Preparing Brazil for its best.

Project Description

Yuxibu REDD Project

Reducing Emissions from Deforestation and Forest Degradation

Project Name	YUXIBU REDD PROJECT
Version	2.3
Date	12/08/2021
Development	Canopée Gestão Ambiental e Florestal S/A
Contact	Av. Presidente Juscelino Kubitschek, 1455, 4º andar. São Paulo – SP. canopee@canopee.com.br www.canopee.com.br

Document prepared by Canopée Gestão Ambiental e Florestal S.A.

Short Version – English (EN)

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Sumary

1. PROJECT DETAILS

1.1 Project Description

Brazil is the country with the largest tropical forest cover in the world and its forests hold immense wealth, being the greatest diversity of plants and animals on the planet (IBGE, 2012). That makes it a territory with great importance in terms of biodiversity conservation and the sequestration and storage of carbon from the atmosphere, putting the country at the center of international debates on climate change.

Currently Brazil has about 59% of its territory with vegetation cover, which is equivalent to 490 million hectares[2]. This entire area is a remnant of a process of deforestation and land occupation over the years, resulting from the increase in population, industrialization, growth of infrastructure and mainly the expansion of agriculture and livestock. It is estimated that between 1990 and 2015 there was a loss of 53 million hectares of vegetation due to deforestation, the highest rate among all countries (FAO, 2014).

Most recent deforestation occurs in the northern region of the country, where agriculture and livestock expand their borders over the still preserved Amazon rainforest. In addition, activities such as illegal mining and illegal logging contribute to increased rates of deforestation and forest degradation.

The Yuxibu REDD Project aims to prevent unplanned deforestation on the farms owned by Companhia ASF Brasil, called São Jorge I, São Jorge II and Mucuripe, and their reference regions. The total area of the three farms together is 15,934 hectares and the total area of the reference region is delimited at 213.21 thousand hectares. The farms are located in the municipality of Sena Madureira, in the state of Acre, between the Iaco River and the BR364 highway.

The ASF Brasil farms that this project will cover are located in a region with extreme risk of deforestation, considering the border between agricultural expansion and preserved forest, where the highest rates of deforestation in the country occur. The main causes of deforestation in the region are associated with agricultural practices, illegal land occupation, extensive livestock and illegal logging. The areas of the farms are all located in a preserved native Amazon forest biome and contain great animal and plant diversity, in addition to being of great social importance, being a source of subsistence for communities living in the region.

The company proposing the project - ASF Brasil - is a private company, based in Rio Branco, Acre. The company's activities consist of the sustainable exploitation of wood through forest management plans, sawmill operations, reforestation and silviculture.

This project was proposed in conjunction with the company's sustainable wood extraction operations, authorized by Organs responsible bodies and carried out on the aforementioned farms. Along with the Bureau Veritas certification seal of the carbon chain, the BV seal is being implemented to certify that all socio-environmental programs with impacts on the local community will be carried out effectively. The project covers the monitoring of biodiversity indicators, and socioeconomic indicators, in addition to preventing deforestation and reducing greenhouse gas emissions foreseen in REDD projects.

According to the deforestation projection models and analyzes carried out, it is estimated that this project will prevent the deforestation of a total area of 6,595.95 hectares and contribute to the reduction of 3,311,169.08 tons of CO2 during the 25 years activity, evidencing the great importance of its protection. In addition, it will generate a great social impact, both for the conservation of the natural resources present there, and for the investment made in infrastructure, health and education of the communities that live in the region.

1.2 Project Type

The development of the project followed the guidelines established by the REDD Emissions Reduction Methodology developed by Bureau Veritas, based on the main standards well established worldwide, and considered the most representative for this type of project.

- VERRA - Voluntary Carbon Standard (VCS)
- Plan Vivo System;
- Climate, Community and Biodiversity (CCB) Project Design Standards;
- American Carbon Registry Forest Project Standard;
- ABNT NBR ISO 14064;

- SOCIALCARBON.

The methodology is applicable to a wide range of unplanned deforestation scenarios and baseline land uses that may include logging activity, firewood collection and charcoal production, agriculture and grazing.

The project generates carbon credits by reducing emissions from deforestation and degradation (REDD) by preventing unplanned deforestation.

1.3 Project Proponent

Company Name	Canopée Gestão Ambiental e Florestal S/A
Participation in the project	Proponent, developer and project manager
Responsible	Jean Pierre Cantaux
Office	CEO
Telephone	+55 11 99901-2520
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1.4 Other Parties Involved in the Project

Company Name	ASF Brasil
Responsible	Flávio de Meira Penna
Participation in the project	Project area owner
Office	Managing partner
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Telephone	+55 68 32218293
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Company Name	Bureau Veritas S. A.
Participation in the project	Auditing and certification of carbon credits
Responsible	Amauri Ávila

Office	Executive Certification Manager
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Company Name	**Elio Tecnologia Ltda.**
Participation in the project	Stock analysis and imaging of the areas
Responsible	Rui Pedro Ribeiro
Office	CEO
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Company Name	**Agrinix**
Participation in the project	Platforms and traceability
Responsible	Ricardo Venceslau
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1.5 Project Area

1.5.1 Location and access

The Yuxibu REDD Project is located in the municipality of Sena Madureira, in the State of Acre (AC), located in the southwest of the Amazon. The project area comprises three properties, almost entirely covered by native vegetation. They are: Fazenda Mucuripe (7,633 hectares), Fazenda S. Jorge I (4,009 hectares) and Fazenda S. Jorge II (4,292 hectares), totaling 15,934 ha.

The main route to reach the project areas starts from the municipality of Sena Madureira, which is located approximately 145 km from Rio Branco, capital of Acre. To access the complex of Fazendas São Jorge I, São Jorge II and Mucuripe, there are 45 km of paved road starting from the Municipality of Sena Madureira heading towards the Capital Rio Branco via Highway BR364 and another 22 km of unpaved road heading right towards the Fazenda Cerejeira crossing the Mário Lobão road and continuing towards the Iaco river until the project area, where there is good access during the less rainy season.

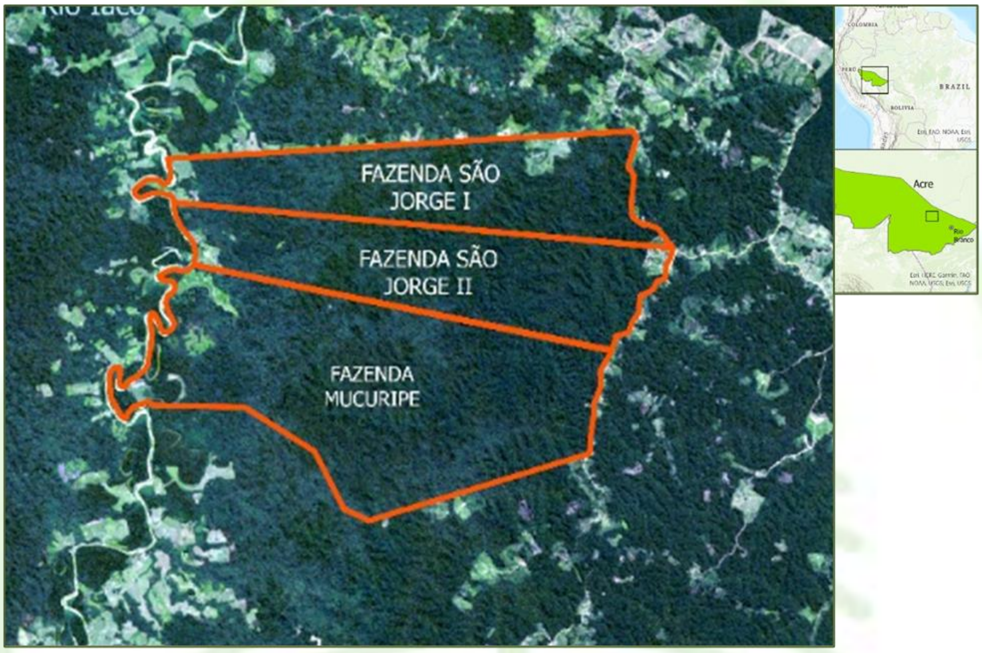


Figure 1. Farms that make up the Yuxibu Project

1.5.2 Ownership of Areas and History

The company that owns it and is responsible for operations on the farms is ASF Brasil, a company responsible for managing forest areas in the state of Acre, aiming at the integrated production of wood products, based on sustainable forest management and a tracked chain of custody. That also includes the reforestation of the explored regions, promoting a lasting and sustainable asset. Currently, ASF Brasil has two sawmills and more than 40,000 hectares of forested areas, in addition to a complex logistics system for transporting and exporting sawn products. ASF Brasil generates, directly and indirectly, more than 500 jobs, being one of the largest private employers in the state of Acre.

The complex of “Fazendas São Jorge I, São Jorge II and Mucuripe” is a private land owned by ASF Brasil. Initially, Acre Brasil Verde Industrial Madereira LTDA., responsible for certifying the Sustainable Forest Management Plan for these lands, owned the properties. In 2005, the properties were sold to the company Laminados Triunfo, which took over the forestry exploitation of the management plan. With the acquisition of Laminados Triunfo and the properties in question in 2019, ASF Brasil took over the PMFS activities and entered into a partnership with Canopée Gestão Ambiental e Florestal S.A. for granting the right to generate carbon credits.

1.5.3 Land use and Occupation

Currently, the project areas are 95% covered by forest formations, as demonstrated by the aerial survey and image analysis.

According to data from the RADAMBRASIL Project, the vegetation that covers the area is represented by the tropical forest, characterized by heterogeneous tree species, with an understory consisting of a stratum and seedlings, generally resulting from the regeneration of trees in the upper stratum. Part of them is occupying sedimentary areas. The elements that make up this forest are characterized by a cover of tall emergent trees. In the high parts, smaller and uniform tree formations of individuals are almost always observed. The understory is denser in hilly areas than in tabular areas, with regeneration of tree species occurring in all topographical situations. In this floristic system, in addition to the dense forest, there is an open forest with two physiognomic types: palm forest and bamboo forest (Brasil, 1976).

As identified by the analysis and classification of the vegetation cover of the farms carried out by Canopée in 2021 with data from the USGS and IBGE, about 5% of the total area of the farms were converted into areas for human use, in order to allow and adapt the establishment of the caretakers and their families. In these areas, residents authorized by the owner to reside on the farms also carry out subsistence agriculture and livestock activities. These residents are partners in the constant monitoring of property boundaries.

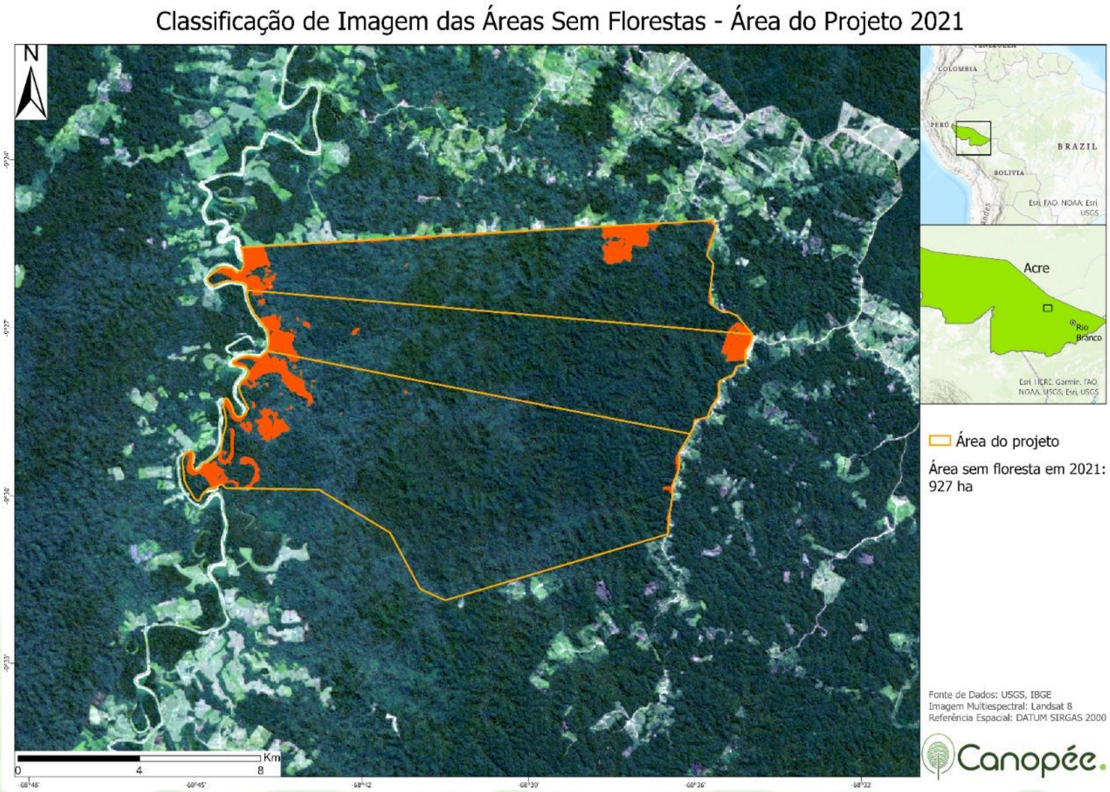


Figure 2. Area without forest on the farms that make up the Yuxibu project

1.5.4 Sustainable Forest Management Plan

The Amazon forest has a high potential for the commercialization of timber and non-timber products, with a wide range of commercial forest species. Illegal and high-impact exploitation has made the Amazon a target of national and international pressures related to its conservation. The pressure promoted by the irrational use of forest resources generated the need to regulate forest exploitation, with the management of native forests being the main alternative for sustainable production.

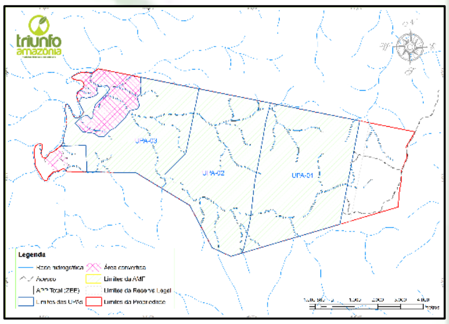
The general objective of the PMFS implementation was:

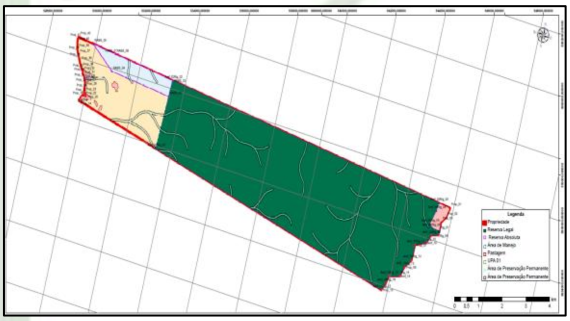
- Harvesting wood from commercial species in native forests in a sustainable and legal way to supply the raw material to the regional timber market, contributing to the reduction of illegal exploitation of forest resources, to the generation of employment, the heating of the economy and stimulating the forestry vocation of the state and entrepreneurs.

Specific objectives of the PMFS implementation were also:

- Carry out exploration work and silvicultural practices in full compliance with the relevant forestry legislation, as mentioned above;
- Enhance the consumption of forest resources in a continuous and lasting way;
- Incorporate local labor in all stages of the production process;
- Enable practices aimed at the use of forest resources, respecting the productive capacity of the forest and the balance of ecosystems;
- Enable the natural potential of the Amazon Forest, in order to increase the region's sustainable development; and
- Check all the favorable conditions for the managed forest to have economic potential and to be managed according to the principles of sustainability.

The forest management area located within the limits of the Project has a logging operation based on reduced impact techniques, where activities are carefully planned to minimize environmental impacts and possible waste, which commonly occur in conventional logging. These are essential techniques to minimize the damage caused to the forest. The first of the three farms to have their resources exploited in a sustainable way through the implementation and approval of a Sustainable Forest Management Plan (PMFS) was São Jorge I in 2005. Later, in 2009, exploration began at Fazenda São Jorge II, and finally, in 2013 at Fazenda Mucuripe.





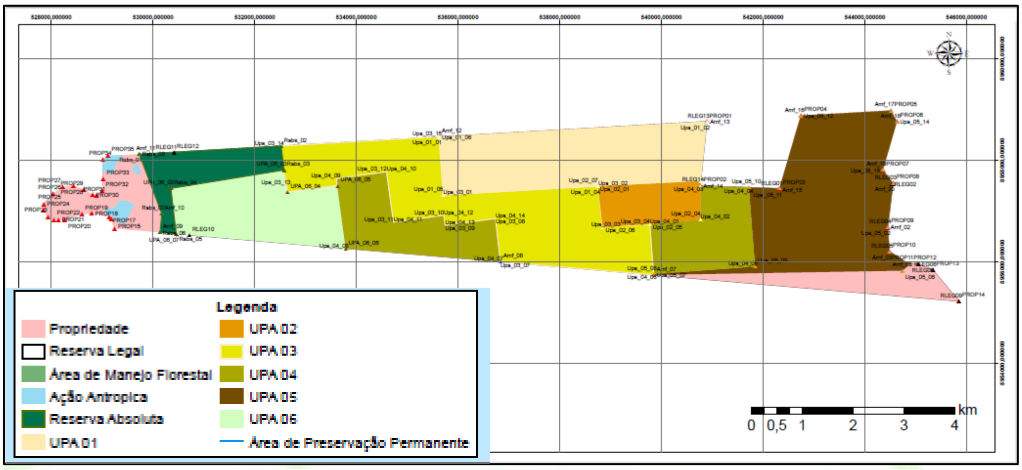


Figure 3. PMFS areas of each project farm

In the first two farms, were established 25-year harvesting cycles for each Annual Production Unit (UPA). This cycle was based on studies that showed an average increase of 1m³/ha/year in managed forests. For Fazenda Mucuripe, the average increment approved was also 1m³/ha/year, with a cycle established at 35 years.

The legislation that governs this practice allows a cutting intensity of up to 30 m³/ha. However, the survey carried out in the post-exploratory reports showed an average exploration intensity in the Farms area equivalent to 20.24 m³/ha, 33.5% lower than the established maximum.

Farm	Years Explored				
São Jorge I	2005	2006	2007	2008	2009
São Jorge II	2009	2010	2011	2012	-
Mucuripe	2013	2017	2020	-	-

Table 1. Years with PMFS explored on each farm

In all farms, harvesting was carried out using techniques to reduce damage, felling, building roads, bridges, culverts, patios, and planning log hauling. Most of the time, and whenever possible, the accesses and patios were opened in an area of natural occurrence of taboca (native bamboo). In addition to causing less damage, this form of procedure provides an improvement in the regeneration of forest vegetation.

Forestry employees who participated in exploration activities received training in techniques that professionalize and increase the productivity and quality of operations.

The hollow test and evaluation of the quality and health of the bole, carried out by trained operators, determined a large number of trees kept standing even though they were classified for cutting by the forest inventory, justifying authorized volumes, but not exploited.

These differences in volumes are even greater due to species with potential timber not having been of interest to the market at the time of exploitation.

In terms of volume, the forest remains with large remaining stocks, of ecological interest as well as economic, and that will be increased by the growth of younger trees.

1.5.5 Project Start Date

The project start date is July 26, 2005.

The company Acre Brasil obtained the logging authorization from the Brazilian Environmental Agency to operate the area on 07/26/2005. From that date onwards, the first Annual Production Unit (UPA) was harvested through a sustainable forest management plan (PMFS) using reduced-impact cutting techniques. The implementation of the PMFS was the main action aimed at reducing GHG emissions, established as the starting point of this REDD project.

In addition, the increased presence in the area has increased enforcement, which helps to prevent unplanned deforestation or illegal logging in the project area by external agents.

1.6 Project Crediting Period

The project has a crediting period of 25 years, from July 26, 2005 to July 25, 2030, the same period of validity of the Sustainable Forest Management Plan.

1st baseline period: 07/26/2005 to 07/25/2021;

2nd baseline period: 07/26/2022 to 07/25/2030.

1.7 Credit issuance period

This document includes the monitoring and issuance of credits for the period from 07/26/2005 to 07/26/2021, totaling 16 years of credits issued and already verified in relation to the baseline. The project also includes the projection of future emissions, estimated for the period from 2021 to 2030, to be monitored annually for the issuance of the predicted credits.

1.8 Estimate of GHG Emissions Reduction or Removals

Estimated annual GHG emission reductions or removals for the project crediting period are presented in Table 2 below.

Year Project	Reference year	Estimation of GHG emission reductions or removals (tCO2e)
1	2005	55.334,66
2	2006	68.657,50
3	2007	28.666,70
4	2008	65.814,73
5	2009	-72.433,34
6	2010	74.772,78
7	2011	16.328,50
8	2012	30.849,30
9	2013	-6.311,61
10	2014	14.257,82
11	2015	168.322,53
12	2016	-6.929,94
13	2017	64.788,55
14	2018	261.030,02
15	2019	259.157,65
16	2020	41.327,89
17	2021	155.264,39
18	2022	207.086,89
19	2023	220.509,62
20	2024	234.905,60
21	2025	250.345,42
22	2026	266.904,75

Year Project	Reference year	Estimation of GHG emission reductions or removals (tCO2e)
23	2027	284.664,76
24	2028	303.712,52
25	2029	324.141,40
Estimated ERs until 2021		1.063.633,73
Total estimated ERs (until 2030)		3.311.169,08
Total number of years of credits		25
Annual / average REs		132.446,76

Table 2. Estimated total and average annual GHG emission reductions

For compliance reasons, Fazenda Mucuripe's credits will be verified, but not issued at this time. The current monitoring will allow the issuance of carbon credits related to the São Jorge I and São Jorge II farms, as shown in table 3 below.

Farm	Emissions avoided by 2021 (tCO2eq)	% of emissions avoided by 2021	Emissions avoided by 2030 (tCO2eq)	% of emissions avoided by 2021	Compilation status
São Jorge I	581.155,09	54,64	1.616.137,50	48,81	Issue in 2021
São Jorge II	140.382,53	13,20	498.749,20	15,60	Issue in 2021
Mucuripe	342.096,11	32,16	1.196.282,38	36,13	Do not issue
Total	**1.063.633,73**	**100,00**	**3.311.169,08**	**100,00**	**-**
Total credits issued in 2021 (SJ1 and SJ2)			721.537,62		
Total credits issued in 2021 (Mucuripe)			342.096,11		

Table 3. Carbon credits related to Project Farms

1.9 Description of Project Activities

The main objective of the present REDD project is the conservation of 15,934 hectares of Amazon forest area within a complex of three properties, namely "Fazenda São Jorge I", "Fazenda São Jorge II" and "Fazenda Mucuripe". That will be achieved by avoiding unplanned deforestation resulting from the pressures exerted by the advance of deforestation in the reference region.

In recent years, the project region has been deforested for the expansion of agricultural activities, mainly due to the advance of the so-called arc of deforestation in the south of the Amazon biome. That pressure is expected to continue, given the globalization of markets in the Amazon region and the international development policies planned for the region.

The main agents of deforestation and degradation in the Yuxibu project region are: livestock, mainly for meat production; wood harvesters, acting legally and illegally; and infrastructure, such as the proximity of existing highways and the expansion and/or renovation of such roads in the near future, as well as the expansion of the urban limits of nearby cities.

The main action to protect the project areas was the approval of sustainable forest management plans, which guaranteed the commitment to sustainable exploitation and the protection of farms.

Protection actions were intensified through annual monitoring carried out by Canopée, with high-precision imaging capable of identifying changes at the individual level. In this way, it is guaranteed that the farms will be mapped and monitored annually with high definition images.

The project's activities also include daily ground monitoring actions by employees on the ground, as well as the partnership with families residing on the farms, which ensure on-site surveillance throughout the year.

1.10 Inventories Considered in Project Calculations

PMFS results in higher carbon stock in wood products than in the baseline, i.e. the conversion of forest to non-forest land in the baseline scenario would certainly lead to lower production of wood products when compared to the baseline scenario. of the project, where the forest is managed with the aim of producing wood products.

Carbon reservoir	Included / Not Included	Justification
Above the ground	Trees: Included	Main carbon reservoir considered, obtained through forest inventory (census).
	Non-trees: Included	Reservoir included in the forest phytophysiognomies used in the baseline scenario (bamboo) and considered in the inland forest stratification.
Below ground	Included in	The carbon stock in this class is significant.

Harvested wood products	Included in	Stock considered in the emissions of the management plan.

Table 4. Carbon Reservoirs on Project Farms

1.11 Emissions Considered in the Project

Deforestation emissions were estimated for four forest strata, whose above- and below-ground carbon pools were previously determined through literature and scientific articles (discussed in item 2.3.1). These emissions were considered and quantified for the reference area and for the project area.

Emissions related to the implementation of sustainable forest management plan activities were also considered.

Emission source	Unity	Justification
Deforestation in the Reference Region	tCO2e	Emissions calculated according to the reduction of forest cover in the reference region
Deforestation in the Project Region	tCO2e	Emissions calculated as a function of the reduction of forest cover in the project region.
Sustainable Forest Management Plan	tCO2e	Emissions arising from the implementation of the sustainable forest management plan.

Table 5. Carbon credits related to Project Farms

2. APPLICATION OF THE METHODOLOGY

2.1 Definition of the Reference Region

The Reference Region (RR) is an analytical domain through which information on rates, agents, drivers and underlying causes of changes in land use and land cover (LU/LC) is obtained and subsequently used for future projections and monitoring.

2.2 Criteria for Defining the Reference Region

The definition of the Reference Region (RR) followed the guidelines of the BV methodology, which recommends the following requirements:

- The RR should include, in addition to the project implementation area itself, the leakage areas (leakage) which are normally the areas where deforestation and forest degradation actions take place over time.
- Only areas that qualify as forest can be included in the reference region (tree canopy coverage of at least 10%, with trees larger than 2 meters and an area larger than 0.5 hectare, under these conditions) for a minimum of 10 years before the project start date.
- The reference region, which includes the project area and leakage areas, must be characterized.
- Identification of the agents and factors that promote deforestation – which when existing elsewhere in the reference region are expected to cause deforestation within the project area in the absence of the proposed project activity. These agents and factors must be identified and characterized in detail, and their effect measured in the reference region in order to demonstrate that they will cause deforestation in the project implementation area.
- The RR must have an ecological and spatial configuration, in which at least 3 of the following 4 criteria must be met:

a. At least 90% of the reference area must have forest or vegetation cover equal to at least 90% of the project area;

b. At least 90% of the reference area must be in the same altitude range as 90% of the project area;

c. At least 90% of the reference area must be in the same relief class as the remaining 90% of the project area;

d. The average annual rainfall of 90% of the reference area must be on the same 90% rainfall base of the project +/- 10%.

- The socio-economic and cultural conditions and characteristics, namely the conditions of ownership, tenure and use of the land, in which the areas of the reference region must be similar to those of the project.

The definition of RR followed all the criteria, and its detailed characterization is presented in the following topics.

2.3 Reference Region

The reference region is the spatial boundary where rates, agents, vectors and land use and cover patterns are analyzed, projected into the future and monitored. The Project area, leakage belt and leakage management area are contained in the reference region (Figure 3).

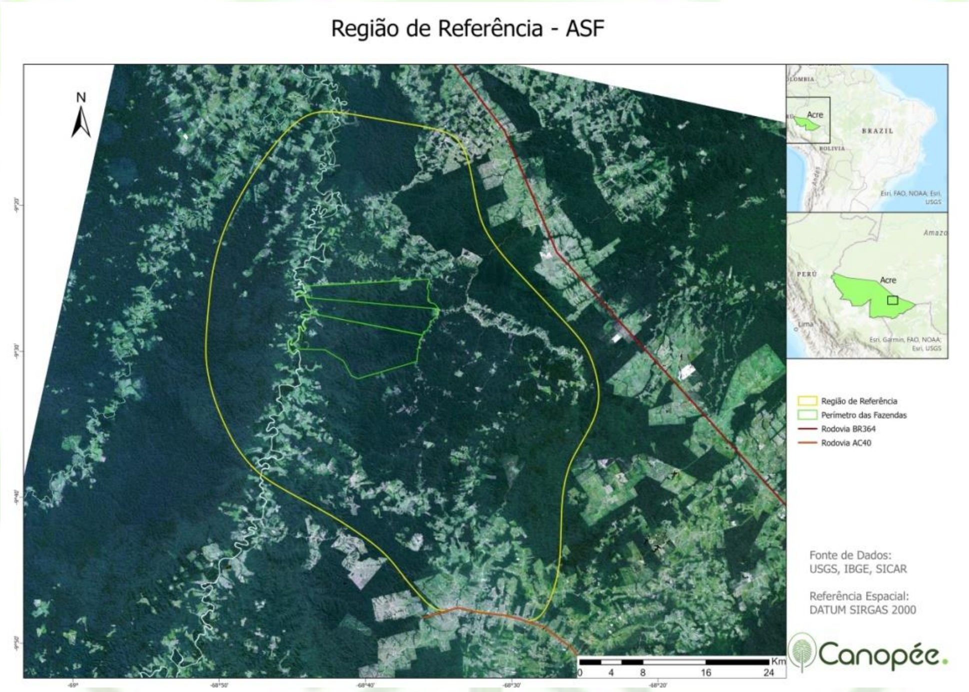


Figure 3. Location of the Reference Region and Project Area

As detailed above, the project area is located entirely in the northeast of the State of Acre, in the municipality of Sena Madureira, which is on the list of regions with increased land tenure conflict, expansion of livestock and a history of increasing deforestation rates.

The project area is located south of the city of Sena Madureira, where it is also influenced by the intensification of urban expansion in the territory of Rio Branco, capital of the State, the largest urban center in Acre and the small town of Bujari, located between Rio Branco and Sena Madureira, and which is in progressive development.

In defining the spatial limits of the reference region, ecological, geographic, environmental and human characteristics were considered, such as vegetation cover typology, relief, vectors of deforestation direction and land tenure situation.

The reference region was delimited by a continuous buffer around the project area, covering 212,213 hectares (two hundred and thirteen thousand, two hundred and thirteen hectares), which is equivalent to more than thirteen times the project area. According to INPE's PRODES data, it has a historical deforestation rate (between 2005 and 2020) of 2,106 ha per year (-0.988% per year – in relation to the remaining forest area in 2005).

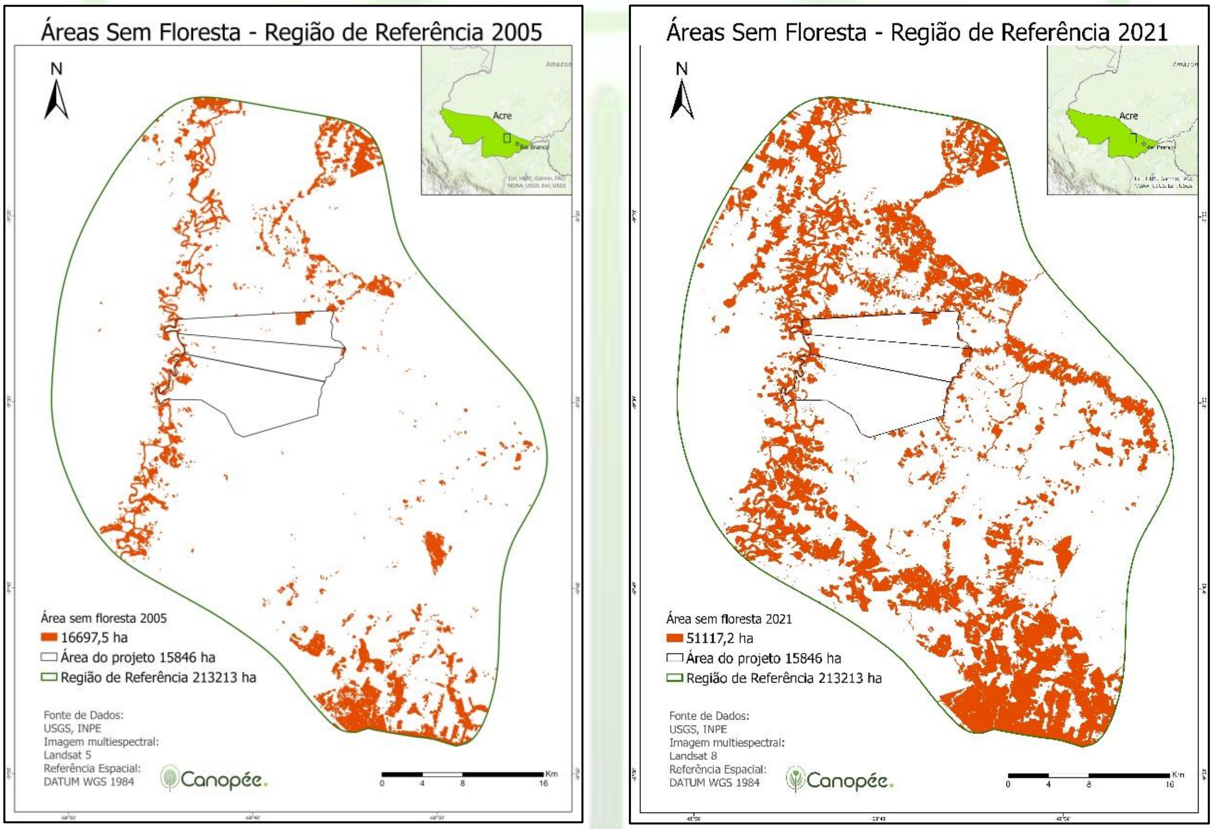


Figure 4. Areas without forest in the Reference Region and Project Area in the years 2005 and 2021

The delimitation of the reference region covered all agents and vectors responsible for the deforestation pressure on the project area, as will be discussed in the topic of deforestation vectors.

Like several other regions present in the so-called arc of Brazilian deforestation, the RR of this project has shown an exponential increase in deforestation in the last 30 years. In 1995, 10 years after the approval of the first PMFS and the beginning of this project, the RR had almost 100% of its area fully covered by native forest.

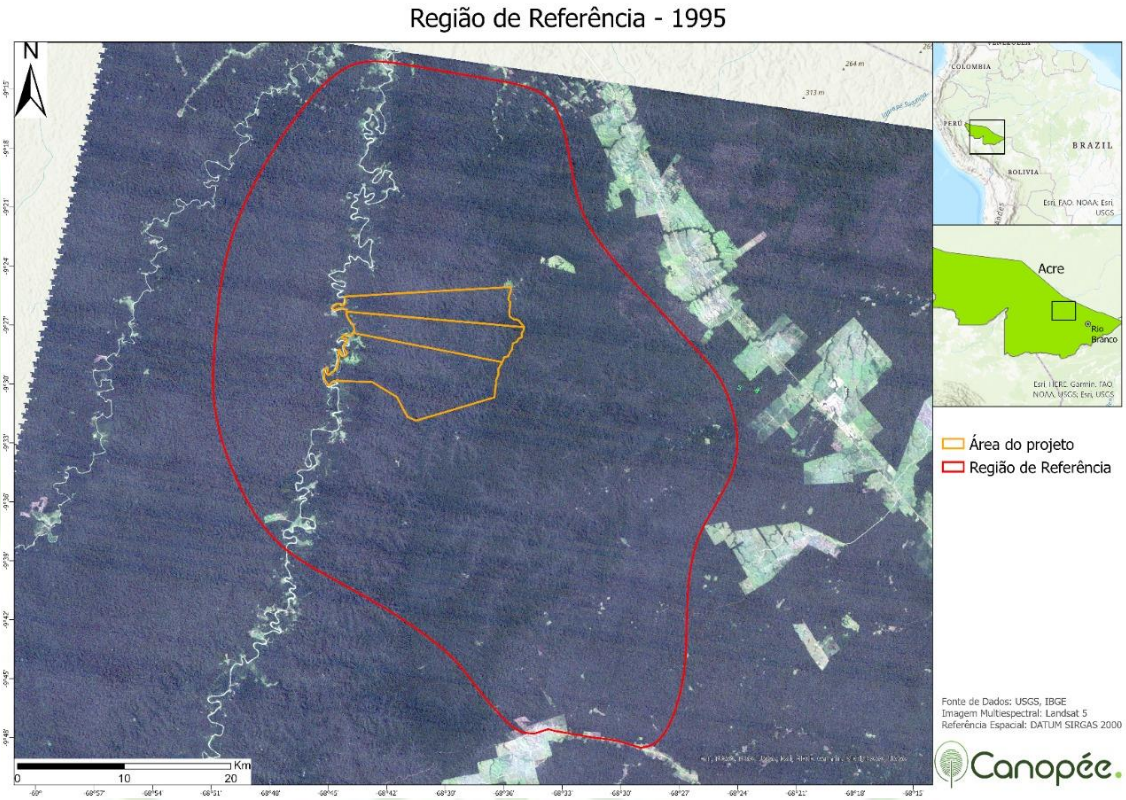


Figure 5. Reference Region in 1995

The characteristics of the delimited Reference Region meet the requirements of similarity with the project area determined by the Greenhouse Gas Emissions Reduction methodology developed by Bureau Veritas, presenting the following characteristics:

2.3.1 Landscape Configuration and Ecological Conditions

Forest types: The reference region has four different forest typologies (Figure 6). Table 6 shows the vegetation typologies in the reference region, ordered from largest to smallest area in hectares. While Table 7 presents the vegetation typologies found in the Project Area, where three typologies are presented, similar to those found in the Reference Region. The vegetation classes found in the project area occupied 100% of the Reference Region. Based on these results, it is believed that the requirement that at least 90% of the project area have forest classes found in at least 90% of the reference region is met.

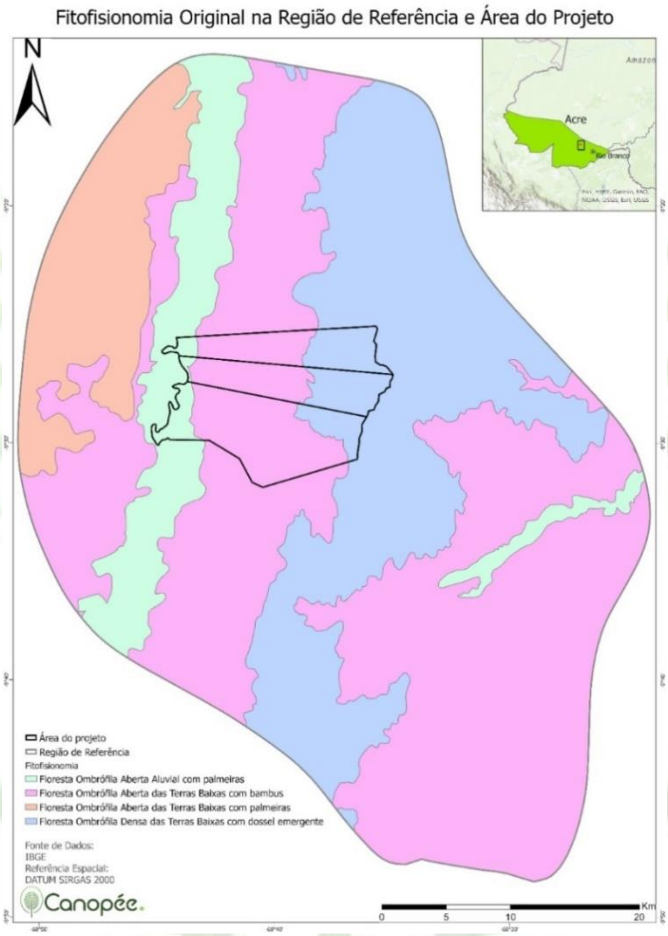


Figure 6. Original Phytophysiognomy of the Reference Region and Project Area.

CLASS OF VEGETATION	Reference Region			
	AREA (ha)	% do Total	% Accumulated	Rank

Lowland open rainforest with bamboos	103.014,46	52,22	52,2262,34	1
Lowland Dense Ombrophilous Forest with emerging canopy	53.916,59	27,33	79,55	2
Lowland open rainforest with palm trees	20.604,43	10,44	89,99	3
Alluvial open rain forest with palm trees	19.741,52	10,01	100	4
TOTAL	**197.277,00**	**100**	**-**	**-**

Table 6. Main forest typologies identified in the Reference Region.

CLASS OF VEGETATION	Project Area			
	AREA (ha)	% do Total	% Accumulated	Rank
Lowland open rainforest with bamboos	9.934,00	62,34	62,34	1
Lowland Dense Ombrophilous Forest with emerging canopy	4.741,70	29,75	92,09	2
Alluvial open rain forest with palm trees	1.260,30	7,91	100,00	3
TOTAL	**15.936,00**	**100,00**	**-**	**-**

Table 7. Main forest typologies identified in the Project area

2.3.2 Climate

The dominant climate in the project area belongs to group A (rainy tropical climate) of its classification system. It is characterized by having average temperatures of the coldest month always above 18°C, a limit below which certain tropical plants do not develop. This condition allows for the existence of megathermal vegetation, which requires constantly high temperatures and copious rainfall (Brasil, 1976).

It covers the climate type Am (monsoon-type rains), presenting a dry season of short duration that, however, has no significant influence on the behavior of the vegetation, as a result of the high precipitation totals that allow a uniform and sufficient distribution of moisture. necessary for the development and maintenance of tropical forests.

The climate type Am is defined as follows:

1) The driest month has average rainfall < 60mm;

2) The project area exhibits very little monthly and annual temperature variation, ranging between 24.2°C and 26.5°C as a monthly average, the minimum temperature is always > 18°C.

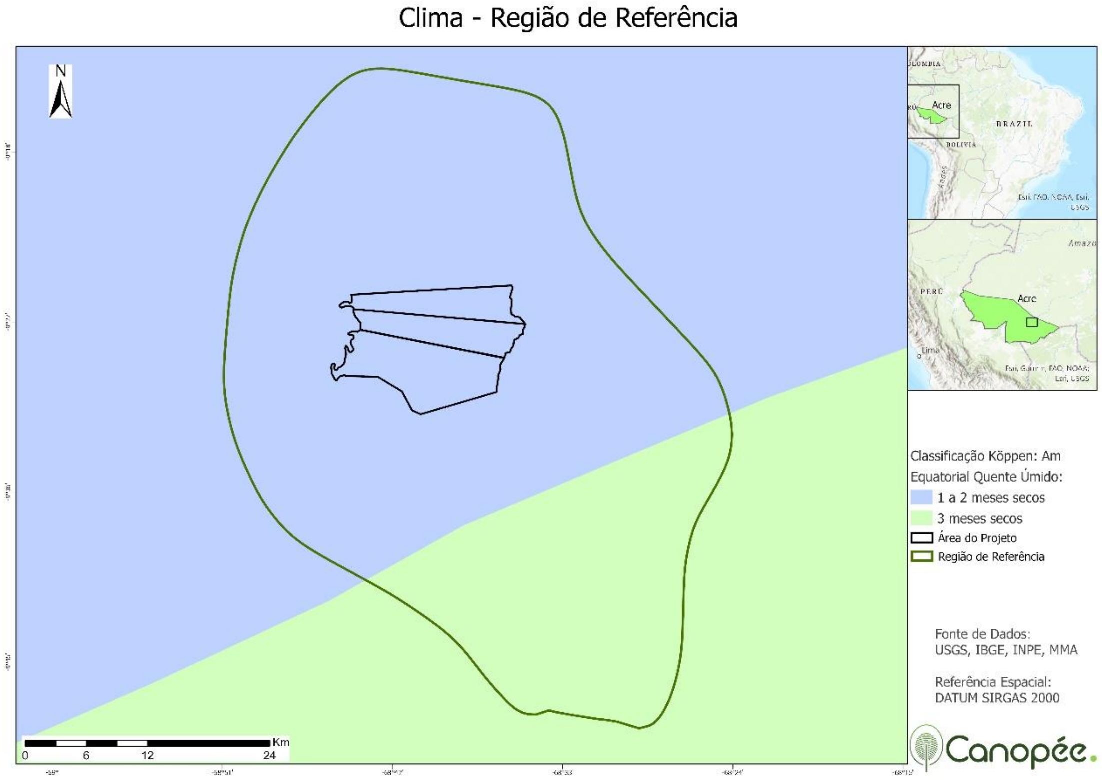


Figure 7. Climate of the Reference Region and Project Area

The project area is located in the southwest region of the Amazon, where between April and July, polar cold fronts coming from the Andes Mountains can lower the temperature to 12°C with a duration of three to eight days. However, climatological data record annual average temperatures ranging between 24.5°C and 25.5°C, with July being the coldest month, with an average of 23.3°C and October the hottest, with an average of 25. 8°C. These data demonstrate the small thermal amplitude of the region.

The average annual rainfall in the project region is 2062mm, with two well-defined seasons: rainy (November to May) and dry (June to October). Relative humidity is at high levels throughout the year, with monthly averages around 80-90%, without significant fluctuations throughout the year (BRASIL, 1976).

2.3.3 Hydrography

The hydrographic network of Acre is quite expressive, it has extensive rivers that are spatially well distributed within the State, with courses directed towards the southwest and northeast pointing to the Amazon River.

The Iaco River that passes through the reference region is part of the Purus River watershed. The Purus River watershed is located in the south-western portion of the Amazon. This basin is the fourth largest in extension (370,000 km²) among the seven tributary basins on the right bank of the Amazon River, and covers territories in Peru, Bolivia and Brazil. Its approximate area in Brazilian territory corresponds to 354,000 km² distributed in 32 municipalities in the states of Acre, Amazonas and Rondônia (ANA, 2011).

With a total population of 668,236 inhabitants and an average density of 4.5 inhab./km² (IBGE, 2010), population densities in the Purus River basin are concentrated along the banks of the rivers, a consequence of the history of spatial organization associated with the rhythm river, forest extraction, and agriculture (ACRE, 2010; RAVENA, 2011; AMAZONAS, 2012). The areas with the highest population concentration are located between the upper and middle reaches of the basin, where logging and commercial activities take place. In the lower course, an economic dynamic that is even more directly linked to the river predominates (eg fishing and seasonal plantations in floodplain areas) and most of the 23 Conservation Units and 39 Indigenous Lands in the basin are concentrated (SOUZA, 2012; MMA, 2013; INCRA, 2013).

The region's hydrological regime is characterized by a period of floods, which is related to the rainy season, and another of drought, corresponding to the dry period. Most rivers in the region are navigable only about six months a year (rainy season), due to the lower water level during the dry season, and are oriented in a south-north direction.

Inside the Fazendas complex, there are no major rivers, but there are several streams well distributed throughout the area that flow into the Iaco River. Figure 8 below shows the hydrography in the project area and reference region.

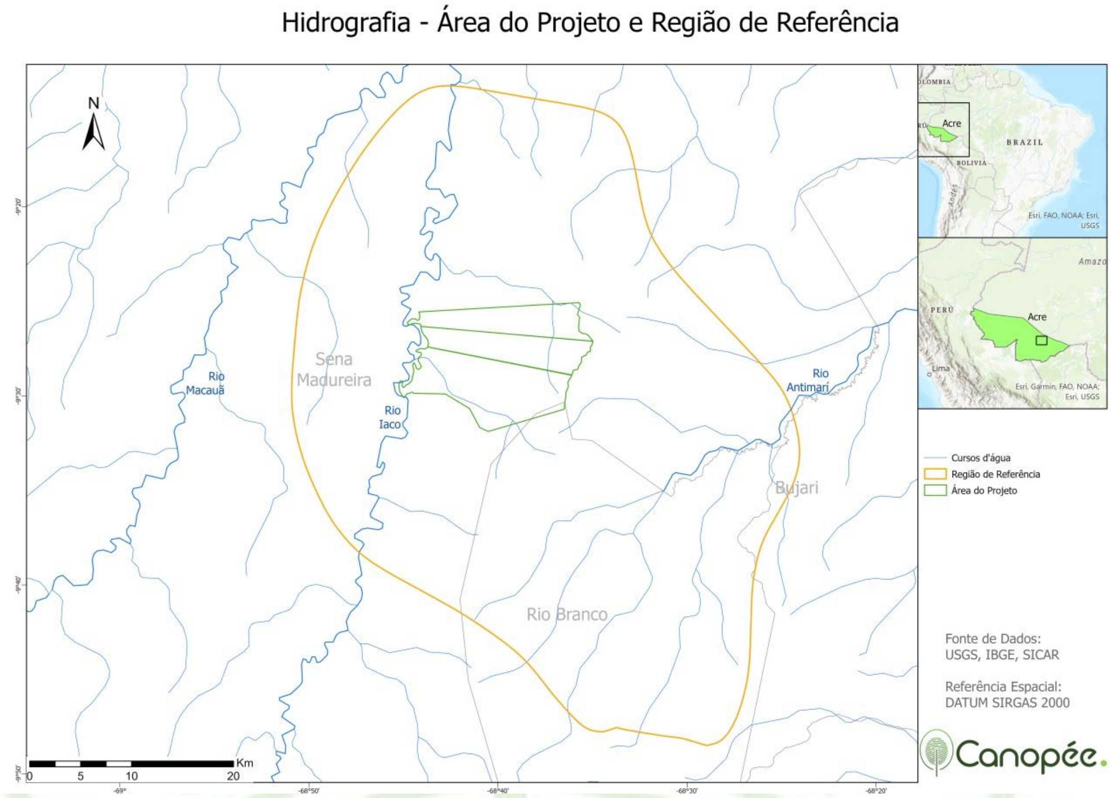


Figure 8. Hydrography in the project area and in the reference region

2.3.4 Geology, Topography e Soils

In the project region, the Solimões Formation occurs, which transgresses over portions of the Acre and Alto Amazonas basins (BRASIL, 1976).

In the region, two very distinct morphological features are also observed, with the presence of low plateaus with low density dendritic drainage that indicate, in terms of photointerpretation, regions with permeable sediments in contrast to others where a denser drainage is observed, indicative of terrain. more impermeable which suggests the predominance of silite-clay sediments, resulting in more dissected landforms. In general, in these areas these phenomena are well discernible and present with a sudden drop when passing from one surface to another.

The type of rock found in this area is classified as sandstone, which is composed of angular and sub-rounded grains of medium and fine sand size, cemented by essentially limonitic material that gives the rocks reasonable cohesion (BRASIL, 1976).

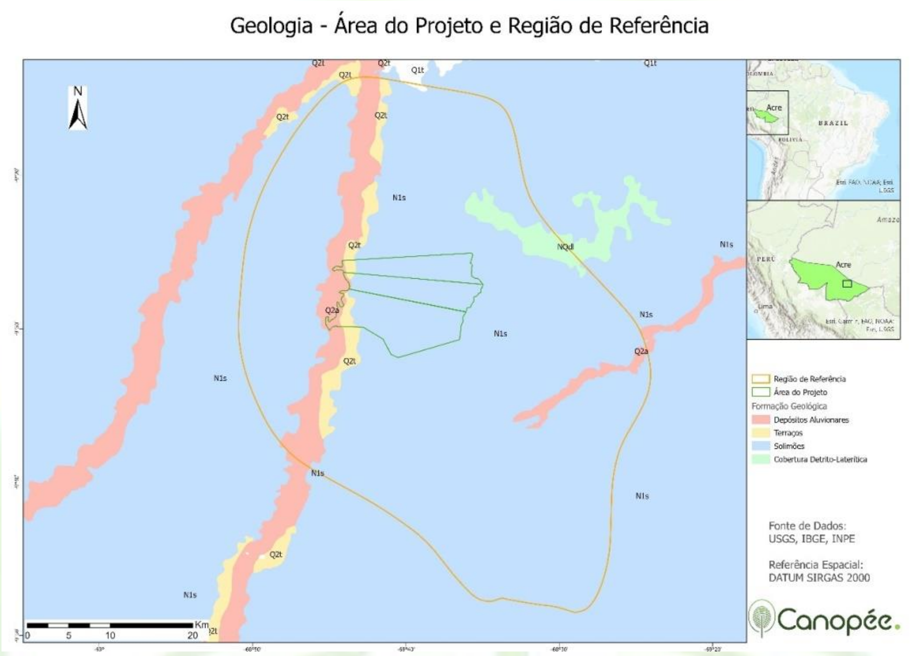


Figure 9. Geological domains in the project area and reference region

The Solimões Formation is composed of sandy and clayey-clay sediments. The floodplain formation is present along the rivers and is composed of alluvial sediments of sand, silt and clay.

The Solimões Formation is basically composed of two distinct morphostructural units: the Lower Plateau of the Western Amazon and the Rio Acre - Depression of the Javari River. The project area is located within the structural unit of the Depression Rio Acre - Rio Javari. The latter is an extensive recessed surface located between the Acre and Javari rivers. The average altimetry is around 200m and the topography does not show major irregularities.

Generally, the aforementioned Depression comprises high activity clays, in which the predominant vegetation cover is open forest with the presence of bamboo, with some areas of dense forest. It is drained by large rivers within the Purus River basin. In addition, this morphostructural unit presents a vast area of fertile soils, classified as red-yellow podzolic and gleyhydromorphic soils.

Red-yellow podzolic soil makes up most of the project area, forming a non-hydromorphic soil class and presenting a dark red color. This type of soil is derived from the weathering of basic rocks, rich in iron and magnesium oxides. In addition, its texture varies from clayey to very clayey, presenting a porous characteristic.

The gleisol generally has a clay-silt texture and high fertility, usually supporting a floodplain or alluvial forest.

The Várzea Formation predominates in less than 5% of the total project area, concentrated in its western portion. Most of the area within this geological formation rests on sedimentary substrate, part of which is periodically flooded during the rainy season, forming alluvial plains or alluvial forest areas.

There are four main geomorphological formations within the project area, detailed in Figure 10 below.

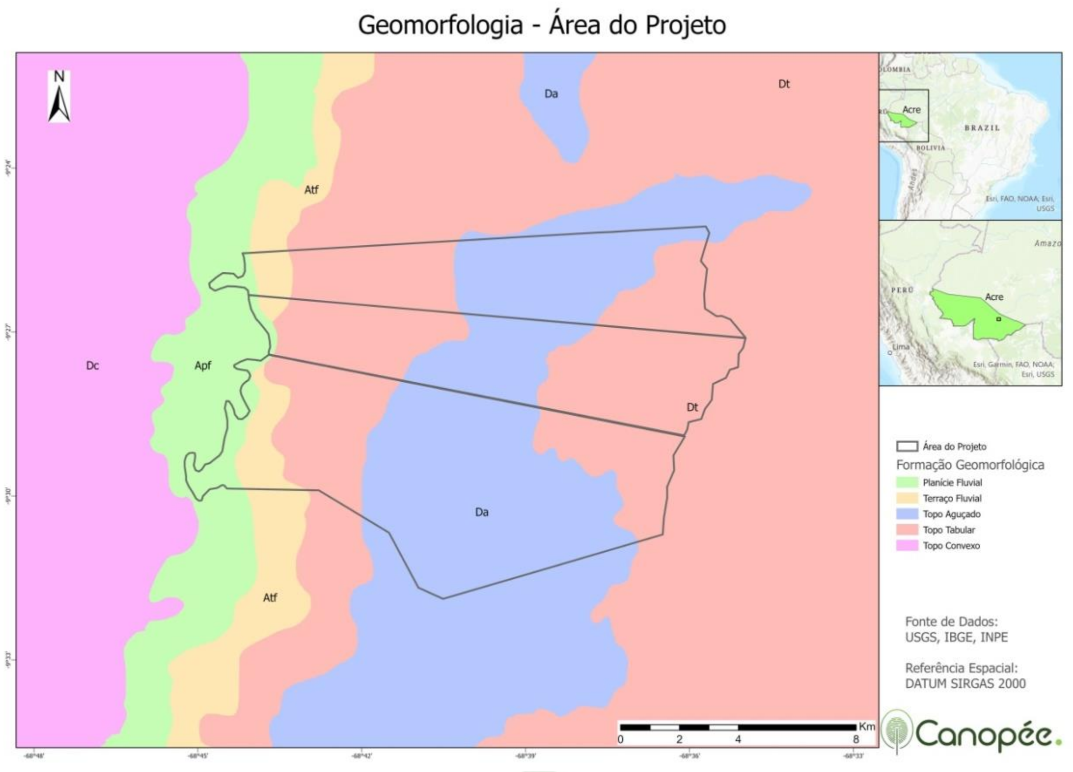


Figura 10. Domínios geológicos da área do projeto

The topography of the area of the Fazendas complex has a shallow dissected relief, represented by the following geomorphological formations:

- Hills: they have a slightly convex top relief, with drainage in different orders of magnitude and depth, normally separated by shallow valleys (Brasil, 1976). Hills are predominant landforms in the area.
- Crests: they have a continuous and sharp top relief, with different orders of magnitude and drainage depth, separated by "V" valleys and eventually flat bottom.
- Flat areas resulting from river accumulation and deposition, periodically or permanently flooded.

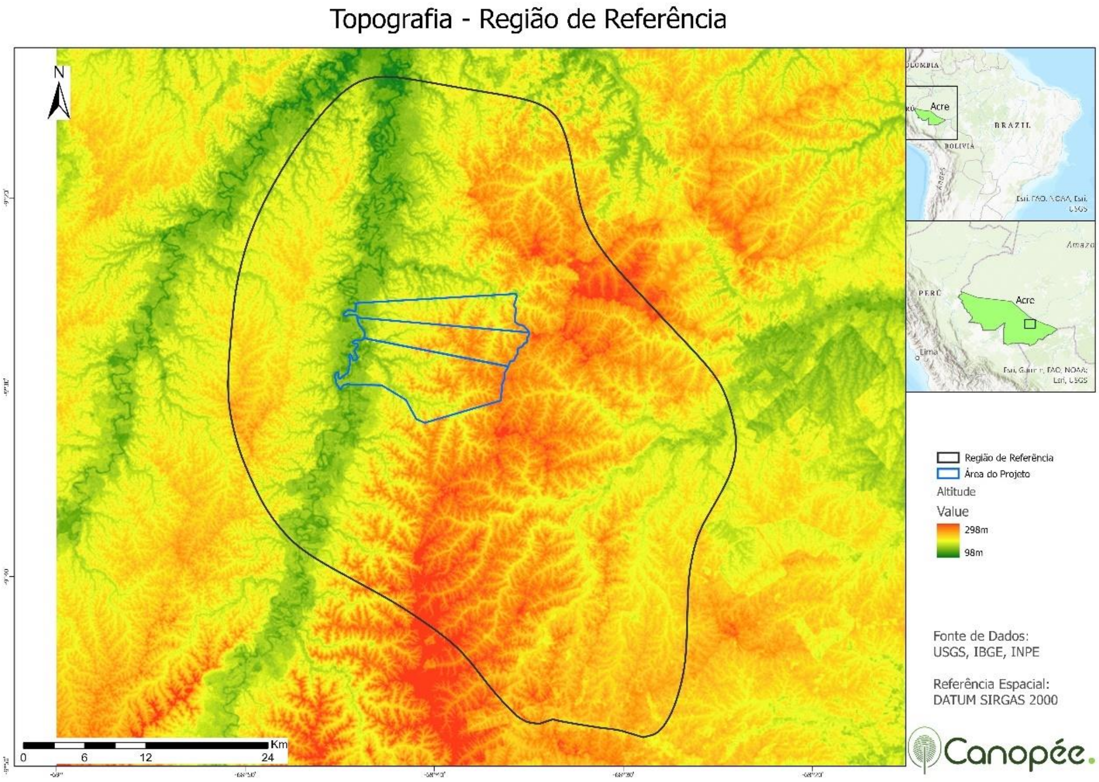


Figure 11. Topography of the project area and reference region

The altitude variation in the reference region is relatively low. The highest parts of the project area do not exceed 298m above sea level, with values between 98m and 298m, with the central and eastern portions of the project area showing the highest values.

2.3.5 Deforestation agents

The agents of deforestation observed in the reference region are mainly linked to the expansion of urban limits, agricultural practices, illegal occupation of land, conversion of forests for extensive livestock and illegal logging. The pattern of occupation of the reference region has characteristics of high density of properties, with occupations most of the times grouped and distributed along the main access roads of the region (roads, branches and rivers). Deforestation agents with this profile can be found throughout the southwestern Amazon;

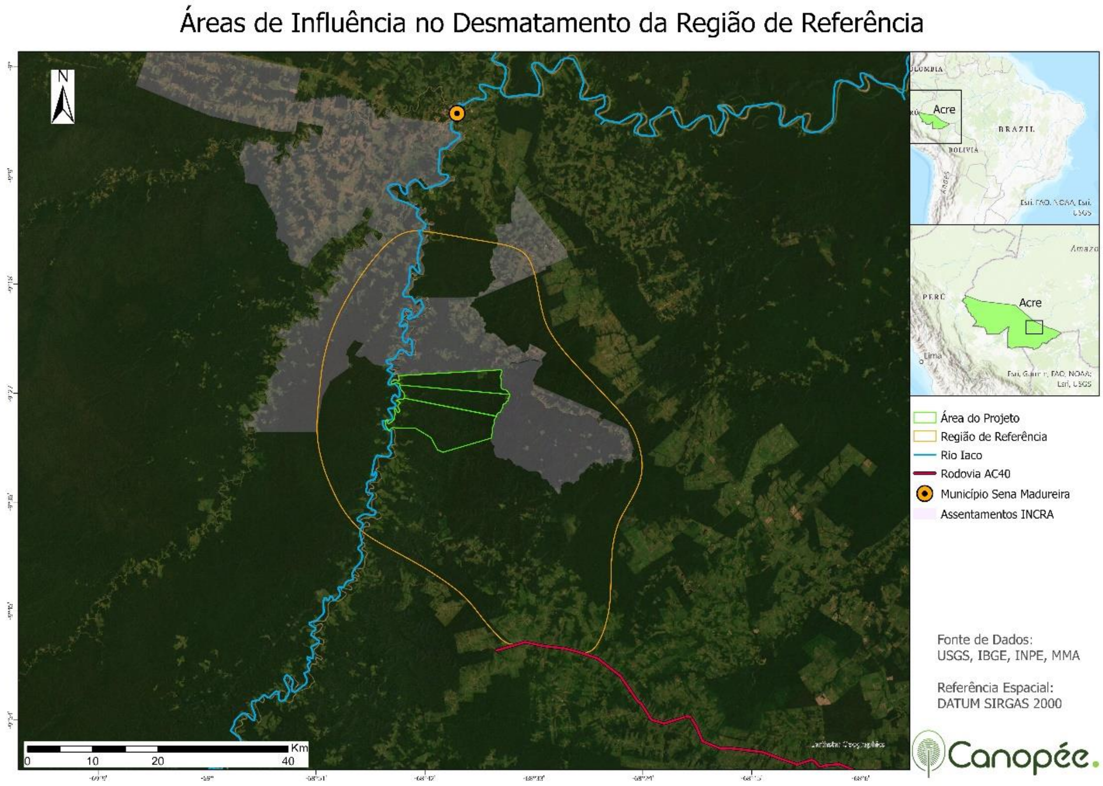


Figure 12. Areas of influence on deforestation in the Reference Region

As illustrated in the map above, it is possible to identify the action of four main deforestation agents putting pressure on the project area. Are they:

Settlements

The direct vectors that cause deforestation in settlements and conservation units are extensive cattle ranching and illegal logging, followed by the practice of slash-and-burn agriculture. In certain areas, these vectors are strengthened by the difficulty of accessing various public policies, such as technical assistance, credit, basic infrastructure for the production and commercialization of agroforestry products (ACRE, 2010).

In these areas, it is common to raise cattle in a partnership system with breeders who need more pasture. In addition, forming pastures also adds value to the land for future sale. The herds in the region are characterized by being raised for the purpose of cutting on large farms, and by the breeding facility intended for cutting and milking in areas of settlement projects (ACRE, 2010).

The deforestation of the settlements located south of the BR-364 highway, exert direct pressure to the north and east of the project area, being the main responsible for the deforestation of areas that border the farms in these regions.

Expansion of Sena Madureira

The unplanned population growth and consequent expansion of the urban area of the municipality of Sena Madureira, that is, in a concentrated way, without concern for the distribution of its impact on the use of resources, has been forming vectors of deforestation directed to the northwest of the project region, can be characterized as an important threat to the forests of this region of the RR. The population increase is due both to the growth of families that already reside in the municipality, and to the entry of new residents.

Roadside

Historically, paved roads in the Amazon along its path cause impacts of 50 km on each side of its main axis. The main drivers of this impact are deforestation caused by the economic activities of livestock, small and large-scale agriculture and logging (Nepstad, et al 2006).

The paving of AC-40 (TransAcreana), allocated to the south of the Project area, promoted the opening of new deforestation fronts in the country, with vectors directed to the farms. The great intensity of deforestation on this highway can be explained by its proximity to the BR-364 that connects the main cities in the state of Acre with the ports of the Pacific Ocean in Peru.

Iaco River Bank

In general, the distribution of deforestation in the state is related to the structure of territorial occupation, concentrating mainly in Southeast Acre, around urban centers and along the hydrographic networks (large rivers).

The Reference Region has the presence of the Iaco River, which is an important asset for the region's logistics as it is navigable for most of the year and serves as a transport for products and the riverside population, having important navigable stretches even in the dry seasons.

Through the identification of agents and the historical analysis of the behavior and progress of deforestation in the reference region, it is possible to define the vectors of deforestation in the region towards the project and their weights.

The weight of a vector is related to the geometric center of the deforested areas added between 2005 and 2021 and its relative distance to the limits of the farms, in addition to the proximity of the agent itself.

It is possible to note the proximity of the center of the different dynamics of historical deforestation in the region (marked by the red dots in the figure above) in relation to the limits of the project area, as well as the adjacent presence of settlements and the Iaco River. The consequence of this is the greater influence of these vectors on the northern, eastern and western limits of the project farms.

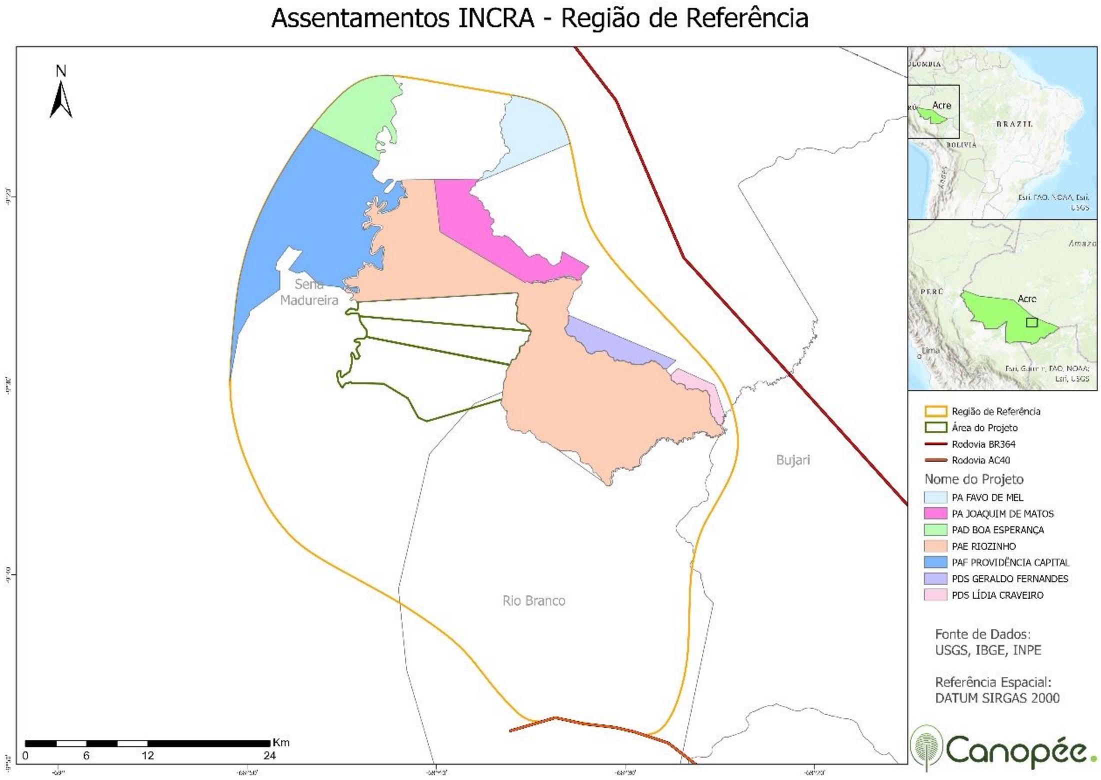
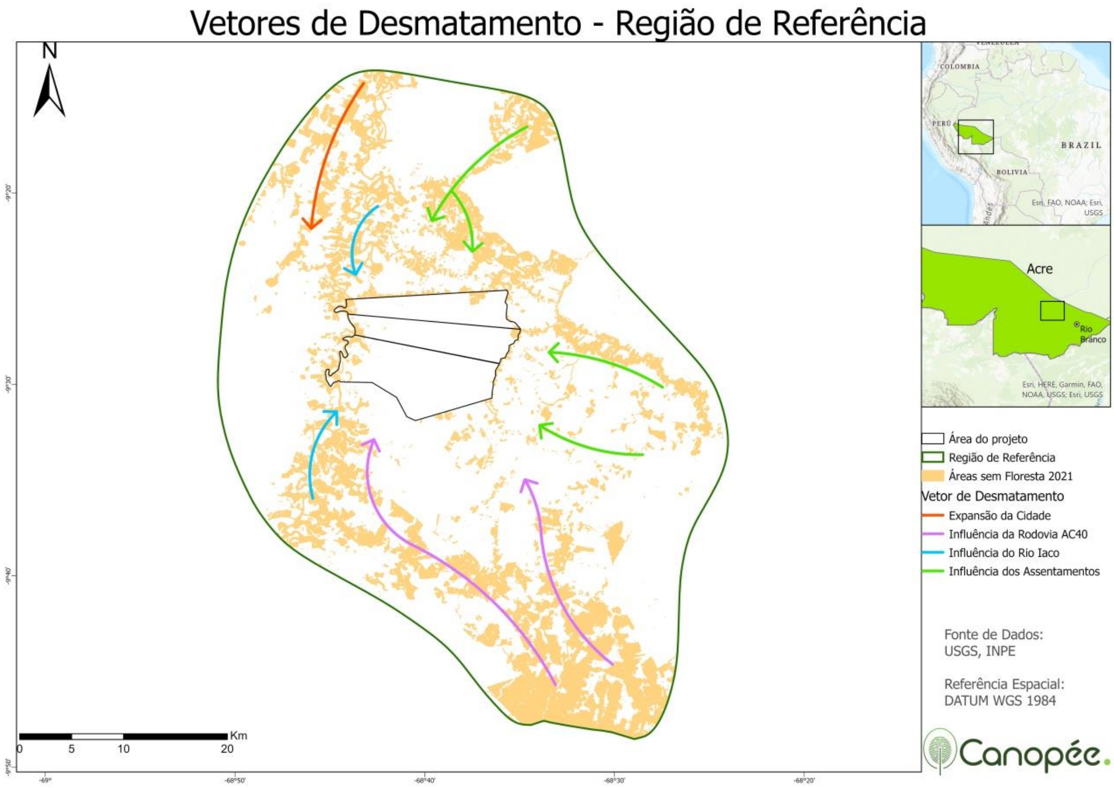


Figure 13. Settlements allocated in the reference region



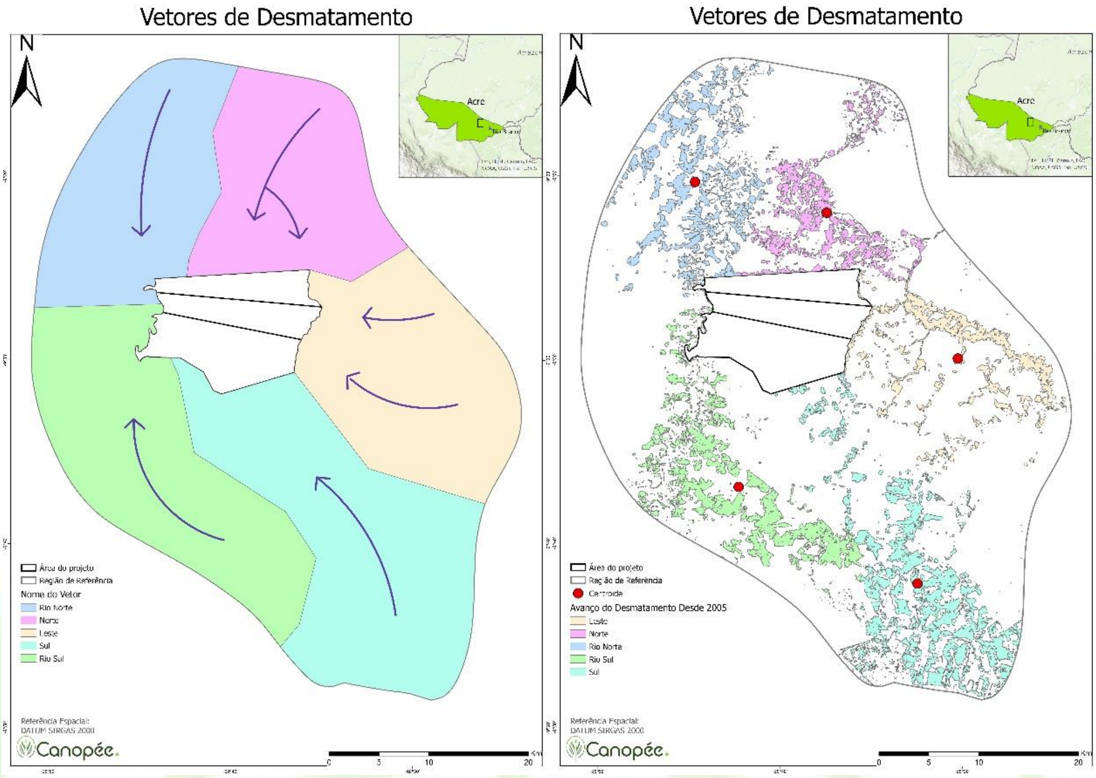


Figure 14. Deforestation vectors in the reference region

3. PROJECT EMISSIONS CALCULATIONS

3.1 Historical Analysis of Deforestation

The historical analysis and quantification of land use change, ie the historical rate of deforestation, is determined by analyzing the change in forest cover in a time series of classified satellite images of the reference area since the beginning of the project. The quantification process starts with an analysis of the spatial change of vegetation cover in the reference region. The dynamics of deforestation in the region over time was observed, from the start date of the project in 2005 to the present day, in 2021.

Through the annual historical analysis, the calculation of the increase in deforested areas in each year is made. From these historical deforestation data, it is possible to generate an equation to quantify future deforestation in the region, up to the end date of the project.

To analyze the spatial changes, multispectral satellite images were used, which underwent classification and quantification of the deforested areas.

3.2 Emissions from the Reference Region

The estimation of GHG emissions in the reference region is made by quantifying the net changes in baseline carbon stock (i.e. emission factors) which are determined by the baseline pre-deforestation stock in all the relevant reservoirs.

As described above, the analysis of the phytophysiognomies present in the reference region of the project showed the presence of 4 different typologies, with different representations in terms of area.

CLASS OF VEGETATION	Reference Region + Project Area			
	AREA (ha)	% of Total	% Accumulated	Rank
Lowland open rainforest with bamboos	112.948,46	52,97	52,97	1
Lowland Dense Ombrophilous Forest with emerging canopy	58.658,29	27,51	80,49	2
Lowland open rainforest with palm trees	20.604,43	9,66	90,15	3
Alluvial open rain forest with palm trees	21.001,82	9,85	100,00	4
TOTAL	**213.213,00**	**100,00**		

Table 8. Vegetation classes found in the reference region and project área

CLASS OF VEGETATION	Região de Referência			
	AREA (ha)	% of Total	% Accumulated	Rank
Lowland open rainforest with bamboos	103.014,46	52,22	52,22	1
Lowland Dense Ombrophilous Forest with emerging canopy	53.916,59	27,33	79,55	2
Lowland open rainforest with palm trees	20.604,43	10,44	89,99	3
Alluvial open rain forest with palm trees	19.741,52	10,01	100,00	4
TOTAL	**197.277,00**	**100,00**	**-**	**-**

Table 9. Vegetation classes found in the reference region

The carbon stocks of the reference region were calculated based on the biomass values of the study presented in Table 10 below. The study in question was carried out in the State of Acre, covering all types of forest that occur in the reference region, and sought to establish an average biomass value (above ground) for each stratum studied. The results of this study were also compared with those of Nogueira et al. (2008) and Saatchi et al. (2007), presenting very similar conclusions. The cited studies obtained these values through inventoried remote sensing, wood volumes and allometric equations, using data from the Amazon region.

These data were chosen after a literature search revealed that these studies had the most accurate biomass values for the vegetation cover of the Project's reference region. Aboveground biomass estimates in the Brazilian state of Acre were mainly based on remote sensing methodology performed by Saatchi et al. (2007) and Nogueira et al. (2008), through the use of sophisticated methods of estimating biomass through detection. These three aboveground biomass estimates from the literature showed very similar results for the State of Acre.

The average biomass stock per hectare was calculated for each project boundary (reference region, project area and leakage belt) and for each vegetation group using the weighted average.

Belowground biomass values were estimated at 24% of aboveground biomass, according to the conversion values adopted worldwide and recommended by the IPCC (root-to-shoot ratio of 0.24 for tropical forest with above-ground biomass values), soil above 125 ton/ha, and 0.20 for values below 125 ton/ha).

The following table describes the biomass values considered in each phytophysiognomy:

CLASS OF VEGETATION	Aboveground biomass (Mg/ha)	Below ground biomass (Mg/ha)	Total biomass (Mg/ha)
Lowland open rainforest with bamboos	274,20	65,81	340,01

CLASS OF VEGETATION	Aboveground biomass (Mg/ha)	Below ground biomass (Mg/ha)	Total biomass (Mg/ha)
Lowland Dense Ombrophilous Forest with emerging canopy	328,80	78,91	407,71
Lowland open rainforest with palm trees	303,10	72,74	375,84
Alluvial open rain forest with palm trees	218,50	52,44	270,94

Table 10. Biomass stored in each physiognomy of the reference region

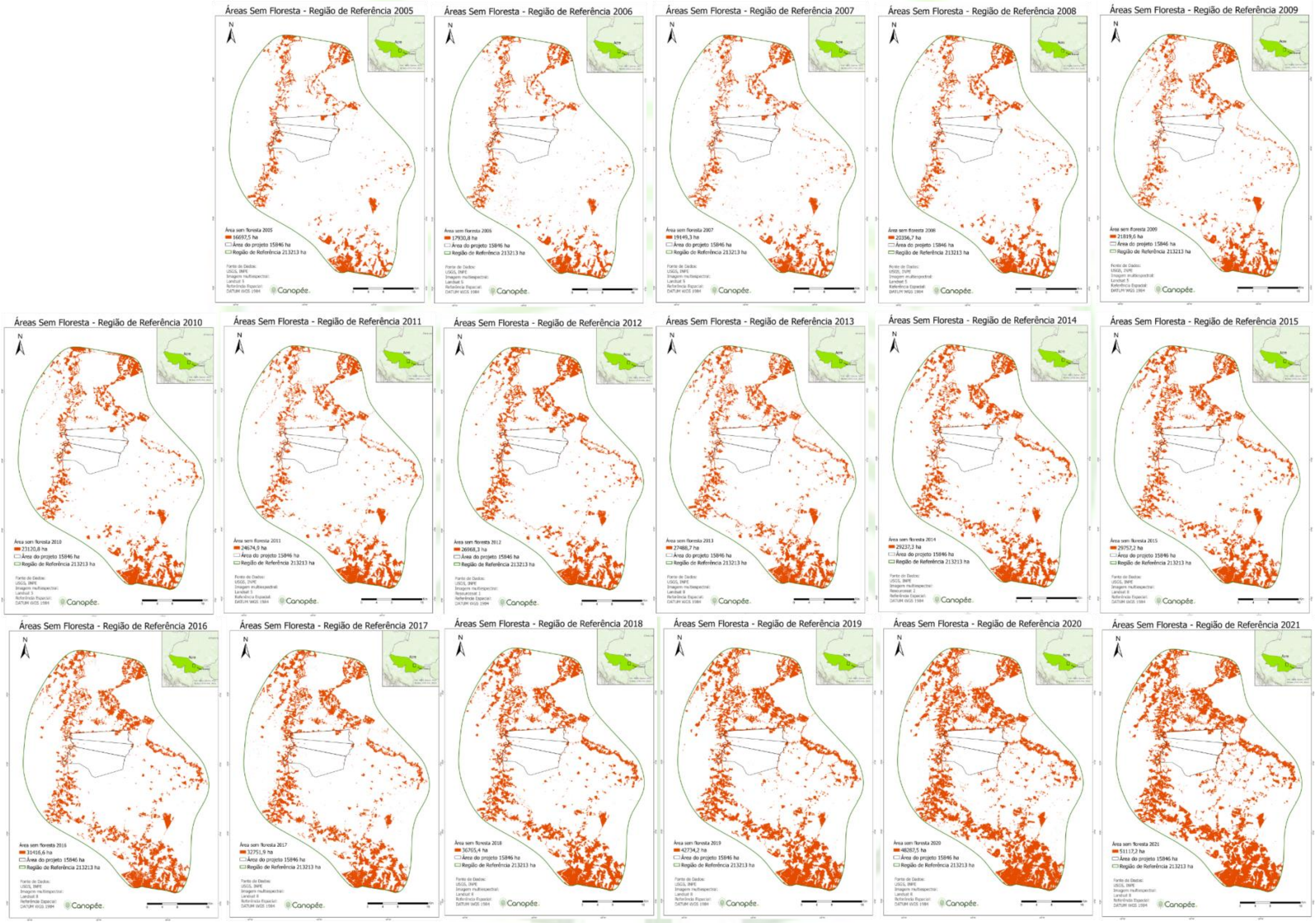


Figure 15. Deforested areas in the reference region from 2005 to 2021

Through the analysis and classification of the images, the deforested area in each phytophysiognomy of occurrence in the reference region was calculated. The deforested areas were converted into equivalent biomass values according to the literature data previously presented. The values below already represent the net area, considering and annually discounting the areas of similar phytophysiognomies deforested within the project area.

This historical analysis, being carried out 16 years after the beginning of the project protection actions (PMFS), also represents the most faithful baseline possible, defined according to real observations and analysis, rather than being based on projections. Therefore, this analysis allows us to categorically state that the project's protection actions were very effective since the same rate of deforestation and land conversion was not observed within the project boundaries, as will be demonstrated in the following topic.

The results indicate that the reference region lost 35,772.98 hectares of forest, which corresponds to about 16.5% of the total area. In terms of biomass, 10,034,388.28 Mg were lost above ground and 2,408,253.19 below ground, totaling 12,442,641.47 Mg of biomass. Applying the carbon fraction expansion factor of 0.47, 5,848,041.49 tons of carbon were emitted into the atmosphere, or 21,442,818.80 tons of CO2e.

The projection indicates an exponential increase in deforested areas in the reference region over the next 10 years, reaching up to 87,409.54 deforested hectares, corresponding to an emission of 46,818,406.48 tons of CO2eq into the atmosphere only during the project's term.

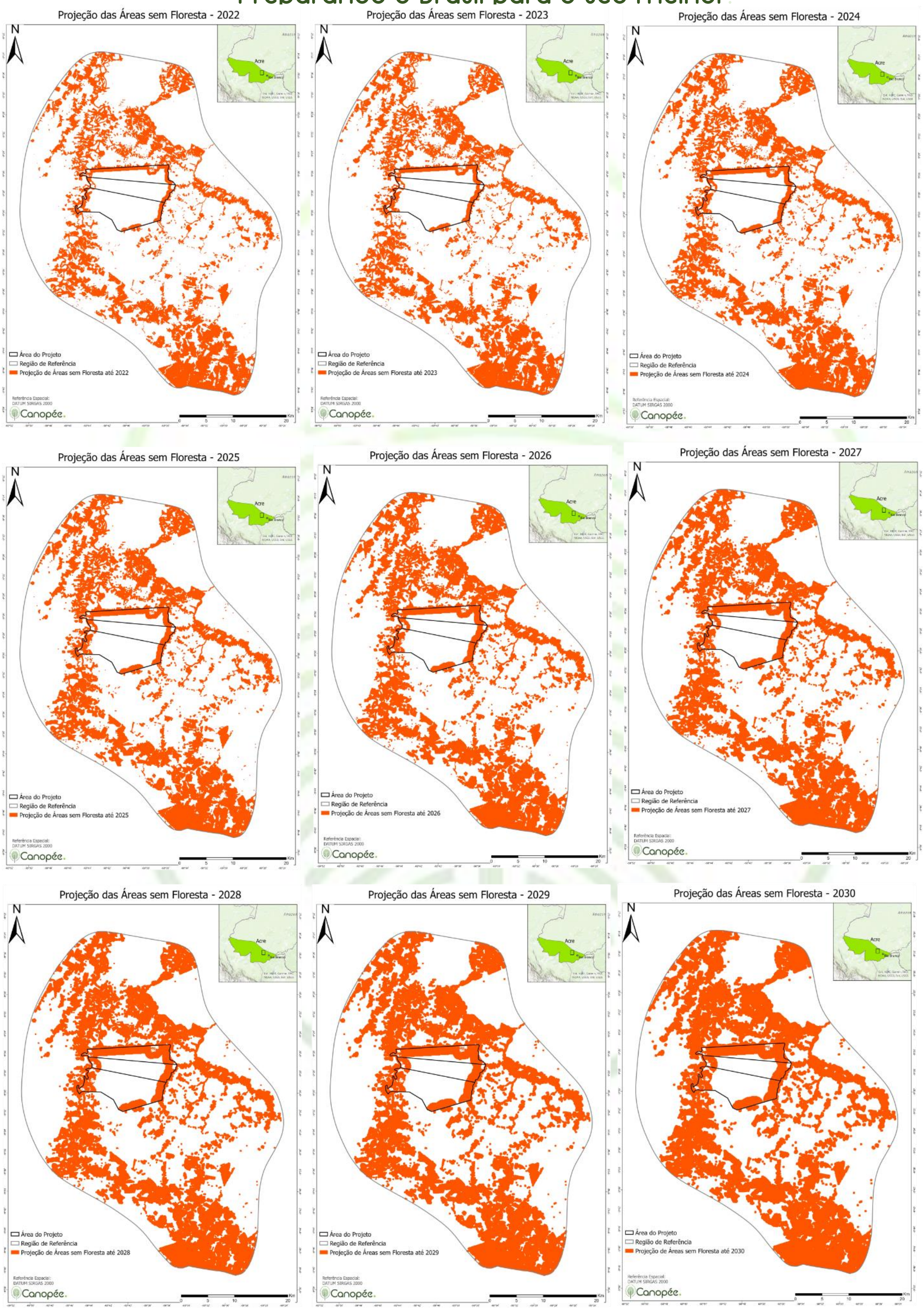


Figure 16. Projection of deforestation in the reference region and project region until 2030

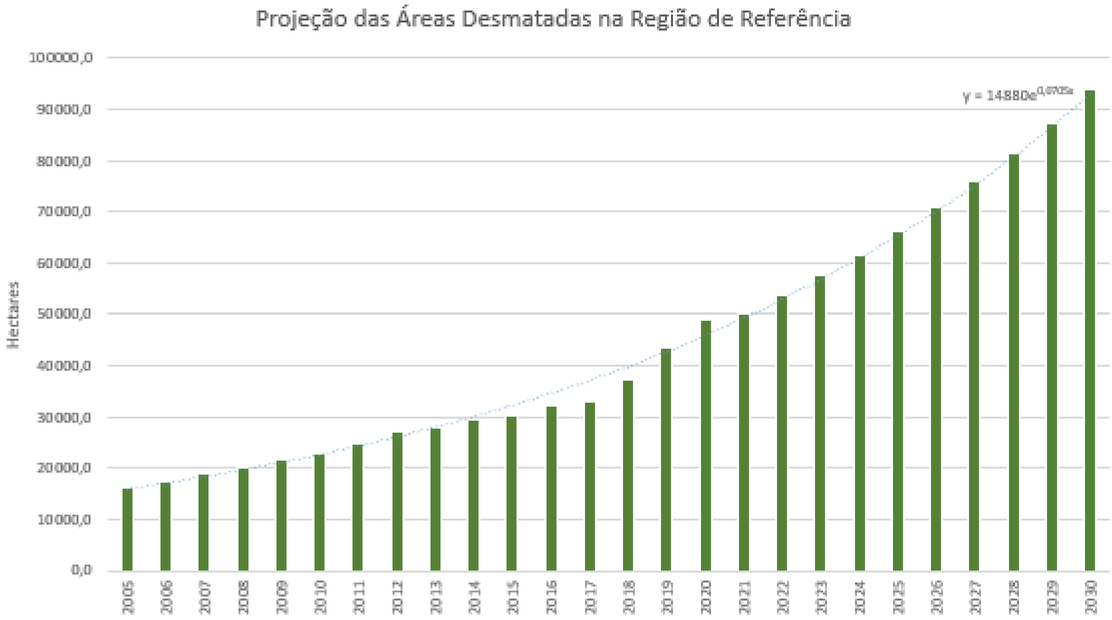


Figure 17. Projection of deforestation in the reference region and project region until 2030

3.3 Carbon Stock in the Project Area

3.3.1 Forest Census in the Project Areas

This greenhouse gas emission mitigation project started in 2005 with the implementation of the Sustainable Forest Management Plan and operation of UPA 1 at Fazenda São Jorge I. Jorge I, São Jorge II and at Fazenda Mucuripe.

The techniques and methods used to measure, monitor and estimate terrestrial carbon pools were based on commonly accepted principles of forest census based on the determination of the requested volume for annual exploitation in the Annual Operation Units (UPA), made through the request for Authorization of Exploration (AUTEX) and validated by IBAMA/IMAC in the annual exploration authorization. Thus, with the use of the forest census, it is possible to accurately determine the emissions and removals of greenhouse gases that are directly attributable to the project activities, and the methodology and results were audited by environmental agencies.

Unlike the forest inventory by sampling, the forest census identifies all forest species within a UPA and measures the DBH (diameter at breast height) and commercial height, as well as determining their location. In this case, and because it is a census, all trees are effectively identified and measured, including those found in permanent preservation areas. These measures, being audited by Organs environmental agencies, guarantee the maximum detail and precision in the determination of forest volumes, which are the basis for the determination of the project's carbon stocks.

Figure 18. Collaborators carrying out the forest census on the project farms

Thus, in the case of the project, all areas were effectively inventoried in the form of a census and the determination of the volume of stock actually measured. The measured value used in the carbon calculation is the average volume, calculated in m³/ha. The determination of carbon is made by the equation:

$$\boldsymbol{Y = Vol \times D \times BEF \times CF}$$

Where:

Y = aboveground dry matter in Kg/ha;

D is the average density of wood (in the tropical region and average around 0.995 kg/m3, and average values per species can be obtained in Vol 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories);

CF = Fraction of carbon in dry matter (in t C per ton of dry matter). Standard 0.47 overall and 0.49 for the woody part, and;

BEF is the commercial volume expansion factor for total tree volume calculated by the following equations

$$\boldsymbol{BEF = e^{(3{,}213-0.506\times\ln(Vol\times D))}, for\ Vol\times D < 190\ ton/ha}$$

(project case)

$$BEF = 1.13, for\ Vol \times D > 190\ ton/ha$$

The value determined by the equation informs the value in kg of carbon per hectare above ground. The inclusion of the belowground component is done by integrating the average component accepted for the Amazon forest, which is 0.24 (according to Vol 4 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories). The final carbon stock will be given by the sum of the fraction above and below the ground and that will have to be multiplied by (44/12) for conversion into CO2eq., to be used in the project.

Farm	Farm Area	Forest Area	Open area	Stock (CO2eq)	Average Stock (CO2eq)	Number of credit units
Mucuripe	7.633,52	7.289,02	344,51	3.590.070,87	492,53	7.747
São Jorge I	4.011,54	3.728,47	283,07	2.002.483,36	537,08	4.112
São Jorge II	4.200,71	4.032,25	168,46	1.921.860,04	476,62	4.315
Total	**15.845,77**	**15.049,74**	**796,04**	**7.514.414,27**	**502,08**	**16.174**

Table 11. Area of effective forest occupation and CO2eq stock. on each project farm

3.4 Balance of Project Emissions and Removals

From the calculation of GHG emissions and removals in the reference region and in the project area, it is possible to estimate the final balance of gases, resulting in the emission of carbon credits related to avoided emissions.

The balance of avoided emissions will be given by the balance expressed by the equation:

CC = [ERR*(AP/ARR)] - (EAP + NEE)

Where:

CC = carbon credits, in t/CO2eq

ERR = net emissions from the reference region, in t/CO

AP = project area, in hectares;

ARR = area of the reference region, in hectares.

EAP = net emissions from the project area, in t/CO2eq

NEE = net emissions from PMFS, in t/CO2eq

The net results indicate that 1,063,633.73 tons of CO2eq had their emissions avoided by the project's actions, between 2005 and 2021, with 2020 as the last reference year (monitored from July 2020 to July 2021).

Projections for the future of the project indicate that in 2030 the accumulated will reach 3,311,169.08 tons of CO2eq avoided from being emitted into the atmosphere, an increase of 2,247,535.35 tons of CO2eq in the next 10 years, to be verified and issued in future annual monitoring.

The future projection of the advance of deforestation in the project area was carried out through the use of the buffer tool in the deforestation areas of the RR that border the project limits, giving a geometric advance towards the interior of the farms. The resulting geometry was adjusted to provide accurate quantification of CO2 equivalent stocks protected for each year of the project, as the farm's internal stratification allows for the information on the CO2 stock per hectare. In this way, it became evident that in 2021, without the project's protection actions, about 32.16% of the avoided deforestation would have reached the Mucuripe Farm, while about 67.84% of the deforestation would have entered the São Jorge I and II.

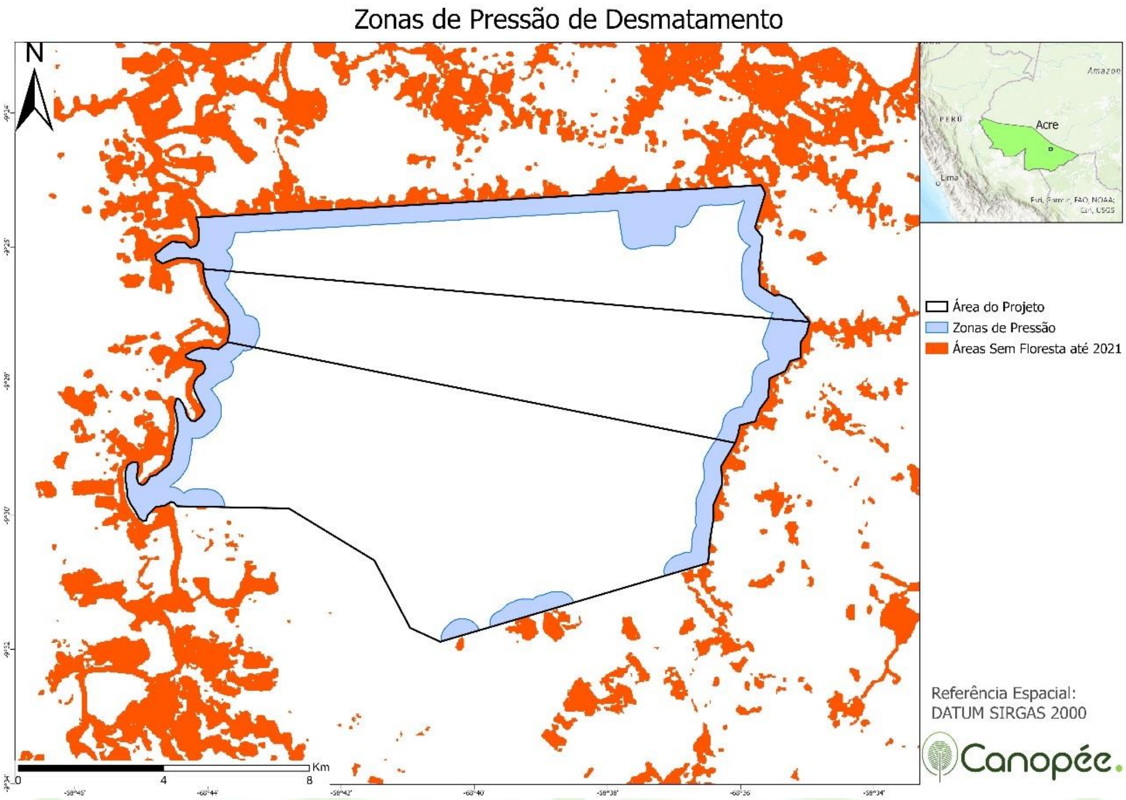


Figure 19. Deforestation pressure zones in the project area

The projection above indicates how deforestation would have progressed in the project region, in the absence of the project. The projections took into account the points of advance of deforestation in the region on the boundaries of properties, as well as the internal carbon stock per hectare.

In the following years, projections continue to advance towards the interior of the farms.

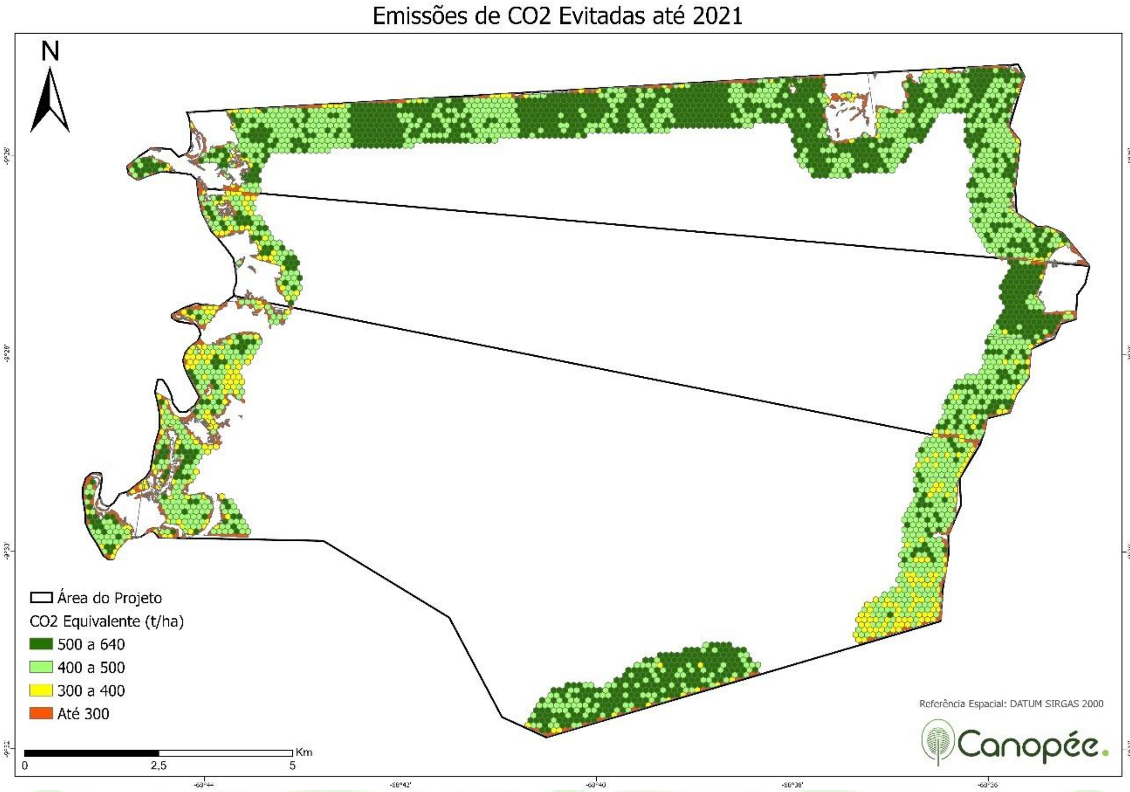
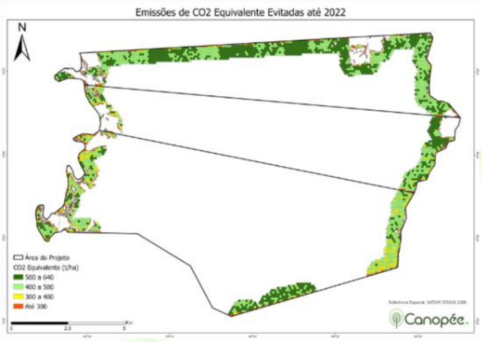


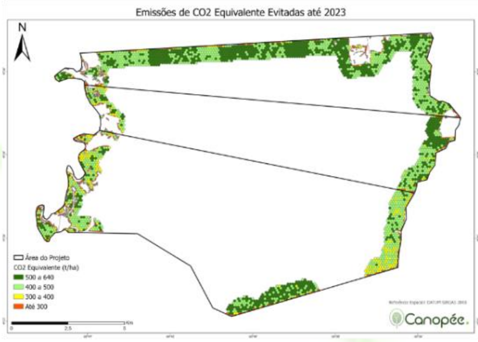
Figure 20. Emissions avoided by the project until the year 2021

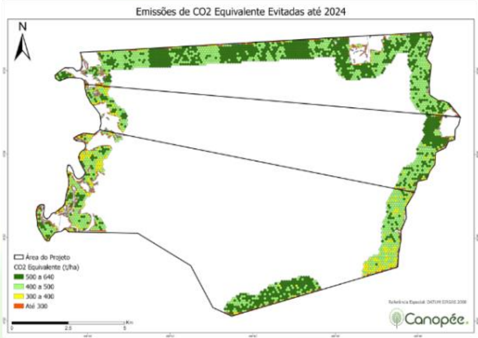
Farm	Emissions avoided by 2021 (tCO2eq)	% of emissions avoided by 2021	Emissions avoided by 2030 (tCO2eq)	% of emissions avoided by 2021
São Jorge I	581.155,09	54,64	1.616.137,50	48,81
São Jorge II	140.382,53	13,20	498.749,20	15,60
Mucuripe	342.096,11	32,16	1.196.282,38	36,13
Total	**1.063.633,73**	**100,00**	**3.311.169,08**	**100,00**

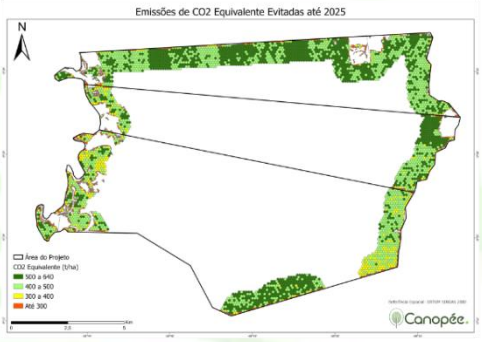
Table 12. CO2eq emissions. Avoided by the project from 2005 to 2030

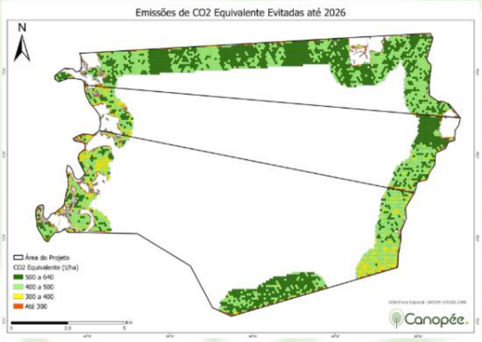
In the following years, the projections continue to advance towards the interior of the farms, as shown in Figure 21 below.

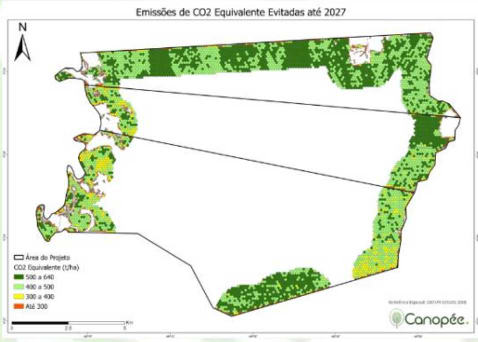

Emissões de CO2 Equivalente Evitadas até 2022
N
Área do Projeto
CO2 Equivalente (t/ha)
500 a 640
400 a 500
300 a 400
Até 300
Canopée

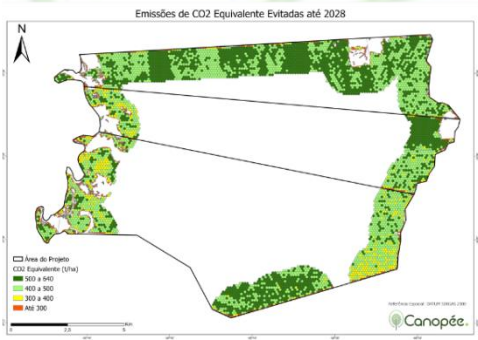

Emissões de CO2 Equivalente Evitadas até 2023
N
Área do Projeto
CO2 Equivalente (t/ha)
500 a 640
400 a 500
300 a 400
Até 300
Canopée

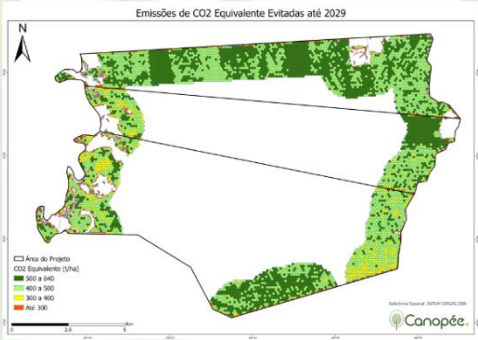

Emissões de CO2 Equivalente Evitadas até 2024
N
Área do Projeto
CO2 Equivalente (t/ha)
500 a 640
400 a 500
300 a 400
Até 300
Canopée


Emissões de CO2 Equivalente Evitadas até 2025
N
Área do Projeto
CO2 Equivalente (t/ha)
500 a 640
400 a 500
300 a 400
Até 300
Canopée


Emissões de CO2 Equivalente Evitadas até 2026
N
Área do Projeto
CO2 Equivalente (t/ha)
500 a 640
400 a 500
300 a 400
Até 300
Canopée


Emissões de CO2 Equivalente Evitadas até 2027
N
Área do Projeto
CO2 Equivalente (t/ha)
500 a 640
400 a 500
300 a 400
Até 300
Canopée


Emissões de CO2 Equivalente Evitadas até 2028
N
Área do Projeto
CO2 Equivalente (t/ha)
500 a 640
400 a 500
300 a 400
Até 300
Canopée


Emissões de CO2 Equivalente Evitadas até 2029
N
Área do Projeto
CO2 Equivalente (t/ha)
500 a 640
400 a 500
300 a 400
Até 300
Canopée

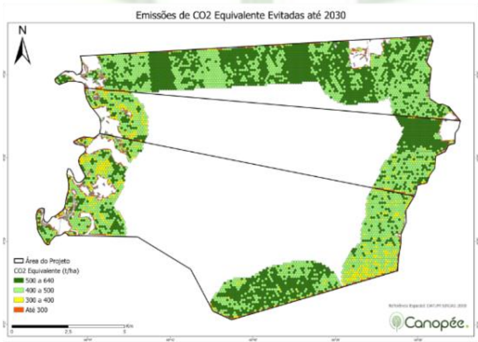

Emissões de CO2 Equivalente Evitadas até 2030
N
Área do Projeto
CO2 Equivalente (t/ha)
500 a 640
400 a 500
300 a 400
Até 300
Canopée

Figure 21. Emissions avoided by the project until the year 2021

For compliance reasons, Fazenda Mucuripe's credits will be verified, but not issued at this time. The current monitoring will allow the issuance of carbon credits related to the São Jorge I and São Jorge II farms, as shown in the table below.

Farm	Emissions avoided by 2021 (tCO2eq)	% of emissions avoided by 2021	Emissions avoided by 2030 (tCO2eq)	% of emissions avoided by 2021	Compilation status
São Jorge I	581.155,09	54,64	1.616.137,50	48,81	Issue in 2021
São Jorge II	140.382,53	13,20	498.749,20	15,60	Issue in 2021
Mucuripe	342.096,11	32,16	1.196.282,38	36,13	Do not issue
Total	**1.063.633,73**	**100,00**	**3.311.169,08**	**100,00**	**-**
Total credits issued in 2021 (SJ1 and SJ2)			**721.537,62**		
Total credits issued in 2021 (Mucuripe)			**342.096,11**		

Table 13. CO2eq emissions. avoided by the project from 2005 to 2030

3.5 Leakage

This stage of the work aims to estimate and verify possible leaks resulting from the project activities, which may cause a decrease in carbon stock and an increase in GHG emissions in regions adjacent to the project.

Leaks associated with this REDD project can originate in two ways:

- Decrease in carbon stocks and increase in GHG emissions associated with the displacement of activities that would occur within the project's protection area.

- Decrease in carbon stocks and increase in GHG emissions in the area of leakage management resulting from protection measures in the project area;

Below, both scenarios are analyzed:

1. Leaks resulting from the displacement of activities that would occur within the project area.

In the case of the Yuxibu Project, native forest protection activities within the limits of the project area will not require the displacement of activities outside the limits of the farm. As it is a private property, in common agreement between the landowner and the farm's residents, it was established that the areas already converted for their own use and destined for the subsistence agriculture of the farm's residents will not be reconverted into forest, allowing continuity of routinely developed activities. However, the increase and conversion of new areas will be prohibited, with the objective of maintaining all the remaining vegetation cover until the year 2020.

Considering a possible demand for growth or intensification of agricultural production, leakage prevention activities will be based on extension activities, training and dissemination of practices and techniques on sustainable agriculture and livestock, in order to allow or stimulate increased production (which would occur at baseline) without increasing the deforested area. Rationalizing the use of land and applying the best agricultural practices, it is expected to allow greater production without increasing the area used, reducing deforestation pressures.

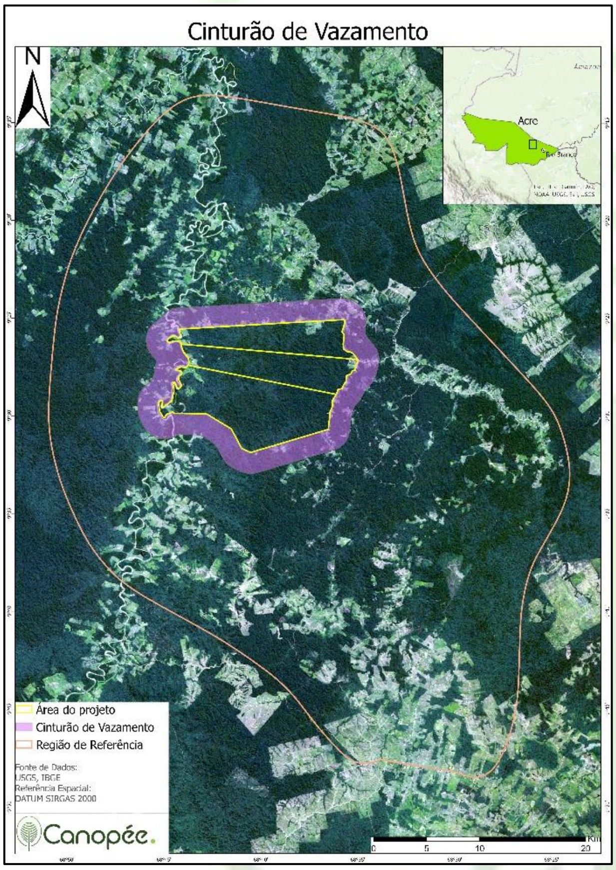
In the case of this project, the protection of the area does not involve a reduction in carbon stocks and a consequent increase in GHG emissions associated with leaks resulting from the displacement of activities in the project area. According to criteria defined by the VM00015 methodology, if the decrease in carbon stock or increase in GHG emissions resulting from leaks is significant, these must be accounted for and monitoring will be necessary. If not significant, it should not be accounted for and ex post monitoring is not necessary. In this way, only the monitoring of leaks resulting from protection activities will be carried out.

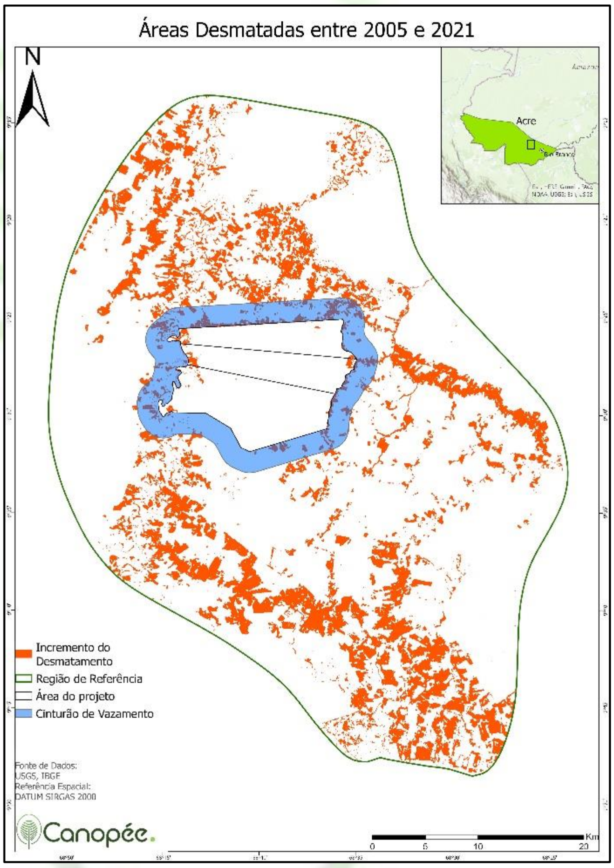
2. Leaks resulting from project area protection measures;

Due to the implementation of measures to protect and monitor the vegetation cover of the project area, the possibility is being worked out that the protection of this forest massif against deforestation could lead to an increase in deforestation rates observed in the region immediately adjacent to the project, the that would characterize a project-related leak.

Following the guidelines of the VM00015 methodology, in order to analyze the presence of leaks resulting from protection measures, the carbon stocks in the delimited region known as “leakage belt” must be evaluated. In this assessment, it is verified whether carbon stocks in the leakage belt have decreased more during project implementation than projected at baseline. If found to be so, this could be an indication that leaks have occurred due to project protection activities. Leakage can thus be estimated by ex post monitoring of deforestation in the leakage belt and compared with observed ex post deforestation against the ex ante projected baseline.

To verify these points, the deforestation rate observed between 2005 and 2020 in the reference region and in the leakage belt was analyzed and compared.





Leakage	Area (ha)	Area deforested between 2005 and 2021 (ha)	Proportion deforested (%)
Total Reference Region	197.377,00	35.459,00	18%
Effective Reference Region (discounting the Leakage Belt)	184.715,00	33.294,00	18%
Leakage Belt	12.661,00	2.165,00	17%

As evidenced by the historical analysis of images from the region, the deforestation rate observed in the leakage belt is lower than the rate observed in the reference region, considering the period since the beginning of the project's protection activities, in 2005.

Therefore, it concludes It is assumed that the deforestation pressure suffered by the leakage belt is similar – and slightly lower – to the reference region rate predicted by the baseline, indicating that there are no leakages from the project for the region defined as the “leakage belt”.

4. MONITORING PLAN

The Yuxibu REDD Project's monitoring plan is made up of a combination of three components, namely climate, community and biodiversity. Canopée Gestão Ambiental e Florestal S/A is the proponent, developer and manager of this Project, being responsible for coordinating the monitoring processes during its life cycle. The climate aspects will be monitored directly by the Canopée team and the social and biodiversity aspects will be monitored by the Canopée technical team and contracted partners with subject skills.

4.1 Technical Description of Monitoring Tasks

In the Project area, the monitoring of carbon stock changes and GHG emissions will be carried out through the analysis of avoided unplanned deforestation. Canopée Gestão Ambiental e Florestal will develop monitoring actions for REDD+ activities, which aim to avoid unplanned deforestation, through the verification of forest cover areas by satellite images and field checks in the Project area.

Local	Reference Region	Project Area
Objective	Monitoring of actual changes in carbon stock and GHG emissions in the Reference Region	Monitoring of actual changes in carbon stock and GHG emissions in the Project Area

Local	Reference Region	Project Area
Technical description	Carry out monitoring of forest cover in the reference area, aiming to identify year by year the % of deforested area, the equivalent biomass and the amount of tons of CO2 emitted into the atmosphere due to the reduction of the area covered by forests.	Carry out monitoring of forest cover in the project area, aiming to identify the occurrence of natural or anthropic disturbances on the forest heritage of the farm, as well as identification of irregular squatters and other activities that may cause changes in carbon stocks within the project.
Monitoring of leakage	Decrease in carbon stocks and increase in GHG emissions associated with leakage prevention activities. Deforestation above the baseline in the leakage belt area will be considered activity displacement leakage. Through the values obtained by the analyses, the deforestation rates observed in the leakage belts will be compared with the projected by the baseline and observed in the Reference Region.	Decrease in carbon stocks and increase in GHG emissions in due to activity displacement leakage. Deforestation above the baseline in the leakage belt area will be considered activity displacement leakage. Through the values obtained by the analyses, the deforestation rates observed in the leakage belts will be compared with the projected by the baseline observed in the Project Area.
Collected data	The reference region will be analyzed based on the satellite images generated from the last monitoring (2021) to the date of the next monitoring (2022).	The project area will be monitored annually through high precision georeferenced images (10 cm GSD), allowing the identification of changes in the forest structure at tree level. Along with the high definition images, forest inventory data from the area are used to estimate the stock and stratification of the stock in the area.
Data collection procedures	The images used in the historical analysis of the reference region come from the satellites Landsat 5, Landsat 8, Resourcesat 1 and Resourcesat 2. The images are obtained from the Earth Explorer platforms of the USGS - United States Geological Sourvey (Landsat 5 and Landsat 8) and in the INPE's Image Catalog platform - National Institute for Space Research (Resourcesat 1 and Resourcesat 2).	Planning and execution of UAV or drone flights, equipped with cameras and high precision sensors, over the entire project area.
Quality control	The classification methods adopted are tested and validated using the statistical accuracy index provided by the analysis of the Kappa index.	The investment in the acquisition of high definition paid images allows the project to reach a level of precision in the analysis of the area that easily meets the objectives and accuracy required by the methodology.
Generated files	The results are expressed in the form of maps (pdf) and in data sheets. The results will be included in the monitoring report issued annually by Canopée. Shapes and bases will also be generated for the analysis.	High precision georeferenced images, stratified polygons representing carbon stock, maps (pdf) and data sheets.

Local	Reference Region	Project Area
Related parties	Canopée technical team	Canopée technical team Elio Tecnologias em Geoprocessamento.

4.2 Biodiversity Impact Monitoring Plan

The biodiversity-related monitoring plan aims to carry out an assessment of the local flora and fauna community in terms of management practices and forest integrity. For flora, the monitoring plan includes the remeasurement of permanent plots in order to assess forest dynamics (recruitment rates, mortality, species replacement) and variations in carbon stock. For fauna, it is planned to implement two annual campaigns, one per semester so that seasonal variations, such as the presence of migratory species and reproductive periods, are considered.

During the studies, data on relevant species will be collected. This information will be systematized and presented through fauna monitoring reports related to a year of monitoring, prior to each verification event.

4.3 Data Archiving

All data and reports produced by the Yuxibu REDD Project will be stored by Canopée through digital files during the Project's life cycle. Original (physical) reports and field sheets produced will be stored by the organizations responsible for the field surveys and/or by ASF Brasil. All documents related to the monitoring of the Project will be gathered in physical and/or virtual files and made available to the verification body in each verification event.

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