MARAUI PROGRAM - GROUPED PROJECT

DRAFT

Document Prepared by OnePlanet Ltda

Project Title	Maraui Program
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1 PROJECT DETAILS

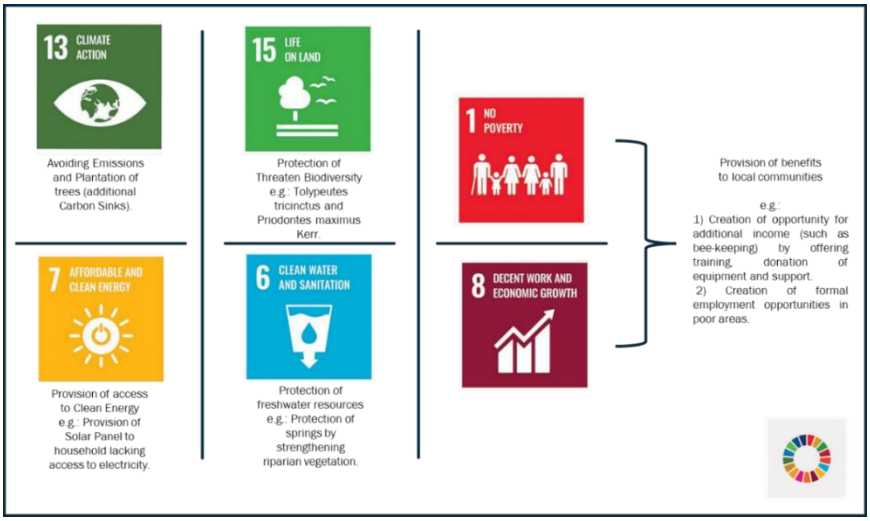
1.1 Summary Description of the Project

Current research established nine planetary boundaries to define the environmental limits within which humanity can safely operate. Within those, two core boundaries — climate change and biosphere integrity — have been highlighted, each of which has the potential to drive the Earth system into a new state should they be substantially and persistently transgressed (Rockström *et al.*, 2009; Steffen *et al.,* 2015).

Inspired by a call of action, Maraui Program was designed to act upon the two wicked problems — Climate Change & Biodiversity Loss. Maraui Program intends to halt GHG emissions by avoiding ecosystem conversion while protecting Biodiversity. Furthermore, such a program aims to aid in a range of pressing issues, from preserving Freshwater Resources to improving Traditional Communities' livelihood.

The Program is a grouped project - as per VCS definition - located in the states of Piauí and Maranhão, Brazil. Owners of rich Biodiversity, Piauí and Maranhão states are home to one of the most **intense agricultural frontiers** of the country and are the **most poverty-stricken** states - the lowest average income in Brazil (IBGE, 2021-b). At the issuance of this document, one Project Activity Instance (PAI) has been instituted, PAI Fazenda Boqueirão.

Maraui Program aims to avoid emissions by preventing the conversion (to Agricultural Activity and Charcoal Production) of existing Native Vegetation (Forest and Grassland). It is estimated 200,000 tCO2e annual average emission reductions through the project's lifespan, totalizing 4,000,000 tCO2e. In addition to the above, below are examples of initiatives the Maraui Program aims to proliferate:



1.2 Sectoral Scope and Project Type

Project Type: Agriculture, Forestry and Other Land Use (AFOLU)

Project Category: REDD & ACoGs

Project Activity: AUC

Maraui Program is a grouped project and was conceptualized with the vision of protecting the ecosystem significantly threatened by conversion. At the issuance of this document, one Project Activity Instance (PAI) has been initiated within the Program, PAI Fazenda Boqueirão.

1.3 Project Eligibility

Maraui Program meets all applicable rules and requirements set out under the VCS Program and applies a methodology developed under VCS Program, in specific the AFOLU VM0009 Methodology.

Eligibility Criteria

Maraui Program was designed as a grouped Project - as per VCS´s definition. To be eligible for this Program, a PAI must meet each of the following requirements:

- New PAI must demonstrate additionality through the most updated VCS´s Additionality Tool.
- New PAI must be located in the states of Maranhão or Piauí, Brazil.
- For a land area to join Maraui Program, the land property must not be involved in disputes around ownership.
- New PAI must provide the following up-to-date documents:
    a. Enforceable and irrevocable agreement with Program Maraui, committing the land area to conservation;
    b. Brazilian Rural Environmental Registry Certificate (known in Brazil as CAR);
    c. Land Registry Certificate;
    d. Institute for Agrarian Reform Certificate (known in Brazil as INCRA);
- New PAI´s end-land use in the baseline scenario must be a non-forest state and/or converted native grassland.
- New PAI´s project accounting areas must be in an unconverted state (i.e., forest or native grassland) for more than 10 years prior to the project start date.

- New PAIs with an unplanned baseline type must have a conversion threat for each project accounting area.
- New PAI´s project accounting areas must not contain peat soil.
- New PAIs, for the respective project accounting areas, must delineate a reference area meeting requirements including minimum size requirement, see section 6.8.1 of VM0009 methodology.
- For new PAIs, as of the project start date, historical imagery of the reference area(s) must exist with sufficient coverage to meet the requirements of section 6.8.4 of VM0009 methodology.
- PAIs must be developed to mitigate ecosystem conversion by addressing the agents and drivers of conversion as described in section 8.3.1 of VM0009 methodology.
- PAI must not result in significant GHG emissions.

1.4 Project Design

When completing a draft project description for the purpose of listing on the pipeline as under development*, complete the following information; otherwise, delete this text:*

☐ The project includes a single location or installation only

☐ The project includes multiple locations or project activity instances, but is not being developed as a grouped project

☒ The project is a grouped project

1.5 Project Proponent

Organization name	OnePlanet Ltda
Contact person	Luiz de Andrade
Title	CEO
Address	Rua Gaivota, 979, São Paulo - SP
Telephone	+55 11 97792 9099
Email	Luiz.andrade@oneplanet.eco

1.6 Other Entities Involved in the Project

Organization name	Neogreen Consultoria Ambiental Ltda
Role in the project	Advisory on emissions model, maps and spatial analyses
Contact person	Patrícia de Luca Lima Greff
Title	CEO
Address	Rua Dona Francisca, 1113, Joinville - SC
Telephone	+55 (47) 98823-4937
Email	gerencia@neogreen.eco.br

1.7 Ownership

While Maraui Program ownership is from OnePlanet Ltda, Fazenda Boqueirão land is owned by Family Freire de Castro. There is no dispute of land ownership over the object area.

All PAIs must provide the following documents, which will be presented to Auditors.

- Environmental Registry for Rural Properties
- Land Registry Certificate
- Certificate from the Institute for Agrarian Reform
- Agreement Proponent (OnePlanet Ltda) & Landowner

1.8 Project Start Date

Maraui Program started on September 1st, 2021., the date on which its activities commenced on PAI Fazenda Boqueirão.

1.9 Project Crediting Period

The Project Crediting Period is 20 years, starting on September 1st, 2021 and ending on September 1st, 2041.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

When completing a draft project description for the purpose of listing on the pipeline as under development*, complete the following information; otherwise, delete this text.*

The estimated annual GHG emission reductions/removals of the project are:

☐ <20,000 tCO_2e/year

☐ 20,000 – 100,000 tCO_2e/year

☒ 100,001 – 1,000,000 tCO_2e/year

☐ >1,000,000 tCO_2e/year

1.11 Description of the Project Activity

Maraui Program will execute activities aiming to avoid ecosystem conversion and so the avoidance of the resulting emissions. For each PAI a set of Initiatives are planned and implemented to mitigate ecosystem conversion, addressing the agents and drivers of conversion.

For example, PAI Fazenda Boqueirão has at its core the objective of Avoidance of Unplanned Conversion. Maraui Program in PAI Fazenda Boqueirão is acting to enhance community livelihood and create alternative opportunities that don´t entail conversion/deforestation. It provides training and equipment to the community to kick-start the Beekeeping activity. In parallel, performs Educational Workshops-series covering, for example, adequate agricultural practices and the importance of conservation and broadcasts (through 3 main Radio Stations) communication of the conservation efforts, aiming to engage communities and demotivate illegal activities.

As part of the support to the community living in Project Area, Maraui Program has donated solar panels to families lacking access to electricity.

Plantation of indigenous trees in areas previously damaged is also an important constant action, 1000 trees have been planted in the first year of this project.

It is important to highlight the efforts on conservation of Fresh Water. PAI Fazenda Boqueirão is blessed with River Springs, one of which is the birthplace of an important stream that brings substance to the main Regional River (Rio Gurguéia). Such a Regional River (Rio Gurguéia) is under much pressure due to the draining of its flow by illegal agricultural production. Water is a scarce resource and crucial for the livelihoods of traditional communities in this region, thus such a river is imperative for the livelihood of many vulnerable communities. Protecting such a spring is of paramount importance thus PAI Fazenda Boqueirão is planting trees to strengthen the Riparian Vegetation.

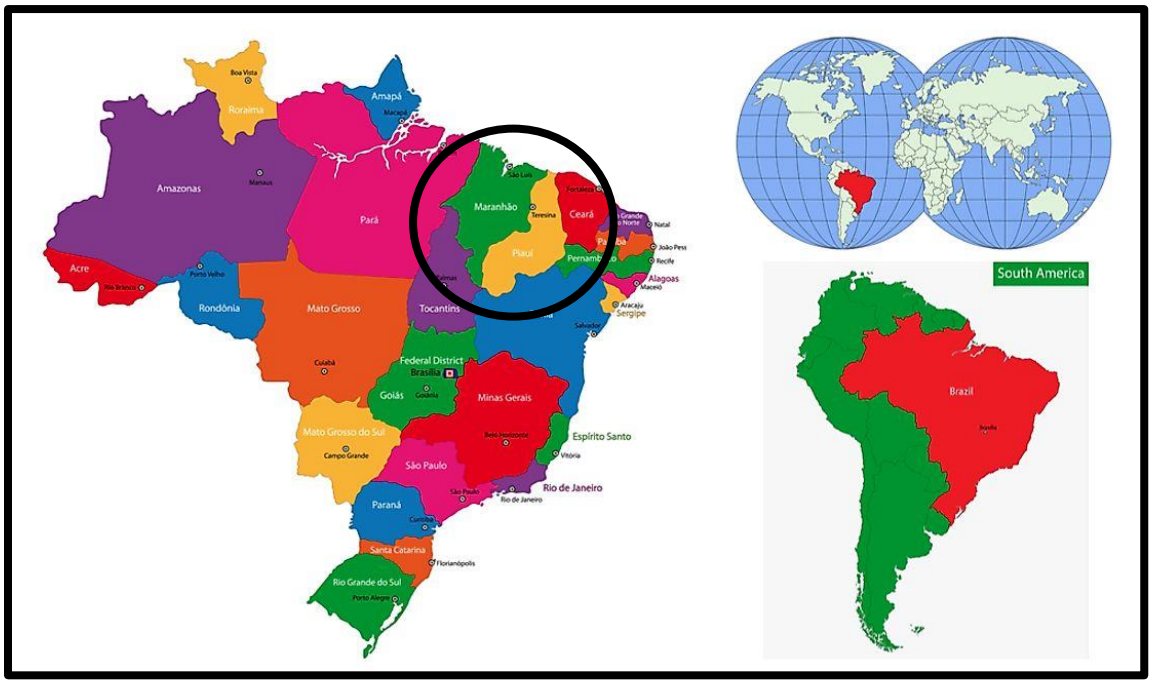
(Source: Maxar Technologies/CNES/Airbus)

Maraui Program has also established a specialized satellite monitoring program and warning sign (through the perimeter) and a 24/7 patrol on the ground (such an initiative also creates formal jobs for the community). In addition, remote outdoor surveillance cameras are expected to be acquired and installed. It has also trained, equipped, and established a Fire Brigade – Staff and Voluntary.



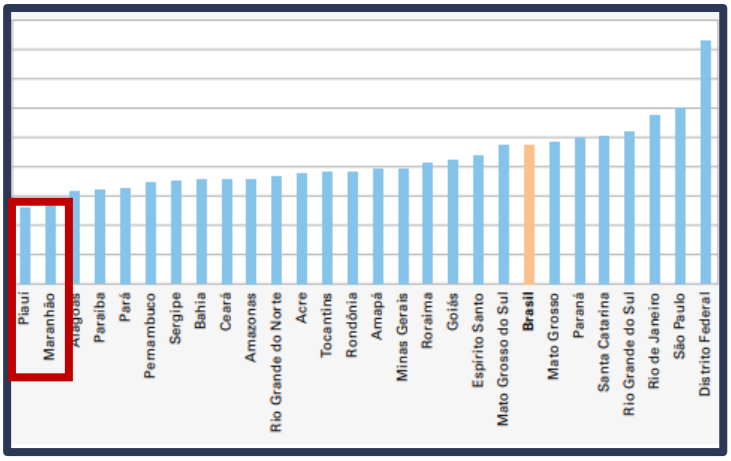
1.12 Project Location

Maraui Program is Grouped Project in which all PAIs (and their respective project area) are to be located on the states of Piaui and Maranhão, Brazil.



Piauí and Maranhão states are home to one of the most intense agricultural frontiers of the country and are the most poverty-stricken States in Brazil. Below is a Chart of Average Income

per State in Brazil, developed by IBGE (Brazilian Institute of Geography and Statistics) (IBGE, 2021).

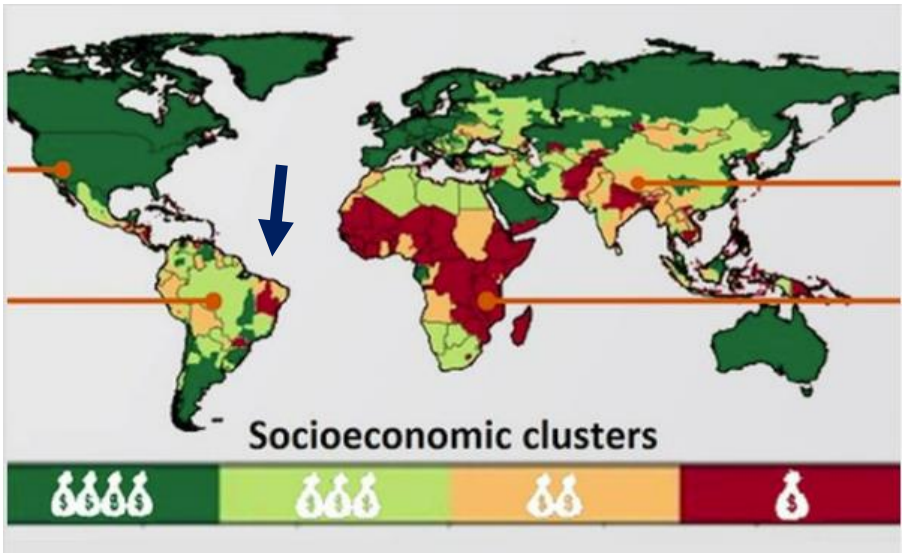


(Source: IBGE (2021A) | National Survey – 2020)

	Piauí	Maranhão	Brazil	Source
Population Size	3,289,290	7,153,262	213,317,639	IBGE (a)
HDI	0.646	0.639	0.765	IBGE (a) & UNDP
Average Income	USD 262.20	USD 275.20	USD 474.40	IBGE (2021-b)
GDP	USD 14 bi	USD 19 bi	USD 1500 bi	IBGE (b)

(Source: IBGE & UNDP) (*USD/BRL=5,00)

This region contains remaining vegetation that is very important as part of the effort to combat climate change. Meanwhile, it will also be part of the most affected if Climate Emergency is not addressed. According to an article from Yale School of the Environment (2022), this region is part of the geographical locations that will "bear the brunt of heat waves as temperatures rise."



(Credit: Mohammad Reza Alizadeh, Yale Environment

(Source: Yale Environment 360, 2022)

1.12.1 Biodiversity

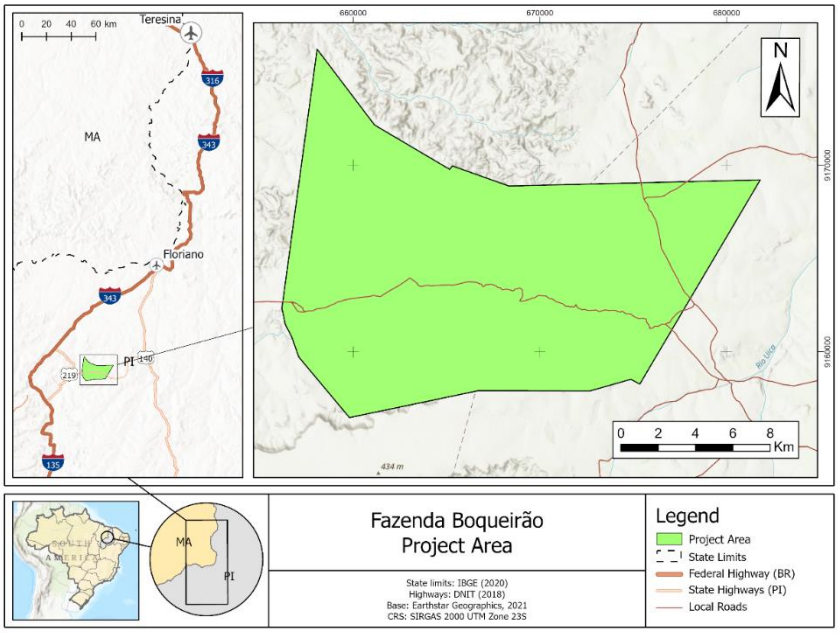
The states of Maranhão and Piauí are much rich in biodiversity. Such states are covered by 3 different Biomes: Amazon, Cerrado and Caatinga. Unfortunately, much of the biodiversity on these biomes is threatened. A biome is a large area characterized by vegetation, soil, climate, and wildlife. The below table displays the number of threatened species (from fauna and flora) per biome:

	Species (Fauna and Flora)			
	Critically Endangered	Endangered	Vulnerable	Near Threatened
Caatinga	66	190	110	73
Amazon	49	81	148	101
Cerrado	216	515	110	73

(Source: IBGE Ecosystem Accounting – Threatened Species in Brazil)

1.12.2 PAI Fazenda Boqueirão Location

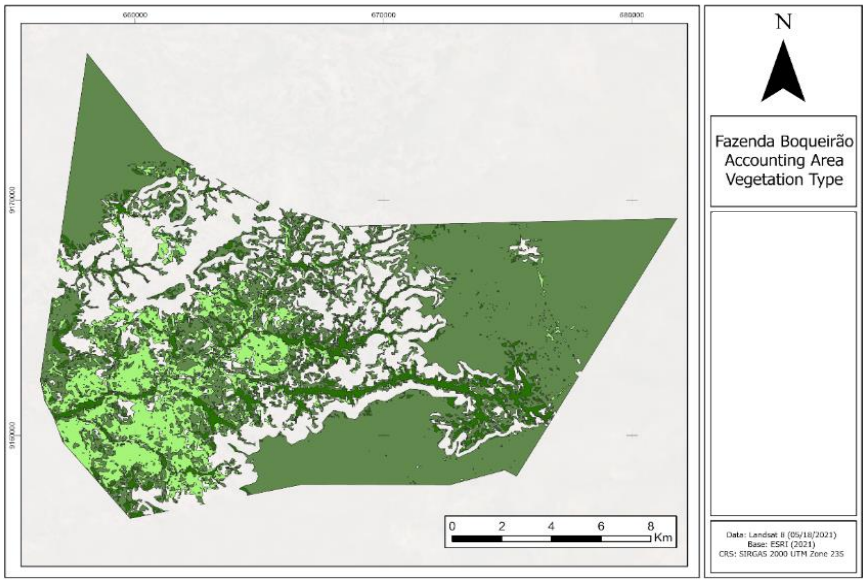
By the issuing of this document, one PAI has joined Maraui Program – Grouped Project, thus the specific Project Area examined in this document is PAI Fazenda Boqueirão area, which is bounded by Fazenda Boqueirão limits. Below is a GIS-based map indicating the precise location of Fazenda Boqueirão, which registered under the municipality of Canavieira, state of Piauí, Brazil.



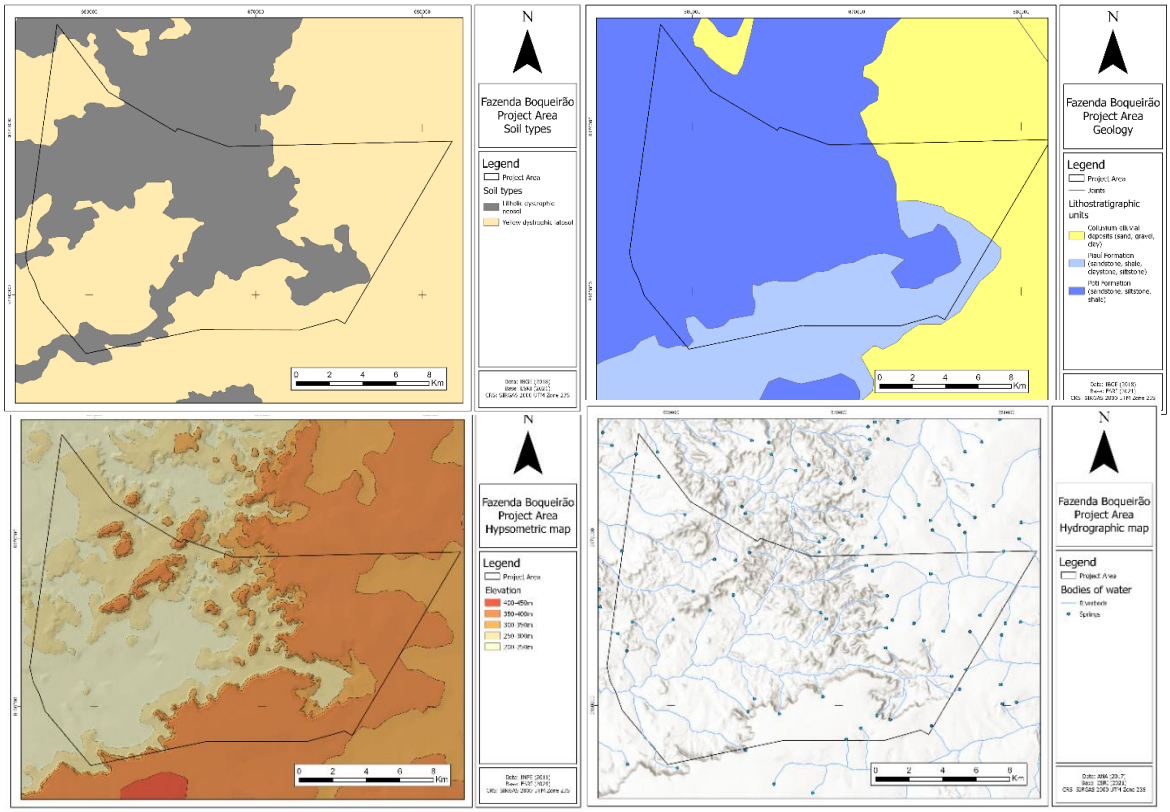
1.13 Conditions Prior to Project Initiation

For all PAIs, Project Accounting Areas (PAA) must have been in an unconverted state for more than 10 years prior to the project start date.

Below follow details of PAI Fazenda Boqueirão. Fazenda Boqueirão is a private property of 27,458.29 hectares, of which landowner decided to commit to conservation perpetually. The entirety of Project Accounting Area is comprised of native vegetation. Below map indicates the different Vegetation Types on the Project Accounting Area. The Vegetation types present on PAA are: Woodland Cerrado (medium green), Forested Caatinga (dark green) and Parkland Caatinga (light green). PAA extends through the entire area of Fazenda Boqueirão excluding the areas that were already anthropized as well as the areas with plus 25 degrees slope, covering an area of 20,209.7805 hectares.



Below follow additional digital (GIS-based) map detailing Project Area:



1.13.1 PAI Fazenda Boqueirão Biodiversity

A relevant aspect of Fazenda Boqueirão is that it is composed of Caatinga and Cerrado Biomes and is home to much threatened biodiversity. Lima *et al.* (2020), produced a study focused on mammals on Fazenda Boqueirão. Even though the groundwork was a few days, multiple threatened species of mammals were detected, including species such as Cerdocyon thous, Eira Barbara, Galictis, Puma yaguarondi Lacépède, Leopardus pardalis Linnaeus, Leopardus tigrinus Schreber, Puma concolor Linnaeus, Panthera onca Linnaeus and Myrmecophaga tridactyla Linnaeus. On the PRA was also recognized the presence of Tolypeutes Tricinctus (Lima *et al.*, 2020).

Panthera onca Linnaeus (commonly known as Jaguar and Onça-Pintada)

Picture: Carlos Botelho

Puma concolor Linnaeus (commonly known as Cougar, Onça-Parda and Onça-vermelha)

Picture: Programa de Conservação de Mamíferos do Cerrado

Leopardus tigrinus Schreber

Picture: Projetos Gatos do Mato

Puma yaguarondi Lacépède (commonly known as Gato-mourisco)

Picture: Projeto Gatos do mato - Brasil

Leopardus wiedii (commonly known as Margay)

Picture: Tadeu G. de Oliveira

Myrmecophaga tridactyla Linnaeus (commonly known as Tamanduá-bandeira and Giant anteater)

Picture: Teresa Anacleto

Leopardus pardalis Linnaeus (commonly known Ocelot)

Picture: Tadeu G. de Oliveira

Cerdocyon thous (commonly known as crab-eating fox)

Picture: Elisa Ilha

Priodontes maximus Kerr (commonly known as Giant armadillo and Tatu-Canastra)

Picture: Fabio Rohe

Tolypeutes tricinctus (also known as brazilian three banded armadillo and Tatu-bola)

Picture: Marco A. Freitas

Lima *et al.* (2020) indicates that the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has placed Puma yaguarondi Lacépède, Leopardus pardalis Linnaeus, Leopardus tigrinus Schreber, Puma concolor Linnaeus, Panthera onca Linnaeus on category I (most threatened), Cerdocyon thous is in category II, Eira Barbara and Galictis are in category III. The same work asserts that "studies have pointed out that primates and carnivores are the mammals most threatened with extinction in Brazil, with 26 and 10 species, respectively, in this situation"; and refer to a study from the Brazilian Ministry of the Environment that points out that the number represents 26.8% of the total number of primates and 34.5% of the total number of carnivores. (Lima *et al.,* 2020)

According to ICMBIO´s classification (the Brazilian Ministry of the Environment's administrative arm), Panthera onca Linnaeus, Puma concolor Linnaeus, Leopardus tigrinus Schreber, Puma yaguarondi Lacépède, Myrmecophaga tridactyla Linnaeus, Priodontes maximus Kerr, Tolypeutes tricinctus and Leopardus wiedii are the most threatened (under Vulnerable and Endangered categories).

Lima *et al.* (2020) points out regard to the felinae (Puma yaguarondi Lacépède, Leopardus pardalis Linnaeus, Leopardus tigrinus Schreber, Puma concolor Linnaeus and Panthera onca Linnaeus): "Despite their great ecological importance, the vast majority of carnivores are highly

threatened by various forms of anthropogenic pressure, such as sport hunting for the illegal fur trade, trafficking in live animals and hunting practiced by rural producers". In addition to these aspects, another great threat is the reduction, fragmentation, or total destruction of their habitats, as many need large living areas and this decrease in their vital spaces can lead to a decrease in their prey populations"; as well as "species such as the felid carnivores recorded for the region have high requirements in terms of their minimum home range. For example, Puma concolor needs from 3200 to 17600ha, Panthera onca from 20000 to 100000ha, Leopardus pardalis from 1600 to 8100ha, Cerdocyon thous from 250 to 720ha and even smaller animals such as Callithrix jacchus need 2.4ha, while marsupials like Didelphis may require between 5 and 24ha of space to carry out their vital activities" (Lima *et al.,* 2020)

Myrmecophaga tridactyla Linnaeus is an important symbol in Brazil and is also included in the Vulnerable category on the List of Brazilian Fauna Threatened with Extinction. "The main causes of the decline of their populations are the deterioration and reduction of habitats" (Lima *et al.*, 2020) (ICMBIO, 2014).

The Giant Armadillo (Priodontes maximus) is an important ecosystem builder, according to World Wide Fund for Nature - WWF (2021), "Researchers have proposed the giant armadillo as an ecosystem engineer" that, through its excavations, alters the physical environment and creates new habitats. In the wetland, these changes in the environment were found to have an influence on at least 24 other vertebrate species. Therefore, the extinction of the giant armadillo can result in the simplification or reduction of fossorial habitats, negatively affecting species that depend on these environments. The species is on the national and world lists of endangered species, classified as vulnerable. Hunting and habitat loss are the main threats to the giant armadillo, which is rarely found in altered habitats. Since the home range of these armadillos can have more than 1000 ha, the preservation of large portions of preserved habitat, in addition to combating predatory hunting, is essential for the conservation of this species (WWF, 2021).

Tolypeutes tricinctus is a unique species from Brazil and is such a symbol was selected as mthe ascot the for 2014 FIFA World Cup (hosted in Brazil). Such species is classified as Endangered by ICMBIO.

On the Flora side, it is also recognized presence of numerous threatened species, some of which are: Handroanthus chrysanthus (also known as Ipê – Vulnerable), Handroanthus impetiginosus (also known as Ipê Rosa – Near Threatened), Handroanthus barbatus (also known as Ipê Roxa – Near Threatened), Handroanthus serratifolius (also known as Ipê Amarelo – Endangered), Tabebuia roseoalba (also known as Ipê Branco – Near Threatened).

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The main regulatory body that regulates Native Vegetation Areas is The Brazilian Forest Code (Law 12,651/2012). It was first introduced in 1934 and updated in 1965 and 2012. The code is the legal instrument for regulating land use on private rural lands in Brazil and one of its main objectives is to promote preservation of native vegetation and so Maraui Program use it as a compass for its actions and works to be a catalyst to the Forest Code enforcement in the region.

Another relevant guideline is the National Policy on Climate Change. The National Policy on Climate Change (PNMC) formalizes Brazil's voluntary commitment to the United Nations Framework Convention on Climate Change to reduce greenhouse gas emissions between 36.1% and 38.9% of projected emissions until 2020. It was instituted in 2009 by Law No. 12,187. Program Maraui was designed to avoid emission of GHG and so is not only in compliance but also is a contributor.

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

Neither Maraui Program nor PAI Fazenda Boqueirão are registered in any other or is seeking registration under any other GHG program.

1.15.2 Projects Rejected by Other GHG Programs

Neither Maraui Program nor PAI Fazenda Boqueirão has been rejected by any GHG program.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

When completing a draft project description for the purpose of listing on the pipeline as under development*, complete the following information; otherwise, delete this text:*

Does the project reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading?

☐ Yes ☒ No

Neither Maraui Program nor PAI Fazenda Boqueirão does not reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading.

1.16.2 Other Forms of Environmental Credit

When completing a draft project description for the purpose of listing on the pipeline as under development*, complete the following information; otherwise, delete this text:*

Has the project sought or received another form of GHG-related credit, including renewable energy certificates?

☐ Yes ☒ No

Neither Maraui Program nor PAI Fazenda Boqueirão has not sought or received another form of GHG-related environmental credit, including renewable energy certificates.

1.17 Sustainable Development Contributions

Brazil as country is still lagging on its journey towards Sustainable Development Goals. Below follow 2020 assessment:

Source Sustainable Development Report 2020

According to Fourth National Communication of Brazil to the UNFCCC, Brazil commits to reduce greenhouse gas emissions by 37% below 2005 levels in 2025 and by 43% below 2005 levels in 2030. According to a study published scientific journal Nature, the main Sector emitting GHG in Brazil is "Land Use Change and Forests", as indicated on the table below:

Total Brazilian GHG emissions

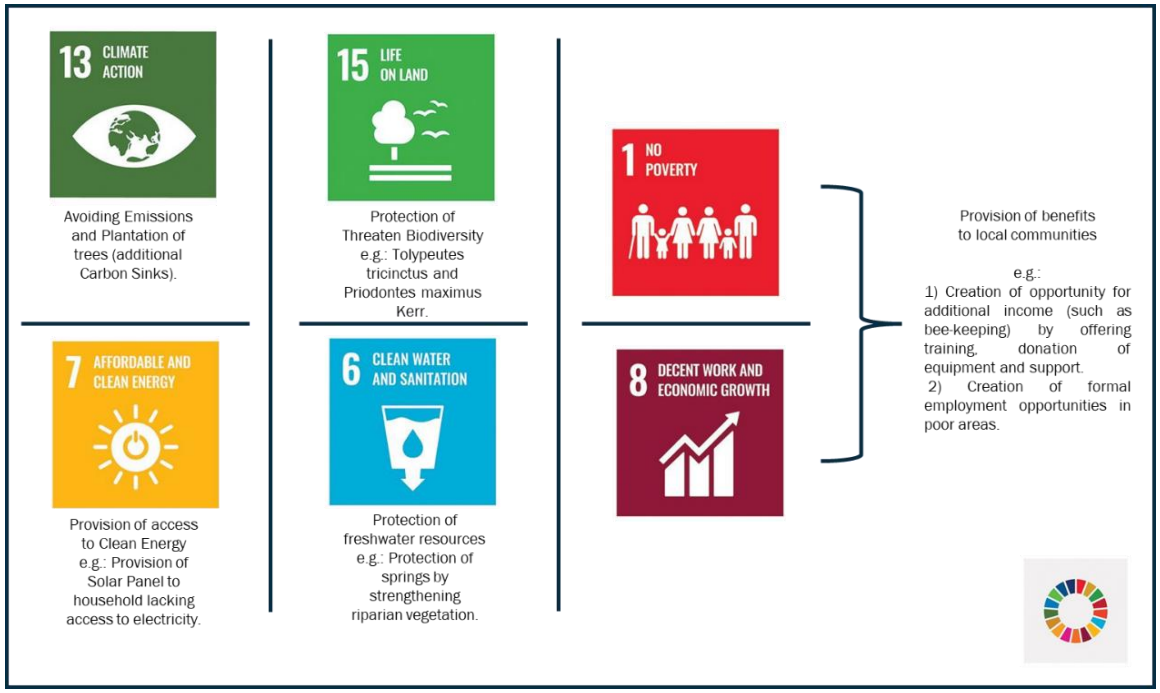
Sector	Total GHG emissions MtCO2e
Energy	454.2
Industrial Processes	99.5
Waste	64.4
Agriculture	425.5
Land Use Change and Forests	884.1
Total	1927.7

(Source: SEEG, 2018)

Program Maraui was designed to avoid emission of GHG and so contributes to Brazilian NDC. Results from Program Maraui in successfully mitigating emission will be communicated on each of its monitoring reports.

One of the main factors that drove the decision to establish the program in the states of Maranhão e Piauí is that such locations are in severe need of helping-hands. The core proposition of this present work is avoidance of suppression of native vegetation, but it is clear that much can be done for these states, and so Maraui Program intends to contribute to a range of

Sustainable Development Goals (SDGs). Below is a summary of the SDGs targeted on PAI Fazenda Boqueirão and examples of contributions:



1.18 Additional Information Relevant to the Project

Leakage Management

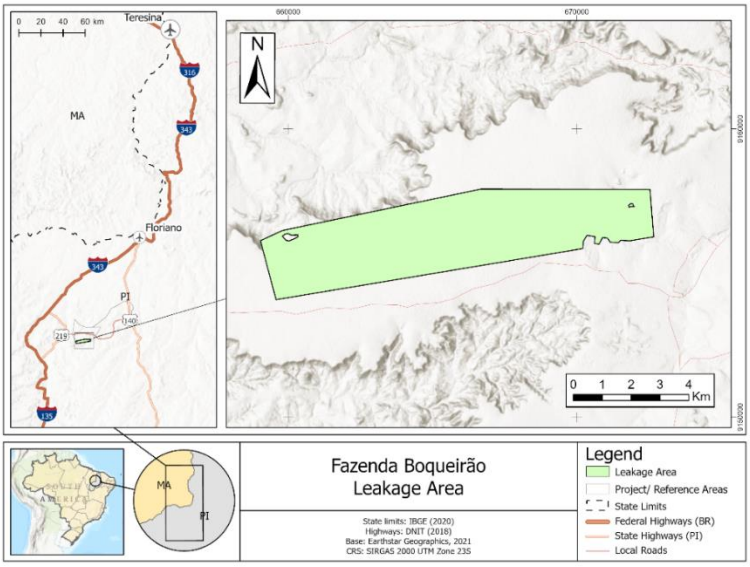
In PAI Fazenda Boqueirão many paths of activities are developed to mitigate risk of leakage.

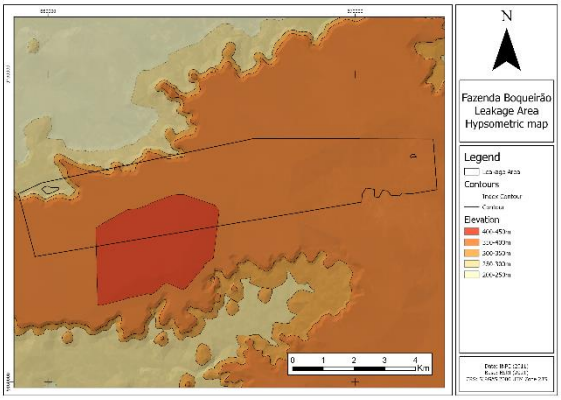
One path adopted is the development of economic opportunities for local communities that encourage conservation. One example is the employment of community members as part of patrol guards. Another path is the development of alternative incomes. One example is kick-starting apiculture (beekeeping) activity for the inner and surrounding community. Maraui Program is donating equipment as well as providing training and support. PRA indicated apiculture as the most likely activity that the local community would be interested in working with, and that generates significant income. A third path is the introduction of improved agricultural practices and so decreasing the urge to clear new areas.

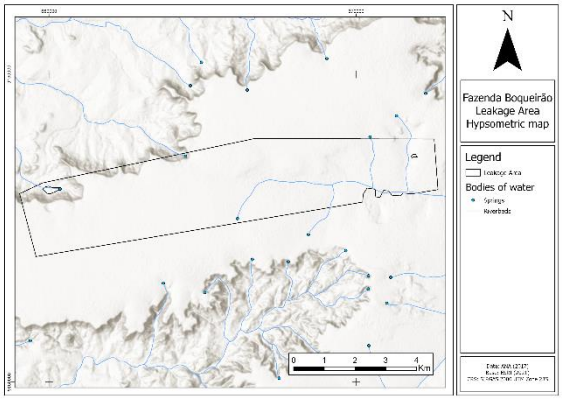
In addition to mentioned initiatives, a Leakage Area has been appointed by PAI Fazenda Boqueirão. The leakage area is adjacent to PAI Fazenda Boqueirão, covers an area of 3,076.9508 hectares and is as accessible as the PAA is. The area is privately owned. Given both areas are adjacent, the vegetation type is similar. Leakage area vegetation type is comprised in its majority

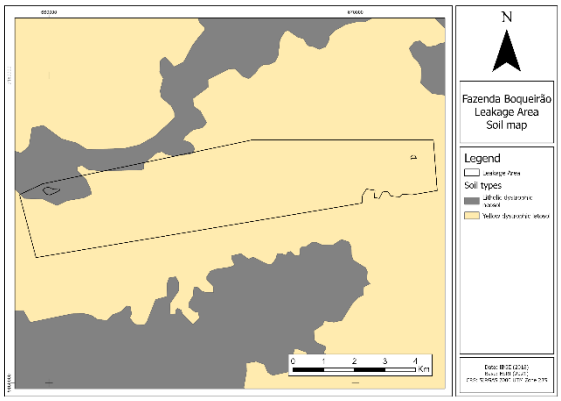
of Woodland Cerrado and patches of Parkland Caatinga. The leakage area is entirely in a non-converted state.

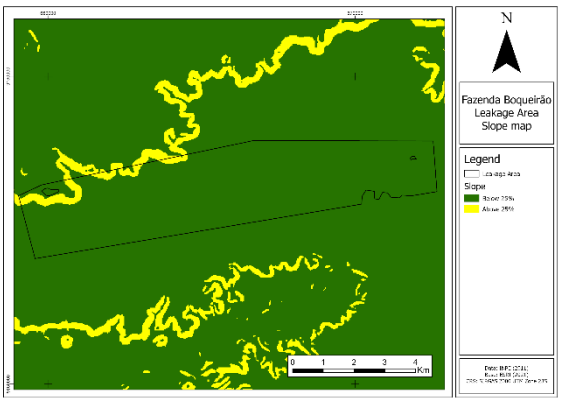
Below follow maps detailing the Leakage Area:











Further Information

Even though UNFCCC is considered the foremost reference body on Climate subject, VM0009 Methodology require application of Host-Country DNA (Designated National Authority) definition, thus all analyses portrayed on this work are paved on Brazilian DNA (Designated National Authority) Forest definition.

UNFCCC´s definition: "Forest is a minimum area of land of 0.05-1.0 hectares with tree crown cover (or equivalent stocking level) of more than 10-30 per cent with trees with the potential to reach a minimum height of 2-5 metres at maturity in situ. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground or open forest. Young natural stands and all plantations which have yet to reach a crown density of 10-30 per cent or tree height of 2-5 metres are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest.

Brazilian DNA (Designated National Authority) definition: "Forest is defined as land spanning more than 0.5 hectare with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ."

Patch size considered on the PAA were those with the minimum size of 250 m x 250 m, so to be identified through remote sensing methods.

2 SAFEGUARDS

2.1 No Net Harm

The Project Activity is not expected to result in any negative environmental and no negative socio-economic impacts.

2.2 Local Stakeholder Consultation

For all PAIs, local stakeholders will be engaged. For on-going communication, clarification and comments it will designated a physical address of easy access in which a stakeholder can meet the PAI representative. Landowners receive updates on periodic meetings.

As for PAI Fazenda Boqueirão, the main stakeholders are the Landowner and the families living in the Project Area. The first meeting in person agglutinating stakeholders took place on

September/2021. Stakeholders' insights were fundamental to the project designing process. An example was the indication of Bee-keeping activity as a source of income for the community.

The primary communication mechanism with the community is on-sight visits, while the main mechanism with landholder is video-conference meetings. The project coordinator visits the community on at least a bi-weekly basis. The mentioned mechanisms are also used to communicate with stakeholders about any new update. In addition, it has been broadcasted to the larger region (through 3 main Radio Stations) communication of the Project Activity, including the phone number to be used for any consultation/comments, and an office on the Urban Center was designated for any further consultation. Monitoring results will be communicated to stakeholders upon release of each monitoring report.

2.3 Environmental Impact

All Project Activities are not expected to result in any environmental impact. On the contrary, all initiatives were designed to preserve the environment.

2.4 Public Comments

Public comments will be addressed by the project proponent after the public comment period to ensure community satisfaction. Updates and Relevant project documents will be shared to landholders and on Verra Registry.

2.5 AFOLU-Specific Safeguards

Maraui Program requires all PAIs to provide details on: 1) Local stakeholder identification process and a description of results, 2) Risks to local stakeholders due to project implementation and how the project will mitigate such risks, 3) Risks to local stakeholder resources due to project implementation and how the project will mitigate such risks, including the plans to ensure the project will not impact local stakeholder's property rights without the free, prior and informed consent and 4) Processes to ensure ongoing communication and consultation with local stakeholders, including a grievance redress procedure to resolve any conflicts which may arise between the project proponent and local stakeholders.

PAI Fazenda Boqueirão is private property. Land-owner decided to commit the land area to conservation perpetually. In light of such context, no risk is perceived due to the implementation of project activity. On the contrary, it is expected that project activity will bring more stability and safety to the entire Project Zone. If any conflict between Program Proponent and Landowner arises, it will be resolved by the procedure stated in Proponent and Land-owner Agreement.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The present work made use of:

- VCS Methodology VM0009, Version 3.0
- VT0001, Version 3.0
- VCS Standard, v4.1
- AFOLU Non-Permanence Risk Tool v4.0

3.2 Applicability of Methodology

Program Maraui was developed under the AFOLU VM0009 Methodology. Each PAI must justify applicability. For eligibility is required - for each applicability condition - a statement of whether it applies to the PAI. If the applicability condition does not apply to the PAI, justification for such must be indicated.

Below are details for each of the 15 conditions regarding PAI Fazenda Boqueirão:

1. The end land use in the baseline scenario is a non-forest state and converted native grassland.
2. All project accounting areas have been in an unconverted state for more than 10 years prior to the project start date. See section 1.13.
3. For project accounting areas with an unplanned baseline type, a conversion threat must exist for each project accounting area. For PAI Fazenda Boqueirão see section 3.5.1.
4. PAI Fazenda Boqueirão is anchored on baseline type G-U1. Thus, condition does not apply.
5. PAI Fazenda Boqueirão is anchored on baseline type G-U1, and as section 3.3.3 sheds light, more than 25% of the project area perimeter is adjacent to the reference area.
6. PAI Fazenda Boqueirão is anchored on baseline type G-U1. Thus, condition does not apply.
7. The project accounting area does not contain peat soil.
8. For each project accounting area, a reference area was delineated for each baseline type in the baseline scenario that meets the requirements, including the minimum size requirement, of section 6.8.1 of VM0009 methodology. PAI Fazenda Boqueirão encompass one Project Accounting Area, and so has one Reference Area. Such Reference area is adjacent to more than 25% of the Project Area and is larger than the Project area.

9. As of the project start date, historic imagery of the reference area(s) exists with sufficient coverage to meet the requirements of section 6.8.4 of VM0009 methodology. Section 4.4 provides details of historic imagery of the reference area.
10. Project activities are planned or implemented to mitigate ecosystem conversion by addressing the agents and drivers of conversion as described in section 8.3.1 of VM0009 methodology.
11. The project proponent has access to a activity-shifting leakage area and proxy area to implement monitoring.
12. Logging is not included in the baseline scenario.
13. PAI Fazenda Boqueirão is located on Tropical Ecosystem.
14. There no manure management taking place on PAI Fazenda Boqueirão.
15. Project activities do not result in significant GHG emissions.

3.3 Project Boundary

3.3.1 GHG Sources (project and baseline scenarios)

Gas	Sources	Inclusion	Justification
CO2 (Carbon Dioxide)	Flux in carbon pools	Yes	Major pool considered in the project scenario
CH4 (Methane)	Burning of biomass	No	Conservatively excluded
	Livestock	No	Conservatively excluded
N2O (Nitrous Oxide)	Burning of biomass	No	Conservatively excluded
	Livestock	No	Excluded on the basis of applicability condition 14
	Synthetic fertilizer	No	Conservatively excluded

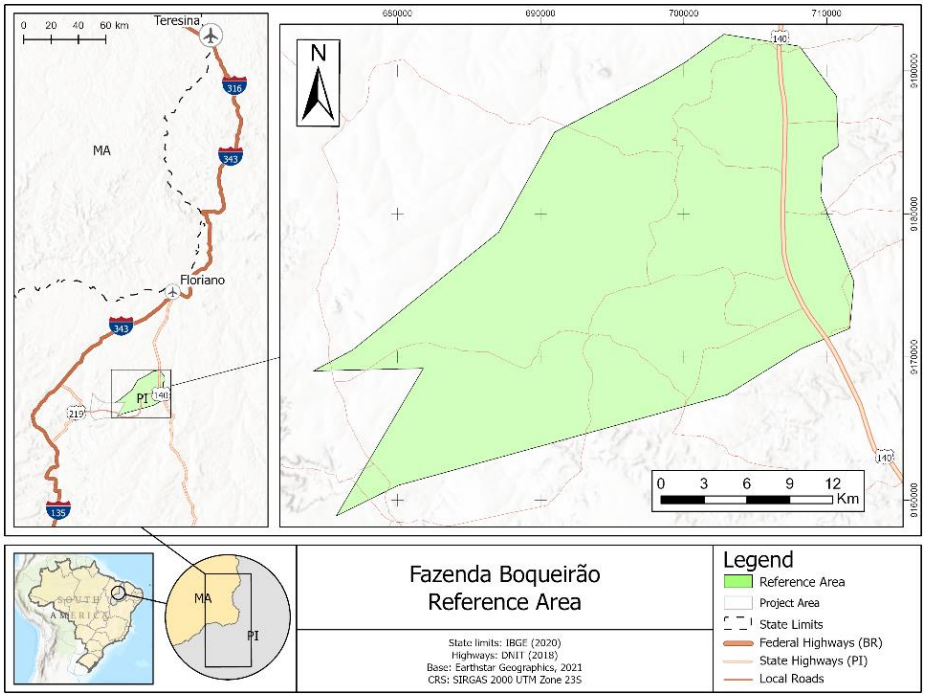
3.3.2 Carbon Pools

Pool		Required	Inclusion	Justification
AGMT	Above-ground merchantable tree	Yes, if baseline includes perennial crops. Otherwise, accounting for this carbon pool is optional	No	Conservatively excluded
AGOT	Above-ground other (non-merchantable) tree*	Yes, if baseline includes perennial crops. Otherwise, accounting for this carbon pool is optional	Yes	Major pool considered
AGNT	Above-ground non tree*	Yes, if baseline includes perennial crops. Otherwise, accounting for this carbon pool is optiona	Yes	Major pool considered
BGMT	Below-ground merchantable tree	Optional	No	Conservatively excluded
BGOT	Below-ground other (non-merchantable) tree*	Optional	Yes	Major pool considered
BGNT	Below-ground non tree*	Optional	Yes	Major pool considered
LTR	Litter	No	No	Conservatively excluded
DW	Dead wood*	Optional	No	Conservatively excluded
SD	Standing dead wood*	Optional	No	Conservatively excluded
LD	Lying dead wood*	Optional	No	Conservatively excluded
SOC	Soil organic carbon	Optional	Yes	Major pool considered
WP	Long-lived wood products	No	No	Conservatively excluded

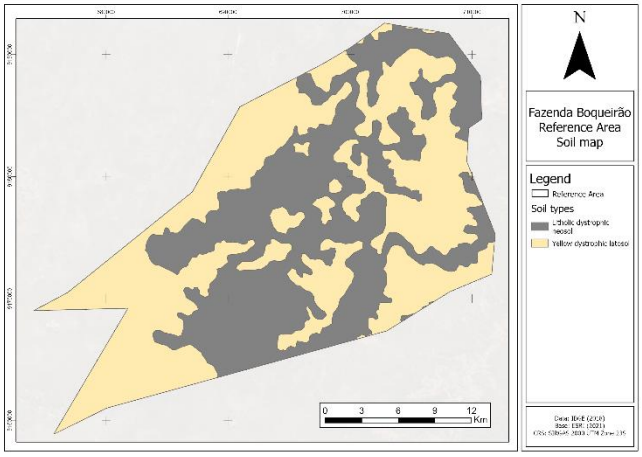
3.3.3 Reference Area

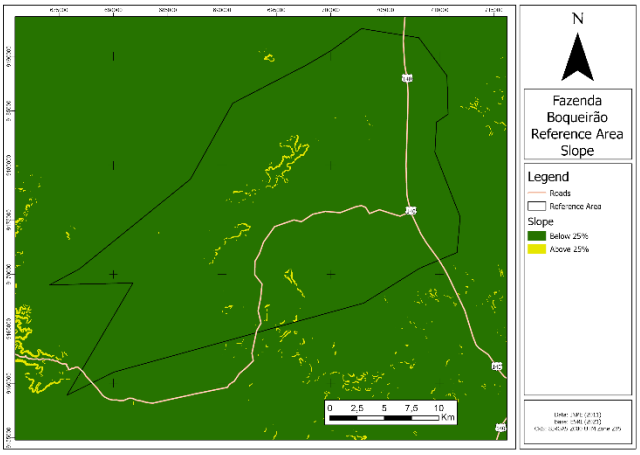
Maraui Program is guided by VCS´s VM0009 Methodology, which indicated that a reference area must be delineated for each project accounting area. Each PAI will have reference areas designated.

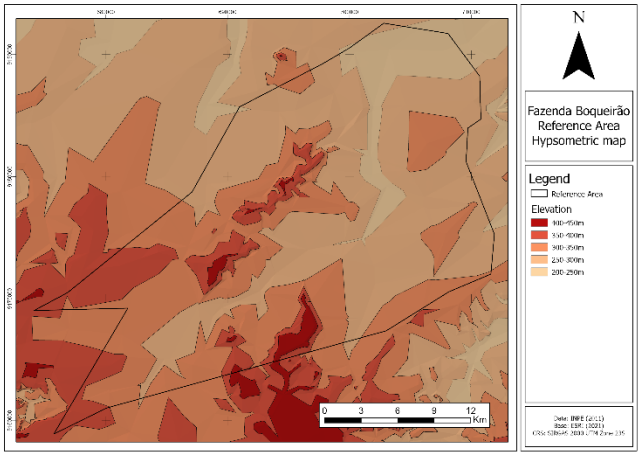
Regarding PAI Fazenda Boqueirão, below follow a map showing location as well as boundaries of the reference area and the project accounting area, including an indication of their locations relative to each other. The Reference area extends over 63,729.74 hectares.The rationale for selection was to find an reference area that has the most similarities around agents of conversion, acting drivers of conversion, socio-economic conditions, cultural conditions and landscape configuration, thus was chosen an adjacent area. The reference area is composed by Private Properties, as it is the case of PAI Fazenda Boqueirão. Both areas are adjancent (+25% of the PAI perimeter), the anthropogenic factors that may influence agents' movement are the same and that the practices in reference area is similar to those that would have been applied to the PAA. Given both are contiguous, vegetation type is also similar, reference area vegetation type is comprised of Woodland Cerrado and Forested Caatinga. In 2010, Reference Area had 60,403.2060 hectares of native vegetation while Project Area had 23,512.501726 hectares.

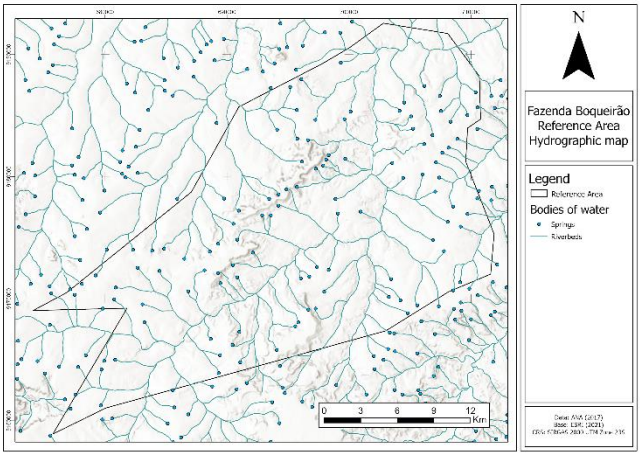


Below follows additional spatial analysis of the Reference Area:









3.3.4 Reference Period

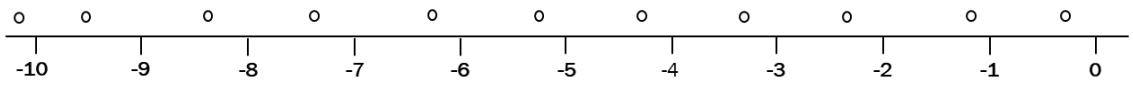
The reference period is defined differently for baseline types F-P1.a, F-P1.b, F-P2, F-U1, F-U2, F-U3, G-P2, G-U1 and G-U2. A reference period must be delineated for each project accounting area. Reference periods must not overlap where reference areas overlap.

Regarding the PAI Fazenda Boqueirão, the PRA indicated that the acceleration of agricultural on activity started 10 years preceding the project start

The reference period for PAI Fazenda Boqueirão is 2011 to 2021.

A line plot of the satellite imaginary follow below. Specific dates and sources are detailed on Section 4.4.

Historical Imagery for Reference Area



(Time yrs)

3.4 Baseline Scenario

The baseline scenario for a project activity shall be determined for each designated geographic area, in accordance with the methodology applied to the project. VM0009 Methodology indicates a step-wise instructions for definition of the Baseline Types that will be used for each PAI of Maraui Program. For PAI Fazenda Boqueirão, the result was Baseline **Type G-U1.**

3.5 Additionality

A project activity is additional if it can be demonstrated that the activity results in emission reductions or removals that are in excess of what would be achieved under a "business as usual" scenario and the activity would not have occurred in the absence of the incentive provided by the carbon markets.

Each PAI to join Maraui Program will have to prove additionality. The next two sub-sections will detail Additionality analysis of PAI Fazenda Boqueirão.

3.5.1 Conversion Threats

This sub-section offers details around the conversion threats: Charcoal Production and Agricultural Activity.

Charcoal Production

A good introduction to the Charcoal Production practice in Piaui state is a television report made by the largest TV Channel in Brazil, Globo TV Channel. Such report brings colors and voice to the destruction of native vegetation by Charcoal Production ravaging in Piaui State. It can be accessed on https://globoplay.globo.com/v/1408042/.

(Extracted from the Television Report; Source: Globo TV Channel)

The report displays a diverse range of interviews: from Charcoal Workers, University Professor, Local Habitants to official from IBAMA (the Brazilian Institute of the Environment and Renewable Natural Resources, and responsible for Environmental law-enforcement). On the Interviews with Piaui Locals habitants was mentioned that after the establishment of the Charcoal Production Ovens the climate changed significantly - temperature rose, river dried out and water source disappeared.

(Extracted from the Television Report; Source: Globo TV Channel)

University Professor pointed out that such activity in general also cut and burn **threatened tree species** (e.g.: Jatobá, Candeia and Ipê).

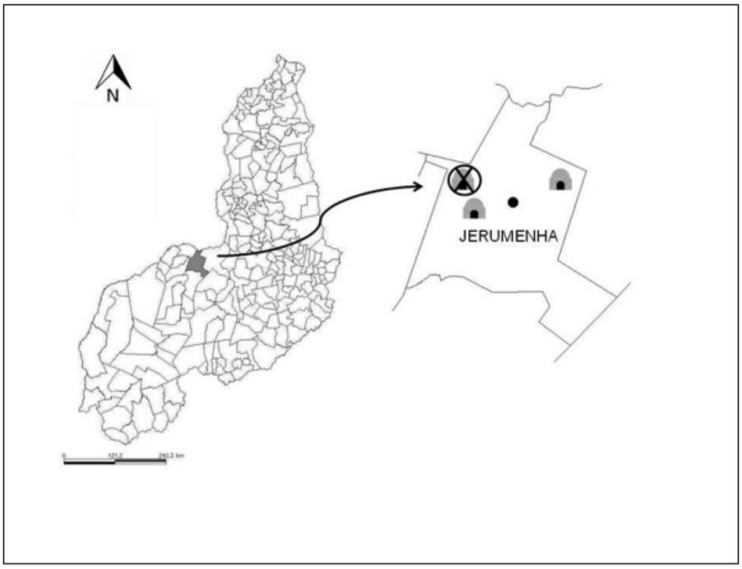
(Extracted from the Television Report; Source: Globo TV Channel)

The journalistic investigation also uncovered a Charcoal Production in Conservation area. In the event of these findings, the Journalist interviewed (recorded on video) a IBAMA (Federal institute responsible for ensuring the preservation and maintenance of the environment) official of the region, which by his turn explained "There is a lot of illegal production (of Charcoal) and IBAMA can't handle it, 2 inspectors can't do it." Such IBAMA official also gave indication of an array of issue that motivates such practices continuum. He asserted "Much of the consumption of large steel companies from the contracts they have arrived in there site as legal but from originated from illegal producers." Following the path indicated by the official, the Journalist uncovered that Charcoal Produced in the specific city in which he was covering the illegal productions were destined to a hub of Steel Companies. There he found that Charcoal is an important ingredient for the Pig Iron (also known as crude iron, is an intermediate product of the iron industry in the production of steel) and that among the 61 factories located in such Hub less than 10 made use of Charcoal from legal origins.

Lustosa *et al.* (2014) indicates that almost all charcoal production in Brazil is destined for the steel industry and much of this production is still carried out without basic concerns about the environment and worker safety. Monteiro (2006) indicates that the dynamics established for charcoal production make use, on a large scale, of primary forest, enabling a low cost in the production of charcoal, which is essential for these projects (Monteiro, 2006; Lustosa, Medeiros *et al,* 2014*)*

Homma *et al. (*2006) points out that Charcoal is an important ingredient in the production of pig iron. More precisely, for production of 1 ton of pig iron is required, in average: 875 kg of charcoal. (Homma *et at.,* 2006)

Lima, Santos & Castro (2015) published a case study of 3 Charcoal Production sites in the municipality of Jerumenha (about 40km from PAI Fazenda Boqueirão), State of Piauí. For such was interviewed personnel involved in two licensed charcoal production sites and one embargoed charcoal production site. According to such study, charcoal production is carried out in the same way as it was in the last century, through the incomplete combustion of wood. In this process, firewood is carbonized in a closed space, for three days, with a small or controlled amount of oxygen, at temperatures exceeding 300°C, with the release of non-condensable gases, organic liquids and finally as residue on the charcoal. Lima, Santos & Castro (2015) points out that this rudimentary process, dependent on human labor, exposes the charcoal workers to permanent contact with the smoke from the ovens, hard working hours, unhealthy conditions, and is considered an inhuman activity (Lima, Santos & Castro, 2015).



Source: Lima, Santos & Castro, 2015

Threatened tree species are commonly used in Charcoal Production. One example and evidence of so is a operation done in 2018 by Brazilian Federal Police in the Piaui State cities: Avelino Lopes, Júlio Borges, Curimatá, Morro Cabeça no Tempo, Gilbués and Floriano (about 80km away from PAI Fazenda Boqueirão). In such an event, **100 tons** of wood was confiscated and destroyed 2 Charcoal Production sites, used to make charcoal from **Ipê wood** (IUCN Red List). (G1, 2018)

(Source: Brazilian Federal Highway Police)

There are two main setups for Charcoal Productions: **Permanent and Itinerant.**

Permanent: one would think that the fact that the Permanent Charcoal Productions are built to operate for the long-term, they would not be linked with illegally deforested trees. Evidence shows that this is far from reality. According to IBAMA (2019), an inspection from IBAMA (Brazilian Institute of the Environment and Renewable Natural Resources) on just 14 Charcoal Productions businesses found 165.9 thousand cubic meters of Charcoal, a volume that is equivalent to the load of at least **1.700 trucks**. The Organism suggests that 7.100 ha were deforested to supply the identified illegal movement. In that case, the practice used by such Businesses was to simulate the purchase of wood from farms with authorization for deforestation. (IBAMA, 2019)

(Source: IBAMA)

Itinerant: such setup is in general located on the wild inside or close-by the region in which the deforestation happens. One example that brings to light the level of neglect and absurdity of such a setup happened in Capivara-Confusãos Ecological Corridor (about 130 km away from PAI Fazenda Boqueirão). This corridor in Piaui State connects "Serra da Capivara National Parks" and "National Parks Serra das Confusãos". "Serra da Capivara National Parks" itself is declared a World Heritage Site by UNESCO and have the largest number of archaeological sites with cave paintings in Brazil. Even with such importance of the protection of this area, the activity of Charcoal Production expanded there – significant deforestation and 32 charcoal ovens were founded within protected area (Meionorte, 2014; Neepes, ENSP & Fiocruz 2015).

(Source: Photo of founded ovens; Source Meionorte)

Agricultural Activity

According to Mapbioma (2021-a), agricultural area mapped in Brazil increased from **19 million** hectares in 1985 to **55 million** hectares in 2020 and the total area occupied by agriculture is even greater. In addition to the areas mapped directly as agricultural cultivation, there are **45.3 million** hectares of undefined fraction of the areas mapped as an agricultural mosaic - including non-perennial agricultural crops as well as part of the perennial crop areas that have not yet been mapped. It is worth highlighting that soybeans plantation, by itself, covers **36 million** hectares, area equivalent to the entire Republic of Congo and larger than countries like Italy, Vietnam or Malaysia. (Mapbioma, 2021-a)

Piaui State is part of Matopida, the country's most active agricultural frontier. There expansion of agriculture on native vegetation is extremely intense. According to a study published on the scientific journal Environment, during 2005–2014 the cultivated crop area in Matopida increased by 86.6% in contrast to the national average of 29% during the same period. The pace in Piauí State itself is even more intense, Piauí State has grown **three-fold (3x)** its agricultural area since the late 1990s (MapBioma, 2021-c) (Lahsen, Bustamante & Dalla-Nora, 2016).

According to Conservation International & ISPN (2017), Cerrado has lost approximately **50% of its natural coverage**. Mapbioma (2021-c) indicates that currently **agricultural activity occupies 44.2% of the Cerrado.** Matopiba is where most of the deforestation is concentrated, with emphasis on the state of Piauí (MapBioma, 2021-c; Campelo, 2017; Conservation International & ISPN, 2017).

Biome	% of Lost Native Vegetation (of the entire Biome Area)	% Agricultural Activity occupies (of the entire Biome Area)
Cerrado	50,00%	44,20%

According to Brazilian Ministry of the Environment, Caatinga Biome has already lost **45.39% of its native vegetation**. Among the factors that cause the loss of native vegetation, the advance of agricultural activity stands out. Between 1985 and 2020, in Caatinga area, agricultural activity expanded such that began to account for **35.2% of the biome's area** in 2020, over 11.26 million hectares. (O Globo, 2010; Mapbioma, 2021-b)

Biome	% of Lost Native Vegetation (of the entire Biome Area)	% Agricultural Activity occupies (of the entire Biome Area)
Caatinga	45,39%	35,20%

Such level of Native Vegetation conversion in such quick pace is much troubling. For instance, resulting fragmentation of the conserved areas, that is, now patches that sometimes cannot maintain themselves and reestablish a **biodiversity.** (Campelo, 2017)

According to Sales (2021), in 2010, on the 10th Conference of the Parties to the Convention on Biological Diversity, was stablished the goal of conserving at least 17% of each existing biome on the Planet, and Brazil is entirely responsible for such conservation of Caatinga - given Caatinga biome **only exist** in Brazil. Current estimative indicates that only *1.3%* (**one point three percent**) of entire Caatinga is under integral protection. (Sales, 2021)

According to Lahsen, Bustamante & Dalla-Nora (2016), even though Cerrado is classified as one of the global 35 "**biodiversity hotspots**", the Cerrado's protected area is in a estimated deficit of 4.5 million hectares. The protected area is **below the 10% minimum** stipulated by the Convention on Biological Diversity (of which Brazil is a signatory) and even further below the treaty's Aichi target of 17% (Lahsen, Bustamante & Dalla-Nora, 2016).

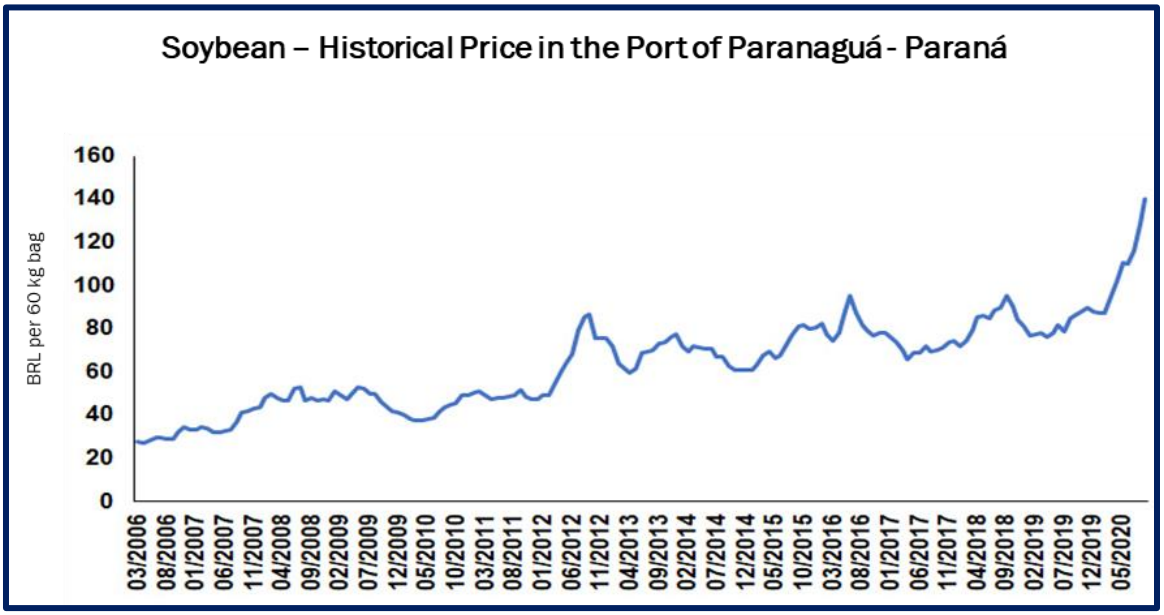
Lack of law-enforcement is at the core of the problems in this region. Lacerda (2021) indicates that illegal activities are motivated by the lack of attention from the public power and by the dismantling of environmental inspection agencies. Greenpeace (2019) indicated that deforestation is a direct result of the anti-environmental policy, which reduced inspections, sabotaged control bodies and encouraged crime (Greenpeace, 2019; Lacerca 2021). According to a study from ICV, Imaflora & Lagesa (2021) supported by World Wide Fund for Nature (WWF)**: in Piauí state**, **98.9%** of all suppression of native vegetation are illegal (ICV, Imaflora & Lagesa, 2021).

(Source: IBAMA)

On the Agricultural Activity, illegality is present throughout the prism of scale. IBAMA (2018), in just one operation, caught 5,041 tons of grains planted on prohibited area. (IBAMA, 2018)

A relevant propeller of conversion of new areas is the **traditional culture** around **Shifting Agriculture**. Farmers cultivate a field for a few years and then abandon the land and clear a new area of native vegetation to establish new fields. On Pria (2011), it is indicated an interview giving voice to a regional farmer around his reasoning behind clearing new areas: “We plant and in the first and second year it grows well, but after three years the land weakens and no longer grows as it did in the first two years”. The agricultural practices based on unsustainable and inefficient land use deplete soil fertility of converted land, causing a continuum of conversion of new lands to maintain crop yields. Diário do Nordeste (2015) portraited an interview with a Researcher from EMBRAPA (The Brazilian Agricultural Research Arm), where is mentioned that “After two or three harvests, the area is depleted and abandoned, looking for another place for planting” and “Among the factors that most impact the environment and stimulate desertification is the traditional shifting agriculture system” (Diário do Nordeste, 2015; Pria, 2011).

Brazil is passing through a **boom of commodities**. The Price of agricultural commodities are reaching record-high (University of Illinois Ag Economists, 2020). According to Piaui state Government, the forecast for grain production in Piauí - in just 2021 itself - will increase 9.74% compared to the year before (Piaui State Government, 2021; University of Illinois Ag Economists, 2020).



(Source: Cepea/Esalq/BM&Fbovespa/University of Illinois Ag Economists, 2020)

The advancement of agriculture frontier also caused **Displacement of Traditional Communities** that used to live from the work on the lands. Monoculture (e.g. soybeans and maize) are using more and more heavy-machinery substituting the work of land-worker. Traditional communities and small farmers are everywhere where the native vegetation remains, but suffer intense pressure from crop and cattle expansion. A common scenario is: "After land is converted to mechanized soy production, rural employment opportunities diminish, pushing the poor either to illegally occupy and convert new areas to farmland or to migrate to urban slums." (Lahsen, Bustamante & Dalla-Nora, 2016).

This process of environmental change and deterioration is resulting on the elimination of key ecological processes, the rapid loss of unique species, soil impoverishment, and the formation of extensive desertification nuclei. To preserve the region's extensive ecosystem services besides biodiversity, it is crucial to increase the protection of the remaining Caatinga and Cerrado native vegetation. The conversion threat indicated above have tormented PAI Fazenda Boqueirão and are being addressed by Maraui Program initiatives.

A participatory rural appraisal was also performed. Its results indicated that the main Class of Agents are Local and Regional Groups (operating in unlawful manners) and their main means of mobility are local non-paved road and state highways. It was pointed out by several respondents that the illegal agents avoid Federal Highways because those are monitored by Federal Highway Police and IBAMA. PRA results indicate that agricultural activity is the predominant conversion threat to PAI Fazenda Boqueirão.

3.5.2 VT0001 Assessment

The additionality analysis was performed through the application of the tool "VT0001 Tool for Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use AFOLU project Activities", Version 3.0. Below follow details regarding each of the 4 steps and the conclusion:

STEP 1. Identification of alternative land use scenarios to the AFOLU project activity.

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

Based on the analysis offered on the introduction of this section (sub-section 3.5.1), follow below realistic and credible land-use scenarios that would have occurred on the land within the proposed project boundary:

i. Continuation of the pre-project land use

The most likely land-use scenario to Fazenda Boqueirão is continuation and proliferation of Charcoal Production and Agricultural activity – detailed above (sub-section 3.5.1). Such practices were historically observed across the Project Region and Area. Unplanned conversion continues due to a mix of lack of law-enforcement, unsustainable practices, and socio-economic factors. This scenario is expected to be exacerbated due to boom of commodities in the region. Such situation entails significant pressure on biodiversity and communities (pushed to marginalization) (Lahsen, Bustamante & Dalla-Nora, 2016).

ii. Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project

This scenario consists of AUC activity without the VCS AFOLU project. Therefore, it represents the project activities taking place on the land within the PA without being

registered as a VCS AFOLU project, which entails the absence of funds derived from VCU.

In the absence of a VCS AFOLU Project, the threats described in the section above (3.5.1), coupled with inadequate financial resources across the landscape, will continue unremittingly. In the lack of funding from the sale of emission reductions, the Project Proponent will be unable to fund project activities to protect the Project Area from ecosystem conversion. The only potential perennial funding alternative activity (other than the VCS AFOLU Project) that could bring revenue to fund the protection and conservation of this area would be tourism. However, PAI Fazenda Boqueirão is located in a remote location, far from the touristic routes. This scenario is unattainable and not a credible alternative.

iii. Project activity on the land within the project boundary registered as VCS AFOLU project

This scenario consists of conservation activity registered as VCS AFOLU project and funded by the sales of VCUs.

Results from Sub-step 1a

- Continuation of the pre-project land use
- Project activity on the land within the project boundary registered as VCS AFOLU project

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

- Continuation of the pre-project land use

The practices that configure the pre-project land use are in violation of Brazilian Law, in special the Brazilian Forect Code (Law #12.651, May, 25th 2012). Unfortunately, the applicable mandatory legal and regulatory requirements are systematically not enforced, and non-compliance with those requirements is widespread. According to a study from ICV, Imaflora & Lagesa (2021) supported by WWF (World Wide Fund for Nature): in Piauí state, **98.9%** of all suppression of native vegetation are illegal. Currently, agricultural activity occupies 44.2% of the Cerrado region (MapBioma,

2021c), and 35,2% of the Caatinga region. (Mapbioma, 2021-b; ICV, Imaflora & Lagesa, 2021).

Law enforcement can be challenging in many of Brazil rural areas, especially in remote zone such as the one PAI Fazenda Boqueitão is located. This is often due to a lack of financial and human capacity among the law-enforcement agencies. For example, local officials are often unable to exercise control over large parts of the areas under their authority because of a lack of staff members, technical equipment and means of transportation. This gap in enforcement is largely caused by a lack of funding limiting Government´s ability to patrol the native vegetation area with enough frequency and efficacy to deter conversion activities. The proposed project activities are therefore important to help enforce the national laws and ensure that the PA is not converted in the future.

- Project activity on the land within the project boundary funded by VCS AFOLU project

  This scenario is comprised by the conservation activity proposed by the Project, which complies with all applicable Brazilian Laws and Regulatory requirements.

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

The PRA indicated the most likely end land-use activity enticing ecosystem conversion is the agricultural activity. Such activity is also the prevalent activity leading to conversion in the Region and PA – see section 3.5.1.

Step 2. Investment analysis

Maraui Program VCS AFOLU generates no financial or economic benefits other than VCS-related income derived from the commercialization of carbon credits. Therefore, simple cost analysis (Option I) applies. The proposed project activities are not revenue-generating (other than VCS-related carbon income), and the protection of the Project Area as well as provision of conversion mitigation activities cost significant financial amounts on an annum basis generating a continuum deficit and the other land-use scenario alternative to the registered VCS AFOLU Project is unlawful and doesn´t generate any revenue.

Step 3. Barrier analysis

According to VT0001 Tool, Barrier Analysis is applicable if it is determined that the Barriers prevent the implementation of this type of proposed project activity without the revenue from the sale of GHG credits and do not prevent the implementation of at least one of the alternative land-use scenarios.

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

Many barriers would prevent the implementation of the type of proposed project activity from being carried out if the project activity was not registered as a VCS AFOLU project and so has no funding from the commercialization of VCU. The following elucidation will focus on the three most prevalent barriers within the list present on VT0001 tool: 1) Barriers related to local tradition, inter alia: i) Traditional knowledge or lack thereof, laws and customs, market conditions, practices; ii) Traditional equipment and technology; 2) Institutional barriers, lack of enforcement of forest or land-use-related legislation; 3) Barriers due to social conditions and land-use practices, inter alia: Widespread illegal practices. Such barriers would preclude project activity from being successful in case the Project was not registered as VCS AFOLU project (and as consequence would not have access to funding originated by VCU sales).

Lax Law-enforcement and Widespread illegal practices - well explained in sub-section 3.5.1 - imposes a necessary investment on the protection of the land area (e.g.: 24/7 ground patrolling and satellite monitoring). Those investments are required from the start of the project and will continue through the project's lifetime. Given the boom of commodities and the consequent scarcity of available land– see section 3.5.1 - the threats will be exacerbated progressively, so it is presumed that the investment in protection will increase with time.

Traditional Local Culture has shifting agriculture as a common practice – see section 3.5.1.. An array of initiatives must be performed to mitigate the clearing of new native vegetation areas. Such initiatives are core to the success of the proposed project activity. The initiatives require significant investment from the project start and demand constant flow of capital to continuum performance. That is the case of the alternative economic activity supported by the project (apiculture). It is also the case of the initiative of improvement of their current production activity (to reduce the pressure exerted on the

native vegetation), uninterrupted investment in education, training, and equipment will be demanded. New initiatives must be implemented throughout the project's lifespan to cope with the socio-economic needs and threats encircling the project area.

Sub-step 3b. Show that the identified barriers would not prevent the implementation of at least one of the alternative land use scenarios (except the proposed project activity):

While the identified barriers would not prevent the continuation of the pre-project land use (given they are the ground in which such scenario thrives), they would prevent project proponent from carrying out the proposed project activity if it was not expected to be registered as a VCS AFOLU (and have access to revenue arising from VCU commercialization).

Step 4. Common practice analysis

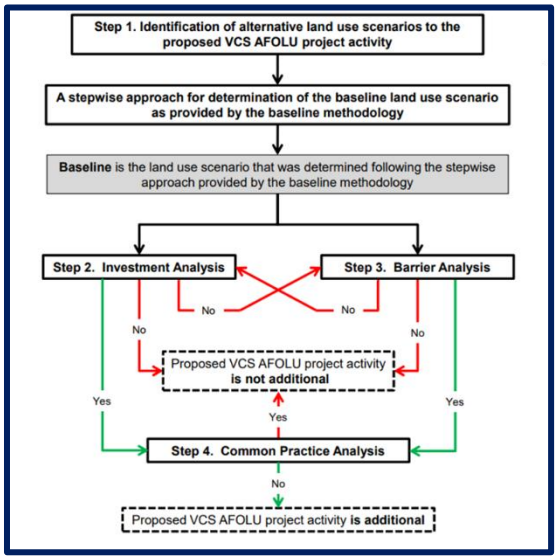
The previous steps shall be complemented with an analysis of the extent to which similar activities have already diffused in the geographical area of the proposed VCS AFOLU project activity. This test is a credibility check to demonstrate additionality that complements the barrier analysis (Step 3) and the investment analysis (Step 2).

GHG emission reduction project in Private Property that does not rely on tourism was not identified in the state of Piauí. Tourism Revenue is not an option for PAI Fazenda Boqueirão, given its location in a more remote region, far from the regular touristic routes. Therefore, PAI Fazenda Boqueirão will rely on VCU sales to fund all activities/initiatives.

Conclusion

In the right side follow the step-wise process illustration:

For a project Activity to be additional it must satisfy Step 4 and Step 2 **or** Step 3. PAI Fazenda Boqueirão satisfies Step 4, Step 2 **and** Step 3, thus it is **Additional.**



3.6 Methodology Deviations

In this present work, there was no methodology deviation.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

The underlying mechanics of VM0009 methodology utilize four types of emissions models. The first two relate to the baseline scenario and are referred to as the baseline emissions models. The baseline emissions models include the Biomass Emissions Model (BEM) and Soil Emissions Model (SEM) that characterize the baseline scenario for each accounting area to estimate avoided baseline emissions from forest degradation, land-use conversion and subsequent soil carbon loss. Depending on the baseline type, different model parameters are selected.

The BEM and SEM do not account for carbon stored in long-lived wood products or the decay of carbon in dead wood, below-ground biomass or soil. These emissions are accounted for on the Decay Emissions Model (DEM). The fourth model is the Leakage Emissions Model (LEM) which accounts for emissions from activity-shifting leakage or market leakage. Project emissions are accounted for separately from the models to determine gross credit generation. Net credit generation is determined by subtracting deductions for contributions to the AFOLU Pooled Buffer Account.

4.1 Baseline Emissions

For each project accounting area, a baseline type must be selected. The following explanation will cover calculation for the possible baseline types covered under VM0009 Methodology.

The baseline emissions ($E_{B\,\Delta}^{[m]}$) for the current monitoring period are given by equation [F.15]:

$$E_{B\,\Delta}^{[m]} = E_{B}^{[m]} - E_{B}^{[m-1]} \qquad \text{[F.15]}$$

This is a function of the cumulative baseline emissions at the beginning and end of the current monitoring period as given by equation [F.16]:

$$E_B^{[m]} = E_{B\,BM}^{[m]} + E_{B\,SOC}^{[m]} - C_{B\,SOC}^{[m]} - C_{B\,BGB}^{[m]} - C_{B\,DW}^{[m]} - C_{B\,WP}^{[m]} \quad \text{[F.16]}$$

After this quantity is verified, it becomes fixed when determining emissions at subsequent monitoring events. It is possible that $E_{B\,\Delta}^{[m]}$ could be less than zero due to conditions in the proxy area and parameter effects in the baseline emissions models over time. However, for most projects, this value will be positive indicating baseline emissions would have occurred in the absence of the project.

If any of the following pools are not selected, their corresponding values in [F.15] are zero: SOC, BGB, DW or WP.

Maraui Program selected the Biomass (above and below ground) and Soil Organic Carbon pools. Below follow explanation of calculations for each.

Biomass

Baseline emissions from biomass are determined based on the baseline type and selected carbon pools. For each selected carbon pool in biomass (BM), the appropriate BEM is applied to calculate baseline emissions. Baseline emissions from biomass for the current monitoring period are based on the average carbon stock in selected carbon pools from AGMT, AGOT, AGNT, BGMT, BGOT and BGNT given by [F.17] for the project accounting area and [F.18] for the proxy area. This set of selected carbon pools in biomass $\mathcal{B}$ is a subset of all selected carbon pools $\mathcal{C}$ (see section 5.4 of VM0009 Methodology).

$$c_{P\,BM}^{[m]} = \sum_{b \in \mathcal{B}} c_{P\,b}^{[m]} \quad \text{[F.17]}$$

$$c_{B\,BM}^{[m]} = \sum_{b \in \mathcal{B}} c_{B\,b}^{[m]} \quad \text{[F.18]}$$

The cumulative baseline emissions from biomass $E_{B\,BM}^{[m]}$ as of monitoring period [$\boldsymbol{m}$] are calculated by equations [F.19], [F.20], [F.21], and [F.22] (see sections 8.1.1.1, 8.1.1.2, 8.1.1.3 and 8.1.1.4. of VM0009 Methodology). Once verified, these quantities do not change when calculating baseline emissions for subsequent monitoring periods.

$$E_{B\,BM}^{[m]} = BEM_{P1}\left(c_{P\,BM}^{[m=0]}, c_{B\,BM}^{[m]}, t^{[m]}, x^{[m]}\right) \quad [F.19]$$

$$E_{B\,BM}^{[m]} = BEM_{P2}\left(c_{P\,BM}^{[m=0]}, c_{B\,BM}^{[m]}, t^{[m]}, x^{[m]}\right) \quad [F.20]$$

$$E_{B\,BM}^{[m]} = BEM_{U2,3}\left(c_{P\,BM}^{[m=0]}, c_{B\,BM}^{[m]}, t^{[m]}, x^{[m]}\right) \quad [F.21]$$

$$E_{B\,BM}^{[m]} = BEM_{U1}\left(c_{P\,BM}^{[m=0]}, c_{B\,BM}^{[m]}, t^{[m]}, x^{[m]}\right) \quad [F.22]$$

For the calculation of Cumulative Baseline Emissions from Biomass, difference scenarios have different guidance:

For F-P1.a, the cumulative baseline emissions from biomass $E_{B\,BM}^{[m]}$ as of monitoring period [m] are calculated by [F.19], indicated above. The variables $c_{P\,BM}^{[m=0]}$ is the average carbon stocks in biomass as measured in the project accounting area prior to the first monitoring event for F-P1.a. $c_{B\,BM}^{[m]}$ is the average carbon stocks in biomass as measured in the proxy area, $t^{[m]}$ is the time of the monitoring event and $x^{[m]}$ is the monitored covariates as of the time of the monitoring event. These variables are monitored per section 9 of VM0009 Methodology.

For F-P2 and G-P2, the cumulative baseline emissions from biomass $E_{B\,BM}^{[m]}$ as of monitoring period [m] are calculated by [F.20], indicatec above. The variable $c_{P\,BM}^{[m=0]}$ is the average carbon stocks in biomass as measured in the project account area prior to the first monitoring event, $c_{B\,BM}^{[m]}$ is the average carbon stocks in biomass as measured in the proxy area, $t^{[m]}$ is the time of the monitoring event and $x^{[m]}$ is the monitored covariates as of the time of the monitoring event. These variables are monitored per section 9 of VM0009 Methodology.

For F-U1 and G-U1, the cumulative baseline emissions from biomass $E_{B\,BM}^{[m]}$ as of monitoring period $[m]$ are calculated by [F.22], indicated above. The variable $c_{P\,BM}^{[m=0]}$ is the average carbon stocks in biomass as measured in the project account area prior to the first monitoring event, $c_{B\,BM}^{[m]}$ is the average carbon stocks in biomass as measured in the proxy area, $t^{[m]}$ is the time of the monitoring event and $x^{[m]}$ is the monitored covariates as of the time of the monitoring event. These variables are monitored per section 9 of VM0009 Methodology.

For F-U2 and G-U2, the cumulative baseline emissions from biomass $E_{B\,BM}^{[m]}$ as of monitoring period $[m]$ are calculated by [F.21], indicated above. The variable $c_{P\,BM}^{[m=0]}$ is the average carbon stocks in biomass as measured in the project account area prior to the first monitoring event, $c_{B\,BM}^{[m]}$ is the average carbon stocks in biomass as measured in the proxy area, $t^{[m]}$ is the time of the monitoring event and $x^{[m]}$ is the monitored covariates as of the time of the monitoring event. These variables are monitored per section 9 of VM0009 Methodology.

For F-U3 and F-P1.b, a spatial model called the spatial algorithm is used to estimate baseline emissions from biomass by carbon pool per AFOLU requirements (see section 8.1.1.5.1 of VM0009 Methodology.). The cumulative baseline emissions from biomass $E_{B\,BM}^{[m]}$ as of monitoring period $[m]$ are calculated by [F.24] using the spatial algorithm. Once verified, this quantity does not change when calculating baseline emissions for subsequent monitoring periods.

$$E_{B\,BM}^{[m]} = BEM_{SP}\left(c_{P\,1\,BM}^{[m=0]}, c_{B\,BM}^{[m]}, t^{[m]}, x^{[m]}\right) = BEM_{U2,3/P1}(c_{P\,1\,BM}^{[m=0]}, c_{B\,BM}^{[m]}, t^{[m]}, x^{[m]}) \quad \text{[F.24]}$$

when $E_{B\,BM}^{[m]} \geq A_{P\,1}^{[m=0]}\left(c_{P\,1\,BM}^{[m=0]} - c_{B\,BM}^{[m]}\right)$

then $E_{B\,BM}^{[m]} = BEM_{U2,3}(wc_{P\,1,2\,BM}^{[m=0]}, c_{B\,BM}^{[m]}, t^{[m]}, x^{[m]})$

when $E_{B\,BM}^{[m]} \geq A_{P\,1}^{[m=0]}c_{P\,1\,BM}^{[m=0]} + A_{P\,2}^{[m=0]}c_{P\,2\,BM}^{[m=0]} - c_{B\,BM}^{[m]}\left(A_{P\,1}^{[m=0]} + A_{P\,2}^{[m=0]}\right)$

then $E_{B\,BM}^{[m]} = BEM_{U2,3/P1}(wc_{P\,1,2,3\,BM}^{[m=0]}, c_{B\,BM}^{[m]}, t^{[m]}, x^{[m]})$

...

$$E_{B\,BM}^{[m]} = A_{P\,1}^{[m=0]}c_{P\,1\,BM}^{[m=0]} + A_{P\,2}^{[m=0]}wc_{P\,1,2\,BM}^{[m=0]} + \cdots + A_{P\,n}^{[m=0]}wc_{P\,i,n\,BM}^{[m=0]} - c_{B\,BM}^{[m]}\left(A_{P\,1}^{[m=0]} + A_{P\,2}^{[m=0]} + \cdots + A_{P\,n}^{[m=0]}\right)$$

Soil Organic Carbon (SOC)

Baseline emissions from SOC are determined based on the baseline type if the SOC pool is selected. Baseline emissions from SOC for the current monitoring period are based on the average carbon stock in SOC in the project accounting area and in the proxy area.

The current baseline emissions from $^{SOC}E^{[m]}_{B\,\Delta SOC}$ are estimated as [F.26] from all types other than F-P1.b and F-U3, which is the difference in cumulative baseline emissions for the current monitoring period $E^{[m]}_{B\,SOC}$ and the cumulative baseline emissions for the prior monitoring $E^{[m-1]}_{B\,SOC}$ (fixed at prior monitoring event). Current baseline emissions from $^{SOC}E^{[m]}_{B\,\Delta SOC}$ are used to calculate carbon not decayed in soil (see section 8.1.5 of VM0009 Methodology).

$$E^{[m]}_{B\,\Delta\,SOC} = E^{[m]}_{B\,SOC} - E^{[m-1]}_{B\,SOC} \qquad [F.26]$$

For baseline types F-P1.b and F-U3, current baseline emissions from $^{SOC}E^{[m]}_{B\,\Delta SOC}$ are calculated as in [F.29].

$$E^{[m]}_{B\,SOC} = SEM_{sp}\left(c^{[m=0]}_{P1\,SOC}, c^{[m]}_{B\,SOC}, t^{[m]}, x^{[m]}\right) = SEM_{U2,3/P1}\left(c^{[m=0]}_{P1\,SOC}, c^{[m]}_{B\,SOC}, t^{[m]}, x^{[m]}\right) \qquad [F.29]$$

when $E^{[m]}_{B\,SOC} \geq A^{[m=0]}_{P\,1}\left(c^{[m=0]}_{P\,1\,SOC} - c^{[m]}_{B\,SOC}\right)$

then $E^{[m]}_{B\,SOC} = SEM_{U2,3/P1}\left(wc^{[m=0]}_{P\,1,2\,SOC}, c^{[m]}_{B\,SOC}, t^{[m]}, x^{[m]}\right)$

when $E^{[m]}_{B\,SOC} \geq A^{[m=0]}_{P\,1}c^{[m=0]}_{P\,1\,SOC} + A^{[m=0]}_{P\,2}c^{[m=0]}_{P\,2\,SOC} - c^{[m]}_{B\,SOC}\left(A^{[m=0]}_{P\,1} + A^{[m=0]}_{P\,2}\right)$

then $E^{[m]}_{B\,SOC} = SEM_{U2,3/P1}\left(wc^{[m=0]}_{P\,1,2,3\,SOC}, c^{[m]}_{B\,SOC}, t^{[m]}, x^{[m]}\right)$

...

$$E^{[m]}_{B\,SOC} = A^{[m=0]}_{P\,1}c^{[m=0]}_{P\,1\,SOC} + A^{[m=0]}_{P\,2}wc^{[m=0]}_{P\,1,2\,SOC} + \cdots + A^{[m=0]}_{P\,n}wc^{[m=0]}_{P\,i,n\,SOC} - c^{[m]}_{B\,SOC}\left(A^{[m=0]}_{P\,1} + A^{[m=0]}_{P\,2} + \cdots + A^{[m=0]}_{P\,n}\right)$$

For the calculation of Cumulative Baseline Emissions from SOC, difference scenarios have different guidance

Baseline emissions from SOC for Types **F-P1.a, F-P2, and G-P2** are calculated using the SEM. The cumulative baseline emissions from $E_{B\,SOC}^{[m]}$ as of monitoring period $[m]$ are estimated by [F.25]. Once verified, this quantity does not change when calculating baseline emissions for subsequent monitoring periods.

$$E_{B\,SOC}^{[m]} = SEM_P\left(c_{P\,SOC}^{[m=0]} c_{B\,SOC}^{[m]}, t^{[m]}, x^{[m]}\right) \quad [F.25]$$

Baseline emissions from SOC for Types **F-U1 and G-U1** are estimated using the SEM. The cumulative baseline emissions from $E_{B\,SOC}^{[m]}$ as of monitoring period $[m]$ are estimated by [F.27]. Once verified, this quantity does not change when calculating baseline emissions for subsequent monitoring periods.

$$E_{B\,SOC}^{[m]} = SEM_{U1}\left(c_{P\,SOC}^{[m=0]} c_{B\,SOC}^{[m]}, t^{[m]}, x^{[m]}\right) \quad [F.27]$$

Baseline emissions from SOC for Types **F-U2 and G-U2** are estimated using the SEM. The cumulative baseline emissions from $E_{B\,SOC}^{[m]}$ as of monitoring period $[m]$ are estimated by [F.28]. Once verified, this quantity does not change when calculating baseline emissions for subsequent monitoring periods.

$$E_{B\,SOC}^{[m]} = SEM_{U2,3}\left(c_{P\,SOC}^{[m=0]} c_{B\,SOC}^{[m]}, t^{[m]}, x^{[m]}\right) \quad [F.28]$$

Baseline emissions from SOC for $E_{B\,SOC}^{[m]}$ Types **F-U3, and F-P1.b** are estimated using the SEM. The cumulative baseline emissions from as of monitoring period $[mm]$ are estimated by [F.29]. Once verified, this quantity does not change when calculating baseline emissions for subsequent monitoring periods

$$E_{B\,SOC}^{[m]} = SEM_{sp}\left(c_{P1\,SOC}^{[m=0]} c_{B\,SOC}^{[m]}, t^{[m]}, x^{[m]}\right) = SEM_{U2,3/P1}(c_{P1\,SOC}^{[m=0]}, c_{B\,SOC}^{[m]}, t^{[m]}, x^{[m]}) \quad \text{[F.29]}$$

when $E_{B\,SOC}^{[m]} \geq A_{P\,1}^{[m=0]}\left(c_{P\,1\,SOC}^{[m=0]} - c_{B\,SOC}^{[m]}\right)$

then $E_{B\,SOC}^{[m]} = SEM_{U2,3/P1}(wc_{P\,1,2\,SOC}^{[m=0]}, c_{B\,SOC}^{[m]}, t^{[m]}, x^{[m]})$

when $E_{B\,SOC}^{[m]} \geq A_{P\,1}^{[m=0]} c_{P\,1\,SOC}^{[m=0]} + A_{P\,2}^{[m=0]} c_{P\,2\,SOC}^{[m=0]} - c_{B\,SOC}^{[m]}\left(A_{P\,1}^{[m=0]} + A_{P\,2}^{[m=0]}\right)$

then $E_{B\,SOC}^{[m]} = SEM_{U2,3/P1}(wc_{P\,1,2,3\,SOC}^{[m=0]}, c_{B\,SOC}^{[m]}, t^{[m]}, x^{[m]})$

...

$$E_{B\,SOC}^{[m]} = A_{P\,1}^{[m=0]} c_{P\,1\,SOC}^{[m=0]} + A_{P\,2}^{[m=0]} wc_{P\,1,2\,SOC}^{[m=0]} + \cdots + A_{P\,n}^{[m=0]} wc_{P\,i,n\,SOC}^{[m=0]} - c_{B\,SOC}^{[m]}\left(A_{P\,1}^{[m=0]} + A_{P\,2}^{[m=0]} + \cdots + A_{P\,n}^{[m=0]}\right)$$

Carbon Not Decayed in SOC

Calculate carbon in non-decayed SOC using [F.33], where λ_{SOC} is determined in section 6.19.1 on VM0009 Methodology and $\mathcal{M}$ is the set of all monitoring periods including the current and past monitoring periods. The cumulative emissions from $^{SOC}E_{B\,SOC}^{[m]}$ are calculated as instructions of section 8.1.2.1, 8.1.2.2 or 8.1.2.3. Once verified, this quantity does not change when calculating baseline emissions for subsequent monitoring periods. For the first monitoring period, the cumulative emissions from the prior monitoring period, $^{SOC}E_{B\,SOC}^{[i-1]}$ are zero

$$C_{B\,SOC}^{[m]} = \sum_{i \in \mathcal{M}} DEM_{SOC}\left(E_{B\,\Delta\,SOC}^{[i]}, t^{[m]}, t^{[i-1]}\right) \quad \text{[F.33]}$$

Maraui Program aiming to be conservative and makes use on its calculations the default value (as per VM0009 Methodology λ_{SOC} suggestion) of "0.2". Such value is derived from E. Davidson & Ackerman (1993).

4.2 Project Emissions

Project emissions for any monitoring period $[m]$ are calculated from the events of biomass consumption through fire, burning, logging or other disturbance. Current project emissions for the current monitoring period $E_{P\,\Delta}^{[m]}$ are estimated by equation [F.41]. Emissions from fire, natural disturbances and logging are inherently captured by the monitoring of carbon stocks in the project area. Maraui Program require all PAIs to have constant monitoring of disturbances through staff on the ground, remote sensing, or some other method that captures conversion in a timely manner.

$$E_{P\,\Delta}^{[m]} = E_{P\,\Delta\,BRN}^{[m]} + E_{P\,\Delta\,LS}^{[m]} + E_{P\,\Delta\,SF}^{[m]} + A_{PAA}\left(c_P^{[m-1]} - c_P^{[m]}\right) - C_{P\,\Delta\,WP}^{[m]} \quad \text{[F.41]}$$

4.3 Leakage

Emissions from activity-shifting leakage are calculated using the Leakage Emissions Model and an activity-shifting leakage area.

Total emissions from leakage for the current monitoring period $E_{L\,\Delta}^{[m]}$ are calculated by [F.44]. The cumulative emissions from leakage for the current monitoring period are given by [F.45], the sum of cumulative emissions from activity-shifting leakage in forest strata $E_{L\,ASF}^{[m]}$, the activity-shifting leakage in grassland strata $E_{L\,ASG}^{[m]}$ and market leakage $E_{L\,ME}^{[m]}$ for the current monitoring period. Once estimated for the current monitoring period, these cumulative emissions from leakage $E_L^{[m]}$ are fixed for subsequent monitoring periods.

$$E_{L\,\Delta}^{[m]} = E_L^{[m]} - E_L^{[m-1]} \quad \text{[F.44]}$$

$$E_L^{[m]} = E_{L\,ASF}^{[m]} + E_{L\,ASG}^{[m]} + E_{L\,ME}^{[m]} \quad \text{[F.45]}$$

According to VM0009 Methodology: if, for a PAI, market leakage is not considered, then cumulative emissions from market leakage $E_{L\,ME}^{[m]}$ should be set to zero. If the emissions from activity-shifting leakage in forest strata $E_{L\,ASF}^{[m]}$, in grassland strata $E_{L\,ASG}^{[m]}$ or market leakage $E_{L\,ME}^{[m]}$ are negative (indicating "negative leakage"), then their value must be set to zero. If the total emissions from leakage for the current monitoring period are negative (indicating "negative leakage") then the value of $E_{L\,\Delta}^{[m]}$ should be set to zero.

Activity-shifting leakage is estimated by directly observing conversion. Each PAI must establish leakage plots. The activity-shifting leakage area must be monitored throughout the project lifetime. In the instance where there is no accessible forest or native grassland for the agents of conversion other than the project, then activity-shifting leakage from the project cannot occur. In this instance, there need not be an activity shifting leakage area. This can be demonstrated using the PRA and/or expert knowledge, coupled to analysis of native vegetation areas accessible to the agents of conversion, those nearest to the project. In all other cases, there must be one activity shifting leakage area for each project accounting area.

Cumulative emissions from activity-shifting leakage for the current monitoring period $E_{L\,AS}^{[m]}$ are estimated by [F.46] and [F.47] using the Leakage Emissions Model. Once verified, this quantity becomes fixed for subsequent monitoring periods. For the first monitoring period, cumulative emissions from activity-shifting leakage $E_{L\,ASF}^{[m]}$ and $E_{L\,ASG}^{[m]}$ are zero. Carbon stocks in the project accounting area and the proxy area, $c_P^{[m]}$ and $c_B^{[m]}$ are the sum of all selected carbon pools for the current monitoring period (tCO2e/ha).

$$E_{L\,ASF}^{[m]} = LEM\left(c_P^{[m]}, c_B^{[m]}, p_{L\,DEG}^{[m]}, t^{[m]}, x^{[m]}\right) \quad \text{[F.46]}$$

$$E_{L\,ASG}^{[m]} = LEM\left(c_P^{[m]}, c_B^{[m]}, p_{L\,CON\,G}^{[m]}, t^{[m]}, x^{[m]}\right) \quad \text{[F.47]}$$

The Leakage Emissions Model given by [F.48] and [F.49] estimates cumulative emissions from activity-shifting leakage and is based on the parameterization of α, β and θ and others from section 6.7 of VM0009 Methodology . Equation [F.48] is for forested project accounting areas while [F.49] is for grassland project accounting areas. Upon baseline reevaluation, the leakage

model is updated to reflect the re-parameterization of α, β and θ and other parameters remain unchanged per section 6.20 of VM0009 Methodology.

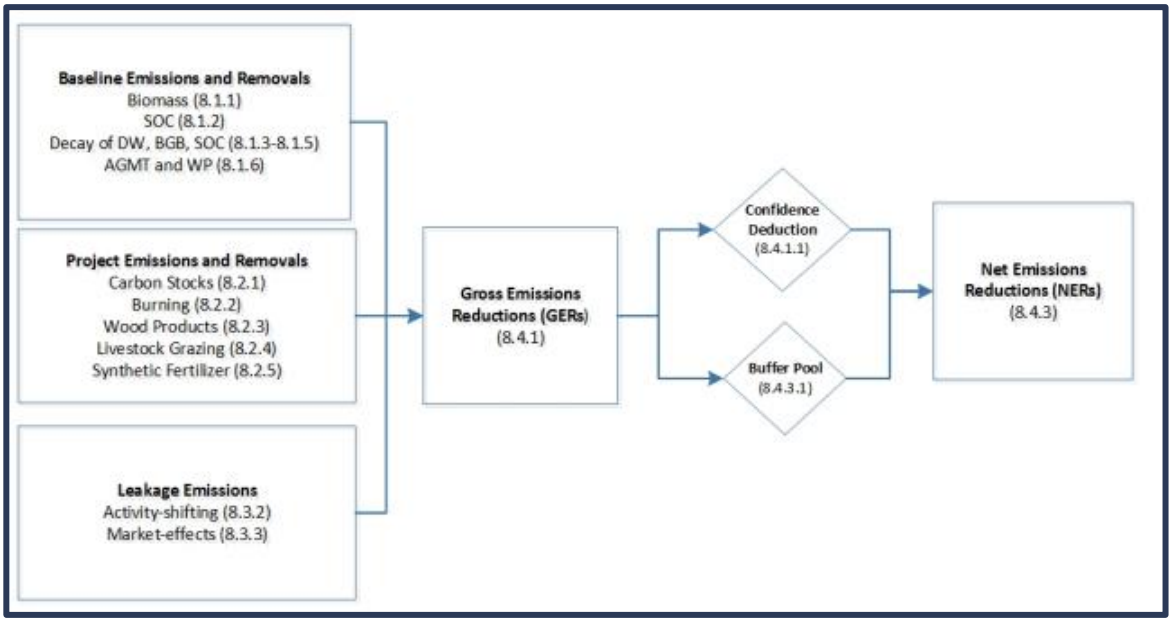
$$LEM_F(c_P, c_B, p_{L\,DEG}, t, x) = p_{L\,DEG}^{[m]} A_{AS}(c_P - c_B) - \frac{A_{AS}(c_P - c_B)}{1 + e^{\ln\left(\frac{1}{p_{L\,DEG}^{[m=0]}} - 1\right) - \beta t - \theta(x_0 - x)^T}} \quad [F.48]$$

$$LEM_G(c_P, c_B, p_{L\,DEG}, t, x) = p_{L\,CON\,G}^{[m]} A_{AS}(c_P - c_B) - \frac{A_{AS}(c_P - c_B)}{1 + e^{\ln\left(\frac{1}{p_{L\,CON\,G}^{[m=0]}} - 1\right) - \beta t - \theta(x_0 - x)^T}} \quad [F.49]$$

4.4 Net GHG Emission Reductions and Removals

According to VM0009 Methodology, cumulative emissions reductions and/or removals are quantified as those since the project crediting period start date up to the end of the current monitoring period. Current gross emissions reductions and/or removals (GERs) are quantified as the difference between cumulative emissions up to the end of the current monitoring period and cumulative emissions up to the end of the previous monitoring period, minus any project emissions that have occurred during the current monitoring period, emissions from leakage and carbon not decayed in certain decay pools. Net emissions reductions and/or removals (NERs) are GERs minus a confidence deduction (if any) and buffer pool allocation. NERs are determined for each project accounting area and if the project area contains multiple project accounting areas, summed across project accounting areas.

Below follow a flow Diagram for the Quantification of GHG Emissions Reductions and/or Removals as well the respective section of VM0009 Methodology:



The total NERs generated during a monitoring period $[m]$ are determined by [F.55], which are GERs minus buffer account allocation.

$$E_{\Delta\, NER}^{[m]} = E_{\Delta\, GER}^{[m]} - E_{BA}^{[m]} \qquad \text{[F.55]}$$

In the case where there are multiple project accounting areas in a single project area, the NERs for each project accounting area will be quantified individually, and then summed to determine the total NERs for the current monitoring period for the project.

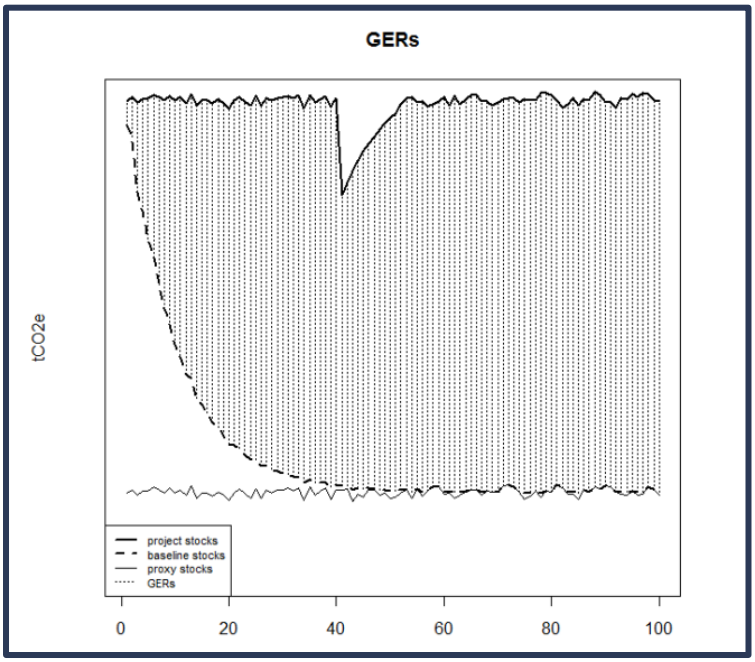
When the current monitoring period spans more than one calendar year, NERs are allocated by year proportional to the number of calendars days in each year relative to the total number of days in the current monitoring period.

GER

The GERs for a monitoring period $[m]$ and project accounting area are quantified as [F.53]. Quantified GERs should be rounded down to the nearest whole number.

$$E_{\Delta\, GER}^{[m]} = E_{\mathrm{B}\,\Delta}^{[m]} - E_{\mathrm{P}\,\Delta}^{[m]} - E_{\mathrm{L}\,\Delta}^{[m]} - E_{U}^{[m]} \qquad \text{[F.53]}$$

Below follows a Hypothetical Graph of Gross Emissions Reductions Over Time suggested as example by VM0009 Methodology. This figure represents hypothetical GERs over time, where the difference between the project and the baseline stocks are the GERs, and monitored proxy stocks determine the lowest possible stocks in the baseline. The temporary drop in GERs in year 40 of this graph represents a major emissions event such as fire or hurricane that resulted in an efflux of GHG gases from the project. This hypothetical graph does not show discounts for leakage or uncertainty.



Deductions for Uncertainty

VM0009 Methodology stated that confidence deduction $E_U^{[m]}$ is determined by [F.57], which is a linear combination of weighted standard errors of estimates from baseline emissions models and carbon stock measurements. The confidence deduction is not based on propagation of error. If the confidence deduction $E_U^{[m]}$ is negative, then it should be set to zero.

$$E_U^{[m]} = E_{B\,\Delta}^{[m]} \left[\frac{1.64}{E_{B\,\Delta}^{[m]} + A_{PAA} c_P^{[m]} + A_{PX} c_B^{[m]}} \sqrt{\left(U_{EM}^{[M]}\right)^2 + \left(U_P^{[m]}\right)^2 + \left(U_B^{[m]}\right)^2} - 0.15 \right] \quad \text{[F.57]}$$

Buffer Account Allocation

Determining the allocation of GERs to the buffer account should conform to current VCS requirements. Those GERs allocated to the buffer account are denoted by $E_{BA}^{[m]}$ and its calculation is developed upon AFOLU Non-Permanence Risk Tool v4.0.

For PAI Fazenda Boqueirão, AFOLU Non-Permanence Risk Tool indicated that 10% of GERs should be allocated to the buffer account.

Parameters

VM0009 Methodology indicates that the baseline emissions models for each project accounting area is parameterized differently depending on the associated baseline type. Each PAI and PAA has distinct Parameters values. Below follow details of parametrization of PAI Fazenda Boqueirão.

Parameters		PAI Fazenda Boqueirão
α	Average effects of time and other covariates on degradation, deforestation and conversion (conversion parameters)	-0.77048357
β	Effect of time on degradation, deforestation and conversion (conversion parameters)	0.00058764
θ_1	Effect of covariates on degradation, deforestation and conversion (conversion parameters)	-1.44402070
θ_2	Effect of covariates on degradation, deforestation and conversion (conversion parameters)	-0.18956740
X_1	Covariates as of the project start date	0.434
X_2	Covariates as of the project start date	4.416
tPAI	Time of project activity instance start date relative to project start date for a project activity instance in a grouped project (days)	0
q	Time shift between start of degradation and conversion (days)	0

The parametrization of **α, β, and θ** is based on observation of conversion of the reference area over the historical reference period. With this end, it was developed a sample size of 3000 random points within the limits of the Reference Area, then it was visually interpreted all images at each point, which was recorded as 0 or 1 (0 = native vegetation; 1 = converted area). Such

registration was done for each of all 3000, year-by-year, throughout the reference period (2011 - 2021). It was discarded those points for which the first conversion entry in the table is 1, leaving a total of 2846 points on the analysis.

The historical imagery was extracted from Spot 4, Spot 5 and Landsat 8. All have resolution equal or better than the required resolution (30 x 30 m). All Satellite imagery was registered to within 10% RMSE. Dates of each observations follow below:

Satellite Imagery	Date	Source
1	06/14/2011	Spot 4
2	04/12/2012	Spot 5
3	05/28/2013	Landsat 8
4	05/31/2014	Landsat 8
5	06/19/2015	Landsat 8
6	06/21/2016	Landsat 8
7	05/07/2017	Landsat 8
8	05/26/2018	Landsat 8
9	04/27/2019	Landsat 8
10	07/02/2020	Landsat 8
11	05/18/2021	Landsat 8

VM0009 Methodology indicates that analyses must have “double coverage” for at least 90% of the reference area over the entire reference period. In the case of PAI Fazenda Boqueirão it was achieved 100% “double coverage”, and no point had lower than 8 coverages.

The procedure was also executed by independent verification. On average, there was 94.5% alignment. No systematic errors were identified in the accuracy assessment. Methodology VM0009 does not provide a limit of accuracy, but the overall accuracy of 94.5% exceeds the limits of other VCS methodologies

The covariates considered were Water Resources and Roads, the respective data were obtained through a spatial analysis.

Four models were developed to assess the effect of covariates. The variables evaluated during model selection were:

- Model 1: CONVERSION ~ TIME
- Model 2: CONVERSION ~ TIME + RIVER
- Model 3: CONVERSION ~ TIME + ROAD
- Model 4: CONVERSION ~ TIME + RIVER + ROAD

In all four estimated models, the coefficients associated with the effect of covariates on conversion were statistically significant (existing, different from zero) in the corresponding hypothesis tests (perceived through low p-values, close to zero - see Table 8). It means that in all tested scenarios, the covariates used are associated with conversion, and therefore the best models are those that consider these covariates in their structure, as they are thus able to better predict the outcome (conversion) in corresponding situations. In addition and very importantly, the AIC adjustment quality criterion calculated for each of the four estimated models indicated the lowest value for model 4. Thus, model 4 has the best fit and was the source of **α, β, θ1 and θ2.**

For the parameter $\boldsymbol{q}$ was applied the conservative value of Zero, suggested by VM0009 Methodology.

For $\boldsymbol{\lambda_{soc}}$, it was applied the default value of 0.2), derived from E. Davidson & Ackerman (1993) and suggested by VM0009 Methodology.

5 MONITORING

5.1 Data and Parameters to be Available at Validation.

Data / Parameter	**α**
Data unit	Unitless
Description	Combined effects of β and θ at the start of the historic reference period
Source of data	Reference area and historic reference period
Value applied	-0.77048357
Justification of choice of data or description of measurement methods and procedures applied	Time and place in which the logistic model is fit
Purpose of Data	Calculation of baseline emissions

Data / Parameter	β
Data unit	Unitless
Description	Effect of time on the cumulative proportion of conversion over time
Source of data	Reference area and historic reference period
Value applied	0.00058764
Justification of choice of data or description of measurement methods and procedures applied	Time and place in which the logistic model is fit.
Purpose of Data	Calculation of baseline emissions

Data / Parameter	Θ1
Data unit	Unitless
Description	Effect of certain covariates on the cumulative proportion of conversion over time
Source of data	Reference area and historic reference period
Value applied	-1.44402070
Justification of choice of data or description of measurement methods and procedures applied	Effect of certain covariates on the cumulative proportion of conversion over time
Purpose of Data	Calculation of baseline emissions

Data / Parameter	Θ2
Data unit	Unitless
Description	Effect of certain covariates on the cumulative proportion of conversion over time
Source of data	Reference area and historic reference period
Value applied	-0.18956740
Justification of choice of data or description of measurement methods and procedures applied	Effect of certain covariates on the cumulative proportion of conversion over time
Purpose of Data	Calculation of baseline emissions

Data / Parameter	λSOC
Data unit	Proportion (unitless)
Description	Exponential soil carbon decay parameter
Source of data	Default values suggested by VM0009 Methodology
Value applied	0.2
Justification of choice of data or description of measurement methods and procedures applied	A conservative default suggested by VM0009 Methodology
Purpose of Data	Calculation of baseline emissions

Data / Parameter	σ^EM
Data unit	standard deviation (unitless)
Description	The estimated standard deviation of the state observations used to fit the logistic function
Source of data	Remote sensing image interpretation
Value applied	0.2151
Justification of choice of data or description of measurement methods and procedures applied	Remote sensing image interpretation
Purpose of Data	Equations [F.12], [F.14]. [B.13]

Data / Parameter	$\mathcal{B}$
Data unit	Set
Description	The set of all selected carbon pools in biomass. Is a subset of $\mathcal{C}$
Source of data	Project Boundaries
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	See section 3.3.2
Purpose of Data	Equations [F17], [F18] and [F23]

Data / Parameter	c
Data unit	Set
Description	The set of all selected carbon pools
Source of data	Project Boundaries
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	See section 3.3.2
Purpose of Data	Calculation of baseline emissions

Data / Parameter	j
Data unit	Set
Description	The set of all observations of conversion. When superscripted with a monitoring period, the conversion observations are taken for leakage analysis
Remote sensing image interpretation or field observations in the leakage area	Remote sensing image interpretation or field observations in the leakage area
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Equation [F.13]

Data / Parameter	$\mathcal{M}$
Data unit	Set
Description	The set of all monitoring periods
Source of data	Monitoring records
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Equations [F.32], [F.33], [F.36], [F.54], [F.56]

Data / Parameter	$\mathcal{T}$
Data unit	Set
Description	The set of all species/categories of livestock
Source of data	Monitoring records
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	Equations [F.43]

Data / Parameter	A_{PAA}
Data unit	Hectares
Description	Area of project accounting area
Source of data	GIS analysis prior to sampling
Value applied	20,209.7805 hectares
Justification of choice of data or description of measurement methods and procedures applied	See section 1.13
Purpose of Data	Calculation of baseline emissions

Data / Parameter	CL_p
Data unit	t CO2e / ha
Description	Carbon stocks in project leakage area
Source of data	Leakage area sampling
Value applied	
Justification of choice of data or description of measurement methods and procedures applied	Direct measurement
Purpose of Data	Equation [F.50]
Comments	

Data / Parameter	fLS_i
Data unit	kg CH4 head-1 yr-1
Description	Emission factor for the defined livestock population, i
Source of data	
Value applied	
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	Equation [F.43]
Comments	

Data / Parameter	n_d
Data unit	
Description	Number of spatial points in the reference area
Source of data	Remote sensing image interpretation
Value applied	3000
Justification of choice of data or description of measurement methods and procedures applied	See section 4.4
Purpose of Data	Equation [F.14]
Comments	

Data / Parameter	oi
Data unit	*Binary*
Description	State observation for the ith sample point in the reference area
Source of data	Remote sensing image interpretation
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	VM0009 Methodology requirement
Purpose of Data	*Equation [F.13]*

Data / Parameter	A_{px}
Data unit	*Hectares*
Description	Area of proxy area
Source of data	
Value applied	
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	Equation [F.57]
Comments	

Data / Parameter	q
Data unit	Days
Description	Lag between start of degradation and conversion
Source of data	VM0009 Methodology
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	For the parameter $\boldsymbol{q}$ was applied the conservative value of Zero, suggested by VM0009 Methodology.
Purpose of Data	Equation [F.3], [F.4], [F.5]

Data / Parameter	rRS
Data unit	Unitless
Description	Expansion factor for above-ground biomass to below-ground biomass (root/shoot ratio)
Source of data	
Value applied	
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	Equation [F.30]
Comments	

Data / Parameter	t
Data unit	Days
Description	Time since project start date
Source of data	Monitoring records
Value applied	
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	Equation [F.2], [F.3], [F.4], [F.5], [F.6], [F.7], [F.8], [F.10]
Comments	

Data / Parameter	ti
Data unit	Days
Description	The point in time of the observation made at point i
Source of data	Remote sensing image interpretation
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	Equation [F.11], [A.6]

Data / Parameter	tPL
Data unit	Days
Description	Length of project crediting period
Source of data	PD
Value applied	7300
Justification of choice of data or description of measurement methods and procedures applied	See section 1.8 & 1.9
Purpose of Data	Equation [F.5]
Comments	

Data / Parameter	tPAI
Data unit	Days
Description	Number of days after the project start date for the start of a project activity instance in a grouped project
Source of data	PD
Value applied	
Justification of choice of data or description of measurement methods and procedures applied	See section 1.8 & 1.9
Purpose of Data	*Equations [F.2], [F.3], [F.4], [F.5], [F.6], [F.7], [F.8]*

Data / Parameter	wi
Data unit	Unitless
Description	Weight applied to the ith sample point in the reference area
Source of data	Remote sensing image interpretation
Value applied	0.0000336
Justification of choice of data or description of measurement methods and procedures applied	VM0009 Methodology requirement
Purpose of Data	*Equations [A.6], [F.13]*
Comments	

Data / Parameter	X1
Data unit	Unitless
Description	Covariate values
Source of data	remotely sensed imagery
Value applied	0.434
Justification of choice of data or description of measurement methods and procedures applied	Spatial Analyses
Purpose of Data	*Equations [F.2], [F.3], [F.4], [F.5], [F.6], [F.7], [F.8]*
Comments	

Data / Parameter	X2
Data unit	Unitless
Description	Covariate values
Source of data	remotely sensed imagery
Value applied	4.416
Justification of choice of data or description of measurement methods and procedures applied	Spatial Analyses
Purpose of Data	*Equations [F.2], [F.3], [F.4], [F.5], [F.6], [F.7], [F.8]*
Comments	

Data / Parameter	xi
Data unit	Latitude of the ith sample point
Description	Geographic coordinates
Source of data	Remote sensing image interpretation
Value applied	
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	*Equations [A.6], [F.11]*
Comments	

Data / Parameter	yi
Data unit	Geographic coordinates
Description	Longitude of the ith sample point
Source of data	Remote sensing image interpretation
Value applied	
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of Data	*Equations [A.6], [F.11]*
Comments	

5.2 Monitoring Plan, Data and Parameters Monitored

In all PAIs, carbon stocks will be estimated for the first monitoring period (of the respective PAI) by sampling all plots in all strata in the project, activity-shifting leakage and proxy areas. After the first monitoring period, all plots and all strata in the project and the activity-shifting leakage areas will be re-measured at least every five years, a process which may be accomplished on an intermittently rotating basis. In particular, soil carbon stocks may require a sampling framework distinct from that applied for other pools. Soil carbon is estimated using soil samples collected from soil cores or pits. VM0009 Methodology employs fixed area plots coupled with allometric equations for estimating carbon stocks in trees. Allometric equations or destructive sampling may be used for estimating non-tree carbon stocks. Allometric equations may change or be supplemented each monitoring period as allometry improves. These sampling procedures are designed to detect both increases in carbon stocks, such as those that occur as a result of forest growth, and decreases in carbon stocks, such as changes that may take place as a result of degradation or natural disturbance events.

All leakage plots, proxy area plots and project accounting area plots must be remeasured at least every five years, or after a significant event that changes stocks in the proxy or project accounting areas. Plots may not be re-measured every monitoring period if the length of the monitoring period is less than five years and there are no significant events that change carbon stocks. If livestock grazing is occurring within the project area boundary, the number of each species of livestock being grazed must be determined. All heads of livestock being grazed within the project area must be measured for the first verification (unless deemed to be de minimis) and remeasured at least every five years.

PAI Fazenda Boqueirão baseline reevaluation will be conducted before August 30th, 2031 and monitoring is expected to be performed every year.

Below are of all variables monitored, data and parameters and the respective descriptions.

Data / Parameter	$\mathcal{W}[m]$
Data unit	*Set*
Description	The set of all burned wood or herbaceous material
Source of data	Monitoring Records
Description of measurement methods and procedures to be applied	N/A.

Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of Monitoring Records
Purpose of data	Equation [F.42]

Data / Parameter	$A_{B\Delta PAA}^{[m]}$
Data unit	hectares
Description	Area of avoided conversion
Source of data	Generated from equation
Description of measurement methods and procedures to be applied	Section 8.3.4.4
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	Equation [F.52]

Data / Parameter	$Bb\ [m]$
Data unit	Tonnes
Description	Biomass in burned wood or herbaceous material b
Source of data	Measurements of biomass
Description of measurement methods and procedures to be applied	*Scale*
Frequency of monitoring/recording	Every monitoring period
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records.
Purpose of data	*Equation [F.42]*

Data / Parameter	cB[m]
Data unit	tCO2e / ha
Description	Baseline carbon stocks at the end of the current monitoring period
Source of data	Proxy area sampling
Description of measurement methods and procedures to be applied	*B.2,6.4*
Frequency of monitoring/recording	Every time measured (≤ 5 yrs)
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.2], [F.3], [F.4], [F.5], [F.6], [F.7], [F.57]*

Data / Parameter	$C_{B\,BGB}^{[m]}$
Data unit	tCO2e
Description	Carbon not decayed in BGB at the end of the current monitoring period
Source of data	Proxy area sampling
Description of measurement methods and procedures to be applied	*VM0009, Section 8.1.4*
Frequency of monitoring/recording	Every monitoring period
Value applied	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.16]*

Data / Parameter	$C_{B\,SOC}^{[m]}$
Data unit	tCO2e
Description	Carbon not decayed in SOC at the end of the current monitoring period
Source of data	Proxy area sampling
Description of measurement methods and procedures to be applied	*VM0009, Section 8.1.5*
Frequency of monitoring/recording	Every monitoring period
Value applied	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.16]*

Data / Parameter	$c_{B\,b}^{[m]}$
Data unit	tCO2e / ha
Description	Baseline scenario average carbon stock in selected carbon pools
Source of data	Proxy area sampling
Description of measurement methods and procedures to be applied	VM0009, B.1.5
Frequency of monitoring/recording	Every time measured (≤ 5 yrs)
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.18]*

Data / Parameter	$C_{B\,SOC}^{[m]}$
Data unit	tCO2e / ha
Description	Baseline soil carbon stocks at the end of the current monitoring period
Source of data	Proxy area sampling
Description of measurement methods and procedures to be applied	VM0009: B.2.6
Frequency of monitoring/recording	Every time measured (≤ 5 yrs)
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.27]*

Data / Parameter	Cp[m]
Data unit	tCO2e / ha
Description	Project carbon stocks at the end of the current monitoring period
Source of data	Project accounting area sampling
Description of measurement methods and procedures to be applied	*VM0009:* B.2
Frequency of monitoring/recording	Every time measured (≤ 5 yrs)
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.41], [F.57]*

Data / Parameter	$c_p^{[m-1]}$
Data unit	tCO2e / ha
Description	Project carbon stocks at the beginning of the current monitoring period
Source of data	Project accounting area sampling
Description of measurement methods and procedures to be applied	*VM0009:* B.2
Frequency of monitoring/recording	Prior monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Already reviewed
Purpose of data	*Equation [F.41]*

Data / Parameter	$c_p^{[m=0]}$
Data unit	tCO2e / ha
Description	Project carbon stocks prior to first verification event
Source of data	Project accounting area sampling
Description of measurement methods and procedures to be applied	*VM0009:* B.2
Frequency of monitoring/recording	First monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.7]*

Data / Parameter	$C_{P\,BM}^{[m=0]}$
Data unit	tCO2e
Description	Project carbon stocks in biomass prior to first verification event
Source of data	Project accounting area sampling
Description of measurement methods and procedures to be applied	*VM0009:* B.2
Frequency of monitoring/recording	First monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records.
Purpose of data	*Equation [F.52]*

Data / Parameter	$c_{Pb}^{[m]}$
Data unit	tCO2e / ha
Description	Average carbon in biomass in the project accounting area
Source of data	Project accounting area sampling
Description of measurement methods and procedures to be applied	VM0009: B.2
Frequency of monitoring/recording	Every time measured (≤ 5 yrs)
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.17]*

Data / Parameter	$c_{P,s,b}^{[m]}$
Data unit	tCO2e / ha
Description	Average carbon in biomass for each project accounting area stratum S
Source of data	Project accounting area sampling
Description of measurement methods and procedures to be applied	VM0009: B.2
Frequency of monitoring/recording	Every time measured (≤ 5 yrs)
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	Equation [F.23]

Data / Parameter	$C_{P\,SOC}^{[m=0]}$
Data unit	tCO2e / ha
Description	Project soil carbon stocks prior to first verification event
Source of data	Project accounting area sampling
Description of measurement methods and procedures to be applied	*VM0009:* B.2.6
Frequency of monitoring/recording	First monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equations [F.25], [F.27], [F.28]*

Data / Parameter	$E_{\Delta GER}^{[m]}$
Data unit	tCO2e
Description	GERs for the current monitoring period
Source of data	Area measurements
Description of measurement methods and procedures to be applied	*VM0009: Section 8.4.1*
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of GER calculations
Purpose of data	*Equations [F.55], [F.57]*

Data / Parameter	$E_{\Delta GER}^{[i]}$
Data unit	tCO2e
Description	GERs for monitoring period i
Source of data	Area measurements
Description of measurement methods and procedures to be applied	VM0009: Section 8.4.1
Frequency of monitoring/recording	Prior monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of GER calculations
Purpose of data	Equation [F.54]

Data / Parameter	$E_{\Delta NER}^{[i]}$
Data unit	tCO2e
Description	NERs for monitoring period i
Source of data	Area measurements
Description of measurement methods and procedures to be applied	*VM0009: Section 8.4.3*
Frequency of monitoring/recording	Prior monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of NER calculations
Purpose of data	*Equation [F.56]*
Calculation method	
Comments	

Data / Parameter	$E_B^{[m]}$
Data unit	tCO2e
Description	Cumulative baseline emissions at the end of the current monitoring period
Source of data	Proxy area measurements
Description of measurement methods and procedures to be applied	VM0009: Section 8.1
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records.
Purpose of data	Equation [F.15]

Data / Parameter	$E_B^{[m-1]}$
Data unit	tCO2e
Description	Cumulative baseline emissions at the beginning of the current monitoring period
Source of data	Proxy area measurements
Description of measurement methods and procedures to be applied	VM0009: Section 8.1
Frequency of monitoring/recording	Prior monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	Equation [F.15]

Data / Parameter	$E_{B\,\Delta}^{[m]}$
Data unit	tCO2e
Description	Change in baseline emissions
Source of data	Proxy area measurements
Description of measurement methods and procedures to be applied	VM0009: Section 8.1
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	Equation [F.9], [F.10], [F.14], [F.53], [F.57]

Data / Parameter	$E^{[i]}_{B\,\Delta\,BGB}$
Data unit	tCO2e
Description	Change in baseline emissions from below-ground biomass during monitoring period i
Source of data	Monitoring the proxy area
Description of measurement methods and procedures to be applied	*VM0009:* B.2.3
Frequency of monitoring/recording	Prior monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.32]*

Data / Parameter	$E_{B\ \Delta SOC}^{[m]}$
Data unit	tCO2e
Description	Baseline change in emissions from soil carbon
Source of data	Measurements in the proxy area
Description of measurement methods and procedures to be applied	VM0009: Section 8.1.2.1, 8.1.2.2. 8.1.2.3, B.2.6
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records.
Purpose of data	Equation [F.15], [F.33]

Data / Parameter	$E_{B\,\Delta\,SOC}^{[i]}$
Data unit	tCO2e
Description	Baseline emissions from soil carbon in monitoring period i
Source of data	Measurements in the proxy area
Description of measurement methods and procedures to be applied	B.2.6
Frequency of monitoring/recording	Prior monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.33]*

Data / Parameter	$E_{B\ BGB}^{[m-1]}$
Data unit	tCO2e
Description	Cumulative baseline emissions from below-ground biomass at the beginning of the current monitoring period
Source of data	Measurements in the proxy area
Description of measurement methods and procedures to be applied	*VM0009: Section 8.1.4*
Frequency of monitoring/recording	Prior monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	*N/A*
Purpose of data	*Equation [F.31]*

Data / Parameter	$E_{B\,BM}^{[m]}$
Data unit	tCO2e
Description	Cumulative baseline emissions from biomass at the end of the current monitoring period
Source of data	Measurements in the proxy area
Description of measurement methods and procedures to be applied	VM0009: Section 8.1.1, 8.1.1.5.1
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	Equation [F.16], [F.30], [F.52]

Data / Parameter	$E_{B\ SOC}^{[m]}$
Data unit	tCO2e
Description	Cumulative baseline emissions from soil carbon at the end of the current monitoring period
Source of data	Measurements in the proxy area
Description of measurement methods and procedures to be applied	VM0009: Section 8.1.2.1, 8.1.2.2. 8.1.2.3
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	Equation [F.16], [F.26]

Data / Parameter	$E_{B\ SOC}^{[m-1]}$
Data unit	tCO2e
Description	Cumulative baseline emissions from soil carbon at the beginning of the current monitoring period
Source of data	Measurements in the proxy area
Description of measurement methods and procedures to be applied	VM0009: Section 8.1.2.1, 8.1.2.2. 8.1.2.3
Frequency of monitoring/recording	Prior monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	N/A
Purpose of data	Equation [F.26]

Data / Parameter	$E_{BA}^{[m]}$
Data unit	tCO2e
Description	Cumulative emissions allocated to the buffer account at the end of the current monitoring period
Source of data	N/A
Description of measurement methods and procedures to be applied	VM0009: Section 8.4.4
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	Equation [F.55]

Data / Parameter	$E_L^{[m]}$
Data unit	tCO2e
Description	Cumulative emissions from leakage at the end of the current monitoring period
Source of data	Measurements in the leakage area(s)
Description of measurement methods and procedures to be applied	VM0009: Section 8.3
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	Equation [F.44]

Data / Parameter	$E_L^{[m-1]}$
Data unit	tCO2e
Description	Cumulative emissions from leakage at the beginning of the current monitoring period
Source of data	Measurements in the leakage area(s)
Description of measurement methods and procedures to be applied	VM0009: Section 8.3
Frequency of monitoring/recording	Prior monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	N/A
Purpose of data	Equation [F.44]

Data / Parameter	$E_{L\Delta}^{[m]}$
Data unit	tCO2e
Description	Change in emissions due to leakage
Source of data	N/A
Description of measurement methods and procedures to be applied	VM0009: Section 8.3
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	Equation [F.53]

Data / Parameter	$E_{L\ ASF}^{[m]}$
Data unit	tCO2e
Description	Cumulative emissions from activity-shifting leakage in forested strata at the end of the current monitoring period
Source of data	Measurements in the activity-shifting leakage area
Description of measurement methods and procedures to be applied	VM0009: Section 8.3
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	Equation [F.45]

Data / Parameter	$E_{L\,ASG}^{[m]}$
Data unit	tCO2e
Description	Cumulative emissions from activity-shifting leakage in native grassland strata at the end of the current monitoring period
Source of data	Measurements in the activity-shifting leakage area
Description of measurement methods and procedures to be applied	VM0009: Section 8.3.3.4
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.44], [F.45]*

Data / Parameter	$E_{L\,ME}^{[m]}$
Data unit	tCO2e
Description	Cumulative emissions from market leakage at the end of the current monitoring period
Source of data	Measurements in the market leakage area
Description of measurement methods and procedures to be applied	VM0009: Section 8.3
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.45]*

Data / Parameter	$E_{P\Delta}^{[m]}$
Data unit	tCO2e
Description	Change in project emissions
Source of data	Monitoring records for Forest Fire, Burning, logging, wood products, and natural disturbance events
Description of measurement methods and procedures to be applied	VM0009: Section 8.2
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.53]*

Data / Parameter	$E_{P\,\Delta BRN}^{[m]}$
Data unit	tCO2e
Description	Cumulative project emissions due to burning at the end of the current monitoring period
Source of data	Monitoring plots in the project
Description of measurement methods and procedures to be applied	VM0009: Section 8.2.2
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.41]*

Data / Parameter	$E_{P\Delta LS}^{[m]}$
Data unit	tCO2e
Description	Cumulative project emissions due to livestock grazing within the project area
Source of data	Monitoring in the project area
Description of measurement methods and procedures to be applied	VM0009: Section 8.2.4
Frequency of monitoring/recording	Every time measured (≤ 5 yrs)
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.43]*

Data / Parameter	$E_U^{[m]}$
Data unit	tCO2e
Description	Cumulative confidence deduction at the end of the current monitoring period
Source of data	N/A
Description of measurement methods and procedures to be applied	VM0009: Section 8.4.1.1
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.55]*

Data / Parameter	$n_{LS\,i}$
Data unit	Count
Description	The number of head of livestock species / category i in the project area
Source of data	Monitoring in the project area
Description of measurement methods and procedures to be applied	VM0009: Section 8.2.4
Frequency of monitoring/recording	Every time measured (≤ 5 yrs)
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.43]*

Data / Parameter	$p_{L\,DEG}^{[m]}$
Data unit	Proportion (unitless)
Description	Portion of leakage due to degradation in forest at the end of the current monitoring period
Source of data	Monitoring in the leakage area
Description of measurement methods and procedures to be applied	VM0009: Section 8.3.2.3
Frequency of monitoring/recording	Every time measured (≤ 5 yrs)
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equations [F.46], [F.47], [F.48], [F.49]*

Data / Parameter	$p_{L\,DEG}^{[m=0]}$
Data unit	Proportion (unitless)
Description	Portion of leakage due to degradation prior to first verification event
Source of data	Monitoring in the leakage area
Description of measurement methods and procedures to be applied	VM0009: Section 8.3.2.3
Frequency of monitoring/recording	First monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Project verification
Purpose of data	*Equation [F.48]*

Data / Parameter	$p_{L\,CON\,G}^{[m=0]}$
Data unit	Proportion (unitless)
Description	Portion of leakage due to native grasslands prior to the first verification event
Source of data	Monitoring in the leakage area
Description of measurement methods and procedures to be applied	VM0009: Section 8.3.2.4
Frequency of monitoring/recording	First monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.47], [F.49]*

Data / Parameter	$p_{L\,CON\,G}^{[m]}$
Data unit	Proportion (unitless)
Description	Portion of leakage due to native grasslands conversion at the beginning of the current monitoring period
Source of data	Monitoring in the leakage area
Description of measurement methods and procedures to be applied	VM0009: Section 8.3.2.4
Frequency of monitoring/recording	Every time measured (≤ 5 yrs)
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.47], [F.49]*

Data / Parameter	$p_{L\,CON\,G}^{[m-1]}$
Data unit	Proportion (unitless)
Description	Portion of leakage due to native grasslands conversion at the end of the current monitoring period
Source of data	Monitoring in the leakage area
Description of measurement methods and procedures to be applied	VM0009: Section 8.3.2.4
Frequency of monitoring/recording	Every time measured (≤ 5 yrs)
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.47], [F.49]*

Data / Parameter	$t^{[i-1]}$
Data unit	Days
Description	Time from project start date to beginning of monitoring period i
Source of data	Monitoring records
Description of measurement methods and procedures to be applied	VM0009: Section 8.1.6.3
Frequency of monitoring/recording	Every time measured (≤ 5 yrs)
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	Equations [F.32], [F.33]

Data / Parameter	$t^{[m]}$
Data unit	Days
Description	Time from project start date to end of current monitoring period
Source of data	Monitoring records
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	Equations [F.19], [F.20], [F.24], [F.21], [F.25], [F.27], [F.28], [F.32], [F.33], [F.36], [F.37], [F.38], [F.39], [F.40]

Data / Parameter	$t^{[m-1]}$
Data unit	Days
Description	Time from project start date to beginning of current monitoring period
Source of data	Monitoring records
Description of measurement methods and procedures to be applied	*N/A*
Frequency of monitoring/recording	Prior monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	*N/A*
Purpose of data	*Equations [F.10], [F.36]*

Data / Parameter	$U_B^{[m]}$
Data unit	tCO2e
Description	Total uncertainty in proxy area carbon stock estimate
Source of data	
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.57]*

Data / Parameter	$U_{EM}^{[M]}$
Data unit	tCO2e
Description	Total uncertainty in Baseline Emissions Models
Source of data	
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.57]*

Data / Parameter	$U_P^{[m]}$
Data unit	tCO2e
Description	Total uncertainty in project accounting area carbon stock estimate
Source of data	
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Every monitoring period
Value applied	
Monitoring equipment	
QA/QC procedures to be applied	Review of monitoring records
Purpose of data	*Equation [F.57]*