AMAZON BLUECARBON GROUPED REDD PROJECT

Document Prepared by Future Forest

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1 PROJECT DETAILS

1.1 Summary Description of the Project

In Brazil, around 16.44% of its entire 851,029,591.4 ha territory[1] is covered by mangrove forests, representing 1,398,966.13 hectares of mangrove area[2], and putting it in third place for nations with most mangrove coverage worldwide[3]. About 80% of the Brazilian mangrove cover is located throughout the Amazon coast, constituting the world's largest continuous area of this ecosystem[4], 28% of which being located in the State of Pará, where the Project is located in, with a total 390,589.41 ha coverage area[5].

In the Northeast region of Brazil, deforestation in mangroves can reach up to 40%, the biggest threat for deforestation being real estate speculation and the advance of shrimp farms[6], aside from environmental disasters such as oil spills[7].

The primary objective of the Amazon Bluecarbon Grouped REDD Project is to avoid the unplanned deforestation (AUD) within its 3,242.18-ha area, consisting of 100% of mangrove forest. The Project Area is located within a private property in the municipality of São João de Pirabas, Pará State. This Project was designed as a grouped project, in order to be able to increase its contribution with the protection of the mangrove ecosystem, through the addition of new project activity instances in the future.

It is expected that, with the present carbon project, it will be possible to expand the area's surveillance, by hiring new professionals to work in the farm as well as to monitor it. In addition to the project's ecological and carbon benefits, a proportion of the carbon credits generated will be dedicated to improving the social and environmental conditions in the project region, specifically contributing to improving deforestation control, aiming at the propagation of

[1] IBGE – Instituto Brasileiro de Geografia e Estatística. Brazil. 2019. Available at: <https://www.ibge.gov.br/cidades-e-estados>

[2] MMA – Ministério do Meio Ambiente. Atlas dos Manguezais do Brasil. 2018. Page 59.

[3] WWF-Brasil apud Global Mangrove Aliance. Mangue. Available at: <https://www.wwf.org.br/natureza_brasileira/reducao_de_impactos2/programa_marinho/mangues/>

[4] Global Mangrove Aliance. The State of the World's Mangroves 2022. Available at: <https://www.mangrovealliance.org/wp-content/uploads/2022/09/The-State-of-the-Worlds-Mangroves-Report_2022.pdf>

[5] MMA – Ministério do Meio Ambiente. Atlas dos Manguezais do Brasil. 2018. Page 59.

[6] WWF-Brasil apud ICMBio. Mangue. Available at: <https://www.wwf.org.br/natureza_brasileira/reducao_de_impactos2/programa_marinho/mangues/>

[7] WWF-Brasil. Mangue. Available at: <https://www.wwf.org.br/natureza_brasileira/reducao_de_impactos2/programa_marinho/mangues/>

environmental awareness, generation of alternative sources of income and environmental education actions.

The present Bluecarbon REDD project is expected to avoid a predicted 290.46 ha of deforestation, equating to 100,918 tCO2e in emissions reductions over the 30-year project lifetime, with an annual average of 3,364 tCO2e.

1.2 Sectoral Scope and Project Type

Sectoral Scope: 14 – Agriculture, Forestry, Land Use

Project Category: Avoided Unplanned Deforestation (AUD Project Activity)

This is a grouped project.

1.3 Project Eligibility

According to the VCS Methodology Requirements, v4[8], for Reduced Emissions from Deforestation and Degradation (REDD) projects, eligible activities are those that reduce net GHG emissions by reducing deforestation. Thus, the project is eligible under the scopes of the VCS Program, following the VCS Standard, v4[9], Sections 3.1, 3.2 and Appendix A1.5 – A1.8:

Eligibility Conditions	Amazon Bluecarbon Grouped REDD Project Justification of Eligibility
Projects shall meet all applicable rules and requirements set out under the VCS Program, including this document. Projects shall be guided by the principles set out in Section 2.2.1	The project meets all applicable rules and requirements set out under the VCS Program, as detailed in this section and in the Applicability of Methodology section.
Projects shall apply methodologies eligible under the VCS Program. Methodologies shall be applied in full, including the full application of any tools or modules referred to by a methodology, noting the exception set out in Section 3.13.1	The applied methodology is VM0015 – Methodology for Avoided Unplanned Deforestation, v1.1. Applicability conditions are detailed in section 3.2.

[8] Available at <https://verra.org/wp-content/uploads/2022/06/VCS-Methodology-Requirements-v4.2.pdf>
[9] Available at <https://verra.org/wp-content/uploads/2022/06/VCS-Standard_v4.3.pdf>

Eligibility Conditions	Amazon Bluecarbon Grouped REDD Project Justification of Eligibility
Projects and the implementation of project activities shall not lead to the violation of any applicable law, regardless of whether or not the law is enforced.	The project activity involves the conservation of native mangrove forest. This activity is eligible under the Brazilian law according to conditions set out in sections 1.14 and 3.5.
Where projects apply methodologies that permit the project proponent its own choice of model (see the VCS Program document Program Definitions for definition of model), such model shall meet with the requirements set out in the VCS Program document VCS Methodology Requirements and it shall be demonstrated at validation that the model is appropriate to the project circumstances (i.e., use of the model will lead to an appropriate quantification of GHG emission reductions or removals).	Not applicable. The Project applies the VM0015 Methodology.
Where projects apply methodologies that permit the project proponent its own choice of third party default factor or standard to ascertain GHG emission data and any supporting data for establishing baseline scenarios and demonstrating additionality, such default factor or standard shall meet with the requirements set out in the VCS Program document VCS Methodology Requirements.	Not applicable. The Project applies the VM0015 Methodology, in addition to the VT0001 for additionality assessment.

Eligibility Conditions	Amazon Bluecarbon Grouped REDD Project Justification of Eligibility
Projects shall preferentially apply methodologies that use performance methods (see the VCS Program document VCS Methodology Requirements for further information on performance methods) where a methodology is applicable to the project that uses a performance method for determining both additionality and the crediting baseline (i.e., a project shall not apply a methodology that uses a project method where such a performance method is applicable to the project).	Not applicable. The Project applies the VM0015 Methodology, in addition to the VT0001 for additionality assessment.
Where the rules and requirements under an approved GHG program conflict with the rules and requirements of the VCS Program, the rules and requirements of the VCS Program shall take precedence	The Project applies an approved VCS methodology and tool. The project shall take precedence to the rules and requirements of the VCS Program over other approved GHG Program.
Where projects apply methodologies from approved GHG programs, they shall comply with any specified capacity limits (see the VCS Program document Program Definitions for definition of capacity limit) and any other relevant requirements set out with respect to the application of the methodology and/or tools referenced by the methodology under those programs.	The Project applies an approved VCS methodology and tool. The project shall take precedence to the rules and requirements of the VCS Program over other approved GHG Program.

Eligibility Conditions	Amazon Bluecarbon Grouped REDD Project Justification of Eligibility
Where Verra issues new requirements relating to projects, registered projects do not need to adhere to the new requirements for the remainder of their project crediting periods (i.e., such projects remain eligible to issue VCUs through to the end of their project crediting period without revalidation against the new requirements). The new requirements shall be adhered to at project crediting period renewal, as set out in Section 3.8.9.	The Project was designed under the VCS Standard, v4 and VM0015, v1.1. Any new requirements shall be adhered to at project crediting period renewal (i.e 30 years, which may be renewed up to 100 years from Project Start Date).
There are currently six AFOLU project categories eligible under the VCS Program, as defined in Appendix 1 Eligible AFOLU Project Categories below: afforestation, reforestation and revegetation (ARR), agricultural land management (ALM), improved forest management (IFM), reduced emissions from deforestation and degradation (REDD), avoided conversion of grasslands and shrublands (ACoGS), and wetland restoration and conservation (WRC).	This is an eligible AFOLU project category under the VCS Program: Reduced Emissions from Deforestation and Degradation (REDD).
Where projects are located within a jurisdiction covered by a jurisdictional REDD+ program, project proponents shall follow the requirements in this document and the requirements related to nested projects set out in the VCS Program document Jurisdictional and Nested REDD+ Requirements.	This Project is not located within a jurisdiction covered by a jurisdictional REDD+ program.

Eligibility Conditions	Amazon Bluecarbon Grouped REDD Project Justification of Eligibility
Where an implementation partner is acting in partnership with the project proponent, the implementation partner shall be identified in the project description. The implementation partner shall identify its roles and responsibilities with respect to the project, including but not limited to, implementation, management and monitoring of the project, over the project crediting period	Any implementation partners are described on the Project Description, in sections 1.5 and 1.6.
Activities that convert native ecosystems to generate GHG credits are not eligible under the VCS Program. Evidence shall be provided in the project description that any ARR, ALM, WRC or ACoGS project areas were not cleared of native ecosystems to create GHG credits (e.g., evidence indicating that clearing occurred due to natural disasters such as hurricanes or floods). Such proof is not required where such clearing or conversion took place at least 10 years prior to the proposed project start date.	This Project does not convert native ecosystems to generate GHG. The project area only contains native forested mangrove for a minimum of 10 years prior to the project start date.
Activities that drain native ecosystems or degrade hydrological functions to generate GHG credits are not eligible under the VCS Program. Evidence shall be provided in the project description that any AFOLU project area was not drained or converted to create GHG credits. Such proof is not required where such draining or conversion took place prior to 1 January 2008.	This Project does not occur on wetlands and does not drain native ecosystems or degrade hydrological functions.

Eligibility Conditions	Amazon Bluecarbon Grouped REDD Project Justification of Eligibility
The project proponent shall demonstrate that project activities that lead to the intended GHG benefit have been implemented during each verification period in accordance with the project design. Where no new project activities have been implemented during a verification period, project proponents shall demonstrate that previously implemented project activities continued to be implemented during the verification period (e.g., forest patrols or improved agricultural practices of community members).	PP will demonstrate that project activities that lead to the intended GHG benefit have been implemented during each verification period in accordance with the project design.
For all IFM, APDD (except where the agent is unknown), RWE, APWD, APC, and ALM project types, the project proponent shall, for the duration of the project, reassess the baseline every ten years and have this validated at the same time as the subsequent verification. For all AUDD, APDD (where the agent is unknown), AUC and AUWD project types, the project proponent shall, for the duration of the project, reassess the baseline every six years and have this validated at the same time as the subsequent verification.	The baseline reassessment will be conducted every six years as this is an AUDD project.
Where ARR, ALM, IFM or REDD project activities occur on wetlands, the project shall adhere to both the respective project category requirements and the WRC requirements, unless the expected emissions from the soil organic carbon pool or change in the soil organic carbon pool in the project scenario is deemed below de minimis or can be conservatively excluded as set out in the VCS Program document VCS Methodology	Not applicable. The project activity does not occur on wetlands.

Eligibility Conditions	Amazon Bluecarbon Grouped REDD Project Justification of Eligibility
Requirements, in which case the project shall not be subject to the WRC requirements.	
Projects shall prepare a non-permanence risk report in accordance with the VCS Program document AFOLU Non-Permanence Risk Tool at both validation and verification. In the case of projects that are not validated and verified simultaneously, having their initial risk assessments validated at the time of VCS project validation will assist VCU buyers and sellers by providing a more accurate early indication of the number of VCUs projects are expected to generate. The non-permanence risk report shall be prepared using the VCS Non-Permanence Risk Report Template, which may be included as an annex to the project description or monitoring report, as applicable, or provided as a stand-alone document.	The Project has conducted a non-permanence risk analysis on validation, according to the VCS Program document *AFOLU Non-Permanence Risk Tool*, v4.0, and shall perform the same report during subsequent verifications.
Eligible REDD activities are those that reduce net GHG emissions by reducing deforestation and/or degradation of forests. The project area shall meet an internationally accepted definition of forest, such as those based on UNFCCC hostcountry thresholds or FAO definitions, and shall qualify as forest for a minimum of 10 years before the project start date. The definition of forest may include mature forests, secondary forests, and degraded forests. Under the VCS Program, secondary forests are considered to be forests that have been cleared and have recovered naturally and that are at least 10-years-old and meet the lower bound of the forest threshold	The Project Area is composed of 100% native forest. The area is considered forest as per the definition of forest adopted by FAO[10]: Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10%, or trees able to reach these thresholds in situ.

[10] Available at <https://www.fao.org/3/y4171e/y4171e10.htm#:~:text=FAO%202000a%20(FRA%202000%20Main,of%20other%20predomina>

Eligibility Conditions	Amazon Bluecarbon Grouped REDD Project Justification of Eligibility
parameters at the start of the project. Forested wetlands, such as floodplain forests, peatland forests and mangrove forests, are also eligible provided they meet the forest definition requirements mentioned above.	
Activities covered under the REDD project category are those that are designed to stop planned (designated and sanctioned) deforestation or unplanned (unsanctioned) deforestation and/or degradation. Avoided planned degradation is classified as IFM.	The project activity is designed to stop unplanned (unsanctioned) deforestation as described throughout the PD.
Activities that stop unsanctioned deforestation and/or illegal degradation (such as removal of fuelwood or timber extracted by non-concessionaires) on lands that are legally sanctioned for timber production are eligible as REDD activities. However, activities that reduce or stop logging only, followed by protection, on forest lands legally designated or sanctioned for forestry activities are included within IFM. Projects that include both avoided unplanned deforestation and/or degradation as well as stopping sanctioned logging activities, shall follow the REDD guidelines for the unplanned deforestation and/or degradation and the IFM guidelines for the sanctioned logging activities, and shall follow the requirements set out in the VCS Program document *VCS Standard*.	In case future project activity instances have areas legally sanctioned for timber production, baseline and project activity shall comprehend unsanctioned deforestation and/or illegal degradation, not the reduction of logging.
Eligible REDD activities include: 1) Avoiding Planned Deforestation and/or Degradation (APDD): This category includes activities that reduce net GHG emissions by	The Amazon Bluecarbon Grouped REDD Project is within category AUDD: Avoided Unplanned Deforestation and/or Degradation.

Eligibility Conditions	Amazon Bluecarbon Grouped REDD Project Justification of Eligibility
stopping or reducing deforestation or degradation on forest lands that are legally authorized and documented for conversion. 2) Avoiding Unplanned Deforestation and/or Degradation (AUDD): This category includes activities that reduce net GHG emissions by stopping deforestation and/or degradation of degraded to mature forests that would have occurred in any forest configuration.	

1.4 Project Design

This project has been designed as a grouped project activity.

Eligibility Criteria

A set of eligibility criteria for the inclusion of any new areas as instances willing to participate within the grouped project are described below.

As the Amazon Bluecarbon Grouped REDD Project is a grouped project, all instances implemented after validation shall meet the elements mentioned in Sections 3.5.15 and 3.5.16, as well as the specific AFOLU Projects criteria (3.5.17 and 3.5.18) of the VCS Standard, v4.

In addition, new areas willing to become instances of the project shall comply with the applicability conditions of the selected methodology, including conditions applicable to each activity, as described in Section 3.2.

VCS Standard Eligibility criteria for the inclusion of new project activity instances	Amazon Bluecarbon Grouped REDD Project	Instance 1
Projects shall meet the applicability conditions set out in the methodology applied to the project.	The GHG emission reductions shall be calculated according to the approved VCS Methodology VM0015 – Methodology for Avoided Unplanned Deforestation, v1.1, published on 03-December-2012.	Instance 1 complies with this requirement because it adopts the Methodology VM0015 – Methodology for Avoided Unplanned Deforestation, v1.1, published on 03-December-2012.
Projects shall use the technologies or measures specified in the project description.	All new instances shall use and apply the same technologies or measures specified in the Project description - forest conservation by avoiding unplanned deforestation, with or without forest management in project scenario.	The Instance 1 project activity complies with this criterion because it was the instance that originated the baseline scenario and the development of the Amazon Bluecarbon Grouped REDD Project. Also, this instance is in the same reference region described in the VCS PD.
Projects shall apply the technologies or measures in the same manner as specified in the project description.		Instance 1 applies the same technologies or measures specified on the present Project Description: forest conservation by avoiding unplanned deforestation, without forest management in project scenario.
Projects are subject to the baseline scenario determined in the project description for the specified project activity and geographic area.	The Project shall be in accordance with the same baseline scenario established in Section 3.4. of the VCS PD: "In the baseline scenario, forest is expected to be converted to non-forest by the agents of deforestation acting in the reference region, project area and leakage belt. Therefore, the project falls into the AFOLU-REDD".	The Instance 1 Project Activity complies with this criterion because it was the instance that originated the baseline scenario and the development of the Amazon Bluecarbon Grouped REDD Project. Therefore, this instance is in accordance with the same baseline scenario determined in Section 3.4 of the VCS PD.
Projects must have characteristics with	All instances must be additional to be included in the Grouped Project. The project	Since the PD was developed based on the characteristics,

respect to additionality that are consistent with the initial instances for the specified project activity and geographic area. For example, the new project activity instances have financial, technical and/or other parameters (such as the size/scale of the instances) consistent with the initial instances, or face the same investment, technological and/or other barriers as the initial instances.	activity must be consistent with Grouped Project Description: forest conservation by avoiding unplanned deforestation. In this case, the project activity may or may not include Sustainable Forest Management Plan. In the additionality assessment, each instance shall determine the appropriate analysis method, whether to apply simple cost, investment comparison or benchmark analysis, according to STEP 2 of VCS VT001 v 3.0 tool. 1) Instances may or may not include Sustainable Forest Management Plan. 2) In case the project activity does not involve Sustainable Forest Management Plan: - The instance should have financial, technical and scale consistent with the described in the VCS PD, facing similar investments, technological and/or other barriers as the initial instance. As the VCS AFOLU project generates no financial or economic benefits other than VCS related income, the simple cost analysis (Option I) shall be applied. 3) In case the project activity includes a Sustainable Forest Management Plan: - A new additionality analysis shall be provided. In this case, the investment comparison analysis (Option II) or the benchmark analysis (Option III) of the Tool VCS VT001 v 3.0 shall be used. - In addition, a new AFOLU non-permanence risk analysis shall be performed.	reference region and activity of the initial instance, Instance 1 complies with this additionality criterion. The additionality analysis for Instance 1 was made according to Option I of VCS VT0001 v3.0, as detailed in section 3.5.
New Project Activity Instances shall occur within one of the designated geographic areas specified in the project description.	Projects must be located within the Reference Region described in Section 3.3 of the VCS PD. The areas to be included must evidence the ownership of the property in accordance with Brazilian legislation, even if overlapping public areas such as Conservation Units. - As per the VCS Standard, new *AFOLU Non-Permanence Risk* assessments shall be carried out for each geographic area	The project activity within the area referring to instance 1 is located in the project's reference region as described in section 3.3 of the VCS PD.

	specified in the project description (for requirements related to geographic areas of grouped projects, see the VCS Standard). Where risks are relevant to only a portion of each geographic area, the geographic area shall be further divided such that a single total risk rating can be determined for each geographic area. Where a project is divided into more than one geographic areas for the purpose of risk analysis, the project's monitoring and verification reports shall list the total risk rating for each area and the corresponding net change in the project's carbon stocks in the same area, and the risk rating for each area applies only to the GHG emissions reductions generated by project activity instances within the area.	
Instances shall comply with at least one complete set of eligibility criteria for the inclusion of new project activity instances. Partial compliance with multiple sets of eligibility criteria is insufficient.	All Instances must comply with the complete set of eligibility criteria for the inclusion of new project activities instances.	Instance 1 complies with all eligibility criteria for the inclusion of a new Project Activity.
Instances must be included in the monitoring report with sufficient technical, financial, geographic and other relevant information to demonstrate compliance with the applicable set of eligibility criteria and enable sampling by the validation/verification body.	The Project Activity Instances must be included in the Monitoring Report with sufficient technical, financial, geographic and other relevant information to demonstrate compliance with the applicable set of eligibility criteria and enable sampling by the validation/ verification body.	Instance 1 complies with this criterion, as it is included in this Joint PD as the first Project Activity Instance.
New Project Activity Instances must be validated at the time of verification against the applicable set of eligibility criteria	The addition of new Project Activity Instances shall be made in the monitoring report for the Grouped Project, being validated at the time of verification.	Instance 1 complies with this criterion, as it is included in this Joint PD as the first Project Activity Instance.

New Project Activity Instances must have evidence of project ownership, in respect of each project activity instance, held by the project proponent from the respective start date of each project activity instance (i.e., the date upon which the project activity instance began reducing or removing GHG emissions).	All Project Activity instances must provide evidence of Project ownership (land title and related documents) and Project start date (agreements, protection or management plan, or others in accordance with the applicable VCS Standard definitions).	Instance 1 is in accordance with this criterion. The evidence of Project ownership and Project start date were provided, as described in Sections 1.7 and 1.8 of the VCS PD.
New Project Activity Instances must have a start date that is the same as or later than the grouped project start date.	The start date of the activity of each instance shall be the same as or after the start date of the grouped project, as established in Section 1.8 of the VCS PD.	Instance 1 project activity has the same start date of the grouped Project, as described in section 1.8 of the VCS PD.
Instances shall be eligible for crediting from the start date of the instance through the end of the project crediting period (only). Note that where a new project activity instance starts in a previous verification period, no credit may be claimed for GHG emission reductions or removals generated during a previous verification period and new instances are eligible for crediting from the start of the next verification period.	Instances shall be eligible for crediting from the start date of the instance activity until the end of the grouped project crediting period, i.e., the instance shall not generate credits after the end date of the Grouped Project. Where a new project activity instance starts in a previous verification period, no credit may be claimed for GHG emission reductions or removals generated during a previous verification period. New instances are eligible for crediting from the start of the next verification period.	Instance 1 project activity's crediting period has the same start and end dates of the grouped Project, as described in section 1.8 of the VCS PD.

1.5 Project Proponent

Organization name	Future Carbon Holding S.A. (Future Carbon Group)
Contact person	Marcelo Hector Sabbagh Haddad Bárbara Silva e Souza Carolina Chiarello de Andrade Carolina Pendl Abinajm Eliane Seiko Maffi Yamada Gabriel Fernandes de Toledo Piza Gabriella Hita Marangom Cesilio Guilherme Lucas Medeiros Prado Laura Cristina Pantaleão Letícia Moraes Teixeira Lyara Carolina Montone Amaral Yara Fernandes da Silva
Title	Marcelo Hector Sabbagh Haddad – Head of Forest Bárbara Silva e Souza – Technical Analyst Carolina Chiarello de Andrade – Technical Analyst Carolina Pendl Abinajm – Technical Coordinator Eliane Seiko Maffi Yamada – Technical Coordinator Gabriel Fernandes de Toledo Piza – Technical Coordinator Gabriella Hita Marangom Cesilio – Technical Analyst Guilherme Lucas Medeiros Prado – Technical Coordinator Laura Cristina Pantaleão – Technical Analyst Letícia Moraes Teixeira – Technical Analyst Lyara Carolina Montone Amaral – Technical Coordinator Yara Fernandes da Silva – Technical Coordinator
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1.6 Other Entities Involved in the Project

Organization name	William dos Santos Anjo Raquel dos Santos Anjo Rodrigues da Cunha Marco Tulio Rodrigues da Cunha Ariane Gotti Brandão dos Santos Anjo

Role in the project	Instance 1
Contact person	William dos Santos Anjo Raquel dos Santos Anjo Rodrigues da Cunha Marco Tulio Rodrigues da Cunha Ariane Gotti Brandão dos Santos Anjo
Title	Owners of *Ilha Portal das Areias* property
Address	-
Telephone	-
Email	-

1.7 Ownership

Instance 1 is located in the municipalities of São João de Pirabas, in the State of Pará, and is composed by 1 property: *Ilha Portal das Areias* (*Portal das Areias* island).

Ilha Portal das Areias is owned by 4 people, as per listed above in Section 1.6. The legal documents proving the land title and ownership of the properties will be made available to the auditors during the validation process.

As per the rules stated at Section 3.6 – Ownership of the VCS Standard, v.4, an enforceable and irrevocable agreement was set between the property owners – the holders of the statutory, property and contractual right in the land, vegetation or conservational or management process that generates GHG emission reductions or removals –, and Future Carbon Holding S.A. (hereafter, "Future Carbon Group" or "Future Carbon"), which vests project ownership in the Project Proponent. Evidence of such agreement will also be made available to the audit team.

1.8 Project Start Date

According to the rules established by the VCS Standard, v4 at Section 3.7 – Project Start Date, "the project start date of an AFOLU project is the date on which activities that led to the generation of GHG emission reductions or removals are implemented (eg, preparing land for seeding, planting, changing agricultural or forestry practices, rewetting, restoring hydrological functions, or implementing management or protection plans)".

Therefore, the project start date is 08-September-2022, and it was defined taking into consideration the date on which the property owners acquired *Ilha Portal da Areias*. From this date on, forest conservation activities started to be implemented, due to the high pressure for deforestation in the region.

The legal documents supporting the project start date will be made available to the auditors during the validation process.

1.9 Project Crediting Period

The project has a crediting period of 30 years, from 08-September-2022 to 07-September-2052, which may be renewed up to 100 years.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	X
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
2022	3,967
2023	3,989
2024	4,012
2025	4,035
2026	4,058
2027	4,081
2028	3,707
2029	3,728
2030	3,748
2031	3,769
2032	3,715
2033	3,713
2034	3,353
2035	3,349
2036	3,345
2037	3,340
2038	3,343
2039	3,341
2040	3,018
2041	3,014
2042	3,010
2043	3,006
2044	3,009
2045	3,007
2046	2,716
2047	2,713
2048	2,709

2049	2,706
2050	2,708
2051	2,706
Total estimated ERs	100,918
Total number of crediting years	30
Average annual ERs	3,364

1.11 Description of the Project Activity

The Project Activity for the Amazon Bluecarbon Grouped REDD Project (hereafter "the Project") consists in conservation measures in the Project Area's properties.

Among the conservation measures adopted by Instance 1, there is maintenance of the fences that surround the properties and managing teams present at the Project Area's location in order to monitor suspicious and/or illegal activities and control the entrance and exit within the area's boundaries. Keeping environmental and police entities updated on the suspicious and illegal activities around the Project Area is also a way to ensure that the Project is secure, these reports are made by filing formal complaints.

Other mitigation actions proposed by the Project in order to avoid unplanned deforestation will be carried out by strengthening surveillance in the area, mapping the local deforestation patterns, setting partnerships with educational and research institutions, and through the insertion of the surrounding communities in the Project Activities, aiming to minimize invasions and illegal deforestation, offering alternative income, education and professional training.

Therefore, besides forest conservation, the present project aims to improve and quantify its social and environmental activities that benefit the local communities, and aims to deliver high-integrity benefits in each in order to improve social and environmental conditions in the project region.

The implementation of REDD mechanisms promotes sustainable development through forest conservation resulting in the permanence of carbon stocks, while reducing pressure for timber from other forest areas. In this way, biodiversity conservation and development of the local economy can be achieved simultaneously.

All the aforementioned measures aid in achieving the net GHG emission reductions by preventing illegal deforestation agents to advance with their activities, as well as by retrieving their practices and, therefore, protecting and even restoring the carbon pools.

The project is not located within a jurisdiction covered by a jurisdictional REDD+ program.

1.12 Project Location

The first Project Activity Instance Area is in the municipality of São João de Pirabas, in the State of Pará, a region known as Northeast Amazon. The Instance 1 property is an island located

between the Japerica Bay (Baía do Japerica) and the Fortaleza Beach (Praia da Fortaleza), and its total area is of 4,337.51 ha.

This municipality's distance to Pará States capital, Belém, is around 201 km, and the closest access roads is PA-324, a highway that crosses the State of Pará.

Geodetic coordinates of the project location have been submitted separately as a KML file, as the Figure below presents the properties' location:

Figure 1. Property Location

1.13 Conditions Prior to Project Initiation

Conditions prior to the project initiation as well as general characteristics of the project area and reference region are described below.

Climate and Hydrography

According to the Köppen classification, the project region has a dominant hot and humid climate, characteristic of Tropical Forests. Furthermore, the region maintains heavy rainfall rates (around 2,400 mm of rain), high average air temperature (26ºC) and relative humidity above 85%. The average annual temperature varies from 26º to 27ºC, highs between 31ºC and 33ºC and lows between 21ºC and 24ºC.

Regarding the pluviometric regime, the region has total annuals generally between 1800 mm and 2800 mm, but it is subject to important fluctuations during the time. The rains are not

distributed equally during the year, being characterized by a sharp division in a period with heavy rains from January to July, and another with low rainfall from August to December.

Geology, Topography and Soils

The lowered plateau of the Amazon is the extensive surface of the Pleistocene Pediplano that borders the river banks with the Amazonian plain; to the south with the peripheral depression of southern Pará and to the north with the plateau of the sedimentary basin of Amazonas. In the region in question, the pediplane is preserved despite the dense forest cover, however Cametá has on the left bank Tocantins River where isolated, depressed areas appear with sandy deposits, subject to floods covered by undergrowth (RADAM, 1974).

According to SUDAM (1974), the region to the north originates from the Quaternary period, with sand and clay sediments formed by rivers, or sometimes by the sea. To the south is Tertiary, with sediments mainly of clay, with sand and layers of sand stones.

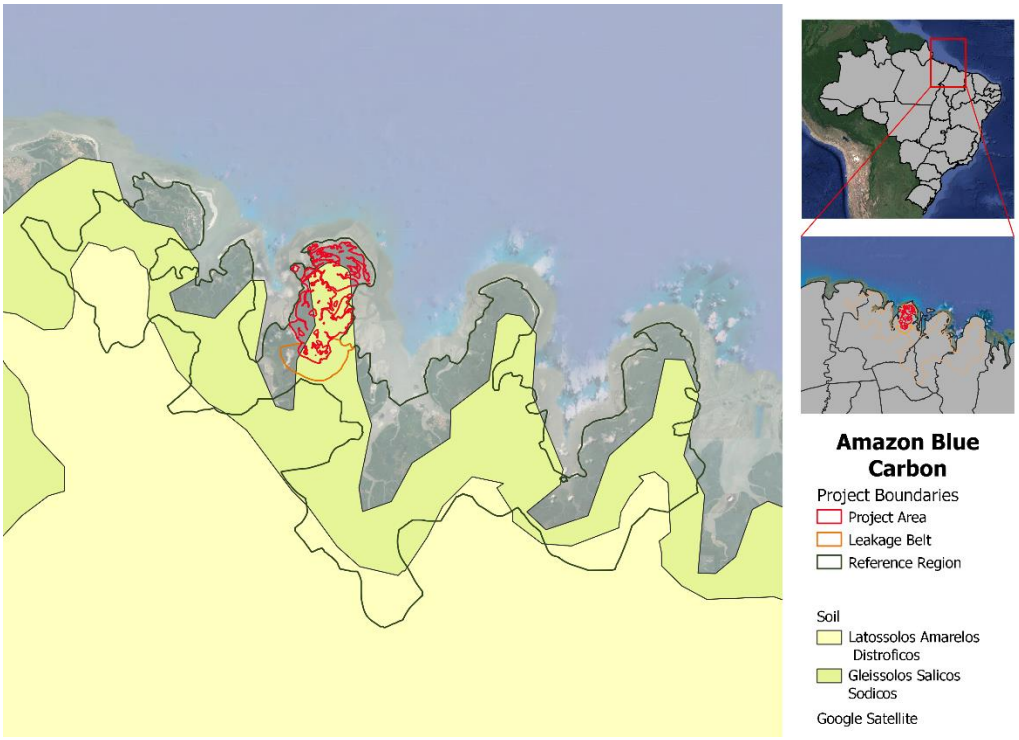
According to IBGE (1990) the rocks of the mesozoic sedimentary cover constitute the Alter do Chão formation of Cretaceous age and which represents the most widely distributed mapping unit in the plateau area of the Amazonian sedimentary basin. This formation supports the reliefs of the lowered plateau of the Amazon in which the area of the plan is inserted.

According to the Brazilian Soil Classification System (EMBRAPA, 2006), the Reference Region's soils are composed of the following types:

- Dystrophic Yellow Latosol;
- Sodic Salic Gleissol.

In the area of Ilha Portal das Areias, there is a predominance of soil classified as Yellow Latosol, as show in the Figure below:

Figure 2. Soil type within the Reference Region and Project Area



Vegetation cover

The project area is covered by native Amazonian vegetation. The Region has several types of vegetation groups, which vary depending on the types of soils and water drainage.

With the intense and necessary dynamics of the tides, the vegetation formation of the mangrove can be subdivided into three categories[11]:

- Red mangrove (*Rhizophora mangle*): It is the plant formation that is closest to the watercourse. Its roots are most of the time submerged.
- Black mangrove, siriúba, seriba (*Avicennia schauriana*): It is a kind of calara-brown trunk that has roots exposed to the air that support the tree. This adaptation is necessary for life in the muddy, oxygen-poor soil of the mangrove. It alternates between submerged and exposed moments, depending on the tide and is located on the mangrove fringe and along the rivers.
- White mangrove *(Laguncularia racemosa*): It is the most distant plant formation from the water course. The roots of the white mangrove are similar to those of the black mangrove,

[11] WWF-Brasil. Mangue. Available at <https://www.wwf.org.br/natureza_brasileira/reducao_de_impactos2/programa_marinho/mangues/>

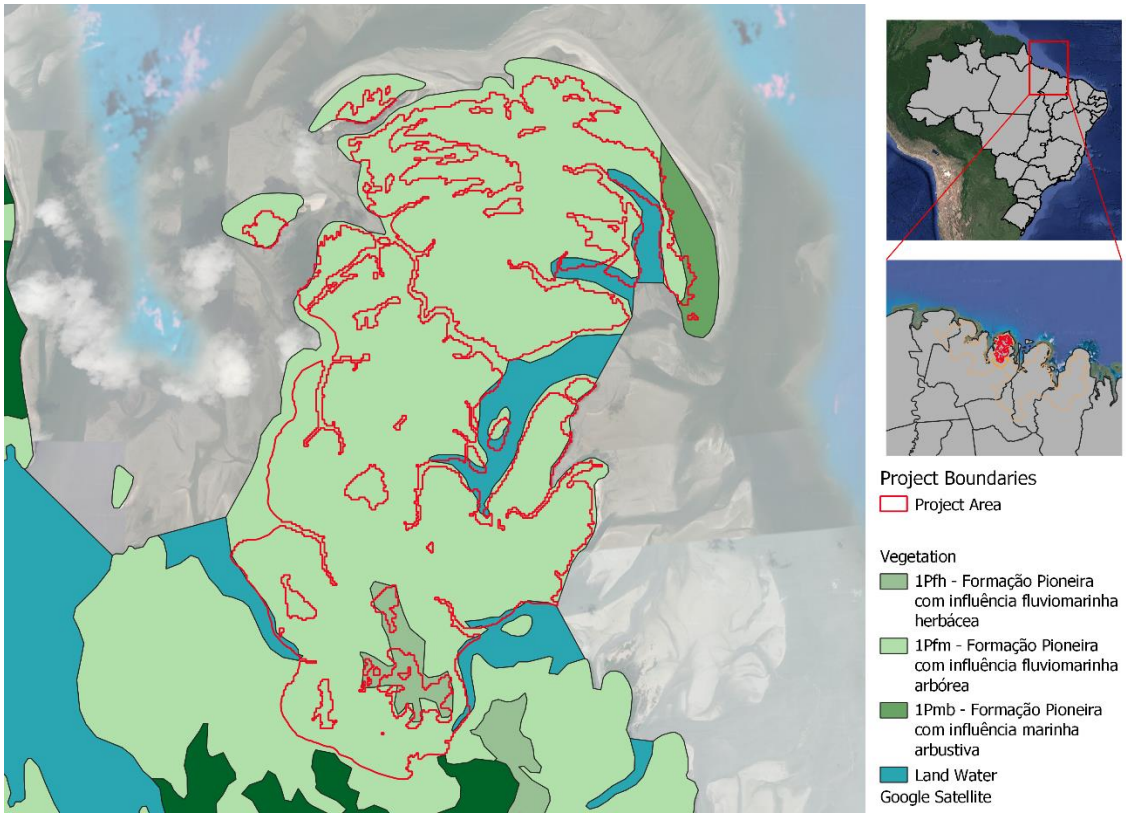
however with fewer and less developed pneumatophores (type of exposed root adapted for oxygen exchange).

The areas related to native vegetation are the most representative element in the region under study. The municipality of São João de Pirabas comprises three large groups of forest cover, which are:

1. Pioneer Formation with fluviomarine herbaceous influence
2. Pioneer Formation with arboreal fluviomarine influence
3. Pioneer Formation with shrubby fluviomarine influence

The definition and profile of each vegetation class is detailed at Section 3.3.

Figure 3. Vegetation cover in the Project Area



Socio-economic conditions

São João de Pirabas

São João de Pirabas a 66,843.40-ha municipality located in the State of Pará, in Brazil. Its accounted population in 2021 was of 23,440 citizens, its demographic density in 2010 being of 29.26 inhab/km². Of all population, in 2020 only 1,365 people had formal or informal jobs, which is only 5.9% of the municipality's population[12]. The average monthly wage of formal workers in

[12] https://cidades.ibge.gov.br/brasil/pa/sao-joao-de-pirabas/panorama

2020 was of 1.9 minimum wages, and the minimum wage R$ 1,039.00[13]. This means a minimum wage of US$ 211.17 (considering the average exchange rate between January and June in 2020, of US$ 4.92[14]), and an average monthly wage of formal workers equivalent to US$ 401.23.

About 96.3% of the municipality's population studied until a 6 to 14 years old- range. São João de Pirabas' IDHM in 2010 (last sensus) was of 0.539. The IDHM - *Índice de Desenvolvimento Humano Municipal* (Municipal Human Development Index in free translation) is a measurement composed by indicators of three dimensions of human development: longevity, education, and income. The index ranges from 0 to 1. The closer to 1, the greater human development[15]. Per capita GDP of the municipality was R$ 7,357.27 (equivalent to US$ 1,495.38) in 2019, it is important to note that despite the GDP, the majority of São João de Pirabas' population is not employed.

Biodiversity

Brazil harbours the greatest concentration of biodiversity on the planet. It has a great abundance of life forms – which translates to over 20% of the total species on Earth – and raises Brazil to the main nation among the 17 countries with the highest biodiversity levels globally, containing over 70% of the planet's biodiversity[16].

Brazil has the greatest flora species richness globally, with 46,392 species described. Furthermore, it contains over 8,700 known species of vertebrates consisting of 720 mammals, 986 amphibians, 759 reptiles, 1,924 birds and 4,388 fish species. It is estimated that around 93 thousand invertebrate species are known[17].

The project region is covered by Amazonian Rainforest but is located in mangrove area. This increases its already great environmental heterogeneity, allowing diversity of fauna and flora. The mangrove is one of the systems with the vastest biodiversity as known. It houses mammals, reptiles, crustaceans, birds, marine mammals, fishes, many insects, and others[18].

[13] https://www.in.gov.br/en/web/dou/-/lei-n-14.013-de-10-de-junho-de-2020-261279533

[14] https://www.bcb.gov.br/estabilidadefinanceira/historicocotacoes

[15] https://www.br.undp.org/content/brazil/pt/home/idh0/conceitos/o-que-e-o-idhm.html

[16] Available at: <Information System about the Brazilian Biodiversity (SiBBr). Available at: <http://www.sibbr.gov.br/areas/?area=biodiversidade>. Last visit on: March 18th, 2021>

[17] Available at: <https://www.icmbio.gov.br/portal/especies-ameacadas-destaque>

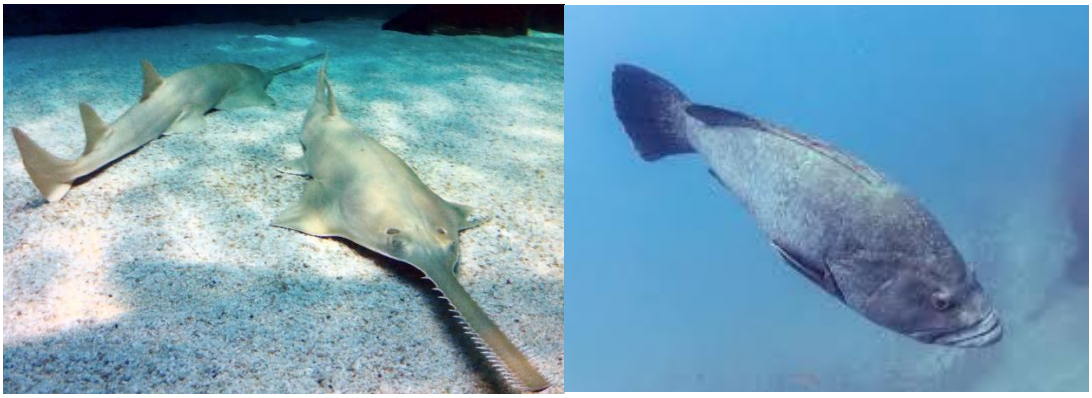
[18] WWF-Brasil. Mangue. Available at <https://www.wwf.org.br/natureza_brasileira/reducao_de_impactos2/programa_marinho/mangues/>

Yellow hakes, shrimp and crabs also depend on mangroves in their life cycle. They also compose part of the food consumed by thousands of people every year and are important for local economies. The ucha crab is one of the main symbols representing the mangrove[19].

Figure 4. Caranguejo-ucá (ucha crab)

Mangroves area also a marine life nursery. Many species of fish, such as sea bass, mero fish and grouper fish, use the mangrove regions for the spawning and growth of their pups. One species extremely threatened with extinction which depends on the mangroves to live is the sawfish[20].

Figure 5. Peixe-serra (sawfish) and Garoupa (grouper fish)



1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

In a brief context of Brazilian legislation, the Federal Constitution determines that it is concurrent between the Union, Member States and the Federal District the competence to legislate on

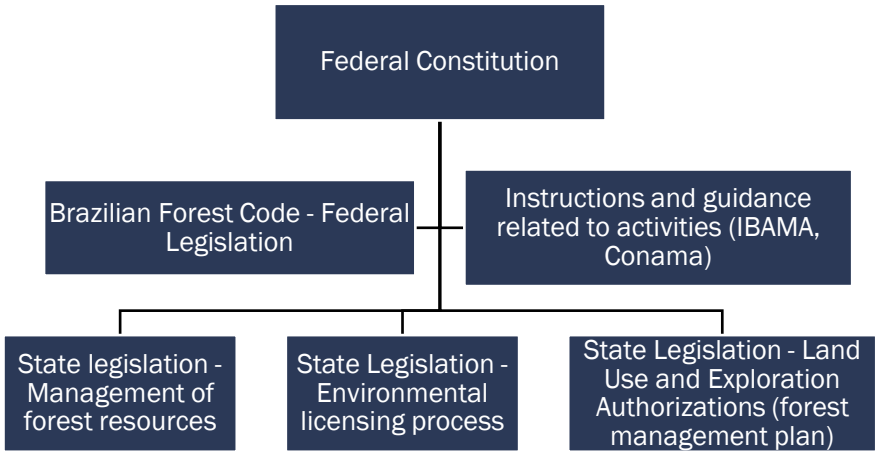
[19] WWF-Brasil. Mangue. Available at <https://www.wwf.org.br/natureza_brasileira/reducao_de_impactos2/programa_marinho/mangues/>

[20] WWF-Brasil. Mangue. Available at <https://www.wwf.org.br/natureza_brasileira/reducao_de_impactos2/programa_marinho/mangues/>

matters related to the protection of the environment, conservation of nature, defense of the soil, protection of landscape heritage and responsibility for damages to the environment. The same document establishes that municipalities are responsible for legislation at the local level[21].

However, in the absence of a qualified environmental agency or environmental council in the municipality, the state must carry out municipal administrative actions until its creation. In turn, in the absence of a qualified environmental agency or environmental council in the state and municipality, the Union will have to carry out administrative actions until its creation in one of those federative entities[22]. It is also necessary to observe that a municipal law cannot contradict a state law, which in turn cannot contradict a federal law, under penalty of unconstitutionality.

Figure 6. Structure of the Brazilian legislation



Thus, in the state of Pará, the Secretariat of the Environment (Sema/PA) is the body responsible for environmental licensing, including authorizations for forestry intervention.

- National legislation

According to the current Brazilian Forest Code (Law Nº 12.651, 25/05/2012[23]), all rural estates located in forest zones shall have:

I. Permanent Preservation Area (APP): protected areas covered or not by native vegetation, with the environmental function of preserving water resources, landscape, geological stability, biodiversity, gene flow of plants and animals, protecting the soil and ensuring the well-being of human population.

II. Legal Reserve: an area located within a rural property or possession which is required to be segregated, as well as the permanent preservation area, for the sustainable use of

[21] Available at http://www.mpsp.mp.br/portal/page/portal/documentacao_e_divulgacao/doc_biblioteca/bibli_servicos_produtos/bibli_boletim/bibli_bol_2006/RDC_07_23.pdf
[22] Available at http://pnla.mma.gov.br/competencias-para-o-licenciamento-ambiental
[23] BRASIL. Law nº. 12.651, of 25 May 2012. Forest Code. Diário Oficial [da] República Federativa do Brasil, Brasília, DF, 25 May 2012. < http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12651.htm>

natural resources, conservation and rehabilitation of ecological processes, biodiversity conservation and shelter, and protection of native flora and fauna. In the Brazilian Legal Amazon[24], eighty percent (80%) of a rural property should be preserved.

The 1934 version of the Brazilian Forestry Code demanded the conservation of only 25% of the vegetation coverage; the 1965 version, increased the conservation area to 50% in the Amazon; and finally, in the 2012 version, the conservation requirements increased even more, reaching 80% of areas located in the Amazon biome[25].

However, there is a clear disregard for legal conservation requirements in the region. Much of the deforestation occurs in areas that should be preserved. Lack of law enforcement by local authorities along with public policies seeking to increase commodities production and encourage land use for agricultural, bio energy and cattle breeding purposes created a scenario of almost complete disregard of the mandatory provisions of the Forest Code. High rates of criminality associated with land disputes usually jeopardize efforts concerning law enforcement improvement. In addition to that, to cover vast distances of areas with low demographic density makes tracking of illegal activities and land surveillance very difficult for the authorities[26]. Accordingly, policies implemented to address illegal deforestation only by means of command-and-control approaches have proven to be ineffective so far.

Given the permanent attempts against the Project Area, the project proponent uses their best efforts to prevent property invasion and to remain in compliance with Brazilian Forest Code.

- State legislation

Instance 1 does not have Sustainable Forest Management Plan activities. In the state of Pará, the Secretariat for the Environment (Sema/PA) is the body responsible for environmental licensing and monitoring.

- Climate change legislation

Regarding other regulatory frameworks that exist in Brazil, on November 28th, 2019, occurred the approval of the Federal Decree 10,144/2019, which establishes the National Commission for Reducing Emissions of Greenhouse Gases from Deforestation and Forest Degradation, Conservation of Forest Carbon Stocks, Sustainable Management of Forests and Increase of Forest Carbon Stocks - REDD+[27].

[24] The concept of Legal Amazonia was originated in 1953 and its boundaries arise from the necessity of planning the economic development of the region. For this reason, Legal Amazonia's boundaries do not correspond to those of the Amazon biome. The former has an area of approximately 5 million km², distributed through the entirety or a proportion of 9 Brazilian states.
[25] Available at https://oeco.org.br/dicionario-ambiental/28574-o-que-e-o-codigo-florestal/
[26] MOUTINHO, P. *et al*. REDD no Brasil: um enfoque amazônico: fundamentos, critérios e estruturas institucionais para um regime nacional de Redução de Emissões por Desmatamento e Degradação Florestal – REDD. Brasília, DF: Instituto de Pesquisa Ambiental da Amazônia, 2011. < https://ipam.org.br/wp-content/uploads/2015/12/redd_no_brasil_um_enfoque_amaz%C3%B4nico.pdf>
[27] The Decree is available in Portuguese at: < http://www.planalto.gov.br/ccivil_03/_Ato2019-2022/2019/Decreto/D10144.htm>

The development of this Project is not in conflict with such Decree. In terms of the object, jurisdictionally and scope of the Decree 10,144/2019, it is understood that its application is merely administrative, that is, it merely organizes the functioning of the Federal Government about the REDD+ agenda. Its application is restricted to the federal entities of the Public Administration, and, because it is a decree, a normative type that only grants regulation to the matter of law, does not establish duties or obligations to the society.

Thus, Decree 10,144/2019 only limits the Federal Government's understanding of what shall be accounted for in order to comply with mitigation commitments of other countries to the United Nations Framework Convention on Climate Change. It does not impose a barrier or obstacles to the implementation of REDD projects and the commercialization of carbon assets generated from these projects. This consideration in the Decree does not affect or interfere with the voluntary or regulated carbon market, domestic or international.

There is no law in Brazil that does not allow or restrict the execution of REDD projects or that does not allow or restrict any commercial transaction of assets resulting from REDD projects. On the contrary, such transactions are valid and legally permitted. Thus, there is no contradiction or irregularity between the Project Activity and such Decree.

The Table below presents the compliance of the Project with aforementioned laws:

Law	Content	Compliance
Federal Legislation		
Law Nº 12.651	This Law establishes general rules on the protection of vegetation, Permanent Preservation areas and Legal Reserve areas; forest exploitation, the supply of forest raw materials, the control of the origin of forest products and the control and prevention of forest fires and provides economic and financial instruments to achieve its objectives.	Instance 1 complies with the current Federal legislation, as evidenced by the regularity in the CAR and the absence of legal pending issues on environmental matters.
Decree 5975	Provides information for the exploitation of forests and successor formations, comprising the regime of sustainable forest management and the regime of suppression of forests and successor formations for alternative land use.	Instance 1 does not perform sustainable forest management within its forest area; therefore, this Decree does not apply.
Standards and guidelines from national agencies		
Administrative Rule 1 IBAMA	It institutes, within the scope of this autarchy, the technical guidelines for the elaboration of sustainable forest management plans – SFMP mentioned in art. 19 of Law 4,771, of September 15, 1965	Instance 1 does not perform sustainable forest management within its forest area; therefore, this Administrative Rule does not apply.
Administrative Rule 5 IBAMA	Provides for technical procedures for the preparation, presentation, execution and technical evaluation of sustainable forest	Instance 1 does not perform sustainable forest management within

	management plans - SFMP in primitive forests and their forms of succession in the legal Amazon, and other measures	its forest area; therefore, this Administrative Rule does not apply.
Normative Instruction 2 MMA	Amends provisions of normative instruction no. 5, of December 11, 2006, and makes other provisions	Instance 1 does not perform sustainable forest management within its forest area; therefore, this Normative Instruction does not apply.
Resolution 406 CONAMA	Establishes technical parameters to be adopted in the preparation, presentation, technical evaluation and execution of a sustainable forest management plan - SFMP for timber purposes, for native forests and their forms of succession in the Amazon biome	Instance 1 does not perform sustainable forest management within its forest area; therefore, this Resolution does not apply.
Legislation on climate change and carbon market		
Decree 10144	Establishes the National Commission for the Reduction of Greenhouse Gas Emissions from Deforestation and Forest Degradation, Conservation of Forest Carbon Stocks, Sustainable Management of Forests and Increase of Forest Carbon Stocks - REDD+.	The development of this Project is not in conflict with such Decree. In terms of the object, jurisdictionally and scope of the Decree 10,144/2019, it is understood that its application is merely administrative, that is, it merely organizes the functioning of the Federal Government about the REDD+ agenda. Its application is restricted to the federal entities of the Public Administration, and, because it is a decree, a normative type that only grants regulation to the matter of law, it does not establish duties or obligations to the society.
Decree 11075[28]	Establishes the procedures for the elaboration of Sectoral Plans for Mitigation of Climate Changes, institutes the National System for the Reduction of Greenhouse Gas Emissions	The decree defines the carbon credit as a financial asset, the institution of the National System for the Reduction of Greenhouse Gas Emissions and organizes the functioning of the Government about the carbon agenda. Its application is restricted to the federal entities of the Public Administration, and, because it is a decree, a normative type that only grants regulation to the matter of law, it does not establish duties or obligations to the society.

1.15 Participation under Other GHG Programs

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

[28] Available at https://presrepublica.jusbrasil.com.br/legislacao/1505298704/decreto-11075-22

This project has not been registered and is not seeking registration under any other GHG Programs.

1.15.2 Projects Rejected by Other GHG Programs

Not applicable. This project has not requested registration under any other GHG Programs, therefore, the project has not been rejected by any other GHG programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The project activity is not included in an emission trading program or any other mechanism that includes GHG allowance trading.

1.16.2 Other Forms of Environmental Credit

The project area has not sought or received any other form of GHG-related environmental credit, including renewable energy certificates.

Supply Chain (Scope 3) Emissions

The present REDD project's GHG emission reductions are not part of a supply chain, i.e., there is no network of organizations (e.g., manufacturers, wholesalers, distributors, and retailers) involved in the production, delivery, and sale of a product or service to the consumer. Therefore, there are no organizations upstream nor downstream of the goods and services whose GHGs are impacted by the present REDD project activity.

1.17 Sustainable Development Contributions

The primary objective of the Amazon Bluecarbon Grouped REDD Project is to avoid the unplanned deforestation (AUD) of its instances, consisting of 100% Amazon mangrove forest. The Project also has the function of establishing a barrier against the advancement of deforestation, making an important contribution to the conservation of Amazon biodiversity and also to climate regulation in Brazil and South America.

These measures contribute to several nationally stated sustainable development priorities, such as the objectives from the Brazilian Government related to the UN Sustainable Development Goals (SDGs)[29] and the Nationally Determined Contribution (NDC).

In Brazil, the National Commission for Sustainable Development Objectives (CNODS) is responsible for internalizing, disseminating and providing transparency to the process of

[29] UN's Sustainable Development Goals and targets available at: https://sdgs.un.org/goals

implementing the 2030 Agenda for Sustainable Development in Brazil[30]. The Commission is made up of eight government representatives (Government Secretariat of the Presidency of the Republic; Civil House of the Presidency of the Republic; Ministry of Foreign Affairs; Ministry of Citizenship; Ministry of Economy; Ministry of Environment; representative of the state/district levels; representative of the municipal level) and by eight representatives of civil society and the private sector. The monitoring of the country's advances in relation to the SDGs established as priorities is carried out by the Institute of Applied Economic Research (IPEA) and the Brazilian Institute of Geography and Statistics (IBGE), which are also permanent technical advisory bodies.

There is no monitoring at the specific level of projects, and progress at the national level can be accompanied by the synthesis report carried out by IBGE[31] and by the IPEA reports[32]. In addition, in 2018 there was the SDG Award, an initiative of the Federal Government whose objective is to encourage, value and give visibility to practices that contribute to achieving the goals of the 2030 Agenda throughout the national territory. The first edition of the Award had 1045 entries to compete in four categories: government; for-profit organizations; non-profit organizations; and teaching, research and extension institutions.

The Amazon Bluecarbon Grouped REDD Project main planned contributions to the Brazilian Priority Goals are listed below[33]. These contributions are monitored by the parameters defined by the REDD project.

- SDG 1: No poverty

  The project positively impacts people in situations of poverty and vulnerability, mainly through investments in the local community that lives in the vicinity of the project area, thus ensuring access to basic and essential services for human development. Thus, the project collaborates with targets such as:

  - 1.3 “Implement nationally appropriate social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable”;
  - 1.4 “By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance”;
  - 1.5 “By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters”.

- SDG 2: Zero hunger

[30] More information on the CNODS available at < http://www4.planalto.gov.br/ods/noticias/governanca-nacional-para-os-ods>
[31] Available at < https://odsbrasil.gov.br/relatorio/sintese>
[32] Available at < https://www.ipea.gov.br/ods/publicacoes.html>
[33] Available at < https://odsbrasil.gov.br>

The project itself enhances better management of non-timber forest products as, through the carbon credits sales, qualifies investments in the local community training and capacity building programs. Likewise, strengthen ecosystem conservation and preservation. Guideline targets are:

- 2.4“By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality”.

- SDG 3: Good health and well-being

Via carbon credits income, the project promotes the community's well-being and helps to solve local common issues. Therefore, the project may contribute to the following targets:

- 3.3 “By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases”.

- SDG 4: Quality education

The carbon project encourages the local community to participate in courses regarding technical skills and educational basis. Moreover, the carbon project encourages the development of partnerships with educational entities striving for socioenvironmental scholarly initiatives. The targets determined by the UN that will act as a guideline for monitoring actions are:

- 4.1 “By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes”;

- 4.4 “By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship”;

- 4.5 “By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations”;

- 4.6 “By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy”;

- 4.7 “By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture’s contribution to sustainable development”.

- SDG 5: Gender equality

The carbon project expects a continuous improvement concerning women's inclusion, such as through sponsoring events and initiatives which promote a gender equality

environment. Thus, the project may have initiatives that contribute to the following targets:

- 5.2 “Eliminate all forms of violence against all women and girls in the public and private spheres, including trafficking and sexual and other types of exploitation”;
- 5.4 “Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate”.

- SDG 8: Decent work and economic growth

The REDD project aims to offer training and income generation in the project region as a measure to conserve native forest standing and promote economic viability and growth in the local community. Guideline targets are:

- 8.3 “Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small-and medium-sized enterprises, including through access to financial services”;
- 8.6 “By 2020, substantially reduce the proportion of youth not in employment, education or training”.

- SDG 12: Ensure sustainable production and consumption patterns

The carbon project nurtures a better environmental management system since increases stakeholder awareness concerning the climate changes mitigations, and whichever environmental activity the landowners intend to apply. Alongside, the project is based on encouraging sustainable development and maintaining the standing forest, and it aims to optimize access to non-timber forest products and the consumption of local inputs. One of the main objectives is to reduce illegal deforestation and profit from this activity, offering alternatives for income and extraction. The Amazon Bluecarbon Grouped REDD Project has the following target and guidelines:

- 12.6 “Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle”;
- 12.8 “By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature”.

- SDG 13: Take urgent action to combat climate change and its impacts

Another of the main objectives of the REDD project is to reduce greenhouse gas emissions through the conservation of standing forest. Thus, its activity is already an action to combat climate change and its effects. In addition, the project stimulates biodiversity monitoring initiatives in a measure to combat climate changes. The targets and guidelines for this objective are:

- 13.2 “Integrate climate change measures into national policies, strategies and planning”;
- 13.3 “Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

- SDG 15: To protect, restore and promote the sustainable use of terrestrial ecosystems, to manage forests sustainably, to combat desertification, to halt and reverse land degradation, and to halt the loss of biodiversity

The project is based on the conservation and restoration of forests in the Amazon biome, ensuring forest services, preservation of natural resources, and biodiversity. The targets and guidelines related to this objective are:

- 15.1 "By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements";
- 15.5 "Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species";
- 15.9 "By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts";
- 15.a "Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems";
- 15.c "Enhance global support for efforts to combat poaching and trafficking of protected species, including by increasing the capacity of local communities to pursue sustainable livelihood opportunities".

Reducing deforestation and promoting sustainable development in the Amazon is also a key component to Brazil's Nationally Determined Contribution (NDC) under the Paris Agreement. According to the Brazilian Government Ministry for the Environment (in Portuguese, Ministério do Meio Ambiente), the implementation of REDD+ activities are an important component to meet the Country's contribution under the United Nations Framework Convention on Climate Change while preserving natural forest resources[34].

The following components of the Brazilian commitments under the Convention are reinforced by the development of the Amazon Bluecarbon Grouped REDD Project:

- Strengthening and enforcing the implementation of the Forest Code, at federal, state and municipal levels;
- Strengthening policies and measures with a view to achieve, in the Brazilian Amazon, zero illegal deforestation by 2030 and compensate for greenhouse gas emissions from legal suppression of vegetation by 2030.

1.18 Additional Information Relevant to the Project

Leakage Management

Leakage Management Area Diagnosis

[34] Commitments available in Brazil's iNDC, from 2016, and reinforced in its update in 2020/2021. Available at <https://www4.unfccc.int/sites/NDCStaging/Pages/Party.aspx?party=BRA>

An assessment was carried out in order to identify the nearest communities to the Project's location, and, from that, a brief diagnosis of the leakage management area could be performed. One settlement was chosen to integrate the Leakage Management Area. Further information about boundaries of the leakage management area is located at section 3.3, Project Boundaries, of the present VCS PD.

- *Comunidade Quatipuru-Mirim* (*Quatipuru-Mirim* Community)

  The *Quatipuru-Mirim* community[35] is settled inside a Conservation Unit called *Reserva Extrativista* (RESEX) *Marinha de Tracuateua* (*Tracuateua* Marine Extractive Reserve, in free translation) in Tracuateua/PA, created in 2005. The reserve's area is 27,154 ha, and there are around 2,500 residents[36]. For the Leakage Management Area, Community *Quatipuru-Mirim* was chosen due to the proximity and possibility of implementing a partnership opportunity for alternative income generation, which would require further study.

More information on the relationship between the LMA and the Project, as well as the prospects for socio-environmental activities will be further discussed throughout the monitoring reports.

Leakage Management Plan

The main objective of the project is to avoid unplanned deforestation. This goal will be achieved through the expansion of monitoring of the area, along with the inclusion of the local community in the project activities, with environmental education and alternative sources of income to minimize risks of invasion and deforestation within the project area and the reference region.

As aforementioned throughout this project description document, Amazon Bluecarbon Grouped REDD Project plans to implement a program regarding the extraction of NTFPs as a way of providing an alternative income source for the local communities that surround the project area.

The non-timber forest product is still to be chosen, as further study is necessary.

Brazilian law such as Decree No. 6,040 ensures the rights of traditional people and communities of attaining sustainable development, and by this, activities such as collection of forest products are permitted as long as they do not cause any damage to the area in question[37]. Hereupon, the project proponents neither can (by law) or want to prohibit the local communities from collecting NTFP in the project area.

Moreover, the project activities will enable the creation of jobs to monitor the area, prioritizing the hiring of local residents for monitoring of the area, with professional training. Income from

[35] Available at <http://bdta.ufra.edu.br/jspui/bitstream/123456789/1610/1/Mapeamento%20socioambiental%20da%20comunidade%20de%20quatipuru-mirim%20na%20resex%20marinha%20de%20tracuateua%2C%20par%C3%A1.pdf>

[36] Available at <https://uc.socioambiental.org/arp/4324>

[37] Further detailed information about legal guarantees is discussed on sections 1.14 and 2.5 of this document.

the sale of credits will make it possible to invest in the educational and professional training of children and adults in the community.

Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of the project description.

Further Information

No further information to disclose.

2 SAFEGUARDS

2.1 No Net Harm

The project is designed so that there are no negative impacts. The Table below provides details on the identified potential risks which might affect the project activities and will be monitored through the CCB Standard.

Table 1. Project Risks

Identify Risk	Potential impact of risk on climate, community and/or biodiversity benefits	Actions needed and designed to mitigate the risk
Uncertainties relating to standing native vegetation cover in the future	GHG emissions, loss of habitat, ecological interactions and animal and plant species.	Monitoring and supervision to avoid deforestation of forest within the project area.
Catastrophic natural and/or human-induced events (e.g. landslides, fire)	Potential risk to community life and permanence, loss of habitat, ecological interactions, animal and plant species.	
Illegal activities within the project area	Deforestation, social conflicts, development of parallel and illegal economies, increase in criminality.	Job creation, development of socioeconomic actions involving the community, promotion of formal and environmental education.
Increase suppression of native vegetation within the project area	Deforestation, land use change, GHG emissions.	REDD+ Project: the additional income generated by carbon credits aims to mitigate the absence of another economic

		activity that would be carried out in the forest area.
Conflict management with communities in the project area, due to banning of negative impacting/illegal activities	Conflicts with the community can prevent/hinder the implementation of new socioeconomic activities aimed at the local society.	Encouragement and investment in social, economic and environmental aspects in the project region; Increasing independence of the communities in the project area.

These risks will be monitored as part of the monitoring report described on the section Monitoring Plan of this VCS PD and also as part of the monitoring of the non-permanence risk, which shall be evaluated at each verification event. Nevertheless, these risks will also be assessed by the CCB Standard methodology.

2.2 Local Stakeholder Consultation

As preconized in the VCS Standard v4 (item 3.17.3), the project proponent has conducted an assessment of the classes of local stakeholders that might be potentially impacted by the project. Information on the local stakeholders identified are discussed throughout this Section.

Local entities having some influence, activities and impact on the project region were chosen through a process to identify them. Stakeholders chosen for local consultation also included potentially impacted communities and neighbours. Thus, the output list of stakeholders from this analysis is described below:

Table 2. Profile of the stakeholders identified

Stakeholder Classification	Justification
Government agency and/or representatives -Direct public administration (State and Municipality)	The carbon project is believed to be in the public sector's interest as it can help the state and municipalities achieve their goals of mitigating greenhouse gas emissions and illegal deforestation. In addition, partnerships with the public sector are very important for the development of activities throughout the project.

Public Administration Company (Autarchy) • INCRA (National Institute of Colonization and Agrarian Reform) • ICMBio (Chico Mendes Institute for Biodiversity Conservation)	These are agencies that are related to the project activity. INCRA is the institute responsible for regulating all rural properties and public lands in the Union and may also assist in verifying the ownership of properties included in the project. ICMBio is an institution linked to the Ministry of the Environment that works in the administration and conservation of protected areas. Since a REDD project is a conservation project, communication with this type of stakeholder is considered essential.
Unions	The participation of unions is important to spread knowledge of the carbon market and include the vision of employees and workers in the region in the development of the project.
Universities and Research institutes	It is believed that the participation of education and research institutions throughout the project is important to develop partnerships and help in the search for sustainable technological innovations, as well as the development of monitoring of fauna and flora, employees and communities training, carbon stock research, etc.
NGOs	NGOs are entities focused on the population's objectives, whether social, environmental or economic, without ties to public governmental entities. Thus, they bring a different point of view to the activity, and communication with these entities brings transparency to the project. In addition, they are key agents for the development of partnerships to strengthen the project activity and enhance socio-environmental co-benefits.
Private organizations	Organizations responsible for carrying out outsourced activities related to forest conservation and social impact.
Local communities	Communities surrounding the Project Area are fundamental agents for the conservation of the region, and the strengthening of their relationship with the property will enhance the generation of socio-environmental co-benefits. Thus, in addition to communicating with the resident families, it is also important

	to communicate with associations, cooperatives and public health programs that deal directly with the people of the region and can bring insight on the needs of these communities, generating opportunities for improvement with the income from the carbon project.

As required on the VCS Standard, v.4 item 3.17.15, "the management teams involved in the project have expertise and prior experience implementing land management and carbon projects with community engagement at the project scale". Information on the Project Management Team will be further detailed as part of the Non-Permanence Risk analysis.

As required on the VCS Standard, v4, item 3.17.17 – Communication and Consultation, for the Local Stakeholder Consultation, a comprehensive project summary will be actively presented to the communities and other stakeholders in Portuguese. The Project Proponent will objectively communicate in a culturally appropriate manner, including language and gender sensitivity, directly with local stakeholders or their legitimate representatives when appropriate:

i) The project design and implementation, including the results of monitoring;

ii) The risks, costs and benefits the project may bring to local stakeholders;

iii) All relevant laws and regulations covering workers' rights in the host country;

iv) The process of VCS Program validation and verification and the validation/verification body's site visit.

The project proponent understands that stakeholders want and need to be involved in the Project design, implementation, monitoring and evaluation throughout the Project's lifetime. Therefore, complying with the VCS Standard v4 (item 3.17.18), a communication channel will be established for stakeholders to continually express their concerns and to solve eventual conflicts and grievances that arise during project planning, implementation, and monitoring.

It is expected that the communication channel will be a mechanism to ensure that the project proponent and all other entities involved in project design and implementation are not involved in or complicit in any form of discrimination or harassment with respect to the project. All complaints will be available to stakeholders and auditors.

The process for receiving, hearing, responding to and attempting to resolve grievances will be performed within a reasonable time period. This Grievance Redress Procedure has three stages (VCS Standard, v4; item 3.17.18):

1) The project proponent shall attempt to amicably resolve all grievances and provide a written response to the grievances in a manner that is culturally appropriate;

2) Any grievances that are not resolved by amicable negotiations shall be referred to mediation by a neutral third party;

3) Any grievances that are not resolved through mediation shall be referred either to a) arbitration, to the extent allowed by the laws of the relevant jurisdiction or b) competent

courts in the relevant jurisdiction, without prejudice to a party's ability to submit the grievance to a competent supranational adjudicatory body, if any (the time to accomplish this stage depends on local jurisdiction delays).

Due to the worldwide Coronavirus pandemic that was established in 2020, security and protection measures had to be taken in order to carry out the consultation with stakeholders. Thus, the Stakeholder Consultation is going to be divided into two events: a remote meeting and an on-site consultation with the local community that resides near the project area, both to be scheduled throughout the project development process.

2.3 Environmental Impact

Deforestation and the associated GHG emissions are a global environmental issue but its effects, locally and regionally, are particularly concerning in developing countries, where economies and livelihoods are more closely linked to farming and use of natural resources. This REDD project will result in positive environmental benefits by conserving forest land leading to less deforestation than would have occurred in the baseline deforestation dynamics.

The Amazon Biome, the location of a hugely diverse fauna and flora, spreads over almost 50% of the Brazilian territory[38], mainly in coastal territories, where mangroves are located, which due to their ecosystemic importance, are commonly called "nature nurseries". However, the uncontrolled deforestation is breaking up the forest in this habitat and, without necessary care, entire regions with local fauna and ancient habitats of unique species are at risk of complete destruction[39]. To further quantify, this biome holds the biggest variety of species in the world, and deforestation and degradation of tropical forests are the main cause of global biodiversity loss[40].

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2.4 Public Comments

The present PD is now being submitted as under validation to the VCS Pipeline Listing in order to start the public comment period.

2.5 AFOLU-Specific Safeguards

Local Stakeholder Identification and Background

[38] BRASIL. Ministério do Meio Ambiente (MMA). Projeto de monitoramento do desmatamento nos biomas brasileiros por satélite (PMDBBS). Brasília, 2012. Available at: http://siscom.ibama.gov.br/monitora_biomas/

[39] Margulis S. Causas do Desmatamento da Amazônia Brasileira. BANCO MUNDIAL. Brasil. July, 2003. Available at: http://www.terrabrasilis.org.br/ecotecadigital/pdf/causas-do-desmatamento-da-amazonia-brasileira.pdf .

[40] BRASIL. Ministério do Meio Ambiente (MMA). Inter-relações entre biodiversidade e mudanças climáticas: Recomendações para a integração das considerações sobre biodiversidade na implementação da Convenção-Quadro das Nações-Unidas sobre Mudança do Clima e seu Protocolo de Kyoto. Brasília, 2007. 220 p. (Biodiversidade, v.28). Available at:http://www.terrabrasilis.org.br/ecotecadigital/index.php/estantes/diversos/2115-serie-biodiversidade-28-inter-relacoes-entre-biodiversidade-e-mudancas-climaticas .

According to the VCS Standard, v4, the project proponent shall conduct a thorough assessment of the local stakeholders that will be impacted by the project, including:

a) The process(es) used to identify the local stakeholders likely impacted by the project and a list of such stakeholders:

Stakeholders were identified through research, visits to the project region, as well as local knowledge from the 1 landowners and management team. As detailed in Section 2.2, stakeholders were identified considering the communities, government agencies, educational and research entities, taking into consideration relevant Pará State and Amazon biome institutions, in addition to NGOs within the Reference Region. Sustainable development and rural development agencies were also contacted. The list is available at section Local Stakeholders Consultation, above.

The Project and actions involving local communities will be monitored by the CCB Standard or any other applicable social-environmental standard at each verification event, in order to analyze the generation of co-benefits and further programs, besides the applied methods for local stakeholders' consultation.

b) Identification of any legal or customary tenure/access rights to the territories and resources, including collective and/or conflicting rights, held by local stakeholders:

There are no communities living within the Project Area. The landowners recognize the presence of the communities near the Project Area and take efforts to maintain a healthy relationship with them. These communities have no rights over the Project Area nor conflicts over land tenure or use rights with the owners.

On July 13, 2006, the Commission for the Sustainable Development of Traditional Communities was instituted in Brazil by decree[41] and updated in 2016[42], with the objective of implementing a national policy especially directed at such communities.

The Decree No. 6,040 of February 7, 2007[43], called National Policy for the Sustainable Development of Traditional People and Communities, has the specific objective of promoting the aforementioned "sustainable development" with an emphasis on the recognition, strengthening and guarantee of their territory, social rights, environment, economic and culture. It also advocates the respect and appreciation of the identity of traditional people and communities, as well as their forms of organization and their different institutions[44].

The Policy is structured around four strategic axes:

1. Access to Traditional Territories and Natural Resources
2. Infrastructure
3. Social Inclusion and

[41] Available at <http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2006/dnn/dnn10884.htm> Last visit 20/07/2022
[42] Available at <http://www.planalto.gov.br/ccivil_03/_Ato2015-2018/2016/Decreto/D8750.htm#art20> Last visit 20/07/2022
[43] Available at <http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2007/decreto/d6040.htm> Last visited on 05/01/2021.
[44] Available at <https://direito.mppr.mp.br/arquivos/File/DireitodospovosedascomunidadesradicionaisnoBrasil.pdf> Last visit 05/01/2021

4. Promotion and Sustainable Production

As previously described in section 1.17, these are the same goals and guidelines of this REDD Project.

Article 215 of the Brazilian Constitution determines that the State will guarantee the full exercise of cultural rights. And as distinctive signs of the identity of the different groups that form Brazilian society, it includes, among others, their forms of expression and their ways of creating, making and living (art. 216, i and ii)[45].

The REDD methodology and the application of additional standards such as the CCB guarantee and are guidelines for the execution of a forest conservation project that ensures not only the avoidance of unplanned deforestation, but also the integration and benefits of the traditional communities surrounding the project area.

Thus, the project is neither based on or plans the removal or alteration of this people's way of life, guaranteeing land use and subsistence production, in addition to traditional customs and methods.

c) A description of the social, economic and cultural diversity within local stakeholder groups and the differences and interactions between the stakeholder groups:

As stated in Item 1, project stakeholders might involve from government agencies to the resident community inside and outside the Project Area. Thus, by applying different forms of consultation, it is considered that the Project covers the social, economic, and cultural diversity of the different stakeholders.

For government agencies, private companies and NGOs, communication will be carried out remotely, through writing and speaking, with the presentation of the Project, its impacts and monitoring methodologies, accounting for credits and actions in the region. In a different way, for communicating the Project to local communities within the Reference Region, a presentation will be performed considering their particularities, as well as a socioeconomic diagnosis aiming the development of an action plan to be put into practice along the project lifetime.

These communities have their rights guaranteed by federal, state, and municipal legislation, in addition to assistance from NGOs and various agencies, characterizing the interaction between the groups of stakeholders.

d) Any significant changes in the makeup of local stakeholders over time:

No changes were identified among the stakeholders involved with the Project. Any future significant changes will be informed in this Section.

e) The expected changes in well-being and other stakeholder characteristics under the baseline scenario, including changes to ecosystem services identified as important to local stakeholders:

[45] Available at <https://direito.mppr.mp.br/arquivos/File/DireitodospovosedascomunidadesradicionaisnoBrasil.pdf> Last visited on 05/01/2021.

The risks and impacts of the Project are analyzed at Section "No Net Harm", designing mitigation strategies for each impact observed. No alteration of communities' area, methodology or way of life in general is predicted. It is planned that the project's revenue will be invested on more socio-environmental programs to involve the local community in the Project and, therefore, minimize the damage to the environment and illegal deforestation.

f) The location of communities, local stakeholders and areas outside the project area that are predicted to be impacted by the project:

- Quatipuru-Mirim Community: Latitude: -0.8383; Longitude: -46.8980

g) The location of territories and resources which local stakeholders own or to which they have customary access.

Territories and resources used or accessed by the communities are included on the Leakage Management Area and are, therefore, within the Reference Region.

Risks to Local Stakeholders

The Project Proponent understands that some risks are inherent to the Project Activity, and that others may arise from the stakeholder's point of view. Considering this, the Table below presents potential risks and impacts to local stakeholders and measures taken to mitigate those:

Table 3. Project risks

Identify Risk	Potential impact of risk on climate, community and/or biodiversity benefits	Actions needed and designed to mitigate the risk
Uncertainties relating to standing native vegetation cover in the future	GHG emissions, loss of habitat, ecological interactions and animal and plant species.	Monitoring and supervision to avoid deforestation of forest within the project area.
Catastrophic natural and/or human-induced events (e.g. landslides, fire)	Potential risk to community life and permanence, loss of habitat, ecological interactions, animal and plant species.	
Illegal activities within the project area	Deforestation, social conflicts, development of parallel and illegal economies, increase in criminality.	Job creation, development of socioeconomic actions involving the community, promotion of formal and environmental education.
Increase suppression of native vegetation within the project area	Deforestation, land use change, GHG emissions.	REDD+ Project: the additional income generated by carbon credits aims to mitigate the absence of another economic

		activity that would be carried out in the forest area.
Conflict management with communities in the project area, due to banning of negative impacting/illegal activities	Conflicts with the community can prevent/hinder the implementation of new socioeconomic activities aimed at the local society.	Encouragement and investment in social, economic and environmental aspects in the project region; Increasing independence of the communities in the project area.

Respect for Local Stakeholder Resources

The Project recognizes, respects, and supports local stakeholders' customary tenure/access rights to territories and resources. The Project will never encroach on private properties or relocate people off their lands without consent. At present there are not any ongoing or unresolved conflicts over property ownership, usage or resources rights, the Project shall not undertake activities that could exacerbate the conflict or influence the outcome of unresolved disputes.

The Project intends to offer benefits and training for the local community, which will be monitored by the CCB Standard.

No community member has been or will be removed from their land, on the contrary, communities will be supported through programs and incentives the stimulated by the Project. In addition, the Project did not introduce any invasive species or allow an invasive species to thrive through its implementation.

Communication and Consultation

The project will take all appropriate measures to communicate and consult with local stakeholders in an ongoing process for the life of the project. As described above, the project intends to carry out local stakeholder consultations. Every consultation shall communicate:

- The project implementation, including the project results and the importance of forest conservation activities.
- The risks, costs and benefits the project brings to local stakeholders.
- The benefit sharing mechanism.
- Procedures related to resolving eventual conflicts with stakeholders.
- The process of VCS Program validation and verification and the validation/verification body's site visit.

Grievance redress and conflict management procedures, as well as benefit sharing mechanisms, will be discussed with communities through the stakeholder consultations.

For validation and verification, two consultations is going to be held, one remotely and the other one on-site, as per described at Section 2.2 – Local Stakeholder Consultation.

Furthermore, a permanent communication channel with local stakeholders will be established with stakeholders at the time of consultation in order to receive any comments or suggestions regarding the present REDD project. All the interested parts will receive Future Carbon's contact addresses during the Local Stakeholder Consultation. All comments received will be responded, and grievances will be resolved in a suitable time frame whenever possible, taking into account culturally appropriate conflict resolution methods

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

This project uses the approved VCS Methodology VM0015 – Methodology for Avoided Unplanned Deforestation, v1.1, published on 03-December-2012[46].

Furthermore, the following tools were used:

- VT0001 - Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities, v3, published on 01-February-2012[47];
- AFOLU Non-Permanence Risk Tool v4, published on 19-September-2019[48].

3.2 Applicability of Methodology

VM0015 – Methodology for Avoided Unplanned Deforestation, v1.1	
Applicability Conditions	**Justification of Applicability**
a) Baseline activities may include planned or unplanned logging for timber, fuelwood collection, charcoal production, agricultural and grazing activities as long as the category is unplanned deforestation according to the most recent VCS AFOLU requirements.	None of the baseline land-use conversion activities are legally designated or sanctioned for forestry or deforestation, and hence the project activity qualifies as avoided unplanned deforestation. This is in accordance with the definition of unplanned deforestation under the VCS Standard v4.

[46] Available at: https://verra.org/methodology/vm0015-methodology-for-avoided-unplanned-deforestation-v1-1/
[47] Available at https://verra.org/methodology/vt0001-tool-for-the-demonstration-and-assessment-of-additionality-in-vcs-agriculture-forestry-and-other-land-use-afolu-project-activities-v3-0/
[48] Available at https://verra.org/wp-content/uploads/2019/09/AFOLU_Non-Permanence_Risk-Tool_v4.0.pdf

	The primary land uses in the baseline scenario are: mining activities and illegal fishing. These unplanned deforestation and degradation agents have been attracted due to due to the sanction of laws to encourage mining activity in the Amazon. Therefore, in the baseline scenario, the Project Area would continue to be illegally deforested by the deforestation agents described above. With that said, the present criteria are fulfilled.
b) Project activities may include one or a combination of the eligible categories defined in the description of the scope of the methodology (table 1 and figure 2).	Within the categories of Table 1 and Figure 2 of the Methodology, the present Project Activity falls within category A, "Avoided Deforestation without Logging". The reason is that the project area contains 100% native vegetation and has never been deforested in the past. In addition, it is important to note that degradation is not included neither in the baseline nor in the project scenario.
c) The project area can include different types of forest, such as, but not limited to, old growth forest, degraded forest, secondary forests, planted forests and agroforestry systems meeting the definition of "forest".	These forest classes composing the Project Area are named as per the Technical Manual for Brazilian Vegetation[49]. The area is considered forest as per the definition of adopted by FAO[50]: Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10%, or trees able to reach these thresholds in situ. No deforested, degraded or areas otherwise modified by humans were included in the Project Area at the Project Start Date.
d) At project commencement, the project area shall include only land qualifying as "forest" for a minimum of 10 years prior to the project	The Project Area consisted of 100% tropical rainforest in 2012 – over 10 years prior to the project start date – all of which according to

[49] Avaliable at https://www.terrabrasilis.org.br/ecotecadigital/pdf/manual-tecnico-da-vegetacao-brasileira.pdf
[50] Available at < https://www.fao.org/3/y4171e/y4171e10.htm#:~:text=FAO%202000a%20(FRA%202000%20Main,of%20other%20predominant%20land%20uses>

start date.	the Brazilian definition of forest[51]. This was ascertained using satellite images, as described in the section Baseline Scenario of the present VCS PD.
e) The project area can include forested wetlands (such as bottomland forests, floodplain forests, mangrove forests) as long as they do not grow on peat. Peat shall be defined as organic soils with at least 65% organic matter and a minimum thickness of 50 cm. If the project area includes forested wetlands growing on peat (e.g. peat swamp forests), this methodology is not applicable.	As described at Section 1.13 of the present VCS PD, the only soil type within the Project Area are Dystrophic Yellow Latosol and Sodic Salic Gleissols. Therefore, no peat or peat swamp forests were found within the Project Area, satisfying this applicability criterion.

VT001	
a) AFOLU activities the same or similar to the proposed project activity on the land within the proposed project boundary performed with or without being registered as the VCS AFOLU project shall not lead to violation of any applicable law even if the law is not enforced;	The present AFOLU project activity does not involve any economic activity apart from forest conservation, i.e., there are no financial or economic benefits other than VCUs related income. Therefore, it does not lead to violation of any applicable law even if the law is not enforced. Sustainable Forest Management Plan is an authorized and endorsed activity in Brazil, and Instances must have all environmental and legal authorizations necessary to conduct the activity, should it be the case for new Instances joining the Project, as Instance 1 does not perform sustainable forest management activities.
b) The use of this tool to determine additionality requires the baseline	The Methodology provides a stepwise approach to justify the determination of the

[51] Brazil adopts the FAO forest definition: "Land with tree crown cover (or equivalent stocking level) of more than 10 percent and area of more than 0.5 hectares (ha). The trees should be able to reach a minimum height of 5 meters (m) at maturity in situ." Available at: <http://www.fao.org/docrep/006/ad665e/ad665e06.htm>.

methodology to provide for a stepwise approach justifying the determination of the most plausible baseline scenario. Project proponent(s) proposing new baseline methodologies shall ensure consistency between the determination of a baseline scenario and the determination of additionality of a project activity.	most plausible baseline scenario, which is detailed at Section 3.4 – Baseline Scenario, below.

3.3 Project Boundary

Spatial Boundaries

The Table below presents the Project Area, and Reference Region Leakage Belt areas:

Table 4. Project Area, Reference Region and Leakage Belt

Name	Area (ha)
Reference Region	72,364.06
Project Area	3,242.18
Leakage Belt	1,135

- Reference Region

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

  According to the applied Methodology, as no applicable sub-national or national baseline is available, and the country or subnational region has not been divided into spatial units for which deforestation baselines will be developed, a baseline must be developed for the Reference Region.

  The Reference Region must encompass the Project Area, the Leakage Belt and any other geographic area that is relevant to determine the baseline of the Project Area.

  A geographic area with agents, drivers and overall deforestation patterns observed during the minimum 10-year period preceding the start date was determined,

representing a credible proxy for possible future deforestation patterns in the project area.

The RR was defined in accordance with the Methodology, following two criteria:

1. For projects below 100,000 ha, the Reference Region should be 20-40 times the size of the Project Area.

2. The conditions determining the likelihood of deforestation within the Project Area being similar or expected to become similar to those found within the Reference Region, depending on: the landscape configuration and ecological conditions (elevation, slope, vegetation, and rainfall), socio-economic and cultural conditions, and agents and drivers of deforestation (agent groups, infrastructure or other drivers). The latter condition was the most important for adjusting the RR for it to represent the land-use dynamics more accurately. Specifically, this was based on the waterways (watersheds) and infrastructure (roads), which are the principal means of human and product transportation in the region. As such, from the areas directly surrounding the project, the RR was expanded to meet the nearest main waterways and roads.

In addition, according to the Methodology, three main criteria are relevant to demonstrate that the conditions determining the likelihood of deforestation within the Project Area are similar or expected to become like those found within the Reference Region:

- **Agents and drivers of deforestation:** Mining and fishing are important economic activities within the Reference Region. As detailed in Section 1.13 and to be presented in Section 3.4, those agents of deforestation are considered threats throughout the Amazon region. Thus, the analysis of the Reference Region definition includes these factors.

- **Socio-economic and cultural conditions:** The Methodology implies that "the legal status of the land (private, forest concession, conservation concession, etc.) in the baseline case within the project area must exist elsewhere in the reference region. If the legal status of the project area is a unique case, demonstrate that legal status is not biasing the baseline of the project area". This is complied with the areas surrounding the properties that are not public or part of any protected area, such as the Project Area. These conditions also comply with Land Use and Land Tenure items once the conditions of the Project Area are found elsewhere in the Reference Region. The Project Area is governed by the same policies, legislation and regulations that apply elsewhere in the Reference Region. These policies are detailed in Section 1.14. Data presented of the private areas is available at Brazil's Environmental Rural Registration[52], National Protected

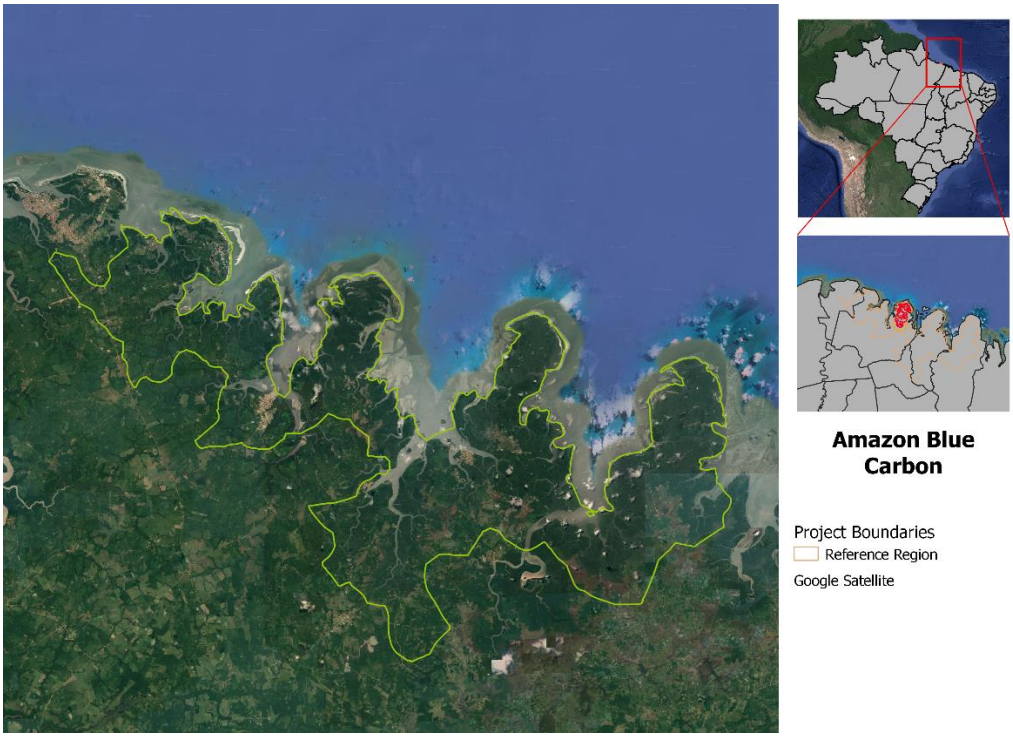
[52] Available at <https://www.car.gov.br/publico/municipios/downloads>

Areas[53]. It is important to note that neither Indigenous Lands[54] nor Protected Areas were found nearby the Project Area.

- **Landscape configuration and ecological conditions:** To define the Reference Region, the watersheds located within an area around the Project Area were used as units. For each of these watersheds, the average values of elevation, slope and precipitation were determined, as well as the percentages of the different types of vegetation. Based on these values, it was possible to visualize areas that presented similar values to the Project Area's parameters. The area units were then used to achieve an extent of approximately 20 times the size of the Project Area as the Reference Region.

  From the definition of this area, which has 72.364.06 ha (22.32 times the Project Area), the criteria related to the type of vegetation, elevation, slope and precipitation were tested to verify the similarity in relation to the Project Area and the rest of the Reference Region. For all four variables, the values met the criteria, which indicates an adequacy of the Reference Region.

Figure 7. Reference Region location



- Project Area

  The Project Area comprises Instance 1.

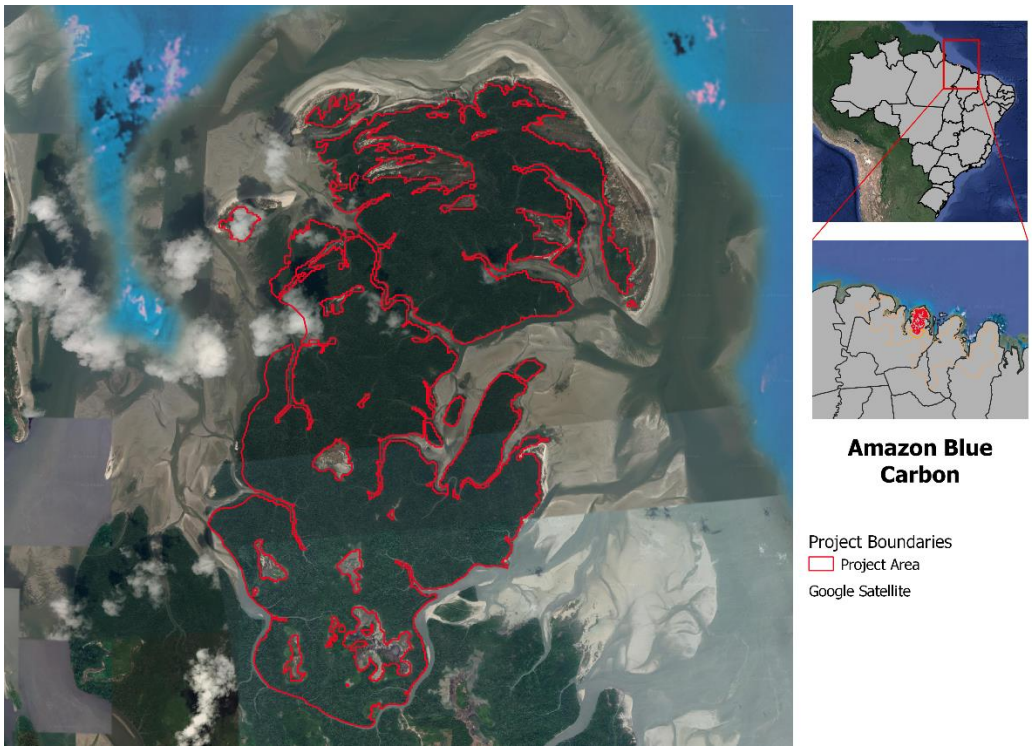
[53] Available at <https://metadados.snirh.gov.br/geonetwork/srv/api/records/9407d38f-84d2-48ea-97dd-ee152c493043>

[54] Available at <https://www.gov.br/funai/pt-br/atuacao/terras-indigenas/geoprocessamento-e-mapas>

Instance 1 is composed by Ilha Portal das Areias property. According to the VM0015 methodology, the Project Area "shall include only land qualifying as 'forest' for a minimum of 10 years prior to the project start date": the date when activities are initiated to protect against the risk of future deforestation. Thus, some adjustments and discounts are made to comply with the Methodology.

In order to define the Project Area, areas deforested up to the Project Start Date, vegetation areas classified as pioneer formation (including peats and wetlands) and areas containing water bodies were excluded from the properties' area. As a result, the Project Area was defined as 3.242,18 ha. Further characteristics of the Project Area until the Project Start Date are described in Section 1.13.

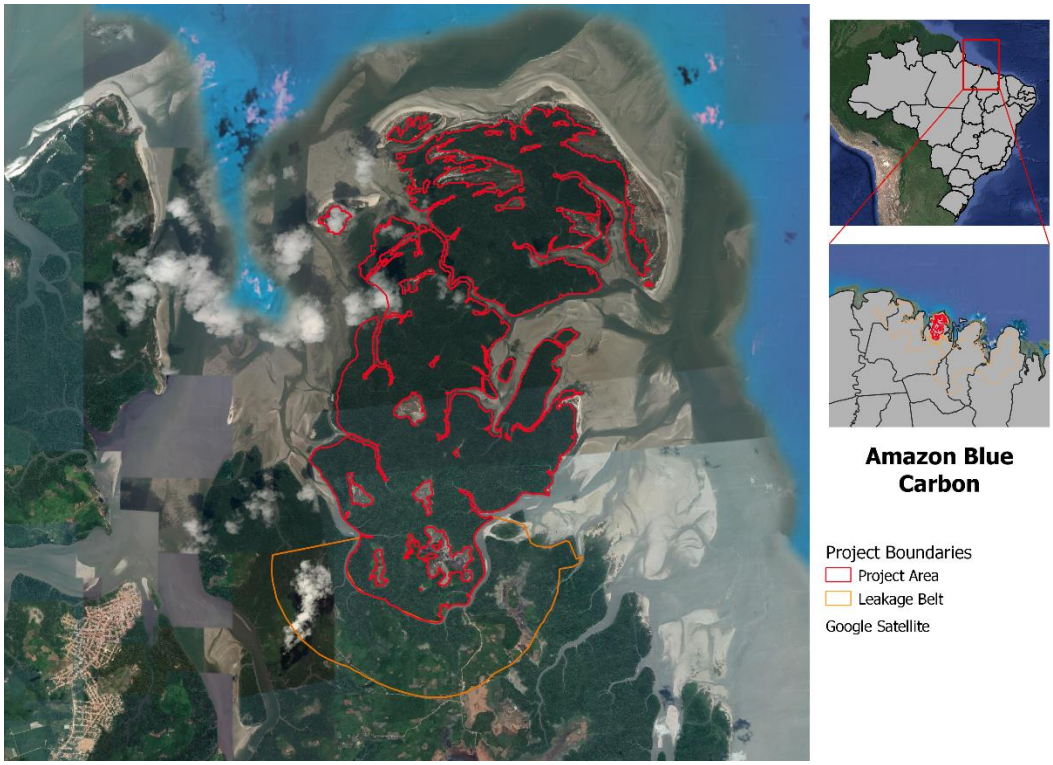
Figure 8. Project Area Location



- Leakage Belt

The Leakage Belt is defined by the Methodology as "the land area or land areas surrounding or adjacent to the project area in which baseline activities could be displaced due to the project activities implemented in the project area", in other words, an area where emissions may occur due to the change in behavior of external agents in response to conservation actions carried out within the Project Area. These areas also include previously deforested areas given the region's economic patterns, but the focus is mainly on areas with potential for forest conversion for other uses. The Leakage Belt was defined as 1,135 ha.

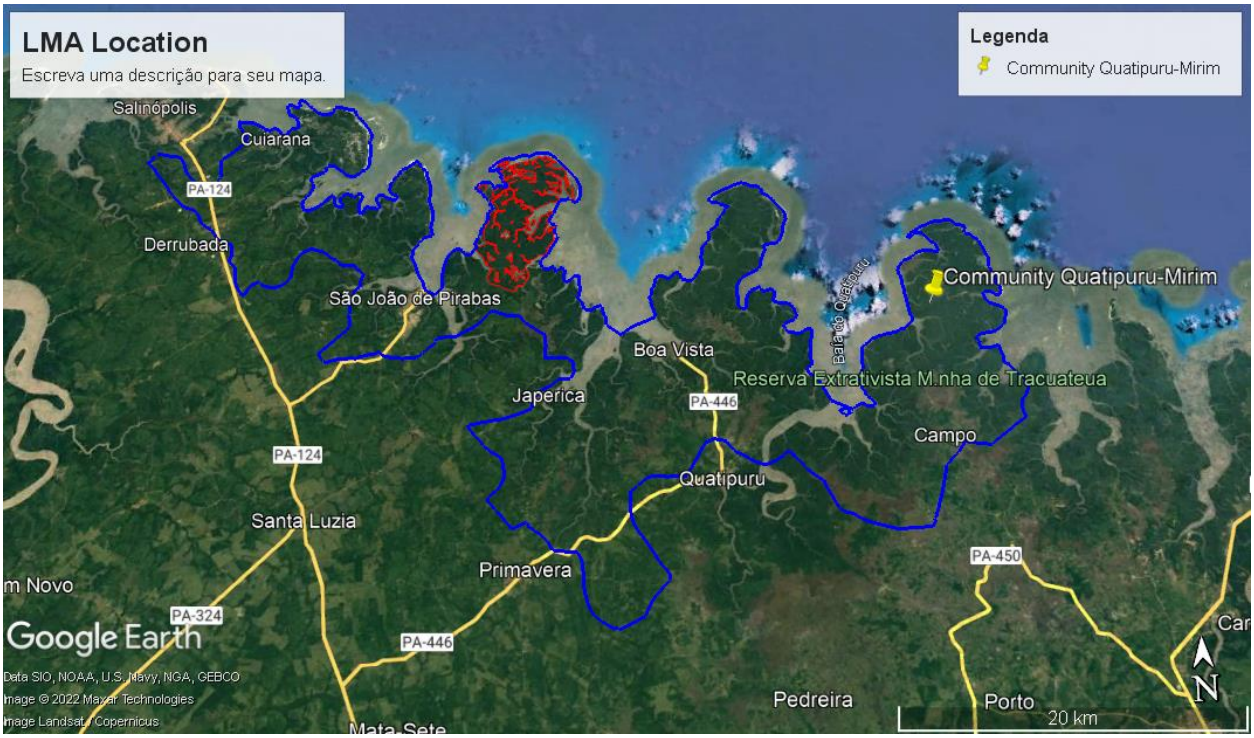
Figure 9. Leakage Belt Location



- Leakage Management Area

  The Leakage Management Area (LMA) combines non-forest areas located outside the project boundary in which the Project intends to implement activities that will reduce the risk of leakage in the Project Scenario. These activities must include the agents of deforestation and seeks to implement alternative income sources in order to contribute to forest conservation. Leakage management could involve agricultural, agroforestry, reforestation, education, among other activities.

Figure 10. Leakage Management Area (Quatipuru-Mirim Community) location



- Forest

  The Brazilian Forest Service's definition of forests is lands that correspond to the vegetation typologies according to the Classification System of the Brazilian Institute of Geography and Statistics (IBGE)55, updated by the SIVAM project56. Brazil endorses the definition of forest adopted by FAO: "Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 %, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use".

  In order to define the Project Area, as previously described in this Section, only areas that comply with the definition of forest were considered. From this, the Project Area was submitted to an analysis using MapBiomas mapping and classification. MapBiomas applies a hierarchical system with a combination of LULC classes in accordance with national definition[55]. Thus, this assessment guarantees that the Project Area meets a definition of forest that has international recognition.

[55] A cross-reference of the MapBiomas LCLU classes with classes from other classification systems such as FAO, IBGE and National Inventory is available at Annex III of MapBiomas general handbook. Available at <https://mapbiomas-br-site.s3.amazonaws.com/Metodologia/Amazon_-_Appendix_-_ATBD_Collection_6.docx.pdf>

Temporal Boundaries

- Starting date and end date of the historical reference period

  The adopted historical reference period was from 2012 to 2022.

- Starting date of the project crediting period of the AUD project activity

  The project has a crediting period of 30 years, from 08-September-2022 to 07-September-2052, which may be renewed up to 100 years.

- Starting date and end date of the first fixed baseline period

  The first baseline period is from 08-September-2022 to 07-September-2032.

Carbon Pools

The applied Methodology considers six carbon pools. Their inclusion or exclusion within the boundary of the proposed AUD Project Activity, as well as the respective justification/explanation, are described in the Table below:

Table 5. Carbon pools included or excluded within the boundary of the proposed AUD Project Activity

Carbon pools	Included / Excludedf	Justification / Explanation of choice
Above-ground	Tree: Included	Carbon stock change in this pool is always significant
	Non-Tree: Included	Included in carbon stocks estimates
Below-ground	Included	Stock change in this pool is significant
Dead wood	Exluded	Excluded for simplification. In the baseline scenario, dead wood is not removed and/or used before the deforestation, as it is often in the process of decomposition in the forest, being left to burn in the baseline case. Therefore, not accounting for this carbon pool is conservative, as it does not consider GHG emissions from deforestation and burning in the baseline.
Litter	Excluded	Excluded as it does not lead to a significant over-estimation of the net anthropogenic GHG emission reductions of the AUD project activity. This exclusion is conservative.
Soil organic carbon	Excluded	Recommended when forests are converted to cropland. Not to be measured in conversions to pasture grasses and perennial crop according to VCS Methodology Requirements, 4.2.

In accordance with the Methodology, approximately 1/10 of the carbon stock in the below-ground pool of the initial "forest" class will be released in a ten-year interval. This is further discussed at Section 4.1 – Baseline Emissions.

Furthermore, the Methodology considers the two sources of GHG emissions listed in the Table below. Their inclusion or exclusion within the boundary of the proposed AUD Project Activity, as well as the respective justification/explanation, were also discussed:

Table 6. Sources of GHG included or excluded within the boundary of the proposed AUD Project Activity

Source		Gas	Included / Excluded	Justification / Explanation of choice
Baseline scenario	Biomass burning	CO_2	Excluded	Excluded as recommended by the applied methodology. Counted as carbon stock change.
		CH_4	Included	Included as non-CO2 emissions from biomass burning in the baseline scenario, according to the methodology.
		N_2O	Included	Included as non-CO2 emissions from biomass burning in the baseline scenario, according to the methodology.
		Other	Excluded	No other GHG gases were considered in this project activity.
	Livestock emissions	CO_2	Excluded	Not a significant source
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
		Other	Excluded	No other GHG gases were considered in this project activity.
Project scenario	Biomass burning	CO_2	Excluded	No biomass burning increase is predicted to occur in the project scenario compared to the baseline case. Therefore considered insignificant.
		CH_4	Included	Included as non-CO2 emissions from biomass burning in the project scenario, according to the methodology.
		N_2O	Included	Included as non-CO2 emissions from biomass burning in the project scenario, according to the methodology.
		Other	Excluded	No other GHG gases were considered in this project activity.
		CO_2	Excluded	Not a significant source

	Livestock emissions	Other	Excluded	No other GHG gases were considered in this project activity.

3.4 Baseline Scenario

Analysis of agents, drivers, and underlying causes of deforestation

As specified in the methodology, it is necessary to understand "who" the deforesting agent is and what drives land-use decisions ("drivers" and "underlying causes"). This analysis is important for two main reasons: (i) Estimating the quantity and location of future deforestation; and (ii) Designing effective measures to address deforestation, including leakage prevention measures.

- **Identification of agents of deforestation**

In recent years, the project region has been deforested for the expansion of mineral extraction activities. This pressure is expected to continue, given the globalization of markets in the amazon region and the weakening of Brazilian environmental legislation.

The main agents of deforestation identified in the area are detailed below:

a) Mining

Mining is an extensive driver of land use change. In Pará State, are located the two largest mineral deposits in the Amazon region: *Oriximiná*, which mines bauxite; and *Serra dos Carajás*, which appears to be one of the largest on the planet. The mining in Amazon biome have become more intensive due to the weakening of environmental legislation since 2018.

Impacts of mining on forests can extend beyond the sites of mineral extraction. This activity leads to deforestation and degradation, besides fragmenting forested landscapes due to establishing new infrastructure to process and transport extracted materials. Previous studies about large-scale mining in the Brazilian Amazon have shown that indirect impacts outside of mining leases caused 9% of deforestation between 2005 and 2015 – representing an area 12 times larger than the mines themselves[56].

In addition to the loss of the forest itself, the activity is highly impactful and generates a chain of disastrous events, contaminating water bodies, affecting aquatic life and threatening the health of riverside communities and indigenous peoples who live near these areas.

Key driver variables are detailed in section below.

a) Driver variables explaining the quantity (hectares) of deforestation:

[56] SIQUEIRA-GAY, J; SONTER, L.J; SÁNCHEZ, L.E. Exploring potential impacts of mining on forest loss and fragmentation within a biodiverse region of Brazil's northeastern Amazon. Resources Policy, Volume 67, August 2020.

- **Population growth and density**

Population is a variable that significantly predicts future deforestation quantity. Local residents are expected to carry out unplanned deforestation, which involves economic activities.

The population growth is tightly correlated with deforestation. Local population is primarily composed of migrants, videos from different parts of the country to sell your labor to mining companies. The lack of economic alternatives then turns this population into the primary deforestation agents in the region. As these cities rely on mining for income generation, forest areas will likely be deforested for promoting the infrastructure necessary for the flow of minerals, and other land uses, following historical patterns.

The increasing rate identified in the population data is an important variable affecting the amount of deforestation in the reference region.

- **Prices of mineral commodities**

The extracted ores prices have much higher value than other products exploited in the region. According to the Brazilian Institute of Mining, in 2022, the mining sector earned around R$75.8 billion, of which the State of Pará was responsible for 42.5% of the production[57].

b) Driver variables explaining the location of deforestation:

- **Access to forests – Roads, highways, access roads and navigable rivers and ocean**

Access roads are means of communication, which influence the spatial distribution of land-uses. Access roads have an influence on fragmentation, population densities and mineral deposits. The possible creation of new access roads, added to the already plentiful rivers, and even the ocean, in the region, increases anthropogenic pressure and, consequently, the intensity of deforestation[58][59][60].

The proximity to waterways historically determined the locations of settlements in relation to extraction of mineral products. Waterways remain the overwhelmingly predominant means of transport and access to mineral extraction sites.

- **Slope**

The project area has very low slope class, being considered mostly flat. This is a great condition to mineral extraction and expansion.

[57] Mineração em números. Available at: https://ibram.org.br/publicacoes/

[58] BROADBENT et al. Forest fragmentation and edge effects from deforestation and selective logging in the Brazilian Amazon. Biological Conservation. Volume 141, Issue 7, July 2008, Pages 1745–1757.

[59] GENELETTI, D. Biodiversity Impact Assessment of roads: an approach based on ecosystem rarity. Environmental Impact Assessment Review, v.23, n.3, p.343-365, 2003

[60] Fearnside, P.M. e P.M.L.A. Graça. 2006. BR-319: Brazil's Manaus-Porto Velho Highway and the Potential Impact of Linking the Arc of Deforestation to Central Amazonia. Environmental Management 38:705-716

- Identification of underlying causes of deforestation

Underlying causes of deforestation include the political scenario related to environment in the baseline period. This political instability would probably reflect in the increase of deforestation.

Environmental governance in Brazil can be divided into three major periods: pre-2005, a period with very poor governance and high rates of deforestation; 2005-2011, a period with improvements in environmental governance and effective results in reducing deforestation; and after 2012, when governance suffered a gradual erosion with the large amnesty granted to past illegal deforesters in the revision of the Forest Code and a return of deforestation rates to the peak levels of the last decade.

2012's political scenario, with the flexibilization of the forest code legislation and amnesty to deforesters, the interruption of the creation of protected areas, including the unprecedented reduction of several of these protected areas in the Amazon, among other actions, proved to be the beginning of a series of setbacks, which have continued over the past 5 years.

In the pre-election period in 2018, the country was already discussing the threat of political bargaining to climate mitigation and the forest conservation in general. In exchange of political support, the government offered landholders to increase deforestation, and the signature of provisionary acts and decrees lowering environmental licensing requirements, suspending the ratification of indigenous lands, reducing the size of protected areas and facilitating land grabbers to obtain the deeds of illegally deforested areas.

In the beginning of 2019, the fusion of Environment and Agriculture Ministries was a clear attempt to obtain more rights for the expansion of agriculture and livestock. The decision was canceled a few days later, after pressure from environmentalists and others in the sector; however, major changes occurred in the ministerial office, limiting the reach and autonomy of the Environmental Ministry, with the absence of mention to combat of deforestation in the office's functions being highlighted by specialists[61].

In addition, the transference of policies and instruments of water resources, including the National Water Agency (ANA) to the Ministry of Regional Development and the Brazilian Forest Service and the Rural Environmental Registry (main instrument for controlling the regularization of large and small properties in forest regions) to the Ministry of Agriculture, Livestock and Supply demonstrated the dismantling of the Environment Ministry. The officialization of indigenous lands, in addition to other land issues, such as the agrarian reform and land regularization in the legal Amazon and traditional territories has been also transferred to the Ministry of Agriculture, Livestock and Supply.

As a consequence, the deforestation in the Amazon Rainforest was widely reported in 2019, as it was the third largest in history, with an increase of 29.5% in comparison to 2018. In total,

[61] Available in < https://www.socioambiental.org/pt-br/blog/blog-do-isa/a-anatomia-do-desmonte-das-politicas-socioambientais > Last visited on 29/12/2020

10,129 km² of the forest were deforested during that year. In August, during the peak of fire warnings in the forest, fact that caused climate effects in São Paulo, 2,790 km away from the Amazon[62], the government tried to deviate attention from the fires, claiming they were fake news[63]. The number of wildfires in Brazilian forests increased 70% in 2019, the highest rate in 7 years. According to National Spatial Research Institute (INPE), the most affected biome was the Amazon, with 51.9%.

This situation continued during the following years, with 10,851 km² deforested within the Amazon biome in 2020, and 13,235 km² in 2021 – the highest value since 2006. Therefore, there is a clear increasing deforestation trend in Brazil, which have underlying political and historical causes mentioned in this section.

Even though deforestation and fire alerts increased in the period between 2019 and 2021, the Brazilian Government reduced the budget for forest fire prevention and deforestation control personnel. A reduction of 58% reached the brigade teams[64].

Government agencies such as INPE and IBAMA, responsible for deforestation monitoring have suffered funding cut-offs, dismissals and had their functions and increasing deforestation data publicly questioned and denied by the government[65].

The quantity of national parks and conservation units in the country's forests was already questioned by the government, that intended to extinguish those by decree[66], an unconstitutional action, after announcing the intention to review the conservation units law (SNUC) and the existing units[67]. In addition, the former Minister of the Environment speaks publicly, in a video released during investigations, of his intention to take advantage of the Covid-19 pandemic to approve several controversial changes to environmental protection and avoid critics and Justice processes.

There are also several threats to the national environmental license process, which has existed since 1981, including from the Minister of the Economy, who wants to loosen the process to

[62] Available in <https://www.economist.com/the-americas/2019/08/22/forest-fires-in-the-amazon-blacken-the-sun-in-sao-paulo> Last visited on 29/12/2020

[63] Available in <https://www.theguardian.com/environment/2019/sep/09/amazon-fires-brazil-rainforest> Last visited on 29/12/2020

[64] Avaliable in <https://g1.globo.com/natureza/noticia/2020/09/12/em-um-ano-governo-bolsonaro-corta-verba-para-brigadistas-em-58.ghtml>

[65] Available in < https://g1.globo.com/natureza/noticia/2019/08/02/cronologia-reacao-do-governo-ao-uso-de-dados-sobre-desmatamento-leva-a-exoneracao-de-diretor-do-inpe.ghtml>

[66] Available in <http://www.ihu.unisinos.br/78-noticias/589958-em-live-bolsonaro-reclama-que-nao-consegue-extinguir-parques-por-decreto>

[67] Available in <https://www.oeco.org.br/noticias/ricardo-salles-quer-rever-todas-as-unidades-de-conservacao-federais-do-pais-e-mudar-snuc/.>

favour mining companies, even with the several recent cases of environmental crimes of breaches of poorly executed and maintained mining dams from companies in the country[68]

Specialists affirm that, with the current pace of dismantling of the inspection structure and environmental legislation demonstrated since the first 6 months of the current government, the forest destruction can reach an irreversible limit in 4 to 8 years. Recent scientific researches show that if an area of 40% of the original forest gets deforested, the rest can't sustain the functioning of the tropical rainforest, and in this scenario, part of the forest may not be able to sustain itself. The Amazon has so far lost approximately 20% of its original coverage[69].

The development of REDD projects and a new culture of sustainable management and production, in addition to the profit from carbon credit sales, to encourage the maintenance of standing forest, goes against the non-environmental policy currently adopted by the country.

- Analysis of chain of events leading to deforestation

The analysis of chain events leading to deforestation within the reference region was based on the facts presented above, analysing the relations between main deforestation agents, drivers and underlying causes that caused and most likely will lead to deforestation.

The project region is located in the limits of Amazon Biome, a region of high vulnerability, deforestation risk and rate. The historical deforestation that has been occurring over the past 15 years within the reference region has followed this same pattern.

Furthermore, location of deforestation usually occurs nearby already deforested areas, along rivers, and in low sloped areas. In addition, roads are an important driver explaining the location of future deforestation.

It is possible to relate the deforestation curve to the mining and extraction activities in the region, which are growing. Those land-use changes are the main deforestation agents in the region. The profit from these products is beyond higher than the production of other common products in the region, such as Brazil nuts and açaí.

The socioeconomic conditions of the population of the region and the demographic growth implies the need for new infrastructure projects and the arrival of new habitants coming from other regions of the country, attracted by the high job creation and favourable conditions of production in low-cost forested areas. This increases the pressure on the forests in the project area.

The recent history of polemics and anti-environmentalism of the Brazilian government, in addition to not tackling the direct causes, minimizing monitoring and restrictions in critical environmental areas and the removal of barriers to large-scale mining in the Amazon, including extraction on

[68] Available in <https://brasil.elpais.com/brasil/2019/01/27/opinion/1548547908_087976.html

[69] Available in <https://www.bbc.com/portuguese/brasil-48805675>

indigenous lands end up influencing and even motivating deforestation, illegal occupation and non-compliance with environmental laws. There is no strong environmental policy, and even with good advances, Brazilian laws have gaps that allows to be taken advantage of by mining companies, or the inspection mechanisms suffer dismantling by the interest parties, making the conservation of the extensive Brazilian biomes even more difficult.

- **Conclusion**

The conduction of the Step 3 and available evidence allows to analyze that the most likely future deforestation trend within the reference region and project area is conclusive.

The increasing deforestation rate, added to the region's mining extraction acitivities advancement, population increase, lack of effective governmental control and environmental planning are clear evidence that the overall trend in future baseline deforestation rates will be increasing, and this demonstrates the need for conservation measures that encourage a change in the business and production model in the region.

3.5 Additionality

The VCS Tool for the Demonstration and Assessment of Additionality in VCS Agricultural, Forestry and Other Land Use (AFOLU) Project Activities - VT0001 version 3.0[70] must be applied for all project activities instances.

On the additionality assessment, each instance shall determine the appropriate analysis method, whether to apply simple cost, investment comparison or benchmark analysis, according to STEP 2 of VCS VT001 v. 3.0.

Project instances must not be mandated by any law, statute, or other regulatory framework, or for UNFCCC non-Annex I countries, any systematically enforced law, statute, or other regulatory framework;.

Instances may or may not include Sustainable Forest Management Plan, as described on the Grouped Project Eligibility Criteria in Section 1.4.

In case the project activity does not involve Sustainable Forest Management Plan:

- The instance shall have financial, technical and scale consistent with the described in this PD, facing similar investments, technological and/or other barriers as the initial instance. As the VCS AFOLU project generates no financial or economic benefits other than VCS related income, the simple cost analysis (Option I) shall be applied.

In case the project activity includes a Sustainable Forest Management Plan:

[70] Available in <https://verra.org/wp-content/uploads/2017/11/VT0001v3.0.pdf>

- A new additionality and AFOLU non-permanence risk analyses shall be provided. In this case, the investment comparison analysis (Option II) or the benchmark analysis (Option III) of the Tool shall be used.

This tool is applicable for this project activity because the following conditions have been met:

a) AFOLU activities the same or similar to the proposed project activity on the land within the proposed project boundary performed with or without being registered as the VCS AFOLU project shall not lead to violation of any applicable law even if the law is not enforced;

b) The applied baseline methodology provides a stepwise approach to justify determination of the most plausible baseline scenario, in accordance to VCS AFOLU Requirements.

Other instances shall perform the additionality analysis at the time of their inclusion in the monitoring report.

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

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

Credible alternative land use scenarios to the present AFOLU project activity are:

Instance 1 (Ilha Portal das Areias)

I. The continuation of the current (pre-project) land use scenario:

As there is no activity being held on Instance 1, the pre-project land use is the maintenance of the area as it is, without any activities and conservation measures, but still being accountable for the costs of taxes required to maintain the land tenure. Although no economic activities are carried out in the pre-project scenario, the area is exposed to invasions and illegal deforestation, precedents to cattle raising, a common practice in the region, for example, as detailed in section 3.4.

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

The application of the Project Activity could be carried out on the land within the project boundary, nevertheless performed without being registered as the VCS REDD project. This scenario would include avoiding deforestation through security and monitoring installation. Additionally, complementary activities to improve the monitoring of deforestation caused by the agents (identified in Section 3.4, above) would have to be carried out, such as: increased surveillance, monitoring and control by satellite images, REDD+ technical studies, social and environmental activities promoted by the SOCIALCARBON Standard, among others. These investments are usually not made by the Brazilian Government, as they are not mandatory. Therefore, the economic feasibility of this scenario would be reduced without additional revenues from the sale of VCUs.

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

Scenario I - The pre-project activity consists of no activities to be developed within the area, which is in compliance with the Brazilian environmental laws.

Scenario II - The conservation of the forest, monitoring and surveillance are in compliance with the Brazilian environmental laws.

Sub-step 1c. Selection of the baseline scenario

The baseline scenario is the continuation of the pre project activity. The area holds no activity in the baseline scenario. There are no economic activities implemented in the area or other land use activities.

Therefore, the difficulty in monitoring the area makes it exposed to encroachment and illegal deforestation, and activities such as cattle raising and wood extraction, without any control of the activities carried out within the area.

STEP 2. Investment Analysis

Sub-step 2a. Determine appropriate analysis method

Instance 1 generates no financial or economic benefits other than VCS related income, then it was applied the Simple Cost Analysis (Option I).

Sub-step 2b. Simple Cost Analysis

The simple cost analysis was determined as the appropriate analysis method once the Project does not generate any financial or economic benefits other than VCUs related income. There is no for-profit sale of any products, as the NTFPs has not yet been implemented and as there is no timber production in the area as well.

Table below provides an estimate of yearly expenses for the landowner, without considering the costs of the present REDD project:

Table 7. Estimated annual costs for the REDD Project[71]

Estimated Annual Costs of Conservation (R$/year)	
Surveillance and security of the area	R$ 180,000.00
Fuel and machinery maintenance	R$ 12,500.00
Proposed socio-environmental activities	R$ 87,500.00[72]
TOTAL	**R$ 280,000.00**

71 Costs were estimated based on the quotes provided by the respective service providers, according to the available cashflow.
72 The cost with socio-environmental activities was calculated based on other REDD projects, which have implemented similar measures.

According to the additionality tool applied: If it is concluded that the proposed VCS AFOLU project produces no financial benefits other than VCS related income then proceed to Step 4 (Common Practice Analysis).

STEP 4. Common practice analysis

Given that no financial benefits were found in the results of the Simple Cost Analysis, the following step according to the VCS additionality tool is the Common Practice Analysis.

The practice of conservation of privately-owned forest areas in the State of Pará as a whole is extremely rare. Conservation activities in larger areas are usually made in public areas, such as Conservation Units, Federal and State protected areas.

Although most of Brazil's agricultural output is deforestation-free, it is observed that a fraction of properties in the Amazon and Cerrado are responsible for 62% of all potentially illegal deforestation and that roughly 20% of soy exports and at least 17% of beef exports from both biomes to the EU may be contaminated with illegal deforestation[73]. As previously detailed, Pará is one of the main producers of cattle in the country, and this sector represents most of the State's GDP.

In addition to REDD projects, other forms of conservation of private areas are promoted in the country:

- **Private Reserve of Natural Heritage (RPPN)[74]:** it is a category of conservation unit created voluntarily by the landowner. When the area is categorized as RPPN, the owner is committed to nature conservation, without land expropriation. The benefits of the private reserve are preference in the analysis of applications to acquire rural credit, tax benefits and the possibility of cooperation with private and public entities in the protection and management of the land, but no revenue is generated as it is on REDD+ projects due to the sale of verified carbon units. In Pará State, there are 6 registered RPPNs and none of them are located in the municipalities of the reference region[75].

  RPPN management tends to be much more affordable than REDD+ projects due to its costless implementation.

- **Payment for Environmental Services (PES)[76]:** PES is a transaction of voluntary nature, through which a buyer of environmental services grants the provider of these services with financial resources or other form of payment, under the agreed conditions, in compliance with the relevant legal and regulatory provisions, so the provider can maintain, restore or improve the environmental conditions of ecosystems. Regulation regarding this type of service in Brazil is at its early stages, as it has recently been approved, on January 13, 2021, when Law n° 14.119 was sanctioned. The

73 Available at <https://www.gov.br/icmbio/pt-br/servicos/crie-sua-reserva/perguntas-e-respostas-sobre-rppn>.
74 Available at <https://www.icmbio.gov.br/portal/images/stories/comunicacao/downloads/perguntaserespostasrppn.pdf>
75 Available at: < https://sistemas.icmbio.gov.br/simrppn/publico/>
76 Available at <http://www.planalto.gov.br/ccivil_03/_ato2019-2022/2021/lei/L14119.htm>

aforementioned law establishes the National Policy on Payment for Environmental Services and amends other laws to adapt to the new policy. However, the financial incentive is usually determined by the State, and it is commonly applied in taxes discounts, not representing an income to invest in other activities or in the maintenance of the area.

It is possible to note that, for the aforementioned reasons, the project does not characterize as a common practice due to the presented barriers, such as lack of investment and opportunity cost of other land uses. During the attempt to identify similar projects, the essential distinctions between REDD+ projects compared in terms of area, challenges, monitoring costs, among other aspects, greatly diverge from the alternative initiatives identified.

The significant difference between the present REDD+ project and similar conservation practices on the region, regarding financial and opportunity obstacles, makes it possible to conclude that the project is unable to support itself and its conservation activities without the revenues from the verified carbon units, as investment and capital costs for REDD+ projects are very high, which differ from other similar practices (RPPN and PES).

Besides, due to the context of the region, and the fact that the project is located in a reference area for both logging and cattle ranching of the State offer risks to the conservation of the Project Area.

Therefore, the present Instance depends on the revenue from the VCUs to support itself and hence, it is additional.

3.6 Methodology Deviations

Not applicable as no methodology deviations were performed.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

PROJECTION OF FUTURE DEFORESTATION

As the Methodology stipulates, the aim of this step is to locate in space and time the baseline deforestation in the project area, reference region and leakage belt.

- **Selection of Baseline Approach**

According to the Section 3.4 – Baseline Scenario above, between 2011 and 2021, there was a deforestation of 2,510 ha within the Reference Region, with an average oscillation of approximately 220 ha/year and a low increasing trend (R^2 = 0.1).

Therefore, the Historical Average (Approach A from the applied methodology) was chosen as Baseline Approach, since deforestation rates measured in different historical sub-periods in the reference region reveal a low increasing trend and therefore, in order to be conservative, a constant historical average deforestation rate trend was utilized to project future deforestation.

The analysis of presented evidence related to deforestation agents and drivers, in addition to underlying causes, allows to conclude that the deforestation rate trend is likely to continue in the future.

- Quantitative projection of future deforestation

For the deforestation baseline, the average deforestation rate during the 2011-2021 period (0.33%/year).

- Projection of the annual areas of baseline deforestation in the reference region, leakage belt and project area:

Based on the selection of baseline approach, using the historical average approach, tables below show the results of the projection of the annual areas of baseline deforestation in reference region, leakage belt and project area.

Table 8. Annual areas of baseline deforestation in the reference region

Project year t	Stratum i in the reference region (ha)	Total (ha)	
	ABSLRR	annual $ABSLRR_t$	cumulative ABSLRR
2022	207.11	207.11	207.11
2023	207.11	207.11	414.21
2024	207.11	207.11	621.32
2025	207.11	207.11	828.43
2026	207.11	207.11	1,035.53
2027	207.11	207.11	1,242.64
2028	186.40	186.40	1,429.04
2029	186.40	186.40	1,615.43
2030	186.40	186.40	1,801.83
2031	186.40	186.40	1,988.22
2032	186.40	186.40	2,174.62
2033	186.40	186.40	2,361.02

2034	167.76	167.76	2,528.77
2035	167.76	167.76	2,696.53
2036	167.76	167.76	2,864.29
2037	167.76	167.76	3,032.04
2038	167.76	167.76	3,199.80
2039	167.76	167.76	3,367.55
2040	150.98	150.98	3,518.54
2041	150.98	150.98	3,669.52
2042	150.98	150.98	3,820.50
2043	150.98	150.98	3,971.48
2044	150.98	150.98	4,122.46
2045	150.98	150.98	4,273.44
2046	135.88	135.88	4,409.32
2047	135.88	135.88	4,545.20
2048	135.88	135.88	4,681.09
2049	135.88	135.88	4,816.97
2050	135.88	135.88	4,952.85
2051	135.88	135.88	5,088.74

Table 9. Annual areas of baseline deforestation in the project area

Project year t	Stratum i in the project area (ha)	Total (ha)	
	ABSLPA	annual $ABSLPA_t$	cumulative ABSLPA
2022	12.51	12.51	12.51
2023	12.51	12.51	25.01
2024	12.51	12.51	37.52
2025	12.51	12.51	50.02
2026	12.51	12.51	62.53
2027	12.51	12.51	75.03
2028	11.26	11.26	86.29
2029	11.26	11.26	97.54
2030	11.26	11.26	108.80
2031	11.26	11.26	120.05
2032	11.26	11.26	131.31
2033	11.26	11.26	142.56
2034	10.13	10.13	152.69
2035	10.13	10.13	162.82
2036	10.13	10.13	172.95
2037	10.13	10.13	183.08

2038	10.13	10.13	193.21
2039	10.13	10.13	203.34
2040	9.12	9.12	212.46
2041	9.12	9.12	221.57
2042	9.12	9.12	230.69
2043	9.12	9.12	239.81
2044	9.12	9.12	248.92
2045	9.12	9.12	258.04
2046	8.20	8.20	266.25
2047	8.20	8.20	274.45
2048	8.20	8.20	282.66
2049	8.20	8.20	290.86
2050	8.20	8.20	299.07
2051	8.20	8.20	307.27

Table 10. Annual areas of baseline deforestation in the leakage belt

Project year t	Stratum i in the leakage belt (ha)	Total (ha)	
	ABSLLK	annual $ABSLLK_t$	cumulative ABSLLK
2022	3.49	3.49	3.49
2023	3.49	3.49	6.98
2024	3.49	3.49	10.47
2025	3.49	3.49	13.96
2026	3.49	3.49	17.45
2027	3.49	3.49	20.94
2028	3.14	3.14	24.09
2029	3.14	3.14	27.23
2030	3.14	3.14	30.37
2031	3.14	3.14	33.51
2032	3.14	3.14	36.65
2033	3.14	3.14	39.79
2034	2.83	2.83	42.62
2035	2.83	2.83	45.45
2036	2.83	2.83	48.28
2037	2.83	2.83	51.10
2038	2.83	2.83	53.93
2039	2.83	2.83	56.76
2040	2.54	2.54	59.30
2041	2.54	2.54	61.85
2042	2.54	2.54	64.39
2043	2.54	2.54	66.94
2044	2.54	2.54	69.48
2045	2.54	2.54	72.03

2046	2.29	2.29	74.32
2047	2.29	2.29	76.61
2048	2.29	2.29	78.90
2049	2.29	2.29	81.19
2050	2.29	2.29	83.48
2051	2.29	2.29	85.77

- Projection of the location of future deforestation

The projection of the future deforestation within the reference region followed four steps:

(i) Definition of the model assumptions, which consists of defining the modelled deforestation;

(ii) Organization of the spatial and non-spatial database that represents the selection and standardization of the variables used;

(iii) Calibration and validation of the model, which consist of the combination of variables and evaluation of the adjustments of the models; and

(iv) Development of scenarios, which is the creation of future scenarios using historical trends through the Business-as-usual scenario.

- Assigning weightings to change agents

The predictive variables considered to have the potential to influence the risk of deforestation in the region are the proximity to roads, proximity to cities, slope, altitude, proximity to settlements and proximity rivers.

Deforestation risk maps show regions with the highest (risk = 1) or lowest (risk = 0) conditions for deforestation to occur. The risk map was created using Dinamica EGO Software[77], which modeling techniques are used for calibrating, running and validating space-time models.

Dinamica EGO is an environmental platform for land use change modeling. Dinamica EGO allows the design of a model by simply dragging and connecting operators that perform calculations upon various types of data, such as constants, matrices, tables and raster maps. In this way, it is possible to set up a model by establishing a sequence of operators involving an ample range of analytical and simulation algorithms.

In addition, Dinamica EGO holds multiple transitions that can be calibrated employing the Weights of Evidence. This method calculates the influence of spatial determinants on the changes, producing as a result an integrated transition potential map, also known as the transition probability map.

[77] Dinamica Ego Software. Available at: https://csr.ufmg.br/dinamica/ .

The weights of evidence are calculated in Dinamica EGO based on the predictor variables and also on the deforestation maps. The weights of evidence are defined by a Bayesian method, which considers the joint probability of deforestation a posteriori within each class of all explanatory variables. These values represent how much each of the different ranges that compose each predictor variable is related to deforestation. Positive values indicate a correlation with deforestation and negative values indicate ranges that have suffered little deforestation in the past and, therefore, should be less likely to be deforested in the future. Higher values, whether positive or negative, indicate greater weight to positively or negatively influence the calculation of the probability of deforestation in an area.

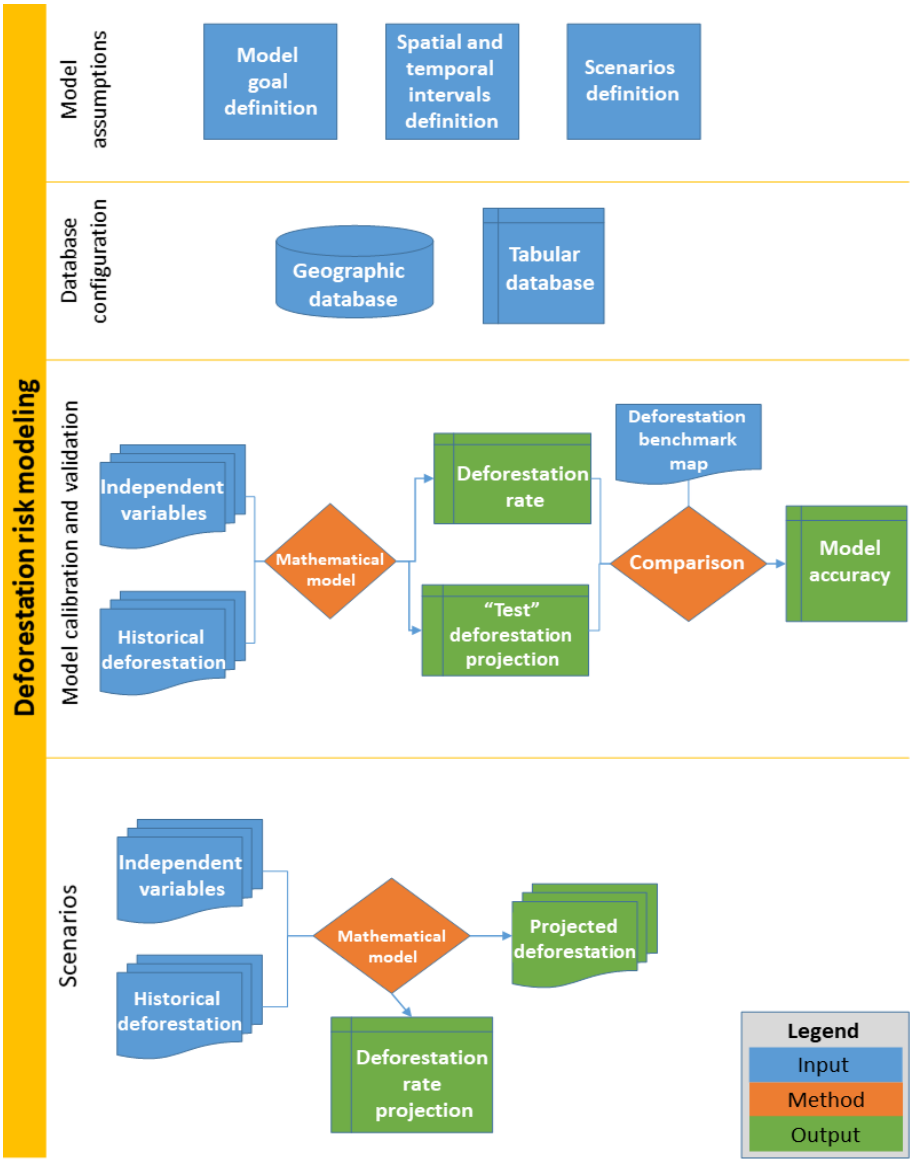
Based on the weights of the evidence, the transition probability of each forest pixel to become other types of anthropic use is calculated. This probability is calculated based on the sum of all the weights of evidence that overlap on a given pixel and are dependent on the combinations of all static and dynamic maps[78].

The result of the application of Dinamica EGO is a transition potential map that identifies areas that present favorable conditions for deforestation to occur in areas classified as forest. This map is the starting point for spatialization of future areas of deforestation, from which annual rates are allocated in conjunction with dynamic variables.

The flowchart below illustrates the modelling steps, showing how the risk map was generated and how the projection of future deforestation was carried out.

[78] Soares-Filho, B., Nepstad, D., Curran, L. et al. Modelling conservation in the Amazon basin. Nature 440, 520–523 (2006). <https://doi.org/10.1038/nature04389>

Figure 11. Modelling steps focusing on the creation of the deforestation risk map and the projection of future deforestation



The spatial variables that most likely represent the patterns of baseline deforestation in the reference region were identified, and the digital maps representing the spatial features of each variable were created. The list of variables, maps and factor maps is presented below.

Table 11. List of variables, maps and factor maps

Factor Map		Source	Variable represented		Meaning of categories or pixel value		Other maps or variables used to create the Factor Map		Algorithm or equation used	Comments
ID	File Name		Unit	Description	Range	Meaning	ID	File Name		
1	d_estradas_edited_v2.tif	IBGE/Imazon	Meter	Distance from paved and unpaved roads	0-15,017.7	Lower values mean more proximity		Merge_IBGE_Imazon_edited_v2	Euclidean Distance (ArcGis 10.6)	Quantitative variable
2	UCs.tif	MMA		Sustainable Use Protected Areas						Categoric variable
3	Tis.tif	FUNAI		Indigenous lands						Categoric variable
4	Assentamentos.tif	INCRA		Rural Settlements						Categoric variable
5	d_rios_g.tif	ANA	Meter	Distance from water bodies	0 – 33,354	Lower values mean more proximity		RiosGrandes_ANA	Euclidean Distance (ArcGis10.6)	Quantitative variable
6	d_rios_mbiomas.tif	MapBiomas	Meter	Distance from water bodies	0-17,197.6	Lower values mean more proximity		Rios_MapBiomas	Euclidean Distance (ArcGis10.6)	Quantitative variable
7	d_rios.tif	ANA	Meter	Distance from rivers	0-11,370.4	Lower values mean more proximity		Rios_ANA	Euclidean Distance (ArcGis10.6)	Quantitative variable
8	d_urbana.tif	IBGE	Meter	Distance from urban centers	10,441.6-101,033	Lower values mean more proximity		AreasUrbanas_IBGE	Euclidean Distance (ArcGis10.6)	Quantitative variable
9	dem.tif	SRTM	Meter	Average altitude variation	0-139	Lower values mean lower altitude				Quantitative variable
10	slope_perc.tif	SRTM	Degrees	Average slope variation	0-97.1825	Lower values mean lower slope			Slope (ArcGis 10.6)	Quantitative variable

The variables and deforestation patterns presented in the Table above were analyzed together to produce the risk map. Factor maps were created using the empirical approach, in which the deforestation likelihood was estimated as the percentage of pixels that were deforested during the period of analysis.

- Selection of most accurate deforestation risk map

As previously noted, the historical average approach was chosen to project the quantity of future deforestation, given the tendency to increase over time. In addition, to validate which are the best models to allocate where the deforestation happens, the calibration and confirmation methodology was applied, dividing the deforestation period in two.

For that, simulations of the deforestation projection were made, taking three dates as reference: 2011, 2015 and 2021. The period of 2011-2015 was used to generate the correlations between the deforested areas and the predictor variables, calculating the adjustment parameters of the models. After that a projection from 2016 to 2021 was made, developing a reference region scenario for this date. Therefore, the deforestation map for the period of 2016 to 2021 and two 2021 scenarios, real and projected, were developed. These scenarios were compared regarding the degree of similarity considering the exponential decay. The higher the similarity, the better the prediction of the model. This index ranges from 0 (no overlapping) to 1 (completely overlapped), and the closer to 1, the more similar is the simulated scenario in relation to the real. Two values are calculated for the indices, the comparison of the simulated map in relation to the real deforestation map and, the opposite, the real map in relation to the simulated map. Thus, to define the most accurate map, the average of these two values was used.

The first tested model was the one with all the predictor variables of deforestation (m00); next, the models were tested by removing each factor separately and measuring the degree of correctness of the model (m01 to m08). Therefore, the most important variables were those in which their absence caused a greater drop in the degree of similarity between the real and projected deforestation maps.

Next, the inverse combinations were made, that is, the models were analyzed only with the deforestation proximity variable (dynamic variable) and the static variables with the greatest impact on the degree of similarity, adding one by one in order of impact. Through this procedure it is possible to guarantee that all the best models could be assessed. During this second round of analysis, only the dynamic variable “Proximity to Deforestation” was used in all models, as there is evidence that proximity to deforested areas is one of the most important variables to predict deforestation.

The best model was chosen, with an average similarity of 0.493. This model applies seven variables: distance from deforestation, distance from protected areas, distance from

settlements, distance from roads, distance from urban areas, slope and altitude. Thus, it was selected to project the future deforestation.

- Definition of Land-Use and Land-Cover Change Component of the Baseline

Now that the area and location of future deforestation are both known, pre-deforestation carbon stocks can be determined by matching the predicted location of deforestation with the location of forest classes with known carbon stocks. The goal of this step is to calculate activity data of the initial forest classes (icl) that will be deforested and activity data of the post-deforestation classes (fcl) that will replace them in the baseline case.

In accordance with analysis achieved through the procedure described above, the quantity of baseline LU/LC-change was projected throughout the crediting period, in the reference region, project area and leakage belt in each stratum. This is in accordance with step 5 of the methodology "Definition of the land-use and land-cover change component of the baseline".

- Calculation of baseline activity data per forest class

The following is in accordance with step 5.1 Calculation of baseline activity data per forest class", in which is stipulated that the previously created maps of annual baseline deforestation and LU/LC map can be combined, producing a map showing deforestation per class in the baseline case.

The LU/LC-change within the project crediting period, caused by baseline deforestation consisted of initial forest classes being converted to the final LU/LC class of 'non-forest'.

Table 12. Annual areas deforested per forest class icl within the project area in the baseline case (baseline activity data per forest class)

Area deforested per forest class *icl* within the reference region		Total baseline deforestation in the reference region	
IDicl	1	annual ABSLRRt (ha)	ABSLRR cumulative (ha)
Name	Forest		
Project year *t*	ha		
2022	207.11	207.11	207.11
2023	207.11	207.11	414.21
2024	207.11	207.11	621.32
2025	207.11	207.11	828.43
2026	207.11	207.11	1,035.53
2027	207.11	207.11	1,242.64
2028	186.40	186.40	1,429.04
2029	186.40	186.40	1,615.43
2030	186.40	186.40	1,801.83

2031	186.40	186.40	1,988.22
2032	186.40	186.40	2,174.62
2033	186.40	186.40	2,361.02
2034	167.76	167.76	2,528.77
2035	167.76	167.76	2,696.53
2036	167.76	167.76	2,864.29
2037	167.76	167.76	3,032.04
2038	167.76	167.76	3,199.80
2039	167.76	167.76	3,367.55
2040	150.98	150.98	3,518.54
2041	150.98	150.98	3,669.52
2042	150.98	150.98	3,820.50
2043	150.98	150.98	3,971.48
2044	150.98	150.98	4,122.46
2045	150.98	150.98	4,273.44
2046	135.88	135.88	4,409.32
2047	135.88	135.88	4,545.20
2048	135.88	135.88	4,681.09
2049	135.88	135.88	4,816.97
2050	135.88	135.88	4,952.85
2051	135.88	135.88	5,088.74

Table 13. Annual areas deforested per forest class icl within the project area in the baseline case (baseline activity data per forest class)

Area deforested per forest class icl within the project area		Total baseline deforestation in the project area	
IDicl	1	annual ABSLPAt (ha)	ABSLPA cumulative (ha)
Name	Forest		
Project year *t*	ha		
2022	12.51	12.51	12.51
2023	12.51	12.51	25.01
2024	12.51	12.51	37.52
2025	12.51	12.51	50.02
2026	12.51	12.51	62.53
2027	12.51	12.51	75.03
2028	11.26	11.26	86.29
2029	11.26	11.26	97.54
2030	11.26	11.26	108.80

2031	11.26	11.26	120.05
2032	11.26	11.26	131.31
2033	11.26	11.26	142.56
2034	10.13	10.13	152.69
2035	10.13	10.13	162.82
2036	10.13	10.13	172.95
2037	10.13	10.13	183.08
2038	10.13	10.13	193.21
2039	10.13	10.13	203.34
2040	9.12	9.12	212.46
2041	9.12	9.12	221.57
2042	9.12	9.12	230.69
2043	9.12	9.12	239.81
2044	9.12	9.12	248.92
2045	9.12	9.12	258.04
2046	8.20	8.20	266.25
2047	8.20	8.20	274.45
2048	8.20	8.20	282.66
2049	8.20	8.20	290.86
2050	8.20	8.20	299.07
2051	8.20	8.20	307.27

Table 14. Annual areas deforested per forest class icl within the leakage belt in the baseline case (baseline activity data per forest class)

Area deforested per forest class icl within the leakage belt		Total baseline deforestation in the leakage belt	
IDicl	1	annual ABSLLKt (ha)	ABSLLK cumulative (ha)
Name	Forest		
Project year *t*	ha		
2022	3.49	3.49	3.49
2023	3.49	3.49	6.98
2024	3.49	3.49	10.47
2025	3.49	3.49	13.96
2026	3.49	3.49	17.45
2027	3.49	3.49	20.94
2028	3.14	3.14	24.09
2029	3.14	3.14	27.23
2030	3.14	3.14	30.37
2031	3.14	3.14	33.51
2032	3.14	3.14	36.65
2033	3.14	3.14	39.79
2034	2.83	2.83	42.62
2035	2.83	2.83	45.45

2036	2.83	2.83	48.28
2037	2.83	2.83	51.10
2038	2.83	2.83	53.93
2039	2.83	2.83	56.76
2040	2.54	2.54	59.30
2041	2.54	2.54	61.85
2042	2.54	2.54	64.39
2043	2.54	2.54	66.94
2044	2.54	2.54	69.48
2045	2.54	2.54	72.03
2046	2.29	2.29	74.32
2047	2.29	2.29	76.61
2048	2.29	2.29	78.90
2049	2.29	2.29	81.19
2050	2.29	2.29	83.48
2051	2.29	2.29	85.77

- Calculation of baseline activity data per post deforestation forest class

The following is in accordance with step 5.2 of the methodology: "Calculation of baseline activity data per post-deforestation forest class". As all of the initial classes represented in the tables above were transformed into non-forest (final post-deforestation class) in the considered baseline, the annual values corresponding to the final classes are the same as those of the initial classes.

According to the methodology VM0015, the Historical LU/LC-change (Method 1) was used to calculate the LU/LC class that will replace the forest cover in the baseline scenario. The table below shows the area of Zone 1 that encompasses areas of possible post-deforestation LU/LC-class within the reference region.

Table 15. Zones of the reference region encompassing different combinations of potential post-deforestation LU/LC classes

Zone		Name		Total area of each zone	
		Non-forest			
		ID_{fcl}	1		
		Area	% of zone	Area	% of zone
IDz	Name	ha	%	ha	%
1	Reference region	5,088.74	9%	5,088.74	9%
Total area of each class *fcl*		5,088.74	9%	5,088.74	9%

Tables below depict the annual areas deforested in each zone in the baseline case within the reference region, project area and leakage belt, respectively.

Table 16. Annual areas deforested in each zone within the reference region in the baseline case (baseline activity data per zone)

Area established after deforestation per zone within the reference region		Total baseline deforestation in the reference region	
ID_{fcl}	1	$ABSLRR_t$	$ABSLRR$
Name	No forest	annual	cumulative
Project year	ha	ha	ha
2022	207.11	207.11	207.11
2023	207.11	207.11	414.21
2024	207.11	207.11	621.32
2025	207.11	207.11	828.43
2026	207.11	207.11	1,035.53
2027	207.11	207.11	1,242.64
2028	186.40	186.40	1,429.04
2029	186.40	186.40	1,615.43
2030	186.40	186.40	1,801.83
2031	186.40	186.40	1,988.22
2032	186.40	186.40	2,174.62
2033	186.40	186.40	2,361.02
2034	167.76	167.76	2,528.77
2035	167.76	167.76	2,696.53
2036	167.76	167.76	2,864.29
2037	167.76	167.76	3,032.04
2038	167.76	167.76	3,199.80
2039	167.76	167.76	3,367.55
2040	150.98	150.98	3,518.54
2041	150.98	150.98	3,669.52
2042	150.98	150.98	3,820.50
2043	150.98	150.98	3,971.48
2044	150.98	150.98	4,122.46
2045	150.98	150.98	4,273.44
2046	135.88	135.88	4,409.32
2047	135.88	135.88	4,545.20
2048	135.88	135.88	4,681.09
2049	135.88	135.88	4,816.97
2050	135.88	135.88	4,952.85

2051	135.88	135.88	5,088.74

Table 17. Annual areas deforested in each zone within the project area in the baseline case (baseline activity data per zone)

Area established after deforestation per zone within the project area		Total baseline deforestation in the project area	
ID_{fcl}	1	$ABSLPA_t$	$ABSLPA$
Name	No forest	annual	cumulative
Project year	ha	ha	ha
2022	12.51	12.51	12.51
2023	12.51	12.51	25.01
2024	12.51	12.51	37.52
2025	12.51	12.51	50.02
2026	12.51	12.51	62.53
2027	12.51	12.51	75.03
2028	11.26	11.26	86.29
2029	11.26	11.26	97.54
2030	11.26	11.26	108.80
2031	11.26	11.26	120.05
2032	11.26	11.26	131.31
2033	11.26	11.26	142.56
2034	10.13	10.13	152.69
2035	10.13	10.13	162.82
2036	10.13	10.13	172.95
2037	10.13	10.13	183.08
2038	10.13	10.13	193.21
2039	10.13	10.13	203.34
2040	9.12	9.12	212.46
2041	9.12	9.12	221.57
2042	9.12	9.12	230.69
2043	9.12	9.12	239.81
2044	9.12	9.12	248.92
2045	9.12	9.12	258.04
2046	8.20	8.20	266.25
2047	8.20	8.20	274.45
2048	8.20	8.20	282.66
2049	8.20	8.20	290.86
2050	8.20	8.20	299.07
2051	8.20	8.20	307.27

Table 18. Annual areas deforested in each zone within the leakage belt in the baseline case (baseline activity data per zone)

Area established after deforestation per zone within the leakage belt		Total baseline deforestation in the leakage belt	
ID_{fcl}	1	$ABSLLK_t$	$ABSLLK$
Name	Non forest	annual	cumulative
Project year	ha	ha	ha
2022	3.49	3.49	3.49
2023	3.49	3.49	6.98
2024	3.49	3.49	10.47
2025	3.49	3.49	13.96
2026	3.49	3.49	17.45
2027	3.49	3.49	20.94
2028	3.14	3.14	24.09
2029	3.14	3.14	27.23
2030	3.14	3.14	30.37
2031	3.14	3.14	33.51
2032	3.14	3.14	36.65
2033	3.14	3.14	39.79
2034	2.83	2.83	42.62
2035	2.83	2.83	45.45
2036	2.83	2.83	48.28
2037	2.83	2.83	51.10
2038	2.83	2.83	53.93
2039	2.83	2.83	56.76
2040	2.54	2.54	59.30
2041	2.54	2.54	61.85
2042	2.54	2.54	64.39
2043	2.54	2.54	66.94
2044	2.54	2.54	69.48
2045	2.54	2.54	72.03
2046	2.29	2.29	74.32
2047	2.29	2.29	76.61
2048	2.29	2.29	78.90
2049	2.29	2.29	81.19
2050	2.29	2.29	83.48
2051	2.29	2.29	85.77

CALCULATION OF BASELINE EMISSIONS

The total average biomass stock per hectare (Mg ha^{-1}) was converted to tCO_2e using the following equations:

$$Cab_{icl} = ab \times CF \times 44/12$$

Where,

Cabicl	Average carbon stock per hectare in the above-ground biomass carbon pool of initial forest class icl; tCO2e ha^{-1}
ab	Average biomass stock per hectare in the above-ground biomass pool of initial forest class icl; Mg ha^{-1}
CF	Default value of carbon fraction in biomass
44/12	Ratio converting C to CO2e

$$Cbb_{icl} = bb \times CF \times 44/12$$

Where,

Cbbicl	Average carbon stock per hectare in the below-ground biomass carbon pool of initial forest class icl; tCO2e ha^{-1}
bb	Average biomass stock per hectare in the below-ground biomass pool of initial forest class icl; Mg ha^{-1}
CF	Default value of carbon fraction in biomass
44/12	Ratio converting C to CO2e

The total baseline carbon stock change in the project area at year t is calculated as follows:

$$\Delta CBSLPA_t = \Delta CabBSLPA_{icl,t} + \Delta CbbBSLPA_{icl,t}$$

Where,

ΔCBSLPAt	Total baseline carbon stock changes in the project area at year t; tCO2e
ΔCabBSLPAicl,t	Total baseline carbon stock change for the above-ground biomass pool in the project area for initial forest class at year t; tCO2e
ΔCbbBSLPAicl,t	Total baseline carbon stock change for the below-ground biomass pool in the project area for initial forest class at year t; tCO2e

$$\Delta CabBSLPA_{icl,t} = ABSLPA_{icl,t} * \Delta Cab_{icl}$$

Where,

ΔCabBSLPAicl,t	Total baseline carbon stock change for the above-ground biomass pool in the project area for initial forest class at year t; tCO2e
ABSLPAicl,t	Area of initial forest class icl deforested at time t within the project area in the baseline case; ha
ΔCabicl	Average carbon stock change factor per hectare in the above-ground biomass carbon pool of initial forest class icl; tCO2e ha^{-1}

$$\Delta CbbBSLPA_{icl,t} = ABSLPA_{icl,t} * \Delta Cbb_{icl}$$

Where,

ΔCbbBSLPAicl,t	Total baseline carbon stock change for the below-ground biomass pool in the project area for initial forest class at year t; tCO2e
ABSLPAicl,t	Area of initial forest class icl deforested at time t within the project area in the baseline case; ha
ΔCbbicl	Average carbon stock change factor per hectare in the below-ground biomass carbon pool of category icl; tCO2e ha^{-1}

Estimation of the average carbon stocks of each LU/LC class

According to the applied methodology, average carbon stocks must be estimated for the forest classes existing within the project area. This information must be collected from existing carbon stock data for these classes from local published studies and existing forest and carbon inventories, according to the following criteria:

- The data are less than 10 years old;
- The data are derived from multiple measurement plots;
- All species above a minimum diameter are included in the inventories;
- The minimum diameter for trees included is 30 cm or less at breast height (DBH);
- Data are sampled from good coverage of the classes over which they will be extrapolated.

The forest class was not stratified, i.e., the "Forest" class includes just one stratum due to the low difference in average carbon stocks within the project area.

The estimation of the average carbon stocks was based on the article described below, which fulfil the criteria mentioned above:

Rovai Andre S., Twilley Robert R., Worthington Thomas A., Riul Pablo. Brazilian Mangroves: Blue Carbon Hotspots of National and Global Relevance to Natural Climate Solutions[79].

[79] Average value for Pará Mangroves, pg 4. Available at <https://www.frontiersin.org/articles/10.3389/ffgc.2021.787533>

The study reviewed published datasets to derive the first integrated assessment of carbon stocks, carbon sequestration rates and potential CO2eq emissions across Brazilian mangroves.

Global mangrove aboveground biomass (AGB) and soil organic carbon stock (SOC) values were retrieved from various independent datasets that have explicitly mapped the spatial distribution parameters'. These global datasets were subsetted for Brazilian mangroves, and median statistics were computed from grided or vectorized datasets where available or directly from the original references. Where possible, uncertainties were assessed on the basis of bootstrapped 95% confidence intervals for medians using the bias corrected and accelerated (BCa) method.

Biomass (AGB and BGB) and SOC (top 1 meter) stock estimates for Brazilian mangroves used throughout the study were computed from Rovai et al. (2018, 2021b) respectively, given the comparatively larger number of observations (>900 forest plots for AGB and >65 sites for SOC stocks distributed only within Brazil's mangroves; Supplementary Table 1) used in these studies. It is noteworthy that mean AGB and SOC estimates for global and Brazilian mangroves are consistent to mean values computed among previous studies.

Carbon sequestration in mangrove woody biomass and soils were estimated based on a comprehensive literature review performed online on Google Scholar, Science Direct, Web of Science, and the Brazilian SciELO databases. Carbon dioxide equivalents (CO2eq) for both carbon stock and carbon sequestration rate values were estimated using a CO2:C stoichiometric ratio of 3.67 (i.e., CO2/C = 44/12 = 3.67), which is used as a multiplying factor to convert carbon atoms to CO2 molecules.

The analysis results in a table listing Brazil's mangrove area and carbon stock:

Figure 12. Median (95% Confidence Intervals) and total values for above- and belowground biomass (AGB and BGB) and, soil organic carbon (SOC) stock estimates for Brazilian states

State	Mangrove area (ha)[a]	AGB (Mg ha^{-1})	SOC (Mg ha^{-1})	Total OC in AGB (Tg)	Total OC in BGB (Tg)[b]	Total SOC (Tg)	Ecosystem-level C (Tg)	Ecosystem-level C (%)
Maranhão (MA)	297,158.47	167 (160–171)	178 (174–179)	24.74	12.37	54.15	91.26	36.56
Pará (PA)	186,977.44	205 (200–208)	196 (173–209)	18.17	9.08	33.94	61.19	24.52
Amapá (AP)	141,625.98	215 (200–227)	209 (138–209)	14.26	7.13	25.92	47.31	18.95
Bahia (BA)	46,460.39	106 (90–114)	278 (276–279)	2.53	1.27	12.90	16.70	6.69
Paraná (PR)	19,581.39	99 (92–108)	269 (260–269)	0.97	0.48	5.26	6.71	2.69
São Paulo (SP)	14,776.24	84 (76–88)	270 (269–272)	0.60	0.30	4.07	4.97	1.99
Sergipe (SE)	10,056.71	98 (87–121)	286 (283–286)	0.53	0.26	2.90	3.69	1.48
Pernambuco (PE)	8,821.82	99 (93–121)	281 (276–281)	0.44	0.22	2.47	3.13	1.25
Paraíba (PB)	8,579.79	80 (75–84)	269 (268–269)	0.33	0.16	2.33	2.82	1.13
Rio de Janeiro (RJ)	7,182.39	83 (77–87)	293 (289–306)	0.35	0.17	2.21	2.73	1.09
Santa Catarina (SC)	6,430.90	57 (44–66)	285 (279–297)	0.21	0.10	1.82	2.14	0.86
Espírito Santo (ES)	5,796.23	119 (102–128)	292 (256–304)	0.29	0.14	1.68	2.11	0.85
Rio Grande do Norte (RN)	5,012.71	102 (93–105)	272 (268–272)	0.27	0.13	1.37	1.77	0.71
Ceará (CE)	3,532.48	79 (74–93)	253 (247–253)	0.16	0.08	0.89	1.14	0.46
Alagoas (AL)	2,826.20	97 (88–106)	284 (281–285)	0.13	0.06	0.81	1.00	0.40
Piauí (PI)	2,680.41	144 (80–182)	239 (237–239)	0.18	0.09	0.65	0.92	0.37
Total				64.14	32.07	153.37	249.58	100

[a]*Estimated using Hamilton and Casey (2016) mangrove cover dataset.*
[b]*Estimated using Hamilton and Friess (2018) 0.5 AGB to BGB conversion factor.*
OC, organic carbon.

The value applied in this project is from Pará state, 205 Mg/ha. Over 80% of all mangrove carbon stocks in Brazil are found in the states of Maranhão (91.3 TgC), Pará (61.2 TgC) and Amapá (47.3 TgC), reflecting extensive coverage which amounts to more than 80% of the country's total mangrove area.

According to the applied methodology, as the uncertainty of the total average carbon stock is less than 10% of the average value, the average carbon stock value can be used.

In addition, average values for the below-ground biomass were taken from the applied methodology VM0015 v1.1, which estimates a root-to-shoot ratio of 0.24 for tropical rainforest having above ground biomass values above 125 tons/ha.

In order to convert biomass into carbon, and carbon into carbon-dioxide, the conversion factors defined in table below were used.

Table 19. Biomass to CO2 conversion factors[80]

Conversion Factors***	
Biomass to Carbon	0.5
C to CO_2	3.6667

Therefore, the carbon stocks values for above and belowground biomass for this project activity are described below.

[80] IPCC, 2003. Good practice guidance for land use, land-use change and forestry. Kanagawa: IGES, 2003. Available at: http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.html

Table 20. Biomass values used for the "forest" classes within the Reference Region, Project Area and Leakage Belt

REFERENCE REGION, PROJECT AREA AND LEAKAGE BELT									
Forest class	Aboveground*			Belowground**			TOTAL		
	Biomass (Mg ha^{-1})	Biomass to Carbon (tC/ha)	Cab_{icl} (tCO2/ha)	Biomass (Mg ha^{-1})	Biomass to Carbon (tC/ha)	Cbb_{icl} (tCO2/ha)	Total biomass (Mg ha^{-1})	Biomass to Carbon (tC/ha)	$Ctot_{icl}$ (tCO_2/ha)
Forest	205.00	102.50	375.83	49.20	24.60	90.20	254.20	127.10	466.03

Average carbon stocks of post-deforestation classes

Fearnside (1996)[81] is one of the most recognized studies for the Brazilian Amazon about long term carbon stocks in deforested areas. This study constructed a Markov matrix of annual transition probabilities to estimate landscape composition and to project future changes in the Brazilian Amazon. The average carbon stock value of non-forest vegetation in anthropic areas in equilibrium (post deforestation class) was defined as 12.8 tC/ha, or 46.93 tCO_2e/ha. It is important to note that no sampling was applied to calculate this data.

Table 21. Long-term (20 years) average carbon stocks per hectare of post-deforestation LU/LC classes present in the reference region

Post deforestation class fcl	
Name	Non forest
ID_{fcl}	1
Average carbon stock per hectare ±90% CI	
$Ctot_{fcl}$	
tCO_2e/ha	
46.93	

Following a literature review, the use of Fearnside (1996) value for non-forest vegetation carbon stocks in equilibrium is conservative because it is based on several land-use types in the Amazon, including agriculture, pasturelands and secondary vegetation, reaching a final value of 46.93 tCO_2/ha. Meanwhile, based on the Brazilian Government data available in the 3rd National GHG Inventory[82], the weighted average for carbon stocks in other land uses (mainly agriculture and pasturelands) was 32.99 tCO_2e. Therefore, the most conservative value between these two data was used.

Uncertainty assessment

81 FEARNSIDE, Philip M. Amazonian deforestation and global warming: carbon stocks in vegetation replacing Brazil's Amazon forest. Forest Ecology And Management, Manaus, v. 80, p.21-34, 1996 Available at < https://www.jstor.org/stable/3591054>

82 Available at https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/arquivos/LIVRORESULTADOINVENTARIO30062021WEB.pdf

According to the applied methodology, if the uncertainty of the total average carbon stock is less than 10% of the average value, the average value, the average carbon stock value can be used. Otherwise, the lower boundary of the 90% confidence interval must be considered in the calculations if the class is an initial forest class in the project area or a final non-forest class in the leakage belt, and the higher boundary of the 90% confidence interval if the class is an initial forest class in the leakage belt or a final non-forest class in the project area.

The literature applied for the definition of carbon stock was conducted at a 95% confidence interval and present an uncertainty level less than 10% of the average carbon stock value.

Therefore, tables below present carbon stocks per hectare of initial forest classes icl existing in the project area and leakage belt, uncertainties at confidence interval of 90%, and final values after discounts for uncertainties, if applicable.

Table 22. Carbon stocks per hectare of initial forest classes icl existing in the project area and leakage belt

Initial forest class *icl*						
Boundaries	Average carbon stock 90% CI					
	Name	Forest				
	ID_{icl}	1				
	Cab_{icl}		Cbb_{icl}		$Ctot_{icl}$	
	C stock	±90% CI	C stock	±90% CI	C stock	±90% CI
	tCO2e/ha	tCO2e/ha	tCO2e/ha	tCO2e/ha	tCO2e/ha	tCO2e/ha
Project Area	375.83	6.31	75.17	1.51	451.00	7.82
Leakage Belt	375.83	6.31	75.17	1.51	451.00	7.82

Table 23. Carbon stocks per hectare of initial forest classes icl existing in the project area and leakage belt after discounts for uncertainties

	Initial forest class *icl*						
	Boundaries	Average carbon stock 90% CI					
		Name	Forest				
		ID_{icl}	1				
		Cab_{icl}		Cbb_{icl}		$Ctot_{icl}$	
		C stock	C stock change	C stock	C stock change	C stock	C stock change
		tCO2e/ha	tCO2e/ha	tCO2e/ha	tCO2e/ha	tCO2e/ha	tCO2e/ha
Initial forest class	Project Area	375.83	375.83	75.17	75.17	451.00	451.00
Final forest class		375.83	375.83	75.17	75.17	451.00	451.00
Initial forest class	Leakage Belt	375.83	375.83	75.17	75.17	451.00	451.00
Final forest class		375.83	375.83	75.17	75.17	451.00	451.00

Carbon stock change factors

The VM0015 methodology v1.1 applies default linear functions to account for the decay of carbon stock in initial forest classes (icl) and increase of carbon stocks in post-deforestation classes. In addition, the methodology stipulates that various change factors must be applied to the baseline case initial and post-deforestation classes in above-ground and below ground biomass:

a) Above-ground biomass:

- Initial forest classes (icl): immediate release of 100% of the carbon stock is assumed to happen during year t = t* (year in which deforestation occurs).
- Post-deforestation classes (fcl): linear increase from 0 tCO_2e/ha in year t = t* to 100% of the long-term average carbon stock in year t = t*+10 is assumed to happen in the 10-years period following deforestation (i.e. 1/10th of the final carbon stock is accumulated each year).

b) Below-ground biomass:

- Initial forest classes (icl): an annual release of 1/10th of the initial carbon stock is assumed to happen each year between t = t* and t = t*+9.
- Post-deforestation classes (fcl): linear increase from 0 tCO_2e/ha in year t = t* to 100% of the long-term average carbon stock in year t = t*+10 is assumed to happen in the 10 years period following deforestation (i.e. 1/10th of the final carbon stock is accumulated each year).

As such, the tables below show carbon stock change factors for initial and final forest classes in above and below-ground carbon pools, which were then applied to calculate baseline carbon stock changes.

Table 24. Carbon stock change factors for initial forest classes (icl) in the reference region (Method 1)

Forest			
Year after deforestation		$\Delta Cab_{icl,t}$	$\Delta Cbb_{icl,t}$
		tCO_2/ha	tCO_2/ha
1	t*	375.83	-9.02
2	t*+1	0	-9.02
3	t*+2	0	-9.02
4	t*+3	0	-9.02
5	t*+4	0	-9.02
6	t*+5	0	-9.02
7	t*+6	0	-9.02
8	t*+7	0	-9.02
9	t*+8	0	-9.02
10	t*+9	0	-9.02
11	t*+10	0	0
12	t*+11	0	0
13	t*+12	0	0
14	t*+13	0	0
15	t*+14	0	0
16	t*+15	0	0
17	t*+16	0	0

18	t*+17	0	0
19	t*+18	0	0
20	t*+19	0	0
21-T	t*+20...	0	0

Table 25. Carbon stock change factors for initial forest classes (icl) in the Project Area (Method 1)

Forest			
Year after deforestation		$\Delta Cab_{icl,t}$	$\Delta Cbb_{icl,t}$
		tCO_2/ha	tCO_2/ha
1	t*	-375.83	-7.52
2	t*+1	0	-7.52
3	t*+2	0	-7.52
4	t*+3	0	-7.52
5	t*+4	0	-7.52
6	t*+5	0	-7.52
7	t*+6	0	-7.52
8	t*+7	0	-7.52
9	t*+8	0	-7.52
10	t*+9	0	-7.52
11	t*+10	0	0
12	t*+11	0	0
13	t*+12	0	0
14	t*+13	0	0
15	t*+14	0	0
16	t*+15	0	0
17	t*+16	0	0
18	t*+17	0	0
19	t*+18	0	0
20	t*+19	0	0
21-T	t*+20...	0	0

Table 26. Carbon stock change factors for initial forest classes (icl) in the Leakage Belt (Method 1)

Forest			
Year after deforestation		$\Delta Cab_{icl,t}$	$\Delta Cbb_{icl,t}$
		tCO_2/ha	tCO_2/ha
1	t*	-375.83	-7.52
2	t*+1	0	-7.52
3	t*+2	0	-7.52
4	t*+3	0	-7.52
5	t*+4	0	-7.52
6	t*+5	0	-7.52
7	t*+6	0	-7.52
8	t*+7	0	-7.52
9	t*+8	0	-7.52
10	t*+9	0	-7.52
11	t*+10	0	0
12	t*+11	0	0
13	t*+12	0	0
14	t*+13	0	0
15	t*+14	0	0
16	t*+15	0	0
17	t*+16	0	0
18	t*+17	0	0
19	t*+18	0	0
20	t*+19	0	0
21-T	t*+20...	0	0

Table 27. Carbon stock change factors for final classes fcl or zones z (Method 1)

Year after deforestation		$\Delta Ctot_{fcl,t}$ (tCO_2e/ha)
1	t*	0.00
2	t*+1	5.21
3	t*+2	5.21
4	t*+3	5.21
5	t*+4	5.21
6	t*+5	5.21
7	t*+6	5.21
8	t*+7	5.21
9	t*+8	5.21
10	t*+9	5.21
11	t*+10	0

12	t*+11	0
13	t*+12	0
14	t*+13	0
15	t*+14	0
16	t*+15	0
17	t*+16	0
18	t*+17	0
19	t*+18	0
20	t*+19	0
21-T	t*+20…	0

Calculation of baseline carbon stock changes

The resulting changes in carbon stock for initial forest classes for the reference region, project area and leakage belt are shown in tables below.

Table 28. Baseline carbon stock change in the reference region

Carbon stock change in the above-ground biomass per initial forest class *icl*		Total carbon stock change in the above-ground biomass of initial forest class in the reference region	
ID_{cl}	1	$\Delta CabBSLRR_{icl,t}$	$\Delta CabBSLRR_{icl}$
Name	Forest	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e
2022	77,838	77,838	77,838
2023	77,838	77,838	155,675
2024	77,838	77,838	233,513
2025	77,838	77,838	311,350
2026	77,838	77,838	389,188
2027	77,838	77,838	467,026
2028	70,054	70,054	537,079
2029	70,054	70,054	607,133
2030	70,054	70,054	677,187
2031	70,054	70,054	747,241
2032	70,054	70,054	817,295
2033	70,054	70,054	887,349
2034	63,048	63,048	950,397
2035	63,048	63,048	1,013,445
2036	63,048	63,048	1,076,494
2037	63,048	63,048	1,139,542
2038	63,048	63,048	1,202,591
2039	63,048	63,048	1,265,639
2040	56,744	56,744	1,322,383
2041	56,744	56,744	1,379,126
2042	56,744	56,744	1,435,870
2043	56,744	56,744	1,492,614
2044	56,744	56,744	1,549,357
2045	56,744	56,744	1,606,101
2046	51,069	51,069	1,657,170
2047	51,069	51,069	1,708,239
2048	51,069	51,069	1,759,309
2049	51,069	51,069	1,810,378
2050	51,069	51,069	1,861,447
2051	51,069	51,069	1,912,516

Carbon stock change in the below-ground biomass per initial forest class *icl*		Total carbon stock change in the below-ground biomass of initial forest class in the reference region	
ID_{cl}	1	$\Delta CbbBSLRR_{icl,t}$	$\Delta CbbBSLRR_{icl}$
Name	Forest	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e
2022	1,868	1,868	1,868
2023	3,736	3,736	5,604
2024	5,604	5,604	11,209
2025	7,472	7,472	18,681
2026	9,341	9,341	28,022
2027	11,209	11,209	39,230
2028	12,890	12,890	52,120
2029	14,571	14,571	66,691
2030	16,252	16,252	82,944
2031	17,934	17,934	100,878
2032	17,747	17,747	118,624
2033	17,560	17,560	136,185
2034	17,205	17,205	153,390
2035	16,850	16,850	170,240
2036	16,495	16,495	186,735
2037	16,140	16,140	202,876
2038	15,972	15,972	218,848
2039	15,804	15,804	234,652
2040	15,485	15,485	250,137
2041	15,165	15,165	265,302
2042	14,846	14,846	280,148
2043	14,526	14,526	294,674
2044	14,375	14,375	309,049
2045	14,224	14,224	323,273
2046	13,936	13,936	337,209
2047	13,649	13,649	350,858
2048	13,361	13,361	364,219
2049	13,074	13,074	377,293
2050	12,938	12,938	390,231
2051	12,801	12,801	403,032

Carbon stock changes in above-ground biomass per post-deforestation zone z		Total carbon stock change of post deforestation zones in the reference region	
ID_{iz}	1	$\Delta CBSLRR_{z,t}$	$\Delta CBSLRR_{z}$
Name	Non-forest	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e
2022	0	0	0
2023	1,080	1,080	1,080
2024	2,160	2,160	3,240
2025	3,240	3,240	6,480
2026	4,320	4,320	10,800
2027	5,400	5,400	16,200
2028	6,480	6,480	22,680
2029	7,452	7,452	30,133
2030	8,424	8,424	38,557
2031	9,396	9,396	47,953
2032	10,368	10,368	58,321
2033	10,260	10,260	68,581
2034	10,152	10,152	78,734
2035	9,947	9,947	88,681
2036	9,742	9,742	98,422
2037	9,537	9,537	107,959
2038	9,331	9,331	117,290
2039	9,234	9,234	126,525
2040	9,137	9,137	135,662
2041	8,952	8,952	144,614
2042	8,768	8,768	153,382
2043	8,583	8,583	161,965
2044	8,398	8,398	170,363
2045	8,311	8,311	178,674
2046	8,223	8,223	186,897
2047	8,057	8,057	194,954
2048	7,891	7,891	202,845
2049	7,725	7,725	210,569
2050	7,558	7,558	218,128
2051	7,480	7,480	225,608

Total net carbon stock change in the reference region	
$\Delta CBSLRR_{t}$	$\Delta CBSLRR$
annual	cumulative
tCO_2e	tCO_2e
79,706	79,706
80,494	160,199
81,282	241,481
82,070	323,551
82,858	406,409
83,646	490,055
76,464	566,519
77,173	643,692
77,882	721,574
78,591	800,165
77,433	877,598
77,354	954,952
70,101	1,025,053
69,952	1,095,005
69,802	1,164,807
69,652	1,234,459
69,689	1,304,148
69,618	1,373,767
63,091	1,436,858
62,957	1,499,815
62,822	1,562,636
62,687	1,625,323
62,720	1,688,044
62,657	1,750,700
56,782	1,807,483
56,661	1,864,144
56,540	1,920,683
56,418	1,977,101
56,448	2,033,550
56,391	2,089,941

Table 29. Baseline carbon stock change in the project area

Carbon stock change in the above-ground biomass per initial forest class *icl*		Total carbon stock change in the above-ground biomass of initial forest class in the project area	
ID_{cl}	1	$\Delta CabBSLPA_{icl,t}$	$\Delta CabBSLPA_{icl}$
Name	Forest	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e
2022	4,700	4,700	4,700
2023	4,700	4,700	9,400
2024	4,700	4,700	14,100
2025	4,700	4,700	18,800
2026	4,700	4,700	23,500
2027	4,700	4,700	28,200
2028	4,230	4,230	32,430
2029	4,230	4,230	36,660
2030	4,230	4,230	40,890
2031	4,230	4,230	45,120
2032	4,230	4,230	49,350
2033	4,230	4,230	53,580
2034	3,807	3,807	57,387
2035	3,807	3,807	61,194
2036	3,807	3,807	65,001
2037	3,807	3,807	68,808
2038	3,807	3,807	72,615
2039	3,807	3,807	76,423
2040	3,426	3,426	79,849
2041	3,426	3,426	83,275
2042	3,426	3,426	86,701
2043	3,426	3,426	90,128
2044	3,426	3,426	93,554
2045	3,426	3,426	96,980
2046	3,084	3,084	100,064
2047	3,084	3,084	103,148
2048	3,084	3,084	106,232
2049	3,084	3,084	109,315
2050	3,084	3,084	112,399
2051	3,084	3,084	115,483

Carbon stock change in the below-ground biomass per initial forest class *icl*		Total carbon stock change in the below-ground biomass of initial forest class in the project area	
ID_{cl}	1	$\Delta CbbBSLPA_{icl,t}$	$\Delta CbbBSLPA_{icl}$
Name	Forest	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e
2022	94	94	94
2023	188	188	282
2024	282	282	564
2025	376	376	940
2026	470	470	1,410
2027	564	564	1,974
2028	649	649	2,623
2029	733	733	3,356
2030	818	818	4,174
2031	902	902	5,076
2032	893	893	5,969
2033	884	884	6,853
2034	866	866	7,718
2035	848	848	8,566
2036	830	830	9,396
2037	812	812	10,208
2038	804	804	11,012
2039	795	795	11,807
2040	779	779	12,587
2041	763	763	13,350
2042	747	747	14,097
2043	731	731	14,828
2044	723	723	15,551
2045	716	716	16,267
2046	701	701	16,968
2047	687	687	17,655
2048	672	672	18,327
2049	658	658	18,985
2050	651	651	19,636
2051	644	644	20,280

Carbon stock changes in above-ground biomass per post-deforestation zone z		Total carbon stock change of post deforestation zones in the project area	
ID_{lz}	1	$\Delta CBSLPA_{z,t}$	$\Delta CBSLPA_{z}$
Name	Non-forest	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e
2022	0	0	0
2023	65	65	65
2024	130	130	196
2025	196	196	391
2026	261	261	652
2027	326	326	978
2028	391	391	1,370
2029	450	450	1,819
2030	509	509	2,328
2031	567	567	2,896
2032	626	626	3,522
2033	620	620	4,141
2034	613	613	4,754
2035	601	601	5,355
2036	588	588	5,943
2037	576	576	6,519
2038	563	563	7,082
2039	558	558	7,640
2040	552	552	8,192
2041	541	541	8,732
2042	529	529	9,262
2043	518	518	9,780
2044	507	507	10,287
2045	502	502	10,789
2046	497	497	11,285
2047	487	487	11,772
2048	476	476	12,248
2049	466	466	12,715
2050	456	456	13,171
2051	452	452	13,623

Total net carbon stock change in the project area	
$\Delta CBSLPA_{t}$	$\Delta CBSLPA$
annual	cumulative
tCO_2e	tCO_2e
4,794	4,794
4,823	9,617
4,852	14,468
4,880	19,349
4,909	24,258
4,938	29,196
4,487	33,683
4,513	38,197
4,539	42,736
4,565	47,301
4,497	51,798
4,494	56,292
4,060	60,352
4,054	64,406
4,049	68,455
4,043	72,498
4,047	76,545
4,045	80,590
3,654	84,244
3,649	87,893
3,644	91,537
3,639	95,176
3,643	98,818
3,640	102,458
3,288	105,747
3,284	109,031
3,280	112,310
3,275	115,585
3,278	118,864
3,276	122,140

Table 30. Baseline carbon stock change in the leakage belt

Carbon stock change in the above-ground biomass per initial forest class *icl*		Total carbon stock change in the above-ground biomass of initial forest class in the leakage belt	
ID_{cl}	1	$\Delta CabBSLLK_{icl,t}$	$\Delta CabBSLLK_{icl}$
Name	Forest	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e
2022	1,312	1,312	1,312
2023	1,312	1,312	2,624
2024	1,312	1,312	3,936
2025	1,312	1,312	5,248
2026	1,312	1,312	6,560
2027	1,312	1,312	7,872
2028	1,181	1,181	9,052
2029	1,181	1,181	10,233
2030	1,181	1,181	11,414
2031	1,181	1,181	12,595
2032	1,181	1,181	13,775
2033	1,181	1,181	14,956
2034	1,063	1,063	16,019
2035	1,063	1,063	17,081
2036	1,063	1,063	18,144
2037	1,063	1,063	19,207
2038	1,063	1,063	20,269
2039	1,063	1,063	21,332
2040	956	956	22,288
2041	956	956	23,245
2042	956	956	24,201
2043	956	956	25,158
2044	956	956	26,114
2045	956	956	27,070
2046	861	861	27,931
2047	861	861	28,792
2048	861	861	29,653
2049	861	861	30,514
2050	861	861	31,374
2051	861	861	32,235

Carbon stock change in the below-ground biomass per initial forest class *icl*		Total carbon stock change in the below-ground biomass of initial forest class in the leakage belt	
ID_{cl}	1	$\Delta CbbBSLLK_{icl,t}$	$\Delta CbbBSLLK_{icl}$
Name	Forest	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e
2022	26	26	26
2023	52	52	79
2024	79	79	157
2025	105	105	262
2026	131	131	394
2027	157	157	551
2028	181	181	732
2029	205	205	937
2030	228	228	1,165
2031	252	252	1,417
2032	249	249	1,666
2033	247	247	1,913
2034	242	242	2,154
2035	237	237	2,391
2036	232	232	2,623
2037	227	227	2,850
2038	224	224	3,074
2039	222	222	3,296
2040	217	217	3,513
2041	213	213	3,726
2042	209	209	3,935
2043	204	204	4,139
2044	202	202	4,341
2045	200	200	4,541
2046	196	196	4,736
2047	192	192	4,928
2048	188	188	5,116
2049	184	184	5,299
2050	182	182	5,481
2051	180	180	5,661

Carbon stock changes in above-ground biomass per post-deforestation zone z		Total carbon stock change of post deforestation zones in the leakage belt	
ID_{lz}	1	$\Delta CtotBSLLK_{z,t}$	$\Delta CtotBSLLK_{z}$
Name	Non-forest	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e
2022	0	0	0
2023	18	18	18
2024	36	36	55
2025	55	55	109
2026	73	73	182
2027	91	91	273
2028	109	109	382
2029	126	126	508
2030	142	142	650
2031	158	158	808
2032	175	175	983
2033	173	173	1,156
2034	171	171	1,327
2035	168	168	1,495
2036	164	164	1,659
2037	161	161	1,820
2038	157	157	1,977
2039	156	156	2,133
2040	154	154	2,287
2041	151	151	2,437
2042	148	148	2,585
2043	145	145	2,730
2044	142	142	2,871
2045	140	140	3,012
2046	139	139	3,150
2047	136	136	3,286
2048	133	133	3,419
2049	130	130	3,549
2050	127	127	3,676
2051	126	126	3,803

Total net carbon stock change in the leakage belt	
$\Delta CtotBSLLK_{t}$	$\Delta CtotBSLLK$
annual	cumulative
tCO_2e	tCO_2e
1,338	1,338
1,346	2,684
1,354	4,039
1,362	5,401
1,370	6,771
1,378	8,150
1,253	9,402
1,260	10,662
1,267	11,929
1,274	13,203
1,255	14,458
1,254	15,713
1,133	16,846
1,132	17,978
1,130	19,108
1,129	20,237
1,130	21,366
1,129	22,495
1,020	23,515
1,019	24,534
1,017	25,551
1,016	26,567
1,017	27,583
1,016	28,600
918	29,517
917	30,434
915	31,350
914	32,264
915	33,179
914	34,093

Baseline non-CO2 emissions from forest fires

As described in baseline scenario, slash-and-burn deforestation to clear the area is carried out for cattle ranching, which is the main cause of deforestation within the project area.

Therefore, baseline deforestation in the project area involves fire and all above ground biomass is burnt. It is worth mentioning that the effect of fire on CO2 emissions is counted in the estimation of carbon stock changes; therefore, CO2 emissions from biomass burning were ignored to avoid double counting. However, non-CO2 emissions (CH4 and N2O) from forest fires (EBBBSLPAt) were quantified and included as baseline emissions, as follows.

$$EBBtot_{icl,t} = EBBN_2O_{icl,t} + EBBCH_{4icl,t}$$

Where,

$EBBtot_{icl,t}$	Total GHG emission from biomass burning in forest class icl at year t; tCO_2e/ha
$EBBN_2O_{icl,t}$	N_2O emission from biomass burning in forest class icl at year t; tCO_2e/ha
$EBBCH_{4icl,t}$	CH_4 emission from biomass burning in forest class icl at year t; tCO_2e/ha

$$EBBN_2O_{icl,t} = EBBCO_{2icl,t} * 12/44 * NCR * ER_{N2O} * 44/28 * GWP_{N2O}$$

Where,

$EBBCO_{2icl,t}$	Per hectare CO_2 emission from biomass burning in slash and burn in forest class icl at year t; tCO_2e/ha
NCR	Nitrogen to Carbon Ratio (IPCC default value = 0.01); dimensionless
ER_{N2O}	Emission ratio for N_2O (IPCC default value = 0.007)
GWP_{N2O}	Global Warming Potential for N_2O (IPCC default value)[83]

$$EBBCH_{4icl,t} = EBBCO_{2icl,t} * 12/44 * ER_{CH4} * 16/12 * GWP_{CH4}$$

Where,

$EBBCO_{2icl,t}$	Per hectare CO_2 emission from biomass burning in slash and burn in forest class icl at year t; tCO_2e/ha
ER_{CH4}	Emission ratio for CH_4 (IPCC default value = 0.012)

83 According to the VCS Standard, the six Kyoto Protocol greenhouse gases and ozone-depleting substances shall be converted using 100 year global warming potentials derived from the IPCC's Fifth Assessment Report (GWP for N2O = 265).

GWP_{CH4}	Global Warming Potential for CH_4 (IPCC default value) [84]

$$EBBCO_{2icl,t} = Fburnt_{icl} * \sum_{p=1}^{P} (C_{picl,t} * Pburnt_{p,icl} * CE_{p,icl})$$

Where,

$EBBCO_{2icl,t}$	Per hectare CO_2 emission from biomass burning in the forest class icl at year t; tCO_2e/ha
$Fburnt_{icl}$	Proportion of forest area burned during the historical reference period in the forest class icl; %
$C_{picl,t}$	Average carbon stock per hectare in the carbon pool p burnt in the forest class icl at year t; tCO_2e/ha
$Pburnt_{p,icl}$	Average proportion of mass burnt in the carbon pool p in the forest class icl; %
$CE_{p,icl}$	Average combustion efficiency of the carbon pool p in the forest class icl; dimensionless (IPCC default of 0.5)
p	Carbon pool that could burn, above-ground biomass

The Fburnt analysis was carried out on the municipalities of the reference region, as it is where the Project Area is fully inserted in. Hot spots were considered during the period from historical reference period (prior to 2014, the data has no fire risk classification, and therefore, was not taken into account). For the assessed years, the fire risk predicted for the day of detection of the outbreak was considered, contemplating only outbreaks with a fire risk of >= 0.5 as, according to INPE's methodology, fire risk higher than 0.4 is considered as medium to critical (=1). By overlapping these fire outbreaks with the deforestation mapping of the same time period, it was possible to verify the tendency of fire outbreaks being directly related to areas with recent and/or consolidated deforestation. This can also be verified by the proximity of deforestation detection dates by satellite and the close or overlapping heat spots. Thus, it is possible to assume that these outbreaks are related to anthropic actions to open pastures/crops. Thereby, there was an overlap of 89.44% of the pixels analysed during the reference period where the project is located.

The Pburnt estimated using the average biomass per hectare that has commercial value and could be removed prior to clear cutting and burning. Based on literature, an average value of 61.6 m^3/ha was obtained, which would correspond to approximately 11% of the total biomass in 1 ha. In this way, the remaining is burned to clear the area, therefore, its new value is 88.6%.

However, due to the lack of literature estimates, a study from the Brazilian Amazon in the Cerrado vegetation was used for the comparison. This study reported that the total biomass consumed by

84 According to the VCS Standard, the six Kyoto Protocol greenhouse gases and ozone-depleting substances shall be converted using 100 year global warming potentials derived from the IPCC's Fifth Assessment Report (GWP for CH4 = 28).

fires varies from 72% to 84% (average 78%) in denser Cerrado types, which is a forest vegetation. The most conservative value between these two estimates were used, i.e., Pburnt was estimated as 78%.

It is important to note that slash and burn practices are commonly used in the Amazon region to clear the area for other land uses thus, when burning an area, the main objective is to completely remove all the remaining biomass. Therefore, assuming that 78% of the biomass is combusted, there would still be a 22% remaining biomass that shall be left to decompose, which also emits GHG to the atmosphere in this process.

Thus, the total actual non-CO_2 emissions from forest fire at year t in the project area at the baseline scenario ($EBBBSLPA_t$) were calculated as follows.

$$EBBBSLPA_t = ABSLPA_{icl,t} * EBBtot_{icl,t}$$

Where,

$EBBBSLPA_t$	Total actual non-CO_2 emissions from forest fire at year t in the project area in the baseline scenario; tCO_2e/ha
$ABSLPA_{icl,t}$	Annual area of deforestation of initial forest classes icl in the project area at year t; ha
$EBBtot_{icl,t}$	Total GHG emission from biomass burning in forest class icl at year t; tCO_2e/ha

Values of all estimated parameters are reported in the following table:

Table 31. Parameters used to calculate non-CO2 emissions from forest fires

Initial Forest Class		Parameters								
IDcl	Name	$Fburnt_{icl}$	Cab	$Pburnt_{ab,icl}$	$CE_{ab,icl}$	ECO2-ab	EBBCO2-tot	$EBBN2O_{icl}$	$EBBCH4_{icl}$	$EBBtot_{icl}$
		%	tCO2e/ha	%	%	tCO2e/ha	tCO2e/ha	tCO2e/ha	tCO2e/ha	tCO2e/ha
1	Forest	89%	375.83	78%	50%	131.10	131.10	1.17	14.30	15.47

Table 32. Baseline non-CO2 emissions from forest fires in the project area

Project year *t*	Emissions of non-CO_2 gasses from baseline forest fires		Total baseline non-CO_2 emissions from forest fires in the project area	
	ID_{cl} = 1 Forest		annual	cumulative
	$ABSLPA_{icl,t}$	$EBBBSLtot_{icl}$	$EBBBSLPA_t$	EBBBSLPA
	ha	tCO_2e/ha	tCO_2e	tCO_2e
2022	12.51	15.47	193.52	193.52
2023	12.51	15.47	193.52	387.03
2024	12.51	15.47	193.52	580.55
2025	12.51	15.47	193.52	774.06
2026	12.51	15.47	193.52	967.58
2027	12.51	15.47	193.52	1,161.09
2028	11.26	15.47	174.16	1,335.25
2029	11.26	15.47	174.16	1,509.42
2030	11.26	15.47	174.16	1,683.58
2031	11.26	15.47	174.16	1,857.74
2032	11.26	15.47	174.16	2,031.91
2033	11.26	15.47	174.16	2,206.07
2034	10.13	15.47	156.75	2,362.82
2035	10.13	15.47	156.75	2,519.57
2036	10.13	15.47	156.75	2,676.31
2037	10.13	15.47	156.75	2,833.06
2038	10.13	15.47	156.75	2,989.81
2039	10.13	15.47	156.75	3,146.55
2040	9.12	15.47	141.07	3,287.63
2041	9.12	15.47	141.07	3,428.70
2042	9.12	15.47	141.07	3,569.77
2043	9.12	15.47	141.07	3,710.84
2044	9.12	15.47	141.07	3,851.92
2045	9.12	15.47	141.07	3,992.99
2046	8.20	15.47	126.97	4,119.95
2047	8.20	15.47	126.97	4,246.92
2048	8.20	15.47	126.97	4,373.89
2049	8.20	15.47	126.97	4,500.85
2050	8.20	15.47	126.97	4,627.82
2051	8.20	15.47	126.97	4,754.78

4.2 Project Emissions

The present activity instance does not include planned deforestation and planned logging activities within the project area. In case future instances include Sustainable Forest Management Plan, the respective parameters and calculation must be included in this section.

Nevertheless, some unplanned deforestation may happen in the project area despite the implemented REDD project activity. The level at which deforestation will actually be reduced in the project case depends on the effectiveness of the proposed activities, which cannot be measured *ex ante*. *Ex post* measurements of the project results will be important to determine actual emission reductions.

To allow ex ante projections to be made, a conservative assumption was made about the effectiveness of the proposed project activities in order to define the Effectiveness Index (EI). The estimated value of EI is used to multiply the baseline projections by the factor (1 - EI) and the result was considered to be the *ex ante* estimated emissions from unplanned deforestation in the project case. This is calculated as follows:

$$\Delta CUDdPA_t = \Delta CBSLPA_t * (1 - EI)$$

Where,

$\Delta CUDdPA_t$	Total ex ante actual carbon stock change due to unavoided unplanned deforestation at year t in the project area; tCO_2e
$\Delta CBSLPA_t$	Total baseline carbon stock change in the project area at year t; tCO_2e
EI	*Ex ante* estimated Effectiveness Index; %
t	1, 2, 3 … T, a year of the proposed project crediting period; dimensionless

$$\Delta CPSPA_t = \Delta CPAdPA_t + \Delta CUDdPA_t - \Delta CPAiPA_t$$

Where,

$\Delta CPSPA_t$	Sum of ex ante estimated actual carbon stock changes in the project area at year t; tCO_2e
$\Delta CPAdPA_t$	Total decrease in carbon stock due to all planned activities at year t in the project area; tCO_2e
$\Delta CUDdPA_t$	Total ex ante actual carbon stock change due to unavoided unplanned deforestation at year t in the project area; tCO_2e
$\Delta CPAiPA_t$	Total increase in carbon stock due to all planned activities at year t in the project area; tCO_2e

Due to the importance of project activities, which is expected to generate improvements in the local economy and employment generation, the Effectiveness Index (EI) was conservatively assumed as 94.53%. This percentage was calculated based on the effectiveness of other VM0015 REDD projects located in Brazil in containing deforestation, comparing the project versus the baseline scenarios in verified monitoring reports.

It was then applied to the ex-ante estimate of net carbon stock change in the project area under the project scenario, shown in Table below.

Project year *t*	Total carbon stock decrease due to planned activities		Total carbon stock increase due to planned activities		Total carbon stock decrease due to unavoided unplanned deforestation		Total carbon stock change in the project case	
	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	$\Delta CPAdPA_t$	$\Delta CPAdPA$	$\Delta CPAiPA_t$	$\Delta CPAiPA$	$\Delta CUDdPA_t$	$\Delta CUDdPA$	$\Delta CPSPA_t$	$\Delta CPSPA$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2022	0.00	0.00	0.00	0.00	262.29	262.29	262.29	262.29
2023	0.00	0.00	0.00	0.00	263.86	526.15	263.86	526.15
2024	0.00	0.00	0.00	0.00	265.44	791.59	265.44	791.59
2025	0.00	0.00	0.00	0.00	267.01	1,058.60	267.01	1,058.60
2026	0.00	0.00	0.00	0.00	268.59	1,327.19	268.59	1,327.19
2027	0.00	0.00	0.00	0.00	270.16	1,597.35	270.16	1,597.35
2028	0.00	0.00	0.00	0.00	245.51	1,842.86	245.51	1,842.86
2029	0.00	0.00	0.00	0.00	246.93	2,089.78	246.93	2,089.78
2030	0.00	0.00	0.00	0.00	248.34	2,338.12	248.34	2,338.12
2031	0.00	0.00	0.00	0.00	249.76	2,587.88	249.76	2,587.88
2032	0.00	0.00	0.00	0.00	246.03	2,833.92	246.03	2,833.92
2033	0.00	0.00	0.00	0.00	245.88	3,079.80	245.88	3,079.80
2034	0.00	0.00	0.00	0.00	222.11	3,301.91	222.11	3,301.91
2035	0.00	0.00	0.00	0.00	221.81	3,523.73	221.81	3,523.73
2036	0.00	0.00	0.00	0.00	221.52	3,745.24	221.52	3,745.24
2037	0.00	0.00	0.00	0.00	221.22	3,966.46	221.22	3,966.46
2038	0.00	0.00	0.00	0.00	221.43	4,187.89	221.43	4,187.89
2039	0.00	0.00	0.00	0.00	221.29	4,409.18	221.29	4,409.18
2040	0.00	0.00	0.00	0.00	199.90	4,609.08	199.90	4,609.08
2041	0.00	0.00	0.00	0.00	199.63	4,808.71	199.63	4,808.71
2042	0.00	0.00	0.00	0.00	199.36	5,008.08	199.36	5,008.08
2043	0.00	0.00	0.00	0.00	199.09	5,207.17	199.09	5,207.17
2044	0.00	0.00	0.00	0.00	199.29	5,406.46	199.29	5,406.46
2045	0.00	0.00	0.00	0.00	199.16	5,605.62	199.16	5,605.62
2046	0.00	0.00	0.00	0.00	179.91	5,785.54	179.91	5,785.54
2047	0.00	0.00	0.00	0.00	179.67	5,965.21	179.67	5,965.21
2048	0.00	0.00	0.00	0.00	179.43	6,144.63	179.43	6,144.63
2049	0.00	0.00	0.00	0.00	179.19	6,323.82	179.19	6,323.82
2050	0.00	0.00	0.00	0.00	179.36	6,503.18	179.36	6,503.18
2051	0.00	0.00	0.00	0.00	179.24	6,682.42	179.24	6,682.42

As forest fires were included in the baseline scenario, non-CO_2 emissions from biomass burning should also be included in the project scenario. This is done by multiplying the baseline emissions by the factor (1 – EI), as follows.

$$EBBPSPA_t = EBBBSPA_t * (1 - EI)$$

Where,

$EBBPSPA_t$	Total *ex ante* actual non-CO_2 emissions from forest fire due to unavoided unplanned deforestationat at year t in the project area; tCO_2e/ha
$EBBBSPA_t$	Total non-CO_2 emissions from forest fire at year t in the project area; tCO_2e
EI	*Ex ante* estimated Effectiveness Index; %
t	1, 2, 3 … t, a year of the proposed project crediting period; dimensionless

Furthermore, it is conservatively assumed that all unplanned deforestation within the project area will involve fire and all above ground biomass will be burnt. It is worth mentioning that the effect of fire on CO_2 emissions is counted in the estimation of carbon stock changes in the parameter ΔCUDdPAt; therefore, CO_2 emissions from forest fires should be ignored to avoid double counting.

Table 33. Total ex ante estimated actual emissions of non-CO2 gasses due to forest fires in the project area

Project year *t*	Total ex ante estimated actual non-CO_2 emissions from forest fires in the Project area	
	$EBBPSPA_t$	EBBPSPA
	annual	cumulative
	tCO_2e	tCO_2e
2022	10.59	10.59
2023	10.59	21.17
2024	10.59	31.76
2025	10.59	42.35
2026	10.59	52.94
2027	10.59	63.52
2028	9.53	73.05
2029	9.53	82.58
2030	9.53	92.11
2031	9.53	101.64
2032	9.53	111.17
2033	9.53	120.70
2034	8.58	129.27
2035	8.58	137.85
2036	8.58	146.42
2037	8.58	155.00
2038	8.58	163.58
2039	8.58	172.15
2040	7.72	179.87
2041	7.72	187.59

2042	7.72	195.31
2043	7.72	203.02
2044	7.72	210.74
2045	7.72	218.46
2046	6.95	225.41
2047	6.95	232.35
2048	6.95	239.30
2049	6.95	246.25
2050	6.95	253.19
2051	6.95	260.14

Total *ex ante* estimations for the project area

The expected *ex ante* net carbon stock changes and non-CO_2 emissions in the Project area is summarized in the table below.

Table 34. Total ex ante estimated actual net carbon stock changes and emissions of non-CO2 gases in the project area

Project year *t*	Total *ex ante* carbon stock decrease due to planned activities		Total *ex ante* carbon stock increase due to planned activities		Total *ex ante* carbon stock decrease due to unavoided unplanned deforestation		Total *ex ante* carbon stock change		Total *ex ante* estimated actual non-CO_2 emissions from forest fires in the project area	
	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	$\Delta CPAdPA_t$	$\Delta CPAdPA$	$\Delta CPAiPA_t$	$\Delta CPAiPA$	$\Delta CUDdPA_t$	$\Delta CUDdPA$	$\Delta CPSPA_t$	$\Delta CPSPA$	$EBBPSPA_t$	$EBBPSPA$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2022	0.00	0.00	0.00	0.00	262.29	262.29	262.29	262.29	10.59	10.59
2023	0.00	0.00	0.00	0.00	263.86	526.15	263.86	526.15	10.59	21.17
2024	0.00	0.00	0.00	0.00	265.44	791.59	265.44	791.59	10.59	31.76
2025	0.00	0.00	0.00	0.00	267.01	1,058.60	267.01	1,058.60	10.59	42.35
2026	0.00	0.00	0.00	0.00	268.59	1,327.19	268.59	1,327.19	10.59	52.94
2027	0.00	0.00	0.00	0.00	270.16	1,597.35	270.16	1,597.35	10.59	63.52
2028	0.00	0.00	0.00	0.00	245.51	1,842.86	245.51	1,842.86	9.53	73.05
2029	0.00	0.00	0.00	0.00	246.93	2,089.78	246.93	2,089.78	9.53	82.58
2030	0.00	0.00	0.00	0.00	248.34	2,338.12	248.34	2,338.12	9.53	92.11
2031	0.00	0.00	0.00	0.00	249.76	2,587.88	249.76	2,587.88	9.53	101.64
2032	0.00	0.00	0.00	0.00	246.03	2,833.92	246.03	2,833.92	9.53	111.17
2033	0.00	0.00	0.00	0.00	245.88	3,079.80	245.88	3,079.80	9.53	120.70
2034	0.00	0.00	0.00	0.00	222.11	3,301.91	222.11	3,301.91	8.58	129.27
2035	0.00	0.00	0.00	0.00	221.81	3,523.73	221.81	3,523.73	8.58	137.85
2036	0.00	0.00	0.00	0.00	221.52	3,745.24	221.52	3,745.24	8.58	146.42
2037	0.00	0.00	0.00	0.00	221.22	3,966.46	221.22	3,966.46	8.58	155.00
2038	0.00	0.00	0.00	0.00	221.43	4,187.89	221.43	4,187.89	8.58	163.58
2039	0.00	0.00	0.00	0.00	221.29	4,409.18	221.29	4,409.18	8.58	172.15
2040	0.00	0.00	0.00	0.00	199.90	4,609.08	199.90	4,609.08	7.72	179.87
2041	0.00	0.00	0.00	0.00	199.63	4,808.71	199.63	4,808.71	7.72	187.59
2042	0.00	0.00	0.00	0.00	199.36	5,008.08	199.36	5,008.08	7.72	195.31
2043	0.00	0.00	0.00	0.00	199.09	5,207.17	199.09	5,207.17	7.72	203.02
2044	0.00	0.00	0.00	0.00	199.29	5,406.46	199.29	5,406.46	7.72	210.74
2045	0.00	0.00	0.00	0.00	199.16	5,605.62	199.16	5,605.62	7.72	218.46
2046	0.00	0.00	0.00	0.00	179.91	5,785.54	179.91	5,785.54	6.95	225.41
2047	0.00	0.00	0.00	0.00	179.67	5,965.21	179.67	5,965.21	6.95	232.35
2048	0.00	0.00	0.00	0.00	179.43	6,144.63	179.43	6,144.63	6.95	239.30
2049	0.00	0.00	0.00	0.00	179.19	6,323.82	179.19	6,323.82	6.95	246.25
2050	0.00	0.00	0.00	0.00	179.36	6,503.18	179.36	6,503.18	6.95	253.19
2051	0.00	0.00	0.00	0.00	179.24	6,682.42	179.24	6,682.42	6.95	260.14

4.3 Leakage

This step provides an *ex ante* estimate of the possible decrease in carbon stock and increase in GHG emissions (other than carbon stock change) due to leakage. According to the applied methodology, two sources of leakage are considered: a) decrease in carbon stocks and increase in GHG emissions associated with leakage prevention measures; and b) decrease in carbon stocks and increase in GHG emissions associated with activity displacement leakage.

***Ex ante* estimation of decrease in carbon stocks and increase in GHG emissions due to leakage prevention measures**

To reduce the risk of activity displacement leakage, baseline deforestation agents could participate in activities within the project area and leakage management area that together will replace baseline income, product generation and livelihood of the agents as much as possible, so that deforestation will be reduced, and the risk of displacement minimized. As such, a reduction in carbon stocks and/or an increase in GHG emissions may occur compared to the baseline case. If this decrease in carbon stock or increase in GHG emission is significant, it must be accounted, and ex post monitoring will be required.

Leakage prevention activities generating a decrease in carbon stocks should be estimated *ex ante* and accounted. In order to calculate the net carbon stock changes that the planned leakage prevention measures are expected to occasion during the project crediting period, the projected carbon stocks shall be estimated in the leakage management area under the baseline case and project scenario.

The following activities in leakage management areas could occasion a decrease in carbon stocks or an increase in GHG emissions:

- Carbon stock changes due to activities implemented in leakage management areas;
- Methane (CH_4) and nitrous oxide (N_2O) emissions from livestock intensification (involving a change in the animal diet and/or animal numbers).

$$\Delta CLPMLKt = \Delta CBSLLKt - \Delta CPSLKt$$

Where,

$\Delta CLPMLKt$	Carbon stock decrease due to leakage prevention measures at year t; tCO_2e
$\Delta CBSLLKt$	Annual carbon stock changes in leakage management areas in the baseline case at year t; tCO_2e
$\Delta CPSLKt$	Annual carbon stock change in leakage management areas in the project case; tCO_2e

If the net sum of carbon stock changes within a monitoring period is more than zero, leakage prevention measures are not causing any carbon stock decrease. The net increase shall conservatively be ignored in the calculation of net GHG emission reductions of the project activity. Nevertheless, if the net sum is negative, it must be accounted if significant.

According to the planned interventions proposed by present project activity, no decrease in carbon stocks and/or increase in GHG emissions due to activities implemented in the leakage management area were identified. The leakage prevention measures proposed by the present project do not include agricultural intensification, fertilization, fodder production and/or other measures to enhance cropland and grazing land areas. However, if such activities are

implemented in the future, changes in carbon stock will be monitored, and if significant, will be accounted. In addition, it is important to note that consumption of fossil fuels is considered insignificant in avoided unplanned deforestation project activities and shall not be considered

Therefore, the total *ex ante* estimated carbon stock changes and increases in GHG emissions due to leakage prevention measures are shown in the table below.

Table 35. Ex ante estimated net carbon stock change in leakage management areas

Project year	Total carbon stock change in the baseline case		Total carbon stock change in the project case		Net carbon stock change due to leakage prevention measures	
	annual	cumulatve	annual	cumulatve	annual	cumulatve
	$\Delta CBSLLK_t$	$\Delta CBSLLK$	$\Delta CPSLK_t$	$\Delta CPSLK$	$\Delta CLPMLK_t$	$\Delta CLPMLK$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2022	0.00	0.00	0.00	0.00	0.00	0.00
2023	0.00	0.00	0.00	0.00	0.00	0.00
2024	0.00	0.00	0.00	0.00	0.00	0.00
2025	0.00	0.00	0.00	0.00	0.00	0.00
2026	0.00	0.00	0.00	0.00	0.00	0.00
2027	0.00	0.00	0.00	0.00	0.00	0.00
2028	0.00	0.00	0.00	0.00	0.00	0.00
2029	0.00	0.00	0.00	0.00	0.00	0.00
2030	0.00	0.00	0.00	0.00	0.00	0.00
2031	0.00	0.00	0.00	0.00	0.00	0.00
2032	0.00	0.00	0.00	0.00	0.00	0.00
2033	0.00	0.00	0.00	0.00	0.00	0.00
2034	0.00	0.00	0.00	0.00	0.00	0.00
2035	0.00	0.00	0.00	0.00	0.00	0.00
2036	0.00	0.00	0.00	0.00	0.00	0.00
2037	0.00	0.00	0.00	0.00	0.00	0.00
2038	0.00	0.00	0.00	0.00	0.00	0.00
2039	0.00	0.00	0.00	0.00	0.00	0.00
2040	0.00	0.00	0.00	0.00	0.00	0.00
2041	0.00	0.00	0.00	0.00	0.00	0.00
2042	0.00	0.00	0.00	0.00	0.00	0.00
2043	0.00	0.00	0.00	0.00	0.00	0.00
2044	0.00	0.00	0.00	0.00	0.00	0.00
2045	0.00	0.00	0.00	0.00	0.00	0.00
2046	0.00	0.00	0.00	0.00	0.00	0.00
2047	0.00	0.00	0.00	0.00	0.00	0.00
2048	0.00	0.00	0.00	0.00	0.00	0.00
2049	0.00	0.00	0.00	0.00	0.00	0.00
2050	0.00	0.00	0.00	0.00	0.00	0.00
2051	0.00	0.00	0.00	0.00	0.00	0.00

No livestock agriculture increase resulting from activities developed by the 1st Instance is predicted to occur in the project scenario compared to the baseline case. However, in case any future instance includes any activity that might result in such increase, in order to estimate the increase in emissions of methane and nitrous oxide from grazing animals in leakage management areas, the GHG emissions are estimated as follows, according to Appendix 4 of the

applied Methodology and default values from 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4 – AFOLU, Chapter 10[85]:

$$EgLK_t = ECH_4ferm_t + ECH_4man_t + EN_2Oman_t$$

Where,

$EgLK_t$	Emissions from grazing animals in leakage management areas at year t; tCO_2e/year
ECH_4ferm_t	CH_4 emissions from enteric fermentation in leakage management areas at year t; tCO_2e/year
ECH_4man_t	CH_4 emissions from manure management in leakage management areas year t; tCO_2e/year
EN_2Oman_t	N_2O emissions from manure management in leakage management areas at year t; tCO_2e/year
t	1, 2, 3, … T years of the project crediting period; dimensionless

$$ELPMLK_t = EgLK_t + \Delta CLPMLK_t$$

Where,

$ELPMLK_t$	Annual total increase in GHG emissions due to leakage prevention measures at year t; tCO_2e

The leakage prevention measures proposed by the 1st instance project activity does not include agricultural intensification, fertilization, fodder production and/or other measures to enhance cropland and grazing land areas.

Table 36. Ex ante estimated total emissions above the baseline from leakage prevention activities

Project year	Carbon stock decrease due to leakage prevention measures		Total *ex ante* GHG emissions from increased grazing activities		Total *ex ante* increase in GHG emissions due to leakage prevention measures	
	annual	cumulative	annual	cumulative	annual	cumulative
	$\Delta CLPMLK_t$	$\Delta CLPMLK$	$EgLK_t$	$EgLK$	$ELPMLK_t$	$ELPMLK$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e

[85] Available at https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_10_Ch10_Livestock.pdf

2022	0.00	0.00	0.00	0.00	0.00	0.00
2023	0.00	0.00	0.00	0.00	0.00	0.00
2024	0.00	0.00	0.00	0.00	0.00	0.00
2025	0.00	0.00	0.00	0.00	0.00	0.00
2026	0.00	0.00	0.00	0.00	0.00	0.00
2027	0.00	0.00	0.00	0.00	0.00	0.00
2028	0.00	0.00	0.00	0.00	0.00	0.00
2029	0.00	0.00	0.00	0.00	0.00	0.00
2030	0.00	0.00	0.00	0.00	0.00	0.00
2031	0.00	0.00	0.00	0.00	0.00	0.00
2032	0.00	0.00	0.00	0.00	0.00	0.00
2033	0.00	0.00	0.00	0.00	0.00	0.00
2034	0.00	0.00	0.00	0.00	0.00	0.00
2035	0.00	0.00	0.00	0.00	0.00	0.00
2036	0.00	0.00	0.00	0.00	0.00	0.00
2037	0.00	0.00	0.00	0.00	0.00	0.00
2038	0.00	0.00	0.00	0.00	0.00	0.00
2039	0.00	0.00	0.00	0.00	0.00	0.00
2040	0.00	0.00	0.00	0.00	0.00	0.00
2041	0.00	0.00	0.00	0.00	0.00	0.00
2042	0.00	0.00	0.00	0.00	0.00	0.00
2043	0.00	0.00	0.00	0.00	0.00	0.00
2044	0.00	0.00	0.00	0.00	0.00	0.00
2045	0.00	0.00	0.00	0.00	0.00	0.00
2046	0.00	0.00	0.00	0.00	0.00	0.00
2047	0.00	0.00	0.00	0.00	0.00	0.00
2048	0.00	0.00	0.00	0.00	0.00	0.00
2049	0.00	0.00	0.00	0.00	0.00	0.00
2050	0.00	0.00	0.00	0.00	0.00	0.00
2051	0.00	0.00	0.00	0.00	0.00	0.00

***Ex ante* estimation of the decrease in carbon stocks and increase in GHG emissions due to activity displacement leakage**

Activities that will cause deforestation within the project area in the baseline case could be displaced outside the project boundary due to the implementation of the AUD project activity. A greater decrease in carbon stocks within the leakage belt during the project scenario than those predicted ex-ante would indicate displacement of deforestation activities due to the project.

The baseline rate of deforestation within the leakage belt is shown in the variable ABSLLK. The ex ante activity displacement leakage is calculated based on the anticipated combined effectiveness of the proposed leakage prevention measures and project activities. This is done by multiplying the estimated baseline carbon stock changes for the project area by a

"Displacement Leakage Factor" (DLF) representing the percent of deforestation expected to be displaced outside the project boundary. It is calculated as follows:

$$\Delta CADLK_t = \Delta CBSLPA_t * DLF$$

Where,

$\Delta CADLK_t$	Total decrease in carbon stocks due to displaced deforestation at year t; tCO_2e
DLF	Displacement leakage factor; %

As per the methodology, where leakage prevention activities are implemented, the factor shall be equal to the proportion of the baseline agents estimated to be given the opportunity to participate in leakage prevention activities and project activities.

To reduce the risk of activity displacement leakage, baseline deforestation agents mapped may participate in activities within the project area and leakage management area, so that deforestation will be reduced, and the risk of displacement minimized. This is monitored by social reports such as SOCIALCARBON report, which analyzes education and training programs, alternative income sources and the extent of social activities to local communities.

For this project, the default activity-shifting leakage deduction of 15 percent to the gross GHG emission reductions and/or removals was considered, as per VCS Standard.

Furthermore, the *ex ante* emissions from forest fires due to activity displacement leakage was calculated by multiplying baseline forest fire emissions in the project area by the same DLF[86] used to estimate the decrease in carbon stocks, as follows.

$$EADLKt_t = EBBBSPA_t * DLF$$

Where,

$EADLKt_t$	Total *ex ante* estimated increase in GHG emissions due to displaced forest fires; tCO_2e
$EBBBSPA_t$	Total non-CO_2 emissions from forest fire at year t in the project area; tCO_2e
DLF	Displacement leakage factor; %
t	1, 2, 3 … t, a year of the proposed project crediting period; dimensionless

The actual calculated values for ex ante estimated leakage due to activity displacement, annually and cumulatively, are shown in the table below:

[86] If deforestation agents do not participate in leakage prevention activities and project activities, the Displacement Factor shall be 100%. Where leakage prevention activities are implemented, the factor shall be equal to the proportion of the baseline agents estimated to be given the opportunity to participate in leakage prevention activities and project activities.

Table 37. Ex ante estimated leakage due to activity displacement

Project year	Total ex ante estimated decrease in carbon stocks due to displaced deforestation		Total ex ante estimated increase in GHG emissions due to displaced forest fires	
	annual	cumulative	annual	cumulative
	$\Delta CADLK_t$	$\Delta CADLK$	$EADLK_t$	$EADLK$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2022	719.10	719.10	29.03	29.03
2023	723.42	1,442.53	29.03	58.05
2024	727.74	2,170.27	29.03	87.08
2025	732.06	2,902.33	29.03	116.11
2026	736.38	3,638.70	29.03	145.14
2027	740.69	4,379.40	29.03	174.16
2028	673.10	5,052.50	26.12	200.29
2029	676.99	5,729.49	26.12	226.41
2030	680.87	6,410.36	26.12	252.54
2031	684.76	7,095.12	26.12	278.66
2032	674.55	7,769.67	26.12	304.79
2033	674.11	8,443.78	26.12	330.91
2034	608.96	9,052.75	23.51	354.42
2035	608.14	9,660.89	23.51	377.93
2036	607.32	10,268.21	23.51	401.45
2037	606.50	10,874.71	23.51	424.96
2038	607.09	11,481.80	23.51	448.47
2039	606.70	12,088.51	23.51	471.98
2040	548.07	12,636.57	21.16	493.14
2041	547.33	13,183.90	21.16	514.30
2042	546.59	13,730.49	21.16	535.47
2043	545.85	14,276.34	21.16	556.63
2044	546.38	14,822.73	21.16	577.79
2045	546.03	15,368.76	21.16	598.95
2046	493.26	15,862.02	19.04	617.99
2047	492.60	16,354.61	19.04	637.04
2048	491.93	16,846.55	19.04	656.08
2049	491.27	17,337.81	19.04	675.13
2050	491.74	17,829.56	19.04	694.17
2051	491.43	18,320.99	19.04	713.22

***Ex ante* estimation of total leakage**

The result of all sources of leakage is calculated as follows:

$$\Delta CLKt = \Delta CADLKt + \Delta CLPMLKt$$

Where,

$\Delta CLKt$ Total decrease in carbon stocks within the leakage belt at year t; tCO_2e

$\Delta CADLKt$ Total decrease in carbon stocks due to displaced deforestation at year t; tCO_2e

$\Delta CLPMLK_t$	Carbon stock decrease due to leakage prevention measures at year t; tCO_2e

To reduce the risk of activity displacement leakage, baseline deforestation agents shall participate in activities within the project area and leakage management area, so that deforestation will be reduced, and the risk of displacement minimized.

If leakage prevention activities include measures to enhance cropland and grazing land areas, a reduction in carbon stocks and/or an increase in GHG emissions may occur compared to the baseline case. The reduction in carbon stocks ($\Delta CLPMLK_t$) shall be calculated as explained above. However, leakage emissions due to leakage prevention measures implemented by the project activity shall be calculated as follows:

$$ELK_t = EgLK_t + EADLK_t$$

Where,

ELK_t	Annual total increase in GHG emissions due to leakage prevention measures at year t; tCO_2e
$EgLK_t$	Emissions from grazing animals in leakage management areas at year t; tCO_2e
$EADLK_t$	Total *ex ante* increase in GHG emissions due to displaced forest fires at year t; tCO_2e

No displaced forest fires nor increase in GHG emissions due to activities implemented in the leakage management area are expected to occur, such as emissions from fertilizer or fuel use.

Table 38. Ex ante estimated total leakage

Project year	Total ex ante GHG emissions from increased grazing activities		Total ex ante increase in GHG emissions due to displaced forest fires		Total ex ante decrease in carbon stocks due to displaced deforestation		Carbon stock decrease due to leakage prevention measures		Total net carbon stock change due to leakage		Total net increase in emissions due to leakage	
	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	$EgLK_t$	EgLK	$EADLK_t$	EADLK	$\Delta CADLK_t$	ΔCADLK	$\Delta CLPMLK_t$	ΔCLPMLK	ΔCLK_t	ΔCLK	ELK_t	ELK
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2022	0.00	0.00	29.03	29.03	719.10	719.10	0.00	0.00	719.10	719.10	29.03	29.03
2023	0.00	0.00	29.03	58.05	723.42	1,442.53	0.00	0.00	723.42	1,442.53	29.03	58.05
2024	0.00	0.00	29.03	87.08	727.74	2,170.27	0.00	0.00	727.74	2,170.27	29.03	87.08
2025	0.00	0.00	29.03	116.11	732.06	2,902.33	0.00	0.00	732.06	2,902.33	29.03	116.11
2026	0.00	0.00	29.03	145.14	736.38	3,638.70	0.00	0.00	736.38	3,638.70	29.03	145.14
2027	0.00	0.00	29.03	174.16	740.69	4,379.40	0.00	0.00	740.69	4,379.40	29.03	174.16
2028	0.00	0.00	26.12	200.29	673.10	5,052.50	0.00	0.00	673.10	5,052.50	26.12	200.29
2029	0.00	0.00	26.12	226.41	676.99	5,729.49	0.00	0.00	676.99	5,729.49	26.12	226.41
2030	0.00	0.00	26.12	252.54	680.87	6,410.36	0.00	0.00	680.87	6,410.36	26.12	252.54
2031	0.00	0.00	26.12	278.66	684.76	7,095.12	0.00	0.00	684.76	7,095.12	26.12	278.66
2032	0.00	0.00	26.12	304.79	674.55	7,769.67	0.00	0.00	674.55	7,769.67	26.12	304.79
2033	0.00	0.00	26.12	330.91	674.11	8,443.78	0.00	0.00	674.11	8,443.78	26.12	330.91
2034	0.00	0.00	23.51	354.42	608.96	9,052.75	0.00	0.00	608.96	9,052.75	23.51	354.42
2035	0.00	0.00	23.51	377.93	608.14	9,660.89	0.00	0.00	608.14	9,660.89	23.51	377.93
2036	0.00	0.00	23.51	401.45	607.32	10,268.21	0.00	0.00	607.32	10,268.21	23.51	401.45
2037	0.00	0.00	23.51	424.96	606.50	10,874.71	0.00	0.00	606.50	10,874.71	23.51	424.96
2038	0.00	0.00	23.51	448.47	607.09	11,481.80	0.00	0.00	607.09	11,481.80	23.51	448.47
2039	0.00	0.00	23.51	471.98	606.70	12,088.51	0.00	0.00	606.70	12,088.51	23.51	471.98
2040	0.00	0.00	21.16	493.14	548.07	12,636.57	0.00	0.00	548.07	12,636.57	21.16	493.14
2041	0.00	0.00	21.16	514.30	547.33	13,183.90	0.00	0.00	547.33	13,183.90	21.16	514.30
2042	0.00	0.00	21.16	535.47	546.59	13,730.49	0.00	0.00	546.59	13,730.49	21.16	535.47
2043	0.00	0.00	21.16	556.63	545.85	14,276.34	0.00	0.00	545.85	14,276.34	21.16	556.63
2044	0.00	0.00	21.16	577.79	546.38	14,822.73	0.00	0.00	546.38	14,822.73	21.16	577.79
2045	0.00	0.00	21.16	598.95	546.03	15,368.76	0.00	0.00	546.03	15,368.76	21.16	598.95
2046	0.00	0.00	19.04	617.99	493.26	15,862.02	0.00	0.00	493.26	15,862.02	19.04	617.99
2047	0.00	0.00	19.04	637.04	492.60	16,354.61	0.00	0.00	492.60	16,354.61	19.04	637.04
2048	0.00	0.00	19.04	656.08	491.93	16,846.55	0.00	0.00	491.93	16,846.55	19.04	656.08
2049	0.00	0.00	19.04	675.13	491.27	17,337.81	0.00	0.00	491.27	17,337.81	19.04	675.13
2050	0.00	0.00	19.04	694.17	491.74	17,829.56	0.00	0.00	491.74	17,829.56	19.04	694.17
2051	0.00	0.00	19.04	713.22	491.43	18,320.99	0.00	0.00	491.43	18,320.99	19.04	713.22

4.4 Net GHG Emission Reductions and Removals

The net anthropogenic GHG emission reduction of the proposed AUD project activity is calculated as follows:

$$\Delta REDDt = (\Delta CBSLPAt + EBBBSLPAt) - (\Delta CPSPAt + EBBPSPAt) - (\Delta CLKt + ELKt)$$

Where:

ΔREDDt	Ex ante estimated net anthropogenic greenhouse gas emission reduction attributable to the AUD project activity at year t; tCO2e
ΔCBSLPAt	Sum of baseline carbon stock changes in the project area at year t; tCO2e
EBBBSLPAt	Sum of baseline emissions from biomass burning in the project area at year t; tCO2e
ΔCPSPAt	Sum of ex ante estimated actual carbon stock changes in the project area at year t; tCO2e Note: If ΔCPSPAt represents a net increase in carbon stocks, a negative sign before the absolute value of ΔCPSPAt shall be used. If ΔCPSPAt represents a net decrease, the positive sign shall be used.
EBBPSPAt	Sum of (ex ante estimated) actual emissions from biomass burning in the project area at year t; tCO2e
ΔCLKt	Sum of ex ante estimated leakage net carbon stock changes at year t; tCO2e Note: If the cumulative sum of ΔCLKt within a fixed baseline period is > 0, ΔCLKt shall be set to zero.
ELKt	Sum of ex ante estimated leakage emissions at year t; tCO2e
t	1, 2, 3 … t, a year of the proposed project crediting period; dimensionless.

The number of Verified Carbon Units (VCUs) to be generated through the proposed AUD project activity at each year is calculated as follows:

$$VCUt = \Delta REDDt - VBCt$$

$$VBCt = (\Delta CBSLPAt - \Delta CPSPAt) * RFt$$

Where:

VCUt	Number of Verified Carbon Units that can be traded at time t; t CO2e
ΔREDDt	Ex ante estimated net anthropogenic greenhouse gas emission reduction attributable to the AUD project activity at year t; tCO2e
VBCt	Number of Buffer Credits deposited in the VCS Buffer at time t; t CO2e
ΔCBSLPAt	Sum of baseline carbon stock changes in the project area at year t; tCO2e
ΔCPSPAt	Sum of ex ante estimated actual carbon stock changes in the project area at year t; tCO2e ha-1
RFt	Risk factor used to calculate VCS buffer credits; %

t	1, 2, 3 … T, a year of the proposed project crediting period; dimensionless.

The RFt was estimated using the most recent version of the VCS-approved AFOLU Non-Permanence Risk Tool and the resulting value was 15%.

The specific summary of GHG reductions and removals by this project activity is included in the table below, which includes estimates of GHG emissions reduction (REDDt), calculations of buffer and leakage, and the calculation of tradable Verified Carbon Units (VCUt).

The present REDD project is expected to avoid a predicted 290 ha of deforestation, equating to 100,918 tCO_2e in emissions reductions over the 30-year project lifetime, with an annual average of 3,364 tCO_2e.

Table 39. Ex ante estimated net anthropogenic GHG emission reductions (ΔREDDt) and Verified Carbon Units (VCUt)

Project year	Baseline carbon stock changes		Baseline GHG emissions from biomass burning		Ex ante project carbon stock changes		Ex ante project GHG emissions from biomass burning		Ex ante leakage carbon stock changes		Ex ante leakage GHG emissions		Ex ante net anthropogenic GHG emission reductions		Ex ante VCUs tradable		Ex ante buffer credits	
	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	$\Delta CBSLPA_t$	ΔCBSLPA	$EBBBSLPA_t$	EBBBSLPA	$\Delta CPSPA_t$	ΔCPSPA	$EBBPSPA_t$	EBBPSPA	ΔCLK_t	ΔCLK	ELK_t	ELK	$\Delta REDD_t$	ΔREDD	VCU_t	VCU	VBC_t	VBC
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2022	4,794	4,794	194	194	262	262	11	11	719	719	29	29	3,967	3,967	3,286	3,286	680	680
2023	4,823	9,617	194	387	264	526	11	21	723	1,443	29	58	3,989	7,956	3,305	6,591	684	1,364
2024	4,852	14,468	194	581	265	792	11	32	728	2,170	29	87	4,012	11,968	3,324	9,915	688	2,052
2025	4,880	19,349	194	774	267	1,059	11	42	732	2,902	29	116	4,035	16,004	3,343	13,258	692	2,744
2026	4,909	24,258	194	968	269	1,327	11	53	736	3,639	29	145	4,058	20,062	3,362	16,620	696	3,440
2027	4,938	29,196	194	1,161	270	1,597	11	64	741	4,379	29	174	4,081	24,143	3,380	20,000	700	4,140
2028	4,487	33,683	174	1,335	246	1,843	10	73	673	5,052	26	200	3,707	27,850	3,070	23,070	636	4,776
2029	4,513	38,197	174	1,509	247	2,090	10	83	677	5,729	26	226	3,728	31,578	3,087	26,157	640	5,416
2030	4,539	42,736	174	1,684	248	2,338	10	92	681	6,410	26	253	3,748	35,326	3,104	29,261	644	6,060
2031	4,565	47,301	174	1,858	250	2,588	10	102	685	7,095	26	279	3,769	39,095	3,121	32,382	647	6,707
2032	4,497	51,798	174	2,032	246	2,834	10	111	675	7,770	26	305	3,715	42,810	3,077	35,459	638	7,345
2033	4,494	56,292	174	2,206	246	3,080	10	121	674	8,444	26	331	3,713	46,523	3,075	38,534	637	7,982
2034	4,060	60,352	157	2,363	222	3,302	9	129	609	9,053	24	354	3,353	49,876	2,777	41,311	576	8,557
2035	4,054	64,406	157	2,520	222	3,524	9	138	608	9,661	24	378	3,349	53,225	2,774	44,085	575	9,132
2036	4,049	68,455	157	2,676	222	3,745	9	146	607	10,268	24	401	3,345	56,570	2,770	46,855	574	9,706
2037	4,043	72,498	157	2,833	221	3,966	9	155	607	10,875	24	425	3,340	59,910	2,766	49,621	573	10,280
2038	4,047	76,545	157	2,990	221	4,188	9	164	607	11,482	24	448	3,343	63,253	2,769	52,390	574	10,854
2039	4,045	80,590	157	3,147	221	4,409	9	172	607	12,089	24	472	3,341	66,595	2,767	55,157	574	11,427
2040	3,654	84,244	141	3,288	200	4,609	8	180	548	12,637	21	493	3,018	69,613	2,499	57,656	518	11,945
2041	3,649	87,893	141	3,429	200	4,809	8	188	547	13,184	21	514	3,014	72,627	2,496	60,152	517	12,463
2042	3,644	91,537	141	3,570	199	5,008	8	195	547	13,730	21	535	3,010	75,637	2,493	62,645	517	12,979
2043	3,639	95,176	141	3,711	199	5,207	8	203	546	14,276	21	557	3,006	78,643	2,490	65,135	516	13,495
2044	3,643	98,818	141	3,852	199	5,406	8	211	546	14,823	21	578	3,009	81,652	2,492	67,627	516	14,012
2045	3,640	102,458	141	3,993	199	5,606	8	218	546	15,369	21	599	3,007	84,660	2,491	70,118	516	14,528
2046	3,288	105,747	127	4,120	180	5,786	7	225	493	15,862	19	618	2,716	87,376	2,249	72,367	466	14,994
2047	3,284	109,031	127	4,247	180	5,965	7	232	493	16,355	19	637	2,713	90,088	2,247	74,614	466	15,460
2048	3,280	112,310	127	4,374	179	6,145	7	239	492	16,847	19	656	2,709	92,798	2,244	76,858	465	15,925
2049	3,275	115,585	127	4,501	179	6,324	7	246	491	17,338	19	675	2,706	95,503	2,241	79,099	464	16,389
2050	3,278	118,864	127	4,628	179	6,503	7	253	492	17,830	19	694	2,708	98,211	2,243	81,342	465	16,854
2051	3,276	122,140	127	4,755	179	6,682	7	260	491	18,321	19	713	2,706	100,918	2,241	83,583	465	17,319

Table 40. Summary of net GHG Emission Reductions and Removals

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	*Ex ante* buffer credits (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
2022	4,988	273	748	680	3,286
2023	5,016	274	752	684	3,305
2024	5,045	276	757	688	3,324
2025	5,074	278	761	692	3,343
2026	5,103	279	765	696	3,362
2027	5,131	281	770	700	3,380
2028	4,662	255	699	636	3,070
2029	4,687	256	703	640	3,087
2030	4,713	258	707	644	3,104
2031	4,739	259	711	647	3,121
2032	4,671	256	701	638	3,077
2033	4,668	255	700	637	3,075
2034	4,217	231	632	576	2,777
2035	4,211	230	632	575	2,774
2036	4,206	230	631	574	2,770
2037	4,200	230	630	573	2,766
2038	4,204	230	631	574	2,769
2039	4,201	230	630	574	2,767
2040	3,795	208	569	518	2,499
2041	3,790	207	568	517	2,496
2042	3,785	207	568	517	2,493
2043	3,780	207	567	516	2,490
2044	3,784	207	568	516	2,492
2045	3,781	207	567	516	2,491
2046	3,415	187	512	466	2,249
2047	3,411	187	512	466	2,247
2048	3,407	186	511	465	2,244
2049	3,402	186	510	464	2,241
2050	3,405	186	511	465	2,243
2051	3,403	186	510	465	2,241
Total	**126,895**	**6,943**	**19,034**	**17,319**	**83,583**

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	CF
Data unit	tC/tdm
Description	Default value of carbon fraction in biomass
Source of data	Values from the literature, e.g. IPCC 2003. Good practice guidance for land use, land-use change and forestry. Kanagawa: IGES, 2003. Available at: <http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.html>.
Value applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	The default IPCC value was used.
Purpose of Data	This parameter is used to calculate the baseline, project and leakage emissions from deforestation occurred in the baseline and project scenarios. Provides an estimate of the carbon content of the vegetation biomass within the project reference region.
Comments	If new and more accurate carbon fraction data become available, these can be used to estimate the net anthropogenic GHG emission reduction of the subsequent fixed baseline period.

Data / Parameter	$Ctot_{fcl}$
Data unit	tCO_2e/ha
Description	Average carbon stock per hectare in anthropic areas in equilibrium of post-deforestation class fcl in tCO_2e/ha
Source of data	Long-term average carbon stocks per hectare of post-deforestation LU/LC classes present in the reference region were taken from the following study: FEARNSIDE, Philip M. Amazonian deforestation and global warming: carbon stocks in vegetation

	replacing Brazil's Amazon forest. **Forest Ecology And Management,** Manaus, v. 80, p.21-34, 1996.
Value applied	46.93
Justification of choice of data or description of measurement methods and procedures applied	Fearnside (1996) is one of the most recognized studies for the Brazilian Amazon about long term carbon stocks in deforested areas. Following a literature review, the use of Fearnside value for non-forest vegetation carbon stocks in equilibrium is conservative because it is based on several land-use types in the Amazon, including agriculture, pasturelands and secondary vegetation, reaching a final value of 46.93 tCO2/ha. Meanwhile, based on the Brazilian Government data available in the 3rd National GHG Inventory from 2019, the weighted average for carbon stocks in other land uses (mainly agriculture and pasturelands) was 32.99 tCO2e. Therefore, the most conservative value between these two data was used.
Purpose of Data	This parameter is used to calculate the baseline emissions from deforestation occurred in the baseline scenario. Provides an average of the post-deforestation carbon stock per hectare within the reference region.
Comments	If new and more accurate biomass stock data become available, these can be used to estimate the net anthropogenic GHG emission reduction of the subsequent fixed baseline period.

Data / Parameter	DLF
Data unit	%
Description	Displacement Leakage Factor
Source of data	According to VCS requirements, where the applied methodology requires the quantification of activity-shifting leakage, projects may apply the optional default activity-shifting leakage deduction of 15 percent to the gross GHG emission reductions and/or removals.
Value applied	15%
Justification of choice of data or description of measurement methods and procedures applied	The DLF was estimated as 15%, based on default value of the VCS requirements, where the applied methodology requires the quantification of activity-shifting leakage.
Purpose of Data	This parameter is used to calculate leakage emissions in the baseline scenario due to activity displacement leakage, providing

	an *ex ante* estimation of the decrease in carbon stocks and increase in GHG emissions. This value was calculated based on the percent of deforestation expected to be displaced outside the project boundary due to the implementation of the AUD project activity.
Comments	*Ex post* monitoring of the leakage belt will be done to determine deforestation rate outside the project area and the leakage emissions and carbon stock decrease. This parameter will be updated at each renewal of fixed baseline period.

Data / Parameter	$\Delta CBSLLK_t$
Data unit	tCO_2e
Description	Annual carbon stock changes in leakage management areas in the baseline case at year t
Source of data	- Planned interventions proposed by the project proponent. - Remote sensing and GIS.
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	Leakage prevention activities generating a decrease in carbon stocks should be estimated *ex ante* and accounted. The leakage prevention measures proposed by the present project do not include decrease in carbon stocks due to activities implemented in the leakage management area.
Purpose of Data	This parameter was used to calculate leakage emissions in the baseline scenario due to leakage prevention measures implemented in the leakage management area. It provides an *ex ante* estimation of the decrease in carbon stocks due to the activities implemented.
Comments	*Ex post* monitoring of the leakage management area will be done to determine the carbon stock decrease and the leakage emissions. This parameter will be updated at each renewal of fixed baseline period.

Data / Parameter	$EBBBSLPA_t$
Data unit	tCO_2e

Description	Sum of (or total) baseline non-CO2 emissions from forest fire at year t in the project area
Source of data	Remote sensing data and GIS, supervisor reports.
Value applied	158.00 (Annual average actual non-CO_2 emissions due to biomass burning within the project area during the crediting period)
Justification of choice of data or description of measurement methods and procedures applied	Slash-and-burn deforestation to clear the area is carried out for subsistence agriculture, which is the main cause of deforestation within the project area. Therefore, baseline deforestation in the project area involves fire and all above ground biomass is burnt. Non-CO_2 emissions from biomass burning are calculated according to requirements of methodology VM0015 v1.1. In order to estimate non-CO_2 emissions from forest fires, the average percentage of the area which contemplates the three municipalities within the RR that was cleared by burning for other land uses involving deforestation, such as cattle raising and farming (Fburnt), and the average of biomass that has commercial value, and could be removed prior to clear cutting and burning (Pburnt,p) were estimated, either for the baseline and project case. Baseline deforestation in the project area involves fire and all above ground biomass is burnt to clear the area. Therefore, this parameter is estimated as the multiplication of the annual area of deforestation of initial forest classes in the project area in the baseline scenario (ABSLPAicl,t) times the total GHG emission from biomass burning in initial forest classes (EBBtoticl,t).
Purpose of data	This parameter is used to calculate non-CO_2 emissions due to forest fires within the project area in the baseline scenario, providing an ex-ante estimation.
Comments	Ex post monitoring of forest fires and non-CO_2 emissions (EBBPSPAt) will be done to determine GHG emissions within the project area (when the forest fire was significant).

Data / Parameter	$Fburnt_{icl}$
Data unit	%
Description	Proportion of forest area burned during the historical reference period in the forest class.
Source of data	*Fburnt data source:* - Heat spots:

	Data from the municipalities within the reference region during the historical reference period. <https://queimadas.dgi.inpe.br/queimadas/bdqueimadas> - Deforestation: <http://terrabrasilis.dpi.inpe.br/downloads/>
Value applied	89.94
Justification of choice of data or description of measurement methods and procedures applied	The Fburnt analysis was carried out on the municipalities of the reference region, as it is where the Project Area is fully inserted in. Heat spots were considered during the historical reference period (prior to 2014, the data has no fire risk classification, and therefore, was not taken into account). For the assessed years, the fire risk predicted for the day of detection of the outbreak was considered, contemplating only outbreaks with a fire risk of >= 0.5 as, according to INPE's methodology, fire risk higher than 0.4 is considered as medium to critical (=1). By overlapping these fire outbreaks with the deforestation mapping of the same time period, it was possible to verify the tendency of fire outbreaks being directly related to areas with recent and/or consolidated deforestation. This can also be verified by the proximity of deforestation detection dates by satellite and the close or overlapping heat spots. Thus, it is possible to assume that these outbreaks are related to anthropic actions to open pastures/crops. Thereby, there was an overlap of 89.94% of the pixels analysed during the reference period in the municipalities.
Purpose of data	This parameter is the average percentage of the area which contemplates the three municipalities within the reference region that was cleared by burning for other land uses involving deforestation, such as cattle raising and farming, and is used to calculate baseline and project non-CO_2 emissions from forest fire at year t in the project area (parameter EBBBSLPAt).
Comments	Monitoring is done only once at project start.

Data / Parameter	$Pburnt_{p,icl}$
Data unit	%
Description	Average proportion of mass burnt in the carbon pool in the forest class
Source of data	Measured or estimated from literature. *Pburnt data source:*

	Anderson LO, Aragão LE, Gloor M, et al. **Disentangling the contribution of multiple land covers to fire-mediated carbon emissions in Amazonia during the 2010 drought.** Global Biogeochem Cycles. 2015; 29 (10):1739-1753. Doi: 10.1002/2014GB005008. Available at <https://agupubs.onlinelibrary.wiley.com/doi/10.1002/2014GB005008>.
Value applied	78
Justification of choice of data or description of measurement methods and procedures applied	Pburnt was estimated using the average biomass per hectare that has commercial value and could be removed prior to clear cutting and burning. Based on literature, an average value of 61.6 m^3/ha was obtained, which would correspond to approximately 11% of the total biomass in 1 ha. In this way, the remaining is burned to clear the area, therefore, its new value is 88.6%. However, due to the lack of literature estimates, a study from the Brazilian Amazon in the Cerrado vegetation was used for the comparison. This study reported that the total biomass consumed by fires varies from 72% to 84% (average 78%) in denser Cerrado types, which is a forest vegetation. The most conservative value between these two estimates were used, i.e., Pburnt was estimated as 78%. It is important to note that slash and burn practices are commonly used in the Amazon region to clear the area for other land uses thus, when burning an area, the main objective is to completely remove all the remaining biomass. Therefore, assuming that 78% of the biomass is combusted, there would still be a 22% remaining biomass that shall be left to decompose, which also emits GHG to the atmosphere in this process.
Purpose of data	This parameter is the average of biomass that has commercial value, and could be removed prior to clear cutting and burning, and is used to calculate baseline and project non-CO_2 emissions from forest fire at year t in the project area (parameter EBBBSLPAt).
Comments	Monitoring is done only once at project start.

Data / Parameter	EI
Data unit	%
Description	*Ex ante* estimated effectiveness index

Source of data	Estimate from project proponent based on verified reports of similar VM0015 REDD projects in Brazil up to date. Available in VERRA database.
Value applied	94.53%
Justification of choice of data or description of measurement methods and procedures applied	Based on the comparison between *ex post* and *ex ante* deforestation of similar REDD projects developed in Brazil, available in verified reports in VERRA database up to date.
Purpose of Data	This parameter is used to calculate project emissions in the baseline scenario. Provides an *ex ante* estimation of the carbon stock changes due to unavoidable unplanned deforestation within the project area, based on the effectiveness of the proposed project activities to reduce the deforestation.
Comments	*Ex post* monitoring of the project area will be done to determine deforestation rate and the project emissions. This parameter will be updated at each renewal of fixed baseline period.

5.2 Data and Parameters Monitored

Data / Parameter	ab_{icl}
Data unit	Mg/ha
Description	Average biomass stock per hectare in the above-ground biomass pool of initial forest class icl in Mg/ha.
Source of data	Average values for the above-ground biomass were taken from the following study: Rovai Andre S., Twilley Robert R., Worthington Thomas A., Riul Pablo. **Brazilian Mangroves: Blue Carbon Hotspots of National and Global Relevance to Natural Climate Solutions.** Available at https://www.frontiersin.org/articles/10.3389/ffgc.2021.787533
Description of measurement methods and procedures to be applied	The following sources will be monitored: - Biomass stock surveys - Periodic reports from area supervisor - Local Forest Inventories
Frequency of monitoring/recording	At each monitoring report.

Value applied	Above-ground biomass ab_{icl} (Mg/ha) Forest class: Forest; Reference Region: 375.83; Project Area: 205.00; Leakage Belt: 205.00
Monitoring equipment	No monitoring equipment is used to determine this parameter.
QA/QC procedures to be applied	Data shall be in accordance to VM0015 v1.1 requirements
Purpose of data	This parameter is used to calculate baseline emissions, project emissions and leakage emissions in both baseline and project scenarios.
Calculation method	Following a literature search the above-ground biomass values of these studies were used as they were determined to accurately represent the values of vegetation within the project reference region.
Comments	The values will be reassessed every 6 years or when data is more than 6 years old, whichever occurs first.

Data / Parameter	bb_{icl}
Data unit	Mg/ha
Description	Average biomass stock per hectare in the below-ground biomass pool of initial forest class icl in Mg/ha.
Source of data	Average values for the below-ground biomass were taken from the applied methodology VM0015 v1.1, which estimates a root-to-shoot ratio of 0.24 for tropical rainforest having above ground biomass values above 125 tons/ha, and 0.20 for values below 125 tons/ha.
Description of measurement methods and procedures to be applied	The following sources will be monitored: - Biomass stock surveys - Periodic reports from area supervisor - Local Forest Inventories
Frequency of monitoring/recording	At each monitoring report.
Value applied	Below-ground biomass

	bb_{icl} (Mg/ha)			
	Forest class	Reference Region	Project Area	Leakage Belt
	Forest	90.20	41.00	41.00
Monitoring equipment	No monitoring equipment is used to determine this parameter.			
QA/QC procedures to be applied	Data shall be in accordance to VM0015 v1.1 requirements			
Purpose of data	This parameter is used to calculate baseline, project and leakage emissions in the baseline and project scenarios.			
Calculation method	Calculation according to the applied methodology VM0015 v1.1, which estimates a root-to-shoot ratio of 0.24 for tropical rainforest having above ground biomass values above 125 tons/ha, and 0.20 for values below 125 tons/ha.			
Comments	The values will be reassessed every 6 years or when data is more than 6 years old, whichever occurs first.			
Data / Parameter	ACPAt			
Data unit	Ha			
Description	Annual area within the Project Area affected by catastrophic events at year t.			
Source of data	- Remote sensing data and GIS, - Forest management team and other field data.			
Description of measurement methods and procedures to be applied	In addition to field data from the management team, he following sources will also be monitored: - INMET[87] - INPE[88]			
Frequency of monitoring/recording	At each time a catastrophic event occurs.			
Value applied	The value will be calculated ex-post at each time a catastrophic event occurs, when significant.			
Monitoring equipment	Remote sensing and GIS			
QA/QC procedures to be applied	Best practices in remote sensing and GIS. Furthermore, the following sources will be also monitored to confirm the data obtained from remote sensing and GIS:			

[87] INMET. Instituto Nacional de Meteorologia. Available at: <https://portal.inmet.gov.br/>.
[88] INPE. Instituto Nacional de Pesquisas Espaciais. Available at: <http://www.inpe.br/>.

	- INMET - INPE - Field data from the management team
Purpose of data	This parameter is used to calculate project emissions in the project scenario. Provides an ex post estimation of the area affected by catastrophic events within the project area.
Calculation method	Remote sensing and GIS
Comments	Decreases in carbon stocks and increases in GHG emissions (e.g. in case of forest fires) due to natural disturbances (such as hurricanes, earthquakes, volcanic eruptions, tsunamis, flooding, drought, fires, tornados or winter storms) or man-made events, including those over which the project proponent has no control (such as acts of terrorism or war), are subject to monitoring and must be accounted under the project scenario, when significant.

Data / Parameter	$ABSLLK_t$
Data unit	Ha
Description	Annual area of deforestation within the leakage belt at year t.
Source of data	Remote sensing and GIS.
Description of measurement methods and procedures to be applied	Deforestation in the leakage belt area may be considered activity displacement leakage. Activity data for the leakage belt area will be determined using the same methods applied to monitoring deforestation activity data in the project area.
Frequency of monitoring/recording	Annually
Value applied	2.86 (annual average deforestation projected in the leakage belt during the crediting period).
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing.
Purpose of data	This parameter is used to calculate leakage emissions in the project scenario. Provides the *ex post* value of the deforested area within the leakage belt.
Calculation method	Analysis of satellite images and maps.

Comments	Where strong evidence can be collected that deforestation in the leakage belt is attributable to deforestation agents that are not linked to the project area, the detected deforestation will not be attributed to the project activity, thus not considered leakage.

Data / Parameter	ABSLPAt
Data unit	Ha
Description	Annual area of deforestation in the project area at year t
Source of data	Remote sensing and GIS
Description of measurement methods and procedures to be applied	Forest cover change due to deforestation will be monitored through periodic assessment of classified satellite imagery covering the project area.
Frequency of monitoring/recording	Annually
Value applied	10.24 (annual average projected deforestation in the project area during the crediting period).
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing.
Purpose of data	This parameter will be used to calculate baseline emissions and project emissions in both baseline and project scenarios. Provides the ex ante and ex post values of the deforested area per forest class within the project area.
Calculation method	Analysis of satellite images and maps.
Comments	N/A

Data / Parameter	$ABSLRR_t$
Data unit	Ha
Description	Annual area of deforestation in the reference region at year t

Source of data	Remote sensing and GIS
Description of measurement methods and procedures to be applied	Forest cover change due to deforestation will be monitored through periodic assessment of classified satellite imagery covering the reference region.
Frequency of monitoring/recording	Annually
Value applied	169.62 (annual average projected deforestation within the reference region during the crediting period).
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing.
Purpose of data	This parameter will be used to calculate baseline emissions and project emissions in both baseline and project scenarios. Provides the *ex ante* and *ex post* values of the deforested area per forest class within the reference region.
Calculation method	Analysis of satellite images and maps.
Comments	N/A

Data / Parameter	$\Delta CADLK_t$
Data unit	tCO_2e
Description	Total decrease in carbon stocks due to displaced deforestation at year t
Source of data	Remote sensing and GIS.
Description of measurement methods and procedures to be applied	Deforestation in the leakage belt area may be considered activity displacement leakage. Activity data for the leakage belt area will be determined using the same methods applied to monitoring deforestation activity data in the project area.
Frequency of monitoring/recording	Annually
Value applied	610.70 (Annual average projected decrease in carbon stocks due to displaced deforestation in the leakage belt during the crediting period)

Monitoring equipment	Remote sensing and GIS.
QA/QC procedures to be applied	Best practices in remote sensing.
Purpose of data	This parameter will be used to calculate leakage emissions in the project scenario. Provides the *ex post* value of the decrease in carbon stocks due to displaced deforestation in the leakage belt.
Calculation method	Emissions from deforestation at each forest class are estimated by multiplying the detected area of forest loss by the average forest carbon stock per unit area.
Comments	Where evidence can be collected that deforestation in the leakage belt is attributable to deforestation agents that are not linked to the project area, the detected deforestation may not be attributed to the project activity and therefore, not considered leakage.

Data / Parameter	ΔCPAdPAt
Data unit	tCO2e
Description	Total decrease in carbon stock due to all planned activities at year t in the project area
Source of data	Documents, remote sensing and GIS.
Description of measurement methods and procedures to be applied	The planned activities in the project area that result in carbon stock decrease will be subject to monitoring, when significant.
Frequency of monitoring/recording	Annually
Value applied	0.00 (Annual average decrease in carbon stocks due to all planned activities within the project area during the crediting period)
Monitoring equipment	Remote sensing and GIS SFMP reports, including the post-harvesting annual report.
QA/QC procedures to be applied	- Best practices in remote sensing. - Internal procedures required by the SFMP and forest certification

Purpose of data	This parameter is used to calculate project emissions in the project scenario. Provides the ex post value of the decrease in carbon stocks due to planned activities in the project area.
Calculation method	This parameter is the sum of: carbon stock decrease due to planned deforestation, carbon stock decrease due to planned logging activities, and carbon stock decrease due to planned fuel-wood and charcoal activities.
Comments	N/A

Data / Parameter	$\Delta CPSLK_t$
Data unit	tCO_2e
Description	Total annual carbon stock change in leakage management areas in the project case at year t
Source of data	- Activities report related to leakage prevention measures - Field assessment - Remote sensing and GIS
Description of measurement methods and procedures to be applied	The planned activities in leakage management areas that result in carbon stock decrease will be subject to monitoring, when significant.
Frequency of monitoring/recording	Annually
Value applied	0
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing.
Purpose of data	This parameter will be used to calculate leakage emissions in the project scenario. Provides the *ex post* value of the change in carbon stocks due to leakage prevention measures in the leakage management area.
Calculation method	Emissions from deforestation are estimated by multiplying the detected area of forest loss by the average forest carbon stock per unit area.

Comments	The leakage prevention measures proposed by the present project do not include decrease in carbon stocks due to activities implemented in the leakage management area.

Data / Parameter	$\Delta CUDdPA_t$
Data unit	tCO_2e
Description	Total actual carbon stock change due to unavoided unplanned deforestation at year t in the project area
Source of data	- Remote sensing and GIS - Field reports.
Description of measurement methods and procedures to be applied	Forest cover change due to unplanned deforestation will be monitored through periodic assessment of classified satellite imagery covering the project area.
Frequency of monitoring/recording	Annually
Value applied	222.75 (Annual average decrease in carbon stocks due to unavoided unplanned deforestation within the project area during the crediting period)
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing.
Purpose of data	This parameter will be used to calculate project emissions in the project scenario. Provides the *ex post* value of the change in carbon stocks due to unavoided unplanned deforestation within the project area.
Calculation method	Emissions from deforestation at each forest class are estimated by multiplying the detected area of forest loss by the average forest carbon stock per unit area.
Comments	N/A

Data / Parameter	$EADLK_t$
Data unit	tCO_2e

Description	Total *ex post* increase in GHG emissions due to displaced forest fires at year t.
Source of data	Remote sensing data and GIS.
Description of measurement methods and procedures to be applied	Forest fires in the leakage belt area may be considered activity displacement leakage. GHG emissions due displaced forest fires will be subjected to monitoring, when significant.
Frequency of monitoring/recording	Annually
Value applied	23.77
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing and GIS.
Purpose of data	This parameter will be used to calculate leakage emissions in the baseline and project scenario. Provides the *ex post* value of the increase in GHG emissions due to displaced forest fires in the leakage belt.
Calculation method	GHG emissions from deforestation are estimated by multiplying the detected area of forest loss in the leakage belt times the average forest carbon stock per unit area.
Comments	Where strong evidence can be collected that deforestation in the leakage belt is attributable to deforestation agents that are not linked to the project area, the detected deforestation will not be attributed to the project activity, thus not considered leakage.

Data / Parameter	$EBBPSPA_t$
Data unit	tCO_2e
Description	Sum of (or total) of actual non-CO_2 emissions from forest fire at year t in the project area
Source of data	- Remote sensing data and GIS, - Forest management team and field data.
Description of measurement methods	If forest fires occur, these non-CO_2 emissions will be subject to monitoring and accounting, when significant.

and procedures to be applied	In addition to remote sensing data and GIS, which can identify the area affected by forest fire, the forest management team could also confirm the obtained data. No forest fire will be used by the project owner for conducting planned deforestation or timber harvesting activities. However, it is expected that some unplanned deforestation within the project area will occur during the crediting period, which conversion of forest to non-forest may involve fire. The effect of fire on carbon emissions is counted in the estimation of carbon stock changes in the parameter $\Delta CUDdPA_t$; therefore CO_2 emissions from forest fires were ignored to avoid double counting. However, non-CO_2 emissions (CH_4 and N_2O) from forest fires must be counted in the project scenario, when they are significant. In order to be conservative, it will be assumed that all unplanned deforestation within the project area will involve fire. Therefore, non-CO_2 emissions from forest fires will be quantified and deducted from emission reductions.
Frequency of monitoring/recording	Annually
Value applied	9.00 (annual average actual non-CO_2 emissions due to biomass burning within the project area during the crediting period)
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing and GIS.
Purpose of data	This parameter will be used to calculate *non-CO_2* emissions due to forest fires within the project area in the project scenario, providing an estimate of the *ex post* value for each vegetation type.
Calculation method	If forest fires occur, *non-CO_2* emissions from biomass burning will calculated according to requirements of methodology VM0015 v1.1. Therefore, this parameter will be calculated as the multiplication of the annual area of deforestation of initial forest classes in the project area in the project scenario times the total GHG emission from biomass burning in initial forest classes ($EBBtot_{icl,t}$), when significant.
Comments	N/A

Data / Parameter	$EBBtot_{icl,t}$
Data unit	tCO2e/ha
Description	Total GHG emission from biomass burning in forest class icl at year t
Source of data	Calculated according to methodology VM0015 v1.1.
Description of measurement methods and procedures to be applied	This parameter was calculated according to requirements and default values established by the VM0015 v1.1 methodology. In order to estimate non-CO_2 emissions from forest fires, the average percentage of the area which contemplates the three municipalities within the RR that was cleared by burning for other land uses involving deforestation, such as cattle raising and farming (Fburnt), and the average of biomass that has commercial value, and could be removed prior to clear cutting and burning (Pburnt,p) were estimated, either for the baseline and project case. These average percentage values are assumed to remain the same in the future, according to the applied methodology
Frequency of monitoring/recording	Annually
Value applied	15.47
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing and GIS.
Purpose of data	This parameter is used to calculate the baseline, project and leakage non-CO_2 emissions from biomass burning occurred in the baseline and project scenarios
Calculation method	This parameter was calculated according to requirements and default values established by the VM0015 v1.1 methodology.
Comments	GWP for CH_4 and N2O were obtained according to the most recent version of the VCS Standard.

Data / Parameter	$EgLK_t$
Data unit	tCO_2e
Description	Emissions from grazing animals in leakage management areas at year t.
Source of data	- Activities report related to leakage prevention measures - Field assessment

	- Remote sensing data and GIS.
Description of measurement methods and procedures to be applied	GHG emissions from grazing animals in the leakage management area (i.e. enteric fermentation or manure management) will be subjected to monitoring, when significant.
Frequency of monitoring/recording	Annually
Value applied	0
Monitoring equipment	Remote sensing and GIS Field assessment data
QA/QC procedures to be applied	Best practices in remote sensing and GIS.
Purpose of data	This parameter will be used to calculate GHG emissions from activities implemented in the leakage management area in the project scenario, providing an *ex post* value.
Calculation method	Described in the methodology VM0015 v1.1, section 8.1.2: *Ex ante* estimation of CH_4 and N_2O emissions from grazing animals.
Comments	The community living within the leakage management area practices grazing activities. Therefore, this shall be monitored during the crediting period. GWP for CH_4 and N2O were obtained according to the most recent version of the VCS Standard.

Data / Parameter	RF_t
Data unit	%
Description	Risk factor used to calculate VCS buffer credits
Source of data	- VCS Non-Permanence Risk Report – Amazon Bluecarbon Grouped REDD+ Project; - Remote sensing data and GIS; - SFMP data; - Literature data.
Description of measurement methods and procedures to be applied	All sources of data from the VCS Non-Permanence Risk Report will be used to measure the various risk factors.

Frequency of monitoring/recording	Annually
Value applied	15
Monitoring equipment	Remote sensing and GIS.
QA/QC procedures to be applied	Best practices in remote sensing and GIS. The VCS Non-Permanence Risk Report will be verified together with the monitoring report at each verification event.
Purpose of data	This parameter represents the non-permanence risk rating of the project, which was used to determine the number of buffer credits that shall be deposited into the AFOLU pooled buffer account.
Calculation method	This parameter was calculated using the last available version of the AFOLU Non-Permanence Risk Tool. All the risk factors described in the VCS Non-Permanence Risk Report will be assessed.
Comments	N/A

5.3 Monitoring Plan

This monitoring plan has been developed according to the VCS Methodology VM0015 version 1.1.

Organizational structure

According to the contract stipulated between Future Carbon and the landowner, the landowner is responsible for the costing and implementation and/or maintenance of the project's forest management and activities to reduce deforestation and degradation, surveillance, fire prevention, illegal extraction of wood, prevention of invasions, among others, implementation and maintenance of social and environmental activities to reduce leakage, decrease the risks of non-permanence of carbon and improve the results of SOCIALCARBON, or other Standard for the assessment of social and environmental co-benefits.

In addition, it is responsible for keeping all documentation required by the project in order, as well as project maintenance expenses; Execute, monitor and maintain in full operation the structure that authorizes and serves as the basis for the development of the Project, ensuring the reduction of deforestation and degradation, the implementation and maintenance of social and environmental activities (or designating and hiring third parties responsible for the activities).

The owner is responsible for establishing prospects in each Social Carbon report, as well as complying with at least 50% of the proposed actions, under penalty of losing the Social Carbon standard.

Future Carbon is responsible for the development of the project documents, assessment of the mapping files for application of the methodology, and internal auditing.

- **Revision of the baseline**

The current baseline is valid for 6 years. The baseline will be reassessed every 6 years, and it will be validated at the same time as the subsequent verification.

Technical description of the monitoring task

The baseline scenario will be monitored through the assessment of agents and drivers variables and satellite images to project expected deforestation. Information on agents, drivers and underlying causes of deforestation in the reference region will be collected at the end of each fixed baseline period, as these are essential for improving future deforestation projections and the design of the project activity. In addition, in the same frequency, the projected annual areas of baseline deforestation for the reference region will be revisited and eventually adjusted for the subsequent fixed baseline period.

The location of the projected baseline deforestation will be reassessed using the adjusted projections for annual areas of baseline deforestation and spatial data. All areas credited for avoided deforestation in past fixed baseline periods will be excluded from the revisited baseline projections as these areas cannot be credited again.

Baseline monitoring task will be done in accordance with the applied methodology, VM0015, version 1.1 or the most recent.

Data to be collected

Data will be collected to comply with the parameters used in the VM0015 v1.1, listed in Appendix 5, or the most recent.

Overview of data collection procedures

Data will be collected according to measurement methods and procedures described in section 5.1 and 5.2 above. All *ex ante* and *ex post* parameters will be reassessed at the moment of revision of the baseline.

Quality control and quality assurance procedures

QA/QC will be done according to best practices in remote sensing and as stated by VM0015 methodology.

Data archiving

All data sources and processing, classification and change detection procedures will be documented and stored in a dedicated long-term electronic archive maintained by the instance owner. Future Carbon will also keep a digital copy of all documents generated during the development of the VCS PD (first fixed baseline period) and the first monitoring period, as well as

further monitoring reports in case it participates in the development of subsequent monitoring periods in the future.

Given the extended time frame and the pace of production of updated versions of software and new hardware for storing data, electronic files will be updated periodically or converted to a format accessible to future software applications, as needed.

All maps and records generated during project implementation will be stored and made available to VVBs at verification for inspection. In addition, any data collected from ground-truth points (including GPS coordinates, identified land-use class, and supporting photographic evidence) will be recorded and archived.

Organization and responsibilities of the parties involved in all the above

Future Carbon is responsible for the development of the Project Design Document and the first Monitoring Report. Therefore, it is responsible for the organization and calculation of items related to the methodology.

The instance owner is responsible for the development of the project activity, monitoring of the required parameters in section 5.2 above, and for the development of subsequent monitoring reports. In addition, it is also responsible for forest surveillance and generation of socioenvironmental activities to local communities.

Future Carbon and/or a related partner is responsible for all GIS related information.

- **Monitoring of actual carbon stock changes and GHG emissions within the project area**
    - **Monitoring of project implementation**

The instance owner is responsible for the implementation of the project activity. The monitoring of the sustainable management plan is carried out by the municipal and state secretariats.

Information from the sustainable forest management plan and post-exploratory reports will be used to update parameters related to planned deforestation and will be verified during the validation and verification of the carbon project.

Updating Forest Carbon Stocks Estimates

If new and more accurate carbon stock data become available, these can be used to estimate the net anthropogenic GHG emission reduction, provided that these data are in accordance to the requirements established by the applied methodology VM0015. New data on carbon stocks will only be used if they are validated by an accredited VVB.

Methods for generating, recording, aggregating, collating and reporting data on monitored parameters

All data sources and processing, classification and change detection procedures will be documented and stored in a dedicated long-term electronic archive maintained by Future Carbon.

Future Carbon will also keep a digital copy of all documents generated during the development of the VCS PD (first fixed baseline period) and the subsequent baseline reports and monitoring periods.

Given the extended time frame and the pace of production of updated versions of software and new hardware for storing data, electronic files will be updated periodically or converted to a format accessible to future software applications, as needed.

All maps and records generated during project implementation will be stored and made available to VCS verifiers at verification for inspection. In addition, any data collected from ground-truth points (including GPS coordinates, identified land-use class, and supporting photographic evidence) will be recorded and archived.

Monitored data will be kept for two years after the end of the crediting period or the last issuance of carbon credits for this project activity, whichever occurs later. For this purpose, the authority for the registration, monitoring, measurement and reporting will be Future Carbon Ltda. Monitored parameters are described in Section 5.2 and will be monitored with the frequency described further below.

Quality Assurance/Quality Control

To ensure consistency and quality of results, spatial analysts carrying out the image processing, interpretation, and change detection procedures will strictly adhere to the steps detailed in the Methodology.

All of this reliable data, which will be collected and documented, will be used as a technical support tool for decision-making in order to improve project outcomes, and to adapt the project according to the current needs and realities. Project activities implemented within the project area must be consistent with the management plan of the PD.

The implementation of the project activity will be monitored by continuous monitoring activities using remote sensing techniques. Additionally, field studies will also be used. The land-use monitoring will be carried out with remote sensing methods, using images generated by Mapbiomas, INPE (PRODES)[89] and LANDSAT satellite images (or other available source accepted by the methodology), which will be subject to digital processing to perform the interpretation and classification of the land cover classes studied.

The management structure will also rely on the local community to help monitor the area. All the monitored parameters will be checked with the frequency detailed in the Section 5.2 above, as requested in the VCS Methodology VM0015, version 1.1.

[89] Available at: <http://www.obt.inpe.br/OBT/assuntos/programas/amazonia/prodes>

With the carbon credits income, in order to complement the monitoring of the project area and its surroundings, the project proponent intends to improve the remote sensing methods and data used, which meet the accuracy assessment requirements laid out in the methodology.

Procedures for handling internal auditing and non-conformities

The procedures for handling internal auditing and non-conformities are going to be established by both project developer and project proponent. All the necessary taskforce and procedures will be in place to meet the highest levels of control.

A project information quality management system will be implemented, the main purpose of which is to minimize the risk of error, obtaining reliable data on which to base the monitoring results, and thus, minimizing non-conformities. It includes the training of general staff in the different roles to play within the framework of the Amazon Bluecarbon Grouped REDD Project; In-field verification, which basically consists of monitoring the procedures set out in the methodological guidelines and review of the monitoring reports prior to its delivery to the VVB, in order to confirm that the calculations, analysis and the conclusions are accurate and measured. This work is in charge of Future Carbon.

If non-conformities exist during the internal or external auditing processes, the data should be reviewed, and the non-conformities addressed.

- **Monitoring of land-use and land-cover change within the project area**

Forest cover change due to unplanned deforestation is monitored through periodic assessment of classified satellite imagery covering the project area. Emissions from deforestation are estimated by multiplying the detected area of forest loss by the average forest carbon stock per unit area.

The project boundary, as set out in the PD, will serve as the initial “forest cover benchmark map” against which changes in forest cover will be assessed over the interval of the monitoring period.

The entire project area has been demonstrated to meet the forest definition at the beginning of the crediting period. For subsequent monitoring periods, change in forest cover will be assessed against the preceding classified forest cover map marking the beginning of the monitoring interval. The resulting classified image is compared with the preceding classified image (forest cover benchmark map marking the start of the monitoring interval) to detect forest cover change over the monitoring interval, and subsequently becomes the updated forest cover benchmark map for the next monitoring interval. Thus, the forest benchmark map is updated at each monitoring event.

The increase or decrease in carbon stocks due to planned activities in the project area will also be monitored through documents and periodic assessment of classified satellite imagery covering the project area. In case of planned deforestation, emissions are estimated by multiplying the area of forest loss by the average forest carbon stock per unit area.

The results of monitoring shall be reported by creating *ex post* tables of activity data per stratum; per initial forest class *icl*; and per post-deforestation zone *z*, for the reference region, project area and leakage belt.

In addition, a map showing Cumulative Areas Credited within the project area shall be updated and presented to VCS verifiers at each verification event. The cumulative area cannot generate additional VCUs in future periods.

Other applied methodologies for monitoring of deforestation are listed below:

Monitoring bases

The instance owner is responsible for the implementation of monitoring bases, if necessary, to guarantee the standing forest and carbon stock.

Satellite images and remote sensing monitoring

The land use and land use cover change will be analyzed through remote sensing methods, using data from INPE (PRODES – deforestation; Queimadas – fire monitoring; TerraClass – qualification of Amazon deforestation), satellite images (LANDSAT, Sentinel, CBRES).

All reliable data collected and documented will be used as a technical support tool for decision making in order to improve project outcomes, and to adapt the project according to the current needs and reality. These decisions will be made during periodic meetings to review the Action Plan, if applicable. On these occasions, the design of the Monitoring Plan will be analyzed according to its efficiency in generating reliable feedback and all the necessary information. If any changes in the Monitoring Plan or management actions are identified, a corrective action will be designed and implemented.

Security procedures

The instance owner is responsible for the security procedures and reporting illegal activity to responsible authorities.

These actions are planned to avoid unplanned deforestation and carbon stock changes in the area. Related parameters shall be monitored and reassessed at every verification and revalidation point.

SOCIALCARBON Report will also monitor the relationship between the company and the communities, and its evolution on mitigating unplanned deforestation caused by these agents.

- **Monitoring of carbon stock changes and non-CO2 emissions from fires**

In addition to the mentioned above, the instance owner is responsible for training monitoring, management, safety and health personnel. This may include periodic fire brigade training, including first aid, fire procedures, training of new monitoring personnel and those responsible for management during harvests.

If forest fires occur, these non-CO2 emissions will be subject to monitoring and accounting, when significant.

- **Monitoring of impacts of natural disturbances and other catastrophic events**

The monitoring of natural impacts and other catastrophic events is responsibility of the instance owner. The company must notify Future Carbon so that it can include the related impacts in the carbon project reports, updating the related parameters, including the buffer report. Where an event occurs that is likely to qualify as a loss event, the project proponent shall notify Verra within 30 days of discovering the likely loss event.

Decreases in carbon stocks and increases in GHG emissions (e.g. in case of forest fires) due to natural disturbances (such as hurricanes, earthquakes, flooding, drought, fires or storms) or man-made events, including those over which the project proponent has no control (such as acts of terrorism or war), are subject to monitoring, when significant. If the area (or a sub-set of it) affected by natural disturbances or man-made events generated VCUs in past verifications, the total net change in carbon stocks and GHG emissions in the area(s) that generated VCUs will be estimated, and an equivalent amount of VCUs will be cancelled from the VCS buffer. No VCUs can be issued for the project until all carbon stock losses and increases in GHG emissions have been offset.

- **Monitoring of Leakage**

Monitoring of the leakage belt and leakage management area will be carried out as in the project area and reference region.

The most recent VCS guidelines on this subject matter shall be applied. Furthermore, as the leakage belt was determined using Option 1 (Opportunity cost analysis), the boundary of the leakage belt will have to be reassessed at the end of each fixed baseline period using the same methodological approaches used in the previous period. The calculation procedure for estimating leakage emissions in the project scenario will be done by monitoring the following sources of leakage:

- Carbon stock changes and GHG emissions associated with leakage prevention activities.

The carbon stock decrease or increase in GHG emissions due to leakage prevention measures, which will probably take place inside the leakage management area, will be monitored through documents and field assessment. In areas undergoing carbon stock enhancement, the project conservatively assumes stable stocks and no biomass monitoring is conducted.

- Carbon stock decrease and increases in GHG emissions due to activity displacement leakage

Deforestation in the leakage belt area above the baseline may be considered activity displacement leakage. Activity data for the leakage belt area will be determined using the same methods applied to monitoring deforestation activity data in the project area. Leakage will be calculated by comparing the *ex ante* and the *ex post* assessment. However, where strong evidence can be collected that deforestation in the leakage belt is attributable to deforestation

agents that are not linked to the project area, the detected deforestation will not be attributed to the project activity, thus not considered leakage.

- **Organizational structure, responsibilities and competencies**

Monitoring will be done by the project proponent and outsourced to a third party having sufficient capacities to perform the monitoring tasks. To ensure the operation of the monitoring activities, the operational and managerial structure will be established according to the table below.

For all aspects of project monitoring, the project proponent will ensure that data collection, processing, analysis, management and archiving are conducted in accordance with the monitoring plan. The authority for the registration, monitoring, measurement and reporting will be Future Carbon.

Table 41. Type of Monitoring and Party Responsible

Variables to be monitored	Responsible	Frequency
Reassessment of the baseline	Future Carbon and external institutions qualified for the GIS analysis and monitoring	Every 6 years
Monitoring Deforestation and Project Emissions	Instance owner together with Future Carbon and external institutions qualified for the GIS analysis and monitoring	Prior to each verification
Monitoring of non-CO_2 emissions from forest fires	Instance owner together with Future Carbon and external institutions qualified for the GIS analysis and monitoring	Prior to each verification
Monitoring Leakage emissions	Instance owner together with Future Carbon and external institutions qualified for the GIS analysis and monitoring	Prior to each verification
Monitoring of Natural Disturbance and catastrophic events	Instance owner and Future Carbon	When a natural event occurs
Updating Forest Carbon Stocks Estimates	Future Carbon	At least, every 10 years, only if necessary.