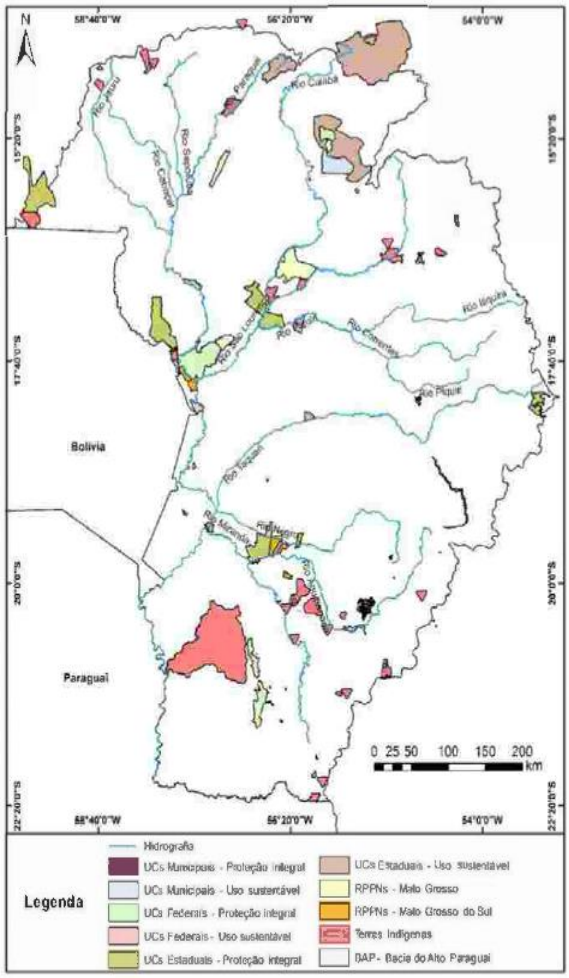


Figure 63. Conservation areas located in the Pantanal biome in Brazil

(Source: Larcher et al., 2017)

Biodiversity element	Connectivity
Estimated change	Positive
Justification of change	The project area is part of the RPCSA, which is the area of the RPPN under the control of the IHP and the Pantanal Matogrossense National Park. This conservation network is also a UNESCO Heritage Site and Biosphere Reserve (Pott and Da Silva, 2015). The advantage of having all these areas under a continuous corridor is that all of the key biological and geographical elements of the Pantanal can be represented and conserved in one area. The RPPN are an important part of Brazil's conservation strategy (Schiavetti et al., 2010). For example, the Dorochê Reserve, which is a former cattle ranch that was always considered an important area to add to the National Park, due to the species of fauna and flora present that were not represented inside the National Park. Moreover, this area is extremely important as a biological corridor for wildlife migration – Dorochê's drier habitat benefits larger mammals. For RPPN Acurizal and Penha, the presence of a variety of ecosystems of continuous green forest, semi-deciduous forest, savanna formations and flooded areas, generate habitats for different endangered species such as jaguar (*Panthera onca*), giant armadillo (*Priodontes maximus*) and marsh deer (*Blastocerus dichotomus*), among others (Larcher et al., 2017). The RPPN Engineer Eliezer Batista is located on the border of the Paraguay River and the Mandioré lake, which is one of the biggest lakes in the Pantanal. The connection between the mountainous areas and the floodplain forms a unique ecological gradient – a notable feature of the RPPN Engineer Eliezer Batista (Rabelo et al., 2012). This area is crucial for the maintenance of the fishing stocks in the area, and as a shelter for fauna in times of flooding. Therefore, the conservation of these unique areas will offer suitable habitats for fauna, providing them with the shelter, food availability, and freedom of movement they require.

Biodiversity element	Fauna and flora
Estimated change	Positive
Justification of change	The geographic characteristics of the Pantanal, together with the Serra do Amolar, creates an area with different aquatic and terrestrial ecosystems with high biological diversity and species richness. The vegetation of the Pantanal contains species from other biomes, like the Cerrado, the Amazon Rainforest and Mata Atlantica. The types of vegetation identified in the area were seasonal deciduous forests, seasonal semi-deciduous alluvial forests, seasonal semi-deciduous forest of lowlands, savannas (Cerrado) and steppe savannas (Chaco) (Silva and Abdon, 2006). The conservation of the flora species of the project area (more than 1,500 species recorded for the Pantanal) can benefit a large number of fauna species that rely on shrubs, trees and palms for food, shelter and movement. Although most of the flora species present in the Pantanal came from the adjacent biomes, their protection is important due to the function of connectivity between these different biomes (ecotone zones), which creates an important relationship between vegetation and fauna dispersion (Junk et al., 2006; Rabelo et al., 2012). The Pantanal is also very important for fauna species. Its status as a well-preserved biome enables it to provide food and habitat for abundant populations of different species like capybaras (Hydrochoerus hydrochaeris) and spectacled caimans (Caiman crocodilus). According to Cavalcanti et al. (2012), the Pantanal has one of the largest jaguar (Panthera onca) populations. As the jaguar is a key umbrella species, its protection helps to protect other species.

Biodiversity element	Fauna (threatened and endangered species)
Estimated change	Positive
Justification of change	The area contains natural areas of exceptional diversity and perhaps the most important and significant natural habitats for the in-situ conservation of biological diversity, including those listed as threatened species (IBAMA, 1999). In the project area, a total of 33 mammal species have been detected through previous studies (Passos Viana et al., 2019; Porfirio et al., 2014). In the 'Panthera Colombia' study, a total of 49 species, including mammals and birds, were identified. Some of the most representative species are the lowland tapir (*Tapirus terrestris*), the white-lipped peccary (*Tayassu pecari*), giant armadillo (*Priodontes maximus*), giant anteater (*Myrmecophaga tridactyla*), giant otter (*Pteronura brasiliensis*) and river otter (*Lontra longicaudis*). In addition, the jaguar (*Panthera onca*), is used to attract wildlife tourists due to its abundance in the area. Regarding the bird species present, it is important to highlight the hyacinth macaw (*Anodorhynchus hyacinthinus*), crowned solitary eagle (*Buteogallus coronatus*) and the marsh seedeater (*Sporophila palustris*), which are all endangered (EN) according to the IUCN; and the chestnut-bellied guan (*Penelope ochrogaster*), the bare-faced curassow (*Crax fasciolata*) and the strange-tailed tyrant (*Alectrurus risora*), which are considered vulnerable (VU). Given the conservation status of the Serra do Amolar, and its healthy populations of fauna and relatively low levels of human disturbance, the objective of the project is to maintain the presence and relative abundance of focal species. The project's focus is to avoid losses or decreasing populations. This will be achieved by preventing habitat loss by limiting human activities in the project area, mainly through controlling human-induced forest fires and the retaliatory hunting of jaguars in response to predation events.

5.2.2 Mitigation measures (B2.3)

The most likely activities that could negatively impact the region's biodiversity include tourism, hunting and fires. Table 69 highlights the activities to be implemented to conserve the HCVs identified and avoid negative impacts on biodiversity.

Table 69. Activities to be implemented to conserve HCVs

Strategic lines	Main activities to be implemented
Fire prevention	• Reviewing the Fire Prevention Contingency Plan • Fire monitoring via satellite • Firefighting drills
Illegal/retaliatory hunting	• Environmental education campaigns to raise awareness about the importance of fauna • Prompt reporting of hunting incidents to IBAMA for investigation
Tourism	• Specialized consultancy in ecotourism, planning and surveying of potential areas, and an analysis of the structure and viability • Definition of the methods used for the observation of mammals (e.g., the use of boats)

5.2.3 Net positive biodiversity impacts (B2.2, GL1.4)

Without the project, the Pantanal's ecosystem would be affected by land use transformation and degradation, largely through an increase in cattle ranching activities and human-wildlife conflict over predation events. It would also be more difficult for local communities to access funding for conservation activities and reap the direct and indirect benefits such activities offer.

The Serra do Amolar REDD+ project will conserve large areas of habitat for seven species listed as threatened, according to the IUCN, and at least 42 other species of terrestrial vertebrates, including many species of birds and flora. Since the project only involves conservation and conservation-compatible activities, all impacts in the project area are positive.

The net impact on the biodiversity of the project will be positive due to the maintenance of conservation activities developed in the project area, and by providing local communities with greater economic opportunity. The project will also implement control activities needed to mitigate any possible negative impacts.

The project actions promote positive conditions for biodiversity, connectivity and the protection of fauna and flora species in the Pantanal. Furthermore, the activities implemented in the project area will serve to protect not only private reserves but also the national park and its buffer zones.

On the other hand, wildlife tourism is underexplored and underdeveloped in Brazil (Tortato & Izzo, 2017). The ability to provide safe, sustainable tourism practices and good management are rare, mainly due to a lack of funding (Pegas & Castley, 2014). Therefore, the expansion and improvement of tourism practices through specialized consultancy in ecotourism would result in better management of the area's natural resources, contribute to the local communities' environmental knowledge, and empower local people

through greater economic opportunities. For this to succeed, jaguars must be protected, as they are a charismatic species and a key tourist attraction.

5.2.4 High conservation values protected (B2.4)

As mentioned previously, the IHP is responsible for biodiversity conservation in the Serra do Amolar. In addition, due to the nature of the activities proposed for implementation, it is expected that no high conservation values will be negatively affected. On the contrary, most of the activities are focused on the protection and improvement of biodiversity, with a particular focus on high conservation values. It is possible that some activities, like ecotourism, could generate negative impacts on HCVs; however, mitigation measures are going to be implemented, reducing the possible risks and negative impacts.

5.2.5 Species used (B2.5)

The project does not contemplate the use of species.

5.2.6 Invasive species (B2.5)

The project does not contemplate the use of invasive species.

5.2.7 Impacts of non-native species (B2.6)

Non-native species are used in the project activities.

5.2.8 GMO exclusion (B2.7)

No GMOs are used in the project activities.

5.2.9 Inputs justification (B2.8)

No fertilizers, chemical pesticides, biological control agents and other inputs are used in the project activities.

5.2.10 Waste products (B2.9)

No waste products are generated by the project activities.

5.3 Offsite biodiversity impacts

5.3.1 Negative offsite biodiversity impacts (B3.1) and mitigation measures (B3.2)

Significant negative biodiversity impacts outside the project area are unlikely due to the presence of the Amolar Network, as well as a buffer zone that functions as a mitigation area to reduce the negative impacts on the protected core zone areas. Furthermore, the activities to be implemented in the project area are related to wildlife management, the prevention of fires, scientific research, and environmental monitoring and education – all of which are bound to have more positive impacts than negative ones.

Nevertheless, mitigation measures have been implemented to ensure that the surrounding communities are involved in the project and that it does not negatively impact forest and fauna conservation.

5.3.2 Net offsite biodiversity benefits (B3.3)

The Serra do Amolar REDD+ project will provide local ecosystem services to communities that depend on services like flood regulation, fish spawning grounds, as well as indirect services such as ecotourism.

The project has overwhelmingly positive impacts on biodiversity, including conserving large areas for endangered and vulnerable species. Considering that the net impacts on biodiversity in the project zone will be positive compared to the without-project scenario, and taking into account that the project activities are focused on the conservation of the Pantanal biome, the areas surrounding the project area will also be positively impacted through the improvement of connectivity, the protection of endangered species, and more effective ecotourism management.

5.4 Biodiversity impact monitoring

5.4.1 Biodiversity monitoring plan (B4.1, B4.2, GL1.4, GL3.4)

The monitoring of biodiversity makes it possible to measure the impacts of the possible activities caused by the project on biodiversity, providing adjustments and relevant corrections in pursuit of the desired goals.

For the Serra do Amolar REDD+ project, the monitoring of the managed areas is systematically carried out by the IHP team through periodic forest and fauna monitoring. This follows the criteria of the certification standards by aiming at short- and long-term monitoring. IHP also carry out the general monitoring of activities, as well as the environmental, economic, and social performance of management.

The monitoring is posted and published annually by the IHP on its website: https://institutohomempantaneiro.org.br/relatorios/

The maintenance of standing forest, as well as the conservation of species of fauna and flora, are necessary to ensure the continuity and improvement of biodiversity. Therefore, a plan for monitoring fauna and flora was established to understand the biota of the region better. For the fauna, the plan set out a campaign to collect primary information using camera traps, in order to evaluate the seasonal dynamics of the species as well as management practices (for further details, see section 5.4.1.2). For the forest, the plan implemented a protocol to analyze LU/LC changes during the monitoring period within the project area, using remote sensing and image sensors such as Landsat 8 Operational Land Imager (OLI), Sentinel 1 and 2 and additional information provides by partnerships.

For future validations, the Serra do Amolar REDD+ project has prioritized the creation of permanent plots, in order to evaluate the forest dynamics (recruitment rates, mortality and species substitution) and variations in the carbon stock.

5.4.1.1 Forest monitoring

To monitor the impact of the project on natural vegetation, it will be necessary to characterize the extent of its coverage, in order to attend to the methodological criteria in the Climate section.

Variables to be monitored	Frequency	Sampling method	Areas to be monitored	Unit
Quantity of forests	Least every verification	Aerial photographs or satellite images analysis	Project area	Extension of natural vegetation (ha)

5.4.1.2 Fauna monitoring

Indicators are important during impact assessments when measuring the outcomes of the activities implemented. To measure the impact of activities on fauna biodiversity, an assessment of fauna species present in the area must be performed. The assessment can include different landscapes, ecosystems and species. Due to the complexity of the landscape and ecosystem configuration in the Pantanal, and taking into account the difficulty of monitoring all aspects of biodiversity, designating focal species is one of the main tools for evaluating the impacts and levels of perturbation in fragile ecosystems, and determining the conservation biodiversity status in a determined area (Kattan et al., 2008; Lambeck, 1997). By concentrating on these focal species, key ecosystem factors are preserved, which helps safeguard other species in the area (Kattan et al., 2008).

All focal species are described according to the threats they face, such as habitat loss, habitat fragmentation, the invasion of exotic species, hunting and wildlife traffic (Lambeck, 1997; Olson et al., 2001). Other factors taken into account are the anthropogenic sensibility, minimal amount of resources, mobile conditions, and the strategies and plans to develop effective monitoring and evaluation (Kattan et al., 2008). Also, it is important to consider the status on the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendices and the IUCN Red List (Table 70).

Table 70. Focal species for the project area

Species	Common name	Selection criteria for focal species		
		CITES	Threat	
			IUCN	Brazilian red list
Panthera onca	Jaguar	Appendix I	NT	VU
Priodontes maximus	Giant armadillo	Appendix II	VU	VU
Myrmecophaga tridactyla	Giant anteater	Appendix II	VU	VU
Pteronura brasiliensis	Giant otter	Appendix I	EN	VU
Tapirus terrestris	Lowland tapir	Appendix II	VU	VU
Tayassu pecari	White-lipped peccary	Appendix II	VU	VU
Crax fasciolata	Bare-faced curassow	Appendix II	VU	VU

(Source: Panthera Colombia, 2020)

The proposed monitoring plan will aim to monitor and record species with HCV so as to detect fluctuations in the presence or abundance of these species. In addition, it is important to establish the season during which the monitoring will take place because seasonal flooding can make some areas very difficult to access. Moreover, the area selected needs to include a variety of topographies, from lowlands near the Paraguay River up to the Serra do Amolar.

To achieve this, three phases are proposed: the collection of secondary information, field trips to collect primary information, and a phase of information processing. The following are the different alternatives that can be used to monitor the fauna in the project.

5.4.1.2.1 Photo traps

Photo traps produce data that enables one to evaluate the populations of medium and large vertebrates (> 1 kg), to estimate relative abundances by species and wealth indexes, and to identify areas of high conservation value. It also helps identify threats to mammals and outline recommendations for the management and mitigation of any negative impacts on local biodiversity.

For each study period, a minimum of 10 camera traps should be used. In order to reduce the influence of seasonal migration patterns on the study, cameras should be installed in the same way as they were for the study carried out in 2019 for ‘Panthera Colombia’, where each camera trap station operates continuously for 24 hours, with an interval of 30 seconds between photos (as shown in Figure 64) (Carbone et al., 2001). At each station, the Global Positioning System (GPS) location, the reference and

serial number of the camera, the time of installation, and a description of the site should be recorded. Researchers should also make note of the trail width, the distance of the camera to the target, the percentage of tree cover and the type of land cover.

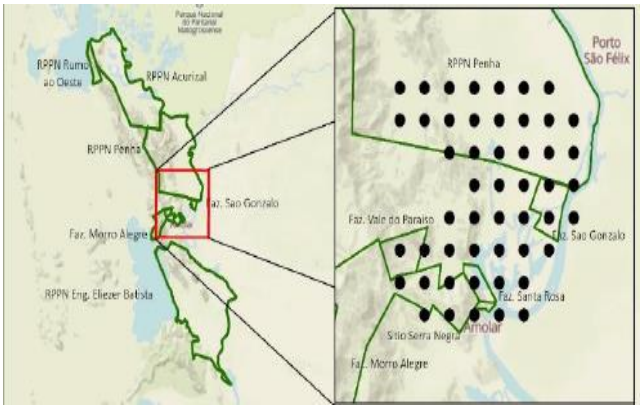


Figure 64. Proposed camera trap matrix for the Serra do Amolar REDD+ project

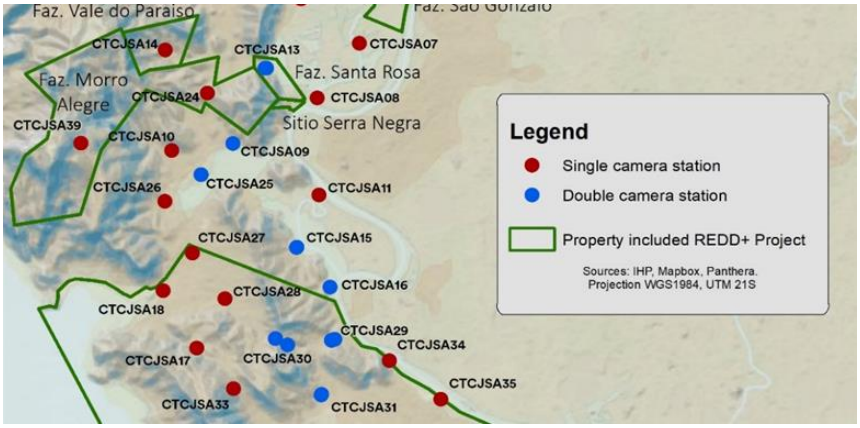


Figure 65. Camera trap installation for the Serra do Amolar REDD+ project. Their code labels the cameras and consecutive number (Camera Trap Conexión, Jaguar Serra do Amolar)

(Source: Panthera Colombia, 2020)

From the photos obtained, a database of the species recorded in the study area will be elaborated by IHP. Species should be identified based on specialized literature, and reporting results are expected on the RAI values and the number of detections for each species.

Table 71. Variables to be reported

Variables to be monitored	Frequency	Sampling method	Areas to be monitored	Unit
Number and diversity of wildlife	At least every verification	Camera traps	Project area properties	RAI; species richness index
Presence of endangered or threatened species	At least every verification	Camera traps	Project area properties	Number of detections for each species

5.4.2 Biodiversity monitoring plan dissemination (B4.3)

Socializations will be planned with the local community and regional authorities. Results from the studies will be posted on IHP's website. The original socialization and environmental education plans were scheduled for June 2020. However, due to COVID-19, the dissemination of the results through these public forums has been postponed indefinitely.

The monitoring plans and all documents and information relating to the monitoring and verification of this project will be published on the VERRA platforms.

5.5 Optional criterion: exceptional biodiversity benefits

5.5.1 High biodiversity conservation priority status (GL3.1)

According to the IUCN Red List, the Serra do Amolar project conserves endangered and vulnerable fauna, including one endangered species – the giant otter (*Pteronura brasiliensis*) – and five vulnerable species: the lowland tapir (*Tapirus terrestris*), the white-lipped peccary, (*Tayassu pecari*), the giant armadillo (*Priodontes maximus*), the giant anteater (*Myrmecophaga tridactyla*) and the bare-faced curassow (*Crax fasciolata*). The project area also has a well-documented population of the near-threatened jaguar (*Panthera onca*).

During a camera trap installation in December 2019, a giant otter (*P. brasiliensis*) was observed and photographed, and two more were documented in February 2020. Both the giant otter and the neotropical river otter (*L. longicaudis*) have been photographed by camera traps in previous studies (Viana et al., 2018). The presence of these species in the project area fulfills the criteria for High Biodiversity Conservation Priority Status, given that both species are considered endangered according to the IUCN Red List.

Figure 66. Camera trap photos of the giant otter (P. brasiliensis, EN) in RPPN Penha

(Source: Panthera Colombia, 2020)

Camera trapping results from the study carried out between December 2019 and February 2020 confirm the presence of more giant otter individuals, which meets the criteria for Gold Status, along with populations of the five vulnerable species listed above. Notably, the number of white-lipped peccary meets the criteria for Gold Status for Exceptional Biodiversity Benefits for a vulnerable species, with at least 45 individuals observed during camera trapping. We also estimate that lowland tapir and giant armadillo populations meet these criteria based on estimates in the sampling area and projections for the rest of the project. There were an estimated eight individuals of each species observed in camera trapping, based on home range size and detailed identification. However, the total number of individuals of these vulnerable species is unconfirmed.

Figure 67. Camera trap photos of the white-lipped peccaries (T. pecari, VU) in RPPN Engineer Eliezer Batista, and a male jaguar (P. onca, NT) in RPPN Penha

(Source: Panthera Colombia, 2020)

Figure 68. Camera trap photos of giant armadillos (P. maximus, VU) in RPPN Engineer Eliezer Batista

(Source: Panthera Colombia, 2020)

Figure 69. Camera trap photos of lowland tapirs (T. terrestris, VU) in RPPN Engineer Eliezer Batista

((Source: Panthera Colombia, 2020)

5.5.2 Trigger species population trends (GL3.2, GL3.3)

According to the IUCN Red List, the Serra do Amolar project conserves one endangered species – the giant otter (*Pteronura brasiliensis*) – and five vulnerable species: the lowland tapir (*Tapirus terrestris*), the white-lipped peccary, (*Tayassu pecari*), the giant armadillo (*Priodontes maximus*), the giant anteater (*Myrmecophaga tridactyla*) and the bare-faced curassow (*Crax fasciolata*). The project area also has a well-documented population of the near-threatened jaguar (*Panthera onca*). Trends in trigger species and their respective population trends for the Serra do Amolar can be found in the tables below:

Trigger species	*Pteronura brasiliensis*
Population trend at start of project	Four individuals were registered on camera traps in RPPN Penha, while two others were directly observed in another area of the reserve. There are at least six confirmed individuals but, due to the size of the area, we believe the total population to be at least four times larger. The RAI for the species at the start of the project is 1.184.
Without-project scenario	Riparian habitat loss and retaliatory killings, due to perceived fishing loss, would reduce the populations of *P. brasiliensis* within the project area.
With-project scenario	IHP has undertaken the conservation of the seven natural reserves within the area, which contain numerous waterways and riparian forests. By protecting these areas, giant otters will have ample habitat in areas with low human impact. The Serra do Amolar and Pantanal regions support some of the only populations of this species outside of the Amazon.

Trigger species	*Tapirus terrestris*
Population trend at start of project	This species is decreasing throughout its territory due to hunting and habitat loss. Approximately eight individuals were observed during camera trapping in an area of 190 km^2, though the project area is four times larger and likely contains a much larger population. The RAI at the start of the project was 5.528.
Without-project scenario	Because the species is highly susceptible to forest disturbance, any land use change would reduce its population. In the absence of the project, land use change, and hunting would increase, leading to a sharp population decline for the lowland tapir.
With-project scenario	The Serra do Amolar REDD+ project conserves large areas with little human influence and pressure, which is highly beneficial for low density and sensitive species like the lowland tapir. We expect the population to be sustained or to slightly increase over time.

Trigger species	*Tayassu pecari*
Population trend at start of project	Decreasing throughout its territory. The species is very sensitive to ecosystem disturbance by humans and is often hunted for both food and pelts. During camera trapping, we registered 45 individuals in an area of 190 km^2, though the project area is four times larger and likely contains a much larger population. The RAI at the start of the project was 3.094.
Without-project scenario	In the absence of the REDD+ project, land use change and hunting would reduce the population. White-lipped peccaries need large areas of primary forest, and without forest conservation, their populations would decrease significantly.
With-project scenario	The conservation of large reserves will promote the maintenance or slight increase of populations of white-lipped peccaries.

Trigger species	*Priodontes maximus*
Population trend at start of project	This species is decreasing throughout its territory due to hunting and habitat loss. Approximately eight individuals were observed during camera trapping in an area of 190 km^2, though the project area is four times larger and likely contains a much larger population. At the start of the project, the RAI was 0.963.
Without-project scenario	In the absence of the project, the population of giant armadillos would decrease due to hunting and habitat loss.
With-project scenario	The conservation of large tracts of suitable habitat will allow for healthy populations of giant armadillos within the project area.

Trigger species	*Myrmecophaga tridactyla*
Population trend at start of project	This species is decreasing throughout its territory due to habitat loss, wildfires, hunting, and road kills. Four individuals were observed during camera trapping in an area of 190 km^2, though the project area is four times larger and likely contains a much larger population. At the start of the project the RAI was 0.277.
Without-project scenario	In the absence of the project, giant anteaters would have a decreasing population from hunting, wildfires and habitat loss.
With-project scenario	The conservation of large tracts of suitable habitat will allow for healthy populations of giant anteaters within the project. Additionally, conservation efforts and fauna rescues when fires occur will also benefit this species.

Trigger species	*Crax fasciolata*
Population trend at start of project	For the case of the bare-faced curassow *(Crax fasciolata)*, the project represents an important conservation area, due to the high abundance of the species. Several couples and hatchlings were observed in the camera trapping study and a total of 311 individuals. At the start of the project the RAI was 17.168.
Without-project scenario	In the absence of the project, bare-faced curassow could experience negative impacts due to hunting, habitat loss and wildfires.
With-project scenario	The conservation of large tracts of suitable habitat will allow for healthy populations of bare-faced curassow within the project. The mitigation activities and management of wildfires will also have a positive impact on the species.

Trigger species	*Panthera onca*
Population trend at start of project	This species is decreasing throughout its territory due to habitat loss and human-wildlife conflict. In general, about 63% of the Pantanal biome is occupied by jaguar; however, the jaguar conservation units in the Pantanal are the poorest represented within the protected area system in Brazil. 25 individuals were observed during camera trapping in an area of 190 km^2, though the project area is four times larger and likely contains a much larger population. At the start of the project the RAI was 1.270.
Without-project scenario	In the absence of the project, jaguars will face decreasing populations from hunting, habitat loss, and human-wildlife conflicts.
With-project scenario	With continuous monitoring, it would be possible to improve the conservation activities and reduce the human-wildlife conflicts. Educational activities are very important and take place with the children of the community, promoting awareness of the importance of jaguars in the ecosystems. The conservation of large tracts of suitable habitat will allow for healthy populations of jaguars within the project.

6 APPENDICES

6.1 Bibliography

Alho, C. 2011. Biodiversity of the Pantanal: Its magnitude, human occupation, environmental threats and challenges for conservation. Brazilian Journal of Biology, 71(1 SUPPL.), 229–232. https://doi.org/10.1590/s1519-69842011000200001

Alho, C., Mamede, S., Benites, M., Andrade, B., Sepúlveda, J. 2019. Threats to the Biodiversity of the Brazilian Pantanal due to land use and occupation. Ambiente & Sociedade. Sao Paulo. Vol 22.

Azevedo, F. Murray, D. 2007. Evaluation of Potential Factors Predisposing Livestock to Predation by Jaguars. Journal of Wildlife Management, 71(7), 2379. https://doi.org/10.2193/2006-520

Brazilian Ministry of the Environment Secretariat of Biodiversity and Forests. Institute of Environment and Renewable Natural Resources. 1999. Pantanal Conservation Complex as natural property to be nominated for inscription to the World Heritage List.

Calheiros, F. 2003. Influência do pulso de inundação na composição isotópica (δ 13 C e δ 15 N) das fontes primárias de energia na planície de inundação do rio Paraguai (Pantanal – MS) Influência do pulso de inundação na composição isotópica (δ 13 C e δ 15 N) das fontes. Dados. Universidade de São Paulo, Piracicaba.

Cavalcanti, S., De Azevedo, F., Tomás, W., Boulhosa, R., Crawshaw, P. 2012. The status of the jaguar in the Pantanal. Catnews Special Issue 7 Spring 2012.

Cowie, S. 2016. 'The Pantanal is National Heritage': protecting the world's largest wetlands. Water in development. The Guardian. Available at: https://www.theguardian.com/global-development-professionals-network/2016/nov/12/pantanal-conservation-wetlands-brazil-paraguay-bolivia

Da Silva, J., Abdon, M., Da Silva, S., Moraes, J. 2011. Evolution of deforestation in the Brazilian Pantanal and surroundings in the timeframe 1976 – 2088. Geografia, Rio Claro. Vol. 36. Número Especial, p. 35-55.

Galdino, S., Marques, L., de Olivera, H., Cardoso, E. 2002. Impactos da Agropecuária nos Planaltos sobre o Regime Hidrológico do Pantanal. Ministério da Agricultura, Pecuária e Abastecimento. ISSN 1517-1965.

Guerra, A., Olivera, F., Couto, L., Ochoa, J., Sanches, P., Dettogni, R., M.D. Rosa. 2020. Drivers and projections of vegetation loss in the Pantanal and surrounding ecosystems. Land Use Policy 91(2020) 104388.

Harris, M., Tomas, W., Mourao, G., Da Silva, C., Guimaraes, E., Sonoda, F., Fachim, E. 2005. Desafios para proteger o Pantanal brasileiro: ameazas e iniciativas em conservazao. Megadiversidade. Vol 1. No 1.

Ivory, S., McGlue, M., Spera, S., Silva, A., Bergier, I. 2019. Vegetation, rainfall, and pulsing hydrology in the Pantanal, the world's largest tropical wetland. Environmental Research Letters. In press https://doi.org/10.1088/1748-9326/ab4ffe.

Junk, W., Nunes, C., Wantzen, K., Petermann, P., Strüssmann, C., Marques, M., Adis, J. 2006. Biodiversity and its conservation in the Pantanal of Mato Grosso, Brazil. Aquatic Sciences. 68 (2006) 278-309. 1015-1621/06/030278-32. Doi: 10.1007/s00027-006-0851-4.

Lapola, D., Martinelli, L., Peres, C., Ometto, J., Ferreira, M., Nobre, C., Aguiar, A., Bustamante, M., Cardoso, M., Costa, M., Joly, C., Leite, C., Moutinho, P., Sampaio, G., Strassburg, B., Viera, I. 2013. Pervasive transition of the Brazilian land-use system. Nature climate change. Review article. Doi: 10.1038/NCLIMATE2056.

Larcher, L., Rabelo, A., Passos, D. 2017. Rede de protezao e conservazao da serra do amolar: um modelo de conservazao integrado. Instituto Homem Pantaneiro.

Michelaina, J. 2018. Climate Change and the Pantanal: Comprehensive Summary of Existing Literature. UC Berkeley: The John Gardner Fellowship Papers. https://escholarship.org/uc/item/1501z09h

MMA, M. do M. A. 2006. Caderno da Região Hidrográfica do Paraguai (Ministério). Brasília: Ministério do Meio Ambiente, Secretaria de Recursos Hídricos.

Nijhawan, S. 2012. Conservation units, priority areas and dispersal corridors for jaguars in Brazil. Catnews Special Issue 7 Spring 2012.

Passos Viana, D., Barreto, S., De Olivera, J., Larcher, L., Porfirio, G. 2019. Monitoramento da Mastofauna da Rede de Protezao e Conservazao Da Serra Do Amolar, Pantanal, MS. Ecologia Aplicada. 71 Reuniao Anual da SBPC.

Pegas, F., Castley, G. 2014. Ecotourism as a conservation tool and its adoption by private protected areas in Brazil. Journal of Sustainable Tourism. 22:4, 604–625. Doi: 10.1080/09669582.2013.875550.

Porfirio, G., Sarmento, P., Leal, S., Fonseca, C. 2016. How is the jaguar Panthera onca perceived by local communities along the Paraguai River in the Brazilian Pantanal? Oryx, 2016. 50(1), 163-168- Fauna & Flora International. Doi:10.1017/S0030605314000349.

Pott, A., Da Silva, J. 2015. Terrestrial and Aquatic Vegetation Diversity of the Pantanal Wetland. Dynamics of the Pantanal Wetland in South America, Hdb Env Chem. DOI: 10.1007/698_2015_352.

Rabelo, A., Moreira, V., Bertassoni, A., Aoki, C. 2012. Descobrindo o Paraíso: Aspectos Biológicos da Reserva Particular do Património Natural Engenheiro Eliezer Batista. RPPN EEB / Pantanal Sul. Instituto Homem Pantaneiro.

Sanderson, E., Redford, K., Chetkiewicz, C., Medellin, R., Rabinowitz, A., Robinson, J., Taber, A. 2002. Planning to Save a Species: the Jaguar as a Model. Conservation in Practice. Conservation Biology, Pages 58 – 72. Vol 16, No. 1.

Schiavetti, A., Torres, H., Da Silva, A., Santana, P. 2010. Analysis of private natural heritage reserves as a conservation strategy for the biodiversity of the cocoa region of the southern state of Bahia, Brazil. Revista Árvore, Vizosa. Vol 34. P 699–711.

Silva, J. S. V. & Abdon, M. M. 2006. Vegetação do Pantanal em escala regional associada ao Sistema Fitogeográfico Brasileiro. In: Congresso Nacional de Botânica, 57, 2006, Gramado. Avanços da botânica no início do século XXI: morfologia, fisiologia, taxonomia, ecologia e genética. Anais... Porto Alegre: Sociedade Botânica do Brasil, p. 316-320.

Sparovek, G., Guidotti, V., Guedes, L., Berndes, G., Barretto, A., Cerignoni, F. 2018. Asymmetries of cattle and crop productivity and efficiency during Brazil's agricultural expansion from 1975 to 2006. Elem Sci Anth, 6: 25. DOI: https://doi.org/10.1525/elementa.187

Tortato, F., Izzo, T. 2017. Advances and barriers to the development of jaguar-tourism in the Brazilian Pantanal. Perspectives in ecology and conservation 15 (2017) 61-63.

Trolle, M. (2003). Mammal survey in the southeastern Pantanal, Brazil. Biodiversity and Conservation, 12, 823–836.

Zalles, V., Hansen, M., Potapov, P., Stehman, S., Tyukavina, A., Pickens, A., Song, X., Adusei, B., Okpa, C., Aguilar, R., John, N., Chavez, S. 2018. Near doubling of Brazil's intensive row crop area since 2000. PNAS Latest Articles. Doi/10.1073/pnas.1810301115.

Zucco, C., Tambelini, F., De Jesus, F., Saracura, V. 2011. Plano de Manejo da RPPN EEB. Documento entregue pelo Instituto Homem Pantaneiro à MMX Minerazao e Metálicos S.A. Corumbá, MS.