MORRO DO FOGO FARM PROJECT – REDD + ARR

Document Prepared by Neo Green Consultoria Ambiental

Project Tittle	Morro do Fogo Project
Property's Registration	12.770 – 1º Real Estate Registration Service and Document Titles of Alto Araguaia/MT
Version	1
Date of Issue	18/07/2023
Prepared by	Neo Green Consultoria Ambiental Ltda
Metodology	UCF REDD + ARR
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SUMMARY

1 PROJECT PROPONENT

Proponent: Agropecuária J L LTDA

CNPJ: 48.138.815/0001-68

Address: 434 Bandeirantes Street, apartment 51, downtown, Araçatuba/SP, CEP 160.100-90

Phone: (18) 98121-0040

Contact Person: (18) 98121-0040 ou José Enrico Rodrigues Lino (18) 98103-2050

E-mail: vitorpgl@gmail.com

2 PROPERTY DATA

Name: Morro do Fogo Farm

Owner: assets of Adelino Ramos Rodrigues and Elza Pereira Rodrigues

Address: Buriti – Right bank of the Ariranha River

County: Alto Araguaia – MT

Rural Property Code: 000.019.383.538-4

Property's registration: 12.770 – 1º Real Estate Registration Service and Document Titles of de Alto Araguaia/MT

Area: 2.387,47 ha

3 IDENTIFICATION OF THE TECHNICAL RESPONSIBLE

Technical Responsible: Patrícia de Luca Lima Greff

Class Council: CRBio SC

Registration Number: 58979-03

Technical Qualification: Master in Environmental Biotechnology, Specialist in Climate Change, Carbon Market and Sustainable Projects

4 SUMMARY DESCRIPTION OF THE PROJECT

The Morro do Fogo Farm Project aims to protect, conserve and develop reforestation and revegetation actions in the pasture areas present in the project area. Thus, this project contributes to the mitigation of climate change focusing on reducing carbon emissions from

deforestation and degradation (REDD) and reforestation, revegetation and afforestation (ARR), in order to conserve the Cerrado Forest standing, and recover previous areas with livestock activities. The Morro do Fogo Farm is located in Alto Araguaia- Mato Grosso, central-west of Brazil, this area is inserted in the Cerrado Biome, which occupies about 25% of the Brazilian territory, in addition to cover ten states (Goiás , Tocantins, Mato Grosso do Sul, southern Mato Grosso, western Minas Gerais, Federal District, western Bahia, southern Maranhão, western Piauí and portions of São Paulo) [1].

The Cerrado is one of the regions with the greatest biodiversity in the world and it is estimated that it has more than 6 thousand species of trees and 800 species of birds. More than 40% of woody plant species and 50% of bees are thought to be endemic. Alongside the Atlantic Forest it is considered one of the world's hotspots, that is one of the richest and most threatened biomes in the world.[2].

The main threats to the Cerrado's biodiversity are related to two economic activities: intensive monoculture of grains and low-technology extensive livestock. The use of techniques for the intensive use of soils has, for years, led to the depletion of local resources. The indiscriminate use of pesticides and fertilizers has also contaminated the soil and water. The few blocks of native vegetation still unaltered in the Cerrado must be considered a priority for the implementation of protected areas, since only 0.85% of the Cerrado is officially in conservation units[3].

The Morro do Fogo Farm Project aims to reduce emissions from deforestation and degradation, protecting the standing forest, and reforesting the pasture areas, so the project will protect and restore the native forest, maintaining and increasing the carbon stock of the trees, conserving fauna, flora, water resources, soil quality, in addition to contributing to the mitigation of climate change. This area is embedded in a region of intense agriculture and livestock, being one of the few areas still with secondary vegetation, which has been reconstituting itself in the last 30 years. This project also ensures actions linked to the Sustainable Development Goals, which have a special connection with SDGs 6, 13, 15 (Figure 1).

1 Biodiversidade do Cerrado. Available in https://www.icmbio.gov.br/cbc/conservacao-da-biodiversidade/biodiversidade.html. Access in June 2023
2 Biodiversidade do Cerrado. Available in: https://www.icmbio.gov.br/cbc/conservacao-da-biodiversidade/biodiversidade.html. Access in June 2023
3 Ameaças Cerrado. Available in: https://www.wwf.org.br/natureza_brasileira/questoes_ambientais/biomas/bioma_cerrado/bioma_cerrado_ameacas/. Access in June 2023.

Figure 1: Sustainable Development Goals related to the project.

GOAL 6: Ensure availability and sustainable management of safe drinking water and sanitation for all.

Target: Protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lake.

Improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally[4].

GOAL 13: Take urgent action to combat climate change and its impacts.

Target: Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning[5].

GOAL 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss;

Target: Mobilize significant resources from all sources and at all levels to finance sustainable forest management and provide adequate incentives to developing countries to advance such management, including for conservation and reforestation.

Enhance global support for efforts to combat poaching and trafficking of protected species, including by increasing the capacity of local communities to pursue sustainable livelihood opportunities[6].

The project area has 2,102.83 hectares of native vegetation inserted between the Forested Savannah and Wooded Savannah transitions (Cerrado Stricto Sensu), and features two project categories, ARR and REDD (REDD_PL and REDD_PA). Annually, the project will remove **67,830.74 tCO2e** through reforestation/revegetation of pastures and will

[4] *ODS. Available in: https://brasil.un.org/pt-br/sdgs/6. Access in July 2023.*
[5] *ODS. Available in: https://brasil.un.org/pt-br/sdgs/13. Access in July 2023.*
6 ODS. Available in: https://brasil.un.org/pt-br/sdgs/15. Access in July 2023.

avoid emissions of **355,551.05 tCO2e** from deforestation or degradation, so this project brings benefits to the climate, biodiversity, water and soil of the Cerrado.

5 MORRO DO FOGO FARM HISTORY

The history of the origin of the farm's name is due to the fact that former neighbors of the property came to look for fire in the property's area.

The property's area originally was 5,033.00 hectares, acquired by three brothers, Adelino, Silvio and José Carlos Ramos Rodrigues in the 1980s, and was divided into two parts divided by the difference in altitude and degree of slope of the site.

Still in the 1980s in the upper part of the property (Cerrado Stricto Censu), where the terrain has slight undulations making it suitable for agriculture, the owners chose not to deforest the site using only the lower part for the development of the activity of livestock.

At the bottom of the property there is the formation of a cave with quite rough terrain, a feature that is not interesting for agriculture, which is why this region was used for livestock activities. As it is an area rich in water resources and less dry than the upper area, conserving a fresh area with green pasture all year, these factors also contributed to the raising of cattle in the area.

The livestock activity, despite having lasted on the farm since its purchase by the family, over time the heads of cattle were being reduced, the family stopped using the lower part of the farm, including some consolidated areas, allowing the native vegetation to regenerate in the area and in large part the vegetation is already over 35 years old.

At present around 89.90% of the farm's area is occupied by native vegetation protected by the project, the other 10.10% are occupied by the farm's infrastructure, a few hectares that use conservationist techniques in agriculture and livestock.

The current owners have no intention of continuing to use the consolidated areas in regeneration or the areas with older vegetation, opting to keep all these areas completely preserved.

6 PROJECT ELIGIBILITY

The project is eligible under the UCF REDD + ARR methodology as it follows the following conditions:

1. The project area qualifies as remaining forest and native primary forest and the project activity involves the reduction of emissions from deforestation and degradation – REDD and recovery of the pasture area with reforestation (ARR) allowing to maintain and increase the stock of forest carbon;
2. The inclusion of the aboveground tree biomass pool as part of the project boundary is mandatory and has been measured for this project;
3. The project is located on a property between 30 and 3000 hectares of native forests;
4. Areas with protected forests, legal reserve areas, permanent preservation areas with or without native vegetation are included;
5. The main activity of the area of the property is the conservation of the standing forest;
6. The project area is not subject to pre-existing legal burden, such as a conduct adjustment term or under forest recovery due to interference without government authorization, according to Brazilian legislation;
7. There are no areas of forest fragments with less than 1 (one) hectare isolated on the property without connection with areas with forests over 1 (one) hectare;
8. This methodology was not applied to areas with other land uses, such as livestock, annual agriculture, except in the areas presented as the baseline of the project.
9. The property is eligible for registration as a UCF (forest carbon unit) in the green CPR in accordance with Decree No. 10828/2021[7], Federal Law No. 13.986/2020[8], Federal Law No. 12187/2009[9], Federal Law No. 8929/1994[10] and Federal Decree No. 11075/2022[11] .
10. The property is also eligible, considering compliance with the country's environmental legislation (Law No. 12,651/2012[12]).

[7] *BRAZIL. Decree No 10.828, October 1, 2021. Available in https://www.planalto.gov.br/ccivil_03/_Ato2019-2022/2021/Decreto/D10828.htm. Access in July 2023*
[8] *BRAZIL. Law No 13.986, April 7, 2020. Available in https://www.planalto.gov.br/ccivil_03/_ato2019-2022/2020/lei/l13986.htm. Access in July 2023*
[9] *BRAZIL. Law No 12.187, December 29, 2009. Available in https://www.planalto.gov.br/ccivil_03/_ato2007-2010/2009/lei/l12187.htm. Acess in July 2023*
[10] *BRAZIL. Law No 8.929 ,August 22, 1994. Available in https://www.planalto.gov.br/ccivil_03/LEIS/L8929.htm. Access in July 2023*
[11] *BRAZIL. Decree No 11.075 May 19, 2022. Available in https://www2.camara.leg.br/legin/fed/decret/2022/decreto-11075-19-maio-2022-792682-norma-pe.html. Access in July 2023*
[12] *BRAZIL. Law No 12.651, May 25, 2012.Available in https://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12651.htm Access in July 2023..*

11. The implementation of this project does not imply any violation of applicable law and property documents.

6.1 COMPLIANCE WITH BRAZILIAN LEGISLATION

The project complies with the Brazilian legal requirement as already mentioned above, having no environmental burden or pendency in its land documentation, this can be proven by the CNDs (Clearance Certificates of Debt) presented in annex, together with the property documentation (CND IBAMA and CND of tax disputes in the state of Mato Grosso).

If the project was not implemented in the area, legal requirements such as conservation of the APP and RL areas could not be attended to on the property considering the history of land use in the region, the most common option is to choose to deforest the areas for conversion to areas of pasture, agriculture or forestry.

Another important point is that with the project all land documentation must always be up to date, a fact that is hardly in accordance with the legislation on Brazilian rural properties.

7 ADDITIONALITIES

7.1 ACTIVITY NOT COMMON IN THE REGION

Areas with reforestation or revegetation from pasture to forest are included in the ARR project category (Afforestation, Reforestation and Revegetation), these areas have 30 years of forest recovery, and are currently with vegetation in the initial or medium stage of regeneration. It is important to highlight that considering that this area was consolidated in accordance with the Brazilian forest code (Law nº 12.651/2012[13]) it could by law continue to be used for pasture, since it had been used for this purpose since 1989, however the owner chose to leave these areas of 458.70 ha for recovery of its natural native vegetation.

The project area qualifies as a consolidated area and is currently left for the regeneration of natural forest, or a project to recover degraded areas will be carried out in it, being additional.

[13] *BRAZIL. Law No 12.651, May 25, 2012.Available in https://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12651.htm. Access in July 2023*

As for the areas where there was no evidence of occupation or human alteration the two categories of REDD project (Reduction of Emissions from Deforestation and Forest Degradation) were adopted. The first considering that by law (Law nº 12.651/2012[14]) the owner has excess areas for sustainable use, a fact that allows the implementation of livestock activities in the place and protects 35% of its native forest (Legal Reserve) and its APPs (Permanent Preservation Areas) – UCF REDD_PL.

Considering then in this baseline scenario the use of all areas outside this area protected by law for livestock according to the farm's history of use the UCF REDD - PL area represents about 809.45 ha.

The other category of REDD project (UCF REDD_AP) considers the deforestation rate of the last three years in the Biome (Cerrado) projected in the area protected by law of the property (RL + APP), where the baseline scenario should be the change of land use and use of forest areas for agrosilvopastoral activities, which in the case of the property, considering the history of land, was considering as if the entire deforested area were for livestock.

Thus, this scenario represents the illegal deforestation of the property's legally protected area, considering the annual deforestation rate of the Biome and tracing the scenario based on the history of land use on the property the UCF REDD – AP area is about 292.47 ha in the first year.

Reminding that in the REDD areas the owner chose to preserve all areas, totalizing a preservation area of 1,644.13 ha of forests over 30 years old.

Considering the history of land use in the region and the biome where the project area is located, it is possible to state that activities for the recovery and preservation of natural resources are not common in the region, with deforestation for agrosilvopastoral activities being more common as projected in the scenarios ARR and REDD baseline cited above.

It is also worth mentioning that even with the existence of strict environmental legislation in the country, the lack of inspection by the responsible environmental agencies creates this scenario of high annual deforestation rates in the Cerrado Biome.

[14] *BRAZIL. Law No 12.651, May 25, 2012.Available in https://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12651.htm Access in July 2023.*

Still according to federal law 12561/12 art 41 § 4 The maintenance activities of Permanent Preservation Areas, Legal Reserves and Restricted Use Areas are eligible for any payments or incentives for environmental services, configuring additionality for the purposes of national and international reduction markets of certified greenhouse gas emissions.

7.2 DRIVERS FOR DEFORESTATION AND FOREST DEGRADATION

Throughout the Cerrado Biome, the main driver of deforestation are landowners who deforest to use the land for agrosilvopastoral uses.

According to the IBGE[15] survey, in 2016, the main crops per planted area were: soybeans – 2 million hectares (45.5%); maize – 789.6 thousand hectares (17.7%); rice – 474.8 thousand hectares (10.7%); herbaceous cotton – 446.4 thousand hectares (10%); beans – 288.9 thousand hectares (6.5%); cassava – 185.8 thousand hectares (4.2%); and sugar cane – 114.4 thousand hectares (2.6%). It is observed that soybean, corn, rice and herbaceous cotton crops occupied 84% of the total cultivated area with temporary crops.

The forestry sector, with eucalyptus as the main species, and the livestock sector are present in a smaller area, however still causing significant damage to the Biome.

The study area is in the middle of several properties deforested for conversion to use for agrosilviculture, being one of the only fragments preserved in the region where it is located. More information and evidences of deforestation drivers present in the project region and Cerrado Biome can be found in the DEFORESTATION DRIVERS Section.

Taking into account all the information mentioned in this study, it is considered that the project has additionality, since without the project, this area would hardly be preserved over time.

8 PROPERTY DOCUMENTS

Property documents attached.

9 PROJECT DESIGN

[15] *IBGE. Pesquisa Agrícola Municipal (PAM). 2016. Available in http://goo.gl/V8b1ga. Access in July 2023.*

The project carries out maintenance activities to increase the forest carbon stock by reducing deforestation and degradation and reforestation of pastures.

Project Start Date	**May 18, 2023**
Sectorial Scope	AFOLU
Category – Green CPR	REDD + ARR
Property Registration	Nº 12.770 – 1º Real Estate Registration Service and Document Titles of Alto Araguaia/MT
Area registered in the Property Registration	2.387,48 hectares
Total Area of Native Forest – Cerrado Biome	2.102,83 hectares
Total Project Area	2.102,83 hectares
UCF Validity Period	May 18, 2023 to May 18, 2024*

* validity period of the UCF of the Fazenda Morro do Fogo Property Registration number 12.770, of 1 year from the certification by the Neo Carbon Institute and registration in the title of the property together with the Responsible Property Registration and Title Service (Registration Service of Real Estate and Titles of Documents of Alto Araguaia/MT) and B3.

10 PROJECT PRODUCT

The UCF REDD + ARR product of this project was obtained based on different categories, namely:

- Deforestation or degradation of areas with legal permission (UCF_{REDD_PL});
- Deforestation or degradation of protected areas (UCF_{REDD_AP});
- Removal of emissions by natural sink in areas undergoing forest recovery (UCF_{ARR}).

Based on this, the amount of emission reductions and removals for the year 2023/2024 is **423,381.79tCO2e**.

Project Type	Total removals and avoided emissions (tCO_{2e})	$UCF_{ARR+REDD}$ (tCO_{2e})
UCF_{ARR}	67.830,74	423.381,79
UCF_{REDD_PL}	264.531,14	
UCF_{REDD_PA}	91.019,91	

11 DESCRIPTION OF PROJECT ACTIVITY

11.1 PROJECT ACTIVITY

Conserve the cerrado forest and allow the natural recovery of the forest in the pasture areas through revegetation, promoting the protection of biodiversity and conservation of water resources, maintenance of the stock and increase of carbon.

11.2 PROJECT LOCATION

The Morro do Fogo Farm Project – Forest Carbon Unit (UCF) is located in the municipality of Alto Araguaia, in the state of Mato Grosso, located 418 km from the state's capital(Cuiabá).

The municipality of Alto Araguaia has a significant Industrial Pole, a relevant advance in education, economy, tourism, livestock, agriculture, culture and sports. Due to its geoclimatic characteristics, agriculture in Alto Araguaia grows substantially. It is one of the largest producers of soy, rice, beans, corn and cotton. The livestock sector has been expanding gradually, becoming a highly profitable option.

The location of the Alto Araguaia municipality is presented in Figure 2 below.

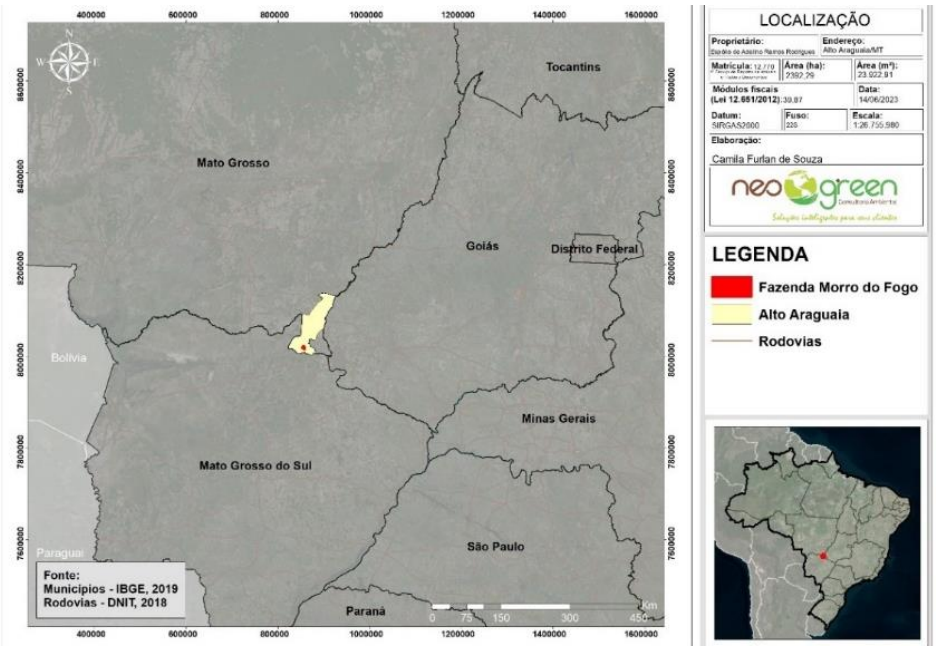

Figure 2: Project area location map

The location of the Morro do Fogo Farm Project area is shown in Figure 3.

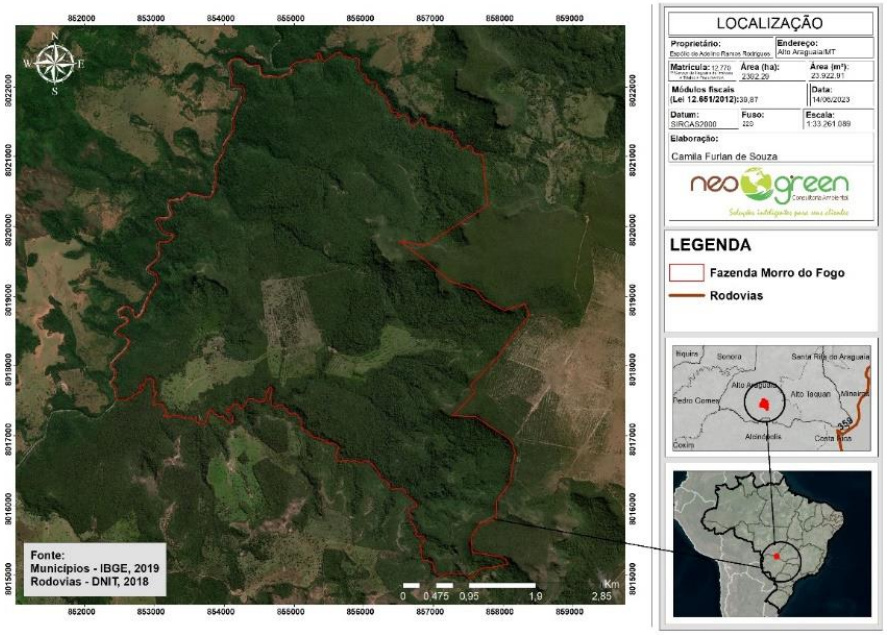

Figure 3: Location map of the Project area.

11.3 PHYSICAL ENVIRONMENT

11.3.1 CLIMATE

The climate in the Cerrado is predominantly seasonal tropical, with the main characteristic being the occurrence of two seasons: a rainy one (October to April), when more than 90% of the rains fall, and a dry one (May to September), with almost total absence of rains. Average annual temperatures range from 18°C to 27°C with the minimum temperature reaching 8°C and the maximum 34°C.

As shown in Figure 4 according to the Köppen climate classification the project area has an Aw climate, which is characterized by a savanna climate or tropical climate.

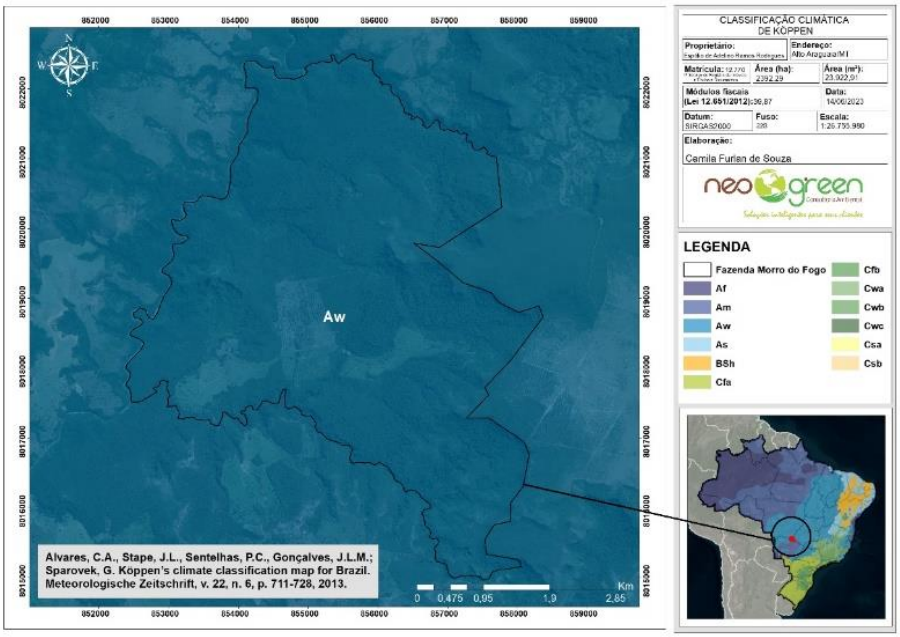

Figure 4: Climate classification map of the Project area.

11.3.2 HYDROGRAPHY

The project is located in the hydrographic region of Paraguay, that has a great importance in the Brazilian strategic context of water resources management, not only because of its size, but also because it includes one of the largest extensions of wetlands on the planet, the Pantanal Mato Grosso , declared a National Heritage Site by the Brazilian Constitution of 1988, a site designated as an area of relevant international importance by the RAMSAR Wetland Convention, in 1993, and a Biosphere Reserve by the United Nations Program for Science and Culture – UNESCO, in the year from 2000[16].

According to Figure 5, 31 springs are shown within the project area. The areas of the springs are not visible by satellite image and were delimited from remote sensing data (MDT – Digital Terrain Model).

[16] *Plano de Recursos Hídricos da Região Hidrográfica do Rio Paraguai.Availible in http://prhparaguai.ana.gov.br/mop/html/01_02_AreaAbrangenciaPIRH.html. Access in June, 2023.*

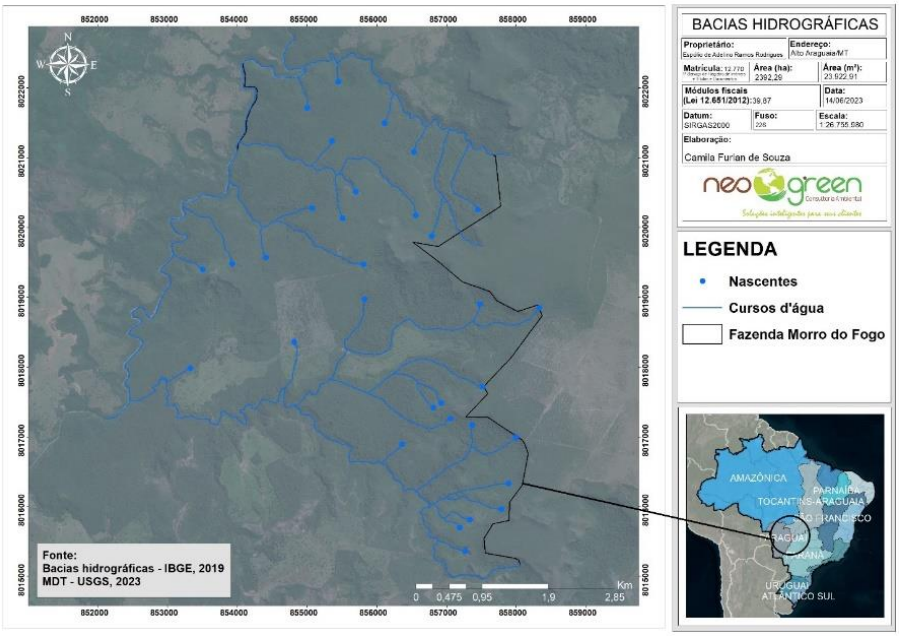

Figure 5: Map with springs and water courses in the Project area.

11.3.3 GROUND, ALTIMETRY AND ELEVATION

In the project area according to EMBRAPA [17] (Figure 6) the soil is characterized as Dystrophic Red-Yellow Argisol, these soils have low to medium natural fertility, presenting as the main restriction those that occur in environments with busy reliefs, related to environments of crystalline rocks. In Coastal Tablelands these soils need correctives and fertilizers to obtain good crop productivity, requiring the use of organic matter in the surface horizon, especially in sandy textured soils[18].

[17] *Mapa de solos do Brasil. Available in http://geoinfo.cnps.embrapa.br/layers/geonode%3Abrasil_solos_5m_20201104. Access in June,2023.*
[18] *Argissolos Vermelhos-Amarelos. Available in https://www.embrapa.br/agencia-de-informacao-tecnologica/territorios/territorio-mata-sul-pernambucana/caracteristicas-do-territorio/recursos-naturais/solos/argissolos-vermelho-amarelos. Access in June,2023.*

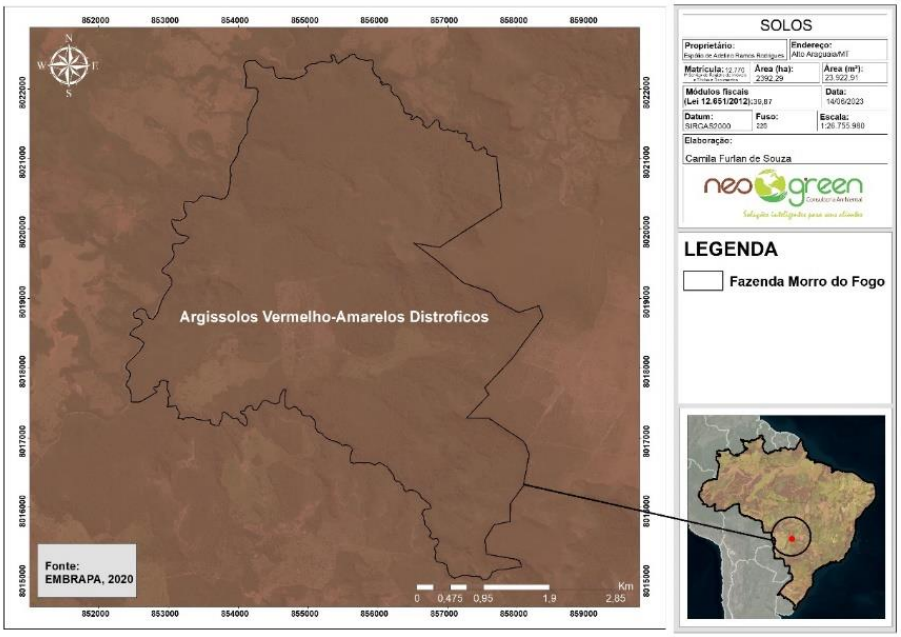

Figure 6: Map with soil typology in the project area.

Figure 7 presents a map with a processed image of altimetry in the project area.

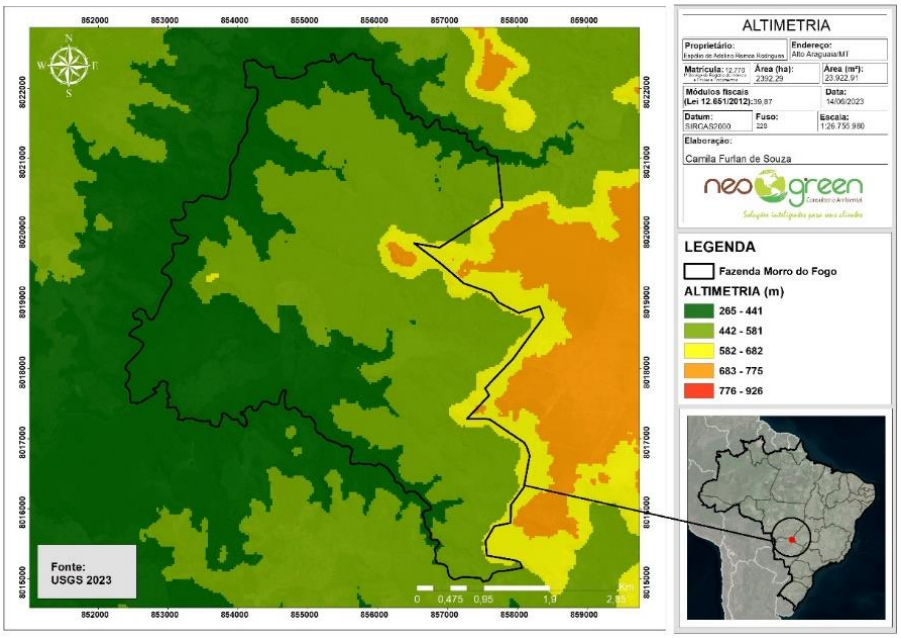

Figure 7: Map with altimetry in the project area.

11.3.4 LAND USE

According to SEEG Methodological Note 9 – Land Use Change and Forests Sector (2021), the classes in the MapBiomas of the project area are classified as Forest Formation, Savanna Formation, Pasture and Mosaic of Uses. The phytophysiognomy in the IBGE is

classified as a transition between Forested Savannah and Wooded Savannah (Cerrado Stricto Sensu).

The area of the property is mostly filled with native vegetation (89%).

As previously mentioned the areas of the springs are not visible by satellite image and were delimited from Remote Sensing data (MDE – Digital Elevation Model – with a spatial resolution of 30 m[19]).

Figure 8 shows the land use in the project area.

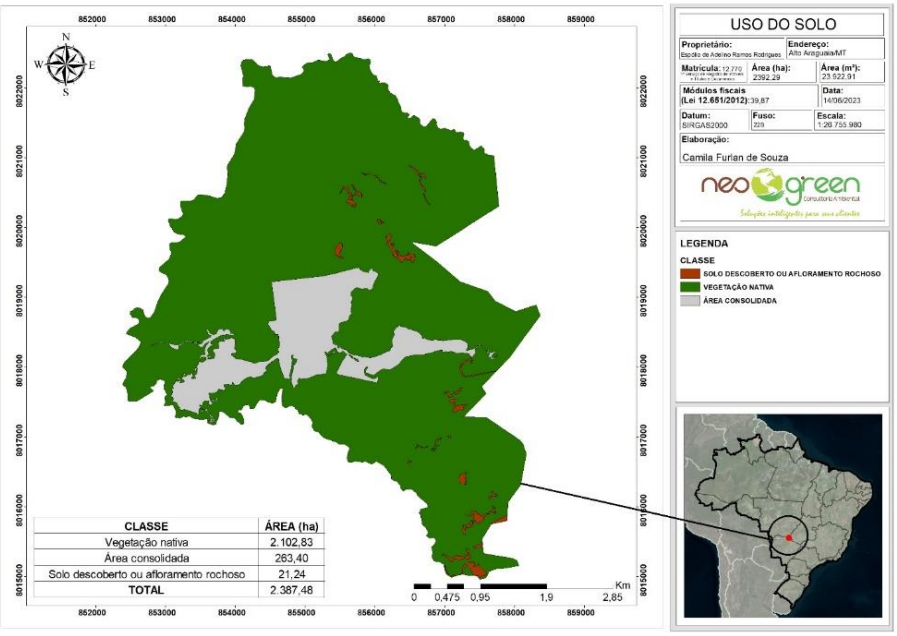

Figure 8: Map with land use in the project area.

11.4 BIOTIC ENVIRONMENT

Considered one of the world's biodiversity hotspots, the Cerrado has an extreme abundance of endemic species and suffers an exceptional loss of habitat. From the point of view of biological diversity, the Brazilian Cerrado is recognized as the richest savannah in the world, harboring 11,627 species of native plants already catalogued. There are a great diversity of habitats, which determine a remarkable alternation of species between different phytophysiognomies[20].

11.4.1 FLORA

[19] *USGS. Earth explorer. Available in https://earthexplorer.usgs.gov/. Access in June,2023.*
[20] *O Bioma Cerrado. Available in https://antigo.mma.gov.br/biomas/cerrado.html. Access in June,2023.*

Cerrado vegetation and its density, however, do not depend on the degree of rainfall, as occurs in the savannas of Africa, but on edaphic factors (fertility, aluminum content and degree of soil saturation) and modifications by fire and cutting. These factors produce different forms or physiognomies for the Cerrado. The types of vegetation that occur in the interfluve are: (1) the cerrado sensu lato; (2) the mesophytic forest; (3) the rupestrian field; (4) the miscellaneous lithosolic fields; and (5) massive rock outcrop vegetation. There are also types of vegetation associated with watercourses, which are: (1) gallery forests or hillside forests; (2) buritizais and paths; (3) the wet field; (4) the permanent swamps; (5) the swamp; (6) aquatic plants and swamp[21].

According to Figure 9, where the forest typology in the project area is presented, it has about 89% of transitional forest cover between Forested Savannah and Wooded Savannah (Cerrado Stricto Sensu), in which 247 tree species were identified.

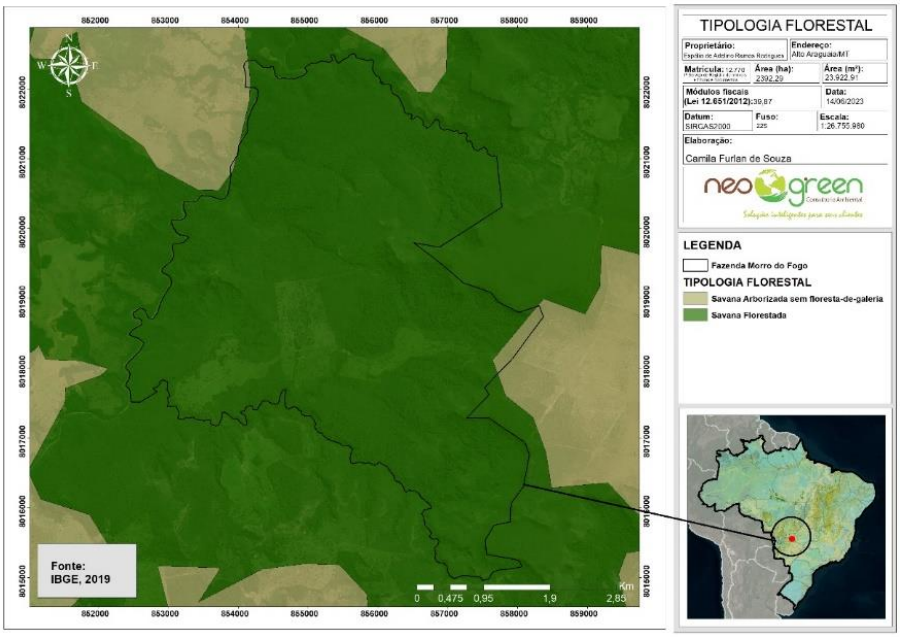

Figure 9: Map with forest typology in the project area.

[21] *EITEN, G. Vegetação do Cerrado In: PINTO, M. N. (Ed.). Cerrado: caracterização, ocupação e perspectivas. 2. ed. Brasília: UnB: SEMATEC, 1994b. p. 17-73.*

11.4.2 FAUNA

The fauna of the Cerrado Biome is very rich and still little known. The index of endemism of its animal species is lower than others Brazilian biomes[22]. This happens probably due to the influence of the fauna of neighboring biomes: Amazon, Caatinga, Atlantic Forest and Pantanal. The main threats to the reduction of biodiversity in the Cerrado are habitat loss and fragmentation, overexploitation the introduction of exotic species and pollution. At least 137 of its animal species are threatened with extinction[23,24]. The project area has unique biodiversity with several species of small, medium and large fauna. The presence of the tapir (Tapirus terrestris) stands out, the largest terrestrial mammal and its presence is essential for the formation and maintenance of the biodiversity of the habitats, classified as a vulnerable specie for extinction. The presence of Puma (Puma Concolor) species classified by the IUCN (International Union for the Conservation of Nature) as a "Least Concern" species and by the ICMBio-MMA "Vulnerable" [25]. In addition to these large mammals, approximately 400 species of avifauna, 40 species of amphibians and herpetofauna and 50 species of mammals are also found on the ground, annual monitoring will be able to confirm these numbers over the years.

11.5 PROJECT ACTIVITY

11.5.1 ECONOMIC ASPECTS

According to IBGE[26], the estimated population of the municipality of Alto Araguaia in 2021 was 19,714 people. In 2020, the average monthly salary of formal workers (2,549 people) was 2.5 minimum wages and considering households with monthly income of up to half a minimum wage per person, 13.1% of the population had these conditions. The GDP per capita in 2019 was equivalent to BRL 48,719.66.

In 2021 it presented an area of the territorial unit of 5,402.30 km² with 7.8% of households with adequate sanitary sewage, 38.3% of urban households on public roads

[22] *KLINK, C. A., MACHADO, R. B. 2005. A conservação do Cerrado brasileiro. In: Megadiversidade. Desafios e oportunidades para a conservação da biodiversidade no Brasil. Vol 1, 1: 147-155. Belo Horizonte: Conservação Internacional.*
[23] *Livro vermelho da fauna brasileira ameaçada de extinção. Available in https://biodiversitas.org.br/wp-content/uploads/2021/06/Livro-Vermelho-BR-Vol-I.pdf. Access in July,2023.*
[24] *Hilton-Taylor, C. 2004. 2004 IUCN red list of threatened species. Species Survival Commission (SSC), IUCN – The World Conservation Union, Cambridge, Reino Unido e Gland, Suíça. Available in http://www.redlist.org. Access in June,2023..*
[25] *https://procarnivoros.org.br/animais/onca-parda/ . Access in June,2023.*
26 IBGE. Available in https://www.ibge.gov.br/cidades-e-estados/mt/alto-araguaia.html. Access in June,2023.

with trees and 10.4% of urban households on public roads with adequate urbanization (presence of manhole, sidewalk, paving and curb).

With regard to the Human Development Index (HDI), which is a summarized measure of long-term progress in three basic dimensions of human development: income, education and health, the municipality presented a value of 0.704 in 2010.

Referring to the schooling rate of 6 to 14 years old, in 2010 the result of 96.7% was presented.

11.6 CULTURAL HISTORICAL ASPECTS

11.6.1 CULTURE, ARCHEOLOGY, INDIGENOUS PEOPLE AND QUILOMBOLS

The municipality is on the border with the state of Goiás, therefore it has a strong cultural and social influence of Goiás.

The municipality of Alto Araguaia, which was initially called Santa Rita do Araguaya, a name in reference to the saint of devotion and to the Araguaia River, which borders the municipal headquarters and at the same time serves as a dividing mark with the neighboring State of Goiás, where there was a village with the same name; one from Goiás, on the right bank, and another from Mato Grosso, on the left bank. They formed as if a single physical unit.

There are reports of quilombos and indigenous communities along the Araguaia Valley, but none overlapping or close to the project area (Figure 10).

IPHAN databases were also consulted and no archaeological site interferes with the project area (Figure 10).

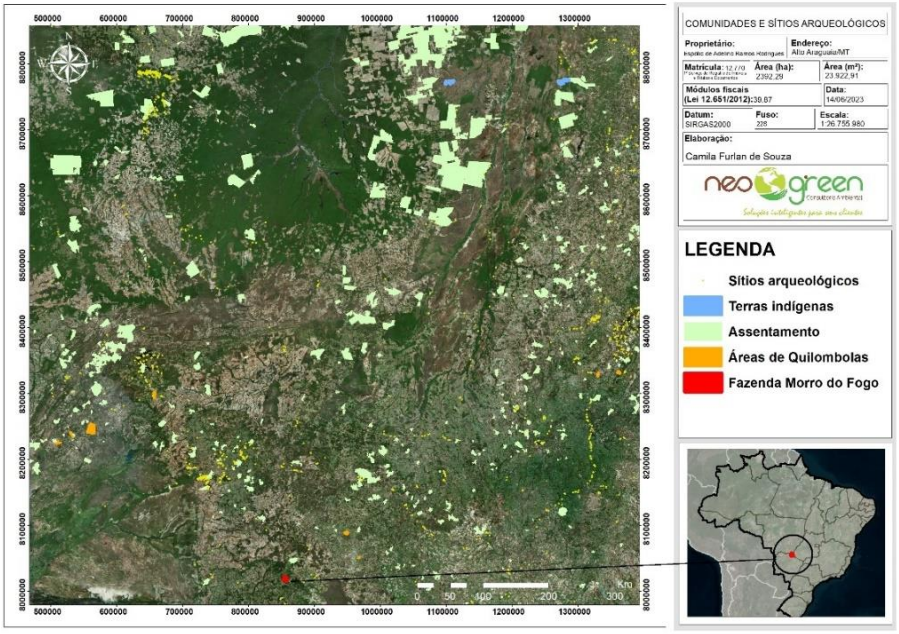

Figure 10. Traditional communities, quilombolas, settlements and archaeological sites in the project region.

12 DEFORESTATION DRIVERS

Using the data provided by MapBiomas, the areas deforested since 1985 in the project region were identified (Figure 11) and the deforestation pattern found and new land uses identified over the years, indicate that the main driver of deforestation in the region is the agricultural expansion.

The main cause of deforestation in the Cerrado is the expansion of agribusiness over native vegetation. Between 2007 and 2014, 26% of agricultural expansion took place directly over Cerrado vegetation [27].

Regarding pastures, recent analyzes indicate that, between 2000 and 2016, 49% of the expansion took place over the Cerrado[28]. It should be noted that many times the area deforested for pasture later becomes an area for agricultural use[29].

[27] *Carneiro Filho, A. e Costa, K. (2016). A expansão da soja no Cerrado: Caminhos para a ocupação territorial, uso do solo e produção sustentável.*
INPUT, Agroicone. Available in http://www.inputbrasil.org/wp-content/uploads/2016/11/A-Expans%C3%A3o-da-Soja-noCerrado_Agroicone_INPUT.pdf. Access in June, 2023.
[28] *IPAM e MapBiomas. Available in http://mapbiomas.org/map#transitions. Access in June, 2023.*
[29] *Carneiro Filho, A. e Costa, K. (2016). A expansão da soja no Cerrado: Caminhos para a ocupação territorial, uso do solo e produção sustentável.*
INPUT, Agroicone. Available in http://www.inputbrasil.org/wp-content/uploads/2016/11/A-Expans%C3%A3o-da-Soja-noCerrado_Agroicone_INPUT.pdf. Access in June, 2023.

Data were also found mentioning that from August 2021 to July 2022 Mato Grosso recorded 742 km² of deforestation in the Cerrado biome. Around 80%, according to a survey by Instituto Centro de Vida (ICV[30]).

In Figure 11, we have the deforestation in the region of the project area, based on the comparison of classifications for the years 1985 and 2021 from MapBiomas[31].

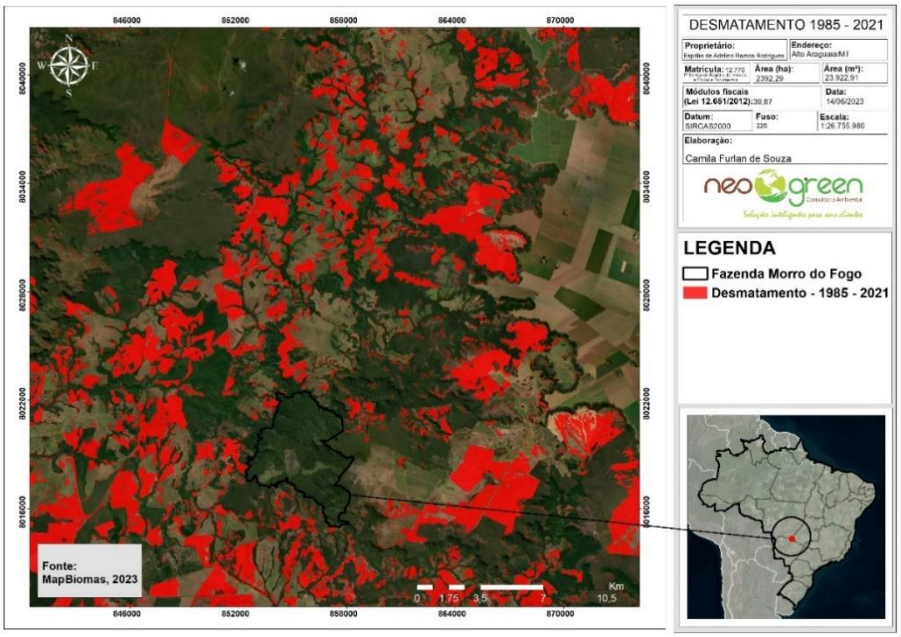

Figure 11. Deforested areas in the project region between the years 1985 and 2021.

Table 1 also presents data on deforestation rates for the municipality of Alto Araguaia for 36 years (1985 - 2021), for 10 years (2011 - 2021) and 3 years (2019 - 2021) according to land use classification records from the MapBiomas platform[32].

Table 1. Deforestation rates in the municipality of Alto Araguaia.

Year	Deforestation (ha)	Deforestation rate (%) (2011 - 2021)	Deforestation rate (%) (1985 - 2021)	Deforestation rate (%) (2018 - 2021)
1985 - 1986	10.775,10	-	6,17	-
1986 - 1987	9.149,29	-	5,24	-
1987 - 1988	10.682,12	-	6,11	-
1988 - 1989	12.213,95	-	6,99	-
1989 - 1990	7.442,79	-	4,26	-
1990 - 1991	6.621,04	-	3,79	-

[30] *Quase 80% do desmatamento no Cerrado no Mato Grosso foi de forma ilegal. Available in https://www.canalrural.com.br/mato-grosso/quase-80-do-desmatamento-do-cerrado-em-mato-grosso-foi-de-forma-ilegal-diz-icv/. Access in June,2023.*
[31] *MapBiomas. Coleções MapBiomas. Available in https://mapbiomas.org/colecoes-mapbiomas-1?cama_set_language=pt-BR. Access in August, 2022.*
[32] *Plataforma MapBiomas. Available in https://plataforma.brasil.mapbiomas.org. Access in June,2023.*

1991 - 1992	11.265,29	-	6,45	-
1992 - 1993	11.258,89	-	6,44	-
1993 - 1994	7.963,37	-	4,56	-
1994 - 1995	7.831,61	-	4,48	-
1995 - 1996	4.139,76	-	2,37	-
1996 - 1997	4.946,66	-	2,83	-
1997 - 1998	3.018,59	-	1,73	-
1998 - 1999	3.900,45	-	2,23	-
1999 - 2000	4.229,12	-	2,42	-
2000 - 2001	3.836,42	-	2,20	-
2001 - 2002	4.561,91	-	2,61	-
2002 - 2003	10.924,97	-	6,25	-
2003 - 2004	4.506,13	-	2,58	-
2004 - 2005	3.148,82	-	1,80	-
2005 - 2006	1.840,92	-	1,05	-
2006 - 2007	1.333,43	-	0,76	-
2007 - 2008	2.310,10	-	1,32	-
2008 - 2009	1.193,15	-	0,68	-
2009 - 2010	1.333,64	-	0,76	-
2010 - 2011	1.989,22	-	1,14	-
2011 - 2012	3.625,69	16,27	2,08	-
2012 - 2013	3.457,17	15,52	1,98	-
2013 - 2014	2.603,80	11,69	1,49	-
2014 - 2015	2.296,16	10,31	1,31	-
2015 - 2016	2.545,84	11,43	1,46	-
2016 - 2017	1.760,86	7,90	1,01	-
2017 - 2018	1.366,14	6,13	0,78	-
2018 - 2019	1.191,01	5,35	0,68	25,76
2019 - 2020	700,59	3,14	0,40	15,15
2020 - 2021	2.731,38	12,26	1,56	59,08
Total(1985 - 2021)	174.695,38	-	100,00	-
Total(2011 - 2021)	22.278,64	100,00	-	-
Total (2018 - 2021)	4.622,98	-	-	-
Average (1985 - 2021)	4.852,65	-	**2,78**	-
Average (2011 - 2021)	2.227,86	**10,00**	-	-
Average (2018 - 2021)	-	-	-	**33,33**

According to the data presented in Table 1 above, during the 36 years of classification made by MapBiomas, the average rate of deforestation was 2.78% per year and for the 10 most recent years it was 10% per year and in the last 3 years it increased, resulting in 33.33% a. Between 1988 and 1989 we had the largest deforested area, accounting for 12,213.95 hectares deforested.

13 APPLICATION OF THE METHODOLOGY

The UCF REDD+ARR methodology was based on the following documents:

- Methodological tool A/R Calculation of number of samples for measurement in project activities, A/R CDM TOOL-03. V02.1.0;
- Guide for determining carbon for small rural properties – IA [33].
- VM0007 REDD+ Methodology Framework (REDD+MF), v1.6[34].
- VMD0041 Estimation of baseline carbon stock changes and greenhouse gas emissions in ARR project activities (BL-ARR)[35];
- VM0034 Canadian forest carbon offset methodology[36];
- Good Practice Guidance for Land Use, Land-Use Change and Forestry[37];
- A/R Large-scale Consolidated Methodology: Afforestation and reforestation of lands except wetlands[38];
- A/R Methodological tool: Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity[39];
- Methodological tool: Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities[40];
- A/R Small-scale Methodology: Afforestation and reforestation project activities implemented on lands other than wetlands[41].

The methodology created for UCF – REDD + ARR based on the documents above, allows the estimation of carbon stocks in trees above ground and annual non-tree woody

[33] *RÜGNITZ, M. T.; CHACÓN, M. L.; PORRO R. Guia para Determinação de Carbono em Pequenas Propriedades Rurais. 1ª ed. Belém, Brasil. Centro Mundial Agroflorestal (ICRAF) / Consórcio Iniciativa Amazônica (IA). 2009. 81 p. Available in https://cetesb.sp.gov.br/proclima/wp-content/uploads/sites/36/2014/05/guia_carbono_pequenas_prop_rurais.pdf. Access in June, 2022.*
[34] *VERRA. VM0007 REDD+ Methodology Framework (REDD+MF), v1.6. 2020. Available in https://verra.org/wp-content/uploads/imported/methodologies/VM0007-REDDMF_v1.6.pdf. Access in July,2023.*
[35] *VERRA. VMD0041 Estimation of baseline carbon stock changes and greenhouse gas emissions in ARR project activities (BL-ARR). 2020. Available in https://verra.org/wp-content/uploads/imported/methodologies/VMD0041-BL-ARR_v1.1.pdf. Access in July,2023*
[36] *VERRA. VM0034 Canadian forest carbon offset methodology.2020. Available in https://verra.org/wp-content/uploads/VM0034-Canadian-Forest-Carbon-Offset-Methodology-v2.0.pdf. Access in July,2023.*
[37] *IPCC. Good Practice Guidance for Land Use, Land-Use Change and Forestry. 2003. Available in https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/GPG_LULUCF_FULL.pdf. Access in July,2023.*
[38] *CDM. AR-ACM0003 - A/R Large-scale Consolidated Methodology: Afforestation and reforestation of lands except wetlands. Available in https://cdm.unfccc.int/UserManagement/FileStorage/THNRJC15IW4K89UBE6DFZYX23OVP0Q. Access in July,2023.*
39 CDM. AR-TOOL15 - A/R Methodological tool: Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity. Available in https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-15-v2.0.pdf. Access in July,2023.
[40] *CDM. AR-TOOL14 - Methodological tool: Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities. Available in https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-14-v4.1.pdf. Access in July,2023.*
[41] *CDM. AR-AMS0007 - A/R Small-scale Methodology: Afforestation and reforestation project activities implemented on lands other than wetlands. Available in https://cdm.unfccc.int/UserManagement/FileStorage/2FQBKA7OS3PZV154GIYR8XWJHDNLCU. Access in July,2023.*

biomass of native forests, for maintenance and increase of forest carbon stock and estimate of removal and reduction of GHG (Greenhouse Gases) in areas of ARR project (Afforestation, Reforestation and Revegetation) and REDD project (Reduction of Emissions from Deforestation and Forest Degradation). This methodology is applicable for the Amazon, Atlantic Forest, Cerrado biomes in non-humid areas.

For the present project, the aboveground Biomass carbon pool was quantified for the current moment for all project areas, including all strata, for and GHG reductions and/or removals for the ARR + REDD areas.

14 PROCEDURES

14.1 FIELD SURVEY

The field survey was carried out following the Operating Procedures presented in a document that will be available to the auditor.

The Operational Procedure was created by Neo Green and is denominated INVCF_01_Inventário_Carbono_Florestal and gives guidelines on how the work of the field team should be developed, describing all the procedures for the inventory and security standards to be followed.

The data collected in the field and statistics of the Forest Inventory will be presented in the document “FORESTIAL INVENTORY OF THE MORRO DO FOGO FARM – REDD + ARR”.

14.2 REMOTE SENSING

In the Remote Sensing stage, images from the Landsat satellite (30 m spatial resolution) were used, provided by the United States Geological Survey (USGS), as well as some images from Copernicus, CNES and Maxar Technologies, present in the database of the computational application Google Earth Pro, for multi-temporal analysis of native vegetation on the project property. Using the series of images from up to 36 years prior to the implementation of the project, it was possible to stratify the areas, between areas of Cerrado Stricto Sensu, Preserved Forest and areas where the Forest suffered some deforestation intervention or burned during the period analyzed (Section DRIVERS

DEFORESTATION). The technical specifications and dates of the respective images used in the analysis are shown in Table 2:

Table 2 Technical specifications and dates of satellite images..

Satellite	Spatial resolution (m)	Temporal resolution (days)	Date
Landsat/Copernicus (Google Earth Pro)	30	18	30/12/1985
CNES/Airbus (Google Earth Pro)	1	1	08/03/2020
Landsat 5	30	18	10/01/1985
Landsat 5	30	18	13/03/1990
Landsat 5	30	18	14/05/1995
Landsat 5	30	18	12/06/2000
Landsat 5	30	18	06/03/2005
Landsat 5	30	18	08/06/2015

Data from MapBiomas were also used for analysis and evidence of historical practices in the Cerrado region and the project for building the baseline of the project.

In the other geospatial analyses, other official sources were used, described in each map produced (PROJECT DESIGN Section).

14.3 MEASUREMENT OF CARBON STOCKS IN BIOMASS

14.3.1 FOREST INVENTORY ELABORATIONS DATE

- From May 18, 2023 to May 24, 2023.

14.3.2 EQUATIONS FOR ESTIMATING THE ABOVE-GROUND TREE CARBON STOCK

a) Estimation of carbon stocks in aboveground tree biomass (CAB_tree, i)[42]

To calculate the estimate of the carbon stock in the aboveground biomass for each individual tree of species group j in the sample plot located in the stratum, the following equation was used:

$$C_{AB_{tree},sp,i} = \sum_{j}^{S} \sum_{l=1}^{Nj,sp,i} B_j(X, Y \ldots) * CF_j \quad \textbf{(1)}$$

[42] *CDM. Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities – AR-Tool 14.*

Where:

CAB_tree, sp, i= Carbon stock in the aboveground biomass of trees in the sp plot in stratum i; t

CFj= Biomass carbon fraction for species in the group (default value = 0,47tC/t.dm[43]) j; t C t^{-1} dm

Bj(X, Y …) = Aboveground biomass of trees based on allometric equation for species group j based on tree variable(s); tdm $tree^{-1}$

i= 1, 2, 3, ... M strata

j = 1, 2, 3 ... S tree species

l = 1, 2, 3, ... Nj, sp, i sequence number of individual trees of species group j in sample sp plot in stratum i

b) Carbon stock in above-ground biomass converted into CO2e

The value resulting from the equation is used to calculate the average carbon stock in the aboveground biomass for each stratum, converted into carbon dioxide equivalents (CAB_tree, i), according to the equation below:

$$C_{AB_{tree},i} = \sum_{sp=1}^{P1} \frac{C_{AB_{tree},sp,i}}{A_{sp,i}} \times \frac{44}{12} \quad \textbf{(2)}$$

Onde:

CAB_tree, i= Average carbon stock of aboveground biomass in stratum i (t CO_{2e} ha^{-1});

CAB_tree, sp, i, t= Aboveground biomass carbon stock of trees in the stratum sp sample lot i, (t C)

A_{spi}= Area of the sample plot sp in the stratum i (ha);

sp = 1, 2, 3 ... Pi sample plots in the stratum i

i = 1, 2, 3 … Stratum M

44/12 = Molecular weight ratio of CO2 to carbon, (t CO_{2e} t C^{-1}).

c) Above ground biomass

Calculation of aboveground tree biomass using allometric equation

$$\mathbf{BS=f\,(dimensional\ data)} \quad \textbf{(3)}$$

BS = Aboveground biomass of trees based on allometric equation for species group j based on measured tree variable(s) (kg.dm/tree)

* variables: DAP, Total height of the tree.

[43] *IPCC. Guidelines for National Greenhouse Gas Inventories. 2006. Available in: https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_04_Ch4_Forest_Land.pdf. Acess in June,2022.*

c.i) Allometric equation for Cerrado vegetation

To determine the best suggested allometric equation (Souza, 2020 & Santos, 2018) for the vegetation in the sampled region, several articles referring to forest inventories in the Cerrado region were reviewed. The following equations were selected based on the results and published dissertation[44].

- Wooded Savanna without gallery forest (Cerrado Sensu stricto):

$$BS = \beta 0 \times DAP^{\beta 1} \times Ht^{\beta 2} \times d^{\beta 3} \quad (4)$$

Onde:

BS = Biomass above ground (kg.dm/tree);

DAP = Diameter at breast height (cm);

Ht = Total height (m);

d = wood density of each species (g/cm³);

β0 = 0,0296;

β1= 2,587;

β2= 0,4926;

β3= 0,1307.

- Forested Savannah (Forest Formation)

$$BS = \beta 0 \times DAP^{\beta 1} \times Ht \times d^{\beta 2} \quad (5)$$

Onde:

BS = Above ground biomass (kg.dm/tree);

DAP = Diameter at breast height (cm);

Ht = Total height (m);

d = wood density of each species * (g/cm³);

β0 = 0,0547;

β1= 2,0706;

β2= 1,6238.

* For wood density, validated databases were consulted (studies, articles, dissertations, theses, among others), prioritizing the density of the species, however some have not yet been determined so data from the

[44] *SOUZA, Y, F. Equações alométricas para estimativa de volume e biomassa em diferentes fitofisionomias do Cerrado. 2020. 123 f., il. Dissertação (Mestrado em Ciências Florestais) — Universidade de Brasília, Brasília, 2020.*

genus or family were used. For species that do not have any of these records in the literature or unidentified or dead species it was decided to use the generic value of 0.5 g/cm³ based on the study by Durigan (2004), who mentions that“ the densities of the Cerrado species found in the literature, result in an average of 0.5 g/cm³”[45].

c.ii) Allometric equation for vines and lianas:

No study was found covering vines and lianas in the Cerrado biome, nor specific allometric equations for the species found.So it was decided to adopt a generic equation and adjusted for a study for the population of Heteropsis spp[46].

$$\boldsymbol{BS = \beta 1 \times DAP} \quad (6)$$

Where:

BS = Biomass above ground (kg.dm/tree);

DAP = Diameter at breast height (cm);

β1= 1,1706;

d) Calculation of tree biomass per hectare

The aboveground biomass calculation per hectare is obtained through the following equation:

$$\mathbf{Btree,i = (\Sigma Bj/1000)\ x\ (10000/\ plot\ area)} \quad (7)$$

Vhere:

Btree,i: Aboveground tree biomass (t.dm ha^{-1});

ΣBS: Sum of Tree Biomass of all trees in the Plot (kg.d.m./plot area);

Factor 1000: Conversion of sample units (Kg.dm to t.dm);

Factor 10000: Area conversion from m^2 to hectare.

e) *UCF_{ARR}*

The calculation for quantification of UCF for the ARR project areas is obtained by the following equation:

$$\boldsymbol{UCF_{ARR} = \frac{(Cpp,i - Clb,i)}{(T_2 - T_1) \times Ai} \times \frac{44}{12}} \quad (8)$$

Where:

UCFARR = Forest Carbon Unit for projects of ARR (t CO_{2e} ha^{-1});

[45] *DURIGAN, G. Oportunidade de negócios em segmentos produtivos nacionais. Secretaria do Meio Ambiente do Estado de São Paulo, São Paulo, 2004. Available in https://www.cgee.org.br/documents/10195/734063/mc09_1250.pdf/4124bc7b-3c49-47c3-a02b-fc0fa9c2b5e2?version=1.0. Access in June, 2023.*

46 SANTOS, L, E. População de Heteropsis spp. Kunth (Cipó Titica) na Floresta Nacional de Tapajós. 2018. 45 p. il. Dissertação (Mestrado em Ciências Florestais) – Universidade Federal Rural da Amazônia, Belém, 2018.

Cpp,i = Carbon stock in the forest in the stratum (tC/ha);
Clb,i = Carbon stock for the chosen activity in the baseline scenario (tC/ha);
T2 = Current year;
T1 = Year baseline scenario;
Ai = Stratum area (ha);
44/12 = CO2 to carbon molecular weight ratio, (t CO_{2e} ha^{-1}).

*In the projection of CO2e stock increase in reforestation for year 1 (baseline scenario) the forest increment will be considered 0, for year 2 onwards it will be added to the carbon stock or annual increment for forest in each biome and depending on the former land use, in the case of this study the value for forest regenerating in pasture in the Cerrado = 2.85 tC/ha/year was used[47].

f) *UCF_{REDD}*

The calculation for quantification UCF for REDD project areas is subdivided into REDD_PL and REDD_PA categories, based on the baseline scenario of each one, the equations are as follows:

$$UCF_{REDD\_PL} = \left[(Clb,i \times Ad_{Ano}) \times \frac{44}{12}\right] - \left[(Cbb,i \times Ad_{Ano}) \times \frac{44}{12}\right] \quad (9)$$

$$UCF_{REDD\_PA} = \left[(Clb,i \times Ad_{Ano}) \times \frac{44}{12}\right] - \left[(Cbb,i \times Ad_{Ano}) \times \frac{44}{12}\right] \quad (10)$$

Onde:

UCF_{REDD_PL} = Forest Carbon Unit for the areas of REDD_PL (t CO_{2e} ha^{-1});

UCF_{REDD_PA} = Forest Carbon Unit for the areas of REDD_PA (t CO_{2e} ha^{-1});

Cpp,i = Carbon stock in the forest in the stratum (tC/ha);

Clb,i = Carbon stock for the chosen activity in the baseline scenario (tC/ha);

Ad_{Ano} = Deforested area in the extract of the analyzed year (ha);

44/12 = Molecular weight ratio of CO2 to carbon, (t CO_{2e} ha^{-1}).

*In the projection of CO2e reductions and removals for year 1 (baseline scenario) the forest increment will be considered 0, for year 2 onwards the annual increment for forest in each biome will be added to the carbon stock and depending on the former land use, in the case of this study, the value for Cerrado forest = 2.10 tC/ha/year was used[48].

g) *$UCF_{ARR+REDD}$*

The calculation for quantification of UCFARR+REDD, for all strata of the project is obtained by the following equation:

[47] *SEEG. Nota Metodológica SEEG 9- Setor Mudança de Uso da Terra e Florestas.2021. Available in https://seeg-br.s3.amazonaws.com/Notas%20Metodologicas/SEEG_9%20%282021%29/Nota_Metodologica_SEEG_9_MUT_v3.docx.pdf. Access in June,2023.*
[48] *SEEG. Nota Metodológica SEEG 9- Setor Mudança de Uso da Terra e Florestas.2021. Available in https://seeg-br.s3.amazonaws.com/Notas%20Metodologicas/SEEG_9%20%282021%29/Nota_Metodologica_SEEG_9_MUT_v3.docx.pdf. Access in June,2023.*

$$UCF_{ARR+REDD} = \left(UCF_{REDD\_PL} + UCF_{REDD\_PA}\right) + UCF_{ARR} \quad (11)$$

Where:

$UCF_{ARR+REDD}$= Total Forest Carbon Unit: (t CO_{2e} ha^{-1});

UCF_{REDD_PL} = Forest Carbon Unit for the areas of REDD_PL (t CO_{2e} ha^{-1});

UCF_{REDD_PA} = Forest Carbon Unit for the areas of REDD_PA (t CO_{2e} ha^{-1});

UCF_{ARR}= Forest Carbon Unit for the areas ARR (t CO_{2e} ha^{-1}).

14.3.3 SAMPLE SUFFICIENCY

The following formula was used to calculate the sample sufficiency [49]:

$$n = \left(\frac{tVAL}{E}\right)^2 \times \left(\sum_i wi \times S_i\right)^2 \quad (12)$$

Where:

n= number of installments;

tVAL= Bilateral T-Student value in infinite degrees of freedom for the required confidence level;

E = Acceptable margin of error (half confidence interval) in estimating biomass stock within the project boundary (t d.m/ha);

Wi = Relative weight of stratum area (stratum area divided by project area);

Si = Estimated standard deviation of biomass stock in the stratum (d.m/ha);

This formula is used for a small sampling fraction (that is, when the sampled area is less than % of the project area).

15 PROJECT ACTIVITY

15.1 UCF ARR

The baseline scenario in the ARR modality was based on the consolidated areas of the property which were used as pasture since 1985 and were gradually abandoned for recovery due to the great difficulty in managing the cattle and removing beef cattle on the farm, taking into account its very undulating terrain, making the whole process very costly, as already described in the historic section of the Morro do Fogo farm, where the entire history of the property is presented.

[49] *CDM. Calculation of the number of sample plots for measurements within A/R CDM project activities - A/R Methodological Tool.*

In addition to the historical evidence described by the landowner, these consolidated areas undergoing recovery were validated with the aid of Remote Sensing (Sections MULTITEMPORAL ANALYSIS of the project and SAMPLING SURVEY OF VEGETATION AND STRATIFICATION), resulting in two strata: forested savanna (burned) (Formação Florestal) - Medium regeneration and Forested Savannah (burned) (Forest Formation) - Initial regeneration.

In Figure 12 we have the map with the location of the regeneration areas within the property:

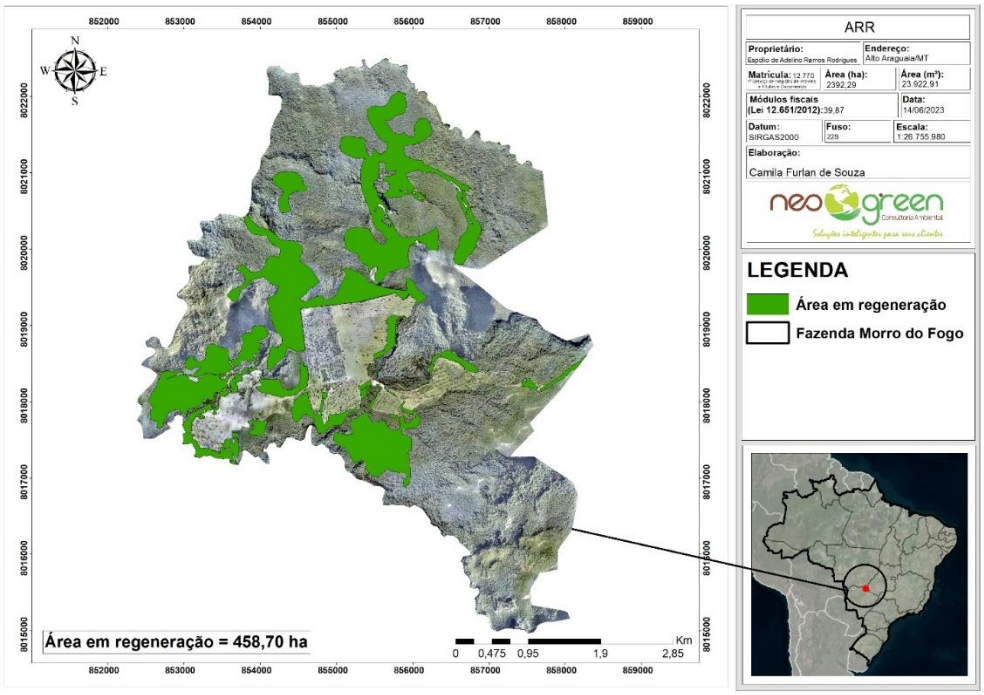

Figure 12. Forest regeneration areas within the project property.

For the baseline it was considered that the owner could continue with his pasture activities for cattle in the entire area currently under regeneration, in this way we can obtain the value of GHG emissions avoided by the current scenario of the property (UCFARR) by the difference of the stock of carbon in the native vegetation for the area of 458.70 ha and of the stock of carbon in the pasture for the same area.

The values of carbon stock in native vegetation were obtained in this study, through the forest inventory of the area while the carbon stock in pasture was found in the literature[50].

[50] SEEG. Nota Metodológica SEEG 9- Setor Mudança de Uso da Terra e Florestas.2021. Available in https://seeg-

15.2 REDD

15.2.1 UCF REDD - PL

The baseline of the project in the REDD - PL modality (Deforestation or degradation of areas with legal permission) assumes that the forest area will be converted into another use, the deforested area in this scenario, must be in accordance with the legal support of the Brazilian legislation for deforestation in the biome. The scenario should be a change in land use and use of forest areas for agrosilvopastoral activities in REDD_PL areas.

That said, the baseline scenario of this project's REDD project area was based on legally protected areas within the property (RL + APP) being modified to use pasture for cattle raising.

For the RL areas on the property, the Brazilian Forest Code (Law No. 12.651/2012[51]) was considered in its Art. 12. which describes:

"Art. 12. Every rural property must maintain an area covered by native vegetation, as a Legal Reserve, without prejudice to the application of rules on Permanent Preservation Areas, subject to the following minimum percentages in relation to the property area, except for the cases provided for in art. 68 of this Law:

I - Located in the Legal Amazon:

a) 80% (eighty percent), in the property located in a forested area;

b) 35% (thirty-five percent), in the property located in the cerrado area);

c) 20% (twenty percent), in the property located in the Campos Gerais area."

Thus, understanding that the project area is inserted within the perimeter of the Legal Amazon in a savannah area, the Legal Reserve of the property is equivalent to 35% of its area, that is 835.62 hectares.

For APP areas on the property, the Forest Code also provides in its Art.7. that:

"Art. 7 The vegetation located in a Permanent Preservation Area must be maintained by the owner of the area, possessor or occupant in any capacity, natural or legal person, public or private law".

In determining the dimensions of the APP of the watercourses of the property, the Forestry Code was also used, which in its Art. 4 determines that:

"I - the marginal strips of any perennial and intermittent natural watercourse, excluding the ephemeral ones, from the edge of the regular bed gutter, in a minimum width of: (Wording given by Law No. 12,727, of 2012).

br.s3.amazonaws.com/Notas%20Metodologicas/SEEG_9%20%282021%29/Nota_Metodologica_SEEG_9_MUT_v3.docx.pdf. Access in June,2023.

[51] *BRASIL. Lei nº 12.651, de 25 de maio de 2012. Available in https://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12651.htm. Access in July,2023.*

a) 30 (thirty) meters, for watercourses less than 10 (ten) meters wide;

b) 50 (fifty) meters, for water courses between 10 (ten) and 50 (fifty) meters wide;

c) 100 (one hundred) meters, for water courses between 50 (fifty) and 200 (two hundred) meters wide;

d) 200 (two hundred) meters, for water courses between 200 (two hundred) and 600 (six hundred) meters wide;

e) 500 (five hundred) meters, for watercourses that are more than 600 (six hundred) meters wide.

IV - the areas surrounding springs and perennial water sources, whatever their topographical situation, within a minimum radius of 50 (fifty) meters; (Wording provided by Law No. 12,727 of 2012). (See ADIN No. 4.903)".

For the REDD_PL areas on the project property the APPs will measure 30 meters in the water courses and 50 meters in the springs.

Considering the aforementioned legislation, the property will have 835.62 ha of protected area (RL+APP). Since for the RL it was projected that the landowner must by law preserve 35% of the native vegetation (area also declared in the CAR) of the property and all APP areas, following the dimensions established in the law and the rest could be used for pasture, as long as the unconsolidated areas were suppressed with approval from the responsible environmental agency.

In Figure 13 we have the map with the location of preservation and pasture areas in the project's REDD baseline scenario.

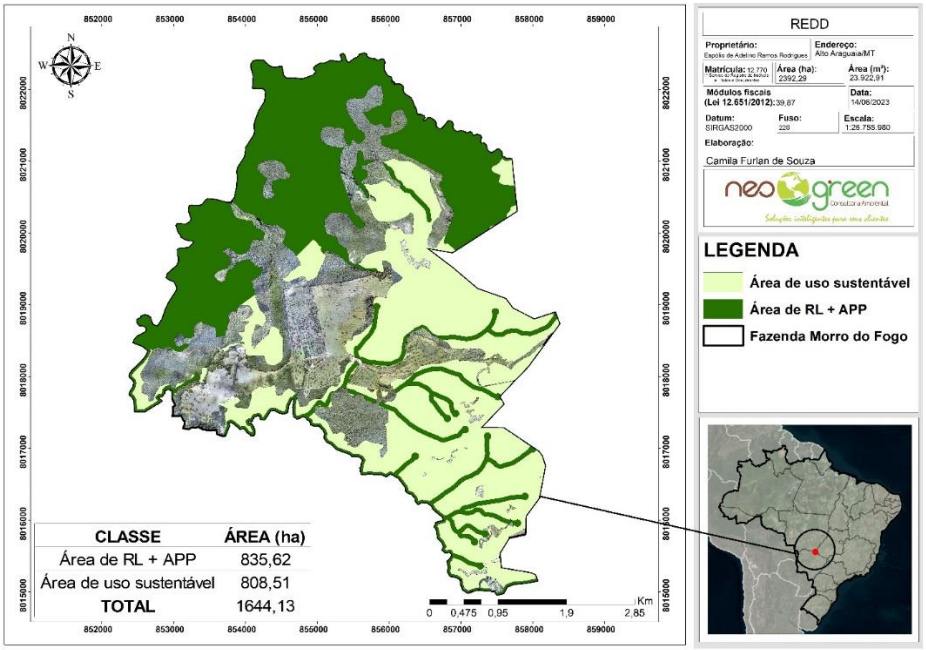

Figure 13 Conservation and grazing areas in the project's REDD baseline scenario.

On the map we can see the preserved areas of RL + APP with 835.62 ha and the Sustainable Use Area considered for the REDD_PL modality with 808.51 ha.

15.2.2 UCF REDD - AP

The baseline of the project assumes that the forest area has been converted to another use, the area deforested in this scenario must be in accordance with the deforestation rate of the biome. The scenario should be the change in land use and use of forest areas for agrosilvopastoral activities in REDD areas and the calculation will be the carbon stock of the project area in year t=-1.

In this way, the Deforestation rate for the Cerrado Biome was projected in the item DRIVERS OF DEFORESTATION over the last 3 years, resulting in 33.33% of deforestation per year. This rate was used to predict the deforestation of the preserved area (RL+APP) in the period of 1 year, considering the current scenario of the Biome.

The map for this baseline scenario is the same as for the UCF REDD_PL, represented in Figure 13. Preservation and pasture areas in the project's REDD baseline scenario.

In the first year the remaining preserved area (RL+APP) would be 557.11 ha and the remaining area of 278.51 ha would be all pasture from the second year on.

For the calculation of UCF REDD_PA, the values already calculated for carbon stock in the native vegetation of the project were considered and for pasture the carbon stock value was considered 0 since in the first year deforestation and land preparation took place and only in the second year the planting of pasture will have some carbon increment.

The values of carbon stock (7.57 tC/ha) and increment (1.27 tC/ha) for pasture in the projection of subsequent years of the project were obtained in SEEG 9[52].

16 RESULTS

16.1 EVIDENCE OF HISTORICAL PRACTICES IN THE REGION

[52] SEEG. Nota Metodológica SEEG 9- Setor Mudança de Uso da Terra e Florestas.2021. Available in https://seeg-br.s3.amazonaws.com/Notas%20Metodologicas/SEEG_9%20%282021%29/Nota_Metodologica_SEEG_9_MUT_v3.docx.pdf. Access in June,2023.

Evidences of historical practices in the Cerrado region and close to the project area were obtained through the MapBiomas classification, which has an annual land use classification base, from 1985 to 2021. Data from all years were used for a general analysis and in Figure 14 and Figure 15 are presented the land use classifications of the Cerrado Biome and the project region in the years 1985, 1995, 2005 and 2020.

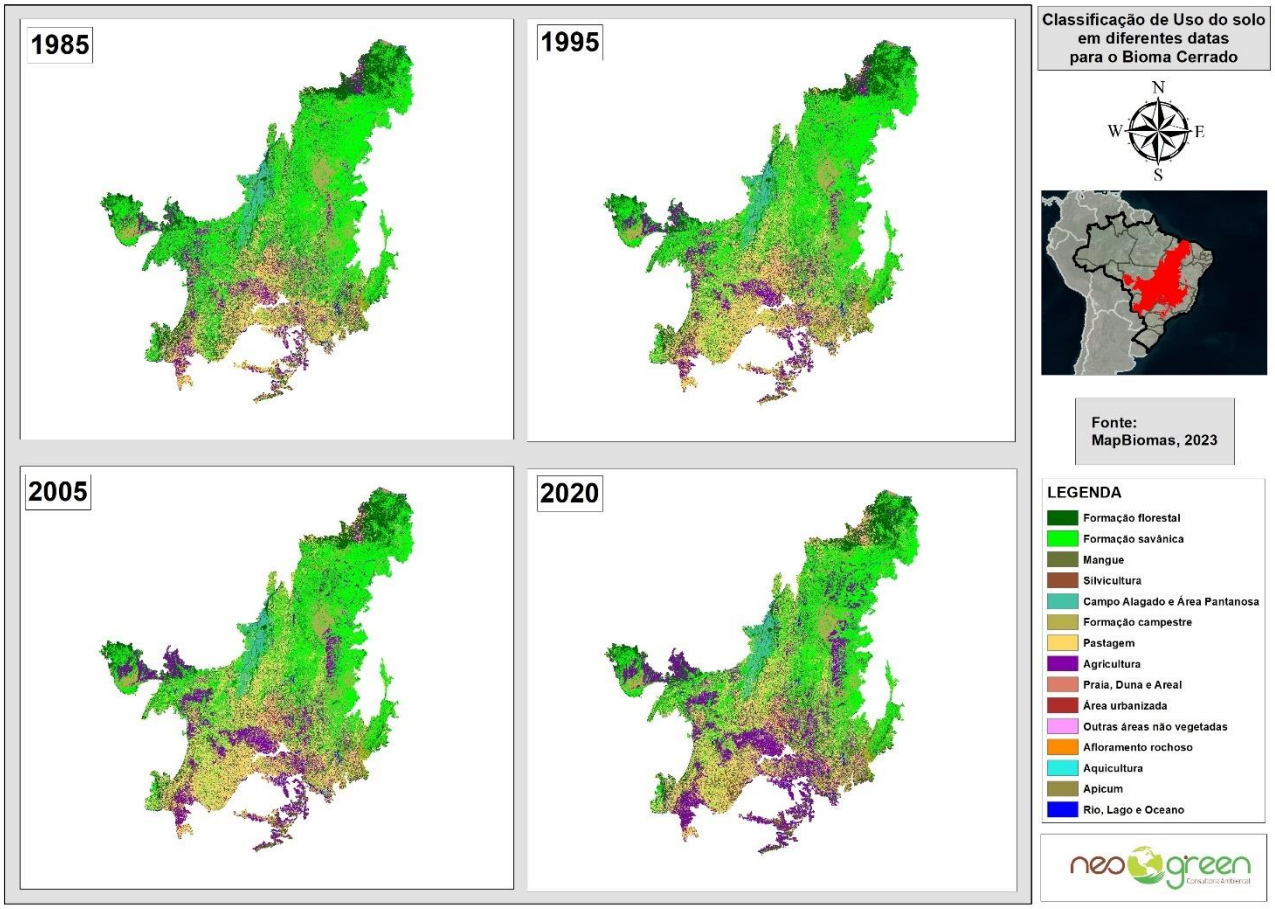

Figure 14. Multitemporal analysis of Cerrado land use.

Analyzing Figure 14, can be observed that over the years the areas of Forest Formation and Savanna Formation suffered a great decrease, being replaced by areas of Pasture, Forestry and Agriculture. As previously mentioned, the Cerrado is a Biome that suffers a lot of anthropic action, there are studies that mention that after the Atlantic Forest, the Cerrado is the Brazilian ecosystem that suffered the most alterations with human occupation[53].

[53] *Ameaças ao Cerrado. Available in https://www.wwf.org.br/natureza_brasileira/questoes_ambientais/biomas/bioma_cerrado/bioma_cerrado_ameacas/. Access in June,2023.*

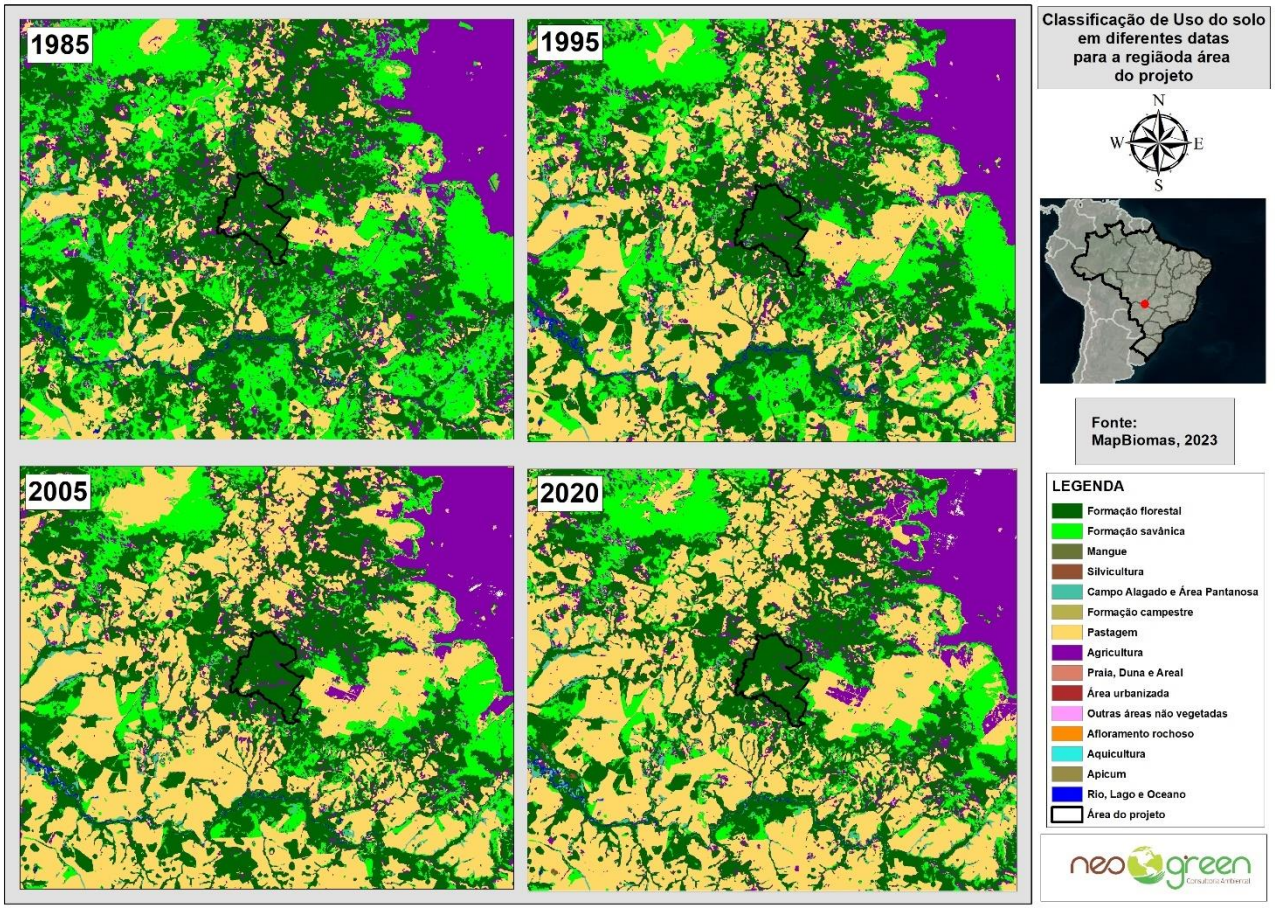

Figure 15. Multitemporal analysis of land use in the project region.

In the project region can be observed that over the years the deforestation of natural areas (Forest Formation and Savanna Formation) has grown exponentially for the use mainly of pasture. It is also important to note that the project area is the largest fragment of natural area that is still preserved and connected to an ecological corridor already very fragmented amid the growth of pastures and agricultural areas.

MapBiomas still does not present the land use classification for the years 2022 and 2023, but according to data released by the SAD (Cerrado Deforestation Alert System), deforestation in the Cerrado reached 188.2 thousand hectares in the first quarter of year 2023. This number represents 35% more than that registered in the first three months of the previous year, when 139.8 thousand hectares were deforested.[54].

[54] *Desmatamento do Cerrado sobe 35% no primeiro trimestre de 2023.Available in Desmatamento do Cerrado sobe 35% no primeiro trimestre de 2023 - IPAM Amazônia. Access in June,2023.*

SAD provides deforestation alerts between the years 2021 and 2023 on its platform. Figure 16 and Figure 17 show the alerts issued by the platform for the Cerrado Biome and the project region consecutively.

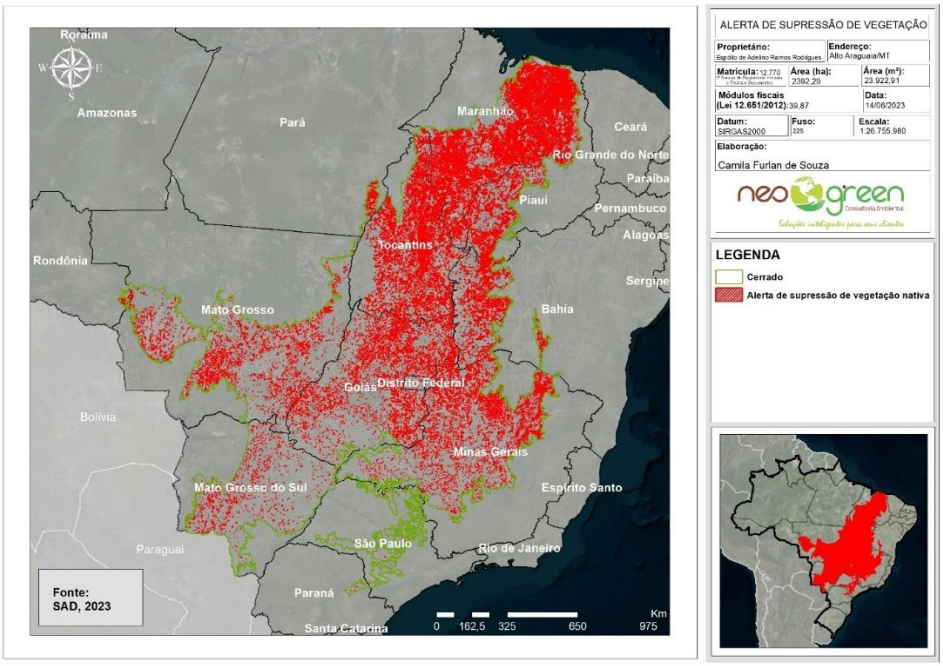

Figure 16. Deforestation alerts for the Cerrado between the years 2021 and 2023.

Between 2021 and 2023 alerts were issued for around 1,222,496.77 ha of suppression area in the Cerrado. The areas with the most alerts are between the states of Tocantins and Maranhão.

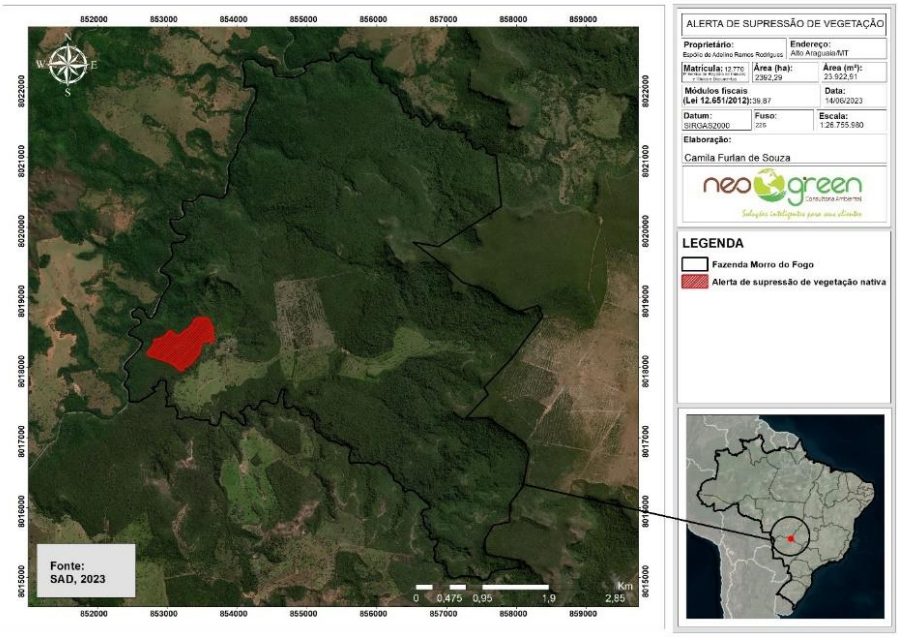

Figure 17. Deforestation alerts for the project area between the years 2021 and 2023.

An alert issued on 05/23/2022 was found within the project area, crossing the classification data, this area is located in one of the stratification areas of Forested Savannah (burned) (Forest Formation) - Initial regeneration. This area was used for pasture since 1985, being considered in the property. However the last intervention in the place was in the year 2022 and since then it has been left for recovery (Figure 18).

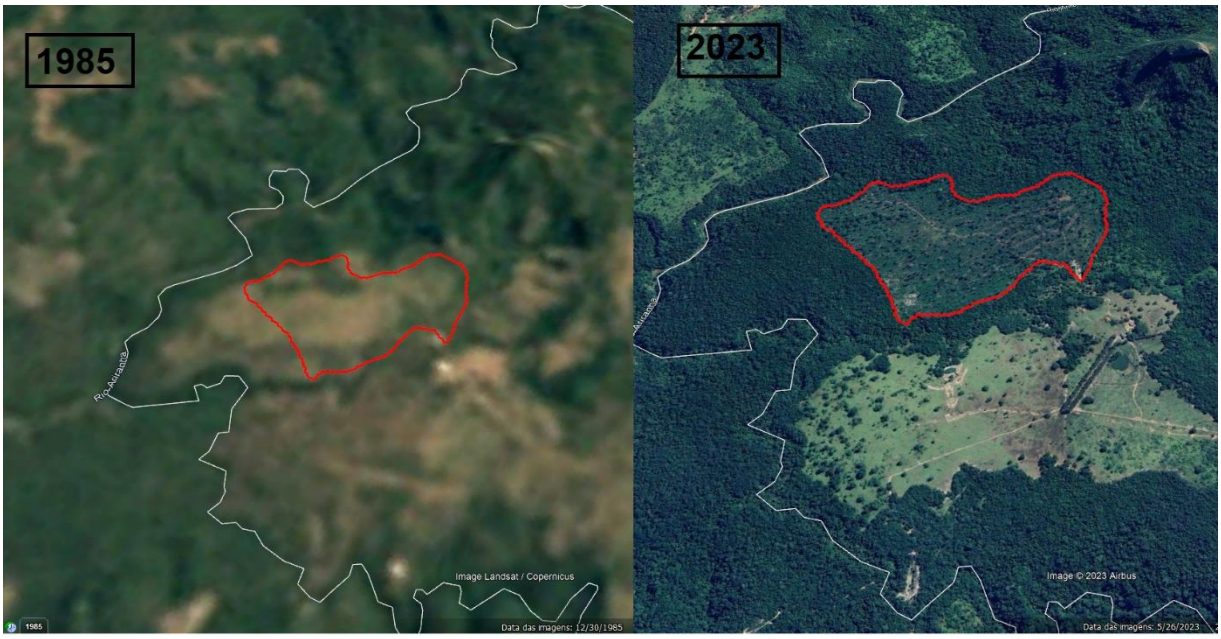

Figure 18. Evidence of the use of the area for pasture since 1985 and area under regeneration in 2023.

The evidence presented here proves, through official databases, how threatened the Cerrado Biome is, mainly by agrosilvopastoral activities. According to data from the WWF (World Wide Fund for Nature), in recent years, the expansion of agriculture and livestock represents the greatest risk factor for the Cerrado[55].

Also according to WWF, the few blocks of native vegetation still unaltered in the Cerrado should be considered a priority for the implementation of protected areas since only 0.85% of the Cerrado is officially in conservation units[56].

Conserving what remains of the Cerrado is a fight against time, given the many threats the biome has been suffering. It is necessary to promote the conservation and sustainable use of biodiversity, reduce or even stop the deforestation of native vegetation, recover what has already been degraded, in addition to strengthening the peoples of the

[55] *Ameaças ao Cerrado. Available in https://www.wwf.org.br/natureza_brasileira/questoes_ambientais/biomas/bioma_cerrado/bioma_cerrado_ameacas/. Access in June, 2023.*
[56] *Ameaças ao Cerrado. Available in https://www.wwf.org.br/natureza_brasileira/questoes_ambientais/biomas/bioma_cerrado/bioma_cerrado_ameacas/. Access in June, 2023.*

Cerrado, guaranteeing access to land and natural resources, encouraging the continuity of their ways of life and their role in the socio-environmental management of the biome[57].

Considering all the data and references cited in this study, it is highlighted how important the Morro do Fogo Farm Project is for this Biome and conservation of the natural vegetation in this already so degraded region. It also emphasizes the importance of project continuity and encouragement of other similar projects throughout the Cerrado Biome.

16.2 MULTITEMPORAL PROJECT ANALYSIS

The multitemporal analysis of the vegetation was carried out for the period of 37 years before the start of the project, to show the recovery of areas of native vegetation and the stratification of the inventoried areas, with images being raised for the years 1985 (Figure 19), 1990 (Figure 20), 1995 (Figure 21), 2000 (Figure 22), 2005 (Figure 23) and 2023 (Figure 24).

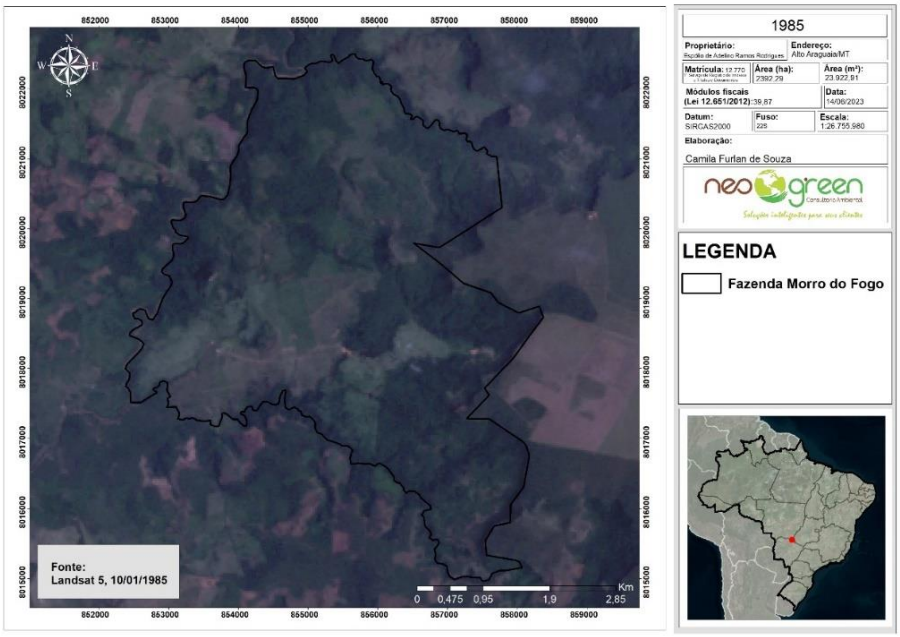

Figure 19: Satellite image from the year 1985.

[57] *Estratégias para conservação do Cerrado. Available in https://ispn.org.br/biomas/cerrado/estrategias-para-conservacao/. Access in June, 2023.*

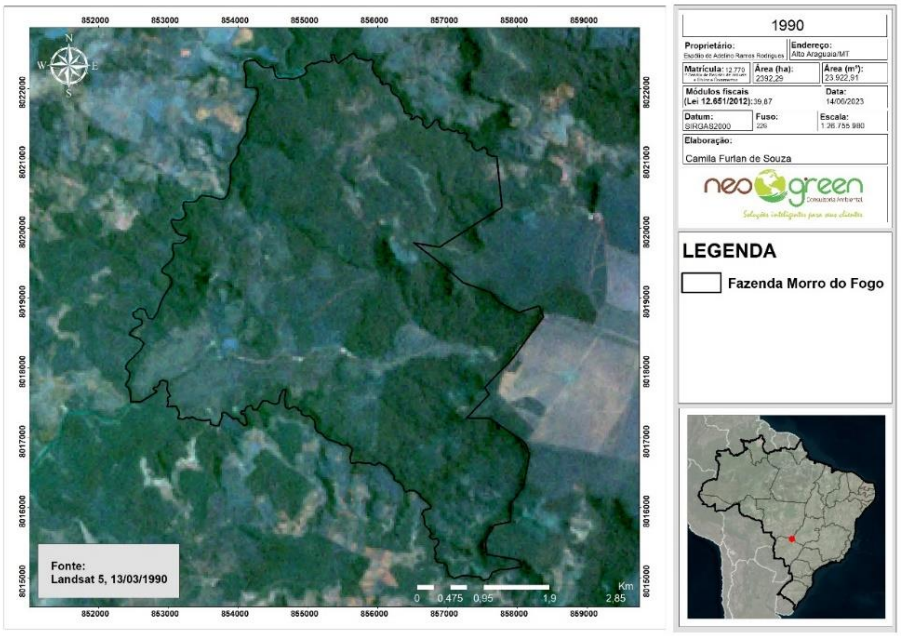

Figure 20: Satellite image from the year 1990.

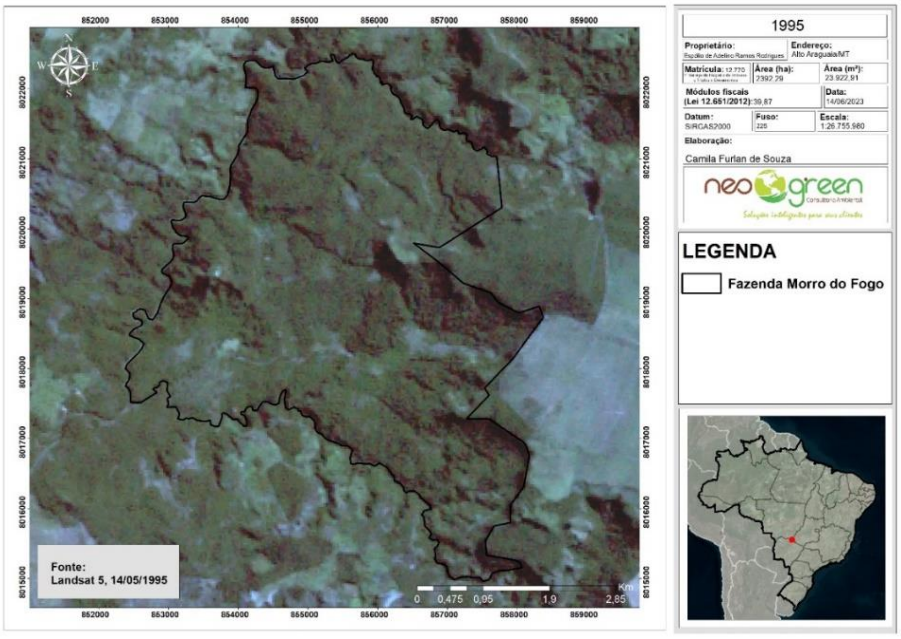

Figure 21: Satellite image from the year 1995.

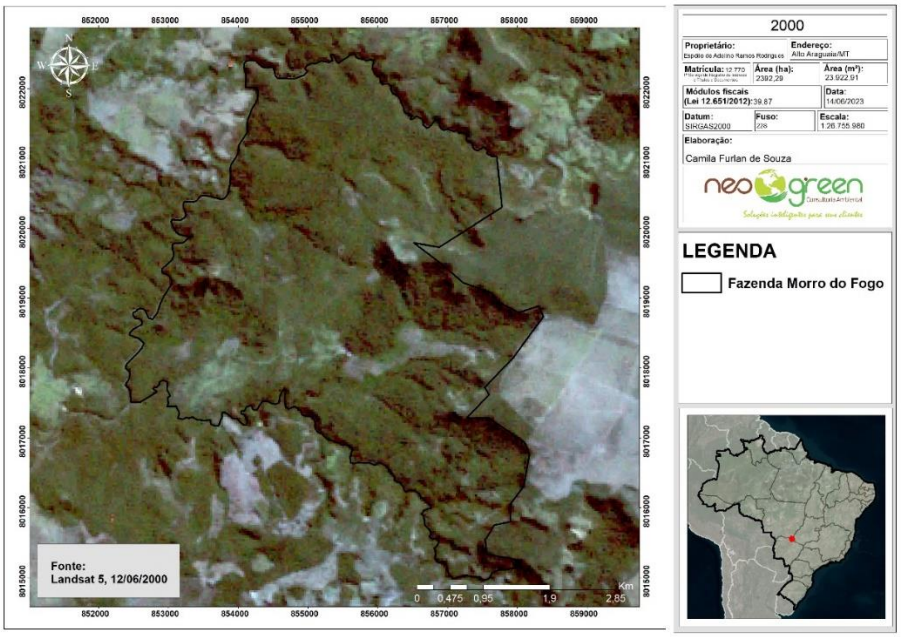

Figure 22: Satellite image from the year 2000.

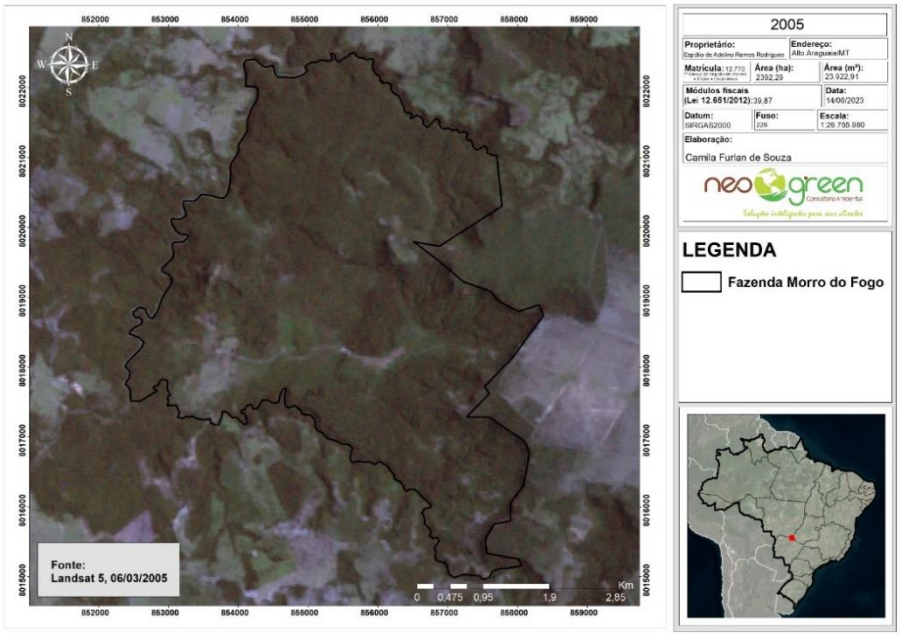

Figure 23: Satellite image from the year 2005.

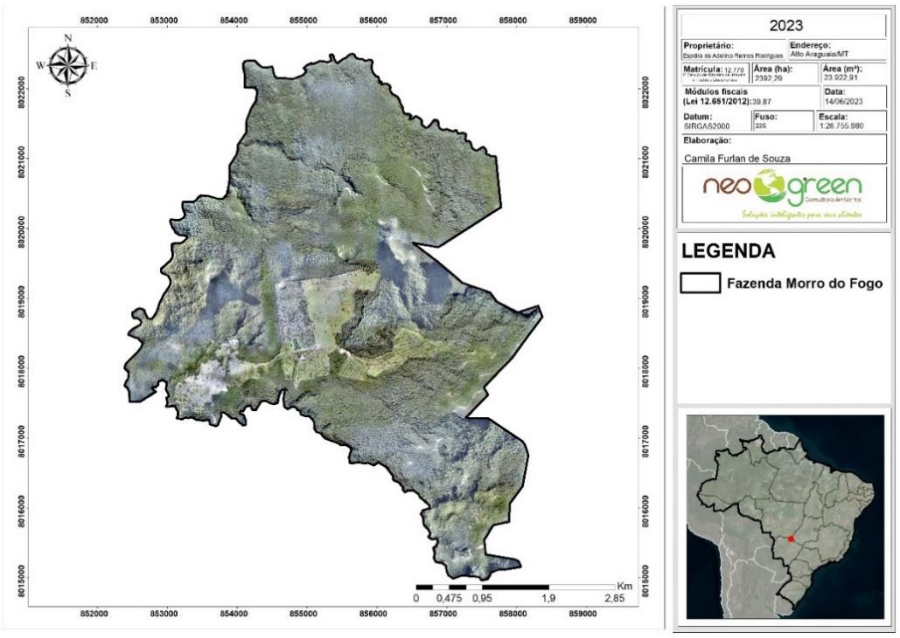

Figure 24: Satellite image from the year 2023.

16.3 SAMPLING OF VEGETATION AND STRATIFICATION

In May 2023, 2,994 individuals were surveyed in the 16 Sampling Units and duly identified. In addition, the coordinates of each plot were obtained with the UTM Zone 22S projection system, DATUM SIRGAS 2000 (Figure 25).

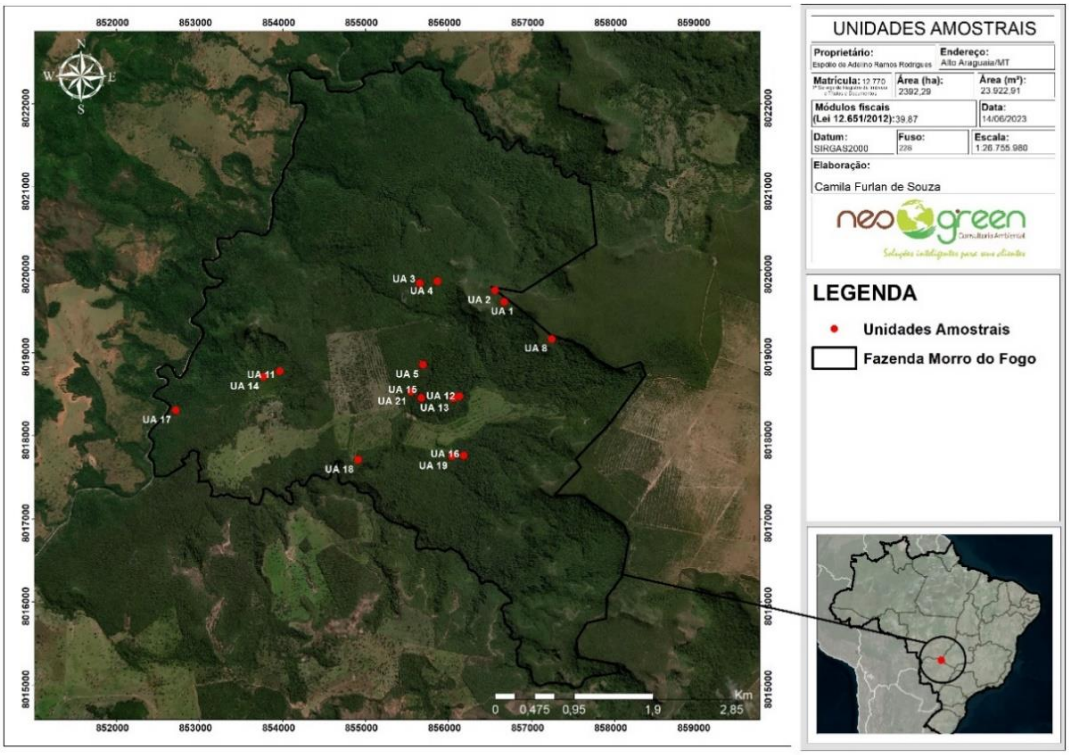

Figure 25. Location of the Sample Units allocated in the Forest Inventory field.

The polygons obtained from the coordinates of each plot (1000m²) were vectorized on the map. However, there may be some displacements in relation to the actual location in the field. This displacement is common when the absolute positioning method is used, that is when the coordinates are linked to only one geocentric reference.

In the literature, a study was found citing these same positioning displacements, which had an amplitude of 5 to 14 m and even so are considered of medium precision taking into account a forest of *Araucaria angustifolia*[58] that has a much smaller coverage in the canopy than the area of the project. In view of this we can conclude that even with the positioning displacements the points collected in the field have quality and can help in the location of the plots in the field.

The stratification of the native vegetation area was initially developed prior to the forest inventory considering the differences between altitudes within the property and forest typologies determined by IBGE with the aim of predetermining the number of Sample Units and assisting the field team in recognizing the location. However, in the field different stages of regeneration were observed at the site, in addition to the distribution of forest typologies that were slightly different from those determined by the IBGE.

Taking into account the knowledge acquired by the field team during the inventory a new stratification was determined (Figure 26 and Figure 27).

[58] *VENANCIO, D. L.; DISPERATI, A. A.; NEVES, R. V. Mapeamento da Araucaria angustifolia utilizando receptores GPS. Cerne, Lavras, v. 16, n. 3, p. 391-398, 201.*

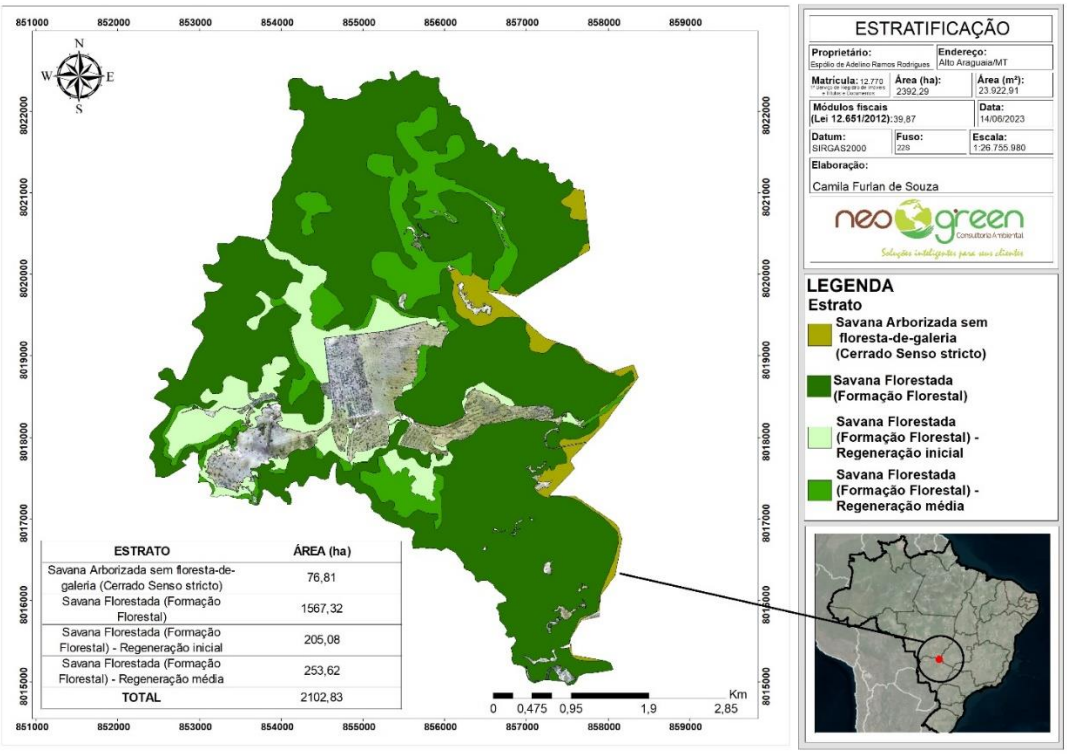

Figure 26. Stratification of the project's native vegetation area.

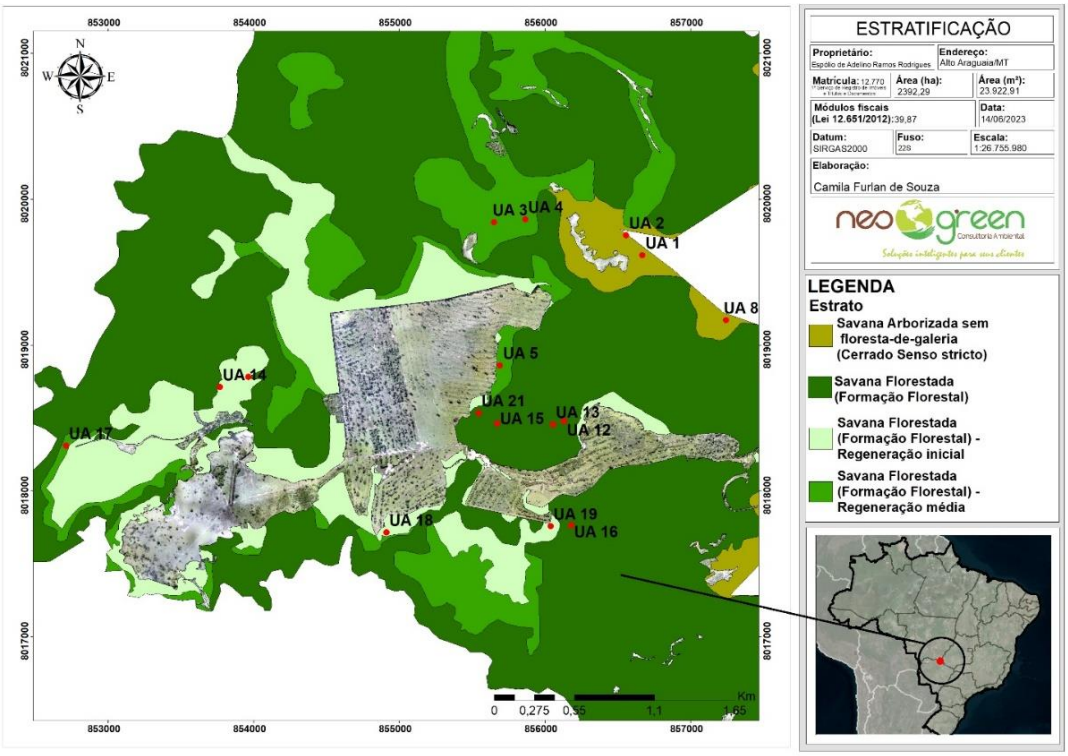

Figure 27. Stratification of native vegetation in the project area and allocated Sample Units.

16.4 CARBON STOCK ESTIMATE

16.4.1 ESTIMATE OF CARBON STOCK - CURRENT MOMENT

To quantify the above-ground biomass data collected in the field were used and the equations described in the Section EQUATIONS FOR ESTIMATING THE ABOVE-GROUND TREE CARBON STOCK were used. All quantification data are presented in Table 3 below by averages and sums of each sample plot.

Table 3: Dendrometric Summary and Quantification of Aboveground Biomass/hectare.

Sampling Units	Stratum	Average DAP (cm)	Average height (m)	Average Btree,l,jp,i(t d.m/ha)	Σ Btree,l,jp,i(t d.m/ha)	No. of trees
1	Wooded Savanna without gallery forest (Cerrado Sensu stricto)	9,76	5,75	0,58	128,54	223
2	Wooded Savanna without gallery forest (Cerrado Sensu stricto)	8,17	5,33	0,54	105,24	195
3	Forested Savannah (not burned) (Forest Formation)	10,54	6,83	0,53	112,97	215
4	Forested Savannah (burned) (Forest Formation) - Medium regeneration	9,67	7,36	0,52	121,46	235
5	Forested Savannah (burned) (Forest Formation) - Medium regeneration	9,42	5,49	0,58	112,79	194
8	Wooded Savanna without gallery forest (Cerrado Sensu stricto)	9,91	5,89	0,62	126,64	203
11	Forested Savannah (not burned) (Forest Formation)	13,48	8,05	1,43	190,09	133
12	Forested Savannah (not burned) (Forest Formation)	16,25	7,36	1,75	207,91	119
13	Forested Savannah (not burned) (Forest Formation)	13,11	6,46	1,40	216,99	155
14	Forested Savannah (burned) (Forest Formation) - Medium regeneration	14,83	6,15	0,49	83,69	171
15	Forested Savannah (not burned) (Forest Formation)	11,71	7,17	1,40	195,43	140
16	Forested Savannah (not burned) (Forest Formation)	10,84	7,97	0,87	173,18	198
17	Forested Savannah (burned) (Forest Formation) - Medium regeneration	16,95	5,43	0,70	136,90	196
18	Forested Savannah (burned) (Forest Formation) - Medium regeneration	8,08	5,87	0,25	72,00	288
19	Forested Savannah (burned) (Forest Formation) - Medium regeneration	22,18	5,07	0,64	78,61	123
21	Forested Savannah (not burned) (Forest Formation)	11,39	5,62	0,84	173,57	206

The total carbon stock converted to carbon dioxide equivalent for the entire study area was **624,058.58tCO2e.**

16.4.2 ESTIMATE OF EMISSIONS FROM AVOID DEFORESTATION – ARR

To quantify avoided emissions from deforestation in the project areas for the ARR modality in an area of 478.70 ha, data collected in the field were used and applied to the

equations described above in the section EQUATIONS FOR ESTIMATE OF TREE CARBON STOCK ABOVE GROUND all data quantification methods are shown in Table 4 below, showing the values per stratum and the UCFARR value.

Table 4. Quantification of carbon per stratum, carbon per hectare and quantification of UCFARR.

Stratum	C (tC/stratum)	Carbon removals (tCO2e/ha)
Forested Savannah (burned) (Forest Formation) - Medium regeneration	14.427,04	12.507,13
Forested Savannah (burned) (Forest Formation) - Initial regeneration	7.527,81	5.975,36
Total	21.954,85	18.482,49
UCF_{ARR}		**67.830,74**

For the two strata in the ARR area, the amount of carbon dioxide equivalent removed from the atmosphere over the 10 years is 67,830.74tCO2e.

16.4.3 ESTIMATE OF EMISSIONS FROM AVOID DEFORESTATION - REDD_PL

To quantify avoided deforestation emissions in project areas for the REDD_PL modality in an area of 809.46 ha, data collected in the field were used and applied to the formulas described in the section EQUATIONS FOR ESTIMATING THE ABOVE-GROUND TREE CARBON STOCK. All quantification data are shown in Table 5 below, showing the values per stratum and the UCFREDD_PL value.

Table 5. Quantification of carbon per stratum, carbon per hectare and quantification of UCFREDD_PL.

Land use classes	C (tC/ha)	UCF_{REDD_PL} tCO2e
Pasture	0,00*	0,00*
Preserved area	72.079,33	264.531,14
Total		**264.531,14**

* The stock value for pasture in the first year was considered as 0, because in the first year it is considered that the forest has just been deforested and the soil will be prepared and later the pasture will be established, with its increment increasing from the second year.

For the two strata in the REDD_PL area, the amount of carbon dioxide equivalent that had its emission avoided by the project resulted in 264,531.14tCO2e.

16.4.4 ESTIMATE OF EMISSIONS FROM AVOID DEFORESTATION - REDD_PA

To quantify the avoided deforestation emissions in the project areas for the REDD_PA modality in an area of 278.51 ha, data collected in the field were used and applied to the formulas described in the section EQUATIONS FOR ESTIMATING THE ABOVE-GROUND TREE CARBON STOCK. All quantification data are shown in Table 6 below, showing the values per stratum and the UCFREDD_PA value.

Table 6. Quantification of carbon per stratum, carbon per hectare and quantification of UCFREDD_PA.

	C (tC/ha)	UCF -REDD tCO2e
Pasture	0,00*	0,00*
Preserved area	24.801,07	91.019,91
Total		**91.019,91**

* The stock value for pasture in the first year was considered as 0, because in the first year it is considered that the forest has just been deforested and the soil will be prepared and later the pasture will be established with its increment increasing from the second year.

For the two strata in the REDD_PA area, the amount of carbon dioxide equivalent that had its emission avoided by the project, resulted in **91,019.91tCO2e.**

16.5 $UCF_{ARR+REDD}$

UCFREDD + ARR resulted in 423,381.79tCO2e for the year 2023. Table 7 describes the results found for the project:

Table 7. UCF quantification results for the project areas in the year 2023.

UCF Type	Project Area (ha)	Removals or Emissions avoided by the project	Amount of UCF
UCF_{ARR}	458,70	67.830,74tCO_{2e}	**67.830,74tCO_{2e}**
UCF_{REDD_PL}	809,45	264.531,14tCO_{2e}	**264.531,14tCO2e**
UCF_{REDD_PA}	278,51	91.019,91tCO_{2e}	**91.019,91tCO2e**
$UCF_{ARR+REDD}$	**1.546,66**	**423.381,79tCO_{2e}**	**423.381,79tCO2e**

17 ANNUAL PROJECTION OF REMOVALS AND AVOIDED EMISSIONS

For the annual projection of Removals and Avoided Emissions of the project, the results found in Table 7 were used as a basis. UCF quantification results for the project

areas in the year 2023 and the following values found in the literature for the Cerrado Biome: increment annual increment for native vegetation in the Cerrado Biome (2.1 tC/ha/year), annual increment for regenerating forests in areas that used to be pasture (2.85 tC/ha/year), annual increment for pasture in the Cerrado Biome, and pasture stock already established (7.57 tC/ha/year[59]).

Using the aforementioned values, Removals and Reductions of CO2e Emissions were calculated for the 10 years of the project (Table 8).

Table 8. Projection of Removals and Reductions of CO2e Emissions over the 10 years of the project.

Year	REDD_PL	REDD_PA	ARR	UCF_ARR+REDD
	Reduction of CO2e removals	Reduction of CO2e removals	CO2e removal	CO2e in the deforested area
2023	264.531,14	91.019,91	67.830,74	423.381,79
2024	264.538,84	93.166,40	72.628,51	430.333,76
2025	264.546,55	95.312,89	77.426,29	437.285,73
2026	264.554,26	97.459,38	82.224,06	444.237,69
2027	264.561,97	99.605,86	87.021,83	451.189,66
2028	264.569,67	101.752,35	91.819,61	458.141,63
2029	264.577,38	103.898,84	96.617,38	465.093,60
2030	264.585,09	106.045,33	101.415,15	472.045,56
2031	264.592,79	108.191,81	106.212,92	478.997,53
2032	264.600,50	110.338,30	111.010,70	485.949,50
Total	2.645.658,19	1.006.791,07	894.207,19	4.546.656,46

Based on the above values, it is possible to have a future projection until the year 2032, where the value of UCFARR+REDD will result in approximately 485,949.50tCO2e. It is worth mentioning that these values will be recalculated throughout the project since the Sampling Units will be remeasured every 2 years, making it possible to obtain a more accurate value of the annual increment for the study area.

18 LEAKAGE

Leakage from properties was estimated based on the methodology of the CDM AR-TOOL15[60].

59 SEEG. Nota Metodológica SEEG 9- Setor Mudança de Uso da Terra e Florestas.2021. Available in https://seeg-br.s3.amazonaws.com/Notas%20Metodologicas/SEEG_9%20%282021%29/Nota_Metodologica_SEEG_9_MUT_v3.docx.pdf. Access in June, 2023.

60 CDM. AR-TOOL15 - A/R Methodological tool: Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity. Available in https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-15-v2.0.pdf. Access in July,2023.

In this methodology it is determined that the leakage emission attributable to the displacement of agricultural activities due to the implementation of a conservation project activity is estimated as the decrease in carbon stocks in the affected carbon pools of the land that receives the displaced activity.

The methodology also highlights that:

- Displacement of an agricultural activity by itself does not result in leakage emissions. Leakage emission occurs when displacement leads to an increase in GHG emissions relative to the GHG emissions attributable to the activity as it exists within the project boundary.
- The increase in GHG emissions occurring outside the project boundary attributable to secondary effects of the A/R CDM project activity (eg changes in demand, supply or price of goods) is considered insignificant for the purpose of this tool and therefore, counted as zero.

  For the case of this project, the leakage emission was considered as zero, since the animals are moved to the existing pasture and the total number of animals in the receiving pasture (displaced and existing) does not exceed the carrying capacity of the pasture.

19 MONITORING PLAN

- Deforestation monitoring will be done via Remote Sensing using satellite images from the USGS and LandViewer platforms, and deforestation alerts from the Global Forest Watch and SAD Cerrado platforms will be monitored;
- Portions of the forest inventory will be measured every 2 years in order to monitor the maintenance and increase of the carbon stock at the site;
- Motorized on-site surveillance will still be carried out which performs patrols once a week;
- Claims are reported to the owner through photographic records obtained from a Smartphone and reported by voice message;
- Elaboration of the half-yearly monitoring report;

- ARR and REDD baseline scenario (REDD_PL and REDD_PA) will be reviewed every 10 years.

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21 TECHNICAL TEAM INVOLVED

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Qualification: Forest Engineer Master in Forest Sciences

Activity: Geoprocessing, quantifications and elaboration of a written project.

Name: Vanderlei dos Santos

Qualification: Forest Engineer

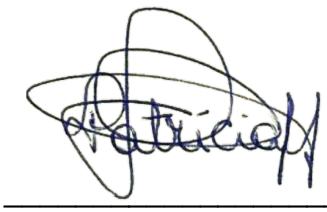
Activity: Field survey and botanical identification

Name: Fernanda Gomes Ferreira

Qualification: Engenheira florestal

Activity: Field survey and botanical identification

Joinville, July 19, 2023.



Biol. Msc Patrícia de Luca Lima Greff

CRBio: 58979-03

22 PHOTOGRAPHIC REGISTER

Figure 28. Field team training.

Figure 29. Field team training. .

Figure 30. Field team training.

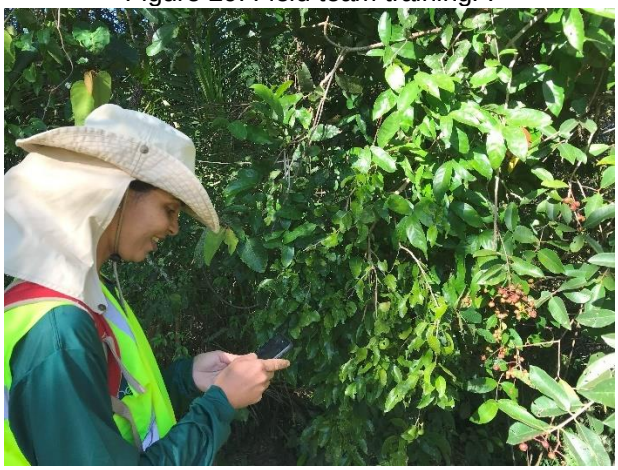


Figure 31 Field team collecting data.

Figure 32 Field team in displacement through the Sampling Unit.

Figure 33. Tree inventoried and tagged.

Figure 34. Tree inventoried and tagged .

Figure 35. Tree inventoried and tagged.

Figure 36. Field team measuring the CAP of one of the inventoried trees.

Figure 37. Field team collecting field data on mobile app.

Figure 38. Field crew tagging inventoried tree.

Figure 39. Sampling Unit demarcated with zebra tape.

Figure 40. Field team measuring the CAP of one of the inventoried trees.

Figure 41. Sampling Unit demarcated with zebra tape.

Figure 42. Field team measuring the CAP of one of the inventoried trees.

Figure 43. Species inventoried.

Figure 44. Species inventoried.

Figura 45. Species inventoried.

Figure 46. View from Morro do Fogo.

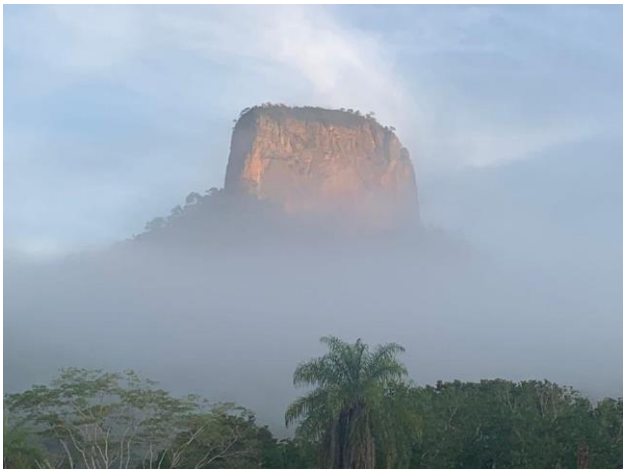


Figure 47. View from Morro do Fogo

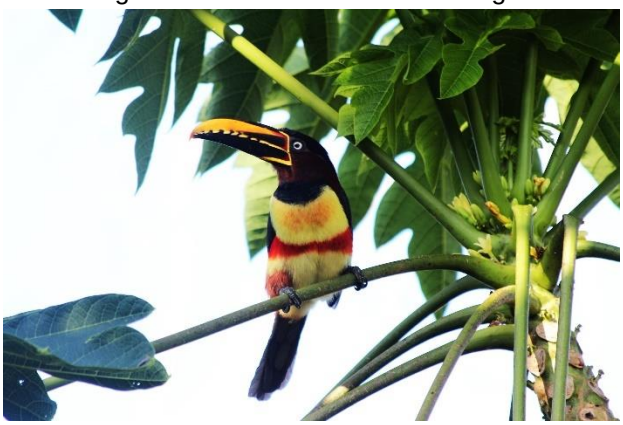


Figure 48. *Pteroglossus castanotis*.

Figure 49. *Anodorhynchus leari*.

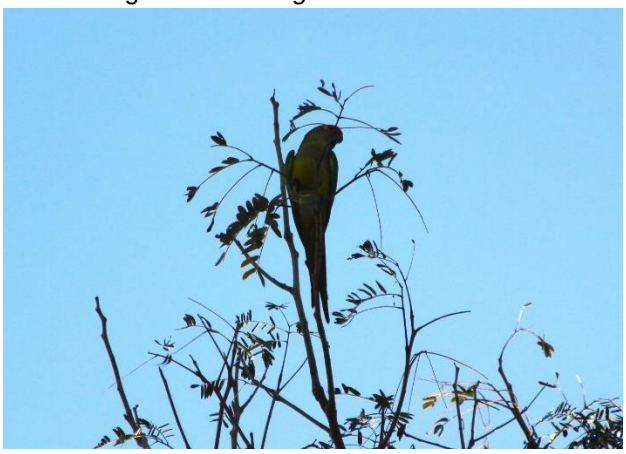


Figure 50. *Ara militaris*.

Figure 51. Aerial image of an area of Forested Savannah undergoing regeneration.

Figure 52. Aerial image of a Forested Savannah area.

Figure 53 Aerial image of the consolidated area of the farm and Forested Savannah areas in the background.

Figure 54. Aerial image of a Forested Savannah area.

Figure 55. Aerial image of the consolidated area of the farm and areas of Forested Savannah in the background.

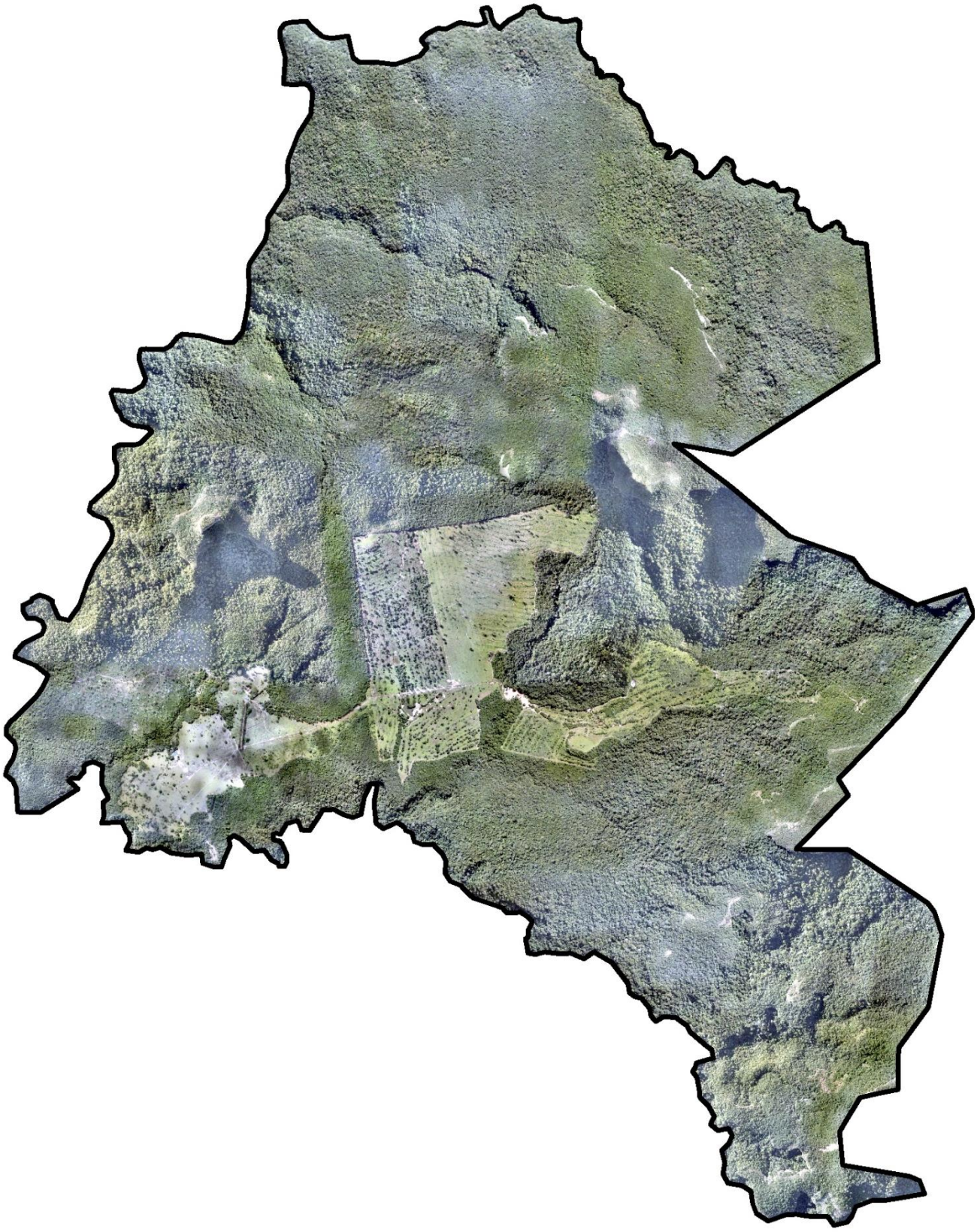


Figure 56. Aerial photograph of the Morro do Fogo Farm area, taken by flying over a UAV in May/2023.