# MAMURIÁ GROUPED REDD PROJECT

Document Prepared by Future Carbon

| | |
|---|---|
| **Project Title** | *Mamuriá Grouped REDD Project* |
| **Version** | *01* |
| **Date of Issue** | *10-January-2023* |
| **Prepared By** | *Future Carbon* |
| **Contact** | *Rua Elvira Ferraz, 250, Conjunto 601, Edifício F.L. Office, Vila Olímpia – São Paulo – SP, Brazil*<br>*Postal Code: 04552-040*<br>*forest@futurecarbon.com.br*<br>*https://www.futurecarbon.com.br/* |

# CONTENTS

# 1 PROJECT DETAILS

## 1.1 Summary Description of the Project

In Brazil, 58.39% of its entire 851,029,591.4 ha territory[1] is covered by forests, representing almost 497 million hectares of forest area[2] and putting it in second place for nations with most forest area worldwide. Brazil has also been at times the country with the highest levels of deforestation in the world, having lost almost 15 million hectares of its forest area from 2010 to 2020[3]. The expansion of the agriculture frontier due to cattle ranching, soy farming, timber collection, infrastructure and colonization by subsistence agriculturalists has contributed to this historically high deforestation rate, which is concentrated in the northern portion of the country, where the Amazon Rainforest lies.

The Mamuriá Grouped REDD Project has its properties located in the State of Acre, Brazil. Acre was one of the most isolated States in the country, however, the inauguration of the Abunã Bridge, built over the Madeira River, officially interconnected the State to the rest of Brazil's road network in May 2021[4]. Acre also registered high deforestation rates in 2021, with 889 km$^2$, behind only Pará (4,037 km$^2$), Amazonas (2,071 km$^2$), Mato Grosso (1,504 km$^2$) and Rondônia (1,290 km$^2$)[5].

The primary objective of the Mamuriá Grouped REDD Project is to Avoid the Unplanned Deforestation (AUD) within the 51,066.42 ha project area and Avoid Planned Deforestation (APD) of the 13,497.42 ha project area, consisting of 100% Amazon rainforest. The project area is located within 2 private properties, which are located in municipalities of Feijó, Manoel Urbano and Santa Rosa do Purus in the State of Acre.

It is expected that, with the carbon project, it will be possible to expand the monitoring of the area, hiring new professionals to work on the farms. 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 environmental awareness, generation of alternative sources of income and environmental education actions.

[1] IBGE – Instituto Brasileiro de Geografia e Estatística. Brazil. 2019. Available at: <https://www.ibge.gov.br/cidades-e-estados>.
[2] FAO and UNEP. 2020. The State of the World's Forests 2020. Forests, biodiversity and people. Rome. Available at: <https://doi.org/10.4060/ca8642en>.
[3] FAO. 2020. Global Forest Resources Assessment 2020: Main report. Rome. Available at: < https://doi.org/10.4060/ca9825en>.
[4] ESTADÃO - Available at: <Ponte integrou Acre à malha rodoviária brasileira em 2021, mas Estado já tinha estrada federal (estadao.com.br)>
[5] Available at:< Acre é o quinto estado com maior índice de desmatamento em 2021, diz relatório - (contilnetnoticias.com.br)>

The AUD REDD project is expected to avoid a predicted 6,807 ha of deforestation, equating to 679,673 $tCO_2e$ in emissions reductions over the 30-year project lifetime (07-October-2020 to 06-October-2020), with an annual average of 22,656 $tCO_2e$.

The APD REDD project is expected to avoid a predicted 13,497.42 ha of deforestation, equating to 2,749,747 $tCO_2e$ in emissions reductions over the 10-year project lifetime, with an annual average of 274,974.7 $tCO_2e$.

## 1.2 Sectoral Scope and Project Type

Sectoral Scope: 14 – Agriculture, Forestry, Land Use

Project Category: Avoided Unplanned Deforestation (AUD Project Activity) and Avoid Planned Deforestation (APD Project Activity).

This is a grouped project.

## 1.3 Project Eligibility

According to the VCS Methodology Requirements, v4[6], 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[7], Sections 3.1, 3.2 and Appendix A1.5 – A1.8:

| Eligibility Conditions | Mamuriá 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 Applicability of Methodology. |
| 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 | Applied methodologies are VM0015 - Methodology for Avoided Unplanned Deforestation, v1.1 and VM0007 - REDD+ Methodology Framework (REDD+MF) for Avoided Planned Deforestation, v1.6. Applicability conditions are detailed on section 3.2. |

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

| Eligibility Conditions | Mamuriá 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 Tropical Rainforest, including sustainable forest management plan or not. These activities are eligible under the Brazilian law according to conditions set out in section 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. Project applies VM0015 and VM0007 methodologies. |
| 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. Project applies the VM0015 and VM0007 methodologies, in addition to the VT0001 for Additionality assessment. |
| 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 | Not applicable. Project applies VM0015 and VM0007 methodologies, in addition to the VT0001 for Additionality assessment. |

| Eligibility Conditions | Mamuriá Grouped REDD Project Justification of Eligibility |
|---|---|
| performance method is applicable to the project). | |
| 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 approved VCS methodologies and tools. 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 approved VCS methodologies and tools. The project shall take precedence to the rules and requirements of the VCS Program over other approved GHG Program. |
| 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. | Project was designed under VCS Standard version 4.3, VM0015 version 1.1 and VM0007 version 1.6. Any new requirements shall be adhered to at project crediting period renewal (i.e six 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 | This is an eligible AFOLU project category under the VCS Program: Reduced Emissions from Deforestation and Degradation (REDD). |

| Eligibility Conditions | Mamuriá Grouped REDD Project Justification of Eligibility |
|---|---|
| (ACoGS), and wetland restoration and conservation (WRC). | |
| 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. |
| 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 in the project description and 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 land for a minimum of 10 years before the project start date. |

| Eligibility Conditions | Mamuriá Grouped REDD Project Justification of Eligibility |
|---|---|
| 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. |
| 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 and APDD project. |

| Eligibility Conditions | Mamuriá Grouped REDD Project Justification of Eligibility |
|---|---|
| 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 Requirements, in which case the project shall not be subject to the WRC requirements. | Not applicable. The project activity does not occur on wetlands. |
| 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 according to the VCS Program Document *AFOLU Non-Permanence Risk Tool,* v4.0 for validation and shall prepare the 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 host country thresholds or FAO definitions and shall | The Project Area is composed of 100% native forest. The area is considered forest as per the definition of forest adopted by FAO[8]: Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of |

[8] Comparative framework and options for harmonization of definitions. Available at: <https://www.fao.org/3/y4171e/y4171e10.htm#:~:text=FAO%202000a%20(FRA%202000%20Main,of%20other%20predomina>

| Eligibility Conditions | Mamuriá Grouped REDD Project Justification of Eligibility |
|---|---|
| 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 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. | more than 10%, or trees able to reach these thresholds in situ. |
| 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. | Project activity is designed to stop unplanned (unsanctioned) and planned (designated and sanctioned) 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 Section 3.5.2. | AUD project activity has the objective of stopping unsanctioned deforestation on lands that are legally sanctioned for timber production, without the reduction or termination of the logging activity. |

| Eligibility Conditions | Mamuriá Grouped REDD Project Justification of Eligibility |
|---|---|
| Eligible REDD activities include:<br>1) Avoided Planned Deforestation and/or Degradation (APDD): This category includes activities that reduce net GHG emissions by stopping or reducing deforestation or degradation on forest lands that are legally authorized and documented for conversion.<br>2) Avoided 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. | The Mamuriá Grouped REDD Project is within category AUDD - Avoided Unplanned Deforestation and/or Degradation – and APDD - Avoided Planned Deforestation and/or Degradation. |

## 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 Mamuriá 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.

**Table 1. Grouped Project eligibility criteria**

<table>
<tr><th>VCS Standard Eligibility criteria for the inclusion of new project activity instances</th><th>Mamuriá Grouped REDD Project</th><th>Instance 1</th></tr>
<tr><td>Projects shall meet the applicability conditions set out in the methodology applied to the project.</td><td>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 and Methodology VM0007 - Methodology for Avoided Planned Deforestation v1.6, published on 08-September-2020.</td><td>Instance 1 complies with this requirement because it adopts the Methodology VM0015 – Methodology for Avoided Unplanned Deforestation, v1.1, published on 03-December-2012 and Methodology VM0007 - Methodology for Avoided Planned Deforestation v1.6, published on 08-September-2020.</td></tr>
<tr><td>Projects shall use the technologies or measures specified in the project description.</td><td rowspan="2">All new instances shall use and apply the same technologies or measures specified in the Project description - forest conservation by avoiding unplanned deforestation and planned deforestation, with or without forest management in project scenario.</td><td rowspan="2">The Instance 1 project activity complies with this criterion because it was the instance that originated the baseline scenario and the development of the Mamuriá Grouped REDD+ Project. Also, this instance is in the same reference region described on the VCS PD.<br>Instance 1 applies the same technologies or measures specified on the present Project Description: forest conservation by avoiding unplanned deforestation and planned deforestation, without forest management in project scenario.</td></tr>
<tr><td>Projects shall apply the technologies or measures in the same manner as specified in the project description.</td></tr>
</table>

| VCS Standard Eligibility criteria for the inclusion of new project activity instances | Mamuriá Grouped REDD Project | Instance 1 |
|---|---|---|
| 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 Mamuriá 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 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. | All instances must be additional to be included in the Grouped Project. The project activity must be consistent with Grouped Project Description: forest conservation by avoiding unplanned deforestation and planned deforestation. In this case, the project activity may or may not include Sustainable Forest Management Plan.<br>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.<br>1) Instances may or may not include Sustainable Forest Management Plan.<br>2) In case the project activity does not involve Sustainable Forest Management Plan:<br>- 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 | Since the PD was developed based on the characteristics, reference region and activity of the initial instance, Instance 1 complies with this additionality criterion.<br>The additionality analysis for Instance 1 was made according to Option II of VCS VT0001 v3.0, as detailed in section 3.5. |

| VCS Standard Eligibility criteria for the inclusion of new project activity instances | Mamuriá Grouped REDD Project | Instance 1 |
|---|---|---|
| | 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.<br>3) In case the project activity includes a Sustainable Forest Management Plan:<br>- 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.<br>- In addition, a new AFOLU non-permanence risk analysis shall be performed. | |
| 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.<br>- As per the VCS Standard, new *AFOLU Non-Permanence Risk* assessments shall be carried out for each geographic area 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 | 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. |

| VCS Standard Eligibility criteria for the inclusion of new project activity instances | Mamuriá Grouped REDD Project | Instance 1 |
|---|---|---|
| | 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 | All Project Activity instances must provide evidence of Project ownership (land title and related | Instance 1 is in accordance with this criterion. The evidence of Project ownership and Project |

| VCS Standard Eligibility criteria for the inclusion of new project activity instances | Mamuriá Grouped REDD Project | Instance 1 |
|---|---|---|
| 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). | documents) and Project start date (agreements, protection or management plan, or others in accordance with the applicable VCS Standard definitions). | 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<br>Bárbara Silva e Souza<br>Carolina Chiarello de Andrade<br>Carolina Pendl Abinajm<br>Eliane Seiko Maffi Yamada<br>Gabriel Fernandes de Toledo Piza<br>Gabriella Hita Marangom Cesilio<br>Guilherme Lucas Medeiros Prado<br>Laura Cristina Pantaleão<br>Letícia Moraes Teixeira<br>Lyara Carolina Montone Amaral<br>Yara Fernandes da Silva |
| Title | Marcelo Hector Sabbagh Haddad – Head of Forest<br>Bárbara Silva e Souza – Technical Analyst<br>Carolina Chiarello de Andrade – Technical Analyst<br>Carolina Pendl Abinajm – Technical Coordinator<br>Eliane Seiko Maffi Yamada – Technical Coordinator<br>Gabriel Fernandes de Toledo Piza – Technical Coordinator<br>Gabriella Hita Marangom Cesilio – Technical Analyst<br>Guilherme Lucas Medeiros Prado – Technical Coordinator<br>Letícia Moraes Teixeira – Technical Analyst<br>Laura Cristina Pantaleão - Technical Analyst<br>Lyara Carolina Montone Amaral – Technical Coordinator<br>Yara Fernandes da Silva – Technical Coordinator |
| Address | Rua Elvira Ferraz, 250, Conj. 601, Edifício F.L. Office – Vila Olímpia, São Paulo/SP, Brazil<br>Postal Code: 04552-040 |
| Telephone | +55 11 3045-3474 |
| Email | forest@futurecarbon.com.br |

## 1.6 Other Entities Involved in the Project

| | |
|---|---|
| Organization name | FSV – Indústria e Comércio de Carnes Ltda |
| Role in the project | Instance 1 |
| Contact person | Jorge Luis Uriarte |
| Title | Owners of Seringal Mamuriá and Seringal Veneza properties |
| Address | Avenida Marechal Rondon, 5710, Sala - 5 BEC, Ponte Grande, São Paulo/SP, Brazil.<br>Postal Code: 76980-002 |
| Telephone | - |
| Email | uri.jorge@gmail.com |

## 1.7 Ownership

Instance 1 is located in the municipalities of Feijó, Manoel Urbano and Santa Rosa do Purus, State of Acre, and is composed by 2 properties that comprise the following areas:

- Fazenda Seringal Porto Mamuriá;
- Fazenda Seringal Veneza.

These properties are owned by FSV – Indústria e comércio de carnes Ltda. (hereafter "FSV" or "the company"). The legal documents proving the land title and ownership of the property 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

### AUD – Avoided Unplanned Deforestation

The FSV company started research and planning activities for the release and execution of sustainable forest management in 2018, resulting in the approval of currently existing environmental licenses for carrying out sustainable forest management. During management activities, encroachments were identified in the property area in 2019. For better verification, in September 2020, an overflight was carried out in the area to identify more characteristics in the invaded regions. With the more detailed identification about the invaded areas, the company filed a complaint with IBAMA reporting the encroachments on their properties on October 7$^{th}$, 2020.

After identification and complaint, the company started the repossession actions in 2021 together with direct actions involving the invaders for a voluntary eviction, with the accompaniment and social diagnosis of the region of a social worker. Nowadays, the areas are unoccupied and without new invasions. The activities after the event are described in section 1.11.

Thus, for the AUD REDD Project, the Project Start Date was defined on 07-October-2020.

**APD – Avoided Planned Deforestation**

Based on the applicability of methodology VM0007 (section 4.3.3) which cites that REDD project for planned deforestation activity is applied where the conversion of forest land to a deforested condition must be legally permitted. Both properties, Fazenda Seringal Porto Mamuriá and Fazenda Seringal Veneza, requested Authorizations for forest suppression and alteration of land use.

Therefore, to define the Start Date of the APD REDD Project, the protocol date of the authorization for forest suppression was adopted. Thus, the PSD was defined as November 25th, 2022.

| | Project Start Date |
|---|---|
| **AUD** | 07 October 2020 |
| **APD** | 25 November 2022 |

## 1.9 Project Crediting Period

The REDD project has a crediting period of 30 years, from 07-October-2020 to 06-October-2050.

According to the VCS requirements[9], the AUD baseline must be reassessed every 6 years for ongoing unplanned deforestation because projections for deforestation are difficult to predict over the long term.

## 1.10 Project Scale and Estimated GHG Emission Reductions or Removals

| Project Scale | |
|---|---|
| Project | X |
| Large project | |

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

| Year | Estimated GHG emission reductions or removals (tCO2e) AUD | Estimated GHG emission reductions or removals (tCO2e) APD |
|---|---|---|
| 2021 | 95,594 | - |
| 2022 | 36,804 | 264,785 |
| 2023 | 38,946 | 264,785 |
| 2024 | 41,089 | 264,785 |
| 2025 | 43,231 | 298,750 |
| 2026 | 45,373 | 264,785 |
| 2027 | 32,613 | 264,785 |
| 2028 | 34,541 | 298,750 |
| 2029 | 36,469 | 264,785 |
| 2030 | 38,397 | 264,785 |
| 2031 | 36,967 | 298,750 |
| 2032 | 36,753 | - |
| 2033 | 23,126 | - |
| 2034 | 22,719 | - |
| 2035 | 22,312 | - |
| 2036 | 21,905 | - |
| 2037 | 21,834 | - |
| 2038 | 21,641 | - |
| 2039 | 9,377 | - |
| 2040 | 9,011 | - |
| 2041 | 8,645 | - |
| 2042 | 8,278 | - |
| 2043 | 8,214 | - |
| 2044 | 8,041 | - |
| 2045 | -2,997 | - |
| 2046 | -3,327 | - |
| 2047 | -3,656 | - |
| 2048 | -3,986 | - |
| 2049 | -4,044 | - |
| 2050 | -4,200 | - |
| Total estimated ERs | 679,673 | 2,749,747 |
| Total number of crediting years | 30 | 10 |
| Average annual ERs | 22,656 | 274,974.7 |

## 1.11 Description of the Project Activity

The Project Activity for the Mamuriá Grouped REDD+ Project (hereafter “Mamuriá” or “the Project”) combines conservation measures and forest management plan in the Project Area’s properties.

Among the conservation measures and mitigation of unplanned deforestation adopted by Instance 1, there is the sustainable forest management in the Project Area site, which contributes to monitor suspicious and/or illegal activities, control entry and exit within the limits of the area, in addition to monitoring possible fires or natural events that may occur in the region.

After identifying a group of invaders on the property in 2019, the company flew over the area to verify the details and filed a complaint with IBAMA about the invasion on October 7th, 2020. Therewith, the repossession actions were constituted by the issuance of the repossession mandates in 2021. In addition, a meeting in the city council was held between the company and the people involved in the invasion for a voluntary eviction, where the families were accompanied by a social worker for the situation, besides to performing a social diagnosis of the region. Nowadays, the areas are unoccupied and without new invasions.

After the event, signs were placed identifying that the areas are private property, demarcating the boundaries of the two properties. In addition, in partnership with a neighboring farm, some measures were taken, such as the hiring of an employee exclusively to monitor and supervise the areas, the purchase of a quadricycle to move around and the construction of a house with solar panels and internet for the employee to live.

Instance 1 properties also have Sustainable Forest Management Plans. The logging generates revenue for the maintenance of activities in the area, in addition to contributing to monitoring against illegal activities, due to the presence of people in the forest.

<u>Sustainable Forest Management Plan within the Instance 1 properties of the Mamuriá Grouped REDD+ Project</u>

The Sustainable Forest Management Plan (PMFS) is a set of plans and techniques for forest extraction, adapted to the conditions of the forest. This concept will guide the exploitation of forest resources (wood, residual woody material from exploration and non-wood products), guaranteeing the supply of wood processing and processing units.

The management of the forest must occur in a sustainable manner, which ensures the use of available resources based on techniques such as the Reduced Impact Exploration (EIR) system, the conservation of the forest, preventing soil wear and erosion, in addition to protecting watersheds, reduce the risk of fire and allow the maintenance of natural regeneration and protection of biological diversity.

Therefore, there is a guarantee that the wood product comes from sustainable management, which makes its commercialization feasible. And the main products are roundwood and sawn wood, to serve the foreign and domestic markets. Arca S/A is committed to the norms and principles of sustainability of the forestry activity.

The SFMP aims to produce and extract forest resources in a sustainable way, planning, harvesting, and using forestry systems that maximize economic efficiency, with socio-environmental responsibility and compliance with forest regulation mechanisms, which are mentioned at Section 1.14, in addition to enabling the supply of raw material of safe and continuous origin to the consumer market.

In the area designated for forest harvest management, permanent preservation and the absolute reserve areas were excluded. According to the Brazilian Forest Code, permanent preservation areas (PPA) at the borders of waterways shall be comprehensively preserved. The sustainable logging is only carried out in the area granted by the Autex (Exploration Authorization), with an average extraction of 17 and 14 $m^3$/ha.

The cutting cycle in this plan is 35 years for Veneza Farm and 25 years for Mamuriá Farm. This cycle is based on an attempt to introduce new paradigms for forest management, in order to reduce the period for recovery of forest stocks. Forest monitoring will provide the growth data from the permanent plots installed in the Forest Management Unity, aiming to adjust the period initially foreseen.

The silvicultural system to be adopted is the polycyclic one, widely recommended for yields upland forests in the Brazilian Amazon. EMBRAPA named the referred system of the Brazilian System of Selective Management. In each cycle, mature trees are harvested in intermediate cuts.

The application of this system is due to the results of research carried out, which indicate this system as the most appropriate for the management of tropical forests. The sequence of operations of the system to be developed in the SFMP is presented below:

**Table 2. Main forestry measures and operations to be conducted by Arca S/A in the SFMP**

| Year | Operations |
|---|---|
| Y-1 | ● Demarcation of UPAs, UTs and trails or guidance trails;<br>● 100% inventory (forest census) and cutting of vines on trees to be harvested;<br>● Preparation of exploration maps;<br>● Establishment and measurement of permanent plots;<br>● Harvest; |

| | |
|---|---|
| | • Planning and construction of permanent infrastructure (roads and storage yards); |
| Y | • Exploration of trees, observing the established guidelines for exploration with reduced impact;<br>• Exploitation of residues for charcoaling; |
| Y+1 | • Remeasurement of permanent parcels;<br>• Maintenance of permanent infrastructure;<br>• Survey of damage caused by exploration and waste;<br>• Data collection for volume equation;<br>• Silvicultural treatments; |
| Y+3 | • Remeasurement of permanent parcels; |
| Y+4 | • Inventory of forest residues; |
| Y+5 | • Remeasurement of permanent parcels;<br>• Data collection for the volume equation;<br>• Adjustment of the volume equation; |
| Y+10 | • Remeasurement of permanent parcels; |
| Y+20 | • Remeasurement of permanent parcels; |
| Y+30 | • Beginning of the new cycle. |

Furthermore, the applied forestry management system has the following objectives:

- Employ Reduced Impact Exploration (EIR) techniques, in order to mitigate damage to remaining forest, regulating production in order to ensure a minimum 25-year cutting cycle;
- Implement a monitoring and control program for forest management activities, aiming to optimize productivity, reduce impacts and costs of operations, in order to guide the possible changes that may be necessary to the original management plan;

- Develop partnerships with research institutions for the development of studies that enhance the improvement of forest management techniques;
- Support forest certification in the management area, through compliance with the principles and criteria of onshore forest management;
- Value local products, whether timber or non-timber;
- Maximize the resources of the management area through the multiple use of the forest;
- Develop markets and secure existing markets with wood and non-wood products (resins, oils, seeds, etc.) of sustainable origin.

All actions that cause direct and indirect impacts on the environment must be monitored and the appropriate mitigating measures implemented. Likewise, it should be noted that both management and field teams must be properly trained to employ natural resource management methodologies in order to minimize impacts and costs, in addition to the use of reduced impact exploration techniques to minimize the damage caused to remaining species, to the soil, hydrography, air and fauna. In this aspect, the activities with the greatest impact will be identified and monitored, offering conditions for assessment and measurement directly in the field by the company's team.

With the management and exploration system employed, the environmental impacts are reduced. The selection method provides a stable habitat for plants and animals. Managed stands support more weeds, secondary vegetation and natural regeneration than unmanaged primitive stands. It increases the diversity and frequency of birds and nests with rapid recovery after exploration and has a reduced impact on the mammal community because of the maintenance of natural conditions important to their development.

The chain of custody is extremely important, as it ensures the tracking of the raw material, from production to the consumer. Tree identification starts at the forest inventory, through the plates that are placed on the tree stump after the cut. The log must also carry identification (UPA number, UT number, tree, section number, species code and log length) after unloading. Marking must be done on each section of the logs when tracing is needed.

For the tracking of wood in the various stages of management, some activities will be developed to ensure control of the entire wood chain, from the tree that will be harvested to the exit from the industrial processing unit.

Despite the importance of sustainable forest management for climate change adaptation and mitigation, its implementation is not considered common practice, primarily due to the shortage of human resources and funding required to implement the necessary measures.

The implementation of REDD+ mechanisms with SFMP promotes sustainable forest use, as it carries on forest conservation and storage of carbon stocks in forests while reducing pressure for timber from other conserved 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 legal deforestation agents to advance with their activities, as well as by retrieving their practices and, therefore, protecting and even restoring the carbon pools. As presented, one of the main initial actions to mitigate deforestation of the Mamuriá Grouped REDD Project was the implementation of forest management, considered as the project start date, since the presence of employees and activity being carried out on the property helps in monitoring and control of the property.

In addition, planned deforestation of the private properties will also be avoided in areas that, in the absence of the project, would have part of its forest cover legally suppressed.

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

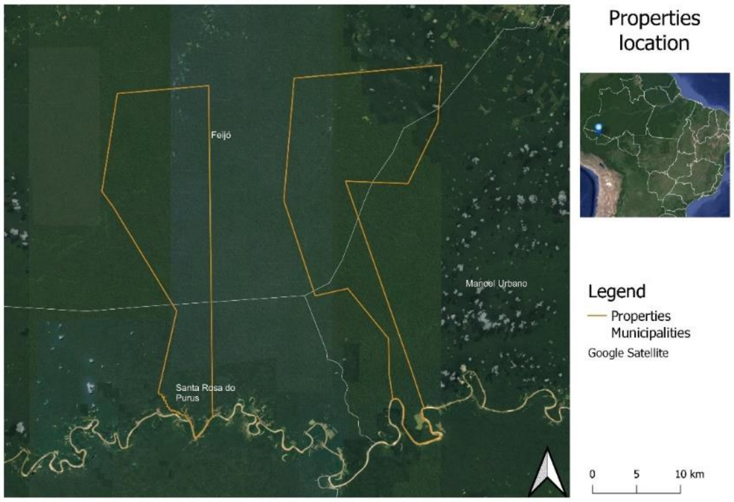
## 1.12 Project Location

The project area is situated in the municipalities of Feijó, Manoel Urbano and Santa Rosa do Purus, in the State of Acre, Northwest of Brazil and border with Peru. These municipalities are located around 363 km from Rio Branco, capital of the State of Acre. The project area is covered 100% by native vegetation, totaling approximately 64,563.84 ha.

The closest access road is BR 364, called Rodovia Marechal Rondon, highway connecting the Brazilian states of São Paulo, Goiás, Mato Grosso, Rondônia, and Acre to Mâncio Lima, the last municipality in Brazil on the border with Peru. In the lower limits of the properties run the Purus River.

The municipalities of Feijó and Manoel Urbano shares borders with three other municipalities in the South of the State of Amazonas, Envira, Pauini and Boca do Acre, as presented in figure below. The South of Amazonas is a region that has also been the target of pressure from different segments, loggers, cattleman, soy producers, among others, coming from neighboring states.

**Figure 1. Properties 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.

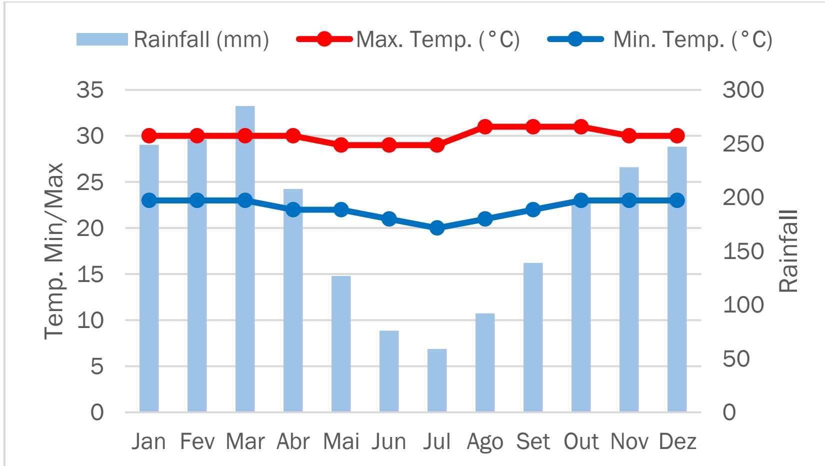
<u>Climate and Hydrography</u>

The project region is classified as Megathermal (humid tropical), according to Köppen climate classification, with average temperatures in the coldest month above 18°C[10]. These are regions with high humidity and average rainfall, 2,249.18 mm/year with reduced rainfall in the months between May and September[11]. These high precipitation values near the Andes Mountains are due to the orographic rise of moisture transported by the east trade winds of the Intertropical Convergence Zone (ITCZ)[12].

The project area is classified as Am category, according to the Köppen classification, with a short dry season, under the influence of monsoons. The Graph below presents the temperature and rainfall pattern in *Feijó*. The period between May and September is the driest, with rainfall up to 150mm. From November to March, rainfall exceeds 200 mm per month, with maximum temperatures of up to approximately 31ºC.

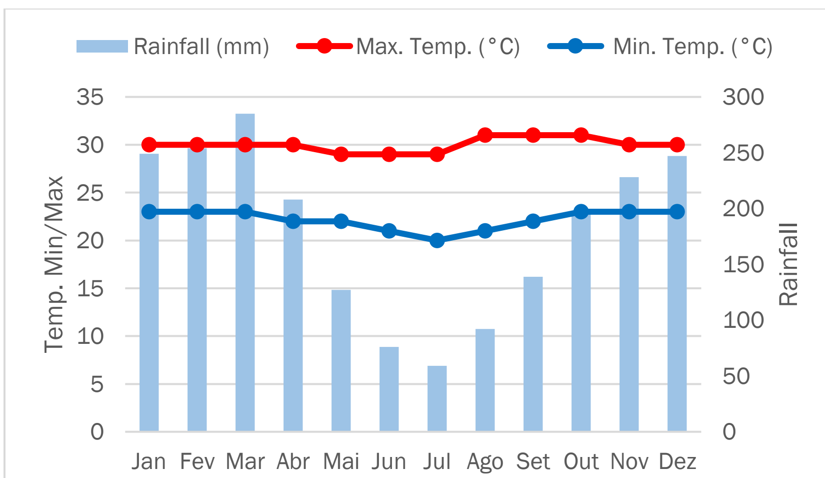
[10] Pereira et. al. Agrometeorologia – Fundamentos e Aplicações Práticas, Guaíba/RS, Edipec, 2002.
[11] .Available at: <https://www.climatempo.com.br/climatologia/2/feijo-ac>
[12] INPE/CPTEC. Available at: <http://climanalise.cptec.inpe.br/~rclimanl/boletim/cliesp10a/fish.html>

**Figure 2. Feijó climate graph**



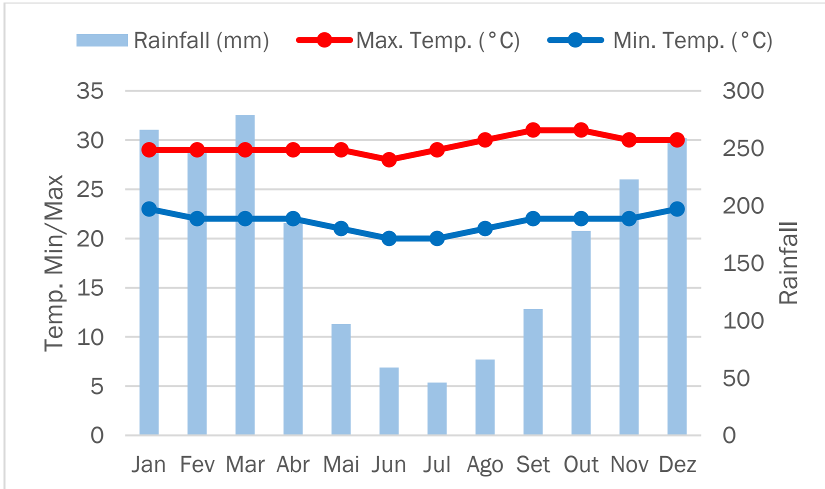

The following Graph presents the temperature and rainfall pattern in Manoel Urbano, with similar patterns to Feijó. The period between May and September is the driest, with rainfall up to 150mm. From November to March the rainfalls are over 200 mm per month, with maximum temperatures up to approximately 31ºC.

**Figure 3. Manoel Urbano climate graph**



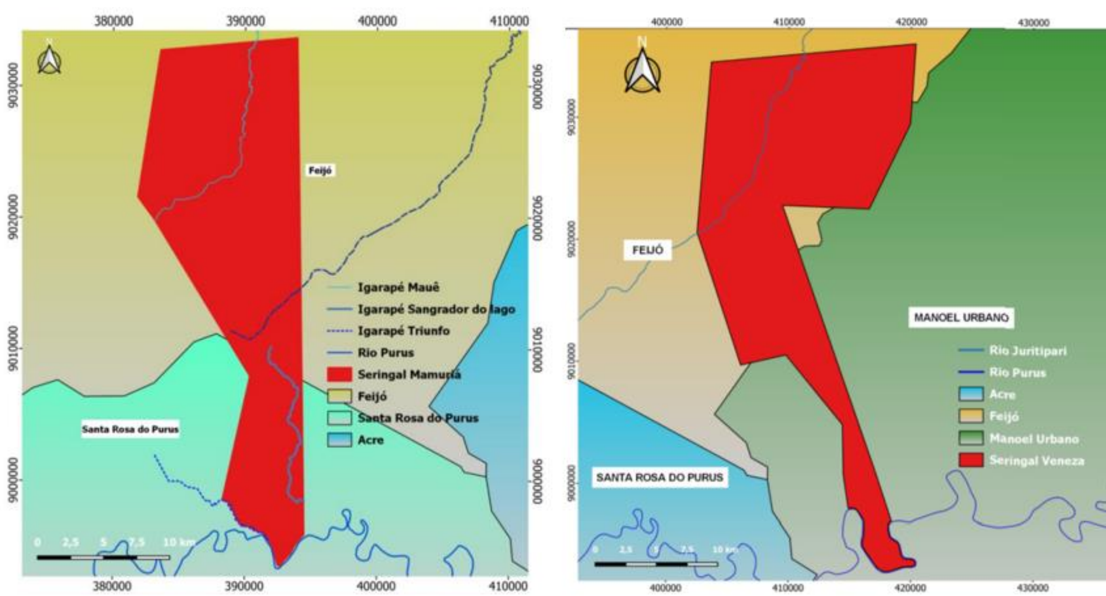

The following Graph presents the temperature and rainfall pattern in Santa Rosa do Purus, with similar patterns to Feijó and Manoel Urbano. The period between May and September is the driest, with rainfall up to 150mm. From November to March the rainfalls are over 200 mm per month, with maximum temperatures up to approximately 31ºC.

Figure 4. Santa Rosa do Purus climate graph




The project area is in the Amazon Basin, specifically in the Coari Lake and Auati Parana River sub-basin and Coari Lake and Purus River sub-bacin. The main rivers near the Project Area are the Jurupari and Purus River. Its springs are in the state of Acre, but it cuts cities both in that state and in Amazonas. In addition to the rivers, there are three streams that enter the Project Area, they are Mauê, Sangrador do Lago and Triunfo.

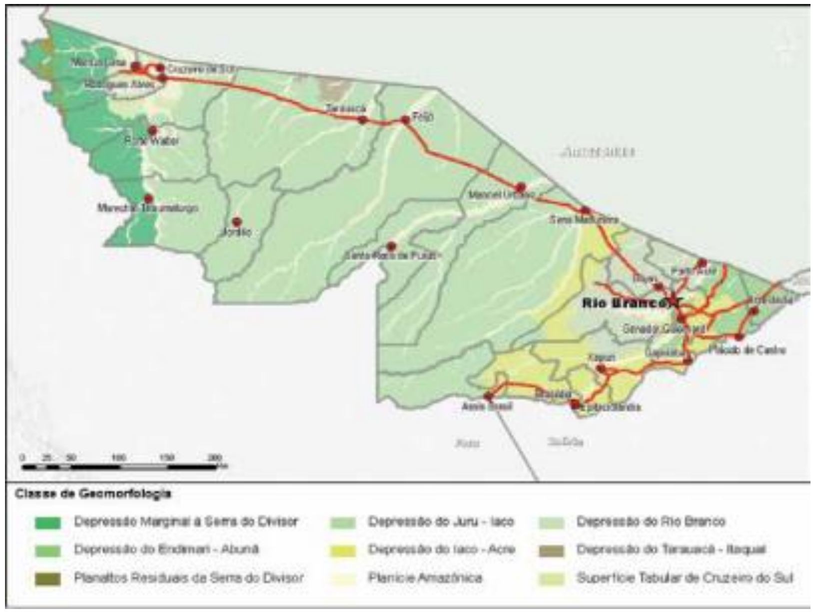
Figure 5. Rivers in the properties




## Geology, Topography and Soils

In Acre, as in other parts of the Amazon, the altimetric variation is not expressive. The geomorphological unit in which the Project Area is inserted is the Juruá-Iaco Depression, which has an altitude between 150 and 440m and slopes that vary from medium to strong.

**Figure 6. Distribution of geomorphological units in the State of Acre[13]**



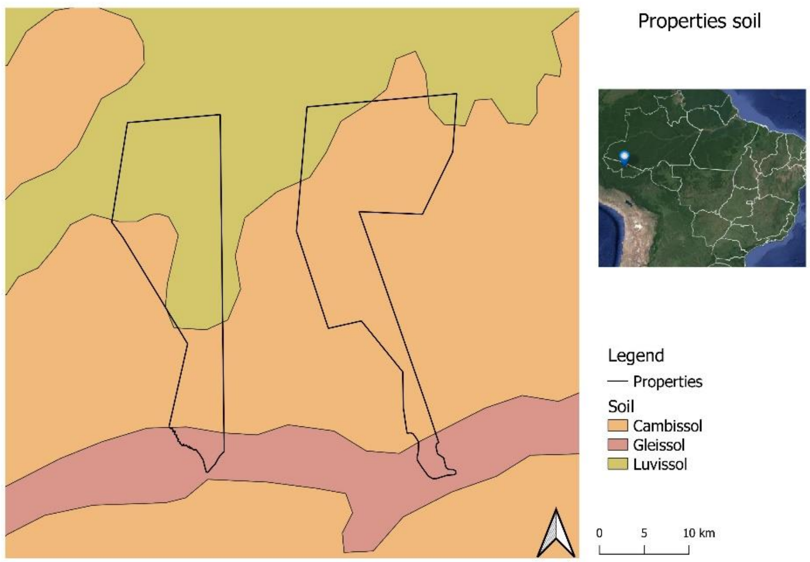

The predominant soil types within the Project Area are Luvissols, Cambissols and Gleissols. The Luvissols are shallow soils, that is, they rarely exceed 1m in depth and usually present an abrupt textural change. The limitations of the use are related to the amount of stones in the surface horizon that can hinder the use of agricultural mechanization and the susceptibility to compaction. The Luvissols are poorly or moderately weathered soil, with clay accumulation on the B horizon. The Cambisol are heavily, even imperfectly, drained, shallow to deep soils. They are soils in the beginning of formation, with few characteristics. A large part of Cambisols is under natural vegetation[14]. Gleissolos are soils that are permanently or periodically saturated with water, characterized by strong gleation. They are defined as hydromorphic soils and constituted by mineral material[15].

[13] ACRE, 2010. Zoneamento Ecológico-Econômico do Acre Fase II, 2006. Available at: https://agencia.ac.gov.br/zoneamento-ecologico-economico-do-acre-e-destaque-entre-os-estados-da-amazonia-legal/

[14] Lepsch, Igo. 2013. Formação e Conservação dos Solos, 2ª ed. Oficina de Textos. São Paulo.

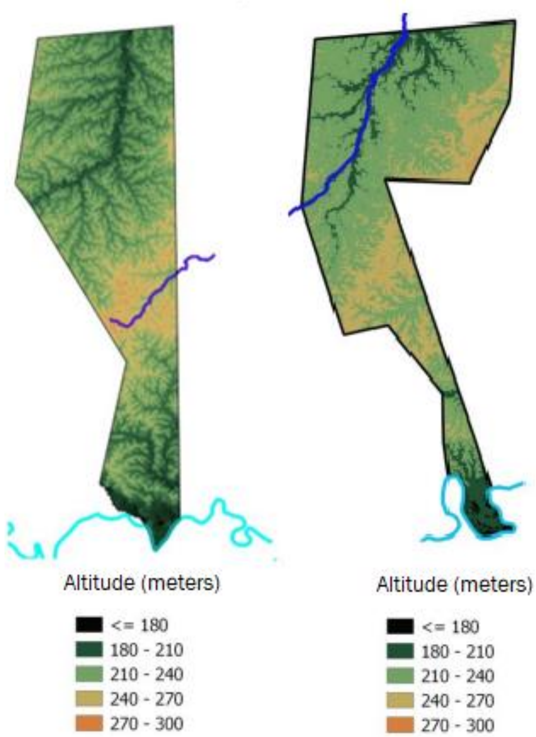
[15] Available at: < https://www.embrapa.br/en/agencia-de-informacao-tecnologica/tematicas/solos-tropicais/sibcs/chave-do-sibcs/gleissolos#:~:text=Apresenta%20baixa%20(distr%C3%B3ficos)%20fertilidade%20natural,mal%20drenados%2C%20em%20condi%C3%A7%C3%B5es%20naturais.>

**Figure 7. Properties soil**




In the properties, altitude ranges up to 300m, as shown on the Maps below:

**Figure 8. Properties altitude**

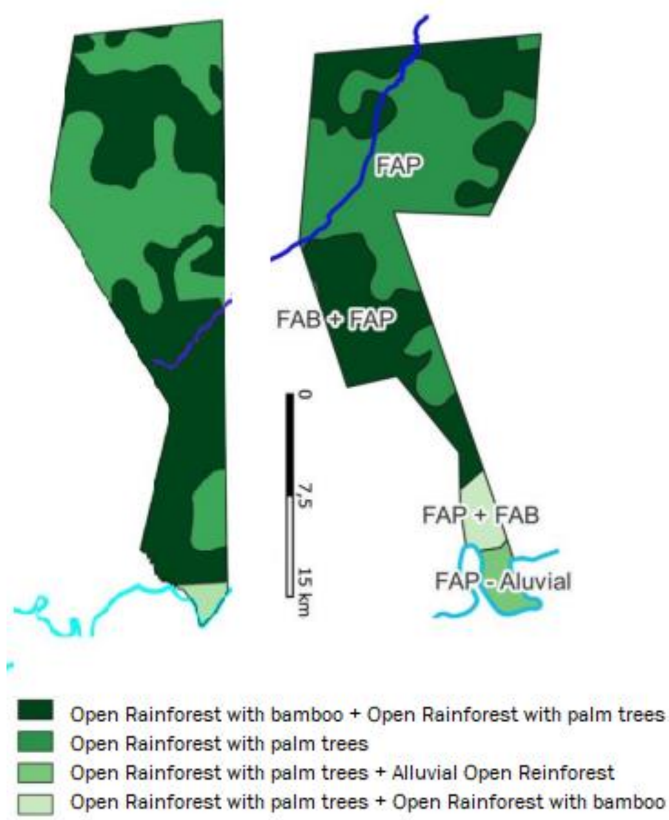


### Vegetation cover

According to the Brazilian Forests at a Glance 2019[16], the Brazilian Forest Service considers as forests the lands that correspond to the vegetation typologies according to the Classification System of the Brazilian Institute of Geography and Statistics (IBGE), updated by the SIVAM project[17].

The Open Rainforest, which surrounds the southern part of the Amazon Basin, occurs in numerous disjoint clusters and is characterized by three facies dominated by typical genera, suggestively located in less humid areas. In the project area there are two mains: "palm forest" and "bamboo forest" and their variations: Alluvial Open Rainforest with palm trees, Lowland Open Rainforest with palm trees and Lowland Open Rainforest with bamboo. In the figure below it is possible to observe that the project area is not inserted in a peatland area and the rivers that cut the areas do not form wetlands areas.

**Figure 9. Properties vegetation cover**




[16] Available at: <https://www.florestal.gov.br/documentos/publicacoes/4262-brazilian-forests-at-a-glance-2019/file>

[17] As of 1996, through a contract signed between the Implementation Commission of the Airspace Control System - Ciscea, and its Amazon's Surveillance System Project - Sivam, and IBGE, updated the information that make up the Legal Amazon, attending, at the same time, the Systematization of Information on Natural Resources project. Information available at: <https://www.terrabrasilis.org.br/ecotecadigital/pdf/manual-tecnico-da-vegetacao-brasileira.pdf>; SIVAM Project: <https://www.camara.leg.br/noticias/55929-o-que-e-o-sivam/>.

<u>Socio-economic conditions</u>

### Feijó

The municipality of Feijó has more than 27,970 km² of territorial extension, being the largest in the State of Acre. The population count, in the last census of 2010, was around 32,412 people and a population density of 1.16 inhab/km². The population estimate for 2021 is 34,986 people. In 2019, only 6% of the total population was considered economically active. Formal workers received, on average, 1.4 minimum wages, which placed the municipality at the lowest levels in the state (21st out of 22 municipalities) and in the country (5265th out of 5570). This represents living with US$ 247.64 per month, considering that in 2019 the salary was R$ 998.00[18] and the average dollar rate, from June to December, was US$ 4.03[19].

The municipality also has one of the lowest schooling rates, around 82% of children aged 6 to 14 years attended schools in the period of the last census, 2010. The HDI of the municipality is low and in 2010 it was 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[20].

### Manoel Urbano

The municipality of Manoel Urbano has more than 10,630 km² of territorial extension, being the largest in the State of Acre[21]. The population count, in the last census of 2010, was around 7,981 people and a population density of 0.75 inhab/km². The population estimate for 2021 is 9,701 people. In 2019, only 5.3% of the total population was considered economically active[21]. Formal workers received, on average, 1.8 minimum wages, which placed the municipality at the medium level in the state (11st out of 22 municipalities) and in the country (3161th out of 5570)[21]. This represents living with US$ 445.7per month, considering that in 2019 the salary was R$ 998.00[22] and the average dollar rate, from June to December, was US$ 4.03[19].

The municipality also has one of the lowest schooling rates, around 78% of children aged 6 to 14 years attended schools in the period of the last census, 2010[21]. The IDHM of the municipality is low and in 2010 it was 0.551. 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[23].

[18] Available at: <http://www.planalto.gov.br/ccivil_03/_Ato2019-2022/2019/Decreto/D9661.htm>
[19] Available at: <https://www.bcb.gov.br/estabilidadefinanceira/historicocotacoes>
[20] Available at: <https://www.br.undp.org/content/brazil/pt/home/idh0/conceitos/o-que-e-o-idhm.html>. Last visit: Oct 2022.
[21] Available at: < https://cidades.ibge.gov.br/brasil/ac/manoel-urbano/panorama>
[22] Available at: <http://www.planalto.gov.br/ccivil_03/_Ato2019-2022/2019/Decreto/D9661.htm>
[23] Available at https://www.br.undp.org/content/brazil/pt/home/idh0/conceitos/o-que-e-o-idhm.html. Last visit: Oct 2022.

### Santa Rosa do Purus

The municipality of Manoel Urbano has more than 6,155 km$^2$ of territorial extension, being the largest in the State of Acre[24]. The population count, in the last census of 2010, was around 4,691 people and a population density of 0.76 inhab/km$^2$. The population estimate for 2021 is 6,893 people. In 2019, only 3.9% of the total population was considered economically active[24]. Formal workers received, on average, 2.4 minimum wages, which placed the municipality at the medium level in the state (2nd out of 22 municipalities) and in the country (646th out of 5570)[242121]. This represents living with US$ 594.34 per month, considering that in 2019 the salary was R$ 998.00[22] and the average dollar rate, from June to December, was US$ 4.03[19].

The municipality also has one of the lowest schooling rates, around 63.8% of children aged 6 to 14 years attended schools in the period of the last census, 2010[19]. The IDHM of the municipality is low and in 2010 it was 0.517. 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[25].

### Biodiversity

The western Amazon is considered by some researchers a high priority region for biodiversity conservation. According to the Acre ZEE, the group of birds was the one that presented the greatest diversity within State, followed by fish, mammals, amphibians and reptiles[26]. According to The World Conservation classification Union (IUCN), Acre has three species of mammals in the category “Endangered” and 14 in the category “Vulnerable”, with nearly all of these species are mammals, with the exception of two species of reptiles - the tracajá (*Podocnemis unifilis*) and the tortoise (*Geochelone denticulata*), highly targeted by hunters.

**Figure 10. Tracajá (left) and tortoise (right)**

*Podocnemis unifilis*

*Geochelone denticulata*

[24] Available at: < https://cidades.ibge.gov.br/brasil/ac/santa-rosa-do-purus/panorama>

[25] Available at https://www.br.undp.org/content/brazil/pt/home/idh0/conceitos/o-que-e-o-idhm.html. Last visit: Oct 2022.

[26] ACRE, 2010. Zoneamento Ecológico-Econômico do Acre Fase II, 2006. Available at: https://agencia.ac.gov.br/zoneamento-ecologico-economico-do-acre-e-destaque-entre-os-estados-da-amazonia-legal/

Two species that occur in Acre appear as “Endangered” by the IUCN. They are on the List of Brazilian Fauna Species Endangered: the giant otter (*Pteronura brasiliensis*) and the giant armadillo *(Priodontes maximus*). both are species targeted by hunters and with reproductive rates relatively low.

**Figure 11. Giant otter (left) and giant armadillo (right).**

*Pteronura brasiliensis*

*Priodontes maximus*

As some of the other conditions existing prior to the project initiation are the same as the baseline scenario and, as per the VCS guidelines, therefore, there is no need to repeat the description of the scenarios, the remaining conditions prior to the project initiation can be found at Section 3.4 (Baseline Scenario).

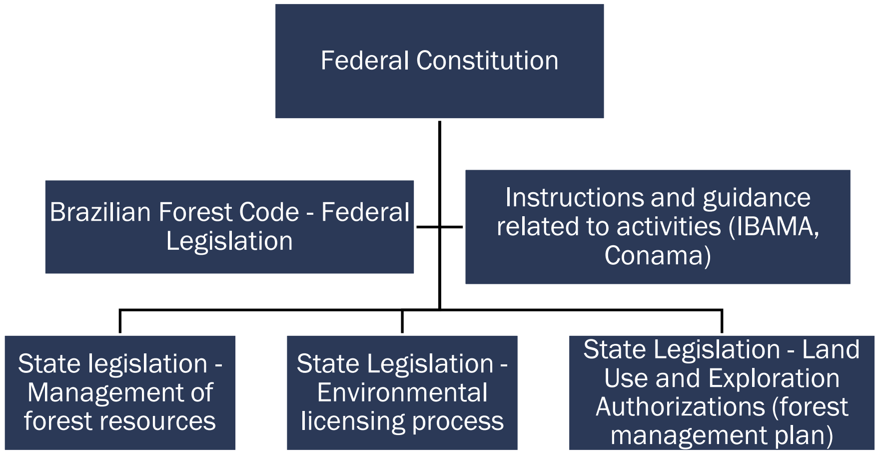
## 1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

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 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[27]. 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[28]. 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.

[27] 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>

[28] Available at: <http://pnla.mma.gov.br/competencias-para-o-licenciamento-ambiental>

**Figure 12. Structure of the Brazilian legislation**




- National legislation

According to the current Brazilian Forest Code (Law Nº 12.651, 25/05/2012[29]), 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 natural resources, conservation and rehabilitation of ecological processes, biodiversity conservation and shelter, and protection of native flora and fauna. In the Brazilian Legal Amazon[30], eighty percent (80%) of a rural property should be preserved.

It is important to highlight that the legal reserve applicable to the area of the properties included in the Mamuriá project is of 50%, as registered in the land title and following the forest code before the 2012 update. 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[31].

---

[29] 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>

[30] 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.

[31] Available at: <https://oeco.org.br/dicionario-ambiental/28574-o-que-e-o-codigo-florestal/>

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[32]. 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.

As the project activity involves planned logging (Sustainable Forest Management) it is important to describe compliance with applicable law.

Sustainable Forest Management is defined in Article 3, VII, of Law 12.651/2012 (National Forest Code), as the administration of natural vegetation to obtain economic, social and environmental benefits, respecting the support mechanisms of the ecosystem object of management and considering, cumulatively or alternatively, the use of multiple wood species or not, of multiple products and by-products of the flora, as well as the use of other goods and services. Decree 5,975[33] also specifies the technical and scientific foundations of the PMFS.

The technical procedures for the preparation, presentation, execution and technical evaluation of sustainable forest management plans are regulated by IBAMA's Normative Instructions: 1, of 24/04/2007[34], 5, of 11/12/2006[35] and 2, of 27/06/2007[36]; in addition to CONAMA's Resolution 406, of 02/02/2009[37]

- State legislation

  In the state of Acre, the Instituto de Meio Ambiente do Acre (IMAC/AC) is the body responsible for environmental licensing, authorizations and permissions for sustainable forest management and alternative land use. Legislation such as laws Nº1,426/2001[38],

---

[32] 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>

[33] Available at: <http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2006/decreto/d5975.htm>

[34] Available at: < https://www.ibama.gov.br/component/legislacao/?view=legislacao&legislacao=113233>

[35] Available at: < https://www.ibama.gov.br/component/legislacao/?view=legislacao&legislacao=112909>

[36] Available at: < https://www.ibama.gov.br/component/legislacao/?view=legislacao&force=1&legislacao=113306>

[37] Available at: < https://www.ibama.gov.br/component/legislacao/?view=legislacao&legislacao=114762>

[38] Available at: < https://www.legisweb.com.br/legislacao/?id=116287>

Decree 9,670/2018[39] and 7,734/2014[40], and IMAC N°27/2021[41] is applicable, as detailed in table below.

All the documents in their entirety are available for consultation by the audit team.

- 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+[42].

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 Mamuriá Grouped REDD Project 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; | The project areas, AUD and APD, complies with current legislation, as evidenced by the authorizations |

[39] Available at: < https://www.legisweb.com.br/legislacao/?id=367705>
[40] Available at: < https://www.legisweb.com.br/legislacao/?id=271236>.
[41] Available at: < https://www.legisweb.com.br/legislacao/?id=412693>
[42] The Decree is available in Portuguese at: < http://www.planalto.gov.br/ccivil_03/_Ato2019-2022/2019/Decreto/D10144.htm>

| | | |
|---|---|---|
| | 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. | issued and the absence of legal pending issues on the environmental side.<br>The AUD project is being carried out in the areas of legal reserves of the properties, representing 80% according to legislation. And for the areas that would be destined for land use change, in this case livestock, the suppression authorizations prove that these areas are regular and applicable for the APD project. |
| 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. | The management plan conducted within the project area was approved by the responsible environmental agency in Acre (IMAC). |
| **State legislation** | | |
| Law 1,426 | Provides for the preservation and conservation of the State's forests, institutes the State System of Protected Natural Areas, creates the State Forestry Council and the State Forest Fund and other provisions | The management plan and activities conducted within the project area were approved by the responsible environmental agency in Acre (IMAC) |
| Decree 9670 | Provides for forest restoration in the State of Acre. | The management plan and activities conducted within the project area were approved by the responsible environmental agency in Acre (IMAC), as well as the current APU. According to legislation, properties can only request a new authorization for sustainable forest management, after inspection by IMAC and proof of management in the previous APU. |
| Decree 7734 | Regulates the Rural Environmental Registry - CAR, in the State of Acre and other provisions. | The property complies with state legislation and the environmental licensing required for carrying out forestry activities, in accordance with current exploration authorizations. |

| | | |
|---|---|---|
| IMAC 27 | Defines the technical and administrative procedures referring to the environmental licensing of activities potentially causing environmental impact, in the State of Acre, in which there is an alternative use of the soil for agricultural activities, agricultural planting and the raising of cattle and buffaloes for commercial purposes. | The property complies with state legislation and the environmental licensing required for carrying out forestry activities, in accordance with current exploration authorizations. |
| Law 1117[43] | Provides for the environmental policy of the State of Acre, and other measures, involving environmental zoning, environmental education and community participation, environmental protection, wild fauna protection, among others. | The property complies with the state legislation required for carrying out forestry activities, in accordance with the appropriate measures to protect the environment and wild fauna. |
| **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 | The management plan and activities conducted within the project area were approved by the responsible environmental agency in Acre (IMAC), as well as the current APU. |
| Administrative Rule 5 IBAMA | Provides for technical procedures for the preparation, presentation, execution and technical evaluation of sustainable forest management plans - SFMP in primitive forests and their forms of succession in the legal Amazon, and other measures | The management plan and activities conducted within the project area were approved by the responsible environmental agency in Acre (IMAC), as well as the current APU. |
| Normative instruction 2 MMA | Amends provisions of normative instruction no. 5, of December 11, 2006, and makes other provisions | The management plan and activities conducted within the project area were approved by the responsible environmental agency in Acre (IMAC), as well as the current APU. |
| 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 | The management plan and activities conducted within the project area were approved by the responsible environmental agency in Acre (APU), as well as the current APU. |

[43] Available at: < https://www.legisweb.com.br/legislacao/?id=116194>

| | | |
|---|---|---|
| | their forms of succession in the Amazon biome | |
| **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, does not establish duties or obligations to the society. |
| Decree 11075[44] | 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, does not establish duties or obligations to the society. |
| **Legislation and guidelines on traditional communities and workers** | | |
| Decree 10088[45] | Establishes normative acts issued by the Federal Executive Branch that provide for the promulgation of conventions and recommendations of the International Labor | The owner has no process related to the rights of traditional and indigenous peoples. The REDD project contributes to and requires that indigenous and traditional |

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

[45] Available at < http://www.planalto.gov.br/ccivil_03/_ato2019-2022/2019/decreto/d10088.htm>

| | | |
|---|---|---|
| | Organization - ILO, ratified by the Federative Republic of Brazil. | peoples' rights be respected, in addition to requiring, according to the applicable legislation, the consultation of these stakeholders for the realization and approval of the project. |
| ILO Convention on Indigenous and Tribal Peoples - n° 169[46] | Convention No. 169 is based on respect for the cultures and ways of life of indigenous peoples and recognizes their rights to land and natural resources, and to define their own priorities for development. | The project area does not overlap with any Indigenous Land. The owner does not have any debts related to the rights of traditional and indigenous peoples and has a good relationship with the tribes around the project area. The project recognizes and includes the indigenous population in the surroundings and allows the flow to collect NTFPs within the project area, according to legislation. |
| Decree 6040[47] | National Policy for the Sustainable Development of Traditional Peoples and Communities. According to Art. 2 "The PNPCT's main objective is to promote the sustainable development of the Traditional Communities, with an emphasis on recognizing, strengthening, and guaranteeing their territorial, social, environmental, economic and cultural rights, with respect and appreciation for their identity, their forms of organization and their institutions. | Will guide the sustainable development actions that the project will promote in the communities, reinforcing the recognition, appreciation and respect for socio-environmental and cultural diversity, avoiding establishing or reinforcing any relationship of inequality. |

.

[46] Available at <https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:55:0::NO::P55_TYPE,P55_LANG,P55_DOCUMENT,P55_NODE:REV,en,C169,/Document>

[47] Available at <http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2007/decreto/d6040.htm>

## 1.15 Participation under Other GHG Programs

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

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 in 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 and 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 Mamuriá Grouped REDD Project is to avoid the unplanned deforestation (AUD) and the planned deforestation (APD) of its instances, consisting of 100% Amazon rainforest. 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)[48] and the Nationally Determined Contribution (NDC).

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

In Brazil, the National Commission for Sustainable Development Objectives (CNODS) is responsible for internalizing, disseminating and providing transparency to the process of implementing the 2030 Agenda for Sustainable Development in Brazil[49]. 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[50] and by the IPEA reports[51]. 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 Mamuriá Grouped REDD Project main planned contributions to the Brazilian Priority Goals are listed below[52]. These contributions are monitored by the parameters defined by the REDD project, in addition to additional standards, if applicable:

- 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”.

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

- 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 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[53].

The following components of the Brazilian commitments under the Convention are reinforced by the development of the Mamuriá 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

Although there is a risk of leakage, the proponents believe that the project activity will have positive impacts on surrounding areas. This project activity might be a successful benchmark of the following technical and economic aspects:

I. Sustainable management of forest resources generating success and profit;

II. Additional return to forest management, thanks to REDD incentives, which can compensate avoiding deforestation for other activities;

III. Positive example of sustainable real estate maintenance, in addition to profits with sustainable management plus REDD revenues.

In this context, the project may well stimulate other landowners to adhere to this project concept.

**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.

By means of Project monitoring activities, satellite imaging, and social and governmental cooperation for monitoring the project and its surroundings, the project proponent believes that

[53] 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>

the success of this business plan will generate an increased number of sustainably managed areas with REDD+.

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[54]. 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 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 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. | |

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

| | | |
|---|---|---|
| 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 local stakeholders that are potentially impacted by the project. Information on the local stakeholders identified are discussed throughout this Section.

Local entities having some influence and activities developed in the Reference Region were chosen through a process to identify them and their possible impact on the Project Activity. Stakeholders chosen for local consultation also include communities and neighbors that might be impacted as well as set potential partnerships in the future.

Thus, the output list of stakeholders from this analysis is described below.

**Table 4. Profile of the stakeholders identified**

| Stakeholder | Justification |
|---|---|
| Government agency and/or representatives – Direct public administration (State and Municipality) | |
| Feijo Municipality | |

| Stakeholder | Justification |
| --- | --- |
| The Environment Agency of Feijo 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.<br><br>In addition, partnerships with the public sector are very important for the development of activities throughout the project. |
| The Citizenship and Social Inclusion Agency of Feijo Municipality | |
| Manoel Urbano Municipality | |
| The Agriculture and Environmental Agency of Manoel Urbano Municipality | |
| The State Environmental and Indigenous Policies Agency of Acre (SEMAPI-AC) | |
| The Climate Change Institute of Acre (IMC) | |
| The Brazilian Environmental Agency (IBAMA) | |
| The National Indigenous Foundation (FUNAI) - Alto Purus Regional Coordination | |
| Environmental Development and Services Company (CDSA) | |
| Brazilian Forest Service (SNIF) | |
| Public Administration Company (Autarchy) | |
| The Chico Mendes Institute for Biodiversity Conservation (ICMBio) | These are agencies that are related to the project activity:<br><br>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.<br><br>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. |
| National Institute of Colonization and Agrarian Reform – Regional Superintendence of Acre (INCRA-AC) | |
| Unions | |
| Seringueiros Association of Seringal Cazumbá (ASSC) | The participation of unions is important to spread knowledge of the carbon market |

| Stakeholder | Justification |
|---|---|
| | and include the vision of local employees and workers in the development of the project. |
| **Universities and education institutes** | |
| National Rural Learning Service (SENAR) | 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. |
| Federal University of Acre (UFAC) | |
| Federal Institute of Acre (IFAC) | |
| **NGOs** | |
| The Environmental Institute of Acre (IMAC) | 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 activities, and communication with these entities brings transparency to the project.<br><br>In addition, they are key agents for the development of partnerships to strengthen the project activity and enhance socio-environmental co-benefits. |
| The Climate Change Institute of Acre (IMC) | |
| REPPU - Purus Representation - IMAC | |
| The Institute of Lands of the State of Acre (ITERACRE) | |
| The Institute of National Historical and Artistic Heritage (IPHAN) | |

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 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. The main communication channel will be the project's own email.

It is expected that this 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).

The Stakeholder Consultation was divided into two events: a remote meeting and an on-site consultation with the local community that resides near the project area, where the Leakage Management Area was defined.

Regarding the stakeholders located in urban areas, which are mostly government agencies, a letter will be sent, briefly presenting the project and inviting them to the remote consultation. This presentation will be a detailed summary of the proposed activities regarding project implementation and monitoring.

In addition to the introduction of the forest conservation measures, the carbon project development process, deforestation monitoring and projection methods, as well as the delimitation of the Project Area, Reference Region, Leakage Belt, among other information that will be also displayed.

Contact information of the Future Forest[55] team will be made available at the end of the meeting. Communication can be carried out via letter, email, or telephone. The presentation will be recorded, and a PDF version might will be made available through e-mail should it be requested by any stakeholder. The participants will be informed that the period for requesting information and comments about the Mamuriá Grouped REDD Project will be open for 30 days starting from the presentation date.

The on-site consultation with stakeholders (local communities) will take place in the main municipalities of the Reference Region (Feijó, Manoel Urbano and Santa Rosa dos Purus), where the presence of actors possibly impacted by the Project are located.

The meetings will have a simplified presentation about the Project, guided by a folder with the main information; maps will be used to explain about the dynamics of historical deforestation and its projection into the future and where the project activities and its repercussions are and/or will be located, exposing the risks and benefits resulting from the project activities for the population, contributing with the SDGs targets.

A permanent communication channel with the local stakeholders will be created in order to receive any comments or suggestions regarding the present REDD Project. Emails, phone numbers and addresses will be made available through the folder aforementioned should they want to contact the Project Proponent. It is important to note that the same contact information that will be made available is also part of the grievance mechanism, where all comments can be received, and outcomes will be documented and stored in digital format.

## 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[56]. 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[57]. To further quantify, this biome holds the

[55] Future Forest is the technical team dedicated towards forestry carbon projects at Future Carbon Holding S.A. Therefore, it is Future Carbon's team responsible for developing and monitoring such projects.

[56] 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/

[57] 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 .

biggest variety of species in the world, and deforestation and degradation of tropical forests are the main cause of global biodiversity loss[58].

Another benefit is that the Mamuriá Grouped REDD Project also has the function of establishing a barrier against the advancement of the Brazilian Arc of Deforestation, in addition to protecting the standing forest in a high-pressure cattle ranching region. This creates an urgent situation on which levels of pressure and priority for conservation are high.

The SFMP conducted in the properties follows all the applicable legislation and comply with all the environmental rules requested for the approval of the licenses.

## 2.4 Public Comments

The PD is currently being written to be submitted for public consultation.

## 2.5 AFOLU-Specific Safeguards

**Local Stakeholder Identification and Background**

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:

1. 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, as well as local knowledge from the Instance 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 Acre State and Amazon biome institutions, in addition to NGOs within the Reference Region. The list is available at section Local Stakeholders Consultation, above.

   The Project and actions involving local communities will be monitored by Future Carbon's Social team in order to analyze the extent of alternative income generation sources and further programs, besides the applied methods for local stakeholders' consultation.

2. 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. Instance 1 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.

[58] 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 .

On July 13, 2006, the Commission for the Sustainable Development of Traditional Communities was instituted in Brazil by decree[59] and updated in 2016[60], with the objective of implementing a national policy especially directed at such communities.

The Decree No. 6,040 of February 7, 2007[61], 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[62].

The Policy is structured around four strategic axes:

1. Access to Traditional Territories and Natural Resources
2. Infrastructure
3. Social Inclusion and
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)[63].

The REDD methodology guarantees and is 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.

3. 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

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

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 was 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 was 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.

4. 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.

5. 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:

   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.

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

   - TI Alto Rio Purus: 70°06’45.11’’S, 09°18’55.16’’W.
   - PAR Aleluia: 69°26’56.39’’S, 08°47’16.80’’W.
   - PA Liberdade: 69°23’41.99’’S, 08°51’57.59’’W.
   - PA Nazaré: 69°15’57.60’’S, 08°46’58.79’’W.
   - PA Castelo: 69°15’28.79’’S, 08°48’57.60’’W.

7. 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 5. 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 property or relocate people off their lands without consent. In the event there are any ongoing or unresolved conflicts over property rights, usage or resources, the project shall undertake no activity that could exacerbate the conflict or influence the outcome of an unresolved dispute.

No community member has been or will be removed from their land. In addition, the project did not introduce any invasive species or allow an invasive species to thrive through project 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 were 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 was created in order to receive any comments or suggestions regarding the present REDD project. All communities has received 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

The list below references the methodologies, tools and modules used in the project scope:

**For AUD**:

- VM0015 “Methodology for Avoided Unplanned Deforestation”, Version 1.1, 03 December 2012[64].
- VT0001 - Tool for the demonstration and assessment of additionality in VCS agriculture, forestry and other land use (AFOLU) project activities Version 3.0, 1 February 2012[65].
- AFOLU “Non-Permanence Risk Tool” VCS Version 4, Procedural Document, 19 September 2019, v4.0[66].

For APD:

- VM0007 REDD + Methodology Framework (REDD+ MF) Version “Methodology for Avoided Unplanned Deforestation”, Version 1.6, 08 September 2020[67].
- VMD0001 – Estimation of carbon stocks in the above and below ground biomass in the live tree and non-tree pools (CP-AB). Version 1.1, 11 October 2013.
- VMD0002 Estimation of carbon stocks in the dead wood pool (CP-D). Version 1.0, 03 December 2010.
- VMD0005 Estimation of carbon stocks in the long-term wood products pool (CP-W). Version 1.1, 20 November 2012.
- VMD0006 Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation/forest degradation and planned wetland degradation (BL-PL). Version 1.3, 08 September 2020.
- VMD0009 Estimation of emissions from activity shifting for avoiding planned deforestation/forest degradation and avoiding planned wetland degradation (LK-ASP). Version 1.3, 08 September 2020.
- VMD0015 Methods for monitoring of GHG Emissions and removals (M-MON). Version 2.1, 20 November 2012.
- VMD0016 Methods for Stratification of the Project Area (X-STR). Version 1.2, 08 September 2020.
- VT0001 Tool for the demonstration and assessment of additionality in VCS agriculture, forestry, and other land use (AFOLU) project activities (T-ADD). Version 3.0 1 February 2012.
- AFOLU Non-Permanence Risk Tool, v4.0, 19 September 2019.
- CDM – Executive Board “Tool for testing significance of GHG emissions in A/R CDM project activities (Version 01)” EB 31[68];

[64] Available at: <https://verra.org/methodology/vm0015-methodology-for-avoided-unplanned-deforestation-v1-1/>
[65] 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/>
[66] Available at: <https://verra.org/wp-content/uploads/2019/09/AFOLU_Non-Permanence_Risk-Tool_v4.0.pdf>
[67] Available at: <https://verra.org/methodology/vm0007-redd-methodology-framework-redd-mf-v1-6/>
[68] Available at: <https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-04-v1.pdf>.

## 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. | The project activity includes planned logging for timber, in addition to avoiding unplanned deforestation. 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 v4.3.<br><br>The primary land uses in the baseline scenario are: cattle ranching, mainly for producing beef cattle; and timber harvesters, acting both legally and illegally. These unplanned deforestation and degradation agents have been attracted due to infrastructure expansion.<br><br>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 B, “Avoided Deforestation with Logging in the Project Case”. The project area contains 100% native vegetation, and a sustainable forest management plan is implemented. In addition, it is important to note that degradation is not included in either the baseline or project scenario. The area is in the 1st logging cycle and most of the area has not |

| | |
|---|---|
| | been managed yet, which categorizes it as old growth. |
| 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". | The forest classes that compose the project area are named as per Technical Manual for Brazilian Vegetation[69]. The area is considered forest as per the definition of forest adopted by FAO[70]: 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.<br><br>No deforested, degraded or areas otherwise modified by humans were included in the project area at 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 start date. | The project area consisted of 100% tropical rainforest in 2008 – 10 years prior to the project start date – all of which conformed to the Brazilian definition of forest[71]. This was ascertained using satellite images, as described in the section Project Location 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. | Project Area is composed of Luvissols and Cambisol. Therefore, none of the project region grows on peatland, satisfying this applicability criterion. The map will be presented in section 1.13 |

[69] Available at: <https://www.terrabrasilis.org.br/ecotecadigital/pdf/manual-tecnico-da-vegetacao-brasileira.pdf>

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

[71] 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>.

| | |
|---|---|
| | |
| **VT001** | |
| 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 activities in the proposed project boundary does not lead to violation of any applicable law even if the law is not enforced. The sustainable forest management plan is an activity authorized and endorsed in Brazil, and the landowner has all the environmental and legal authorizations necessary to conduct the activity. |
| The use of this tool to determine additionality requires the baseline methodology to provide<br>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. | The methodology provides a stepwise approach to justify determination of the most plausible baseline scenario. |
| **VM0007** | |
| **Applicability Conditions** | **Justification of Applicability** |
| a) At project commencement, the project area shall include only land qualifying as “forest” for a minimum of 10 years prior to the project start date. | The project area consisted of 100% tropical rainforest in 2008 – 10 years prior to the project start date – all of which conformed to the Brazilian definition of forest[72]. This was ascertained using satellite images, as described in the section Project Location of the present VCS PD. |

[72] 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>.

| | |
|---|---|
| b) Baseline deforestation in the project area is categorized as planned deforestation | The conversion of forest lands to deforested conditions in the Project Area in the baseline scenario is legally permitted, excluding Permanent Protection and Legal Reserve areas, in accordance with Brazilian legislation and Authorization Conditions. |
| c) The Leakage of a APD project where the baseline deforestation agent is identified | Project Leakage is identified as defined by VMD0009, estimating the total area of deforestation on all land managed by the baseline deforestation agent. Leakage avoidance activities must not include Agricultural lands that are flooded to increase production (e.g., rice paddy) and Intensifying livestock production. |
| d) VMD0001 v1.1 - Estimation of carbon stocks in the above and below ground biomass in the live tree and non-tree pools (CP-AB) | The Mamuriá Grouped REDD Project meets the applicability condition of this tool because the project area is covered by forest.<br><br>Inclusion of the aboveground tree biomass pool as part of the project boundary is mandatory as per the framework module REDD-MF. Non-tree aboveground biomass and belowground biomass will also be considered in carbon stocks estimates, which is optional per the methodology requirements. |
| e) VMD0002 v1.0 - Estimation of carbon stocks in the dead wood pool (CP-D). | The Mamuriá Grouped REDD Project meets the applicability condition of this tool because the project area is covered by forest.<br><br>The dead wood shall be included as part of the project boundary as per applicability criteria in the framework module REDD-MF, specifically: Dead wood shall be included if stocks are greater in the baseline than in the project scenario (in conformance with REDD-MF), and Dead wood shall be included if |

| | |
|---|---|
| | determined to be significant.<br>Inclusion is optional in the case stocks are not greater in the baseline than in the project scenario. |
| g) VMD0005 - Estimation of carbon stocks in the long-term wood products pool (CP-W). | The Mamuriá Grouped REDD Project meets the applicability condition of this tool because logging operations are expected to happen in the baseline scenario prior to the conversion of forest to non-forest.<br>Inclusion of the harvested wood pool as part of the project boundary is mandatory when the process of the deforestation involves timber harvesting for commercial markets, as per the requirements of the framework module REDD-MF (VM0007). |
| h) VMD0006 - Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation/forest degradation and planned wetland degradation (BL-PL). | The Mamuriá Grouped REDD Project is defined by forest that would be legally converted to non-forest land.<br>This tool was used to estimate the GHG baseline emissions in Project Area. |
| i) VMD0009 - Estimation of emissions from activity shifting for avoiding planned deforestation/forest degradation and avoiding planned wetland degradation (LK-ASP). | The Mamuriá Grouped REDD Project meets the applicability condition of this tool because the baseline scenario is the conversion of forest lands that are legally authorized and documented to non-forest land. |
| i) VMD0016 - Methods for Stratification of the Project Area (X-STR) | This module is mandatory because there are several types of forests in the project area featuring different strata. |
| k) VT0001 - Tool for the demonstration and assessment of additionality in VCS agriculture, forestry, and other land use (AFOLU) project activities (T-ADD) | The activities in the proposed project boundary does not lead to violation of any applicable law even if the law is not enforced. The sustainable forest management plan is an activity authorized and endorsed in Brazil, and |

| | |
|---|---|
| | the landowner has all the environmental and legal authorizations necessary to conduct the activity. |
| l) T-SIG: Tool for testing significance of GHG emissions in A/R CDM project activities | This tool must be used to justify the omission of carbon pools and emission sources is significant. |

## 3.3 Project Boundary

**Spatial Boundaries**

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

**Table 6. Project Area, Reference Region and Leakage Belt**

| Boundary | Area (ha) |
|---|---|
| Project Area total | 64,563.84 |
| AUD | |
| Project Area | 51,066.42 |
| Reference Region | 1,626,009 |
| Leakage Belt | 38,615 |
| APD | |
| Project Area | 13,497.42 |

**Project Area**

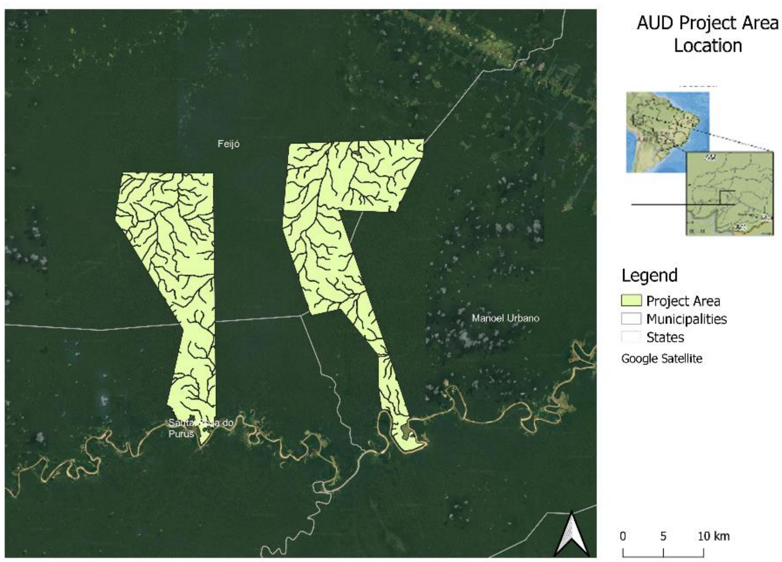
As described in section 1.7, the Project is composed by 2 properties, which have a total area of 64,585.27 ha and the project area (AUD and APD) has 64,564.4 ha. Methodology requirements for both AUD and APD is described below:

### AUD – Avoided Unplanned Deforestation

According to VM00015, Project Area must comprise an area covered only by forest for at least 10 years before 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 to the methodology.

To define the project area, vegetation areas classified as grassland (including flooded fields and swamp areas), water body areas and a 40-meter-wide electrical transmission line area that cuts through part of the property were subtracted from the properties' area. As a result, the project area was defined as 51,066.42 ha. Further characteristics of the Project Area until Project Start Date are described in section 1.13.

**Figure 13. AUD Project Area location**




### APD – Avoided Planned Deforestation

According to the Approved VCS Methodology VM0007, the REDD Boundaries must be clearly delineated and defined and include only land qualifying as forest for a minimum of 10 years prior to the project start date."[73].

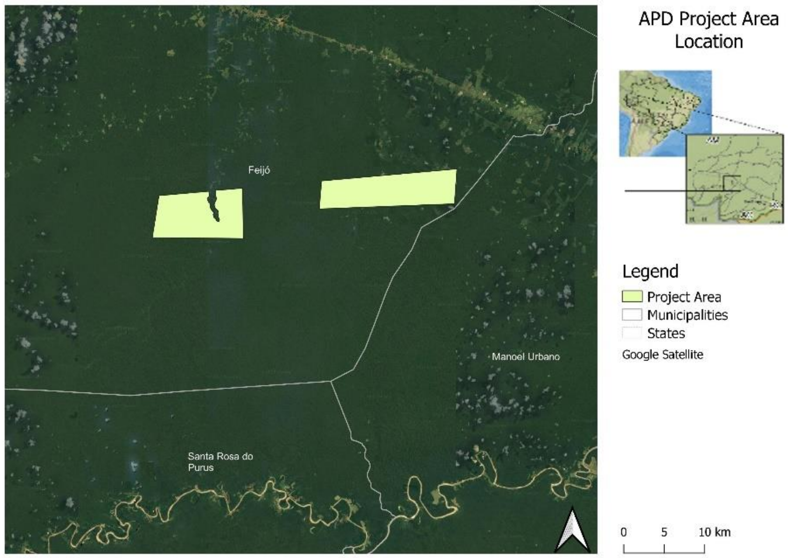
To define the APD project area, deforested areas until the project start date, 25-November-2022, vegetation areas classified as grassland formation (including flooded fields and swamp areas) and water body areas were subtracted from the properties area, keeping only areas where planned deforestation should happen. These water body areas are Permanent Preservation

[73] VM0007, version 1.6. Available at: <https://verra.org/methodology/vm0007-redd-methodology-framework-redd-mf-v1-6/>

Areas, also called APP (in Portuguese), according to the Brazilian Forest Code, Law nº 12.651/12, is a protected area.

The APD project area is 13,497.42 ha.

**Figure 14. APD Project Area Location**




<u>**Reference Region**</u>

### AUD – Avoided Unplanned Deforestation

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 in spatial units for which deforestation baselines will be developed, a baseline must be developed for a 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 10-year period preceding the start date, i.e. October-2010 to October-2020, was determined, representing a credible proxy for possible future deforestation patterns in the project area.

The RR was defined in accordance with two criteria:

- The methodology recommends that projects under 100,000 ha in size should have RRs 20 – 40 times bigger than the project area.

- 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 in order for it to more accurately represent the land-use dynamics. 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 similar to those found within the reference region:

- **Agents and drivers of deforestation**: Timber logging (both legal and illegal) and cattle ranching are important economic activities within the reference region. As detailed in section 1.13 and to be presented in section 3.4, the main agents of deforestation, timber harvesting and cattle ranching, are considered threats throughout the southern 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[74], National Protected Areas[75]. It is important to note that there are no Protected Areas included within the Reference Region. Part of the Alto Rio Purus Indigenous Land is included in the Reference Region.
- **Landscape configuration and ecological conditions:** To define the Reference Region, the watersheds located 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

[74] Available at <https://www.car.gov.br/publico/municipios/downloads>
[75] Available at <https://metadados.snirh.gov.br/geonetwork/srv/api/records/9407d38f-84d2-48ea-97dd-ee152c493043>

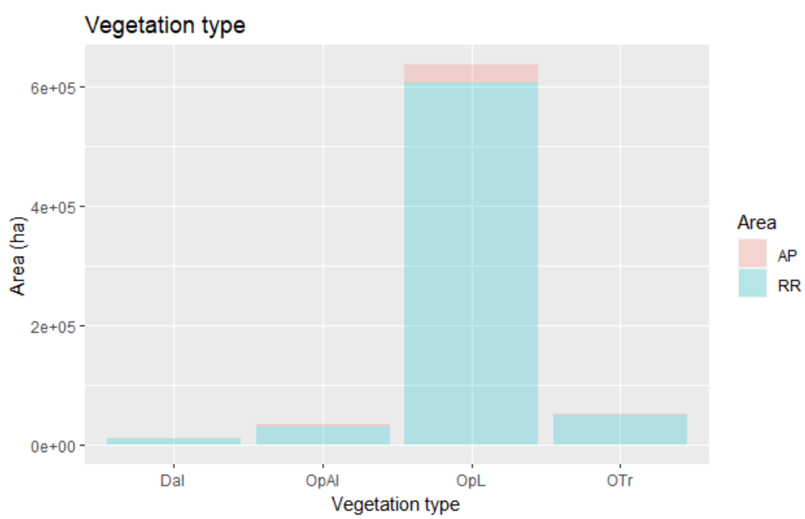
was possible to visualize areas that presented similar values to the Project Area's parameters. The area units were then used to achieve an extent of approximately 20-40 times the size of the Project Area as the Reference Region.

From the definition of this 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. The results are presented below:

<u>Vegetation cover</u>

The phytophysiognomies present in the Project Area is Dense Lowland Tropical Rainforest. In the rest of the reference region, these phytophysiognomies occupy 98.29%.

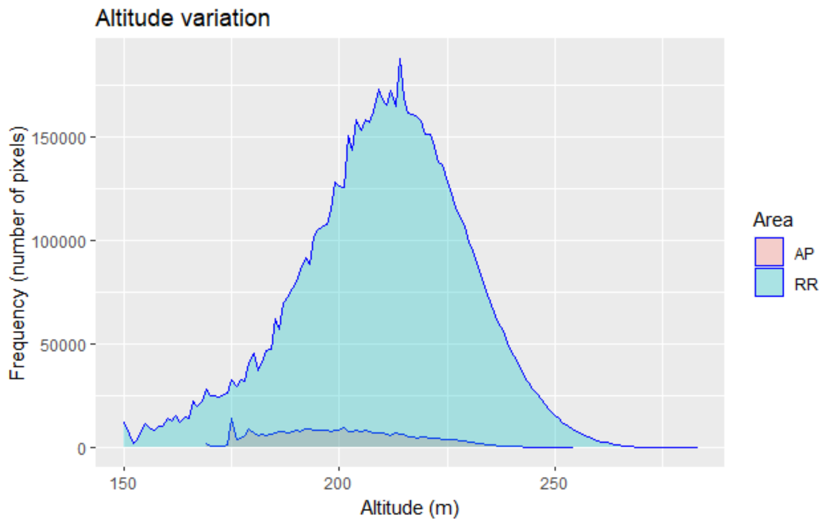
**Figure 15. Distribution of phytophysiognomies, in area (ha), in the Reference Region (RR) and in the Project Area (AP)**




<u>Altitude</u>

The altitude in the project area ranges from 169 to 254 m and these values are within 96.45% of the variation in the rest of the reference region.

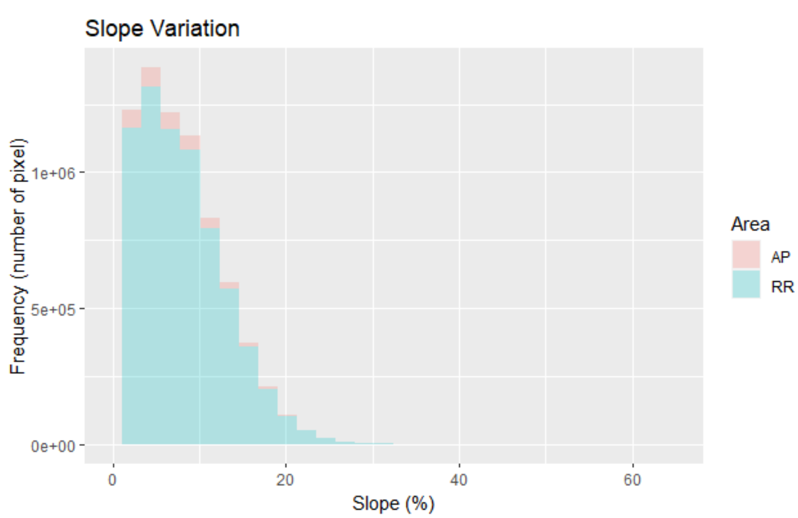
**Figure 16. Altitude distribution (m), in number of pixels, in the Reference Region (RR) and in the Project Area (PA)**




## Slope

The average slope in the project area is 6.81% while in the rest of the reference region it is 7.26%. Therefore, the mean value of 90% of the project area is within the range of ± 10% of the mean in the reference region, which is between 6.54 and 7.99%.

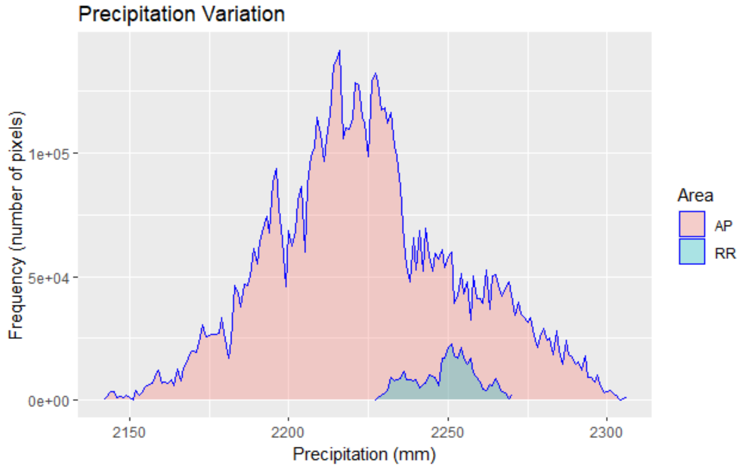
**Figure 17. Slope distribution (degrees), in number of pixels, in the Reference Region and in the Project Area.**




## Rainfall

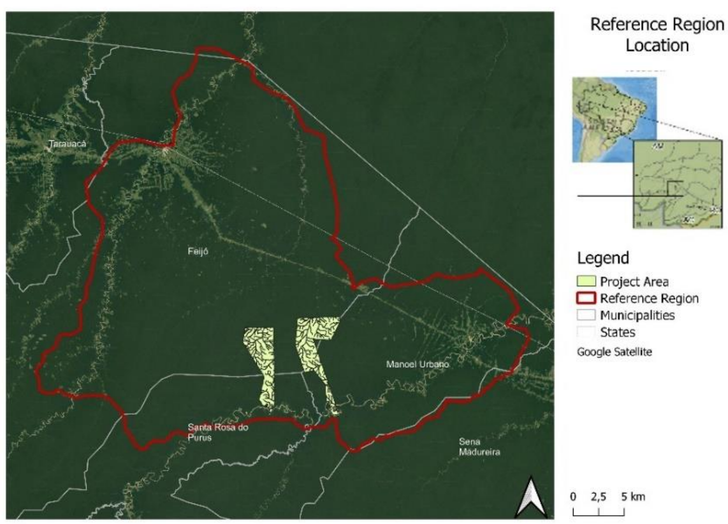
The annual rainfall in the project area is, on average, 2,249.37 mm, while in the rest of the reference region it is 2,224.61 mm. Thus, it is verified that the amount of rainfall in the project area remains within the variation of ± 10% of 100% of the average of the rest of the reference region, which varies between 2,002.15 and 2,447.07mm.

**Figure 18. Distribution of annual precipitation (mm), in number of pixels, in the Reference Region (RR) and in the Project Area (PA).** [76]




Based on the criteria related to the type of vegetation, elevation, slope and precipitation above, the reference region was defined, which has 1,626,009 ha (26.8 times the Project Area). The map showing the RR and PA is presented below:

**Figure 19. Location of the Reference Region**




<u>**Leakage Belt**</u>

The leakage belt is defined as an area where emissions can occur due to changes in the behavior of external agents in response to conservation actions carried out in the project area. These areas

[76] Rainfall data available at: < https://www.worldclim.org/data/worldclim21.html>

also include previously deforested areas given the region's economic viability, but the focus is mainly on areas with potential for forest conversion for other uses.

To determine the leakage belt area, was carried out the methodology of opportunity cost. Therefore, the economic viability of livestock production was spatialized in the Reference Region of the project, which consists of the difference between the sale price of the cattle (per ton) and the average cost of production (per ton) plus the cost of transportation to take the product to the nearest consumer center. The inclusion of pressure from the wood market in the region was also evaluated as an opportunity, as this market had great growth in recent years. However, as will be described later on, livestock farming is viable throughout the region, and it is quite likely that timber will follow this pattern. As the spatialization is based on distance, the inclusion of the two factors should not interfere in the definition of the leakage area, and therefore, the region was delimited based on livestock data. This activity is one of the main agents of deforestation, since in addition to its possible economic gains, it is closely associated with land grabbing, one of the greatest threats in the region[77].

The methodology for calculating road transport costs for livestock in the region considered the sum of the distance that would be travelled in a straight line between the pasture areas and the open accesses (local highways and roads) with the distance traveled to the nearest commercial center.

For monetary costs, it was considered the freight table of “Portaria 314 de 21/05/2013”, which establishes the values for charging ICMS in providing intercity and interstate road transport services in the Acre market[78]. The single attachment of the ordinance mentioned above details the value of the dry cargo transport freight.

Thus, these values were corrected by the Broad National Consumer Price Index (in portuguese, *Índice Nacional de Preços ao Consumidor Amplo - IPCA*) on the project start date. The transport of 25 heads of 17 arrobas (12,750 kg) was considered, For sales values, Portaria 333 de 11/11/2021 was considered, which sets the minimum values of the ICMS tax base levied on operations and services with related goods.

Combining these two data, the economically viable areas for livestock production would be where the sum of revenues minus total costs are positive. The breeding cost per animal was estimated at approximately R$689.69, considering an extensive system of traditional breeding in the state of Acre for the year 2010[79]. After correction by the Broad National Consumer Price Index (IPCA) on the project start date, this amount corresponds to R$1,145.80. The average price of arroba

[77] Information available at: < https://www.climatepolicyinitiative.org/pt-br/publication/a-economia-da-pecuaria-na-amazonia-grilagem-ou-expansao-da-fronteira-agropecuaria/>

[78] ACRE. Portaria nº 314, de 21 de maio de 2013. Estabelece os valores para cobrança do ICMS na prestação de serviço de transporte rodoviário intermunicipal e interestadual de cargas no mercado acreano. Rio Branco, AC. Available at: <http://sefaz.acre.gov.br/2021/?page_id=9510>. Acesso em 2 de julho de 2022.

[79] DE SÁ, C. P.; DE ANDRADE, C. M. S.; VALENTIM, J. F. Análise econômica para a pecuária de corte em pastagens melhoradas no Acre. Embrapa Acre-Circular Técnica (INFOTECA-E), 2010.

varied between R$252.38 and R$293.00 during the year 2021[80]. In the analysis, the minimum value of R$270.00 was used. For an average of 17 arrobas per animal, the income would be R$ 3444.20.

Thus, the calculation of the potential profitability was carried out for each territorial unit in the reference region, which can be summarized using the following formula:

$$PPx_l = S\$x - PCx_i - \sum_{v=1}^{V}(TDv * TCv)$$

Where:

**PPxl:** Potential profitability of product Px at location l (pixel or polygon); $/t

**S$x:** Selling price of product Px; $/t

**PCxi:** Average in situ production costs for one ton of product Px in stratum i; $/t

**TDv:** Transport distance on land, river or road of type v; km

**TCv:** Average transport cost per kilometer for one ton of product Px on land, river or road of type v; $/t/km

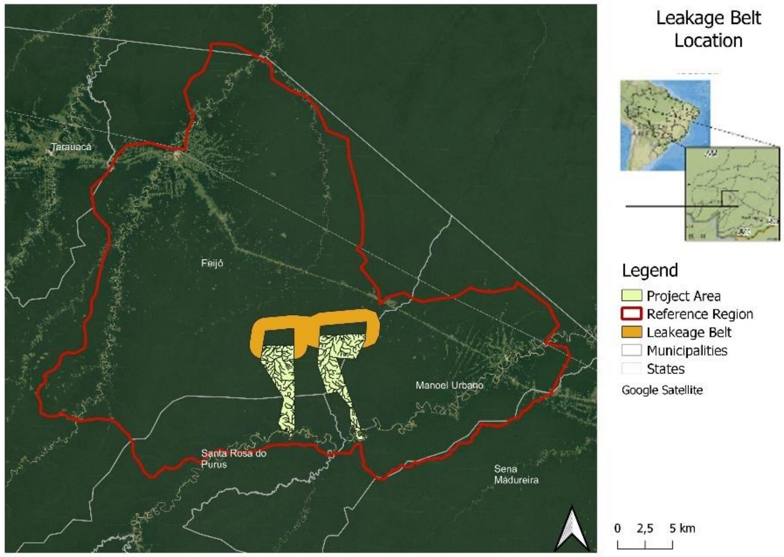
**V:** 1, 2, 3 …V, type of surface to on which transport occurs; dimensionless

With these considerations, the remaining areas with higher profitability values would be more attractive for the activity. Thus, the area with the highest potential value (R$ 7,499.24/t) was highlighted. Furthermore, was considered that areas adjacent to the project area viable according to the opportunity cost analysis within a radius of 5km would be where deforestation could occur directly due to the project's actions. In more distant areas, the increase in deforestation, as has already happened, is probably associated with the proximity to rivers and roads.

Finally, by overlapping the project area buffer with the areas with the greatest potential for profitability, we defined a Leakage Belt area of 38,615 ha. The figure below illustrates its location.

**Figure 20. Leakage Belt location**

[80] CONAB. Companhia Nacional de Abastecimento. Preços agrícolas, da sociobio e da pesca. Available at: https://sisdep.conab.gov.br/precosiagroweb/.



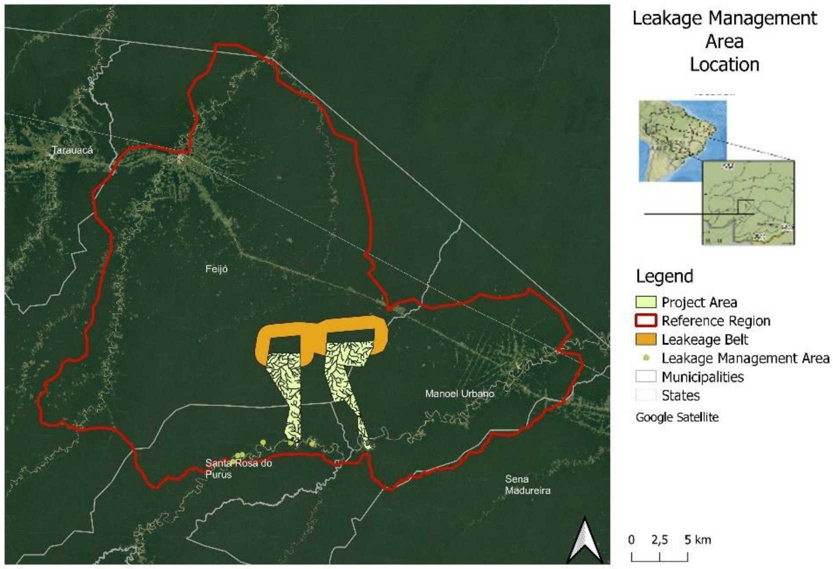

The Instance 1 APD areas were considered as a leakage protection "buffer", so no leakage is expected to occur there.

<u>Leakage Management Area</u>

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.

The Leakage Management Area was defined considering the nearest communities to Instance 1, and their locations are represented in the Figures below:

**Figure 21. Leakage Management Area**




## APD – Avoided Planned Deforestation

### Proxy Areas

For APD projects, it is necessary to define the Proxy Areas. These Proxy Areas may or may not be managed by the same deforestation agent as the project area baseline. At least 6 proxy areas must be included. Criteria for selecting Proxy Areas include:

1. Land conversion practices should be the same as those used by the baseline agent.
2. Post-deforestation land use should be the same in proxy areas as expected in the project area that have the same business.
3. Proxy areas shall have the same type of management and land use rights as the proposed project area.
4. If there are an insufficient number of sites in the immediate area of the project, the sites must be identified elsewhere in the same country as the project.
5. Deforestation agents in proxy areas must have deforested their land under the same criteria as the project lands (legally permitted and suitable for conversion).
6. Deforestation in the proxy area must have occurred in the 10 years prior to the baseline period.
7. The forest types surrounding the proxy area or in the proxy area prior to deforestation shall be in the same proportion as in the project area.
8. Analysis of proxy areas can be done through original data collection (field measurements and/or remote sensing analysis).

The annual deforestation rate in the proxy areas was calculated according to Equation 1. The results and parameters used for this calculation are described in the table below.

$$\boldsymbol{D\%_{planned,i\,t}} = \frac{\left(\sum_{pn=1}^{n^*}\left(\frac{\boldsymbol{D\%_{pn}}}{\boldsymbol{Yrs_{pn}}}\right)\right)}{\boldsymbol{n}}$$

Where:

$D\%_{planned,i\,t}$ : Projected annual proportion of land that will be deforested in stratum *i* during year *t*; %

$D\%_{pn}$: Percentage of deforestation in *pn* portion of a proxy area as a result of planned deforestation; %

$Yrs_{pn}$: Number of years deforestation occurred in the *pn* plot in the proxy area;

$n$: Total number of plots examined.

**Table 7. Deforestation rates and parameters used for this calculation on the proxy areas**

| Proxy Area | Total Parcel Area (ha) | Deforested Area 2010-2020 (ha) | Yrspn | %Dpn | D%/Yrspn |
|---|---|---|---|---|---|
| ID1 | 9,933.11 | 1,617.09 | 10 | 16.28% | 1.63% |
| ID2 | 8,012.42 | 1,022.24 | 10 | 12.76% | 1.28% |
| ID3 | 661.50 | 11.92 | 8 | 1.80% | 0.23% |
| ID4 | 1,787.75 | 12.28 | 9 | 0.69% | 0.08% |
| ID5 | 2,110.35 | 3.96 | 7 | 0.19% | 0.03% |
| ID6 | 1,007.91 | 173.76 | 10 | 17.24% | 1.72% |
| ID7 | 15,342.56 | 1,109.78 | 10 | 7.23% | 0.72% |
| Escanteio | 9,984.53 | 0.00 | 0 | 0.00% | 0.00% |
| Average (n=10) | 0.81% | | | | |

Seven proxy areas were then defined. The ID4 proxy area is located in the municipality of Tarauacá, the proxy areas ID2, ID3, ID5, ID6, and the Escanteio Farm are located in the municipality of Feijó, and the proxy areas ID1 and ID7 in the municipality of Manoel Urbano.

<u>Leakage Area</u>

By estimating the total area of deforestation in all lands managed by the baseline deforestation agent, it is possible to observe the existing displacements of the activities of the same deforestation agent, but in other areas under its management.

The predicted deforestation within the project boundary is then subtracted from the total deforestation on all land managed by the baseline agent/class. This subtraction gives the expected deforestation if no leakage occurs. If deforestation is subtracted from the total area of deforestation monitored by the base deforestation agent, the result is the area of leaked deforestation.

It was possible to prove that the identified deforestation agent does not have forest areas subject to suppression beyond the project area. Thus, there will be no displacement of deforestation due to the project's management actions, and leakage will not be considered, as indicated in the methodology VMD0006-BL-PL v1.3.

<u>Forest</u>

According to the Brazilian Forests at a Glance 2019[81], the Brazilian Forest Service considers as forests the lands that correspond to the vegetation typologies according to the Classification System of the Brazilian Institute of Geography and Statistics (IBGE), updated by the SIVAM project[82]. 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. The compliance of the project area with these definitions is further explained in section 1.13.

In addition, as per VM0015 methodology, the Minimum Mapping Unit (MMU) size of the LULC maps created using RS imagery shall not be more than one hectare irrespective of forest definition. Thus, the 30 m resolution LANDSAT images used for mapping have the minimum mapping unit defined at 30x30m (0.09ha), therefore falling easily to the methodology requirement. Details on data and image processing can be verified in Appendix II.

81 Available at: <https://www.florestal.gov.br/documentos/publicacoes/4262-brazilian-forests-at-a-glance-2019/file>

82 As of 1996, through a contract signed between the Implementation Commission of the Airspace Control System - Ciscea, and its Amazon's Surveillance System Project - Sivam, and IBGE, updated the information that make up the Legal Amazon, attending, at the same time, the Systematization of Information on Natural Resources project. Information available at: <https://www.terrabrasilis.org.br/ecotecadigital/pdf/manual-tecnico-da-vegetacao-brasileira.pdf>; SIVAM Project: <https://www.camara.leg.br/noticias/55929-o-que-e-o-sivam/>.

Temporal Boundaries

AUD – Avoided Unplanned Deforestation

- **Starting date and end date of the historical reference period**

  The adopted historical reference period is January 2010 to December 2020.

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

  The project has a crediting period of 30 years, from 07-October-2020 until 06-October-2050.

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

  The first baseline period is from 07-October-2020 to 06-October-2026.

APD – Avoided Planned Deforestation

- **Starting date and end date of the historical reference period**

  The adopted historical reference period is January 2012 to December 2022.

- **Starting date of the project crediting period the APD project activity**

  APD Project Start Date is 25-November-2022. The project has a crediting period of 30 years, following the AUD crediting period, from 07-October-2020 until 06-October-2050.

Carbon Pools

AUD – Avoided Unplanned Deforestation

The applied Methodology VM00015 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 Table below.

**Table 8. Carbon pools included or excluded within the boundary of the proposed AUD project activity**

| Carbon pools | Included / Excluded | Justification / Explanation of choice |
|---|---|---|
| Above-ground | Tree: Included | Carbon stock change in this pool is always significant |
| | Non-Tree: Excluded | No existence of perennial crops as final class |
| Below-ground | Included | Stock change in this pool is significant |
| Dead wood | Excluded | 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. |

| | | |
|---|---|---|
| Harvested wood products | Excluded | Stock change in this pool was not considered in the baseline or project scenarios. This exclusion is conservative. |
| 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, 4.0. |

According to the applied methodology, harvested wood products must be included if removal of timber is associated with significantly more carbon stored in long-term wood products in the baseline case compared to the project scenario. The significance criterion shall apply.

According to the most common species harvested by illegal agents in the project region[83], relating the species with the highest commercial value and their presence in the region (according to a forest inventory conducted close to the project region in the State of Pará), it can be concluded that the potential volume of wood harvested by illegal loggers during the baseline would be of 17 $m^3$/ha.

In addition, logging in the baseline case occurred through planned and unplanned activities. In both cases, harvesting targeted the most commercially valuable species[84], without the use of proper machinery and planning, i.e., the same species were harvested using low efficiency methods without any criteria regarding the number of remaining trees per species. In addition, in both scenarios, after harvesting the most valuable species, the area was abandoned for illegal deforestation.

Thus, it can be concluded that logging in the baseline scenario, both by planned and unplanned activities, harvested the same species and volumes per hectare[85].

After the conclusions reported above, a significance test was performed following the “Tool for testing significance of GHG emissions in A/R CDM project activities”, according to the applied methodology. According to the Tool, the sum of decreases in carbon pools and increases in emissions that may be neglected shall be less than 5% of the total decreases in carbon pools

[83] Term of apprehension of illegal wood from SEMA-PA. The document gathers information on wood species seized without documentation during the surveillance operation in the project area and its surroundings, originated from reports of illegal deforestation. From this, it is possible to evaluate the most sought-after species, usually for having greater commercial value.

[84] The comparison of the SEMA-PA apprehension term, literature and the post-exploratory report of the management plan executed before the project start date allowed to conclude that around 90% of the harvested volume carried out by baseline planned activities are composed by the same species illegally logged in the baseline.

[85] Information available at Apprehension Report by SEMA-PA – 2019 and EXPLORAÇÃO E VALORAÇÃO EM TORA DE 10 ESPÉCIES FLORESTAIS NO BAIXO AMAZONAS, ESTADO DO PARÁ, ENTRE 2006 – 2016 <https://periodicoscientificos.ufmt.br/ojs/index.php/biodiversidade/article/view/9999 >

and increases in emissions, or less than 5% of net anthropogenic removals by sinks, whichever is lower.

This analysis was conducted for baseline logging activities (both planned and unplanned), and it was found that the sum of decreases in carbon pools and increases in emissions represents less than 5% of the total decrease in carbon pools and increase in emissions and less than 5% of net anthropogenic removals by sinks (i.e., 1.03%).

As per VM0015: If logging activities are present in the baseline, the harvested wood product carbon pool must be estimated and, if significantly higher in the baseline compared to the project scenario, it will have to be accounted. As harvested wood product carbon pool is not significant, harvested wood products was excluded in the baseline scenario, according to the methodology requirements.

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 in the Section 4.1 - Baseline Emissions.

#### APD – Avoided Planned Deforestation

The table below describes the relevant carbon stock considered in the scope of the project, according to VM0007.

**Table 9. Carbon pools included or excluded within the boundary of the proposed APD project activity**

| Carbon pools | Included / Excluded | Justification / Explanation of choice |
|---|---|---|
| Above-ground | Tree: Included | Inclusion is mandatory as per VM0007 v1.6, table 04. Carbon stock in this pool may increase or decrease in the baseline scenario and may increase due to the implementation of the project activity |
| | Non-Tree: Excluded | Included in carbon stocks estimates. Inclusion is optional in the case stocks are not greater in the baseline than in the project scenario |
| Below-ground | Included | Stock change in this pool is significant |
| | Non-Tree: Included | Included in carbon stocks estimates. Inclusion is optional in the case stocks are not greater in the baseline than in the project scenario. |
| Dead wood | Excluded | Excluded for simplification. |

| | | |
|---|---|---|
| Harvested wood products | Included | Inclusion of the harvested wood pool as part of the project boundary is mandatory when the process of the deforestation involves timber harvesting for commercial markets, as per VM0007 v1.6, table 04. |
| Litter | Excluded | Excluded as it does not lead to a significant over-estimation of the net anthropogenic GHG emission reductions of the APD project activity. This exclusion is conservative. |
| Soil organic carbon | Excluded | Inclusion is optional, as per VM0007 v1.6, table 04. |

In addition, 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 and APD project activities, as well as the respective justification/explanation, are described in the Table below.

### AUD – Avoided Unplanned Deforestation

**Table 10. Sources and 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 | $CH_4$ | Excluded | No livestock agriculture increase is predicted to occur in the project scenario compared to the baseline case. Therefore considered insignificant. |
| | | $N_2O$ | Excluded | As above. |
| | | Other | Excluded | No other GHG gases were considered in this project activity. |

APD – Avoided Planned Deforestation

**Table 11. Sources and GHG included or excluded within the boundary of the proposed APD Project Activity.**

| Source | | Gas | Included? | Justification / Explanation of choice |
|---|---|---|---|---|
| Baseline scenario | Burning of woody biomass | $CO_2$ | Included | Excluded as recommended by the applied methodology. Counted as carbon stock change. |
| | | $CH_4$ | Included | For some regions fire is used as a tool to convert the forest into pasture and other crops. In the process of legal forest clearing, commercial timber is harvested and the remaining woody material is felled and burned on site. Non-CO2 gases are expected to be emitted due to the burning of woody biomass in the baseline scenario. |
| | | $N_2O$ | Included | |
| | Combustion of fossil fules | $CO_2$ | Excluded | It is conservative to exclude according to VM0007 v1.6, table 7 |
| | | $CH_4$ | Excluded | Potential emissions are negligible according to VM0007 v1.6, table 7 |
| | | $N_2O$ | Excluded | Potential emissions are negligible according to VM0007 v1.6, table 7 |
| | Use of fertilizers | $CO_2$ | Excluded | Potential emissions are negligible according to VM0007 v1.6, table 7. Fertilizer use is not common for stater pastures. |
| | | $CH_4$ | Excluded | Potential emissions are negligible according to VM0007 v1.6, table 7. Fertilizer use is not common for stater pastures. |
| | | $N_2O$ | Excluded | It is conservative to exclude according to VM0007 v1.6, table 7. |
| Project scenario | Burning of woody biomass | $CO_2$ | Included | Carbon stock decreases due to burning are accounted as a carbon stock change. |
| | | $CH_4$ | 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. |
| | Combustion of fossil fules | $CO_2$ | Excluded | Excluded from baseline |
| | | $CH_4$ | Excluded | Potential emissions are negligible according to VM0007 v1.6, table 7 |
| | | $N_2O$ | Excluded | Potential emissions are negligible according to VM0007 v1.6, table 7 |
| | Use of fertilizers | $CO_2$ | Excluded | Potential emissions are negligible according to VM0007 v1.6, table 7 |

| | | | |
|---|---|---|---|
| | $CH_4$ | Excluded | Potential emissions are negligible according to VM0007 v1.6, table 7 |
| | $N_2O$ | Excluded | Excluded from baseline |

## 3.4 Baseline Scenario

### AUD – Avoided Unplanned Deforestation

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, as described below. Therefore, the project falls into the AFOLU-REDD category, specifically: Avoided unplanned deforestation (AUD). The revenue from the present REDD project is essential to maintain this area as standing forest, as described under additionality of the Project (Section 3.5), as well as to carry out the present project's Leakage Management Activities.

Degradation was not considered in the present REDD project, in accordance with methodology requirements, which define "forest" and "non-forest" as the minimum land-use and land-cover classes.

**Analysis of historical land-use and land-cover change**

- **Collection of appropriate data sources**

**GIS MAPPING, REMOTE SENSING TECHNIQUES**

The historical reference period is the period on which analysis of LU/LC-change within the reference region and project area is carried out. The historical reference period for the present project during the assessment of the baseline period comprised analysis of images from 2010 to 2020. In accordance with the methodology, the analysis shall be made using the data obtained from monitoring LU/LC changes in the reference region during the historical reference period.

In order to assess the land use dynamics within the reference region for the baseline period, remote sensing satellite analysis was carried out, considering a historical period from 2010 to 2022, having MapBiomas[86] (collection 6.0) as the main source, using images that are available in raster format on the program's website. Supervised classifications from Google Earth Engine were also used. This classifier is the same used in MapBiomas, allowing a closer adequacy to the Methodology.

MapBiomas is a multi-institutional initiative of the Greenhouse Gases Emissions Estimation System[87] promoted by the Climate Observatory. Its creation involves NGOs, universities, and

[86] Available at: <http://mapbiomas.org/>

[87] Available at: <SEEG - http://seeg.eco.br/en/>

technology companies. In MapBiomas, the image classification methodology uses, for each year, all Landsat images available in each period, with a cloud cover less than or equal to 50%. Thus, a representative mosaic of each year is generated by selecting cloudless pixels from the available images. For each pixel, metrics that describe its behaviour during the year are extracted and can contain up to 105 layers of information with an artificial intelligence classifier, Random Forest. The acquisition of Landsat images is done via Google Earth Engine, with sources from NASA (American Space Agency) and USGS (US Geological Survey).

The algorithm uses samples obtained by reference maps, generation of stable collections from previous MapBiomas series and direct collection by visual interpretation of Landsat images to classify as a single map per class. This classification then goes through the stages of the spatial filter, applying neighbourhood rules and temporal filters, in particular land cover change and other impossible or prohibited kinds of use, in order to reduce spatial and temporal inconsistencies.

For the supervised classification, this same algorithm was used, but without the use of metrics, temporal filters and neighborhood rules applied in the MapBiomas methodology. In order to obtain an image suitable for direct sample classification, images from the USGS Landsat 8 Collection 1 Tier 1 TOA Reflectance collection with a 15% cloud cover limit were collected within the Reference Region, and an average of these images was generated. Training samples were generated for each land use class (forest, water and deforestation) and the Random Forest automatic classifier was applied via Google Earth Engine. The spatial filter was then applied with the Majority Filter tool from ArcGIS, using 8-pixel neighborhood. This filter is used in MapBiomas in order to avoid unwanted modifications on the edges of pixel groups (blobs).

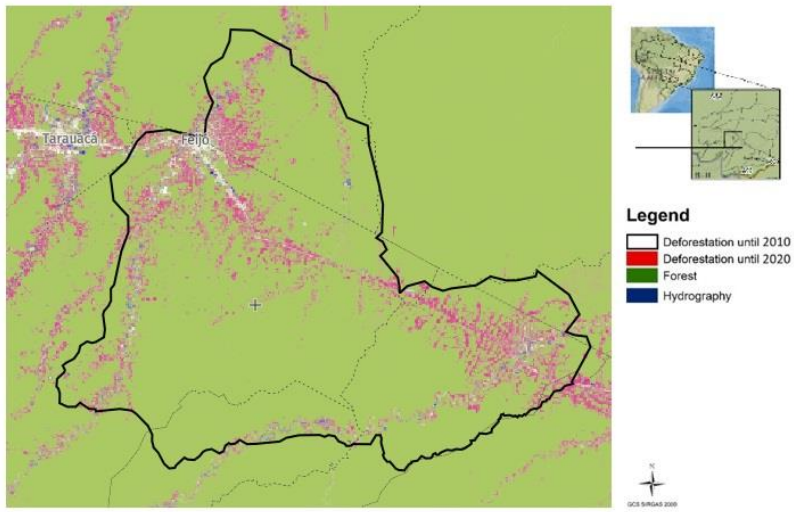
| Vector | Sensor | Resolution | | Coverage | Acquisition date | Scene | |
|---|---|---|---|---|---|---|---|
| | | Spatial (m) | Spectral (µm) | (Km²) | DD/MM/YY | Path/ Latitude | Row/ Longitude |
| Satellite | Landsat TM | 30 | 0.45 - 2.35 | 34225 | 2010 - 2020 | 3 | 66 |
| Satellite | Landsat TM | 30 | 0.45 - 2.35 | 34225 | 2010 - 2020 | 4 | 66 |
| Satellite | Landsat TM | 30 | 0.45 - 2.35 | 34225 | 2010 - 2020 | 4 | 65 |

- <u>Definition of classes of land-use and land-cover (LU/LC)</u>

  The classes of LU/LC were defined as “forest” and “non-forest” in accordance with the procedures described above. These classes are the minimum classes to be considered in the present REDD project, as stipulated by the Methodology. As such, degradation was not a factor.

Stratification was not carried out in either class, and therefore the categories “forest” and “non-forest” have homogenous carbon stocks. Satellite images were used to generate the land-use and land-cover map in 2020, shown on the Figure below.

**Figure 22. Land use and land cover dynamics between 2010 and 2020 within the Reference Region**




Following the VM00015 Methodology requirements, the LU/LC maps have been conducted using satellite images. There are two surveys available in Brazil for deforestation and forest mapping: INPE (PRODES) and Mapbiomas. However, none of them separates deforestation by forest classes.

As aforementioned, land-use change analyses have been conducted through MapBiomas images, which is a new platform that produces maps through a pixel-by-pixel classification from Landsat satellite images. The entire process is done with extensive machine learning algorithms through the Google Earth Engine system that offers more detailed, precise and available information. MapBiomas presents a higher temporal frequency than the official data from Prodes, and thus it is recommended as image reference for regions with high cloud cover throughout the whole year.

Thus, definition of classes of land-use and land-cover was performed through MapBiomas’ classification, which identifies forest, non-forest vegetation, anthropic uses (categorized as deforestation) and hydrography (lakes and rivers). For this map, the accuracy assessment has been conducted, which meets the methodology requirements.

Furthermore, the official map for all vegetation types of the country, which was elaborated by IBGE (Brazilian Institute of Geography and Statistics), was used to check the vegetation types present within the RR, PA and LK. The vegetation type map was created by IBGE considering several aspects that are able to differentiate one type of vegetation to the other, such as species composition, elevation and climate variation, soil type, among others. The accuracy assessment of this mapping would be unfeasible, since the IBGE map was generated considering characteristics such as soil type, elevation, species composition, etc.

Two vegetation types were found, and, according to this analysis, the Dense Lowland Tropical Forest is the main forest type present within the project area, with around 95% of the total forest cover. Thus, after verifying that most of the project boundaries were composed of only one phytophysiognomy, the mapping and modeling of the project proceeded without stratification.

The LU/LC classes present in the project area, reference region and leakage belt at the project start date are listed in Table below, which specifies whether logging, fuel wood collection or charcoal production are occurring in the baseline case.

**Table 12. List of land use and land cover change categories**

| Class identifier | | Trend in carbon stock[1] | Presence in[2] | Baseline activity[3] | | | Description (including criteria for unambiguous boundary definition) |
|---|---|---|---|---|---|---|---|
| IDcl | Name | | | LG | FW | CP | |
| 1 | Forest | constant | RR, PA, LK | yes | no | no | According to official classification of the types of vegetation of Brazil (SIVAM) and the high representativeness of the main forest type within the project area, no stratification in different forest classes was conducted. In addition, carbon density is not expected to undergo significant changes due to degradation in the baseline case. According to the significance test, carbon stock change due to logging activities in the baseline case is considered insignificant and therefore, trend in carbon stock could be deemed as constant. |
| 2 | No forest | constant | RR, PA, LK | no | no | no | Mosaic of anthropic areas: pasture, annual, perennial crops and roads according to the satellite image classification. |
| 3 | Hydrography | constant | RR, PA, LK | no | no | no | Presence of rivers and water bodies in the satellite image classification and information from the National Water Agency - ANA. |

An analysis in the Amazon region[88] between 2009-2016 shows that there is no trend in degradation, although it affects an area larger than deforestation. It was concluded that degradation can serve as a warning that the region will soon be the target of deforestation practices. As the degradation has low local recurrence over the years, i.e., on average the same area is classified as degraded only once during the analyzed period, it is very unusual that the same area will suffer another degradation, since the valuable woods have already been harvested. Thus, it is very likely that carbon stocks after degradation might increase. Therefore, it is conservatively assumed that the trend in carbon stocks in the baseline case is constant.

[88] Available at https://www.climatepolicyinitiative.org/wp-content/uploads/2021/03/DQ-Degradacao-Florestal-Amazonia.pdf

The main forest type present in RR, PA and LB is described below, according to the Technical Manual of the Brazilian Vegetation[89]:

- **Dense Lowland Tropical Rainforest** – This type of vegetation is characterized by woody plants, in addition to woody lianas and epiphytes in abundance, which differentiate it from other classes of formations. However, its main ecological characteristic resides in the ombrophilous environments that mark the “floristic forest region”. Thus, the thermal characteristic of the Dense Ombrophylous Forest is linked to tropical climatic factors of high temperatures (averages of 25ºC) and high precipitation, well distributed throughout the year (from 0 to 60 dry days), which determines a bioecological situation with virtually no biologically dry period. The lowland rainforest is a formation that generally occupies the coastal plains. It occurs in the Amazon, extending throughout the Brazilian Northeast region to the vicinity of the São João River, in the State of Rio de Janeiro. Towards the south, this formation occurs in the Quaternary terrains located generally just above sea level, in the plains formed by silting due to erosion in the coastal mountains, and in the maritime inlets.

**Figure 23. Dense Tropical Rainforest profile**


- <u>Definition of categories of land-use and land-cover change (LU/LC-change)</u>

  The LU/LC-change categories that could occur within the project area and leakage belt during the first baseline period, in both the baseline and project case, are identified in the potential LU/LC-change matrix and the list of LU/LC-change categories during the project crediting period, shown on the Tables below.

  It is shown that deforestation could occur in the baseline and project scenarios within both the PA and LK areas; the hectares show the quantities of deforestation during the crediting period associated with each identifier. The deforestation presented within the PA and LK are shown in the LU/LC-change map.

  As shown in tables below, degradation was not considered in any of the LU/LC classes.

[89] Available at https://www.terrabrasilis.org.br/ecotecadigital/pdf/manual-tecnico-da-vegetacao-brasileira.pdf

**Table 13. Land use change matrix between 2008 and 2018**

| | | Initial LU/LC class | |
|---|---|---|---|
| | IDcl | Forest | No forest |
| Final Class | Forest | I1/F1 | 0 |
| | No forest | I1/F2 | I2/F2 |

BASELINE SCENARIO

| | PA | Initial LU/LC class | |
|---|---|---|---|
| | IDcl | Forest | Non Forest in the PA |
| Final Class | Forest | 43,865.06 | 0.00 |
| | Non Forest in the PA | 7,201.36 | 0.00 |

| | LB | Initial LU/LC class | |
|---|---|---|---|
| | IDcl | Forest | Non Forest in the LK |
| Final Class | Forest | 32,544.20 | 0.00 |
| | Non Forest in the LK | 5,342.80 | 871.00 |

PROJECT SCENARIO

| | PA | Initial LU/LC class | |
|---|---|---|---|
| | IDcl | Forest | Non Forest in the PA |
| Final Class | Forest | 48,666.51 | 0.00 |
| | Non Forest in the PA | 393.99 | 0.00 |

| | LB | Initial LU/LC class | |
|---|---|---|---|
| | IDcl | Forest | Non Forest in the LK |
| Final Class | Forest | 31,463.99 | 0.00 |
| | Non Forest in the LK | 6,423.01 | 871.00 |

The Table below also shows that no classes were predicted to grow in carbon stocks, this is because secondary forest was not considered as a category.

**Table 14. List of land use and land cover change categories**

| IDct | Name - Initial | Trend in carbon stock[1] | Presence in | Activity in the baseline case | | | Name - Final | Trend in carbon stock | Presence in | Activity in the project case | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | LG | FW | CP | | | | LG | FW | CP |
| I1/F1 | Forest | constant | RR, PA, LK | yes | no | no | Forest | constant | RR, PA, LK | yes | no | no |
| I1/F2 | Forest | constant | RR, PA, LK | yes | no | no | Non Forest | constant | RR, PA, LK | yes | no | no |
| I2/F2 | Non Forest | constant | RR, LK | no | no | no | Non Forest | constant | RR, PA, LK | no | no | no |

- <u>Analysis of historical land-use and land-cover change</u>

According to the GIS analysis, between 2010 and 2020, there was a deforestation of 105,210 ha within the reference region, with an average oscillation of approximately 10,521 ha/year.

**Figure 24. Variation in the deforestation rate within the reference region between 2010 and 2021**

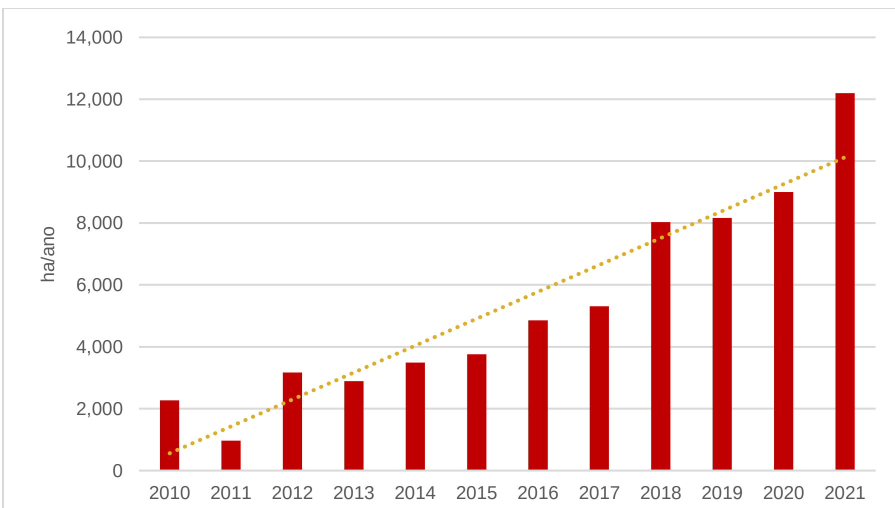


**Figure 25. Deforestation dynamics between 2010 and 2020, in the Reference Region**

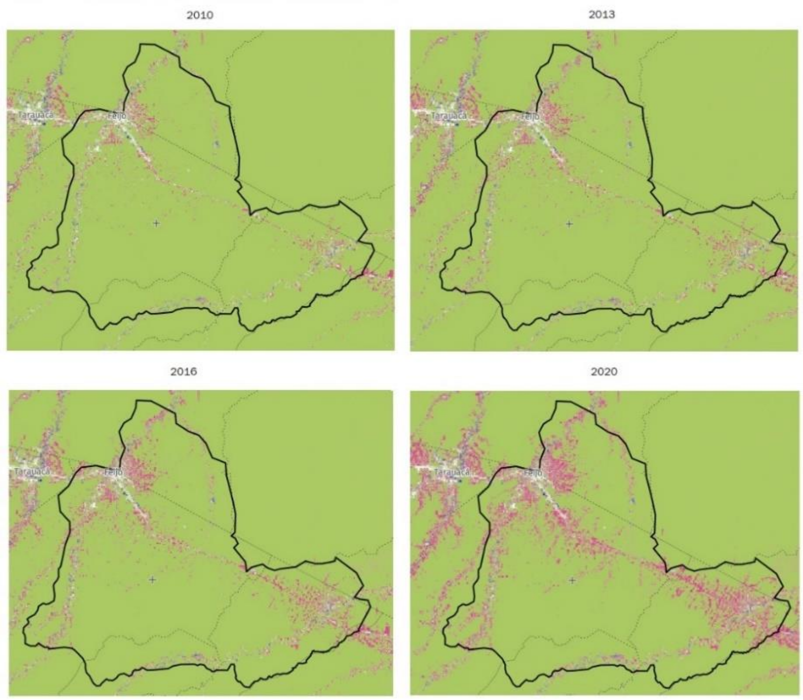



**Table 15. Annual deforestation in the Reference Region between 2010 and 2020**

| Year | Accumulated deforestation (ha) | Deforestation per year (ha) |
|---|---|---|
| 2010 | 39,500.00 | 4,420.00 |
| 2011 | 41,760.00 | 2,260.00 |
| 2012 | 50,040.00 | 8,280.00 |
| 2013 | 56,610.00 | 6,570.00 |
| 2014 | 64,240.00 | 7,630.00 |
| 2015 | 71,650.00 | 7,410.00 |
| 2016 | 83,350.00 | 11,700.00 |
| 2017 | 94,450.00 | 11,100.00 |
| 2018 | 109,350.00 | 14,900.00 |
| 2019 | 124,850.00 | 15,500.00 |
| 2020 | 15,500.00 | 140,350.00 |

- <u>Map accuracy assessment</u>

  The MapBiomas results undergo an accuracy assessment, which for the entire Amazon Biome is on average 95%. However, to meet the particularities of the project region, an independent evaluation was carried out for the reference region between 2010-2020.

  In order to assess the accuracy of the maps produced by the MapBiomas methodology, a confusion matrix was generated by calculating the user's and producer's percentage of correct answers, errors of omission and commission. For that, 200 sample points were randomly drawn on the reference region, 50 in each class (forest, hydrography and deforestation), and the degree of correctness classification was verified. As a reference, high resolution Landsat images were used, where it was possible to visually determine the land use of the sample points drawn.

  For the supervised classification, 300 random points were drawn over the RR, 100 in each of the classes (forest, hydrography and deforestation).

<u>ANALYSIS OF AGENTS, DRIVERS, AND UNDERLYING CAUSES OF DEFORESTATION</u>

- <u>Identification of agents of deforestation</u>

As previously mentioned in "1.13 Conditions Prior to Project Initiation" of this VCS-PD, pasture accounts for virtually all the deforested land occupation in the project region.

The following information is provided for the identified agent of deforestation:

*a)* Cattle Ranchers

Description of the main features of the main agent of deforestation: Cattle ranching (pasture) is usually financed by means of initial capital obtained in wood logging. Deforestation is considered to occur through clear-cutting of forests for logging followed by pasture installation. This deforestation pattern may be caused by private landowners themselves and also by professional land-grabbers, by means of invasions in unguarded areas. The final use of virtually all occupied lands would be cattle ranching (pasture). Thus, it can be affirmed that the deforestation agent group is composed by large and small-scale cattle ranchers supported by land-grabbers and loggers in the initial stage of deforestation. This group is composed by private owners and itinerant land-grabbers. It can also be affirmed that this group of deforestation agents is culturally and economically adapted to this "business cycle" of deforestation, whose results are clearly demonstrated in the Reference Region during the reference period.

Assessment of the most likely development of the population size of the deforestation agent group in the Reference Region, Project Area and Leakage Belt: As the main deforestation agent in the region, cattle ranching (pasture) is expected to increase in the project region. This increase is inferred from official IBGE data on cattle livestock in the municipalities of Feijó, Manuel Urbano and Santa Rosa do Purus.

b) **Timber harvesting**

Timber harvesting can be regarded as the initial approach in a series of activities by deforestation agents, it is the precursor of cattle ranching implementation. Official registration of formally documented logging for sale to sawmills has been volatile over the last 10 years, according to official IBGE data. As shown in figure below, production of legal timber in Feijó, Manuel Urbano and Santa Rosa dos Purus, presented a decrease in years 2011 (8,410 m$^3$) and significant decrease in 2015 (11,545 m$^3$). From that year afterwards, the supply of legal wood only continued to increase. Based on official data from the last 6 years, it is projected that the production tends to increase during the project lifetime, reaching 138,613 m$^3$ in 2050, which also points to a significant increase in timber demand for the following years of project.

<u>Identification of drivers of deforestation</u>

In the State of Acre there is a particularity in deforestation where the highest rates occur in vacant land and rural settlement projects. All related to population increase and cattle herd[90]. In this step, the factors that drive the land-use decisions of the agent group are analyzed to identify the immediate causes of deforestation. For this analysis, two sets of driver variables are distinguished:

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

**Cattle prices**

According to CEPEA (2021)[91], the price of cattle increased 245% over the 2010 (R$ 88.51 per arroba) to 2021 (R$ 305.46 per arroba) period. This economic phenomenon can be observed throughout the country. Young (1998) as cited in Rivero et al. (2009)[92], evaluating the mechanisms that cause deforestation in the Legal Amazon, found a positive relation between the expansion of agricultural areas and the variation of prices of agricultural products. For Margulis (2001) as cited in Rivero et al. (2009), the higher the agricultural prices, the higher is the migration to rural lands, which results in deforestation.

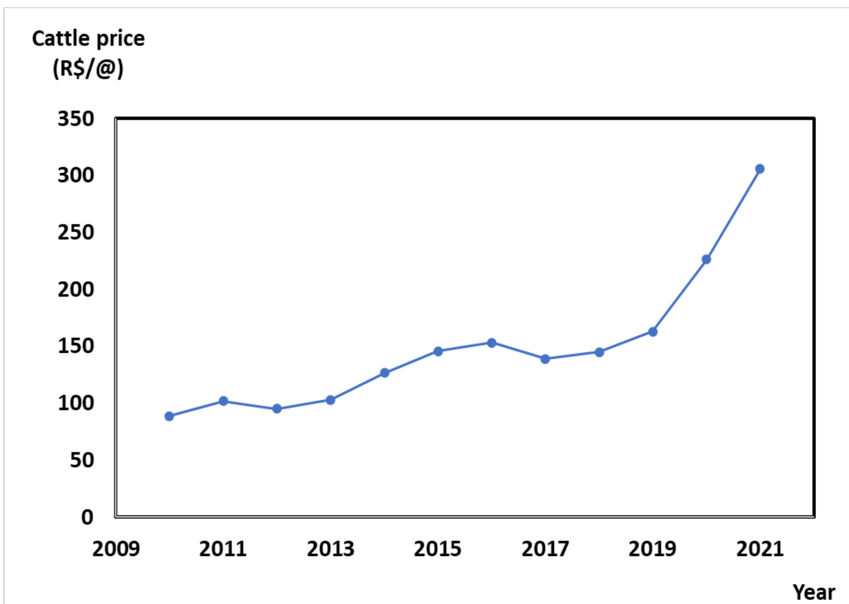
This key driver variable is likely to have a major impact on cattle ranchers' decision to deforest. Considering that the higher is the cattle price, the higher are the profits obtained with pasture for cattle ranching, instead of maintaining standing forests. This driver also plays an important role on the definition of economic radius for cattle activities, which also influences the distances of deforestation from consumption poles.

China's demand for beef is still a reflection of swine flu, which has decimated between 40% and 60% of the country's pig stock (about one third of the world's pork production). In addition to this conjuncture factor, China also contributed to the growth of imports, since it was the only major economy in the world to record economic growth in 2020, even amid the coronavirus pandemic, and a more long-term factor, which is the gradual increase in income of the Chinese population,

[90] Available at: <http://www.journals.ufrpe.br/index.php/JEAP/article/view/2790/482483315>
[91] Available at: <https://www.cepea.esalq.usp.br/br/consultas-ao-banco-de-dados-do-site.aspx>
[92] Available at: <https://www.scielo.br/j/neco/a/jZHjd9B8ZghY7tG9G7qchTk/?format=pdf&lang=pt>

which results in higher consumption of more expensive proteins, such as beef. Analysts estimate that the price of beef should remain under pressure for the next few years, due to the livestock cycle: the low supply of ox is not something that can be solved immediately, because cattle is a multi-year production, as it begins to produce today to deliver animals in two, three, or four years[93]. In 2020, Brazil broke its beef export record, with more than 2 million tons sold (8% more than in 2019). For 2021, the projection indicates an increase of 5% over the value of 2020[94], indicating a strong trend of increased in exports for the coming years. Beef exports have continued increased, growing by almost 7% in 2020 and close to 8% in 2021, increasing by more than 15% in the biennium 2020/2021[95]. Chinese importers have increased the purchases of Brazilian beef by more than 150% in 2020[96]. The dynamics of cattle prices are regulated by micro and macroeconomic scenario throughout the country and abroad, and there are no applicable measures that can be implemented to address this driver.

Figure 26. Cattle prices in Brazil (CEPEA, 2021)




[93] Available at: <https://www.bbc.com/portuguese/brasil-55664305>
[94] Available at: <https://revistagloborural.globo.com/Noticias/Criacao/Boi/noticia/2021/01/apos-recorde-brasil-projeta-alta-de-5-nas-exportacoes-de-carne-bovina-em-2021.html#:~:text=Segundo%20Abrafrigo%2C%20pa%C3%ADs%20alcan%C3%A7ou%20marca,em%20rela%C3%A7%C3%A3o%20ao%20ano%20anterior&text=As%20exports%C3%A7%C3%B5es%20de%20carne%20bovine,by%20fortes%20shipments%20%C3%A0%20China>
[95] Available at: <https://www.avisite.com.br/index.php?page=noticias&id=21284>
[96] Available at: <https://www2.safras.com.br/eng/2020/09/23/meat-exports-in-brazil-will-be-an-important-differential-in-2021/>

**Population density**

This deforestation driver is associated with the dynamics of the local cattle market, as well as with the increase of potential deforestation agents working in the region. Several authors include population density as a prediction variable in deforestation models, which demonstrates that this driver has important impact on deforestation trends (Reis and Margulis, 1991; Reis, 1996; Andersen and Reis, 1997 as cited in Rivero et al. 2009).

This key driver variable provides an increasing pressure of deforestation by cattle ranchers, avid for mitigating poverty by means of a profitable business.

The estimates of population growth in Feijó, Manuel Urbano and Santa Rosa do Purus are not so expressive due to the low rate of development of the municipality. However, over the projection period, it is estimated that the population will increase by more than 20%. This estimate was made by means of a linear regression based on the past 10 years of official data on population, according to official IBGE data[97]. This population growth rate could represent a major driver to increase the deforestation in the region over upcoming decades.

Considering that the project activity cannot regulate the population density, there will be no project measures to address this driver.

**b) Driver variables explaining the location of deforestation:**

These driver variables were used in deforestation projection modelling, the results of which show that such variables can predict the location of deforestation variables explaining the quantity (hectares) of deforestation:

**Access to forests (existing roads and navigable rivers)**

Studies on historical location of deforestation in the Reference Region can evidence that this factor has been a driver for deforestation during the historical reference period. It is broadly recognized that deforestation is accelerated in regions that have denser road networks (IMAZON, 2021[98]).

The presence of roads and navigable rivers is a logical deforestation driver, since it facilitates the flow of wood and other products harvested from the forest. The capacity to transport wood logs, rapidly clear the land for pasture and place wood logs in sawmills, quickly obtaining revenues, certainly has a major impact on cattle ranchers' decision to deforest the most accessible forest areas.

The Reference Region holds a dense network of primary, secondary, and tertiary roads. The lands located near these roads are more likely to undergo deforestation, generating a progressive fishbone effect. This deforestation pattern may even increase exponentially in some cases, given

[97] Available at: <https://ftp.ibge.gov.br/Estimativas_de_Populacao/>

[98] Available at: <https://imazongeo.org.br/>

that a single road may originate several other offshoot roads in the future, and so on. In a brief analysis of deforestation location, the existence of the fishbone deforestation patterns can be noted, which indicates the creation of secondary and tertiary roads in the Reference Region. Barber et al. (2014), in their study on deforestation drivers in the Amazon, conclude that proximity to transportation networks, particularly the rapidly growing unofficial road network, is a major driver of deforestation in the Amazon. Thus, it can be expected that the growth of the unofficial road network will increasingly affect the dynamics of deforestation over the project lifetime.

The project area is cut by the Jurupari and Purus River, which passes through two of the three properties and is a valuable way for land-grabbers to easily invade the property and clear forests for logging and pasture.

The project activity will result in the increase of the intensity of surveillance activities during the crediting period, in such a way that the main means of access to the Project Area will be continuously monitored and controlled.

**Proximity to forest edges**

Studies on historical location of deforestation in the Reference Region provide evidence that this has also been a driver for deforestation over the historical reference period. Similarly, to the proximity to roads and navigable rivers, the effect of this driver on deforestation decisions is related to easier logistics when clearing areas and easier and quicker revenue from logging. The proximity to forest edges has been used in similar ways by other REDD projects, including the "Fortaleza Ituxi REDD Project", "The Suruí Forest Carbon Project", the "RMDLT Portel-Pará REDD Project", the "Florestal Santa Maria REDD Project", and others. Furthermore, this deforestation driver has been used to explain the dynamics of deforestation in similar analyses (LAURANCE et al. 2009[99]; ROSA et al. 2013[100]). According to ROSA et al. (2013), deforestation is contagious, such that local deforestation rates increase over time if adjacent locations are deforested.

The impact of this driver on cattle ranchers' decision to deforest is similar to that explained for roads and navigable rivers: this proximity facilitates the logistics of wood and other products extracted from the forest.

This key driver variable will have increased impact during next years, owing to the advance of deforestation in the region, which will bring deforestation pressures gradually closer to the boundaries of the Project Area. As stated in several parts of this Draft PD, deforestation for logging is a common practice in the project region, and this behavior tends to continue in the future. Thus, it is expected that deforested areas will attract deforestation agents continuously, in a growing deforestation trend, provoked by a "contagious" process, as stated by ROSA et al. (2013).

99 Available at: <https://doi.org/10.1016/j.tree.2009.06.009>
100 Available at: <https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0077231&type=printable>

The project measures that will be implemented to address this driver are the same measures that are being adopted to manage leakage in this project. These measures are described in detail in "1.17 Additional Information Relevant to the Project", subtopic "Leakage Management", of this Draft PD, and involve Sustainable Forest Management practices, increased surveillance, replication of project concepts to other areas (divulgation), engagement of local communities in inhibiting illegal occupation, and others.

- **Identification of underlying causes of deforestation**

According to literature surveys and local interviews, it is concluded that the underlying causes of deforestation are as follows:

**Land-use policies and their enforcement**

As previously mentioned in this Draft PD, in spite of the legal provisions intended to preserve at least 80% of the Amazon's forest cover, the lack of law enforcement by local authorities along with the increase in production and prices of cattle has 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. Accordingly, policies implemented to address illegal deforestation only by means of command-and-control approaches have proven to be ineffective so far.

This key underlying cause has a strong effect on the decisions of the main deforestation agents, as they are at liberty to continue their illegal business activities with very low probability of being detained by authorities. There are several indications of loosening of environmental legislation in recent years, with emphasis on the following subfactors:

*Greater conveniences for obtaining "forest clearing authorization"*: An example of this fact can be observed in the state of Goiás, which reported a 1,100% increase in the number of permits for deforestation in 2020[101]. The new environmental licensing in Goiás, plus technologies that facilitate the inspection work of the Secretariat of Environment and Sustainable Development (Semad), in addition to effort in the analysis of applications, are responsible for increasing the number of deforestation permits in the State. According to data from Semad's Environmental Licensing Superintendence, there was an increase of area suppressed by 673%: 6.5 $km^2$ in 2019, to 43.8 $km^2$ in 2020. Thus, as occurred in the State of Goiás, the facilitation of the issuance of authorization for the suppression of native vegetation can occur at any time in the Amazon Biome. In fact, attempts at facilitation have been sought recently (in 2020), as indicated in the next topic.

[101] Available at: <https://www.meioambiente.go.gov.br/noticias/2089-emiss%C3%A3o-de-licen%C3%A7as-para-supress%C3%A3o-de-vegeta%C3%A7%C3%A3o-tem-aumento-de-1-100-in-a-year-in-goi%C3%A1s.html>

*Granting of tacit (or automatic) environmental licensing, in case of delay of the environmental agency*: The controversial automatic release of environmental permits and permits by maturity of term, that is, after a period stipulated for the government agency to manifest (120 days), was voted on 29/04/2020, by a virtual plenary. Provisional Measure 915 originally referred to the so-called "Economic Freedom Law" edited by the government, but ended up bringing, within the texts, changes that directly affect the rite of environmental licensing throughout the country. The change could lead to the automatic authorization of forest suppression in the Amazon and Atlantic Forest enforced by delay, and without analysis of the environmental agency. This means that, once the 120-day period is expired, the request would be automatically granted with a tacit license[102]. Fortunately, environmentalists have reedited the Provisional Measure 915, to prevent deforestation licensing for term expiration[103].

*Loosening legislation for timber exports*: As reported by Reuters, during 2019 Brazil exported "thousands of cargoes of wood from an Amazonian port without authorization from the federal environmental agency, increasing the risk that they have been extracted from illegally deforested land". The rule change scrapping IBAMA's authorizations for most timber exports came after five cargoes of wood arrived in US and European ports without these mandatory documents. Foreign authorities contacted Brazil to ask about the missing authorizations, with the head of IBAMA in Pará then retroactively granting the authorizations. The problem, however, is much more widespread than just the five shipments. In Pará state, more than half of the roughly 3,000 officially registered shipments in the past year, containing an estimated 54,000 $m^3$ of wood that left one port, did not have authorization. Companies had requested authorizations from IBAMA for those shipments but exported them before the agency had time to respond. Beyond that, many shipments were exported without seeking approval from IBAMA. Shipments went to the US, the Netherlands, France, Germany, Belgium, and possibly other countries. Before the rules changed, IBAMA was required to give authorization to all wood exports before they leave port. Even though, most of the shipments needed only the proper paperwork to be given the green light, but only certain cargoes would be randomly selected for physical inspection[104]. Arbitrarily, the president of IBAMA ensured that all future unauthorized exports of wood, previously classified as illegal, became legal: he took advantage of the inattention of the press to the theme during Carnival, at the end of February 2020, to quietly revoke a 2011 IBAMA policy that required an authorization from the agency before forest products could receive export licenses. From that date on, such permits would be required only for endangered tree species or in other special circumstances. With the repeal, the way was opened for large shipments of illegal timber from the Brazilian Amazon to go abroad[105]. It was also revealed that in February 2020, loggers from

[102] Available at: <https://www.correiobraziliense.com.br/app/noticia/brasil/2020/04/29/interna-brasil,849652/camara-pode-aprovar-hoje-licenciamento-ambiental-automatico.shtml>
[103] Available at: <https://epbr.com.br/ambientalistas-alteram-mp-915-para-prevent-licensing-environmental-by-course-of-time/>
[104] Available at: <https://www.businesslive.co.za/bd/world/americas/2020-03-04-brazil-may-be-exporting-illegally-deforested-wood/>
[105] Available at: <https://brasil.mongabay.com/2020/04/ao-afrouxar-leis-de-exportacao-brasil-permite-saida-de-madeira-ilegal-da-amazonia/>

Pará asked IBAMA to change that rule: the companies wanted to sell wood abroad presenting only the Document of Forest Origin (DFO, "*DOF – Documento de Origem Florestal*" in Portuguese), made by the companies themselves and that originally only serves to allow the transport of the goods to the port. This change has been immediately accepted by the president of IBAMA[106].

*Legislation favoring landgrabbers*. An analysis conducted by IPAM (Environmental Research Institute of the Amazon) showed that 35% of deforestation occurred in the Amazon between August 2018 and July 2019 was recorded in non-designated areas without information. About land regularization, environmental NGOs warn about two ongoing projects. While, in the Senate is presented Bill 510/21, in the House of Representatives it is considered to vote the Bill 2633/20[107]. Commonly, both derive from the original text of Provisional Measure 910, known as "*MP da Grilagem*" (Landgrabbers' Provisional Measure), for changing the law to favor large occupants of recently invaded public lands. Bill 510/21 once again changes the deadline for public land invasions to be legalized (from 2011 to 2014) and allows large areas (up to 2500 hectares) to be titrated without the need for inspection. Indeed, given that the land grabbing of undesignated public lands is responsible for more than 1/3 of the deforestation in the country, it is to be expected that amnesty for landgrabbers and illegal deforesters will be an incentive to intensify this practice in the coming years. Bill 2633/20 has a loophole that would allow to legalize, via bidding, public areas invaded after the deadline for occupation provided for by law (i.e., 2014). Of the 49.8 million hectares of forests under state and federal responsibility, but not yet allocated to any category of use, 11.6 million hectares, or 23%, were irregularly declared as rural properties of particular use, in the National System of Rural Environmental Registration (CAR). If the entire area registered to date as private property was legalized, 2.2 to 5.5 million hectares could be deforested in the coming years, according to the deforestation limits defined by the Forest Code and considering that deforestation is often greater than allowed. In recent years, grabbing of non-destined public forests has increased: in 2019, it was the land category where the most forest felled in the Amazon, according to data from the deforestation alert system of INPE (National Institute of Space Research), Deter. The trend continued in 2020. Among the conditions defined by Provisional Measure 910, for appropriation of public lands by individuals, are: i) the area must be registered in the Rural Environmental Registry (CAR, "*Cadastro Ambiental Rural*"): as it is known, any information can be imputed in the "CAR" system until the current moment without any veracity checking, and ii) the claimant must be performing agricultural activities in the territory (i.e., should have preferably deforested the area)[108]. The Provisional Measure defines that for areas that meet the requirements and have up to 15 fiscal modules (areas with up to 1,650 hectares), the title will be granted without the need for inspection. Before the Provisional Measure, the exemption from inspection was granted to areas with up to four fiscal modules (maximum 440 hectares). The exemption from the inspection may allow large

[106]Available at: <https://g1.globo.com/natureza/noticia/2020/11/17/documentos-mostram-que-ibama-facilitou-exportacao-de-madeira-extraida-ilegalmente.ghtml>

[107] Available at: <https://ipam.org.br/35-do-desmatamento-na-amazonia-e-grilagem-indica-analise-do-ipam/>

[108]Available at: <https://ipam.org.br/cientistas-mapeiam-grilagem-em-florestas-publicas-na-amazonia/#:~:text=O%20impact%20da%20grilagem%20se,main%20g%C3%A1s%20%20effect%20estufa>

illegally deforested areas to be taken over by individuals. This is because the Provisional Measure only prohibits the regularization of areas that have been subject to fines or environmental embargoes, and not all environmental violations are known and fined by the government[109]. Given that the Project Area is surrounded by public lands and that cases of land-grabbing can be evidenced in the Reference Region, an abnormal increase in deforestation in that region is expected in the coming years, because Brazilian legislation increasingly gives all indications that it is very inviting to land-grabbing acts, granting amnesty to landgrabbers and agents of illegal deforestation.

The problem of lack of command-and-control measures to contain deforestation in the Amazon Biome is a widespread issue, which has been getting worse and worse every year, due to lack of personnel and infrastructure of legal authorities, in addition to schemes of corruption and violence established by illegal agents to maintain the *status quo*. In this context, the lack of law enforcement can be assumed to be a constant underlying cause of deforestation during the project lifetime.

Although the project activity cannot solve the problem of lack of enforcement in Brazil, it can serve as a case of success, to encourage neighbors to adopt sustainable practices as a profitable land-use alternative.

**Poverty and wealth**

According to statistics on the municipality of Feijó (IBGE, 2021)[110], in 2018, the average monthly salary was 1.4 minimum wages. The proportion of occupied people in relation to the total population was 6.%. In comparison with other municipalities in the state, it ranked 21 out of 22, while in comparison with cities nationwide, it ranked 5265 out of 5570. Considering households with monthly incomes of up to half a minimum wage per person, it had 51% of the population in these conditions. These data show that the region faces poverty issues.

This key underlying cause has a major impact on deforestation decisions, as the main agents (cattle ranchers, operationally supported by loggers and land-grabbers) can easily recruit cheap manpower, consisting of workers seeking to sustain their families by means of this profitable activity, despite it being illegal, due to the inconsistency of law enforcement.

Over the coming years, it is not expected that the region will rapidly solve the poverty issue, as it is historically deeply rooted in the region. Given this context, poverty can be assumed to be a constant underlying cause during the project lifetime.

Although the project activity cannot solve the poverty issue, it aims to provide new jobs for local agents, who will be able to generate revenues for their families by means of a legal and sustainable initiative.

[109] Available at: <https://amazonia.org.br/como-a-mp-da-grilagem-pode-mudar-o-mapa-de-regioes-da-amazonia/>
[110] Available at: <https://cidades.ibge.gov.br/brasil/ac/feijo/panorama>

- **Analysis of chain of events leading to deforestation**

Based on the historical evidence collected, it is concluded that the implementation of the BAU activity (pasture) is usually financed by means of initial capital obtained through timber logging.

The lack of enforcement of policies and laws also affects land tenure and property rights. This aspect stimulates the action of land grabbers and squatters. Ineffective legal land registration and documentation is also a barrier to official registration of timber production from natural forests. In this scenario, a great portion of harvested wood logs can be regarded as illegal and official registration is not technically feasible.

All the above factors combine to result in uncontrolled land invasions and deforestation, followed by cattle ranching activities, a scenario which is substantiated by illegal trespassing events, and the fact that daily patrolling of the area is required by one or two employees on motorbikes, in order to combat the constant deforestation pressure.

- **Conclusion**

Available evidence about the most likely future deforestation trend within the Reference Region and Project Area is deemed to be "Conclusive". Meaning that the hypothesized relationships between agent groups, driver variables, underlying causes, and historical levels of deforestation have been verified via literature studies and other verifiable local sources of information.

The weight of the available evidence conservatively suggests that the overall trend in future baseline deforestation rates will be "Increasing". During the reference period, the deforestation rate in the Reference Region has consistently increased. In this context, the deforestation rate used in the projections was the Modelling ("c") approach (see step 4.1.1 of the VM0015 methodology: Selection of Baseline Approach).

### APD – Avoided Planned Deforestation

- **Agent of Planned Deforestation**

The company FSV – Indústria e Comércio de Carnes Ltda is identified as the agent of planned deforestation in the baseline considering the current Mamuriá Grouped REDD Project, which is considered as the "simplest scenario" per VMD0006.

- **Area of Deforestation**

According to methodology, the area of deforestation ($A_{planned,i}$) is defined as an immediate site-specific threat of deforestation, which can be demonstrated by the following points:

**Legal permissibility for deforestation**: The application of a sustainable forest management plan is regulated in Brazil by the laws Nº 12,651/2012[111], decree Nº 5,975[112], in addition to Acre's legislation, with law N°1,117/1994[113]. In Art. 12, N°12,651/2012 every rural property must maintain an area with native vegetation coverage. Every rural property must maintain an area of native vegetation such as the Legal Reserve (RL), in addition to the Permanent Preservation Area (APP), observing the minimum required according to the biome. For properties located in the Legal Amazon, the percentage is 80%. Thus, deforestation in the Legal Amazon of a maximum of 20% of the property's area is legally permitted. Authorizations for alternative land use present a series of conditions that must be complied with in accordance with the State's environmental legislation. Among the conditions of the license, highlight the prohibition of forest exploitation of trees in Permanent Preservation Area - APP. It is expressly prohibited even if the trees are not so described in the forest inventory. The forest inventory is a mandatory document for applying for the license. IMAC performs inspections without prior notice, to verify compliance with the authorization conditions. An activity carried out to verify that the removal of vegetation is complying with all requirements and laws regarding forest preservation and exploitation.

**Suitability of project area for conversion to alternative non-forest land use**: To determine the suitability of the project area, a series of analyzes and geoprocessing are performed for the baseline activity. Based on the primary data from the CAR, obtained from the Rural Environmental Registry System (SICAR), the declarations and delimitations of areas protected by law (area of permanent preservation and legal reserve) as well as the limits of the property are verified. Subsequently, it overlaps deforestation data to exclude deforested areas. Data are obtained from MAPBIOMAS[114] for the baseline period. Areas deforested prior to 10 years before the project start date are disregarded to meet the applicability conditions of the methodology. After this step, the information is crossed with topographic data to exclude areas with an inclination greater than 25°, which must also have forest preservation areas according to Brazilian legislation. This topographic criterion is related to the ecology of the forest whose function is to prevent landslides. Afterwards, the use is evaluated according to the soil and climate of the region. Finally, the analysis of access to relevant markets is carried out based on the logistics network used in the existing production chains, such as the BR 364 that connects the project area to the state capital, Rio Branco and the Jurupari and Purus rivers that will flow into others important rivers in the region, which pass through important municipalities in the states of Acre and Amazonas. This analysis of the existing modalities makes it possible to evaluate the flow of wood, cattle, among other products from the existing chains.

**Government approval for deforestation to occur**: according to VMD0006 v1.3, the intention to deforestation within the project area is demonstrated by recent approval from relevant government department for conversion of forest to an alternative land use or documentation that a request for approval has be filed with the relevant government department for permission to

[111] Available at <https://www.planalto.gov.br/ccivil_03/_Ato2011-2014/2012/Lei/L12651.htm>
[112] Available at <http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2006/decreto/d5975.htm> 1
[113] Available at: <http://pnla.mma.gov.br/images/2018/08/Procedimentos-de-Licencamento-Ambiental-ACRE-AC.pdf>
[114] Available at: <https://mapbiomas.org/>

deforest and convert to alternative land use. The properties that make up the project area have documents that present the eligibility of authorization for vegetation suppression to change land use. Generally, in Brazil, deforestation permits are requested for areas smaller than 1,000 ha. This is due to a few reasons: 1) the validity period of the suppression authorization is short; in some states it is valid for only 1 year; 2) high cost of the suppression operation. These two reasons lead landowners to opt for deforestation in smaller plots and 3) implementation of agricultural projects larger than 1,000 ha requires the preparation of an Environmental Impact Study (Estudo de Impacto Ambiental – EIA, in Portuguese) and the issuance of an Environmental Impact Report (Relatório de Impacto Ambiental – RIMA, in Portuguese)[115], which must be submitted for approval by the competent state environmental agency, which entails high costs and a long period of analysis by the agency.

**Intent to deforest**: the intention to deforest is demonstrated by the existence of a land use management plan valid for the project area, called the Forest Exploration Project (Projeto de Exploração Florestal – PEF, in Portuguese). Deforestation authorization must be requested from the responsible government in each state. Brazilian environmental law establishes requirements for forest clearing, leaving specific regulation to the states. In the State of Acre, the competent body is IMAC – Instituto de Meio Ambiente do Acre, which issues both the authorization for the use of forest raw materials (Autorização para Utilização de Matéria Prima Florestal-AUMPF, in Portuguese), and the Authorization for Forest Exploration (Autorização para Exploração Florestal-AUTEX, in Portuguese) for alternative land use.

- Rate of Deforestation

Deforestation rates are defined in accordance with forest exploitation plans. These plans show the area to be deforested in a spatially explicit way and contain an associated execution schedule. The deforestation rate is yet to be defined.

**Table 16. Annual deforestation D% planned**

| Annual deforestation D% planned, i.t | | | | | | |
|---|---|---|---|---|---|---|
| Plots | Area (ha) planned | n | *Yrspn* | *%Dpn* | *D%/Yrspn* | Volume (m3) |
| Faz S. P. Mamuriá - Talhão 1 | 978.00 | 4 | 4 | 31% | 8% | 25,000.00 |
| Faz S.Veneza - Talhão 1 | 934.51 | 4 | 4 | 32% | 8% | 25,000.00 |
| Faz S. P. Mamuriá - Talhão 2 | 978.00 | 4 | 4 | 31% | 8% | 25,000.00 |
| Faz S.Veneza - Talhão 2 | 934.51 | 4 | 4 | 32% | 8% | 25,000.00 |
| Faz S. P. Mamuriá - Talhão 3 | 978.00 | 4 | 4 | 31% | 8% | 25,000.00 |

[115] CONAMA: item XVII, art. .2 of CONAMA Resolution No. 01, of January 23, 1986, amended by CONAMA Resolution No. 11, of March 18, 1986

| | | | | | | |
|---|---|---|---|---|---|---|
| Faz S.Veneza - Talhão 3 | 934.51 | 4 | 4 | 32% | 8% | 25,000.00 |
| Faz S. P. Mamuriá - Talhão 4 | 978.00 | 4 | 4 | 31% | 8% | 25,000.00 |
| Faz S.Veneza - Talhão 4 | 934.51 | 4 | 4 | 32% | 8% | 25,000.00 |
| Faz S. P. Mamuriá - Talhão 5 | 978.00 | 4 | 4 | 31% | 8% | 25,000.00 |
| Faz S.Veneza - Talhão 5 | 934.51 | 4 | 4 | 32% | 8% | 25,000.00 |
| Faz S. P. Mamuriá - Talhão 6 | 978.00 | 4 | 4 | 31% | 8% | 25,000.00 |
| Faz S.Veneza - Talhão 6 | 934.51 | 4 | 4 | 32% | 8% | 25,000.00 |
| Faz S.Veneza - Talhão 7 | 934.51 | 4 | 4 | 32% | 8% | 25,000.00 |
| | | | | $D\%_{planned,i,t}$ | 1.97% | |

- **Likelihood of Deforestation L-Di**

According to VMD0006, v1.3, the likelihood of deforestation ($L\text{-}D_i$) is set to be 100%, because the project area is not under government control and is not zoned for deforestation.

- **Risk of Abandonment**

The risk of abandonment is considered based on proxy areas that have the same class of deforestation agent in an interval of 10 years. Properties close to the project area were analyzed based on the same classes and agents of deforestation, climate, soil and topography. Proxy are areas with similar spatial characteristics to the project area as well as similarities in terms of activities and land use conditions. These areas were selected according to the criteria of VMD0006 based on analysis of geographic data and knowledge by project proponent of existing properties in the proximity of the project area.

Thus, how the history of land use conversion will be analyzed. If any of the proxy areas have been abandoned to forest regrowth, then thee planned deforestation activities is not eligible and this module must not be used.

**Table 17. Elevation classes similarity between Project Area and proxy areas.**

| Elevation (m) | Project Area | Proxy Areas | ID1 | ID2 | ID3 | ID4 | ID5 | ID6 | ID7 |
|---|---|---|---|---|---|---|---|---|---|
| 0 - 500 | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

**Table 18. Forest type similarity between Project Area and proxy areas**

| Phytophysiognomy | Open Lowland tropical rainforest |
|---|---|
| PA (ha) | 4,955.07 |
| PA (%) | 92.40% |
| Proxy Areas (ha) | 46,573.42 |
| Proxy Areas (%) | 95.36% |
| Proxy Area id1 (ha) | 9,757.67 |
| Proxy Area id1 (%) | 98.23% |
| Proxy Area id2 (ha) | 6,661.50 |
| Proxy Area id2 (%) | 98.23% |
| Proxy Area id3 (ha) | 424.66 |
| Proxy Area id3 (%) | 64.20% |
| Proxy Area id4 (ha) | 1,650.70 |
| Proxy Area id4 (%) | 92.33% |
| Proxy Area id5 (ha) | 1,863.05 |
| Proxy Area id5 (%) | 88.28% |
| Proxy Area id6 (ha) | 888.74 |
| Proxy Area id6 (%) | 88.18% |
| Proxy Area id7 (ha) | 15,342.56 |
| Proxy Area id7 (%) | 100.00% |

**Table 19. Slope classes similarity between Project Area and proxy areas**

| Slope | "gentle" (slope <15%) | "steep" (slope ≥15%) |
|---|---|---|
| PA pixel | 55,011.00 | 4,533.00 |
| PA (%) | 92.39% | 7.61% |
| Proxy Areas pixel | 475,391.00 | 67,253.00 |
| Proxy Areas (%) | 87.61% | 12.39% |
| Proxy Area id1 pixel | 99,690.00 | 10,664.00 |
| Proxy Area id1 (%) | 90.34% | 9.66% |
| Proxy Area id2 pixel | 76,579.00 | 12,447.00 |
| Proxy Area id2 (%) | 86.02% | 13.98% |
| Proxy Area id3 pixel | 6,800.00 | 547.00 |
| Proxy Area id3 (%) | 92.55% | 7.45% |
| Proxy Area id4 pixel | 17,018.00 | 2,852.00 |
| Proxy Area id4 (%) | 85.65% | 14.35% |
| Proxy Area id5 pixel | 19,384.00 | 4,053.00 |
| Proxy Area id5 (%) | 82.71% | 17.29% |
| Proxy Area id6 pixel | 10,352.00 | 842.00 |
| Proxy Area id6 (%) | 92.48% | 7.52% |
| Proxy Area id7 pixel | 146,625.00 | 23,843.00 |
| Proxy Area id7 (%) | 86.01% | 13.99% |

**Table 20. Soil type similarity between Project Area and proxy areas**

| Soil type | GXve | PVAa | PVAal | TCo | TXo |
|---|---|---|---|---|---|
| PA (ha) | 233.10 | 0.00 | 0.00 | 3,781.48 | 1,348.24 |
| PA (%) | 4.35% | 0.00% | 0.00% | 70.51% | 25.14% |
| Proxy Areas (ha) | 0.00 | 0.00 | 0.00 | 23,570.44 | 25,269.71 |
| Proxy Areas (%) | 0.00% | 0.00% | 0.00% | 48.26% | 51.74% |
| Proxy Area id1 (ha) | 0.00 | 0.00 | 0.00 | 9,933.11 | 0.00 |
| Proxy Area id1 (%) | 0.00% | 0.00% | 0.00% | 100.00% | 0.00% |
| Proxy Area id2 (ha) | 0.00 | 0.00 | 0.00 | 1,086.63 | 6,925.79 |
| Proxy Area id2 (%) | 0.00% | 0.00% | 0.00% | 13.56% | 86.44% |
| Proxy Area id3 (ha) | 0.00 | 0.00 | 0.00 | 0.00 | 661.50 |
| Proxy Area id3 (%) | 0.00% | 0.00% | 0.00% | 0.00% | 100.00% |
| Proxy Area id4 (ha) | 0.00 | 0.00 | 0.00 | 1,787.75 | 0.00 |
| Proxy Area id4 (%) | 0.00% | 0.00% | 0.00% | 100.00% | 0.00% |
| Proxy Area id5 (ha) | 0.00 | 0.00 | 0.00 | 2,110.35 | 0.00 |
| Proxy Area id5 (%) | 0.00% | 0.00% | 0.00% | 100.00% | 0.00% |
| Proxy Area id6 (ha) | 0.00 | 0.00 | 0.00 | 0.00 | 1,007.91 |
| Proxy Area id6 (%) | 0.00% | 0.00% | 0.00% | 0.00% | 100.00% |
| Proxy Area id7 (ha) | 0.00 | 0.00 | 0.00 | 942.72 | 14,399.84 |
| Proxy Area id7 (%) | 0.00% | 0.00% | 0.00% | 6.14% | 93.86% |

Where:

GXve = haplic gelisols Ta Eutrophic

PVAa = aluminum Red-Yellow argisols

PVAal = Red-yellow argisols Ta Aluminium

TCo = Orthic Chromic luvisols

TXo = Orthic haplic luvisols

The figures above demonstrate that there is similarity between the analyzed classes of the project area and the proxy areas. The following figures show the evolution of the properties regarding the change in land use based on the history of deforestation in the analyzed period. It is possible to conclude that the deforested areas are not abandoned in the region and that there was an increase and consolidation of these areas. The time series depicts the increase in pasture area opening. All maps compare land use and transitions in the years 2010 and 2020, showing that these properties were not abandoned.

- **Annual Area of Deforestation**

The annual Area of Deforestation in the baseline case is determined according to the VMD0006 v1.3, equation 5, which considers:

- $AA_{planned,i,t}$ – Annual area of baseline planned deforestation for stratum *i* at time *t*; ha
- D(%) – projected annual proportion of land that will be deforested in stratum *I* during year *t*.
- $A_{planned,i,t}$ – total area of planned deforestation over baseline period for stratum *I*;
- $L\text{-}D_i$ – likelihood of deforestation for stratum *i.*

The annual projection of the proportion land that will be deforested in each stratum I during year t (D%) is determined according to the forest suppression authorizations issued by the competent environmental agency of the State of Acre, IMAC.

## 3.5 Additionality

### AUD – Avoided Unplanned Deforestation

For the purpose of the present analysis, 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[116] was applied for the project activity of the Feijó AUD REDD Project.

**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:

I. **The continuation of the current (pre-project) land use scenario**: in this scenario, no REDD project is undertaken. The deforestation pattern identified in section 3.4 above, which describes the relationship among the agents, drivers and underlying causes present in the region during the historical period, will most likely continue to cause deforestation in the future.

   This scenario involves the implementation of a sustainable forest management plan within the project boundaries of the proposed VCS REDD project, however without carrying out additional social and environmental activities, as well as activities to reduce

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

unplanned deforestation. This scenario also complies with item iii of the methodological tool (activities similar to the proposed project activity on at least part of the land within the project boundary of the proposed VCS AFOLU project at a rate resulting from legal requirements).

Although this is a similar activity proposed by the present project, i.e. avoiding deforestation through conducting sustainable forest management activities, no other complementary activities to improve monitoring of deforestation would be carried out, such as: increased surveillance, monitoring and control by satellite images, REDD+ technical studies, social and environmental activities, among others.

Many scientific articles conclude that sustainable forest management plans (SFMP), namely those certified, can be considered a tool for forest conservation, maintenance of forest carbon stocks, and decrease of deforestation rates in the region where they are implemented. This mainly occurs due to the use of reduced impact logging techniques, reduced social and environmental operational impacts, greater surveillance in the area, and generation of economic value for forests. On the other hand, there is a belief that forest is a non-productive natural resource and needs replacing with productive activities, such as livestock farming and agriculture, primarily in areas that require social and economic development[117],[118],[119],[120],[121].

However, the complexity and costs of a sustainable timber operation, added to factors such as bureaucratic constraints and fluctuation of certified timber prices, make SFMP less competitive than illegal logging. Thus, investment in additional practices to what is required by law is risky and may affect the survival of the operation. This includes activities that are complementary to the operation, specifically avoidance or reduction of unplanned deforestation/degradation and increase of monitoring of forest management areas.

Therefore, despite the contribution to forest preservation and carbon stock maintenance, SFMP areas are subject to unplanned deforestation and loss of carbon stock due to external agents, however expected to be in a lower intensity than in other areas without forest management. In addition, there are incentives for the local population to perform activities that result in unplanned deforestation, such as the expansion of low productivity agricultural activities, resulting in an ongoing necessity of cutting down the forest to maintain production.

There are many challenges to guarantee the consolidation of these areas and their effective social and environmental protection. Many conservation areas located in the

[117] BRASIL. Ministério do Meio Ambiente (MMA). Plano de ação para prevenção e controle do desmatamento na Amazônia. Brasília, 2012.

[118] SCHULZE, M., GROGAN, J., & VIDAL, E. 2008. O manejo florestal como estratégia de conservação e desenvolvimento socioeconômico na Amazônia: quanto separa os sistemas de exploração madeireira atuais do conceito de manejo florestal sustentável? In N. Bensusan & G. Armstrong (Eds.), O Manejo da Paisagem e a Paisagem do Manejo (1ª ed., pp. 161-213). Brasil: IEB

[119] VIEIRA, I. C. G.; SILVA, J. M. C.; TOLEDO, P. M. Estratégias para evitar a perda de biodiversidade na Amazônia. Estud. av., São Paulo , v. 19, n. 54, Aug. 2005 .

[120] HOLMES, T.P. el al. Custos e benefícios financeiros da exploração de impacto reduzido em comparação à exploração florestal convencional na Amazônia Oriental. Belém: Fundação Floresta Tropical, 2002, 66p, 2nd edition.

[121] VERWEIJ, P. *et al*. Keeping the Amazon Forests standing: a matter of values. Zeist: WWF, 2009. 72p.

Amazon still don't have an approved management plan, and a large amount does not have a management team. Furthermore, the number of Government agents assigned to these areas is greatly lacking and insufficient to carry out effective surveillance. The result is intense deforestation and pressure on protected areas in the legal Amazon, primarily because of wood harvesting activities, agriculture, road construction and mining[122],[123].

II. **Implementation of a sustainable forest management plan, combined with the implementation of additional activities:** In this scenario, the Project activity would 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 conducting sustainable forest management activities.

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, among others. These investments are usually not made by the Brazilian Government, nor are part of sustainable forest management plans, as they are financially unattractive and not necessary to legally perform the timber harvest. Therefore, the economic feasibility of this scenario would be reduced without additional revenues from the sale of VCUs.

III. **If applicable, activities similar to the proposed project activity on at least part of the land within the project boundary of the proposed VCS AFOLU project at a rate resulting**

- **Legal requirements; or**
- **Extrapolation of observed similar activities in the geographical area with similar socioeconomic and ecological conditions to the proposed VCS AFOLU project activity occurring in the period beginning ten years prior to the project start date.**

Not applicable. There is no legal requirement to conduct activities similar to the proposed activity on at least part of the land within the project boundary of the proposed VCS AFOLU project.

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

**Scenario I and II -** The application of a sustainable forest management plan is regulated in Brazil by the laws Nº 12,651[124], decree Nº 5,975[125], in addition to Acre's legislation, with law N°1,117/1994[126]. Despite the requirement to mitigate social impacts, social and environmental activities for the communities surrounding the management plan area are not required by law.

[122] VERÍSSIMO, A. *et al* (Org.). **Áreas Protegidas na Amazônia brasileira:** avanços e desafios. Belém : Imazon ; São Paulo : Instituto Socioambiental, 2011. 90 p.
[123] PORTAL AMAZONIA.COM. Unidades de Conservação do Amazonas ainda sofrem com crimes ambientais. 2013. Available at: <http://www.portalamazonia.com.br/editoria/meio-ambiente/unidades-de-conservacao-do-amazonas-ainda-sofrem-com-crimes-ambientais/>. Last visit on: March 12th, 2015
[124] Available at <https://www.planalto.gov.br/ccivil_03/_Ato2011-2014/2012/Lei/L12651.htm>
[125] Available at <http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2006/decreto/d5975.htm> 1
[126] Available at: <http://pnla.mma.gov.br/images/2018/08/Procedimentos-de-Licencamento-Ambiental-ACRE-AC.pdf>

According to Ribeiro[127], the main obstacles related to the approval of the sustainable forest management plan in the Amazon are a) low investment capacity, financial and fiscal incentives, b) bureaucracy and lack of control in the SFMP approval procedure and c) lack of participation of traditional communities in the process of elaboration of the SFMP, when they are involved. Thus, it is common to see the exclusion of the surrounding community from management activities in private areas.

As it does not contain social and environmental activities to control deforestation coming from communities surrounding the property, scenario I may contain activities that are illegal or of uncertain legal status, not being enforced namely due to the lack of control[128] and government capacity. This type of illegal deforestation, apart from planned deforestation, occurs mainly due to social pressure and low HDI in the Amazon regions. Although not following applicable mandatory laws and regulations, this scenario results from systematic lack of enforcement of applicable laws and regulations. One of the goals of the present REDD project is to contribute to a solution to this problem by promoting the sustainable management of forest resources through increased monitoring and surveillance to avoid unplanned, illegal deforestation.

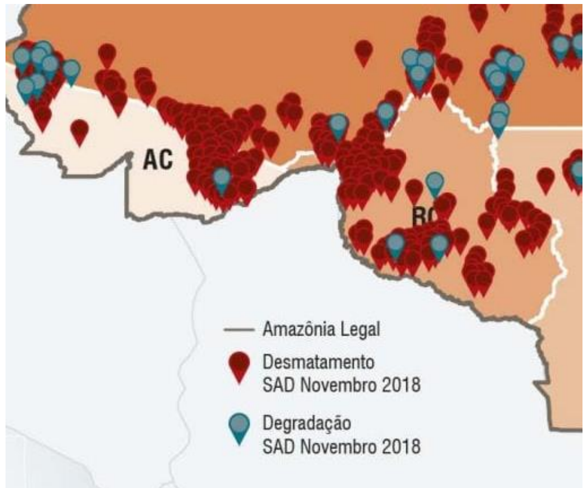
For instance, Government conservation units such as parks and sustainable use areas (APAs) are also affected by advancing deforestation and increased accessibility of the region to economic activities due to creation or improvement of infrastructure. Between 2000 and 2008, 2.25 million hectares were deforested in protected areas in Legal Amazon, and illegal exploitation of wood (degradation) has occurred in many of them. In November 2018, the Deforestation Alert System[129] detected 287 $km^2$ of deforestation in the Legal Amazon, an increase of 406% compared to November 2017, when deforestation totaled 57 $km^2$.

[127] RIBEIRO, A.C.F. et al. O PLANO DE MANEJO FLORESTAL COMO INSTRUMENTO DE DESENVOLVIMENTO SUSTENTÁVEL NA AMAZÔNIA. Direito & Desenvolvimento, ISSN 2236-0859, 2020. Available at <https://periodicos.unipe.br/index.php/direitoedesenvolvimento/article/download/875/715/#:~:text=O%20Plano%20de%20Manejo%20Florestal%20Sustent%C3%A1vel%20%2D%20PMFS%20est%C3%A1%20intimamente%20relacionado,forma%20alcan%C3%A7armos%20um%20desenvolvimento%20ambiental>.

[128] 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.

[129] Available at https://imazon.org.br/publicacoes/boletim-do-desmatamento-da-amazonia-legal-novembro-2018-sad/#:~:text=Bel%C3%A9m%3A%20Imazon.,desmatamento%20somou%2057%20quil%C3%B4metros%20quadrados.

**Figure 27. Deforestation in the Legal Amazon, Acre, Source: SAD - Imazon, 2018**




According to the Ministry of the Environment (MMA-Ministério do Meio Ambiente), the increase in deforestation had four main reasons, signs of change in political winds, a favorable exchange rate for agribusiness, which stimulates the opening of new areas, a period of drought that is more acute than the average and, as a result of this, a large increase in the number of fires[130].

One way to avoid increased accessibility and illegal exploitation of protected areas would be to increase the effectiveness of sanctions in cases of environmental malpractice.

The creation of protected areas is proven to be one of the most effective tools in forest conservation and the fight against deforestation. However, without management and investment, these important reserves do not attain their sustainable development goals, leaving them vulnerable to criminal activity such as land squatting, illegal wood harvesting and deforestation. This underlines the importance of REDD+ projects for forest conservation, despite being located in protected areas, because they are capable of contributing to the improvement of deforestation monitoring and control, promoting social, economic and environmental benefits in the region.

As Scenario II is the implementation of the SFMP with the addition of social environmental activities, as presented above, it is also in compliance with all applicable legal and regulatory requirements. Thus, there are no restrictions for SFMP within the areas where the Mamuriá Grouped REDD project's property is located.

[130] Available at https://www1.folha.uol.com.br/ambiente/2018/11/desmatamento-na-amazonia-cresce-14-e-e-o-maior-desde-2008.shtml

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

Based on the scenarios presented, it is possible to conclude that the baseline scenario is Scenario I.

The continuation of the pre project activity, that is, a SFMP without any socio-environmental activity is the most profitable alternative land use, and thus, the most plausive baseline scenario.

### STEP 2. Investment Analysis

### Sub-step 2a. Determine appropriate analysis method

The Mamuriá Grouped REDD Project generates financial benefits other than the revenue from the sale of VCUs, primarily through the commercialization of timber, as a result of the sustainable forest management plan. Thus, an investment comparison (Option II) will be carried out in order to determine the project's additionality, i.e, whether the proposed project activity, without the revenue from the sale of GHG credits, is economically or financially less attractive than the other land use scenarios.

### Sub-step 2b. - Option II. Apply investment comparison analysis

An investment comparison analysis was performed to demonstrate which of the scenarios identified above is more financially attractive. For such analysis, the Net Present Value (NPV) was considered the most appropriate financial indicator. Many articles on profitability of alternative land uses in areas under similar conditions to the project region applied the Net Present Value (NPV) for financial analysis, such as Amaral et al. (1998)[131], Barreto et al. (1998)[132], Schneider (2000)[133], Razera (2005)[134], Young et al. (2007)[135] and IDESAM (2014)[136].

[131] AMARAL, P. et al. Floresta para Sempre: um Manual para Produção de Madeira na Amazônia. Belém: Imazon, 1998. p. 130. Available at: < https://imazon.org.br/publicacoes/floresta-para-sempre-um-manual-para-a-producao-de-madeira-na-amazonia/>

[132] BARRETO, P. et al. Custos e Benefícios do Manejo Florestal para Produção de Madeira na Amazônia Oriental. Série Amazônia N°10 - Belém: Imazon, 1998. Available at: < https://imazon.org.br/publicacoes/custos-e-beneficios-do-manejo-florestal-para-a-producao-de-madeira-na-amazonia-oriental-n-10/>

[133] SCHNEIDER, R. R. et al. Amazônia sustentável: limitantes e oportunidades para o desenvolvimento. Belém: Instituto do Homem e Meio Ambiente da Amazônia (IMAZON), 2000. 58 p. Available at: < https://imazon.org.br/PDFimazon/Portugues/livros/amazonia-sustentavel-limitantes-e-oportunidades.pdf>

[134] RAZERA, Allan. Dinâmica do desmatamento em uma nova fronteira do sul do Amazonas: uma análise da pecuária de corte no município do Apuí. 2005. 109 f. Thesis (Master grade) - Curso de Biologia, Universidade Federal do Amazonas - UFAM, Amazônia, 2005. Available at: < https://bdtd.inpa.gov.br/handle/tede/1852>

[135] ARIMA, E.; BARRETO, P.; BRITO, M. Pecuária na Amazônia: tendências e implicações para a conservação ambiental. Belém: Instituto do Homem e Meio Ambiente da Amazônia (IMAZON), 2005. 76 p. Available at: < https://imazon.org.br/publicacoes/pecuaria-na-amazonia-tendencias-e-implicacoes-para-a-conservacao/>

[173] YOUNG, C. E. F. et al. Rentabilidade da pecuária e custo de oportunidade privado da conservação no estado do Amazonas. 2007. Available at: < https://www.academia.edu/3393168/Rentabilidade_da_pecu%C3%A1ria_e_custo_de_oportunidade_privado_da_conserva%C3%A7%C3%A3o_no_Estado_do_Amazonas>

[136] INSTITUTO DE CONSERVAÇÃO E DESENVOLVIMENTO SUSTENTÁVEL DO AMAZONAS (IDESAM).

**Sub-step 2c. - Calculation and comparison of financial indicators**

The following scenarios were analyzed as part of the investment analysis:

1. The implementation of a sustainable forest management plan within the project boundaries of the proposed VCS REDD project, however without carrying out additional social and environmental activities, as well as activities to reduce unplanned deforestation.
2. Implementation of a sustainable forest management plan, combined with the implementation of additional activities to reduce deforestation.

Under Scenario I, expenses are mostly related to Sustainable Forest Management Plan, while revenues derive from the commercialization of timber. Under scenario II, the same revenues and expenses are expected. However, scenario II involves additional expenses to reduce deforestation, such as the cost of monitoring the Project Area and promoting social and environmental activities with local communities. The key parameters considered on each scenario are described on the Table below.

**Table 21. Main parameters used for the investment comparison analysis**

| Parameter | Investment Analysis Comparison - 30 years project lifetime (in Brazilian Reais) | |
|---|---|---|
| | Scenario I | Scenario II |
| **TOTAL REVENUES** | R$ 28,132,291.68 | R$ 28,132,291.68 |
| Timber | R$ 28,132,291.68 | R$ 28,132,291.68 |
| Other (cattle ranching) | R$ 0.00 | R$ 0.00 |
| Carbon credits | R$ 0.00 | R$ 0.00 |
| **TOTAL EXPENSES** | -R$ 26,120,331.75 | -R$ 29,833,807.75 |
| SFMP costs | -R$ 21,156,521.23 | -R$ 26,120,331.75 |
| Forest conservation and socio environmental activities | R$ 0.00 | -R$ 3,713,476.01 |
| Other (cattle ranching) | R$ 0.00 | R$ 0.00 |

The Table below provides the results of the investment comparison analysis.

**Table 22. Results from the investment analysis comparison between scenarios**[137]

| Investment Analysis Comparison - 30 years project lifetime (Brazilian Reais) | | |
|---|---|---|
| Land use scenarios Variables | I - Sustainable Forest Management Plan (SFMP) | II – SFMP combined with the implementation of additional activities to reduce deforestation |
| Total costs | -R$ 26,120,331.75 | -R$ 29,833,807.75 |
| Total Revenues | R$ 28,132,291.68 | R$ 28,132,291.68 |
| Accumulated cashflow | R$ 2,011,959.93 | -R$ 1,701,516.07 |
| NPV | R$ 706,071.74 | -R$ 540,407.71 |

Through this analysis, it can be concluded that scenarios I and III would have a higher Net Present Value than what was calculated for scenario II. The implementation of the present VCS AFOLU project over the project lifetime (30 years) would represent a decrease on the expected NPV that would be generated by the sustainable forest management activity alone.

This represents a significant barrier for adopting additional deforestation reduction practices. Scenario I, where no REDD activities are undertaken together with the SFMP, is a more economically attractive scenario than the measures proposed by the project activity.

Therefore, all the additional costs to monitor and reduce deforestation would not be needed if the REDD project did not occur, thus making the proposed VCS AFOLU project without the financial benefits from VCUs substantially less attractive when comparing to other land use scenarios.

### Sub-step 2d. - Sensitivity analysis

The objective of this sub-step is to demonstrate that the conclusion regarding the financial attractiveness of the project is robust to reasonable variations in the critical assumptions. The investment analysis provides a valid argument in favor of additionality only if it consistently supports the conclusion that the proposed VCS AFOLU project without the financial benefits from carbon credits is unlikely to be financially attractive.

To carry out the sensitivity analysis, the following variables were subject to reasonable variation of ±20%:

- Cost of SFMP activities, including the SFM Plan, Yearly operational Plan and other documents (Brazilian Reais/year);

[137] A spreadsheet with a detailed calculation of financial indicators and the comparison of scenarios was made available for the auditing team.

- Cost for forest conservation measures and social and environmental activities required by the REDD Project (Brazilian Reais/year);

Revenues from SFMP will not be subjected to variations in this analysis, as the land owner has a leasing agreement with a Third Party. Such agreement establishes a fixed annual revenue from the leasing of harvesting activities on the Project Area.

The sensitivity analysis demonstrates that even with a variation of ±20% on the assumptions described above, the Scenario II would only the least feasible option compared to Scenario I.

Regarding the comparison between Scenario I and Scenario II, this indicates that forest conservation costs would need to be completely eliminated or be combined with a significant reduction in the cost of SFM activities to be comparable with the Scenario I's NPV.

Figures below show the sensitivity analysis described above.

| Scenario II analysis<br>Revenues from sustainable forest management and costs for forest conservation measures | | | Variation on cost of forest conservation measures | | | | |
|---|---|---|---|---|---|---|---|
| | | | -20% | -10% | 0% | 10% | 20% |
| | | | R$ 86,054 | R$ 96,811 | R$ 107,568 | R$ 118,325 | R$ 129,081 |
| Variation on costs of Sustainable forest management plan | -20% | R$11,809 | -R$ 378,838 | -R$ 461,506 | -R$ 544,174 | -R$ 626,841 | -R$ 709,509 |
| | -10% | R$13,286 | -R$ 390,183 | -R$ 472,850 | -R$ 555,518 | -R$ 638,186 | -R$ 720,854 |
| | 0% | R$14,762 | -R$ 401,527 | -R$ 484,195 | -R$ 566,863 | -R$ 649,531 | -R$ 732,199 |
| | 10% | R$16,238 | -R$ 412,872 | -R$ 495,540 | -R$ 578,207 | -R$ 660,875 | -R$ 743,543 |
| | 20% | R$17,714 | -R$ 424,216 | -R$ 506,884 | -R$ 589,552 | -R$ 672,220 | -R$ 754,888 |

It is not expected that any large variation of project costs will occur, as the average inflation during 2011-2021 period was 6.15%/year[138]. Preventing deforestation is a complex and resource demanding activity, which involves personnel, technology and the engagement with local communities in a broad area surrounding the project. Therefore, the magnitude of these costs is a reflection of the complexity of developing an AFOLU REDD Project and maintaining measures to prevent deforestation and degradation. Such activities need to be performed either by for-profit organizations (such as consultancy companies) or by internal staff, that must be compensated for their services.

The conditions to allow Scenario II to be more financially attractive than Scenario I and III are considered unlikely by the Project Proponents. Hence, the land owner would hardly invest in activities to prevent deforestation beyond what is required by the appliable legislation in the absence of the REDD project.

Since the sensitivity analysis allows determining the VCS AFOLU project without the financial benefits from the VCS is unlikely to be financially attractive, a common practice analysis will be demonstrated next.

[138] Annual inflation (IPCA), cumulative value per year. Available at: <https://www.inflation.eu/pt/taxas-de-inflacao/brasil/inflacao-historica/ipc-inflacao-brasil.aspx>.

**STEP 4. Common practice analysis**

The previous steps shall be complemented with an analysis of the extent to which similar activities have already diffused in the geographical area of the Mamuriá Grouped REDD project activity. Similar activities to the proposed REDD project, i.e., that are of similar scale, take place in a comparable environment, inter alia, with respect to the regulatory framework and are undertaken in the relevant geographical area, shall be analyzed. Other registered VCS AFOLU Project activities shall not be included in this analysis.

The practice of conservation of privately-owned forest areas located in the project region is extremely rare. The conservation of native forest is far from being the most attractive economic scenario, and it is often threatened by the noncompliance of the law, as presented in previous sections.

The barriers to preserve forests can be easily explained just by comparing the price of land in the region: forested property values are almost 4 times cheaper than established pasturelands. This fact alone promotes the purchase of new forested areas, deforestation and further creation of new pasturelands[139]. In addition to that, as mentioned above in Section 3.4, there are several other drivers and underlying causes of deforestation in the region, such as population growth, increase of prices of timber logs and beef, lack of resolution of land tenure, absence of economic alternatives, and low presence of Governance. Additionally, the implementation of new infrastructure projects attracts more people to live in a region with a widespread culture of deforestation. Therefore, forest conservation is not the common practice.

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[140].

Although there are Sustainable Forest Management Plans and logging authorizations in the region and in the reference region, these activities do not involve any additional measures to prevent deforestation and forest, as is it not mandatory by law, and, as presented in the investment comparison, more expensive than strictly applying the requirements of the SFMP. Therefore, no similar activity to the Project was found as part of the common practice analysis. Thus, the proposed VCS AFOLU project is not the baseline scenario and, hence, it is additional.

139 REYDON, Bastiaan Philip. O desmatamento da floresta amazônica: causas e soluções. Economia Verde: Desafios e Oportunidades, Campinas, v. 8, p.143-155, jun. 2011. Available at: <http://www.gestaodaterra.com.br/arquivos/O_desmatamento_da_floresta_amazonia_causas_e_solucoes.pdf>.

140 "The Rotten Apples of Brazil's Agribusiness" Available at: <https://www.researchgate.net/publication/343017296_The_rotten_apples_of_Brazil's_agribusiness> Last visited on 14/01/2022.

### APD – Avoided Planned Deforestation

The following sections present the results of each step to demonstrate additionality in VCS AFOLU projects according to VT0001 v3.0.

**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**

The following describes the realistic and credible land use scenarios that would have occurred within the proposed project boundary in the absence of the AFOLU project activity under VCS.

I. **The continuation of the current (pre-project) land use scenario:** in this scenario, no REDD project is undertaken. The authorized deforestation, through licenses and authorizations for forest exploitation in up to 20% of the property is executed, and the entire project area is suppressed.

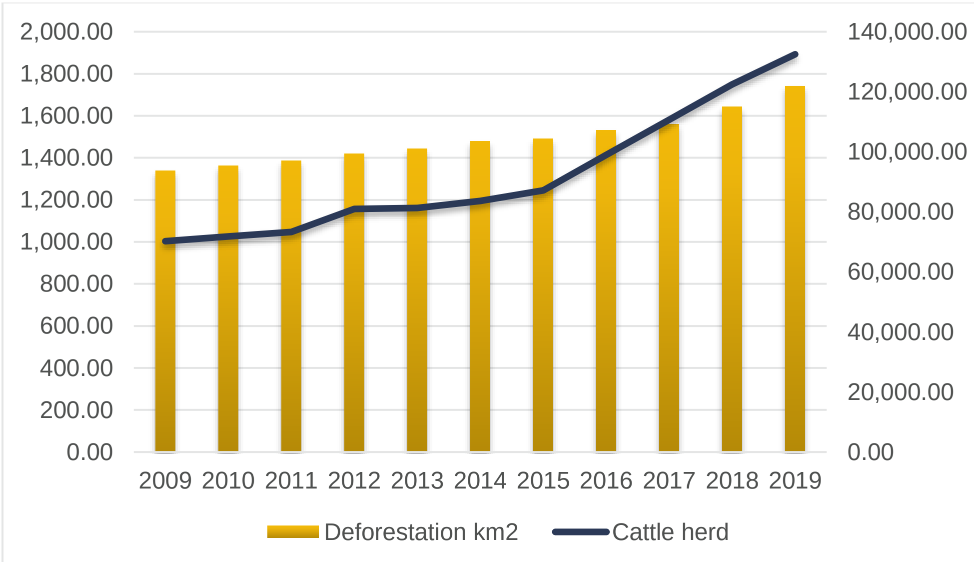
   Scenario I is realistic and credible, as it represents an activity that the project agent has already performed on other properties.

II. **Implementation of a sustainable forest management plan, combined with the implementation of additional activities:** In this scenario, the Project activity would be carried out on the land within the project boundary, nevertheless performed without being registered as the VCS REDD project. Thus, the maintenance of the property's forest cover, without exploitation of the 20% permitted by law;

   Scenario II is difficult to occur, as it implies leaving the property without generating financial resources and with maintenance costs, fees and taxes and risk of encroachment and illegal deforestation. This scenario is more unlikely, but it is in accordance with environmental legislation.

Scenario I is considered the most plausible baseline scenario because the land is expected to be converted to non-forest land in the baseline case and the conversion is legally authorized and documented. Deforestation with an increase in livestock is intrinsically linked and follows a pattern in the Amazon region. What can be confirmed by the increase in head of cattle in the municipality.

Figure 28. Deforestation and cattle herd in Feijó (AC).




In this scenario, the landowner would change its activity from forest management to cattle ranching. This is a plausible scenario since cattle is one of Brazil's main economic activities, as previously described in section above.

The State of Acre is not the most expressive in the number of herds in the northern region of Brazil, but it is pressured by neighboring states (Figure 24), mainly Rondônia and the south of Amazonas. The northern region had more than 24% of the country's herd[141].

This growth in the number of herds over the years in the region can be observed by the type of land use on agricultural properties. In the municipality of Feijó, more than 85% of the properties are destined for pasture and are in good condition. Only 7% of properties are intended for agricultural crops (permanent and temporary)[142].

[141] Available at https://www.ibge.gov.br/estatisticas/economicas/agricultura-e-pecuaria/9107-producao-da-pecuaria-municipal.html?=&t=resultados

[142] https://www.ibge.gov.br/estatisticas/economicas/agricultura-e-pecuaria/9107-producao-da-pecuaria-municipal.html?=&t=resultados

Figure 29. Herd effective in Acre and North region.

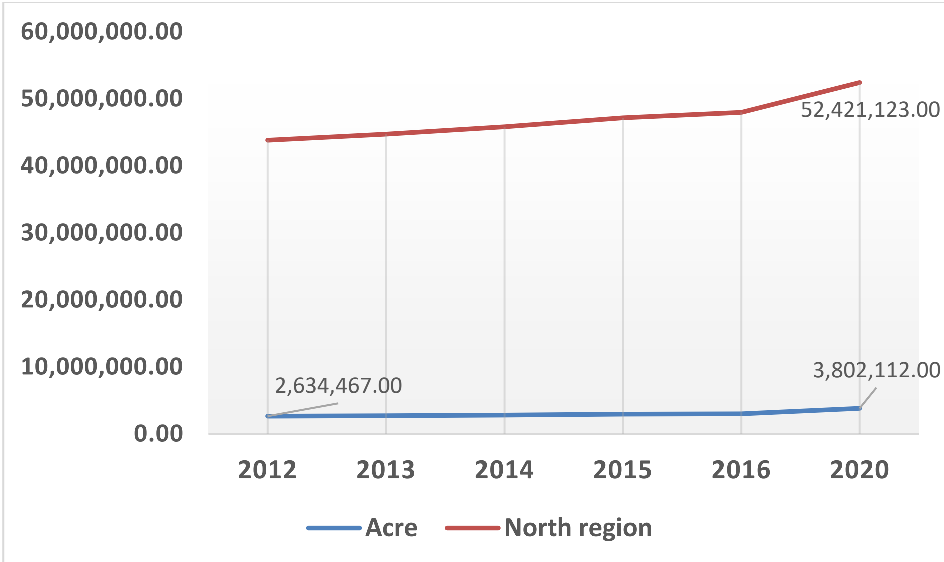



Figure 30. Herd effective in North region and Brazil.

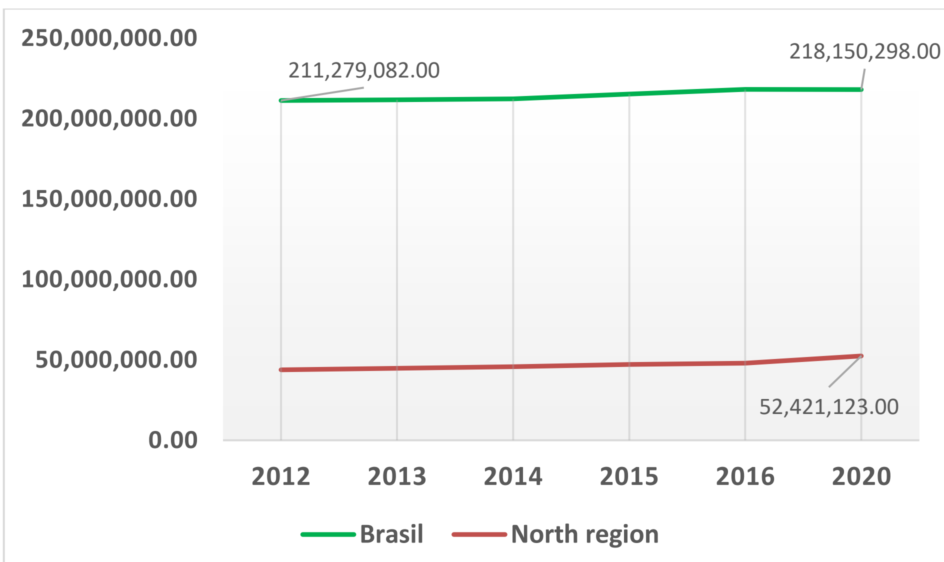
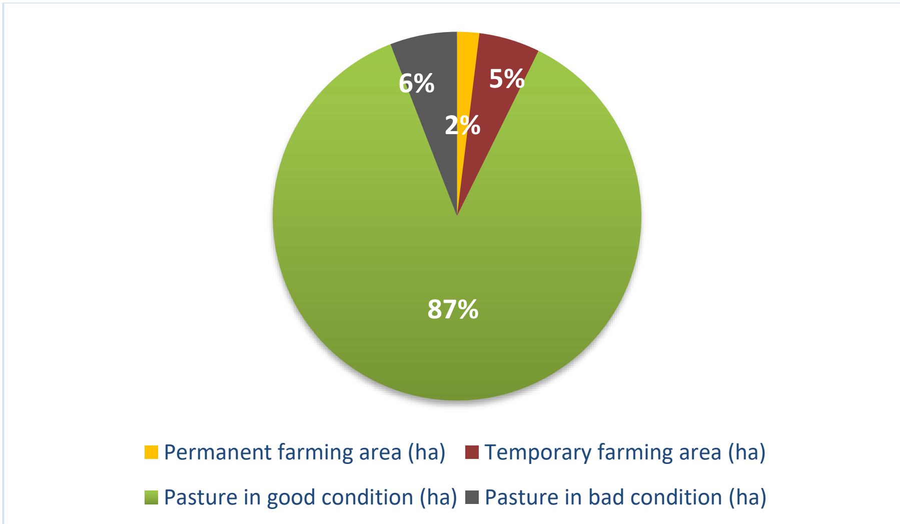


Figure 31. Land use in Feijó/AC.




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

**Scenario I and II:** The application of an authorized deforestation is regulated in Brazil by the laws Nº 12,651[143], decree Nº 5,975[144], as detailed in AUD analysis.

**Scenario III** - Cattle raising in the Amazon Forest is legal as long as the owner follows the 80% Legal Reserve and Permanent Preservation Areas restriction described in the Brazilian legislation. The landowner must also provide a deforestation authorization for clearing the area for pasture. This authorization is provided by the State's government[145], in the responsible environmental agency. The legal reserve area can be exploited and compensation in another area, if there is no duplication of the compensated area. Thus, the AUD project area may have pasture and livestock if the owner requests authorization from the competent body, indicating another area for forest compensation[146].

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

Based on the scenarios presented, it is possible to conclude that the baseline scenario is Scenario I.

[143] Available at: <https://www.planalto.gov.br/ccivil_03/_Ato2011-2014/2012/Lei/L12651.htm>
[144] Available at: <http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2006/decreto/d5975.htm>
[145] Available at < https://www.legisweb.com.br/legislacao/?id=132746>

[146] On the other hand, the registration of another area equivalent to and in excess of the Legal Reserve, in a property owned by the same owner or acquired in a third-party property, consists of the acquisition of a different area for compensation purposes, provided that it has established native vegetation, in regeneration or recomposition, and located in the same biome as the area being regularized. Available at: https://buzaglodantas.adv.br/2021/08/11/compensacao-de-reserva-legal/

Cattle ranching is the most profitable alternative land use, and thus, the clearing of the land and execution of the authorization is the most plausible baseline scenario.

**STEP 2. Investment Analysis**

**Sub-step 2a. Determine appropriate analysis method**

This stage follows the same as for the AUD stage, that is, the proposed project activity is less attractive than the commercialization of wood after suppression and implementation of agricultural activity.

Same for steps 2b, 2c and 2d described in AUD.

**STEP 3. Common practice analysis**

As previously presented, forest conservation is extremely rare, due to the financial attractiveness of other activities, especially when dealing with an area that is allowed to be legally deforested.

The maintenance of 80% of legal reserve in the Legal Amazon is extremely contested by the agricultural sector, and the pressure to change the forest code is high. There is movement to reduce mandatory conservation to 50% in states such as Mato Grosso[147], Roraima and Amapá[148], which indicates the trend and pressure between the environment and agriculture sector. The municipality of Feijó has an area of 2,839,477.5 ha, with a remnant of vegetation on registered properties of 773,421 ha. Of these, 18.6% are categorized as Legal Reserve Surplus[149]. Thus, it can be concluded that the conservation of areas authorized for plant suppression is not a common practice in the municipality.

Therefore, the proposed VCS AFOLU project is not the baseline scenario and is not common practice in the region. Hence, it is additional.

## 3.6 Methodology Deviations

This project activity does not apply any methodology deviations.

[147] Available at: < https://observatorioflorestal.org.br/nota-tecnica-pl337-22-proposta-de-retirada-do-mato-grosso-da-amazonia-legal-traz-prejuizos-ao-brasil-em-beneficio-de-poucos/>
[148] Available at: < https://www.bbc.com/portuguese/brasil-51510482>
[149] Available at: < http://termometroflorestal.org.br/plataforma>

# 4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

## 4.1 Baseline Emissions

### AUD – Avoided Unplanned Deforestation

<u>Projection of Future Deforestation</u>

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 2010 and 2020, there was a deforestation of 105,270 ha within the Reference Region, with an average oscillation of approximately 10,527 ha/year and a low increasing trend ($R^2$ = 0.88).

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 2010-2020 period is 0.66%/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 linear model, tables below show the results of the projection in Reference Region, Project Area and Leakage Belt.

**Table 23. 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 |
| 2021 | 8,465.55 | 8,465.55 | 8,465.55 |
| 2022 | 8,465.55 | 8,465.55 | 16,931.10 |
| 2023 | 8,465.55 | 8,465.55 | 25,396.65 |

| Project year t | Stratum i in the reference region (ha) | Total (ha) | |
|---|---|---|---|
| | ABSLRR | annual $ABSLRR_t$ | cumulative ABSLRR |
| 2024 | 8,465.55 | 8,465.55 | 33,862.20 |
| 2025 | 8,465.55 | 8,465.55 | 42,327.75 |
| 2026 | 8,465.55 | 8,465.55 | 50,793.30 |
| 2027 | 7,618.99 | 7,618.99 | 58,412.29 |
| 2028 | 7,618.99 | 7,618.99 | 66,031.29 |
| 2029 | 7,618.99 | 7,618.99 | 73,650.28 |
| 2030 | 7,618.99 | 7,618.99 | 81,269.28 |
| 2031 | 7,618.99 | 7,618.99 | 88,888.27 |
| 2032 | 7,618.99 | 7,618.99 | 96,507.26 |
| 2033 | 6,857.10 | 6,857.10 | 103,364.36 |
| 2034 | 6,857.10 | 6,857.10 | 110,221.45 |
| 2035 | 6,857.10 | 6,857.10 | 117,078.55 |
| 2036 | 6,857.10 | 6,857.10 | 123,935.64 |
| 2037 | 6,857.10 | 6,857.10 | 130,792.74 |
| 2038 | 6,857.10 | 6,857.10 | 137,649.83 |
| 2039 | 6,171.39 | 6,171.39 | 143,821.22 |
| 2040 | 6,171.39 | 6,171.39 | 149,992.61 |
| 2041 | 6,171.39 | 6,171.39 | 156,163.99 |
| 2042 | 6,171.39 | 6,171.39 | 162,335.38 |
| 2043 | 6,171.39 | 6,171.39 | 168,506.76 |
| 2044 | 6,171.39 | 6,171.39 | 174,678.15 |
| 2045 | 5,554.25 | 5,554.25 | 180,232.40 |
| 2046 | 5,554.25 | 5,554.25 | 185,786.64 |
| 2047 | 5,554.25 | 5,554.25 | 191,340.89 |
| 2048 | 5,554.25 | 5,554.25 | 196,895.14 |
| 2049 | 5,554.25 | 5,554.25 | 202,449.38 |
| 2050 | 5,554.25 | 5,554.25 | 208,003.63 |

**Table 24. 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 |
| 2021 | 293.09 | 293.09 | 293.09 |
| 2022 | 293.09 | 293.09 | 586.18 |
| 2023 | 293.09 | 293.09 | 879.27 |
| 2024 | 293.09 | 293.09 | 1,172.35 |
| 2025 | 293.09 | 293.09 | 1,465.44 |
| 2026 | 293.09 | 293.09 | 1,758.53 |
| 2027 | 263.78 | 263.78 | 2,022.31 |
| 2028 | 263.78 | 263.78 | 2,286.09 |
| 2029 | 263.78 | 263.78 | 2,549.87 |
| 2030 | 263.78 | 263.78 | 2,813.65 |
| 2031 | 263.78 | 263.78 | 3,077.43 |
| 2032 | 263.78 | 263.78 | 3,341.21 |
| 2033 | 237.40 | 237.40 | 3,578.61 |
| 2034 | 237.40 | 237.40 | 3,816.01 |
| 2035 | 237.40 | 237.40 | 4,053.41 |
| 2036 | 237.40 | 237.40 | 4,290.81 |
| 2037 | 237.40 | 237.40 | 4,528.21 |
| 2038 | 237.40 | 237.40 | 4,765.62 |
| 2039 | 213.66 | 213.66 | 4,979.28 |
| 2040 | 213.66 | 213.66 | 5,192.94 |
| 2041 | 213.66 | 213.66 | 5,406.60 |
| 2042 | 213.66 | 213.66 | 5,620.26 |
| 2043 | 213.66 | 213.66 | 5,833.92 |
| 2044 | 213.66 | 213.66 | 6,047.58 |
| 2045 | 192.30 | 192.30 | 6,239.88 |
| 2046 | 192.30 | 192.30 | 6,432.18 |
| 2047 | 192.30 | 192.30 | 6,624.47 |
| 2048 | 192.30 | 192.30 | 6,816.77 |
| 2049 | 192.30 | 192.30 | 7,009.06 |
| 2050 | 192.30 | 192.30 | 7,201.36 |

**Table 25. 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 |
| 2021 | 217.45 | 217.45 | 217.45 |
| 2022 | 217.45 | 217.45 | 434.89 |
| 2023 | 217.45 | 217.45 | 652.34 |
| 2024 | 217.45 | 217.45 | 869.79 |
| 2025 | 217.45 | 217.45 | 1,087.23 |
| 2026 | 217.45 | 217.45 | 1,304.68 |
| 2027 | 195.70 | 195.70 | 1,500.38 |
| 2028 | 195.70 | 195.70 | 1,696.09 |
| 2029 | 195.70 | 195.70 | 1,891.79 |
| 2030 | 195.70 | 195.70 | 2,087.49 |
| 2031 | 195.70 | 195.70 | 2,283.19 |
| 2032 | 195.70 | 195.70 | 2,478.90 |
| 2033 | 176.13 | 176.13 | 2,655.03 |
| 2034 | 176.13 | 176.13 | 2,831.16 |
| 2035 | 176.13 | 176.13 | 3,007.29 |
| 2036 | 176.13 | 176.13 | 3,183.42 |
| 2037 | 176.13 | 176.13 | 3,359.56 |
| 2038 | 176.13 | 176.13 | 3,535.69 |
| 2039 | 158.52 | 158.52 | 3,694.21 |
| 2040 | 158.52 | 158.52 | 3,852.73 |
| 2041 | 158.52 | 158.52 | 4,011.24 |
| 2042 | 158.52 | 158.52 | 4,169.76 |
| 2043 | 158.52 | 158.52 | 4,328.28 |
| 2044 | 158.52 | 158.52 | 4,486.80 |
| 2045 | 142.67 | 142.67 | 4,629.47 |
| 2046 | 142.67 | 142.67 | 4,772.13 |
| 2047 | 142.67 | 142.67 | 4,914.80 |
| 2048 | 142.67 | 142.67 | 5,057.47 |
| 2049 | 142.67 | 142.67 | 5,200.14 |
| 2050 | 142.67 | 142.67 | 5,342.80 |

- **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 small rivers and the proximity to large 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[150], 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.

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

[150] Dinamica Ego Software. Available at: <https://csr.ufmg.br/dinamica/>. Last visited on august 5th, 2022.

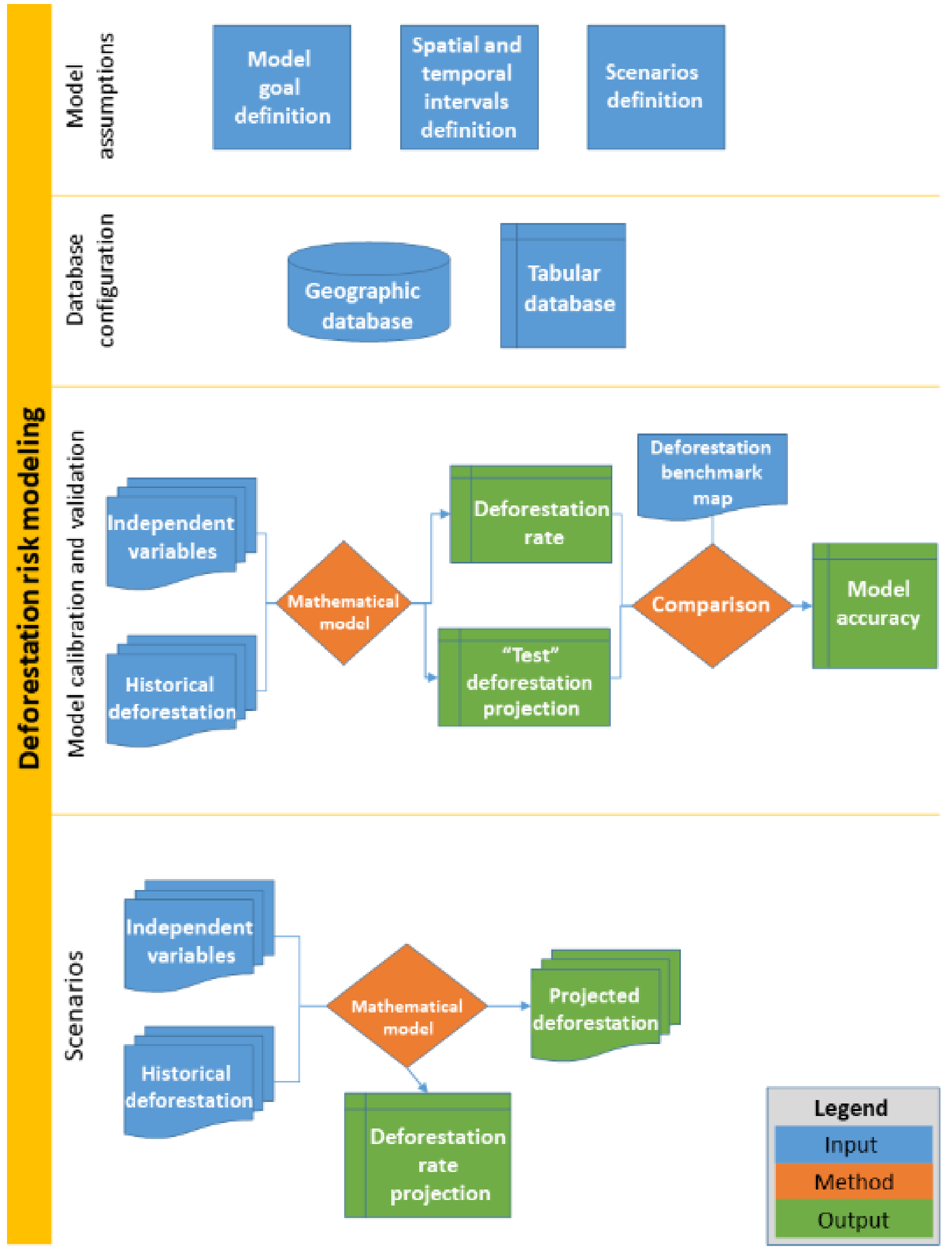
the sum of all the weights of evidence that overlap on a given pixel and are dependent on the combinations of all static and dynamic maps[151].

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.

[151] 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 32. 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 26. 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/ABC Norte data | 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**

  According to the methodology, "The Prediction Map" with the best fit is the map that best reproduced actual deforestation in the confirmation period. The best fit must be assessed using appropriate statistical techniques. Most peer reviewed modeling tools, such as Geomod, Idrisi Taiga, Land Use Change Modeler, and Dinamica Ego, include in the software package appropriate assessment techniques, which can be used under this methodology. Preference should be given to techniques that assess the accuracy of the prediction at the polygon level, such as the predicted quantity of total deforestation within the project area as compared to the observed one."

  For that, simulations of the deforestation projection were made, taking three dates as reference: 2010, 2015 and 2020. The period from 2010 to 2015 was used to generate the correlations between the deforested areas and the predictor variables, calculating the adjustment parameters of the model. After that, a projection from 2016 to 2020 was developing a reference region scenario for this date. Therefore, the deforestation maps for the period from 2016 to 2020 and two scenarios for 2020, real and projected, were developed. These scenarios were compared regarding the degree of similarity considering exponential decay. The higher the similarity, the better the prediction of the model. 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 0.391. 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.

In addition, the AUC (Area Under the Curve), which is the area under the ROC curve (Receiver Operating Characteristic) was calculated. This represents the accuracy of the probability maps, that is, it shows whether the actual deforestation is indicated with the deforestation probabilities by the models (deforestation risk map). Regarding the AUC values, the best model presented a value of 0.78[152].

- **Definition of the 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'.

[152] According to KHATAMI, Reza; MOUNTRAKIS, Giorgos; STEHMAN, Stephen V. **Mapping per-pixel predicted accuracy of classified remote sensing images.** Remote Sensing of Environment, v. 191, p. 156-167, 2017., models that present values over 0.5 may be used.

**Table 27. Annual areas deforested per forest class icl within the Reference Region in the baseline case (baseline activity data per forest class)**

| Area deforested per florest 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 | | |
| 2021 | 8,465.55 | 8,465.55 | 8,465.55 |
| 2022 | 8,465.55 | 8,465.55 | 16,931.10 |
| 2023 | 8,465.55 | 8,465.55 | 25,396.65 |
| 2024 | 8,465.55 | 8,465.55 | 33,862.20 |
| 2025 | 8,465.55 | 8,465.55 | 42,327.75 |
| 2026 | 8,465.55 | 8,465.55 | 50,793.30 |
| 2027 | 7,618.99 | 7,618.99 | 58,412.29 |
| 2028 | 7,618.99 | 7,618.99 | 66,031.29 |
| 2029 | 7,618.99 | 7,618.99 | 73,650.28 |
| 2030 | 7,618.99 | 7,618.99 | 81,269.28 |
| 2031 | 7,618.99 | 7,618.99 | 88,888.27 |
| 2032 | 7,618.99 | 7,618.99 | 96,507.26 |
| 2033 | 6,857.10 | 6,857.10 | 103,364.36 |
| 2034 | 6,857.10 | 6,857.10 | 110,221.45 |
| 2035 | 6,857.10 | 6,857.10 | 117,078.55 |
| 2036 | 6,857.10 | 6,857.10 | 123,935.64 |
| 2037 | 6,857.10 | 6,857.10 | 130,792.74 |
| 2038 | 6,857.10 | 6,857.10 | 137,649.83 |
| 2039 | 6,171.39 | 6,171.39 | 143,821.22 |
| 2040 | 6,171.39 | 6,171.39 | 149,992.61 |
| 2041 | 6,171.39 | 6,171.39 | 156,163.99 |
| 2042 | 6,171.39 | 6,171.39 | 162,335.38 |
| 2043 | 6,171.39 | 6,171.39 | 168,506.76 |
| 2044 | 6,171.39 | 6,171.39 | 174,678.15 |
| 2045 | 5,554.25 | 5,554.25 | 180,232.40 |
| 2046 | 5,554.25 | 5,554.25 | 185,786.64 |
| 2047 | 5,554.25 | 5,554.25 | 191,340.89 |
| 2048 | 5,554.25 | 5,554.25 | 196,895.14 |
| 2049 | 5,554.25 | 5,554.25 | 202,449.38 |
| 2050 | 5,554.25 | 5,554.25 | 208,003.63 |

**Table 28. Annual areas deforested per forest class icl within the Project Area in the baseline case (baseline activity data per forest class)**

| Area deforested per florest 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 | | |
| 2021 | 293.09 | 293.09 | 293.09 |
| 2022 | 293.09 | 293.09 | 586.18 |
| 2023 | 293.09 | 293.09 | 879.27 |
| 2024 | 293.09 | 293.09 | 1,172.35 |
| 2025 | 293.09 | 293.09 | 1,465.44 |
| 2026 | 293.09 | 293.09 | 1,758.53 |
| 2027 | 263.78 | 263.78 | 2,022.31 |
| 2028 | 263.78 | 263.78 | 2,286.09 |
| 2029 | 263.78 | 263.78 | 2,549.87 |
| 2030 | 263.78 | 263.78 | 2,813.65 |
| 2031 | 263.78 | 263.78 | 3,077.43 |
| 2032 | 263.78 | 263.78 | 3,341.21 |
| 2033 | 237.40 | 237.40 | 3,578.61 |
| 2034 | 237.40 | 237.40 | 3,816.01 |
| 2035 | 237.40 | 237.40 | 4,053.41 |
| 2036 | 237.40 | 237.40 | 4,290.81 |
| 2037 | 237.40 | 237.40 | 4,528.21 |
| 2038 | 237.40 | 237.40 | 4,765.62 |
| 2039 | 213.66 | 213.66 | 4,979.28 |
| 2040 | 213.66 | 213.66 | 5,192.94 |
| 2041 | 213.66 | 213.66 | 5,406.60 |
| 2042 | 213.66 | 213.66 | 5,620.26 |
| 2043 | 213.66 | 213.66 | 5,833.92 |
| 2044 | 213.66 | 213.66 | 6,047.58 |
| 2045 | 192.30 | 192.30 | 6,239.88 |
| 2046 | 192.30 | 192.30 | 6,432.18 |
| 2047 | 192.30 | 192.30 | 6,624.47 |
| 2048 | 192.30 | 192.30 | 6,816.77 |
| 2049 | 192.30 | 192.30 | 7,009.06 |
| 2050 | 192.30 | 192.30 | 7,201.36 |

**Table 29. Annual areas deforested per forest class icl within the Leakage Belt in the baseline case (baseline activity data per forest class)**

| Area deforested per florest 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 | | |
| 2021 | 217.45 | 217.45 | 217.45 |
| 2022 | 217.45 | 217.45 | 434.89 |
| 2023 | 217.45 | 217.45 | 652.34 |
| 2024 | 217.45 | 217.45 | 869.79 |
| 2025 | 217.45 | 217.45 | 1,087.23 |
| 2026 | 217.45 | 217.45 | 1,304.68 |
| 2027 | 195.70 | 195.70 | 1,500.38 |
| 2028 | 195.70 | 195.70 | 1,696.09 |
| 2029 | 195.70 | 195.70 | 1,891.79 |
| 2030 | 195.70 | 195.70 | 2,087.49 |
| 2031 | 195.70 | 195.70 | 2,283.19 |
| 2032 | 195.70 | 195.70 | 2,478.90 |
| 2033 | 176.13 | 176.13 | 2,655.03 |
| 2034 | 176.13 | 176.13 | 2,831.16 |
| 2035 | 176.13 | 176.13 | 3,007.29 |
| 2036 | 176.13 | 176.13 | 3,183.42 |
| 2037 | 176.13 | 176.13 | 3,359.56 |
| 2038 | 176.13 | 176.13 | 3,535.69 |
| 2039 | 158.52 | 158.52 | 3,694.21 |
| 2040 | 158.52 | 158.52 | 3,852.73 |
| 2041 | 158.52 | 158.52 | 4,011.24 |
| 2042 | 158.52 | 158.52 | 4,169.76 |
| 2043 | 158.52 | 158.52 | 4,328.28 |
| 2044 | 158.52 | 158.52 | 4,486.80 |
| 2045 | 142.67 | 142.67 | 4,629.47 |
| 2046 | 142.67 | 142.67 | 4,772.13 |
| 2047 | 142.67 | 142.67 | 4,914.80 |
| 2048 | 142.67 | 142.67 | 5,057.47 |
| 2049 | 142.67 | 142.67 | 5,200.14 |
| 2050 | 142.67 | 142.67 | 5,342.80 |

- **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 VM00145, 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 30. Zone of the reference region encompassing potential post-deforestation LU/LC class**

| 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 | 208,003.63 | 13% | 208,003.63 | 13% |
| Total area of each class *fcl* | | 208,003.63 | 13% | 208,003.63 | 13% |

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 31. 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 |
| 2021 | 8,465.55 | 8,465.55 | 8,465.55 |
| 2022 | 8,465.55 | 8,465.55 | 16,931.10 |
| 2023 | 8,465.55 | 8,465.55 | 25,396.65 |
| 2024 | 8,465.55 | 8,465.55 | 33,862.20 |
| 2025 | 8,465.55 | 8,465.55 | 42,327.75 |
| 2026 | 8,465.55 | 8,465.55 | 50,793.30 |
| 2027 | 7,618.99 | 7,618.99 | 58,412.29 |
| 2028 | 7,618.99 | 7,618.99 | 66,031.29 |
| 2029 | 7,618.99 | 7,618.99 | 73,650.28 |
| 2030 | 7,618.99 | 7,618.99 | 81,269.28 |
| 2031 | 7,618.99 | 7,618.99 | 88,888.27 |
| 2032 | 7,618.99 | 7,618.99 | 96,507.26 |
| 2033 | 6,857.10 | 6,857.10 | 103,364.36 |
| 2034 | 6,857.10 | 6,857.10 | 110,221.45 |
| 2035 | 6,857.10 | 6,857.10 | 117,078.55 |
| 2036 | 6,857.10 | 6,857.10 | 123,935.64 |
| 2037 | 6,857.10 | 6,857.10 | 130,792.74 |
| 2038 | 6,857.10 | 6,857.10 | 137,649.83 |
| 2039 | 6,171.39 | 6,171.39 | 143,821.22 |
| 2040 | 6,171.39 | 6,171.39 | 149,992.61 |
| 2041 | 6,171.39 | 6,171.39 | 156,163.99 |
| 2042 | 6,171.39 | 6,171.39 | 162,335.38 |
| 2043 | 6,171.39 | 6,171.39 | 168,506.76 |
| 2044 | 6,171.39 | 6,171.39 | 174,678.15 |
| 2045 | 5,554.25 | 5,554.25 | 180,232.40 |
| 2046 | 5,554.25 | 5,554.25 | 185,786.64 |
| 2047 | 5,554.25 | 5,554.25 | 191,340.89 |
| 2048 | 5,554.25 | 5,554.25 | 196,895.14 |
| 2049 | 5,554.25 | 5,554.25 | 202,449.38 |
| 2050 | 5,554.25 | 5,554.25 | 208,003.63 |

**Table 32. 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 |
| 2021 | 293.09 | 293.09 | 293.09 |
| 2022 | 293.09 | 293.09 | 586.18 |
| 2023 | 293.09 | 293.09 | 879.27 |
| 2024 | 293.09 | 293.09 | 1,172.35 |
| 2025 | 293.09 | 293.09 | 1,465.44 |
| 2026 | 293.09 | 293.09 | 1,758.53 |
| 2027 | 263.78 | 263.78 | 2,022.31 |
| 2028 | 263.78 | 263.78 | 2,286.09 |
| 2029 | 263.78 | 263.78 | 2,549.87 |
| 2030 | 263.78 | 263.78 | 2,813.65 |
| 2031 | 263.78 | 263.78 | 3,077.43 |
| 2032 | 263.78 | 263.78 | 3,341.21 |
| 2033 | 237.40 | 237.40 | 3,578.61 |
| 2034 | 237.40 | 237.40 | 3,816.01 |
| 2035 | 237.40 | 237.40 | 4,053.41 |
| 2036 | 237.40 | 237.40 | 4,290.81 |
| 2037 | 237.40 | 237.40 | 4,528.21 |
| 2038 | 237.40 | 237.40 | 4,765.62 |
| 2039 | 213.66 | 213.66 | 4,979.28 |
| 2040 | 213.66 | 213.66 | 5,192.94 |
| 2041 | 213.66 | 213.66 | 5,406.60 |
| 2042 | 213.66 | 213.66 | 5,620.26 |
| 2043 | 213.66 | 213.66 | 5,833.92 |
| 2044 | 213.66 | 213.66 | 6,047.58 |
| 2045 | 192.30 | 192.30 | 6,239.88 |
| 2046 | 192.30 | 192.30 | 6,432.18 |
| 2047 | 192.30 | 192.30 | 6,624.47 |
| 2048 | 192.30 | 192.30 | 6,816.77 |
| 2049 | 192.30 | 192.30 | 7,009.06 |
| 2050 | 192.30 | 192.30 | 7,201.36 |

**Table 33. 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 |
| 2021 | 217.45 | 217.45 | 217.45 |
| 2022 | 217.45 | 217.45 | 434.89 |
| 2023 | 217.45 | 217.45 | 652.34 |
| 2024 | 217.45 | 217.45 | 869.79 |
| 2025 | 217.45 | 217.45 | 1,087.23 |
| 2026 | 217.45 | 217.45 | 1,304.68 |
| 2027 | 195.70 | 195.70 | 1,500.38 |
| 2028 | 195.70 | 195.70 | 1,696.09 |
| 2029 | 195.70 | 195.70 | 1,891.79 |
| 2030 | 195.70 | 195.70 | 2,087.49 |
| 2031 | 195.70 | 195.70 | 2,283.19 |
| 2032 | 195.70 | 195.70 | 2,478.90 |
| 2033 | 176.13 | 176.13 | 2,655.03 |
| 2034 | 176.13 | 176.13 | 2,831.16 |
| 2035 | 176.13 | 176.13 | 3,007.29 |
| 2036 | 176.13 | 176.13 | 3,183.42 |
| 2037 | 176.13 | 176.13 | 3,359.56 |
| 2038 | 176.13 | 176.13 | 3,535.69 |
| 2039 | 158.52 | 158.52 | 3,694.21 |
| 2040 | 158.52 | 158.52 | 3,852.73 |
| 2041 | 158.52 | 158.52 | 4,011.24 |
| 2042 | 158.52 | 158.52 | 4,169.76 |
| 2043 | 158.52 | 158.52 | 4,328.28 |
| 2044 | 158.52 | 158.52 | 4,486.80 |
| 2045 | 142.67 | 142.67 | 4,629.47 |
| 2046 | 142.67 | 142.67 | 4,772.13 |
| 2047 | 142.67 | 142.67 | 4,914.80 |
| 2048 | 142.67 | 142.67 | 5,057.47 |
| 2049 | 142.67 | 142.67 | 5,200.14 |
| 2050 | 142.67 | 142.67 | 5,342.80 |

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,

| | |
|---|---|
| $Cab_{icl}$ | 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,

| | |
|---|---|
| $Cbb_{icl}$ | 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,

| | |
|---|---|
| $\Delta CBSLPA_t$ | Total baseline carbon stock changes in the project area at year t; tCO2e |
| $\Delta CabBSLPA_{icl,t}$ | Total baseline carbon stock change for the above-ground biomass pool in the project area for initial forest class at year t; tCO2e |
| $\Delta CbbBSLPA_{icl,t}$ | 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,

| | |
|---|---|
| $\Delta CabBSLPA_{icl,t}$ | Total baseline carbon stock change for the above-ground biomass pool in the project area for initial forest class at year t; $tCO_2e$ |
| $ABSLPA_{icl,t}$ | Area of initial forest class icl deforested at time t within the project area in the baseline case; ha |
| $\Delta Cab_{icl}$ | Average carbon stock change factor per hectare in the above-ground biomass carbon pool of initial forest class icl; $tCO_2e\ ha^{-1}$ |

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

Where,

| | |
|---|---|
| $\Delta CbbBSLPA_{icl,t}$ | Total baseline carbon stock change for the below-ground biomass pool in the project area for initial forest class at year t; $tCO_2e$ |
| $ABSLPA_{icl,t}$ | Area of initial forest class icl deforested at time t within the project area in the baseline case; ha |
| $\Delta Cbb_{icl}$ | Average carbon stock change factor per hectare in the below-ground biomass carbon pool of category icl; $tCO_2e\ ha^{-1}$ |

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

According to the applied methodology, VM0015 v1.1, 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.

As previously described, Dense Lowland Tropical Rainforest is the main forest type present within the project area, with around 95% of the total forest cover. Thus, due to the high representativeness of this forest type within the project area, the forest class was not stratified, i.e., the “Forest” class includes just one strata due to the low difference in average carbon stocks within the project area.

The estimation of the average carbon stocks for Dense Lowland Tropical Rainforest was based on Higuchi (2015)[153], which fulfil the criteria mentioned above.

The classification of the Brazilian vegetation is still constantly updated and studied, being evaluated and subdivided according to biological, geological or biodiversity characteristics. Pires & Prance (1985)[154] classified the forest formation of the Amazon biome into two major groups, Forest on *terra firme* (dense forest) and *Várzeas and igapós* forests, and their respective subdivisions. The authors classify that *terra firme* forests dominate the largest percentage of area in the Amazon. Most of it consist of lowland undulating terrain, rarely above 200 m, and most below 100 m.

The IBGE "Technical Manual for Brazilian Vegetation" (1992)[155] divides forestry formation into two types: Ombrophilous and Seasonal, being Ombrophilous, open and dense, predominant in the Brazilian Amazon.

As both classifications are based on characteristics of cover, soil, climate and location of the biome, the table below lists the respective definitions, comparing them:

**Table 34. Comparison of forest classifications by Pires & Prance and IBGE**

| Pires & Prance (1985) | | Technical Manual of the Brazilian vegetation (2012) |
|---|---|---|
| Forest on *Terra firme* (dense forest) | <u>Dense forest</u><br>Dense forest is the formation with the greatest biomass, with a clear litter and occurs where environmental conditions are optimal and there are no limiting factors such as scarcity or excess of water. | <u>Dense Ombrophylous rainforest (tropical rain forest)</u><br>The ombrothermal characteristic of the Dense Ombrophilous Forest is linked to tropical climatic factors of high temperatures and high rainfall, well distributed throughout the year, with practically no biologically dry period. It can be of uniform or emergent canopy.<br><br>It is subdivided into five formations ordered according to topographic hierarchy, which reflect different physiognomies:<br>**Alluvial, low land, submontane, montane and high montane formations.** |
| | <u>Open forest without palms</u> | <u>Open</u> Ombrophylous <u>forest</u> |

[153] HIGUCHI, Francisco Gasparetto. Dinâmica de volume e biomassa da floresta de terra firme do Amazonas. 2015. 201 f. Tese (Doutorado) - Curso de Engenharia Florestal, Setor de Ciências Agrárias, Universidade Federal do Paraná, Curitiba, 2015. Available at: <https://acervodigital.ufpr.br/bitstream/handle/1884/41822/R%20-%20T%20-%20FRANCISCO%20GASPARETTO%20HIGUCHI.pdf?sequence=1&isAllowed=y> Last visited on: August 2021.

[154] Pires & Prance (J.M.Pires, & Prance, G.T.. (1985). The vegetation types of the Brazilian Amazon. Available at <https://www.researchgate.net/publication/259688522_The_vegetation_types_of_the_Brazilian_Amazon> Last visited on 21/March/2021.

[155] Manual Técnico da Vegetação Brasileira – IBGE, 1992. Available at <https://biblioteca.ibge.gov.br/visualizacao/monografias/GEBIS%20-%20RJ/ManuaisdeGeociencias/Manual%20Tecnico%20da%20Vegetacao%20Brasileira%20n.1.pdf> Last visited on 21/March/2021.

| | | |
|---|---|---|
| | Since there is a greater penetration of light, because of its lower trees, there is a tendency for shrub and liana species to develop well, and the forest floor is much more densely covered by vegetation. In this forest, even though it is much lower, occasional scattered individuals of very large trees occur. The lower biomass can be caused by a lower water table, by the impermeability of the soil, by poor drainage or by conditions which do not permit good root penetration, or by the occurrence of relatively long dry seasons and a lower relative humidity. These forests are not notably seasonally deciduous, and they are also not affected by fire.<br><br>Open forest with palms<br>Similar to the preceding, with trees of about the same height in the same density and of a similar floristic composition. It occurs more frequently than the forest without palms.<br><br>Liana forest:<br>Generally has an abundance of lianas. Generally not continuous. Usually intermeshed with dense forests wthout lianas forming a complex mosaic.<br><br>Dry forest:<br>Formation of transition forest that is occasionally found in the southeastern part of Amazonia on the border between Amazonia and Central Brazil. In this region, the climate is much more seasonal and dryer with lower relative humidity, with the result that in the dry season, the trees lose some of their leaves. Dry  forest occurs in small clusters that do not occupy large areas. | This type of vegetation was considered for years as a type of transition between the Amazon rainforest and the extra-Amazonian areas. It presents four floristic factions that alter the ecological physiognomy of the dense rainforest, giving it a clear appearance, hence the name adopted, in addition to the climatic gradients with more than 60 dry days per year. It is divided into:<br>Lowland – predominance of palm trees<br>Submontane – predominance of palm trees, vines, sororoca and bamboo<br>Montane – predominance of palms and vines, the latter much more common.<br>Alluvial – on ancient terraces located along the river; riverside formation that always occupies alluvial lands located in the fluvia of coastal mountains or plateaus. |

| | | |
|---|---|---|
| | <u>Montane forests:</u><br>Forest formations which are differentiated by their altitude and rocky soil types. It occurs only at the extremities of Amazonia. | |
| <u>Inundated forests (*várzeas* and *igapós*)</u><br>Várzeas and igapós are regional terms applied both to types of soil and vegetation, noting the excess of humidity or swampy conditions, i.e., any ground that is not terra firme. *Igapó* is located in black and clearwater areas, while *Várzea* to muddy water inundation. Várzeas are formed by sedimentar ground that during its formation were influenced by fluctuation in sea levels. | | Classification of forests by location - alluvial. While Pires and Prance unified the marshy characteristic in a classification, the manual divides them according to the context of the other formations, with respective information on species, cover, etc. Thus, the term alluvial represents, as a whole, riverside formation or riparian forest that occurs along water courses, occupying the old terraces of quaternary plains. It can occur in dense, open and mixed rain forest within the classifications above. |

Thus, it can be concluded that the general definition of Dense Ombrophylous rainforest is similar to the definition of *terra firme* forests, as described by Higuchi (2015).

Therefore, the Higuchi's study of volume and biomass dynamics of the Amazonian rainforest was adopted to define the carbon stock of the category of dense tropical rainforest (lowland) located in PA, RR and LK. It is important to highlight that this vegetation type is characterized as Dense Ombrophylous Forest.

This choice was motivated by the focus of the study, which covered upland forests and the same phytophysiognomy, despite focusing on the State of Amazonas, the study covered a large number of sample plots and low uncertainty, with a confidence interval of 95%.

The data will be updated and may be stratified if new and more updated references for each phytophysiognomy are published. It is also important to note that revenues from carbon credits will be an important factor in encouraging specific studies in the project area, which would produce direct data on the region's carbon dynamics.

The methodology of Higuchi (2015) is summarized below.

The research was conducted in 11 locations distributed in 12 different municipalities in the State of Amazonas. All plots were allocated in areas of mature upland forests. None of the sampled areas has shown any clear sign of human disturbance in the past 50 years.

Regarding the sampling method, permanent plots were used, in addition to the standard EMBRAPA method.

EMBRAPA Method: 18 square plots of 1 ha (100 m x 100 m) each were installed and measured, randomly distributed over an area of 4 km² (2,000 m x 2,000 m). Each plot of 1 ha was subdivided into 100 units of 100 m², dimensioned in 10 m x 10 m. In each plot, the DBHs of all trees with a diameter greater than or equal to 10 cm were identified and measured. Dead trees and palm trees were not sampled in this location. Trees with DBH between 5 and 10 cm were sampled in ten subsamples randomly distributed in the 1 ha plot.

Permanent plots method: rectangular units with 2,500 m² were installed (¼ ha), dimensioned in 20 m x 125 m, according to the work of Higuchi et al. (1982), Higuchi, 1986-87 and Oliveira et al. (2014). Each sample unit had two sub-plots of 100 m² (10 mx 10 m) at the ends, one at the beginning of the left side and another at the end of the right side of the central path, for the measurement of natural regeneration (RN) (trees with DBH greater than or equal to 5 cm and less than 10 cm). The access path of each plot was arranged in the center of it, dividing it into two sides of 10 m each.

The sampling process adopted was mixed, where the sampling point of the first parcel was randomly drawn and the following parcels were systematically allocated from the first sampling unit.

The estimates of biomass were calculated using the equations adjusted by Silva (2007), in Manaus. The transformation to dry biomass considered the values of water and carbon in the wood determined by Silva (2007). A correction factor (fc) was applied for the use of these equations in different locations according to the dominant height of the sampled site. The equations used were:

$$BStot = 2{,}7179 \times DAP^{1{,}8774} \times 0{,}584 \times fc \text{, onde } R^2 = 0{,}94 \text{ e } Syx\% = 3{,}91.$$

$$AGB = 2{,}2737 \times DAP^{1{,}9156} \times 0{,}584 \times fc \text{, onde } R^2 = 0{,}85 \text{ e } Syx\% = 4{,}20.$$

$$BGB = 0{,}0469 \times DAP^{2{,}4754} \times 0{,}533 \times fc \text{, onde } R^2 = 0{,}95 \text{ e } Syx\% = 5{,}12.$$

$$fc = \frac{Hdom_i}{Hdom_{ZF2}}$$

Considering a minimum DBH of 5 cm and the arithmetic mean of the estimated averages for each site, the aboveground dry biomass (AGB) of *terra firme* forests in the state of Amazonas is 327.4 t.ha-1 (± 24.2 at 95% CI). This value was used for phytophysiognomies of Dense Ombrophilous Forest (Dense Tropical Rainforest).

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 35. Biomass to CO2 conversion factors[156]

| Conversion Factors*** | |
|---|---|
| Biomass to Carbon | 0.5 |
| C to $CO_2$ | 3.6667 |

**Table 36. Biomass values used for the "forest" classes within the Reference Region**

| REFERENCE REGION | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 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) |
| Terra Firme Forest | 327.40 | 163.70 | 600.23 | 78.58 | 39.29 | 144.06 | 405.98 | 202.99 | 744.29 |

**Table 37. Biomass values used for the "forest" classes within the Project Area**

| PROJECT AREA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 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) |
| Terra Firme Forest | 327.40 | 163.70 | 600.23 | 78.58 | 39.29 | 144.06 | 405.98 | 202.99 | 744.29 |

**Table 38. Biomass values used for the "forest" classes within the Leakage Belt**

| 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) |
| Terra Firme Forest | 327.40 | 163.70 | 600.23 | 78.58 | 39.29 | 144.06 | 405.98 | 202.99 | 744.29 |

[156] 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>

**Average carbon stocks of post-deforestation classes**

Fearnside (1996)[157] 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 $tCO_2eq/ha$. It is important to note that no sampling was applied to calculate this data.

Table 39. 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 | |
| $Ctot_{fcl}$ | |
| $tCO_2eq/ha$ | |
| 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 tCO2/ha. Meanwhile, based on the Brazilian Government data available in the 3rd National GHG Inventory, 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.

**Uncertainty assessment**

According to the applied methodology, if the uncertainty of the total average carbon stock is less than 10% of 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.

Higuchi (2015), for the Dense tropical and submontane rainforest, was conducted at a 95% confidence interval and present an uncertainty level less than 10% of the average carbon stock value.

[157] 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

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 40. 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 | 600.23 | 37.23 | 144.06 | 8.94 | 744.29 | 46.17 |
| Leakage Belt | 600.23 | 37.23 | 144.06 | 8.94 | 744.29 | 46.17 |

**Table 41. 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 |
| Project Area | 600.23 | 600.23 | 144.06 | 144.06 | 744.29 | 744.29 |
| | 600.23 | 600.23 | 144.06 | 144.06 | 744.29 | 744.29 |
| Leakage Belt | 600.23 | 600.23 | 144.06 | 144.06 | 744.29 | 744.29 |
| | 600.23 | 600.23 | 144.06 | 144.06 | 744.29 | 744.29 |

<u>Carbon stock change factors</u>

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. $1/10^{th}$ of the final carbon stock is accumulated each year).

b) Below-ground biomass:

- Initial forest classes (icl): an annual release of $1/10^{th}$ 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. $1/10^{th}$ 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 42. 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* | 600.23 | 14.41 |
| 2 | t*+1 | 0 | 14.41 |
| 3 | t*+2 | 0 | 14.41 |
| 4 | t*+3 | 0 | 14.41 |
| 5 | t*+4 | 0 | 14.41 |
| 6 | t*+5 | 0 | 14.41 |
| 7 | t*+6 | 0 | 14.41 |
| 8 | t*+7 | 0 | 14.41 |
| 9 | t*+8 | 0 | 14.41 |
| 10 | t*+9 | 0 | 14.41 |
| 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 43. 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* | -600.23 | -14.41 |
| 2 | t*+1 | 0 | -14.41 |
| 3 | t*+2 | 0 | -14.41 |
| 4 | t*+3 | 0 | -14.41 |
| 5 | t*+4 | 0 | -14.41 |
| 6 | t*+5 | 0 | -14.41 |
| 7 | t*+6 | 0 | -14.41 |
| 8 | t*+7 | 0 | -14.41 |
| 9 | t*+8 | 0 | -14.41 |
| 10 | t*+9 | 0 | -14.41 |
| 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 44. 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* | -600.23 | -14.41 |
| 2 | t*+1 | 0 | -14.41 |
| 3 | t*+2 | 0 | -14.41 |
| 4 | t*+3 | 0 | -14.41 |
| 5 | t*+4 | 0 | -14.41 |
| 6 | t*+5 | 0 | -14.41 |
| 7 | t*+6 | 0 | -14.41 |
| 8 | t*+7 | 0 | -14.41 |
| 9 | t*+8 | 0 | -14.41 |
| 10 | t*+9 | 0 | -14.41 |
| 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 45. 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 |

<u>Calculation of baseline carbon stock changes</u>

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 46. 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 | | 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 | | Carbon stock changes in above-ground biomass per post-deforestation zone z | | Total carbon stock change of post deforestation zones in the reference region | | Total net carbon stock change in the reference region | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $ID_{cl}$ | 1 | $\Delta CabBSLRR_{icl,t}$ | $\Delta CabBSLRR_{icl}$ | $ID_{cl}$ | 1 | $\Delta CbbBSLRR_{icl,t}$ | $\Delta CbbBSLRR_{icl}$ | $ID_{iz}$ | 1 | $\Delta CBSLRR_{z,t}$ | $\Delta CBSLRR_{z}$ | $\Delta CBSLRR_{t}$ | $\Delta CBSLRR$ |
| Name | Forest | annual | cumulative | Name | Forest | annual | cumulative | Name | Non-forest | annual | cumulative | annual | cumulative |
| Project year | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | Project year | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | Project year | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ |
| 2021 | 5,081,305 | 5,081,305 | 5,081,305 | 2021 | 121,951 | 121,951 | 121,951 | 2021 | 0 | 0 | 0 | 5,203,256 | 5,203,256 |
| 2022 | 5,081,305 | 5,081,305 | 10,162,610 | 2022 | 243,903 | 243,903 | 365,854 | 2022 | 44,146 | 44,146 | 44,146 | 5,281,061 | 10,484,318 |
| 2023 | 5,081,305 | 5,081,305 | 15,243,915 | 2023 | 365,854 | 365,854 | 731,708 | 2023 | 88,293 | 88,293 | 132,439 | 5,358,866 | 15,843,184 |
| 2024 | 5,081,305 | 5,081,305 | 20,325,220 | 2024 | 487,805 | 487,805 | 1,219,513 | 2024 | 132,439 | 132,439 | 264,878 | 5,436,671 | 21,279,855 |
| 2025 | 5,081,305 | 5,081,305 | 25,406,525 | 2025 | 609,757 | 609,757 | 1,829,270 | 2025 | 176,585 | 176,585 | 441,463 | 5,514,476 | 26,794,332 |
| 2026 | 5,081,305 | 5,081,305 | 30,487,830 | 2026 | 731,708 | 731,708 | 2,560,978 | 2026 | 220,731 | 220,731 | 662,194 | 5,592,282 | 32,386,614 |
| 2027 | 4,573,174 | 4,573,174 | 35,061,004 | 2027 | 841,464 | 841,464 | 3,402,442 | 2027 | 264,878 | 264,878 | 927,072 | 5,149,761 | 37,536,374 |
| 2028 | 4,573,174 | 4,573,174 | 39,634,179 | 2028 | 951,220 | 951,220 | 4,353,662 | 2028 | 304,609 | 304,609 | 1,231,681 | 5,219,785 | 42,756,160 |
| 2029 | 4,573,174 | 4,573,174 | 44,207,353 | 2029 | 1,060,976 | 1,060,976 | 5,414,639 | 2029 | 344,341 | 344,341 | 1,576,022 | 5,289,810 | 48,045,970 |
| 2030 | 4,573,174 | 4,573,174 | 48,780,528 | 2030 | 1,170,733 | 1,170,733 | 6,585,371 | 2030 | 384,073 | 384,073 | 1,960,095 | 5,359,835 | 53,405,805 |
| 2031 | 4,573,174 | 4,573,174 | 53,353,702 | 2031 | 1,158,538 | 1,158,538 | 7,743,909 | 2031 | 423,804 | 423,804 | 2,383,899 | 5,307,908 | 58,713,712 |
| 2032 | 4,573,174 | 4,573,174 | 57,926,877 | 2032 | 1,146,342 | 1,146,342 | 8,890,251 | 2032 | 419,390 | 419,390 | 2,803,288 | 5,300,127 | 64,013,840 |
| 2033 | 4,115,857 | 4,115,857 | 62,042,734 | 2033 | 1,123,172 | 1,123,172 | 10,013,423 | 2033 | 414,975 | 414,975 | 3,218,263 | 4,824,054 | 68,837,893 |
| 2034 | 4,115,857 | 4,115,857 | 66,158,591 | 2034 | 1,100,001 | 1,100,001 | 11,113,424 | 2034 | 406,587 | 406,587 | 3,624,850 | 4,809,271 | 73,647,164 |
| 2035 | 4,115,857 | 4,115,857 | 70,274,448 | 2035 | 1,076,830 | 1,076,830 | 12,190,254 | 2035 | 398,199 | 398,199 | 4,023,050 | 4,794,488 | 78,441,652 |
| 2036 | 4,115,857 | 4,115,857 | 74,390,305 | 2036 | 1,053,659 | 1,053,659 | 13,243,913 | 2036 | 389,812 | 389,812 | 4,412,861 | 4,779,705 | 83,221,357 |
| 2037 | 4,115,857 | 4,115,857 | 78,506,162 | 2037 | 1,042,684 | 1,042,684 | 14,286,597 | 2037 | 381,424 | 381,424 | 4,794,285 | 4,777,117 | 87,998,474 |
| 2038 | 4,115,857 | 4,115,857 | 82,622,019 | 2038 | 1,031,708 | 1,031,708 | 15,318,305 | 2038 | 377,451 | 377,451 | 5,171,736 | 4,770,115 | 92,768,588 |
| 2039 | 3,704,271 | 3,704,271 | 86,326,290 | 2039 | 1,010,854 | 1,010,854 | 16,329,160 | 2039 | 373,477 | 373,477 | 5,545,213 | 4,341,648 | 97,110,237 |
| 2040 | 3,704,271 | 3,704,271 | 90,030,562 | 2040 | 990,001 | 990,001 | 17,319,161 | 2040 | 365,928 | 365,928 | 5,911,142 | 4,328,344 | 101,438,580 |
| 2041 | 3,704,271 | 3,704,271 | 93,734,833 | 2041 | 969,147 | 969,147 | 18,288,308 | 2041 | 358,379 | 358,379 | 6,269,521 | 4,315,039 | 105,753,620 |
| 2042 | 3,704,271 | 3,704,271 | 97,439,104 | 2042 | 948,293 | 948,293 | 19,236,601 | 2042 | 350,830 | 350,830 | 6,620,352 | 4,301,734 | 110,055,354 |
| 2043 | 3,704,271 | 3,704,271 | 101,143,376 | 2043 | 938,415 | 938,415 | 20,175,017 | 2043 | 343,281 | 343,281 | 6,963,633 | 4,299,405 | 114,354,759 |
| 2044 | 3,704,271 | 3,704,271 | 104,847,647 | 2044 | 928,537 | 928,537 | 21,103,554 | 2044 | 339,706 | 339,706 | 7,303,339 | 4,293,103 | 118,647,862 |
| 2045 | 3,333,844 | 3,333,844 | 108,181,491 | 2045 | 909,769 | 909,769 | 22,013,323 | 2045 | 336,130 | 336,130 | 7,639,468 | 3,907,484 | 122,555,346 |
| 2046 | 3,333,844 | 3,333,844 | 111,515,335 | 2046 | 891,001 | 891,001 | 22,904,324 | 2046 | 329,336 | 329,336 | 7,968,804 | 3,895,509 | 126,450,855 |
| 2047 | 3,333,844 | 3,333,844 | 114,849,180 | 2047 | 872,232 | 872,232 | 23,776,556 | 2047 | 322,541 | 322,541 | 8,291,345 | 3,883,535 | 130,334,390 |
| 2048 | 3,333,844 | 3,333,844 | 118,183,024 | 2048 | 853,464 | 853,464 | 24,630,020 | 2048 | 315,747 | 315,747 | 8,607,093 | 3,871,561 | 134,205,951 |
| 2049 | 3,333,844 | 3,333,844 | 121,516,868 | 2049 | 844,574 | 844,574 | 25,474,594 | 2049 | 308,953 | 308,953 | 8,916,046 | 3,869,465 | 138,075,416 |
| 2050 | 3,333,844 | 3,333,844 | 124,850,712 | 2050 | 835,684 | 835,684 | 26,310,278 | 2050 | 305,735 | 305,735 | 9,221,781 | 3,863,793 | 141,939,209 |

### Table 47. 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 | | 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 | | Carbon stock changes in above-ground biomass per post-deforestation zone z | | Total carbon stock change of post deforestation zones in the project area | | Total net carbon stock change in the project area | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $ID_{cl}$ | 1 | $\Delta CabBSLPA_{icl,t}$ | $\Delta CabBSLPA_{icl}$ | $ID_{cl}$ | 1 | $\Delta CbbBSLPA_{icl,t}$ | $\Delta CbbBSLPA_{icl}$ | $ID_{iz}$ | 1 | $\Delta CBSLPA_{z,t}$ | $\Delta CBSLPA_{z}$ | $\Delta CBSLPA_{t}$ | $\Delta CBSLPA$ |
| Name | Forest | annual | cumulative | Name | Forest | annual | cumulative | Name | Non-forest | annual | cumulative | annual | cumulative |
| Project year | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | Project year | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | Project year | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ |
| 2021 | 175,921 | 175,921 | 175,921 | 2021 | 4,222 | 4,222 | 4,222 | 2021 | 0 | 0 | 0 | 180,144 | 180,144 |
| 2022 | 175,921 | 175,921 | 351,843 | 2022 | 8,444 | 8,444 | 12,666 | 2022 | 1,528 | 1,528 | 1,528 | 182,837 | 362,981 |
| 2023 | 175,921 | 175,921 | 527,764 | 2023 | 12,666 | 12,666 | 25,333 | 2023 | 3,057 | 3,057 | 4,585 | 185,531 | 548,512 |
| 2024 | 175,921 | 175,921 | 703,686 | 2024 | 16,888 | 16,888 | 42,221 | 2024 | 4,585 | 4,585 | 9,170 | 188,225 | 736,736 |
| 2025 | 175,921 | 175,921 | 879,607 | 2025 | 21,111 | 21,111 | 63,332 | 2025 | 6,114 | 6,114 | 15,284 | 190,918 | 927,655 |
| 2026 | 175,921 | 175,921 | 1,055,528 | 2026 | 25,333 | 25,333 | 88,664 | 2026 | 7,642 | 7,642 | 22,926 | 193,612 | 1,121,267 |
| 2027 | 158,329 | 158,329 | 1,213,858 | 2027 | 29,133 | 29,133 | 117,797 | 2027 | 9,170 | 9,170 | 32,096 | 178,291 | 1,299,558 |
| 2028 | 158,329 | 158,329 | 1,372,187 | 2028 | 32,932 | 32,932 | 150,729 | 2028 | 10,546 | 10,546 | 42,642 | 180,716 | 1,480,274 |
| 2029 | 158,329 | 158,329 | 1,530,516 | 2029 | 36,732 | 36,732 | 187,462 | 2029 | 11,922 | 11,922 | 54,564 | 183,140 | 1,663,414 |
| 2030 | 158,329 | 158,329 | 1,688,845 | 2030 | 40,532 | 40,532 | 227,994 | 2030 | 13,297 | 13,297 | 67,861 | 185,564 | 1,848,978 |
| 2031 | 158,329 | 158,329 | 1,847,175 | 2031 | 40,110 | 40,110 | 268,104 | 2031 | 14,673 | 14,673 | 82,534 | 183,767 | 2,032,745 |
| 2032 | 158,329 | 158,329 | 2,005,504 | 2032 | 39,688 | 39,688 | 307,792 | 2032 | 14,520 | 14,520 | 97,053 | 183,497 | 2,216,242 |
| 2033 | 142,496 | 142,496 | 2,148,000 | 2033 | 38,886 | 38,886 | 346,678 | 2033 | 14,367 | 14,367 | 111,420 | 167,015 | 2,383,257 |
| 2034 | 142,496 | 142,496 | 2,290,497 | 2034 | 38,083 | 38,083 | 384,761 | 2034 | 14,077 | 14,077 | 125,497 | 166,503 | 2,549,761 |
| 2035 | 142,496 | 142,496 | 2,432,993 | 2035 | 37,281 | 37,281 | 422,042 | 2035 | 13,786 | 13,786 | 139,283 | 165,991 | 2,715,752 |
| 2036 | 142,496 | 142,496 | 2,575,489 | 2036 | 36,479 | 36,479 | 458,522 | 2036 | 13,496 | 13,496 | 152,779 | 165,480 | 2,881,232 |
| 2037 | 142,496 | 142,496 | 2,717,986 | 2037 | 36,099 | 36,099 | 494,621 | 2037 | 13,205 | 13,205 | 165,984 | 165,390 | 3,046,622 |
| 2038 | 142,496 | 142,496 | 2,860,482 | 2038 | 35,719 | 35,719 | 530,340 | 2038 | 13,068 | 13,068 | 179,052 | 165,148 | 3,211,769 |
| 2039 | 128,247 | 128,247 | 2,988,729 | 2039 | 34,997 | 34,997 | 565,337 | 2039 | 12,930 | 12,930 | 191,983 | 150,314 | 3,362,083 |
| 2040 | 128,247 | 128,247 | 3,116,975 | 2040 | 34,275 | 34,275 | 599,612 | 2040 | 12,669 | 12,669 | 204,651 | 149,853 | 3,511,936 |
| 2041 | 128,247 | 128,247 | 3,245,222 | 2041 | 33,553 | 33,553 | 633,165 | 2041 | 12,408 | 12,408 | 217,059 | 149,392 | 3,661,328 |
| 2042 | 128,247 | 128,247 | 3,373,469 | 2042 | 32,831 | 32,831 | 665,996 | 2042 | 12,146 | 12,146 | 229,205 | 148,932 | 3,810,260 |
| 2043 | 128,247 | 128,247 | 3,501,715 | 2043 | 32,489 | 32,489 | 698,485 | 2043 | 11,885 | 11,885 | 241,090 | 148,851 | 3,959,111 |
| 2044 | 128,247 | 128,247 | 3,629,962 | 2044 | 32,147 | 32,147 | 730,633 | 2044 | 11,761 | 11,761 | 252,851 | 148,633 | 4,107,743 |
| 2045 | 115,422 | 115,422 | 3,745,384 | 2045 | 31,497 | 31,497 | 762,130 | 2045 | 11,637 | 11,637 | 264,488 | 135,282 | 4,243,026 |
| 2046 | 115,422 | 115,422 | 3,860,806 | 2046 | 30,848 | 30,848 | 792,978 | 2046 | 11,402 | 11,402 | 275,890 | 134,868 | 4,377,893 |
| 2047 | 115,422 | 115,422 | 3,976,228 | 2047 | 30,198 | 30,198 | 823,175 | 2047 | 11,167 | 11,167 | 287,057 | 134,453 | 4,512,346 |
| 2048 | 115,422 | 115,422 | 4,091,650 | 2048 | 29,548 | 29,548 | 852,723 | 2048 | 10,932 | 10,932 | 297,989 | 134,038 | 4,646,385 |
| 2049 | 115,422 | 115,422 | 4,207,072 | 2049 | 29,240 | 29,240 | 881,964 | 2049 | 10,696 | 10,696 | 308,685 | 133,966 | 4,780,351 |
| 2050 | 115,422 | 115,422 | 4,322,494 | 2050 | 28,932 | 28,932 | 910,896 | 2050 | 10,585 | 10,585 | 319,270 | 133,770 | 4,914,120 |

### Table 48. 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 | | 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 | | Carbon stock changes in above-ground biomass per post-deforestation zone z | | Total carbon stock change of post deforestation zones in the leakage belt | | Total net carbon stock change in the leakage belt | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $ID_{cl}$ | 1 | $\Delta CabBSLLK_{icl,t}$ | $\Delta CabBSLLK_{icl}$ | $ID_{cl}$ | 1 | $\Delta CbbBSLLK_{icl,t}$ | $\Delta CbbBSLLK_{icl}$ | $ID_{iz}$ | 1 | $\Delta CtotBSLLK_{z,t}$ | $\Delta CtotBSLLK_{z}$ | $\Delta CtotBSLLK_{t}$ | $\Delta CtotBSLLK$ |
| Name | Forest | annual | cumulative | Name | Forest | annual | cumulative | Name | Non-forest | annual | cumulative | annual | cumulative |
| Project year | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | Project year | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | Project year | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ |
| 2021 | 130,519 | 130,519 | 130,519 | 2021 | 3,132 | 3,132 | 3,132 | 2021 | 0 | 0 | 0 | 133,651 | 133,651 |
| 2022 | 130,519 | 130,519 | 261,038 | 2022 | 6,265 | 6,265 | 9,397 | 2022 | 1,134 | 1,134 | 1,134 | 135,650 | 269,301 |
| 2023 | 130,519 | 130,519 | 391,557 | 2023 | 9,397 | 9,397 | 18,795 | 2023 | 2,268 | 2,268 | 3,402 | 137,648 | 406,950 |
| 2024 | 130,519 | 130,519 | 522,076 | 2024 | 12,530 | 12,530 | 31,325 | 2024 | 3,402 | 3,402 | 6,804 | 139,647 | 546,597 |
| 2025 | 130,519 | 130,519 | 652,595 | 2025 | 15,662 | 15,662 | 46,987 | 2025 | 4,536 | 4,536 | 11,339 | 141,645 | 688,242 |
| 2026 | 130,519 | 130,519 | 783,113 | 2026 | 18,795 | 18,795 | 65,782 | 2026 | 5,670 | 5,670 | 17,009 | 143,644 | 831,886 |
| 2027 | 117,467 | 117,467 | 900,581 | 2027 | 21,614 | 21,614 | 87,395 | 2027 | 6,804 | 6,804 | 23,813 | 132,277 | 964,163 |
| 2028 | 117,467 | 117,467 | 1,018,048 | 2028 | 24,433 | 24,433 | 111,829 | 2028 | 7,824 | 7,824 | 31,637 | 134,076 | 1,098,239 |
| 2029 | 117,467 | 117,467 | 1,135,515 | 2029 | 27,252 | 27,252 | 139,081 | 2029 | 8,845 | 8,845 | 40,482 | 135,875 | 1,234,114 |
| 2030 | 117,467 | 117,467 | 1,252,982 | 2030 | 30,072 | 30,072 | 169,153 | 2030 | 9,865 | 9,865 | 50,347 | 137,673 | 1,371,787 |
| 2031 | 117,467 | 117,467 | 1,370,449 | 2031 | 29,758 | 29,758 | 198,911 | 2031 | 10,886 | 10,886 | 61,233 | 136,339 | 1,508,126 |
| 2032 | 117,467 | 117,467 | 1,487,916 | 2032 | 29,445 | 29,445 | 228,356 | 2032 | 10,772 | 10,772 | 72,006 | 136,140 | 1,644,266 |
| 2033 | 105,720 | 105,720 | 1,593,636 | 2033 | 28,850 | 28,850 | 257,206 | 2033 | 10,659 | 10,659 | 82,665 | 123,911 | 1,768,177 |
| 2034 | 105,720 | 105,720 | 1,699,356 | 2034 | 28,255 | 28,255 | 285,461 | 2034 | 10,444 | 10,444 | 93,108 | 123,531 | 1,891,709 |
| 2035 | 105,720 | 105,720 | 1,805,077 | 2035 | 27,660 | 27,660 | 313,120 | 2035 | 10,228 | 10,228 | 103,336 | 123,152 | 2,014,860 |
| 2036 | 105,720 | 105,720 | 1,910,797 | 2036 | 27,064 | 27,064 | 340,185 | 2036 | 10,013 | 10,013 | 113,349 | 122,772 | 2,137,632 |
| 2037 | 105,720 | 105,720 | 2,016,517 | 2037 | 26,782 | 26,782 | 366,967 | 2037 | 9,797 | 9,797 | 123,146 | 122,706 | 2,260,338 |
| 2038 | 105,720 | 105,720 | 2,122,238 | 2038 | 26,501 | 26,501 | 393,468 | 2038 | 9,695 | 9,695 | 132,842 | 122,526 | 2,382,863 |
| 2039 | 95,148 | 95,148 | 2,217,386 | 2039 | 25,965 | 25,965 | 419,432 | 2039 | 9,593 | 9,593 | 142,435 | 111,520 | 2,494,383 |

| | | | |
|---|---|---|---|
| 2040 | 95,148 | 95,148 | 2,312,534 |
| 2041 | 95,148 | 95,148 | 2,407,682 |
| 2042 | 95,148 | 95,148 | 2,502,831 |
| 2043 | 95,148 | 95,148 | 2,597,979 |
| 2044 | 95,148 | 95,148 | 2,693,127 |
| 2045 | 85,633 | 85,633 | 2,778,761 |
| 2046 | 85,633 | 85,633 | 2,864,394 |
| 2047 | 85,633 | 85,633 | 2,950,028 |
| 2048 | 85,633 | 85,633 | 3,035,661 |
| 2049 | 85,633 | 85,633 | 3,121,295 |
| 2050 | 85,633 | 85,633 | 3,206,928 |

| | | | |
|---|---|---|---|
| 2040 | 25,429 | 25,429 | 444,862 |
| 2041 | 24,894 | 24,894 | 469,755 |
| 2042 | 24,358 | 24,358 | 494,113 |
| 2043 | 24,104 | 24,104 | 518,218 |
| 2044 | 23,851 | 23,851 | 542,068 |
| 2045 | 23,368 | 23,368 | 565,436 |
| 2046 | 22,886 | 22,886 | 588,323 |
| 2047 | 22,404 | 22,404 | 610,727 |
| 2048 | 21,922 | 21,922 | 632,649 |
| 2049 | 21,694 | 21,694 | 654,343 |
| 2050 | 21,465 | 21,465 | 675,808 |

| | | | |
|---|---|---|---|
| 2040 | 9,399 | 9,399 | 151,834 |
| 2041 | 9,205 | 9,205 | 161,040 |
| 2042 | 9,011 | 9,011 | 170,051 |
| 2043 | 8,818 | 8,818 | 178,869 |
| 2044 | 8,726 | 8,726 | 187,594 |
| 2045 | 8,634 | 8,634 | 196,228 |
| 2046 | 8,459 | 8,459 | 204,688 |
| 2047 | 8,285 | 8,285 | 212,972 |
| 2048 | 8,110 | 8,110 | 221,083 |
| 2049 | 7,936 | 7,936 | 229,018 |
| 2050 | 7,853 | 7,853 | 236,872 |

| | |
|---|---|
| 111,178 | 2,605,562 |
| 110,837 | 2,716,398 |
| 110,495 | 2,826,893 |
| 110,435 | 2,937,328 |
| 110,273 | 3,047,601 |
| 100,368 | 3,147,969 |
| 100,060 | 3,248,030 |
| 99,753 | 3,347,782 |
| 99,445 | 3,447,228 |
| 99,391 | 3,546,619 |
| 99,246 | 3,645,865 |

Baseline non-$CO_2$ 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 $CO_2$ emissions is counted in the estimation of carbon stock changes; therefore, $CO_2$ emissions from biomass burning were ignored to avoid double counting. However, non-$CO_2$ emissions ($CH_4$ and $N_2O$) 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; $tCO_2e/ha$ |

$$EBBN_2O_{icl,t} = EBBCO_{2icl,t} * 12/44 * NCR * ER_{N20} * 44/28 * GWP_{N20}$$

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 |
| $ER_{N20}$ | Emission ratio for $N_2O$ (IPCC default value = 0.007) |
| $GWP_{N20}$ | Global Warming Potential for $N_2O$ (IPCC default value)[158] |

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

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) |

[158] According to the VCS Standard 4.3, the six Kyoto Protocol greenhouse gases and ozone-depleting substances shall be converted using 100 year global warming potentials derived from the IPCC's Fourth Assessment Report (GWP for $N_2O$ = 298).

$GWP_{CH4}$ Global Warming Potential for $CH_4$ (IPCC default value) [159]

$$EBBCO2_{icl,t} = Fburnt_{icl} * \sum_{p=1}^{P} (C_{picl,t} * Pburnt_{p,icl} * CE_{p,icl})$$

Where,

| | |
|---|---|
| $EBBCO2_{icl,t}$ | 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

[159] According to the VCS Standard v4.3, the six Kyoto Protocol greenhouse gases and ozone-depleting substances shall be converted using 100 year global warming potentials derived from the IPCC's Fourth Assessment Report (GWP for $CH_4$ = 25).

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.

| Initial Forest Class | | Parameters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | $Fburnt_{icl}$ | Cab | $Pburnt_{ab,icl}$ | $CE_{ab,icl}$ | ECO2-ab | EBBCO2-tot | $EBBN2O_{icl}$ | $EBBCH4_{icl}$ | $EBBtot_{icl}$ |
| IDcl | Name | % | tCO2e/ha | % | % | tCO2e/ha | tCO2e/ha | tCO2e/ha | tCO2e/ha | tCO2e/ha |
| 1 | Forest | 89% | 600.23 | 78% | 50% | 209.38 | 209.38 | 1.87 | 22.84 | 24.71 |

**Table 49. 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 | $tCO_2e/ha$ | $tCO_2e$ | $tCO_2e$ |
| 2021 | 293.09 | 24.71 | 7,243.24 | 7,243.24 |
| 2022 | 293.09 | 24.71 | 7,243.24 | 14,486.47 |
| 2023 | 293.09 | 24.71 | 7,243.24 | 21,729.71 |
| 2024 | 293.09 | 24.71 | 7,243.24 | 28,972.95 |
| 2025 | 293.09 | 24.71 | 7,243.24 | 36,216.18 |
| 2026 | 293.09 | 24.71 | 7,243.24 | 43,459.42 |
| 2027 | 263.78 | 24.71 | 6,518.91 | 49,978.33 |
| 2028 | 263.78 | 24.71 | 6,518.91 | 56,497.24 |
| 2029 | 263.78 | 24.71 | 6,518.91 | 63,016.16 |
| 2030 | 263.78 | 24.71 | 6,518.91 | 69,535.07 |
| 2031 | 263.78 | 24.71 | 6,518.91 | 76,053.98 |
| 2032 | 263.78 | 24.71 | 6,518.91 | 82,572.89 |
| 2033 | 237.40 | 24.71 | 5,867.02 | 88,439.92 |
| 2034 | 237.40 | 24.71 | 5,867.02 | 94,306.94 |
| 2035 | 237.40 | 24.71 | 5,867.02 | 100,173.96 |
| 2036 | 237.40 | 24.71 | 5,867.02 | 106,040.98 |
| 2037 | 237.40 | 24.71 | 5,867.02 | 111,908.00 |
| 2038 | 237.40 | 24.71 | 5,867.02 | 117,775.02 |
| 2039 | 213.66 | 24.71 | 5,280.32 | 123,055.34 |
| 2040 | 213.66 | 24.71 | 5,280.32 | 128,335.66 |
| 2041 | 213.66 | 24.71 | 5,280.32 | 133,615.98 |
| 2042 | 213.66 | 24.71 | 5,280.32 | 138,896.30 |
| 2043 | 213.66 | 24.71 | 5,280.32 | 144,176.62 |
| 2044 | 213.66 | 24.71 | 5,280.32 | 149,456.94 |
| 2045 | 192.30 | 24.71 | 4,752.29 | 154,209.23 |
| 2046 | 192.30 | 24.71 | 4,752.29 | 158,961.51 |
| 2047 | 192.30 | 24.71 | 4,752.29 | 163,713.80 |
| 2048 | 192.30 | 24.71 | 4,752.29 | 168,466.09 |
| 2049 | 192.30 | 24.71 | 4,752.29 | 173,218.37 |
| 2050 | 192.30 | 24.71 | 4,752.29 | 177,970.66 |

### APD – Avoided Planned Deforestation

Regarding the estimation of baseline emissions from planned deforestation, the VMD0006 v1.3 (BL-PL) was applied to determine the baseline net GHG emissions.

<u>Deforestation in the Baseline Scenario</u>

According to module VMD0006 v1.3, the annual area of deforestation in the baseline (AAplaned,i,t) is calculated as the equation below.

$$AA_{planned,i,t} = \left(A_{planned,i} * D\%_{planned,i,t}\right) * L - D_i$$

Where:

$AA_{planned,i,t}$,: Annual area of baseline planned deforestation for stratum *i* at time *t*; ha;

$D\%_{planned,i,t}$: Projected annual proportion of land that will be deforested in stratum *i* during year *t*. If actual annual proportion is known and documented (e.g. 25% per year for 4 years), set to proportion; %;

$A_{planned,i}$:, Total area of planned deforestation over the baseline period for stratum *i*; ha;

*L-Di*: Likelihood of deforestation for stratum *i*; %.

The below shows the total and annual area of planned deforestation over the baseline scenario in Project Area.

**Table 50. Total and annual area of planned deforestation over the baseline scenario in PA_APD**

| AAplanned,i,t | | |
|---|---|---|
| Year | Open Lowland Tropical Rainforest | $AA_{planned,i,t}$ |
| | ha | ha |
| 2022 | 600.00 | 600.00 |
| 2023 | 600.00 | 600.00 |
| 2024 | 600.00 | 600.00 |
| 2025 | 712.51 | 712.51 |
| 2026 | 600.00 | 600.00 |
| 2027 | 600.00 | 600.00 |
| 2028 | 712.51 | 712.51 |
| 2029 | 600.00 | 600.00 |

| | | |
|---|---|---|
| 2030 | 600.00 | 600.00 |
| 2031 | 712.51 | 712.51 |
| 2032 | 600.00 | 600.00 |
| 2033 | 600.00 | 600.00 |
| 2034 | 711.51 | 711.51 |
| 2035 | 600.00 | 600.00 |
| 2036 | 600.00 | 600.00 |
| 2037 | 712.51 | 712.51 |
| 2038 | 600.00 | 600.00 |
| 2039 | 600.00 | 600.00 |
| 2040 | 112.51 | 112.51 |
| 2041 | 300.00 | 300.00 |
| 2042 | 300.00 | 300.00 |
| 2043 | 34.51 | 34.51 |
| Total | **12,108.57** | **12,108.57** |

<u>Carbon Stock Change in the Baseline Scenario</u>

According to the module VMD0006 v1.3 the net carbon stock changes in the baseline is equal to the baseline pre-deforestation stock minus the long-term carbon stock after deforestation and minus the baseline stock that enters the wood products pool at the time of deforestation. They are calculated as follows.

*Aboveground Tree Biomass*

The baseline carbon stock change in aboveground tree biomass is calculated according to the equation below.

$$\Delta C_{AB_{tree},i} = C_{AB_{tree_{bsl}},i} - C_{AB_{tree_{post}},i}$$

Where:

$\Delta C_{ABtree,i}$: Baseline carbon stock change in aboveground tree biomass in stratum *i*; t $CO_2$-e $ha^{-1}$;

$C_{ABtree,bsl,i}$: Forest carbon stock in aboveground tree biomass in stratum *i*; t $CO_2$-e $ha^{-1}$;

$C_{ABtree,post,i}$: Post-deforestation carbon stock in aboveground tree biomass in stratum *i*; t $CO_2$-e $ha^{-1}$;

*i*: 1, 2, 3, … *M strata.*

**Table 51. Baseline carbon stock change in aboveground tree biomass (t CO2-e ha-1)**

| Stratum/forest class | $C_{AB\_tree,bsl,i}$ | $C_{AB\_tree,post,i}$ | $\Delta C_{AB\_tree,i}$ |
|---|---|---|---|
| | tCO2e/ha | tCO2e/ha | tCO2e/ha |
| Open Lowland Tropical Rainforest | 413.34 | 7.57 | 405.77 |

The stock of forest carbon in the aboveground tree biomass $C_{ABtree,I}$ was estimated from a literature review for the region and by the type of phytophysiognomy, while the estimate of post-deforestation carbon stock in aboveground tree biomass $C_{ABtree,post,i}$ is taken from peer reviewed literature (Ministério da Ciência, Tecnologia e Inovação, 2015)[160].

***Belowground Tree Biomass***

The baseline carbon stock change in belowground tree biomass is calculated according to the equation below.

$$\Delta C_{BB\_tree,i} = C_{BB_{tree_{bsl}},i} - C_{BB_{tree_{post}},i}$$

Where:

$\Delta C_{BBtree,i}$: Baseline carbon stock change in belowground tree biomass in stratum *i*; t $CO_2$-e $ha^{-1}$;

$C_{BBtree,bsl,i}$: Forest carbon stock in belowground tree biomass in stratum *i*; t $CO_2$-e $ha^{-1}$;

$C_{BBtree,post,i}$: Post-deforestation carbon stock in belowground tree biomass in stratum *i*; t $CO_2$-e $ha^{-1}$;

*i:* 1, 2, 3, … *M strata.*

**Table 52. Baseline carbon stock change in belowground tree biomass (t CO2-e ha-1)**

| Stratum/forest class | $C_{BB\_tree,bsl,i}$ | $C_{BB\_tree,post,i}$ | $\Delta C_{BB\_tree,i}$ |
|---|---|---|---|
| | tCO2e/ha | tCO2e/ha | tCO2e/ha |
| Open Lowland Tropical Rainforest | 99,20 | 6 | 93,20 |

Values for forest carbon stock in belowground tree biomass $C_{BBtree,bsl,i}$ were obtained from the peer reviewed literature FAO, 2020[161] and the estimate of post-deforestation carbon stock in

[160] Available at: <http://redd.mma.gov.br/images/FREL/RR_LULUCF_Mudana-de-Uso-e-Floresta.pdf>

[161] Available at: <https://www.fao.org/3/ca9976en/ca9976en.pdf>.

belowground tree biomass $C_{BBtree,post,i}$ is taken from peer reviewed literature (Ministério da Ciência, Tecnologia e Inovação, 2015).

The baseline carbon stock change in aboveground non-tree biomass is calculated according to the equation below.

$$\Delta C_{AB_{non-tree},i} = C_{AB_{non-tree_{bsl}},i} - C_{AB_{non-tree_{post}},i}$$

Where:

$\Delta C_{ABnon-tree,i}$: Baseline carbon stock change in aboveground non-tree biomass in stratum *i*; t $CO_2$-e $ha^{-1}$;

$C_{ABnon-tree,bsl,i}$: Forest carbon stock in aboveground non-tree vegetation in stratum *i*; t $CO_2$-e $ha^{-1}$;

$C_{ABnon-tree,post,i}$: Post-deforestation carbon stock in aboveground non-tree vegetation in stratum *i*; t $CO_2$-e $ha^{-1}$;

*i*: 1, 2, 3, ... *M strata.*

**Table 53. Baseline carbon stock change in aboveground non-tree biomass (t CO2-e ha-1)**

| Stratum/forest class | $C_{AB\_non-tree,bsl,i}$ | $C_{AB\_non-tree,post,i}$ | $\Delta C_{AB\_non-tree,i}$ |
|---|---|---|---|
| | tCO2e/ha | tCO2e/ha | tCO2e/ha |
| Open Lowland Tropical Rainforest | 16,53 | 8,6 | 7,93 |

Values for forest carbon stock in aboveground non-tree biomass $C_{ABnon-tree,bsl,I}$ were obtained from the peer reviewed literature[162] (Nogueira, 2008)[163], according Nogueira, non-tree in Acre, palm trees represent 4% of the forest biomass stock. While the estimate of post-deforestation carbon stock in aboveground tree biomass $C_{ABtree,post,i}$ is taken from peer reviewed literature (Ministério da Ciência, Tecnologia e Inovação, 2015).

***Belowground Non-Tree Biomass***

The baseline carbon stock change in belowground non-tree Biomass is calculated according to the equation below.

[162] Available at: <https://www.fao.org/3/ca9976en/ca9976en.pdf>.

[163] NOGUEIRA, Euler Melo et al. Estimates of forest biomass in the Brazilian Amazon: New allometric equations and adjustments to biomass from wood-volume inventories. Forest Ecology and Management, v. 256, n. 11, p.1853-1867, 2008. Available at: <https://www.sciencedirect.com/science/article/abs/pii/S0378112708005689>

$$\Delta C_{BB_{non-tree},i} = C_{BB_{non}-tree,bsl,i} - C_{BB_{non}-tree,post,i}$$

Where:

$\Delta C_{BBnon\text{-}tree,i}$: Baseline carbon stock change in belowground non-tree biomass in stratum *i*; t $CO_2$-e $ha^{-1}$;

$C_{BBnontree,bsl,i}$: Forest carbon stock in belowground non-tree biomass in stratum *i*; t $CO_2$-e $ha^{-1}$;

$C_{BBnontree,post,i}$: Post-deforestation carbon stock in belowground non-tree biomass in stratum *i*; t $CO_2$-e $ha^{-1}$;

*i*: 1, 2, 3, … *M strata.*

**Table 54. Baseline carbon stock change in belowground non-tree biomass (t CO2-e ha-1)**

| Stratum/forest class | $C_{BB\_non\text{-}tree,bsl,i}$ | $C_{BB\_non\text{-}tree,post,i}$ | $\Delta C_{BB\_non\text{-}tree,i}$ |
|---|---|---|---|
| | tCO2e/ha | tCO2e/ha | tCO2e/ha |
| Open Lowland Tropical Rainforest | 9,92 | 8,6 | 1,32 |

Values for forest carbon stock in belowground non-tree biomass $C_{BB\_non\text{-}tree,bsl,i}$ were obtained from the peer reviewed literature FAO, 2020[164] and the estimate of post-deforestation carbon stock in belowground non-tree biomass $C_{BB\_non\text{-}tree,post,i}$ is taken from peer reviewed literature (Ministério da Ciência, Tecnologia e Inovação, 2015).

***Deadwood and Litter***

Both deadwood and litter were excluded for simplicity and to be conservative in the calculations.

***Soil organic***

According to the methodology VM0007 v1.6, table 4, the inclusion of soil organic carbon is optional. Thus, the present project excluded soil organic from the carbon pool estimation.

***Harvested wood products***

For estimating the change in carbon stock from baseline in wood products ($C_{WP,i}$) it is calculated from the equation below, according to VMD0005 v1.1.

$$C_{WP,i} = \sum_{ty=s,w,oir,p,o} C_{XB,ty,i} * (1 - WW_{ty})$$

[164] Available at: <https://www.fao.org/3/ca9976en/ca9976en.pdf>.

Where:

$C_{WP,I}$: Carbon stock entering the wood products products pool from stratum *i*; t $CO_2$-e $ha^{-1}$

$C_{XB,ty,I}$ Mean stock of extracted biomass carbon by class of wood product ty from stratum i; t CO2-e ha-1

$WW_{ty}$: Wood waste. The fraction immediately emitted through mill inefficiency by class of wood product ty; dimensionless

ty: Wood product class – defined here as sawnwood (s), wood-based panels (w), other industrial roundwood (oir), paper and paper board (p), and other (o)

i: *1, 2, 3, … M* strata

For Wood Waste, the cited literature reference from Winjum et al. 1998 as indicated in VMD0005 (CP-W) v1.1, which for developed countries multiplies the $C_{XB,ty}$ by 0.19.

The estimate of biomass carbon from the commercial volume extracted by the type of wood product $_{ty}$, $C_{XB,ty,}$ is obtained by the equation below:

$$C_{XB,ty,i} = \frac{1}{A_i} * \sum_{j=1}^{S} (V_{ex,ty,j,i} * D_j * CF_j * \frac{44}{12})$$

Where:

$C_{XB,ty,i}$ Mean stock of extracted biomass carbon by class of wood product ty from stratum i; t CO2-e $ha^{-1}$ .

$A_i$ Total area of stratum i; ha

$V_{ex,ty,j}$ Volume of timber extracted from within stratum i (does not include slash left onsite) by species j and wood product class ty; $m^3$

$D_j$ Mean wood density of species j; t d.m.$m^{-3}$

$CF_j$ Carbon fraction of biomass for tree species j; t C $t^{-1}$ d.m.

j 1, 2, 3, … S tree species

ty Wood product class – defined here as sawnwood (s), wood-based panels (w), other industrial roundwood (oir), paper and paper board (p), and other (o)

*44/12* Ratio of molecular weight of $CO_2$ to carbon, t $CO_2$-e t $C^{-1}$

The carbon expected to be emitted over 100 years ($C_{WP100,i}$) at the time of deforestation and entering the wood product pool is calculated according to equation VMD0005, v1.1:

$$C_{WP100,i} = C_{WP,i} - C_{WP,i} * (1 - SLFp) * (1 - Ofp)$$

Where:

| | |
|---|---|
| $C_{WP100,i}$ | Carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 100-years from stratum i; t $CO_2$-e $ha^{-1}$. |
| $C_{WP,I}$ | Carbon stock entering wood products pool at time of deforestation from stratum i; t CO2-e ha-1. |
| $SLF_{ty}$ | Fraction of wood products that will be emitted to the atmosphere within 5 years of timber harvest by class of wood product ty; dimensionless. |
| $OF_{ty}$ | Fraction of wood products that will be emitted to the atmosphere between 5 and 100 years of timber harvest by class of wood product ty; dimensionless. |
| ty | Wood product class –defined here as sawnwood (s), wood-based panels (w), other industrial roundwood (oir), paper and paper board (p), and other (o). |
| i 1, 2, 3, … | Mstrata. |

Both the fraction of wood products that will be emitted to the atmosphere in 5 years and between 5 and 100 years were obtained from a literature review, Winjum et al, 1998.

| | |
|---|---|
| $SLF_{ty}$ | 0.2 |
| $OF_{ty}$ | 0.8 |

**Table 55. Carbon stocks in wood products pool**

| Stratum/forest class | $C_{WP,i}$ | $C_{WP100,i}$ | $\Delta C_{XB}$ |
|---|---|---|---|
| | tC02e/ha | tC02e/ha | tC02e/ha |
| Open Lowland Tropical Rainforest | 0.24 | 0.19 | 0.26 |

### Carbon Stock Change in All Pools in the Baseline Scenario

According to the module VMD0006 v1.3, the net carbon stock changes in all pools in the baseline ($\Delta C_{BSL,i,t}$) are calculated as the equation below.

$$\Delta C_{BSL,i,t} = AA_{planned,i,t} * (\Delta C_{AB_{tree},i} - \Delta C_{WP,i} + \Delta C_{AB_{non-tree},i} + \Delta C_{LI,i})$$
$$+ (\sum_{t-10}^{t} A_{planned,i,t}) * (\Delta C_{BB_{tree},i} + \Delta C_{BB_{non-tree},i} + \Delta C_{DW,i}) * \left(\frac{1}{10}\right)$$
$$+ (\sum_{t-20}^{t} AA_{unplanned,i,t}) * \left(C_{WP100,i} + \Delta C_{SOC,i}\right) * \left(\frac{1}{20}\right)$$

Where:

| | |
|---|---|
| $\Delta C_{BSL,i,t}$: | Sum of the baseline carbon stock change in all terrestrial pools in stratum i in year t, t $CO_2$-e; |
| $AA_{planned,i,t}$: | Annual area of baseline planned deforestation for stratum *i* in year *t*; ha; |
| $C_{WP100,i}$: | Carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 100-years from stratum i; t $CO_2$-e $ha^{-1}$; |
| $\Delta C_{AB\_tree,i}$: | Baseline carbon stock change in aboveground tree biomass in stratum *i*;*t* $CO_2$-e $ha^{-1}$; |
| $\Delta C_{BB\_tree,i}$: | Baseline carbon stock change in belowground tree biomass in stratum i *i*;*t* $CO_2$-e $ha^{-1}$; |
| $\Delta C_{AB\_non-tree,i}$: | Baseline carbon stock change in aboveground non-tree biomass in stratum *i*;*t* $CO_2$-e $ha^{-1}$; |
| $\Delta C_{BB\_non-tree,i}$: | Baseline carbon stock change in belowground non-tree biomass in stratum i *i*;*t* $CO_2$-e $ha^{-1}$. |
| $\Delta C_{WP,i}$: | Baseline carbon stock change in wood products in stratum *i*;*t* $CO_2$-e $ha^{-1}$; |
| $\Delta C_{DW,i}$: | Baseline carbon stock change in dead wood in stratum *i*;*t* $CO_2$-e $ha^{-1}$; |
| $\Delta C_{LI,i}$: | Baseline carbon stock change in litter in stratum *i*;*t* $CO_2$-e $ha^{-1}$; |
| $\Delta C_{SOC,i}$: | Baseline carbon stock change in soil organic carbon in stratum *i*;*t* $CO_2$-e $ha^{-1}$; |
| *i*: 1, 2, 3, … | *M* strata; |
| *t*: 1, 2, 3, … | *t** years elapsed since the projected start of the project activity. |

**Table 56. Net carbon stock changes in all pools in the baseline period**

| Net carbon stock changes in all pools in the baseline stratum *i* in year *t* | | Total carbon stock change in all pools | |
|---|---|---|---|
| Idi | 1 | $\Delta C_{BSL, i,t}$ | $\Delta C_{BSL, i,t}$ |
| Name | Open Lowland Tropical Rainforest | annual | cumulative |
| Project year | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ |
| 2022 | 362,650 | 362,650 | 362,650 |
| 2023 | 362,650 | 362,650 | 725,300 |
| 2024 | 362,650 | 362,650 | 1,087,950 |
| 2025 | 409,169 | 409,169 | 1,497,119 |
| 2026 | 362,650 | 362,650 | 1,859,769 |
| 2027 | 362,650 | 362,650 | 2,222,419 |
| 2028 | 409,169 | 409,169 | 2,631,588 |
| 2029 | 362,650 | 362,650 | 2,994,238 |
| 2030 | 362,650 | 362,650 | 3,356,887 |
| 2031 | 409,169 | 409,169 | 3,766,057 |
| 2032 | 362,650 | 362,650 | 4,128,706 |
| 2033 | 362,650 | 362,650 | 4,491,356 |
| 2034 | 408,756 | 408,756 | 4,900,112 |
| 2035 | 362,650 | 362,650 | 5,262,762 |
| 2036 | 362,650 | 362,650 | 5,625,412 |
| 2037 | 409,169 | 409,169 | 6,034,581 |
| 2038 | 362,650 | 362,650 | 6,397,231 |
| 2039 | 362,650 | 362,650 | 6,759,881 |
| 2040 | 161,089 | 161,089 | 6,920,969 |
| 2041 | 238,610 | 238,610 | 7,159,579 |
| 2042 | 238,610 | 238,610 | 7,398,189 |
| 2043 | 128,838 | 128,838 | 7,527,027 |

Non-$CO_2$ Emissions in the Baseline Scenario

The GHG emissions in the baseline within the project boundary are estimated according to equation 15 of module VMD0006 v1.3.

$$GHG_{BSL,E,i,t} = E_{FC,i,t} + E_{BiomassBurn,i,t} + N_2O_{direct-N,i,t}$$

Where:

$GHG_{BSL,E}$: Greenhouse gas emissions as a result deforestation activities within the project boundary in the stratum *i* in year *t*; t $CO_2$-e;

$E_{FC,i,t}$: Net CO2e emission from fossil fuel combustion in stratum *i* in year *t*; t $CO_2$-e;

| | |
|---|---|
| $E_{BiomassBurn,i,t}$: | Non-CO2 emissions due to biomass burning in stratum *i* in year *t*; t $CO_2$-e; |
| $N_2O_{direct\text{-}N,i,t}$: | Direct N2O emission as a result of nitrogen application on the alternative land use within the project boundary in stratum *i* in year *t*; t $CO_2$-e; |
| *i*: 1, 2, 3, … | *M* strata; |
| *t*: 1, 2, 3, … | *t** years elapsed since the start of the REDD VCS project activity. |

For the $E_{FC,i,t}$ net $CO_2e$ emission from fossil fuel combustion and $N_2O_{direct\text{-}N,i,t}$ nitrogen application in the baseline scenario are conservative excluded.

The non-$CO_2$ emissions due to biomass burning ($E_{BiomassBurn,i,t}$) are calculated according to VMD0013 v1.2:

$$E_{biomassburn,i,t} = \sum_{g=1}^{G}\left(\left(\left(A_{burn,i,t} \times B_{i,t} \times COMF_i \times G_{g,i}\right) \times 10^{-3}\right) \times GWP_g\right)$$

Where:

| | |
|---|---|
| $E_{biomassburn,i,t}$ | Greenhouse gas emissions due to biomass burning in stratum *i* in year t of each GHG ($CO_2$, $CH_4$, $N_2O$) (t $CO_2e$); |
| $A_{burn,i,t}$ | Area burnt for stratum *i* in year t (ha); |
| $B_{i,t}$ | Average aboveground biomass stock before burning stratum *i,* year (t d.m. $ha^{-1}$); |
| $COMF_i$ | Combustion factor for stratum *i* (unitless); |
| $G_{g,I}$ | Emission factor for stratum *i* for gas g (kg t-1 d.m. burnt); |
| $GWP_g$ | Global warming potential for gas g (t $CO_2$/t gas g); |
| g 1, 2, 3 … | G greenhouse gases including carbon dioxide[165], methane and nitrous oxide(unitless); |

[165] According to VMD0013-E-BPB v1.2 Carbon dioxide may be omitted where carbon dioxide emissions are calculated in an alternate module through stock change

*i* 1, 2, 3 … M strata (unitless);

t 1, 2, 3, … t* time elapsed since the start of the project activity (years);

The average aboveground biomass stock before burning for each stratum is estimated as follows:

$$B_{i,t} = (C_{AB\_tree,i,t} + C_{DWi,t} + C_{LI,i,t}) \times 12/44 \times (1/CF)$$

Where:

*Bi,t* — *Average aboveground biomass stock before burning for stratum i, year t (tonnes d.m. ha-1);*

*CAB_tree,i,t* — *Carbon stock in aboveground biomass in trees in stratum i in year t (t CO2e ha-1);*

*CDWi,t* — *Carbon stock in dead wood for stratum i in year t (t CO2e ha-1);*

*CLI,i,t* — *Carbon stock in litter for stratum i in year t (t CO2e ha-1);*

*12/44* — *Inverse ratio of molecular weight of CO2 to carbon (t CO2e t C-1);*

*CF* — *Carbon fraction of biomass (t C t-1 d.m.);*

*i 1, 2, 3 ⋯* — *M strata (unitless);*

*t 1, 2, 3, ⋯* — *t* time elapsed since the start of the project activity (years);*

**Table 57. Area burnt for stratum *i* in year *t* (ha)**

| Aburn | Open Lowland Tropical Rainforest |
|---|---|
| Project year *t* | $Area_{burn,i,t}$ ha |
| 2022 | 600.00 |
| 2023 | 600.00 |
| 2024 | 600.00 |
| 2025 | 712.51 |

| | |
|---|---|
| 2026 | 600.00 |
| 2027 | 600.00 |
| 2028 | 712.51 |
| 2029 | 600.00 |
| 2030 | 600.00 |
| 2031 | 712.51 |
| 2032 | 600.00 |
| 2033 | 600.00 |
| 2034 | 711.51 |
| 2035 | 600.00 |
| 2036 | 600.00 |
| 2037 | 712.51 |
| 2038 | 600.00 |
| 2039 | 600.00 |
| 2040 | 112.51 |
| 2041 | 300.00 |
| 2042 | 300.00 |
| 2043 | 34.51 |

**Table 58. Greenhouse gas emissions in the baseline within the project boundary**

| Project year *t* | | | | | Total GHG emissions | |
|---|---|---|---|---|---|---|
| | Open Lowland Tropical Rainforest | | | Annual | annual TOTAL | cumulative |
| | $E_{FC,i,t}$ | $E_{BiomassBurn,i,t}$ | $N_2O_{direct-N,i,t}$ | $GHG_{BSL-E,t}$ | $GHG_{BSL-E,t}$ | $GHG_{BSL-E,t}$ |
| | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ |
| 2022 | 0 | 518,564 | 0 | 518,564 | 518,564 | 518,564 |
| 2023 | 0 | 518,564 | 0 | 518,564 | 518,564 | 1,037,128 |
| 2024 | 0 | 518,564 | 0 | 518,564 | 518,564 | 1,555,692 |
| 2025 | 0 | 615,803 | 0 | 615,803 | 615,803 | 2,171,495 |
| 2026 | 0 | 518,564 | 0 | 518,564 | 518,564 | 2,690,059 |
| 2027 | 0 | 518,564 | 0 | 518,564 | 518,564 | 3,208,623 |
| 2028 | 0 | 615,803 | 0 | 615,803 | 615,803 | 3,824,426 |
| 2029 | 0 | 518,564 | 0 | 518,564 | 518,564 | 4,342,990 |
| 2030 | 0 | 518,564 | 0 | 518,564 | 518,564 | 4,861,554 |
| 2031 | 0 | 615,803 | 0 | 615,803 | 615,803 | 5,477,358 |
| 2032 | 0 | 518,564 | 0 | 518,564 | 518,564 | 5,995,922 |
| 2033 | 0 | 518,564 | 0 | 518,564 | 518,564 | 6,514,486 |
| 2034 | 0 | 614,939 | 0 | 614,939 | 614,939 | 7,129,425 |
| 2035 | 0 | 518,564 | 0 | 518,564 | 518,564 | 7,647,989 |
| 2036 | 0 | 518,564 | 0 | 518,564 | 518,564 | 8,166,553 |
| 2037 | 0 | 615,803 | 0 | 615,803 | 615,803 | 8,782,356 |
| 2038 | 0 | 518,564 | 0 | 518,564 | 518,564 | 9,300,920 |
| 2039 | 0 | 518,564 | 0 | 518,564 | 518,564 | 9,819,484 |
| 2040 | 0 | 97,239 | 0 | 97,239 | 97,239 | 9,916,723 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2041 | 0 | 259,282 | 0 | 259,282 | 259,282 | 10,176,005 |
| 2042 | 0 | 259,282 | 0 | 259,282 | 259,282 | 10,435,287 |
| 2043 | 0 | 29,826 | 0 | 29,826 | 29,826 | 10,465,113 |

**Net GHG emissions in the Baseline Scenario**

The baseline net GHG emissions for planned deforestation was determined as follow.

$$\Delta C_{BSL,planned} = \sum_{t=1}^{t^*} \sum_{i=1}^{M} \left( \Delta C_{BSL,i,t} + GHG_{BSL-E,i,t} \right)$$

Where:

$\Delta C_{BSL,planned}$ Net greenhouse gas emissions in the baseline from planned deforestation up to year t*; t CO2-e;

$\Delta C_{BSL,i,t}$ Net carbon stock changes in all pools in the baseline stratum *i* in year *t*; t $CO_2$-e;

$GHG_{BSL-E,i,t}$ Greenhouse gas emissions as a result of deforestation activities within the project boundary in the baseline stratum *i* in year *t*; t $CO_2$-e $yr^{-1}$;

*i*: 1, 2, 3, … *M* strata;

*t*: 1, 2, 3, … *t** years elapsed since the projected start of the project activity;

**Table 59. Estimated net GHG emission in the baseline (tCO2e)**

| Net greenhouse gas emissions in the baseline from planned deforestation up to year *t* | | Total greenhouse gas emissions planned | |
|---|---|---|---|
| Idi | 1 | $\Delta C_{BSL,\ planned}$ | $\Delta C_{BSL,\ planned}$ |
| Name | Open Lowland Tropical Rainforest | annual | cumulative |
| Project year | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ |
| 2022 | 881,214 | 881,214 | 881,214 |
| 2023 | 881,214 | 881,214 | 1,762,428 |
| 2024 | 881,214 | 881,214 | 2,643,642 |
| 2025 | 1,024,972 | 1,024,972 | 3,668,614 |
| 2026 | 881,214 | 881,214 | 4,549,828 |
| 2027 | 881,214 | 881,214 | 5,431,042 |
| 2028 | 1,024,972 | 1,024,972 | 6,456,014 |

| | | | |
|---|---|---|---|
| 2029 | 881,214 | 881,214 | 7,337,228 |
| 2030 | 881,214 | 881,214 | 8,218,442 |
| 2031 | 1,024,972 | 1,024,972 | 9,243,414 |
| 2032 | 881,214 | 881,214 | 10,124,628 |
| 2033 | 881,214 | 881,214 | 11,005,842 |
| 2034 | 1,023,695 | 1,023,695 | 12,029,537 |
| 2035 | 881,214 | 881,214 | 12,910,751 |
| 2036 | 881,214 | 881,214 | 13,791,964 |
| 2037 | 1,024,972 | 1,024,972 | 14,816,937 |
| 2038 | 881,214 | 881,214 | 15,698,151 |
| 2039 | 881,214 | 881,214 | 16,579,364 |
| 2040 | 258,328 | 258,328 | 16,837,693 |
| 2041 | 497,892 | 497,892 | 17,335,584 |
| 2042 | 497,892 | 497,892 | 17,833,476 |
| 2043 | 158,664 | 158,664 | 17,992,140 |

## 4.2 Project Emissions

### AUD – Avoided Unplanned Deforestation

The present activity instance includes logging activities within the project area. These carbon stock changes are estimated *ex ante* and shall be measured *ex post*.

Sustainable Forest Management Plan activities mainly includes implementation of infrastructure, such as opening of main and secondary roads, skidding trails[166], and timber yards in each annual production unit – APU (Unidade de Produção Anual, in portuguese) within the project area, estimated to be around 2.5% of each APU. According to the sustainable forest management plan, 36,48ha are subject to SFMP. The adopted rotation cycle is 35 years, thus each annual productive unit (APU) has around 1,459.04 hectares.

Table below presents an *ex ante* estimated carbon stock decrease due to planned deforestation in the project area. The location of annual planned deforestation areas was proportionally divided among the forest classes existing within the project area. The *ex ante* estimated carbon stock decrease due to planned deforestation in the project area was calculated using the following equation:

$$\Delta CPDdPA_t = \sum_{icl=1}^{icl} (APDPA_{icl,t} \times \Delta Ctot_{icl})$$

[166] According to Holmes et al. (2002) less than 10% of skidding trails from reduced impact logging (RIL) forest management systems caused soil degradation and consequently clearings in the forest, while 100% of trails in conventional management areas are affected.
HOLMES, T.P.; BLATE, G.M.; ZWEEDE, J.C.; PEREIRA JUNIOR, R.L BARRETO, P.; BOLTZ, F. Custos e benefícios financeiros da exploração de impacto reduzido em comparação à exploração florestal convencional na Amazônia Oriental. Belém: Fundação Floresta Tropical, 2002, 66p., 2ª edição.

Where,

| | |
|---|---|
| $\Delta CPDdPA_t$ | Total decrease in carbon stock due to planned deforestation at year t in the project area; $tCO_2e$ |
| $APDPA_{icl,t}$ | Areas of planned deforestation in forest class icl at year t in the project area; ha |
| $\Delta Ctot_{icl}$ | Average carbon stock change of all accounted carbon pools in forest class icl at time t; $tCO_2e/ha$ |

**Table 60. Ex ante estimated actual carbon stock decrease due to planned deforestation in the Project Area**

| Project year *t* | Areas of planned deforestation x Carbon stock change (decrease) in the project area | | Total carbon stock decrease due to planned deforestation | |
|---|---|---|---|---|
| | $ID_{cl}$ = 1 Forest | | annual | cumulative |
| | $APDPA_{icl,t}$ | $Ctot_{icl,t}$ | $\Delta CPDdPA_t$ | ΔCPDdPA |
| | ha | $tCO_2e/ha$ | $tCO_2e$ | $tCO_2e$ |
| 2021 | 36.48 | 744.29 | 27,148.71 | 27,148.71 |
| 2022 | 36.48 | 744.29 | 27,148.71 | 54,297.42 |
| 2023 | 36.48 | 744.29 | 27,148.71 | 81,446.13 |
| 2024 | 36.48 | 744.29 | 27,148.71 | 108,594.83 |
| 2025 | 36.48 | 744.29 | 27,148.71 | 135,743.54 |
| 2026 | 36.48 | 744.29 | 27,148.71 | 162,892.25 |
| 2027 | 36.48 | 744.29 | 27,148.71 | 190,040.96 |
| 2028 | 36.48 | 744.29 | 27,148.71 | 217,189.67 |
| 2029 | 36.48 | 744.29 | 27,148.71 | 244,338.38 |
| 2030 | 36.48 | 744.29 | 27,148.71 | 271,487.08 |
| 2031 | 36.48 | 744.29 | 27,148.71 | 298,635.79 |
| 2032 | 36.48 | 744.29 | 27,148.71 | 325,784.50 |
| 2033 | 36.48 | 744.29 | 27,148.71 | 352,933.21 |
| 2034 | 36.48 | 744.29 | 27,148.71 | 380,081.92 |
| 2035 | 36.48 | 744.29 | 27,148.71 | 407,230.63 |
| 2036 | 36.48 | 744.29 | 27,148.71 | 434,379.33 |
| 2037 | 36.48 | 744.29 | 27,148.71 | 461,528.04 |
| 2038 | 36.48 | 744.29 | 27,148.71 | 488,676.75 |
| 2039 | 36.48 | 744.29 | 27,148.71 | 515,825.46 |
| 2040 | 36.48 | 744.29 | 27,148.71 | 542,974.17 |
| 2041 | 36.48 | 744.29 | 27,148.71 | 570,122.88 |
| 2042 | 36.48 | 744.29 | 27,148.71 | 597,271.58 |
| 2043 | 36.48 | 744.29 | 27,148.71 | 624,420.29 |
| 2044 | 36.48 | 744.29 | 27,148.71 | 651,569.00 |
| 2045 | 36.48 | 744.29 | 27,148.71 | 678,717.71 |
| 2046 | 36.48 | 744.29 | 27,148.71 | 705,866.42 |
| 2047 | 36.48 | 744.29 | 27,148.71 | 733,015.13 |
| 2048 | 36.48 | 744.29 | 27,148.71 | 760,163.83 |
| 2049 | 36.48 | 744.29 | 27,148.71 | 787,312.54 |
| 2050 | 36.48 | 744.29 | 27,148.71 | 814,461.25 |

Planned logging operations are carried out following a Reduced Impact Logging (RIL) system combined with other improved forest management techniques, including: planning of management activities, selection of best locations for infrastructure construction, directional felling, utilization of advanced technologies, tracking record of wood logs, reforestation activities, among others; which are essential practices to minimize the damage caused to the forest.

In the project scenario, emissions due to planned logging activities results from timber harvesting and also from damages to vegetation during the directional tree felling, which generate forest residues (branches, remains of logs and other damaged trees during the tree felling).

According to Feldpausch *et al.* (2005), the mean coarse woody debris returned to the soil as necromass following logging and damage in: (1) tree felling gap formation (trees killed by tree-fall), (2) residual canopy from the felled tree, (3) road, (4) deck construction (whole trees plowed to the ground) and (5) skid maneuvering during logging, is about 6.9 MgC/ha.

According to section 4.3 from this same study, this represents 2.4 times the carbon taken off site in logs. However, the MR already takes into account as planned deforestation the roads and decks constructions, which represent around 16% of the total damage. Therefore, the LDF is 2.4 * (1-0,159) = 2.0174.

Thus, GHG emissions from logging activities include the volume of harvested timber plus the logging damage factor, as follows.

$$\Delta CLd_{icl} = (HI_{icl,t} + LDF) \times D_m \times CF \times 44 / 12$$

Where,

| | |
|---|---|
| $\Delta CLd_{icl,t}$ | Average carbon stock decrease due to logging activities in forest class *icl* at time *t*; $tCO_2e/ha$ |
| $HI_{icl,t}$ | Harvesting intensity of timber in forest class *icl* at year *t* in the project area due to planned logging activities (i.e., sustainable forest management plan); $m^3/ha$ |
| LDF | Logging damage factor; $m^3/m^3$ |
| $D_m$ | Mean wood density; $g/cm^3$ |
| CF | Default value of carbon fraction in biomass; $tC\ t^{-1}$ d.m. |
| 44/12 | Ratio of molecular weight of $CO_2$ to carbon; dimensionless |

Harvested wood products were not accounted as a carbon pool, thus,$\Delta Cwp_t = 0$. Therefore, the *ex ante*estimated carbon stock decrease due to planned logging activities in the project area was calculated using the following equation:

$$\Delta CPLdPA_t = \sum_{icl=1}^{icl} (APLPA_{icl,t} \times \Delta CLd_{icl,t}) - \left(\sum_{icl=1}^{icl} APLPA_{icl,t}\right) \times \Delta Cwp_t$$

Where,

| | |
|---|---|
| $\Delta CPLdPA_t$ | Total decrease in carbon stock due to planned logging activities at year *t* in the project area; $tCO_2e$ |
| $APLPA_{icl,t}$ | Areas of planned logging activities in forest class *icl* at year *t* in the project area; ha |
| $\Delta CLd_{icl,t}$ | Average carbon stock decrease due to logging activities in forest class *icl* at time *t*; $tCO_2e/ha$ |
| $\Delta Cwp_t$ | Average carbon stock per hectare in the harvested wood products carbon pool at time *t*; $tCO_2e/ha$ |

Thus, Table below presents an *ex ante* estimated carbon stock decrease due to planned logging activities in the project area.

**Table 61. Ex ante estimated actual carbon stock decrease due to planned logging activities in the Project Area**

| Project year *t* | Areas of planned logging activities x Carbon stock change (decrease) in the project area | | Total carbon stock decrease due to planned logging activities | |
|---|---|---|---|---|
| | $ID_{cl}$ = 1 Forest | | annual | cumulative |
| | $APLPA_{icl,t}$ | $\Delta CLd_{icl,t}$ | $\Delta CPLdPA_t$ | $\Delta CPLdPA$ |
| | ha | $tCO_2e/ha$ | $tCO_2e$ | $tCO_2e$ |
| 2021 | 439.71 | 59.78 | 26,284.27 | 26,284.27 |
| 2022 | 1,459.04 | 59.78 | 87,216.00 | 113,500.27 |
| 2023 | 1,459.04 | 59.78 | 87,216.00 | 200,716.27 |
| 2024 | 1,459.04 | 59.78 | 87,216.00 | 287,932.27 |
| 2025 | 1,459.04 | 59.78 | 87,216.00 | 375,148.27 |
| 2026 | 1,459.04 | 59.78 | 87,216.00 | 462,364.26 |
| 2027 | 1,459.04 | 59.78 | 87,216.00 | 549,580.26 |
| 2028 | 1,459.04 | 59.78 | 87,216.00 | 636,796.26 |
| 2029 | 1,459.04 | 59.78 | 87,216.00 | 724,012.26 |
| 2030 | 1,459.04 | 59.78 | 87,216.00 | 811,228.26 |
| 2031 | 1,459.04 | 59.78 | 87,216.00 | 898,444.25 |
| 2032 | 1,459.04 | 59.78 | 87,216.00 | 985,660.25 |
| 2033 | 1,459.04 | 59.78 | 87,216.00 | 1,072,876.25 |
| 2034 | 1,459.04 | 59.78 | 87,216.00 | 1,160,092.25 |

| | | | | |
|---|---|---|---|---|
| 2035 | 1,459.04 | 59.78 | 87,216.00 | 1,247,308.25 |
| 2036 | 1,459.04 | 59.78 | 87,216.00 | 1,334,524.25 |
| 2037 | 1,459.04 | 59.78 | 87,216.00 | 1,421,740.24 |
| 2038 | 1,459.04 | 59.78 | 87,216.00 | 1,508,956.24 |
| 2039 | 1,459.04 | 59.78 | 87,216.00 | 1,596,172.24 |
| 2040 | 1,459.04 | 59.78 | 87,216.00 | 1,683,388.24 |
| 2041 | 1,459.04 | 59.78 | 87,216.00 | 1,770,604.24 |
| 2042 | 1,459.04 | 59.78 | 87,216.00 | 1,857,820.23 |
| 2043 | 1,459.04 | 59.78 | 87,216.00 | 1,945,036.23 |
| 2044 | 1,459.04 | 59.78 | 87,216.00 | 2,032,252.23 |
| 2045 | 1,459.04 | 59.78 | 87,216.00 | 2,119,468.23 |
| 2046 | 1,459.04 | 59.78 | 87,216.00 | 2,206,684.23 |
| 2047 | 1,459.04 | 59.78 | 87,216.00 | 2,293,900.23 |
| 2048 | 1,459.04 | 59.78 | 87,216.00 | 2,381,116.22 |
| 2049 | 1,459.04 | 59.78 | 87,216.00 | 2,468,332.22 |
| 2050 | 1,459.04 | 59.78 | 87,216.00 | 2,555,548.22 |

Fossil fuel emissions from sustainable forest management activities are likely to be less than 5% of the total GHG emissions reductions benefits generated by the present project. Considering that emissions from deforestation and forest degradation would be much higher than those associated with timber harvesting, the emissions from fossil fuel during transport and machinery use can be considered *de-minimis*. In addition, according to VCS AFOLU Requirements, fossil fuel emissions from transport and machinery use in REDD project activities can be considered *de minimis*.

No production of fuel wood or charcoal is expected to occur within the project area under the project scenario. However, if any of these activities is implemented in the future, a measurement of the carbon stock changes will be carried out. According to the applied methodology, if the project activity generates a significant decrease in carbon stocks due to these activities, the carbon stock change shall be measured *ex post*. However, if the decrease is not significant, it shall not be accounted, and *ex post* monitoring is not required.

Thus, Table below presents an *ex ante* estimated carbon stock decrease due to planned activities in the project area.

**Table 62. Total ex ante carbon stock decrease due to planned activities in the Project Area**

| Project year *t* | Total carbon stock decrease due to planned deforestation | | Total carbon stock decrease due to planned logging activities | | Total carbon stock decrease due to planned fuel-wood and charcoal activities | | Total carbon stock decrease due to planned activities | |
|---|---|---|---|---|---|---|---|---|
| | annual | cumulative | annual | cumulative | annual | cumulative | annual | cumulative |

| | $\Delta CPDdPA_t$ | $\Delta CPDdPA$ | $\Delta CPLdPA_t$ | $\Delta CPLdPA$ | $\Delta CPFdPA_t$ | $\Delta CPFdPA$ | $\Delta CPAdPA_t$ | $\Delta CPAdPA$ |
|---|---|---|---|---|---|---|---|---|
| | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ |
| 2021 | 27,148.71 | 27,148.71 | 26,284.27 | 26,284.27 | 0.00 | 0.00 | 53,432.98 | 53,432.98 |
| 2022 | 27,148.71 | 54,297.42 | 87,216.00 | 113,500.27 | 0.00 | 0.00 | 114,364.71 | 167,797.69 |
| 2023 | 27,148.71 | 81,446.13 | 87,216.00 | 200,716.27 | 0.00 | 0.00 | 114,364.71 | 282,162.39 |
| 2024 | 27,148.71 | 108,594.83 | 87,216.00 | 287,932.27 | 0.00 | 0.00 | 114,364.71 | 396,527.10 |
| 2025 | 27,148.71 | 135,743.54 | 87,216.00 | 375,148.27 | 0.00 | 0.00 | 114,364.71 | 510,891.81 |
| 2026 | 27,148.71 | 162,892.25 | 87,216.00 | 462,364.26 | 0.00 | 0.00 | 114,364.71 | 625,256.51 |
| 2027 | 27,148.71 | 190,040.96 | 87,216.00 | 549,580.26 | 0.00 | 0.00 | 114,364.71 | 739,621.22 |
| 2028 | 27,148.71 | 217,189.67 | 87,216.00 | 636,796.26 | 0.00 | 0.00 | 114,364.71 | 853,985.93 |
| 2029 | 27,148.71 | 244,338.38 | 87,216.00 | 724,012.26 | 0.00 | 0.00 | 114,364.71 | 968,350.63 |
| 2030 | 27,148.71 | 271,487.08 | 87,216.00 | 811,228.26 | 0.00 | 0.00 | 114,364.71 | 1,082,715.34 |
| 2031 | 27,148.71 | 298,635.79 | 87,216.00 | 898,444.25 | 0.00 | 0.00 | 114,364.71 | 1,197,080.05 |
| 2032 | 27,148.71 | 325,784.50 | 87,216.00 | 985,660.25 | 0.00 | 0.00 | 114,364.71 | 1,311,444.75 |
| 2033 | 27,148.71 | 352,933.21 | 87,216.00 | 1,072,876.25 | 0.00 | 0.00 | 114,364.71 | 1,425,809.46 |
| 2034 | 27,148.71 | 380,081.92 | 87,216.00 | 1,160,092.25 | 0.00 | 0.00 | 114,364.71 | 1,540,174.17 |
| 2035 | 27,148.71 | 407,230.63 | 87,216.00 | 1,247,308.25 | 0.00 | 0.00 | 114,364.71 | 1,654,538.87 |
| 2036 | 27,148.71 | 434,379.33 | 87,216.00 | 1,334,524.25 | 0.00 | 0.00 | 114,364.71 | 1,768,903.58 |
| 2037 | 27,148.71 | 461,528.04 | 87,216.00 | 1,421,740.24 | 0.00 | 0.00 | 114,364.71 | 1,883,268.29 |
| 2038 | 27,148.71 | 488,676.75 | 87,216.00 | 1,508,956.24 | 0.00 | 0.00 | 114,364.71 | 1,997,632.99 |
| 2039 | 27,148.71 | 515,825.46 | 87,216.00 | 1,596,172.24 | 0.00 | 0.00 | 114,364.71 | 2,111,997.70 |
| 2040 | 27,148.71 | 542,974.17 | 87,216.00 | 1,683,388.24 | 0.00 | 0.00 | 114,364.71 | 2,226,362.41 |
| 2041 | 27,148.71 | 570,122.88 | 87,216.00 | 1,770,604.24 | 0.00 | 0.00 | 114,364.71 | 2,340,727.11 |
| 2042 | 27,148.71 | 597,271.58 | 87,216.00 | 1,857,820.23 | 0.00 | 0.00 | 114,364.71 | 2,455,091.82 |
| 2043 | 27,148.71 | 624,420.29 | 87,216.00 | 1,945,036.23 | 0.00 | 0.00 | 114,364.71 | 2,569,456.52 |
| 2044 | 27,148.71 | 651,569.00 | 87,216.00 | 2,032,252.23 | 0.00 | 0.00 | 114,364.71 | 2,683,821.23 |
| 2045 | 27,148.71 | 678,717.71 | 87,216.00 | 2,119,468.23 | 0.00 | 0.00 | 114,364.71 | 2,798,185.94 |
| 2046 | 27,148.71 | 705,866.42 | 87,216.00 | 2,206,684.23 | 0.00 | 0.00 | 114,364.71 | 2,912,550.64 |
| 2047 | 27,148.71 | 733,015.13 | 87,216.00 | 2,293,900.23 | 0.00 | 0.00 | 114,364.71 | 3,026,915.35 |
| 2048 | 27,148.71 | 760,163.83 | 87,216.00 | 2,381,116.22 | 0.00 | 0.00 | 114,364.71 | 3,141,280.06 |
| 2049 | 27,148.71 | 787,312.54 | 87,216.00 | 2,468,332.22 | 0.00 | 0.00 | 114,364.71 | 3,255,644.76 |
| 2050 | 27,148.71 | 814,461.25 | 87,216.00 | 2,555,548.22 | 0.00 | 0.00 | 114,364.71 | 3,370,009.47 |

No significant unavoidable unplanned deforestation is expected in the project scenario, due to the present conservation measures and sustainable forest management practices adopted by Mamuriá Grouped REDD Project. 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 verified reports of similar REDD projects located in Brazil.

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.

**Table 63. Ex ante estimated net carbon stock change in the project area under the project scenario**

| 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 |
|---|---|---|---|---|---|---|---|---|
| | $\Delta CPAdPA_t$ | $\Delta CPAdPA$ | $\Delta CPAiPA_t$ | $\Delta CPAiPA$ | $\Delta CUDdPA_t$ | $\Delta CUDdPA$ | $\Delta CPSPA_t$ | $\Delta CPSPA$ |
| | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ |
| 2021 | 53,432.98 | 53,432.98 | 0.00 | 0.00 | 9,855.87 | 9,855.87 | 63,288.85 | 63,288.85 |
| 2022 | 114,364.71 | 167,797.69 | 0.00 | 0.00 | 10,003.25 | 19,859.11 | 124,367.95 | 187,656.80 |
| 2023 | 114,364.71 | 282,162.39 | 0.00 | 0.00 | 10,150.62 | 30,009.74 | 124,515.33 | 312,172.13 |
| 2024 | 114,364.71 | 396,527.10 | 0.00 | 0.00 | 10,298.00 | 40,307.73 | 124,662.70 | 436,834.84 |
| 2025 | 114,364.71 | 510,891.81 | 0.00 | 0.00 | 10,445.37 | 50,753.11 | 124,810.08 | 561,644.92 |
| 2026 | 114,364.71 | 625,256.51 | 0.00 | 0.00 | 10,592.75 | 61,345.86 | 124,957.46 | 686,602.37 |
| 2027 | 114,364.71 | 739,621.22 | 0.00 | 0.00 | 9,754.54 | 71,100.40 | 124,119.25 | 810,721.62 |
| 2028 | 114,364.71 | 853,985.93 | 0.00 | 0.00 | 9,887.18 | 80,987.58 | 124,251.88 | 934,973.51 |
| 2029 | 114,364.71 | 968,350.63 | 0.00 | 0.00 | 10,019.82 | 91,007.39 | 124,384.52 | 1,059,358.03 |
| 2030 | 114,364.71 | 1,082,715.34 | 0.00 | 0.00 | 10,152.46 | 101,159.85 | 124,517.16 | 1,183,875.19 |
| 2031 | 114,364.71 | 1,197,080.05 | 0.00 | 0.00 | 10,054.10 | 111,213.95 | 124,418.80 | 1,308,293.99 |
| 2032 | 114,364.71 | 1,311,444.75 | 0.00 | 0.00 | 10,039.36 | 121,253.31 | 124,404.07 | 1,432,698.06 |
| 2033 | 114,364.71 | 1,425,809.46 | 0.00 | 0.00 | 9,137.59 | 130,390.90 | 123,502.30 | 1,556,200.36 |
| 2034 | 114,364.71 | 1,540,174.17 | 0.00 | 0.00 | 9,109.59 | 139,500.49 | 123,474.30 | 1,679,674.66 |
| 2035 | 114,364.71 | 1,654,538.87 | 0.00 | 0.00 | 9,081.59 | 148,582.08 | 123,446.30 | 1,803,120.96 |
| 2036 | 114,364.71 | 1,768,903.58 | 0.00 | 0.00 | 9,053.59 | 157,635.67 | 123,418.30 | 1,926,539.25 |
| 2037 | 114,364.71 | 1,883,268.29 | 0.00 | 0.00 | 9,048.69 | 166,684.36 | 123,413.39 | 2,049,952.65 |
| 2038 | 114,364.71 | 1,997,632.99 | 0.00 | 0.00 | 9,035.42 | 175,719.79 | 123,400.13 | 2,173,352.78 |
| 2039 | 114,364.71 | 2,111,997.70 | 0.00 | 0.00 | 8,223.83 | 183,943.62 | 122,588.54 | 2,295,941.32 |
| 2040 | 114,364.71 | 2,226,362.41 | 0.00 | 0.00 | 8,198.63 | 192,142.25 | 122,563.34 | 2,418,504.66 |
| 2041 | 114,364.71 | 2,340,727.11 | 0.00 | 0.00 | 8,173.43 | 200,315.69 | 122,538.14 | 2,541,042.80 |
| 2042 | 114,364.71 | 2,455,091.82 | 0.00 | 0.00 | 8,148.23 | 208,463.92 | 122,512.94 | 2,663,555.73 |
| 2043 | 114,364.71 | 2,569,456.52 | 0.00 | 0.00 | 8,143.82 | 216,607.73 | 122,508.53 | 2,786,064.26 |
| 2044 | 114,364.71 | 2,683,821.23 | 0.00 | 0.00 | 8,131.88 | 224,739.62 | 122,496.59 | 2,908,560.85 |
| 2045 | 114,364.71 | 2,798,185.94 | 0.00 | 0.00 | 7,401.45 | 232,141.07 | 121,766.16 | 3,030,327.00 |
| 2046 | 114,364.71 | 2,912,550.64 | 0.00 | 0.00 | 7,378.77 | 239,519.84 | 121,743.48 | 3,152,070.48 |
| 2047 | 114,364.71 | 3,026,915.35 | 0.00 | 0.00 | 7,356.09 | 246,875.93 | 121,720.80 | 3,273,791.28 |
| 2048 | 114,364.71 | 3,141,280.06 | 0.00 | 0.00 | 7,333.41 | 254,209.33 | 121,698.11 | 3,395,489.39 |
| 2049 | 114,364.71 | 3,255,644.76 | 0.00 | 0.00 | 7,329.44 | 261,538.77 | 121,694.14 | 3,517,183.53 |
| 2050 | 114,364.71 | 3,370,009.47 | 0.00 | 0.00 | 7,318.69 | 268,857.46 | 121,683.40 | 3,638,866.93 |

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 un avoided unplanned deforestation 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 64. Total ex ante estimated actual emissions of non-CO2 gases 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 |
| | $tCO_2e$ | $tCO_2e$ |
| 2021 | 396.29 | 396.29 |
| 2022 | 396.29 | 792.57 |
| 2023 | 396.29 | 1,188.86 |
| 2024 | 396.29 | 1,585.14 |
| 2025 | 396.29 | 1,981.43 |
| 2026 | 396.29 | 2,377.72 |
| 2027 | 356.66 | 2,734.37 |
| 2028 | 356.66 | 3,091.03 |
| 2029 | 356.66 | 3,447.69 |
| 2030 | 356.66 | 3,804.35 |
| 2031 | 356.66 | 4,161.01 |
| 2032 | 356.66 | 4,517.66 |
| 2033 | 320.99 | 4,838.65 |
| 2034 | 320.99 | 5,159.65 |
| 2035 | 320.99 | 5,480.64 |
| 2036 | 320.99 | 5,801.63 |
| 2037 | 320.99 | 6,122.62 |
| 2038 | 320.99 | 6,443.61 |
| 2039 | 288.89 | 6,732.51 |
| 2040 | 288.89 | 7,021.40 |
| 2041 | 288.89 | 7,310.29 |
| 2042 | 288.89 | 7,599.18 |
| 2043 | 288.89 | 7,888.08 |

| | | |
|---|---|---|
| 2044 | 288.89 | 8,176.97 |
| 2045 | 260.00 | 8,436.97 |
| 2046 | 260.00 | 8,696.98 |
| 2047 | 260.00 | 8,956.98 |
| 2048 | 260.00 | 9,216.98 |
| 2049 | 260.00 | 9,476.99 |
| 2050 | 260.00 | 9,736.99 |

**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 65. 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 |
| | $\Delta CPAdPA_t$ | $\Delta CPAdPA$ | $\Delta CPAiPA_t$ | $\Delta CPAiPA$ | $\Delta CUDdPA_t$ | $\Delta CUDdPA$ | $\Delta CPSPA_t$ | $\Delta CPSPA$ | $EBBPSPA_t$ | $EBBPSPA$ |
| | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ |
| 2021 | 53,432.98 | 53,432.98 | 0.00 | 0.00 | 9,855.87 | 9,855.87 | 63,288.85 | 63,288.85 | 396.29 | 396.29 |
| 2022 | 114,364.71 | 167,797.69 | 0.00 | 0.00 | 10,003.25 | 19,859.11 | 124,367.95 | 187,656.80 | 396.29 | 792.57 |
| 2023 | 114,364.71 | 282,162.39 | 0.00 | 0.00 | 10,150.62 | 30,009.74 | 124,515.33 | 312,172.13 | 396.29 | 1,188.86 |
| 2024 | 114,364.71 | 396,527.10 | 0.00 | 0.00 | 10,298.00 | 40,307.73 | 124,662.70 | 436,834.84 | 396.29 | 1,585.14 |
| 2025 | 114,364.71 | 510,891.81 | 0.00 | 0.00 | 10,445.37 | 50,753.11 | 124,810.08 | 561,644.92 | 396.29 | 1,981.43 |
| 2026 | 114,364.71 | 625,256.51 | 0.00 | 0.00 | 10,592.75 | 61,345.86 | 124,957.46 | 686,602.37 | 396.29 | 2,377.72 |
| 2027 | 114,364.71 | 739,621.22 | 0.00 | 0.00 | 9,754.54 | 71,100.40 | 124,119.25 | 810,721.62 | 356.66 | 2,734.37 |
| 2028 | 114,364.71 | 853,985.93 | 0.00 | 0.00 | 9,887.18 | 80,987.58 | 124,251.88 | 934,973.51 | 356.66 | 3,091.03 |
| 2029 | 114,364.71 | 968,350.63 | 0.00 | 0.00 | 10,019.82 | 91,007.39 | 124,384.52 | 1,059,358.03 | 356.66 | 3,447.69 |
| 2030 | 114,364.71 | 1,082,715.34 | 0.00 | 0.00 | 10,152.46 | 101,159.85 | 124,517.16 | 1,183,875.19 | 356.66 | 3,804.35 |
| 2031 | 114,364.71 | 1,197,080.05 | 0.00 | 0.00 | 10,054.10 | 111,213.95 | 124,418.80 | 1,308,293.99 | 356.66 | 4,161.01 |
| 2032 | 114,364.71 | 1,311,444.75 | 0.00 | 0.00 | 10,039.36 | 121,253.31 | 124,404.07 | 1,432,698.06 | 356.66 | 4,517.66 |
| 2033 | 114,364.71 | 1,425,809.46 | 0.00 | 0.00 | 9,137.59 | 130,390.90 | 123,502.30 | 1,556,200.36 | 320.99 | 4,838.65 |
| 2034 | 114,364.71 | 1,540,174.17 | 0.00 | 0.00 | 9,109.59 | 139,500.49 | 123,474.30 | 1,679,674.66 | 320.99 | 5,159.65 |
| 2035 | 114,364.71 | 1,654,538.87 | 0.00 | 0.00 | 9,081.59 | 148,582.08 | 123,446.30 | 1,803,120.96 | 320.99 | 5,480.64 |
| 2036 | 114,364.71 | 1,768,903.58 | 0.00 | 0.00 | 9,053.59 | 157,635.67 | 123,418.30 | 1,926,539.25 | 320.99 | 5,801.63 |
| 2037 | 114,364.71 | 1,883,268.29 | 0.00 | 0.00 | 9,048.69 | 166,684.36 | 123,413.39 | 2,049,952.65 | 320.99 | 6,122.62 |
| 2038 | 114,364.71 | 1,997,632.99 | 0.00 | 0.00 | 9,035.42 | 175,719.79 | 123,400.13 | 2,173,352.78 | 320.99 | 6,443.61 |
| 2039 | 114,364.71 | 2,111,997.70 | 0.00 | 0.00 | 8,223.83 | 183,943.62 | 122,588.54 | 2,295,941.32 | 288.89 | 6,732.51 |
| 2040 | 114,364.71 | 2,226,362.41 | 0.00 | 0.00 | 8,198.63 | 192,142.25 | 122,563.34 | 2,418,504.66 | 288.89 | 7,021.40 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 2041 | 114,364.71 | 2,340,727.11 | 0.00 | 0.00 | 8,173.43 | 200,315.69 | 122,538.14 | 2,541,042.80 | 288.89 | 7,310.29 |
| 2042 | 114,364.71 | 2,455,091.82 | 0.00 | 0.00 | 8,148.23 | 208,463.92 | 122,512.94 | 2,663,555.73 | 288.89 | 7,599.18 |
| 2043 | 114,364.71 | 2,569,456.52 | 0.00 | 0.00 | 8,143.82 | 216,607.73 | 122,508.53 | 2,786,064.26 | 288.89 | 7,888.08 |
| 2044 | 114,364.71 | 2,683,821.23 | 0.00 | 0.00 | 8,131.88 | 224,739.62 | 122,496.59 | 2,908,560.85 | 288.89 | 8,176.97 |
| 2045 | 114,364.71 | 2,798,185.94 | 0.00 | 0.00 | 7,401.45 | 232,141.07 | 121,766.16 | 3,030,327.00 | 260.00 | 8,436.97 |
| 2046 | 114,364.71 | 2,912,550.64 | 0.00 | 0.00 | 7,378.77 | 239,519.84 | 121,743.48 | 3,152,070.48 | 260.00 | 8,696.98 |
| 2047 | 114,364.71 | 3,026,915.35 | 0.00 | 0.00 | 7,356.09 | 246,875.93 | 121,720.80 | 3,273,791.28 | 260.00 | 8,956.98 |
| 2048 | 114,364.71 | 3,141,280.06 | 0.00 | 0.00 | 7,333.41 | 254,209.33 | 121,698.11 | 3,395,489.39 | 260.00 | 9,216.98 |
| 2049 | 114,364.71 | 3,255,644.76 | 0.00 | 0.00 | 7,329.44 | 261,538.77 | 121,694.14 | 3,517,183.53 | 260.00 | 9,476.99 |
| 2050 | 114,364.71 | 3,370,009.47 | 0.00 | 0.00 | 7,318.69 | 268,857.46 | 121,683.40 | 3,638,866.93 | 260.00 | 9,736.99 |

### APD – Avoided Planned Deforestation

Project emissions were estimated according to module VMD0015, Version 2.2. In order to calculate the Net GHG emissions, emissions from Deforestation, Forest Degradation and Non-$CO_2$ Emissions were considered.

The emission per unit area in all pools is equal to the difference between the stocks before and after deforestation minus any wood products created from timber extraction in the process of deforestation. The following equation shows the net carbon stock changes.

$$\Delta C_{pools,Def,i,t} = C_{BSL,i} - C_{P,post,i} - C_{WP,i}$$

Where:

$\Delta C_{pools,Def,u,i,t}$: Net carbon stock changes in all pools as a result of deforestation in the project case in land use $u$ in stratum $i$ in year $t$; t $CO_2$-e ha$^{-1}$;

$C_{BSL,i}$: Carbon stock in all pools in the baseline case in stratum $i$; t $CO_2$-e ha$^{-1}$;

$C_{P,post,u,i}$: Carbon stock in all pools in post-deforestation land use u in stratum $i$; t $CO_2$-e ha$^{-1}$;

$C_{WP,i}$: Carbon stock sequestered in wood products from harvests in stratum $i$; t $CO_2$-e ha$^{-1}$;

$u$: 1, 2, 3, … *U post-deforestation* land uses;

$i$: 1, 2, 3, … *M* strata;

$t$: 1, 2, 3, … $t^*$ years elapsed since the start of the project activity.

**Table 66. Net carbon stock changes in all pools in the Project case**

| Stratum (i) | $C_{BSL,i}$ | $C_{P,post,u,i}$ | $C_{WP,i}$ | $\Delta C_{pools, Def,u,i.t}$ |
|---|---|---|---|---|
| | t CO2-e | t CO2-e | t CO2-e | t CO2-e |
| Open Lowland Tropical Rainforest | 512.55 | 31 | 0.24 | 481.54 |

## Deforestation

The net carbon stock change as a result of deforestation is equal to the area deforested multiplied by the emission per unit area, as follow.

$$\Delta C_{P,DefPA,i,t} = \sum_{u=1}^{U} \left( A_{DefPA,u,i,t} * \Delta C_{pools,P,Def,u,i,t} \right)$$

Where:

$\Delta C_{P,DefPA,i,t}$: Net carbon stock change as a result of deforestation in the project case in the project area in stratum *i* in year *t*; t CO2-e;

$A_{DefPA,u,i,t}$: Area of recorded deforestation in the project area stratum *i* converted to land use *u* in year *t*; ha;

$\Delta C_{pools,Def,u,i,t}$: Net carbon stock changes in all pools in the project case in land use *u* in stratum *i* in year *t*; t $CO_2$-e $ha^{-1}$;

*u*: 1, 2, 3, ,... *U post-deforestation* land uses;

*i*: 1, 2, 3, ... *M* strata;

*t*: 1, 2, 3, ... *t** years elapsed since the start of the project activity.

Area of deforestation recorded in project area stratum i converted to land use u in year t, $A_{DefPA,u,i,t}$, was analyzed based on the historical rate of deforestation observed in the project area between 2010 and 2020 using satellite images for ex ante estimates.

There was no deforestation between 2010 and 2020, so the projection will also remain zero for the coming years.

**Table 67. Net carbon stock change as a result of deforestation in the Project Area in the Project case in stratum *i* in year *t*;**

| ΔCP,DefPA,i,t | | | |
|---|---|---|---|
| Year | Open Lowland Tropical Rainforest | $\Delta C_{P,DefPA,i,t}$ | $\Delta C_{P,DefPA,i,t}$ |
| | t CO2-e | Total | Cumulative |
| 2020 | 0.00 | 0.00 | 0.00 |
| 2021 | 0.00 | 0.00 | 0.00 |
| 2022 | 0.00 | 0.00 | 0.00 |
| 2023 | 0.00 | 0.00 | 0.00 |

| | | | |
|---|---|---|---|
| 2024 | 0.00 | 0.00 | 0.00 |
| 2025 | 0.00 | 0.00 | 0.00 |
| 2026 | 0.00 | 0.00 | 0.00 |
| 2027 | 0.00 | 0.00 | 0.00 |
| 2028 | 0.00 | 0.00 | 0.00 |
| 2029 | 0.00 | 0.00 | 0.00 |
| 2030 | 0.00 | 0.00 | 0.00 |
| 2031 | 0.00 | 0.00 | 0.00 |
| 2032 | 0.00 | 0.00 | 0.00 |
| 2033 | 0.00 | 0.00 | 0.00 |
| 2034 | 0.00 | 0.00 | 0.00 |
| 2035 | 0.00 | 0.00 | 0.00 |
| 2036 | 0.00 | 0.00 | 0.00 |
| 2037 | 0.00 | 0.00 | 0.00 |
| 2038 | 0.00 | 0.00 | 0.00 |
| 2039 | 0.00 | 0.00 | 0.00 |
| 2040 | 0.00 | 0.00 | 0.00 |
| 2041 | 0.00 | 0.00 | 0.00 |
| 2042 | 0.00 | 0.00 | 0.00 |
| 2043 | 0.00 | 0.00 | 0.00 |

**Forest Degradation**

According to the person in charge of the properties, the surrounding communities do not enter the properties to carry out any type of activity. And within the project area there are no communities living. So, $\Delta C_{P,DegW,i,t}$ it is equal to zero (0).

$$\Delta C_{P,DegW,i,t} = 0$$

For the project area, the net greenhouse gas emissions resulting from degradation is equal to the sum of stock changes due to degradation through extraction of trees for illegal timber or fuelwood and charcoal, and extraction of trees for selective logging from forest management areas possessing a FSC certificate, as expressed in the following equation.

$$\Delta C_{P,Deg,i,t} = \Delta C_{P,DegW,i,t} + \Delta C_{P,SelLog,i,t}$$

Where:

$\Delta C_{P,Deg,i,t}$: Net carbon stock change as a result of degradation in the project area in the project case in stratum *i* in year *t*; t $CO_2$-e;

$\Delta C_{P,DegW,i,t}$: Net carbon stock change as a result of degradation through extraction of trees for illegal timber or fuelwood and charcoal in the project area in the project case in stratum *i* in year *t*; t $CO_2$-e;

$\Delta C_{P,SelLog,i,t}$: Net carbon stock change as a result of degradation through selective logging of FSC certified forest management areas in the project area in the project case in stratum *i* in year *t*; t $CO_2$-e;

*i*: 1, 2, 3, … M strata;

*t*: 1, 2, 3, … t* years elapsed since the start of the project activity.

**Table 68. Net carbon stock change as a result of degradation in the Project Area in the Project case in stratum *i* in year *t*;**

| Year | Open Lowland Tropical Rainforest | $\Delta C_{P,Deg,i,t}$ | $\Delta C_{P,Deg,i,t}$ |
|---|---|---|---|
| | t CO2-e | Total | Cumulative |
| 2022 | 0.00 | 0.00 | 0.00 |
| 2023 | 0.00 | 0.00 | 0.00 |
| 2024 | 0.00 | 0.00 | 0.00 |
| 2025 | 0.00 | 0.00 | 0.00 |
| 2026 | 0.00 | 0.00 | 0.00 |
| 2027 | 0.00 | 0.00 | 0.00 |
| 2028 | 0.00 | 0.00 | 0.00 |
| 2029 | 0.00 | 0.00 | 0.00 |
| 2030 | 0.00 | 0.00 | 0.00 |
| 2031 | 0.00 | 0.00 | 0.00 |
| 2032 | 0.00 | 0.00 | 0.00 |
| 2033 | 0.00 | 0.00 | 0.00 |
| 2034 | 0.00 | 0.00 | 0.00 |
| 2035 | 0.00 | 0.00 | 0.00 |
| 2036 | 0.00 | 0.00 | 0.00 |
| 2037 | 0.00 | 0.00 | 0.00 |
| 2038 | 0.00 | 0.00 | 0.00 |
| 2039 | 0.00 | 0.00 | 0.00 |
| 2040 | 0.00 | 0.00 | 0.00 |
| 2041 | 0.00 | 0.00 | 0.00 |
| 2042 | 0.00 | 0.00 | 0.00 |
| 2043 | 0.00 | 0.00 | 0.00 |

In the project area there is no selective extraction of FSC certified wood, so $\Delta C_{P,SelLog,i,t}$, net carbon stock change as a result of degradation through selective logging of FSC certified forest management areas in the project area is considered equal to zero (0). Thus, $\Delta C_{P,Deg,i,t}$, the net carbon stock change as a result of degradation in the project area will be equal to zero (0).

Natural Disturbance in the Project Scenario

Where natural disturbances occur *ex-post* in the project area such as tectonic activity (earthquake, landslide, volcano), extreme weather (hurricane), pest, drought, or fire that result in a degradation of forest carbon stocks, the area disturbed shall be delineated and the resulting emissions estimated. Where the disturbance event occur *ex post* in the project area, the area disturbed shall be delineated and the area of each post-disturbance stratum must be delineated. The area disturbed in the with-project scenario shall be tracked directly using the guidance provided in Step 1 of the methodology VMD0015-M-REDD v2.2.

Projections of natural disturbances are made as a function of the historical rate of forest fires observed in the project area between 2010 and 2020, for ex ante estimates. the area of registered forest fires obtained from the MAPBIOMAS fire module.

No fires were detected in the project area during the period from 2010 to 2020.

Non-$CO_2$ Emissions

Non-$CO_2$ gas greenhouse emissions occurring within the project boundary is calculated according the equation bellow.

$$GHG_{P,E,i,t} = E_{FC,i,t} + E_{BiomassBurn,i,t} + N_2O_{direct-N,i,t}$$

Where:

| | |
|---|---|
| $GHG_{P,E,i,t}$: | Greenhouse gas emissions as a result of deforestation activities within the project area in the project case in stratum *i* in year *t*; t $CO_2$-e; |
| $E_{FC,i,t}$: | Emission from fossil fuel combustion in stratum *i* within the project area in year *t*; t CO2-e; |
| *EBiomassBurn,i,t*: | Non-CO2 emissions due to biomass burning in stratum i in year t; t $CO_2$-e; |
| $N_2O_{direct-N,i,t}$: | Direct $N_2O$ emission as a result of nitrogen application on the alternative land use in stratum *i* within the project area in year *t*; t $CO_2$-e; |
| *i*: 1, 2, 3, … | *M* strata; |
| *t*: 1, 2, 3, … | *t** years elapsed since the start of the REDD VCS project activity. |

Greenhouse gas emissions due to biomass burning was calculated according to equation 1 of module VMD0013, Version 1.2, as follows.

$$E_{biomassburn,i,t} = \sum_{g=1}^{G}\left(\left(\left(A_{burn,i,t} \times B_{i,t} \times COMF_i \times G_{g,i}\right) \times 10^{-3}\right) \times GWP_g\right)$$

Where:

| | |
|---|---|
| $E_{biomassburn,i,t}$: | Greenhouse gas emissions due to biomass burning in stratum *i* in year *t* of each GHG ($CO_2$, $CH_4$, $N_2O$) (t $CO_2$e); |
| $A_{burn,i,t}$: | Area burnt for stratum *i* in year *t* (ha); |
| $B_i$,$t$: | Average aboveground biomass stock before burning stratum *i*, year (t d.m. $ha^{-1}$); |
| $COMF_i$: | Combustion factor for stratum *i* (unitless); |
| $G_{g,i}$: | Emission factor for stratum *i* for gas *g* (kg t-1 d.m. burnt); |
| $GWP_g$: | Global warming potential for gas g (t $CO_2$/t gas g); |
| *g*: 1, 2, 3 ... | *G* greenhouse gases including carbon dioxide, methane and nitrous oxide (unitless); |
| *i*: 1, 2, 3 ... | *M* strata (unitless); |
| *t*: 1, 2, 3, ... | *t** time elapsed since the start of the project activity (years). |

**Table 69. Factor values**

| | | |
|---|---|---|
| $GWP_{N2O}$ | 265 | t CO2/t gas g |
| $GWP_{CH4}$ | 28 | t CO2/t gas g |
| *COMF* | 0.45 | |
| $G_{N2O}$ | 0.2 | kg/t dry matter burnt (dm) |
| $G_{CH4}$ | 6.8 | kg/t dry matter burnt (dm) |

**Table 70. Greenhouse gas emissions in the baseline within the Project boundary**

| Project year *t* | GHG emissions as a result deforestation activities within the project boundary in the stratum i in year t | | | | Total GHG emissions | |
|---|---|---|---|---|---|---|
| | Open Lowland Tropical Rainforest | | | Annual | annual TOTAL | cumulative |
| | $E_{FC,i,t}$ | $E_{BiomassBurn,i,t}$ | $N_2O_{direct\text{-}N,i,t}$ | $GHG_{BSL\text{-}E,t}$ | $GHG_{BSL\text{-}E,t}$ | $GHG_{BSL\text{-}E,t}$ |
| | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ |
| 2022 | 0 | 518,564 | 0 | 518,564 | 518,564 | 518,564 |
| 2023 | 0 | 518,564 | 0 | 518,564 | 518,564 | 1,037,128 |
| 2024 | 0 | 518,564 | 0 | 518,564 | 518,564 | 1,555,692 |
| 2025 | 0 | 615,803 | 0 | 615,803 | 615,803 | 2,171,495 |
| 2026 | 0 | 518,564 | 0 | 518,564 | 518,564 | 2,690,059 |
| 2027 | 0 | 518,564 | 0 | 518,564 | 518,564 | 3,208,623 |
| 2028 | 0 | 615,803 | 0 | 615,803 | 615,803 | 3,824,426 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2029 | 0 | 518,564 | 0 | 518,564 | 518,564 | 4,342,990 |
| 2030 | 0 | 518,564 | 0 | 518,564 | 518,564 | 4,861,554 |
| 2031 | 0 | 615,803 | 0 | 615,803 | 615,803 | 5,477,358 |
| 2032 | 0 | 518,564 | 0 | 518,564 | 518,564 | 5,995,922 |
| 2033 | 0 | 518,564 | 0 | 518,564 | 518,564 | 6,514,486 |
| 2034 | 0 | 614,939 | 0 | 614,939 | 614,939 | 7,129,425 |
| 2035 | 0 | 518,564 | 0 | 518,564 | 518,564 | 7,647,989 |
| 2036 | 0 | 518,564 | 0 | 518,564 | 518,564 | 8,166,553 |
| 2037 | 0 | 615,803 | 0 | 615,803 | 615,803 | 8,782,356 |
| 2038 | 0 | 518,564 | 0 | 518,564 | 518,564 | 9,300,920 |
| 2039 | 0 | 518,564 | 0 | 518,564 | 518,564 | 9,819,484 |
| 2040 | 0 | 97,239 | 0 | 97,239 | 97,239 | 9,916,723 |
| 2041 | 0 | 259,282 | 0 | 259,282 | 259,282 | 10,176,005 |
| 2042 | 0 | 259,282 | 0 | 259,282 | 259,282 | 10,435,287 |
| 2043 | 0 | 29,826 | 0 | 29,826 | 29,826 | 10,465,113 |

The average aboveground biomass stock before burning for a particular stratum is estimated as follows.

$$B_{i,t} = (C_{AB\_tree,i,t} + C_{DWi,t} + C_{LI,i,t}) \times 12/44 \times (1/CF)$$

Where:

$B_{i,t}$: Average aboveground biomass stock before burning for stratum *i*, year *t* (tonnes d.m. $ha^{-1}$);

$C_{AB\_tree,i,}t$: Carbon stock in aboveground biomass in trees in stratum *i* in year *t* (t $CO_2e$ $ha^{-1}$);

$C_{DWi,t}$: Carbon stock in dead wood for stratum stratum *i* in year *t* (t $CO_2e$ $ha^{-1}$);

$C_{LI,i,t}$: Carbon stock in litter for stratum *i* in year *t* (t $CO_2e$ $ha^{-1}$);

12/44: Inverse ratio of molecular weight of $CO_2$ to carbon (t $CO_2e$ t $C^{-1}$);

*CF*: Carbon fraction of biomass (t C $t^{-1}$ d.m.);

*i*: 1, 2, 3 … M strata (unitless);

*t*: 1, 2, 3, … t* time elapsed since the start of the project activity (years).

**Table 71. Parameters to estimation Emissions Due to Biomass Burning**

| Initial Forest Class | Parameters | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $B_{i,t}$ | $C_{AB\_tree}$ | | $C_{BB\_tree}$ | | $C_{dwi,t}$ | $C_{Ll,i,t}$ | $C_{soc,i}$ |
| Name | | C stock | ±90% CI | C stock | ±90% CI | | | |
| | t d.m/ha | tCO2e/ha | tCO2e/ha | tCO2e/ha | tCO2e/ha | tCO2e/ha | tCO2e/ha | tCO2e/ha |
| Open Lowland Tropical Rainforest | 7,891 | 413 | 35.00 | 99.20 | 8.40 | 0 | 0 | 0 |

For deadwood, litter and soil organic carbon it was decided not to consider for simplicity and in the case of litter, excluded as it does not lead to a significant over-estimation of the net anthropogenic GHG emission reductions of the APD project activity. This exclusion is conservative.

<u>Net GHG emissions</u>

The net GHG emissions in the project is equal to the sum of stock changes due to deforestation and forest degradation plus the total GHG emissions minus any eligible forest carbon stock enhancement, according to equation below.

$$\Delta C_{WPS-REDD} = \sum_{t=1}^{t*} \sum_{i=1}^{M} \left( \Delta C_{P,DefPA,i,t} + |\Delta C_{P,Deg,i,t} + \Delta C_{P,DistPA,i,t} + GHG_{P-E,i,t} - \Delta C_{P,Enh,i,t} \right)$$

Where:

$CW_{PS-REDD}$: Net GHG emissions in the REDD project scenario up to year $t*$; t $CO_2$-e;

$\Delta C_{P,DefPA,i,t}$: Net carbon stock change as a result of deforestation in the project area in the project case in stratum $i$ in year $t$; t $CO_2$-e;

$\Delta C_{P,Deg,i,t}$: Net carbon stock change as a result of degradation in the project area in the project case in stratum $i$ in year $t$; t $CO_2$-e;

$\Delta C_{P,DistPA,i,t}$: Net carbon stock change as a result of natural disturbance in the project area in the project case in stratum $i$ in year $t$; t $CO_2$-e;

$GHG_{P-E,i,t}$: Greenhouse gas emissions as a result of deforestation and degradation activities within the project area in the project case in stratum $i$ in year $t$; t $CO_2$-e;

$\Delta C_{P,Enh,i,t}$: Net carbon stock change as a result of forest growth and sequestration during the project in areas projected to be deforested in the baseline in stratum $i$ in year $t$; t $CO_2$-e;

*i*: 1, 2, 3, … *M* strata;

*t*: 1, 2, 3, … *t** years elapsed since the start of the project activity.

**Table 72. Area potentially impacted by natural disturbances**

| Year | Open Lowland Tropical Rainforest | $A_{,DistPA,q,i,t}$ | $A_{,DistPA,q,i,t}$ |
|---|---|---|---|
| | ha | Total | Cumulative |
| 2022 | 11.79 | 11.79 | 11.79 |
| 2023 | 11.79 | 11.79 | 23.58 |
| 2024 | 11.79 | 11.79 | 35.37 |
| 2025 | 14.00 | 14.00 | 49.38 |
| 2026 | 11.79 | 11.79 | 61.17 |
| 2027 | 11.79 | 11.79 | 72.96 |
| 2028 | 14.00 | 14.00 | 86.96 |
| 2029 | 11.79 | 11.79 | 98.75 |
| 2030 | 11.79 | 11.79 | 110.54 |
| 2031 | 14.00 | 14.00 | 124.55 |
| 2032 | 11.79 | 11.79 | 136.34 |
| 2033 | 11.79 | 11.79 | 148.13 |
| 2034 | 13.98 | 13.98 | 162.11 |
| 2035 | 11.79 | 11.79 | 173.90 |
| 2036 | 11.79 | 11.79 | 185.69 |
| 2037 | 14.00 | 14.00 | 199.70 |
| 2038 | 11.79 | 11.79 | 211.49 |
| 2039 | 11.79 | 11.79 | 223.28 |
| 2040 | 2.21 | 2.21 | 225.49 |
| 2041 | 5.90 | 5.90 | 231.39 |
| 2042 | 5.90 | 5.90 | 237.28 |
| 2043 | 0.68 | 0.68 | 237.96 |

**Table 73. Net carbon stock change as a result of natural disturbance in the Project case in the Project Area in stratum i in year t**

| ΔCP,DistPA,i,t | | | |
|---|---|---|---|
| Year | Open Lowland Tropical Rainforest | $\Delta C_{P,DistPA,i,t}$ | $\Delta C_{P,DistPA,i,t}$ |
| | t CO2-e | Total | Cumulative |
| 2022 | 5,677.94 | 5,677.94 | 5,677.94 |
| 2023 | 5,677.94 | 5,677.94 | 11,355.89 |
| 2024 | 5,677.94 | 5,677.94 | 17,033.83 |
| 2025 | 6,742.65 | 6,742.65 | 23,776.48 |
| 2026 | 5,677.94 | 5,677.94 | 29,454.43 |
| 2027 | 5,677.94 | 5,677.94 | 35,132.37 |
| 2028 | 6,742.65 | 6,742.65 | 41,875.02 |
| 2029 | 5,677.94 | 5,677.94 | 47,552.97 |
| 2030 | 5,677.94 | 5,677.94 | 53,230.91 |
| 2031 | 6,742.65 | 6,742.65 | 59,973.56 |
| 2032 | 5,677.94 | 5,677.94 | 65,651.51 |
| 2033 | 5,677.94 | 5,677.94 | 71,329.45 |
| 2034 | 6,733.19 | 6,733.19 | 78,062.64 |
| 2035 | 5,677.94 | 5,677.94 | 83,740.58 |
| 2036 | 5,677.94 | 5,677.94 | 89,418.53 |
| 2037 | 6,742.65 | 6,742.65 | 96,161.18 |
| 2038 | 5,677.94 | 5,677.94 | 101,839.12 |
| 2039 | 5,677.94 | 5,677.94 | 107,517.07 |
| 2040 | 1,064.71 | 1,064.71 | 108,581.77 |
| 2041 | 2,838.97 | 2,838.97 | 111,420.75 |
| 2042 | 2,838.97 | 2,838.97 | 114,259.72 |
| 2043 | 326.58 | 326.58 | 114,586.29 |

**Table 74. Net GHG emissions in the REDD Project scenario**

| Net GHG emissions in the REDD project scenario | | | |
|---|---|---|---|
| Idi | 1 | $\Delta C_{WPS\_REDD}$ | $\Delta C_{WPS\_REDD}$ |
| Name | Open Lowland Tropical Rainforest | annual | cumulative |
| Project year | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ |
| 2022 | 518,576 | 518,576 | 518,576 |
| 2023 | 518,576 | 518,576 | 1,037,151 |
| 2024 | 518,576 | 518,576 | 1,555,727 |
| 2025 | 615,817 | 615,817 | 2,171,545 |
| 2026 | 518,576 | 518,576 | 2,690,120 |
| 2027 | 518,576 | 518,576 | 3,208,696 |
| 2028 | 615,817 | 615,817 | 3,824,513 |
| 2029 | 518,576 | 518,576 | 4,343,089 |
| 2030 | 518,576 | 518,576 | 4,861,665 |
| 2031 | 615,817 | 615,817 | 5,477,482 |
| 2032 | 518,576 | 518,576 | 5,996,058 |
| 2033 | 518,576 | 518,576 | 6,514,634 |
| 2034 | 614,953 | 614,953 | 7,129,587 |
| 2035 | 518,576 | 518,576 | 7,648,163 |
| 2036 | 518,576 | 518,576 | 8,166,738 |
| 2037 | 615,817 | 615,817 | 8,782,556 |
| 2038 | 518,576 | 518,576 | 9,301,131 |
| 2039 | 518,576 | 518,576 | 9,819,707 |
| 2040 | 97,242 | 97,242 | 9,916,949 |
| 2041 | 259,288 | 259,288 | 10,176,237 |
| 2042 | 259,288 | 259,288 | 10,435,524 |
| 2043 | 29,827 | 29,827 | 10,465,351 |

## 4.3 Leakage

### AUD – Avoided Unplanned Deforestation

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,

| | |
|---|---|
| ΔCLPMLKt | Carbon stock decrease due to leakage prevention measures at year t; $tCO_2e$ |
| ΔCBSLLKt | Annual carbon stock changes in leakage management areas in the baseline case at year t; $tCO_2e$ |
| ΔCPSLKt | 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 75. 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 |
| | $\Delta CBSLLK_t$ | $\Delta CBSLLK$ | $\Delta CPSLK_t$ | $\Delta CPSLK$ | $\Delta CLPMLK_t$ | $\Delta CLPMLK$ |
| | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ |
| 2021 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 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 |

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[167]:

$$EgLK_t = ECH_4ferm_t + ECH_4man_t + EN_2Oman_t$$

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.

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

**Table 76. Ex ante estimation of leakage emissions above the baseline from 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 |
| | $\Delta CLPMLK_t$ | $\Delta CLPMLK$ | $EgLK_t$ | $EgLK$ | $ELPMLK_t$ | $ELPMLK$ |
| | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ |
| 2021 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 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 |

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

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.

$$\Delta CADLKt = \Delta CBSLPAt * DLF$$

Where,

| | |
|---|---|
| $\Delta$CADLKt | 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, 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[168] used to estimate the decrease in carbon stocks, as follows.

$$EADLKt_t = EBBBSPA_t * DLF$$

[168] 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.

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.

**Table 77. 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 |
| | $\Delta CADLK_t$ | $\Delta CADLK$ | $EADLK_t$ | $EADLK$ |
| | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ |
| 2021 | 27,021.53 | 27,021.53 | 1,086.49 | 1,086.49 |
| 2022 | 27,425.58 | 54,447.11 | 1,086.49 | 2,172.97 |
| 2023 | 27,829.64 | 82,276.75 | 1,086.49 | 3,259.46 |
| 2024 | 28,233.70 | 110,510.44 | 1,086.49 | 4,345.94 |
| 2025 | 28,637.75 | 139,148.20 | 1,086.49 | 5,432.43 |
| 2026 | 29,041.81 | 168,190.01 | 1,086.49 | 6,518.91 |
| 2027 | 26,743.71 | 194,933.72 | 977.84 | 7,496.75 |
| 2028 | 27,107.37 | 222,041.09 | 977.84 | 8,474.59 |
| 2029 | 27,471.02 | 249,512.10 | 977.84 | 9,452.42 |
| 2030 | 27,834.67 | 277,346.77 | 977.84 | 10,430.26 |
| 2031 | 27,565.00 | 304,911.77 | 977.84 | 11,408.10 |
| 2032 | 27,524.60 | 332,436.37 | 977.84 | 12,385.93 |
| 2033 | 25,052.25 | 357,488.62 | 880.05 | 13,265.99 |
| 2034 | 24,975.48 | 382,464.10 | 880.05 | 14,146.04 |
| 2035 | 24,898.71 | 407,362.81 | 880.05 | 15,026.09 |
| 2036 | 24,821.94 | 432,184.76 | 880.05 | 15,906.15 |
| 2037 | 24,808.50 | 456,993.26 | 880.05 | 16,786.20 |
| 2038 | 24,772.14 | 481,765.39 | 880.05 | 17,666.25 |
| 2039 | 22,547.03 | 504,312.42 | 792.05 | 18,458.30 |
| 2040 | 22,477.93 | 526,790.35 | 792.05 | 19,250.35 |
| 2041 | 22,408.84 | 549,199.19 | 792.05 | 20,042.40 |
| 2042 | 22,339.75 | 571,538.94 | 792.05 | 20,834.44 |

| | | | | |
|---|---|---|---|---|
| 2043 | 22,327.65 | 593,866.59 | 792.05 | 21,626.49 |
| 2044 | 22,294.92 | 616,161.52 | 792.05 | 22,418.54 |
| 2045 | 20,292.32 | 636,453.84 | 712.84 | 23,131.38 |
| 2046 | 20,230.14 | 656,683.98 | 712.84 | 23,844.23 |
| 2047 | 20,167.96 | 676,851.94 | 712.84 | 24,557.07 |
| 2048 | 20,105.77 | 696,957.71 | 712.84 | 25,269.91 |
| 2049 | 20,094.89 | 717,052.60 | 712.84 | 25,982.76 |
| 2050 | 20,065.43 | 737,118.03 | 712.84 | 26,695.60 |

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

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

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

Where,

ΔCLKt Total decrease in carbon stocks within the leakage belt at year t; $tCO_2e$

ΔCADLKt Total decrease in carbon stocks due to displaced deforestation at year t; $tCO_2e$

ΔCLPMLKt 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 (ΔCLPMLKt) 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 78. 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 |
| | $EgLK_t$ | $EgLK$ | $EADLK_t$ | $EADLK$ | $\Delta CADLK_t$ | $\Delta CADLK$ | $\Delta CLPMLK_t$ | $\Delta CLPMLK$ | $\Delta CLK_t$ | $\Delta CLK$ | $ELK_t$ | $ELK$ |
| | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ |
| 2021 | 0.00 | 0.00 | 1,086.49 | 1,086.49 | 27,021.53 | 27,021.53 | 0.00 | 0.00 | 27,021.53 | 27,021.53 | 1,086.49 | 1,086.49 |
| 2022 | 0.00 | 0.00 | 1,086.49 | 2,172.97 | 27,425.58 | 54,447.11 | 0.00 | 0.00 | 27,425.58 | 54,447.11 | 1,086.49 | 2,172.97 |
| 2023 | 0.00 | 0.00 | 1,086.49 | 3,259.46 | 27,829.64 | 82,276.75 | 0.00 | 0.00 | 27,829.64 | 82,276.75 | 1,086.49 | 3,259.46 |
| 2024 | 0.00 | 0.00 | 1,086.49 | 4,345.94 | 28,233.70 | 110,510.44 | 0.00 | 0.00 | 28,233.70 | 110,510.44 | 1,086.49 | 4,345.94 |
| 2025 | 0.00 | 0.00 | 1,086.49 | 5,432.43 | 28,637.75 | 139,148.20 | 0.00 | 0.00 | 28,637.75 | 139,148.20 | 1,086.49 | 5,432.43 |
| 2026 | 0.00 | 0.00 | 1,086.49 | 6,518.91 | 29,041.81 | 168,190.01 | 0.00 | 0.00 | 29,041.81 | 168,190.01 | 1,086.49 | 6,518.91 |
| 2027 | 0.00 | 0.00 | 977.84 | 7,496.75 | 26,743.71 | 194,933.72 | 0.00 | 0.00 | 26,743.71 | 194,933.72 | 977.84 | 7,496.75 |
| 2028 | 0.00 | 0.00 | 977.84 | 8,474.59 | 27,107.37 | 222,041.09 | 0.00 | 0.00 | 27,107.37 | 222,041.09 | 977.84 | 8,474.59 |
| 2029 | 0.00 | 0.00 | 977.84 | 9,452.42 | 27,471.02 | 249,512.10 | 0.00 | 0.00 | 27,471.02 | 249,512.10 | 977.84 | 9,452.42 |
| 2030 | 0.00 | 0.00 | 977.84 | 10,430.26 | 27,834.67 | 277,346.77 | 0.00 | 0.00 | 27,834.67 | 277,346.77 | 977.84 | 10,430.26 |
| 2031 | 0.00 | 0.00 | 977.84 | 11,408.10 | 27,565.00 | 304,911.77 | 0.00 | 0.00 | 27,565.00 | 304,911.77 | 977.84 | 11,408.10 |
| 2032 | 0.00 | 0.00 | 977.84 | 12,385.93 | 27,524.60 | 332,436.37 | 0.00 | 0.00 | 27,524.60 | 332,436.37 | 977.84 | 12,385.93 |
| 2033 | 0.00 | 0.00 | 880.05 | 13,265.99 | 25,052.25 | 357,488.62 | 0.00 | 0.00 | 25,052.25 | 357,488.62 | 880.05 | 13,265.99 |
| 2034 | 0.00 | 0.00 | 880.05 | 14,146.04 | 24,975.48 | 382,464.10 | 0.00 | 0.00 | 24,975.48 | 382,464.10 | 880.05 | 14,146.04 |
| 2035 | 0.00 | 0.00 | 880.05 | 15,026.09 | 24,898.71 | 407,362.81 | 0.00 | 0.00 | 24,898.71 | 407,362.81 | 880.05 | 15,026.09 |
| 2036 | 0.00 | 0.00 | 880.05 | 15,906.15 | 24,821.94 | 432,184.76 | 0.00 | 0.00 | 24,821.94 | 432,184.76 | 880.05 | 15,906.15 |
| 2037 | 0.00 | 0.00 | 880.05 | 16,786.20 | 24,808.50 | 456,993.26 | 0.00 | 0.00 | 24,808.50 | 456,993.26 | 880.05 | 16,786.20 |
| 2038 | 0.00 | 0.00 | 880.05 | 17,666.25 | 24,772.14 | 481,765.39 | 0.00 | 0.00 | 24,772.14 | 481,765.39 | 880.05 | 17,666.25 |
| 2039 | 0.00 | 0.00 | 792.05 | 18,458.30 | 22,547.03 | 504,312.42 | 0.00 | 0.00 | 22,547.03 | 504,312.42 | 792.05 | 18,458.30 |
| 2040 | 0.00 | 0.00 | 792.05 | 19,250.35 | 22,477.93 | 526,790.35 | 0.00 | 0.00 | 22,477.93 | 526,790.35 | 792.05 | 19,250.35 |
| 2041 | 0.00 | 0.00 | 792.05 | 20,042.40 | 22,408.84 | 549,199.19 | 0.00 | 0.00 | 22,408.84 | 549,199.19 | 792.05 | 20,042.40 |
| 2042 | 0.00 | 0.00 | 792.05 | 20,834.44 | 22,339.75 | 571,538.94 | 0.00 | 0.00 | 22,339.75 | 571,538.94 | 792.05 | 20,834.44 |
| 2043 | 0.00 | 0.00 | 792.05 | 21,626.49 | 22,327.65 | 593,866.59 | 0.00 | 0.00 | 22,327.65 | 593,866.59 | 792.05 | 21,626.49 |
| 2044 | 0.00 | 0.00 | 792.05 | 22,418.54 | 22,294.92 | 616,161.52 | 0.00 | 0.00 | 22,294.92 | 616,161.52 | 792.05 | 22,418.54 |
| 2045 | 0.00 | 0.00 | 712.84 | 23,131.38 | 20,292.32 | 636,453.84 | 0.00 | 0.00 | 20,292.32 | 636,453.84 | 712.84 | 23,131.38 |
| 2046 | 0.00 | 0.00 | 712.84 | 23,844.23 | 20,230.14 | 656,683.98 | 0.00 | 0.00 | 20,230.14 | 656,683.98 | 712.84 | 23,844.23 |
| 2047 | 0.00 | 0.00 | 712.84 | 24,557.07 | 20,167.96 | 676,851.94 | 0.00 | 0.00 | 20,167.96 | 676,851.94 | 712.84 | 24,557.07 |
| 2048 | 0.00 | 0.00 | 712.84 | 25,269.91 | 20,105.77 | 696,957.71 | 0.00 | 0.00 | 20,105.77 | 696,957.71 | 712.84 | 25,269.91 |
| 2049 | 0.00 | 0.00 | 712.84 | 25,982.76 | 20,094.89 | 717,052.60 | 0.00 | 0.00 | 20,094.89 | 717,052.60 | 712.84 | 25,982.76 |
| 2050 | 0.00 | 0.00 | 712.84 | 26,695.60 | 20,065.43 | 737,118.03 | 0.00 | 0.00 | 20,065.43 | 737,118.03 | 712.84 | 26,695.60 |

### APD – Avoided Planned Deforestation

Net GHG emissions due to leakage from the REDD project activity are determined according to the equation below, present in module VMD0007 v1.6.

$$\Delta C_{LK\text{-}REDD} = \Delta C_{LK\text{-}AS,planned} + \Delta C_{LK\text{-}ME}$$

Where:

| | |
|---|---|
| $\Delta C_{LK\text{-}REDD}$: | Net GHG emissions due to leakage from the REDD project activity up to year t* (t $CO_2$e); |
| $\Delta C_{LK\text{-}AS,planned}$: | Net GHG emissions due to activity shifting leakage for projects preventing planned deforestation up to year t* – from Module LK-ASP (t $CO_2$e); |
| $\Delta C_{LK\text{-}M}$: | Net GHG emissions due to market-effects leakage up to year t* – from Module LK-ME (t $CO_2$e); |

**Activity Shifting Leakage**

Net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation are calculated according to VMD0009 v1.3 PART 1 and the equation below.

$$\Delta C_{LK-AS,planned} = \sum_{t=1}^{t*} \sum_{i=1}^{M} \left( LKA_{planned,i,t} \times \Delta C_{BSL,i} \right) + GHG_{LK,E,i,t}$$

Where:

| | |
|---|---|
| $\Delta C_{LK\text{-}AS,planned}$: | Net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation up to year *t** (t $CO_2$e); |
| $LKA_{planned,i,t}$: | The area of activity shifting leakage in stratum *i* in year *t* (ha); |
| $\Delta C_{BSL,i}$: | Net carbon stock changes in all pre-deforestation pools in baseline stratum *i* (t $CO_2$e $ha^{-1}$); |
| $GHG_{LK,E,i,t}$: | Greenhouse gas emissions as a result of leakage of avoiding deforestation activities in stratum *i* in year *t* (t $CO_2$e); |
| *i*: 1, 2, 3, … | *M* strata (unitless); |
| *t*: 1, 2, 3, … | *t** time elapsed since the start of the project activity (years). |

The area of activity shifting leakage was determined by the following equation.

$$LKA_{planned\,i,t} = A_{defLK,i,t} - NewR_{i,t}$$

Where:

| | |
|---|---|
| $LKA_{planned,i,}t$: | The area of activity shifting leakage in stratum *i* in year *t* (ha); |
| $NewR_{i,t}$: | New calculated forest clearance by the baseline agent of the planned deforestation in stratum *i* in year *t* where no leakage is occurring (ha); |
| $A_{defLK,i,t}$: | The total area of monitored deforestation by the baseline agent of the planned deforestation in stratum *i* in year *t* (ha); |
| *i*: | 1, 2, 3, … *M* strata (unitless); |
| *t*: | 1, 2, 3, … *t** time elapsed since the start of the project activity (years). |

Considering the scope of the project, the total area of monitored deforestation by baseline agent of the planned deforestation, $A_{defLK,i,t}$ will always be zero, as there are no forested areas subject to legal suppression across all the lands managed by the identified deforestation agent, disregarding the project boundary. Therefore, GHG emissions due to activity shifting to avoid planned deforestation are set to zero in *ex-ante* and *ex-post* estimates.

The new calculated forest clearance by the baseline agent of the planned deforestation where no leakage is occurring is thus the average number of hectares deforested per year in all of the agent´s concessions, as follows.

$$NewR_{i,t} = (D\%_{planned,i,t,OP} \text{ X } A_{planned,i,OP})$$

Where:

| | |
|---|---|
| $NewR_{it}$ | New calculated forest clearance in stratum I in year t by the baseline agent of the planned deforestation where no leakage is occurring (ha) |
| $D\%_{planned,i,t}$ | Projected annual proportion of land that will be deforested in project stratum I in year t (percent) |
| $A_{planned,\,i,}$ | Total area of planned deforestation over the baseline period for project stratum i (ha) |
| *i*: | 1, 2, 3, … *M* strata (unitless); |
| *t*: | 1, 2, 3, … *t** time elapsed since the start of the project activity (years). |

According to VMD0009 LK-ASP v1.3, where the specific agent of deforestation can be identified, leakage need not be considered when it can be demonstrated that the management plans and/or land use designations of the agent's other lands of deforestation (which must be identified by location) have not materially changed as a result of the project (e.g., the clearing agent has not designated new land as timber concessions, increased harvest rates on land already managed for timber, clearing of intact forests for agricultural production or increased use of fertilizers to increase agricultural yields).

Greenhouse gas emissions as a result of leakage of avoiding deforestation activities is calculated according to the following equation.

$$GHG_{LK,E,i,t} = E_{biomassburn,i,t} + N_2O_{direct-N,i,t}$$

Where:

| | |
|---|---|
| $GHG_{LK,E,i,t}$ | Greenhouse gas emissions as a result of leakage of avoiding deforestation activities in stratum i in year t (t CO2e). |
| $E_{biomassburn,i,t}$ | Non-CO2 emissions due to biomass burning in stratum i in year t (t CO2e). |
| $N2O_{direct-N,i,t}$ | Direct N2O emission as a result of nitrogen application on the alternative land use in stratum i in year t (t CO2e). |
| i | 1, 2, 3, … M strata (unitless). |
| t | 1, 2, 3 … t* time elapsed since the start of the project activity (years). |

Non-CO2 emissions due to biomass burning in the area of activity by leakage displacement are calculated according to the same procedures used to estimate baseline GHG emissions, therefore, the N2O emission estimate does not apply either to leakage. Thus, the $GHG_{LK,E,i,t}$ will be equal to zero (0) ex-ante and ex-post estimates.

Therefore, there are no current areas of the project to be considered by the deforestation agent as potential areas for the detachment and considering that other areas in the surroundings are preserved and will be destined to forest conservation projects and REDD AUD, and taking considering that the deforestation agent did not designate new lands for forest management or increase the rates of wood harvesting on lands already managed, this project did not present any leakage.

**Table 79. Net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation**

| Year | GHGLK,E,i,t | NewRi,t | LKAplanned,i,t |
|---|---|---|---|
| | Open Lowland Tropical Rainforest | Open Lowland Tropical Rainforest | Open Lowland Tropical Rainforest |
| | tCO2e | ha | ha |
| 2022 | 0 | 11.79 | 0 |
| 2023 | 0 | 11.79 | 0 |
| 2024 | 0 | 11.79 | 0 |
| 2025 | 0 | 14.00 | 0 |
| 2026 | 0 | 11.79 | 0 |
| 2027 | 0 | 11.79 | 0 |
| 2028 | 0 | 14.00 | 0 |
| 2029 | 0 | 11.79 | 0 |
| 2030 | 0 | 11.79 | 0 |
| 2031 | 0 | 14.00 | 0 |
| 2032 | 0 | 11.79 | 0 |
| 2033 | 0 | 11.79 | 0 |
| 2034 | 0 | 13.98 | 0 |
| 2035 | 0 | 11.79 | 0 |
| 2036 | 0 | 11.79 | 0 |
| 2037 | 0 | 14.00 | 0 |
| 2038 | 0 | 11.79 | 0 |
| 2039 | 0 | 11.79 | 0 |
| 2040 | 0 | 2.21 | 0 |
| 2041 | 0 | 5.90 | 0 |
| 2042 | 0 | 5.90 | 0 |
| 2043 | 0 | 0.68 | 0 |

<u>Market Effects Leakage</u>

Total GHG emissions due to market-leakage effects through decreased timber harvest are calculated according to the equation below, present in module VMD0011 v1.0.

$$\Delta C_{LK\text{-}ME} = LK_{MarketEffects,\ timber} + LK_{MarketEffects,\ FW/C}$$

Where:

$\Delta C_{LK\text{-}ME}$ Net greenhouse gas emissions due to market-effects leakage; t $CO_2$-e.

$LK_{MarketEffects,timber}$ Total GHG emissions due to market-effects leakage through decreased timber harvest; t $CO_2$-e.

$LK_{MarketEffects,FW/C}$ Total GHG emissions due to market leakage through decreased harvest of fuelwood and charcoal sold into regional and/or national markets; t $CO_2$-e.

Leakage due to market effects is equal to the baseline emissions from logging multiplied by a leakage factor.

$$LK_{MarketEffects,timber} = \sum_{i=1}^{M} (LF_{ME} * AL_{T,i})$$

Where:

$LK_{MarketEffects,timber}$ Total GHG emissions due to market-effects leakage through decreased timber harvest; t $CO_2$-e.

$LF_{ME}$ Leakage factor for market-effects calculations; dimensionless

$AL_{T,i}$ Summed emissions from timber harvest in stratum I in the baseline case potentially displaced through implementation of carbon project; t CO2-e

$i$ 1,2,3…M strata

The leakage factor ($LF_{ME}$) was adopted as 0.2 taking into account that the biomass of total aboveground tree is considered equal to $PMP_i$, it is possible to conclude that the amount of leakage will be very close to what should occur in the project area.

**Table 80. Leakage factor**

| Stratum/forest class | PMPi | PML |
|---|---|---|
| Open Lowland Tropical Rainforest | 45% | 56% |

The following deduction factors ($LF_{ME}$) were considered:

Where:

*$PML_{FT}$ is equal (± 15%) to PMPi:* $LF_{ME}$ = 0.4

*$PML_{FT}$ is > 15% less than PMPi* $LF_{ME}$ = 0.7

*$PML_{FT}$ is > 15% greater than PMPi* $LF_{ME}$ = 0.2

The total volume to be suppressed at baseline in the Project Area is estimated as follows.

$$AL_{T,i} = \sum_{t=1}^{t} \left( C_{BSL,XBT,i,t} \right)$$

Where:

| | |
|---|---|
| $AL_{T,I}$ | Summed emissions from timber harvest in stratum i in the baseline case potentially displaced through implementation of carbon project; $tCO_2$-e |
| $C_{BSL,XBT,i,t}$ | Carbon emission due to displaced timber harvests in the baseline scenario in stratum i in time t; $tCO_2$-e |
| i | 1, 2, 3, ….M strata |
| t | 1, 2, 3, ….t* years elapsed since the projected start of the REDD project activity |

The carbon emission due to the displaced logging has two components: the biomass carbon of the extracted timber and the biomass carbon in the forest damaged in the process of timber extraction:

$$C_{BSL,XBT,i,t} = \left( \left[ V_{BSL,XE,i,t} * D_{mn} * CF \right] + \left[ V_{BSL,XE,i,t} * LDF \right] + \left[ V_{BSL,XE,i,t} * LIF \right] \right) * \frac{44}{12}$$

Where:

| | |
|---|---|
| $C_{BSL,XBT,i,t}$ | Carbon emission due to timber harvests in the baseline scenario in stratum *i* at time *t*; t CO2-e |
| $V_{BSL,EX,i,t}$ | Volume of timber projected to be extracted from within the project boundary during the baseline in stratum *i* at time *t*; $m^3$ |
| $D_{mn}$ | Mean wood density of commercially harvested species; t d.m.m-3. The value must be the same as that used in the module CP-W if this pool is included in the baseline. |
| *CF* | Carbon fraction of biomass for commercially harvested species *j*; t C t d.m.-1 . The value must be the same as that used in the module CP-W if this pool is included in the baseline. |
| *LDF* | Logging damage factor; t C m-3 (default 0.53 t C m-3 for broadleaf and mixed forests; 0.25 t C m-3 for coniferous forests) |

*LIF* Logging infrastructure factor; t C m-3 (default 0.29 t C m-3)

*i* 1, 2, 3, … *M* strata

*t* 1, 2, 3, … *t** years elapsed since the projected start of the REDD project activity

**Table 81. Net greenhouse gas emissions due to market-effects leakage**

| Year | $LK_{MarketEffects,timber}$ | $LK_{MarketEffects,FW/C}$ | $\Delta C_{LK\ ME}$ |
|---|---|---|---|
| | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ |
| 2022 | 10,604.56 | 0.00 | 10,604.56 |
| 2023 | 10,604.56 | 0.00 | 10,604.56 |
| 2024 | 10,604.56 | 0.00 | 10,604.56 |
| 2025 | 21,209.12 | 0.00 | 21,209.12 |
| 2026 | 21,209.12 | 0.00 | 21,209.12 |
| 2027 | 10,604.56 | 0.00 | 10,604.56 |
| 2028 | 21,209.12 | 0.00 | 21,209.12 |
| 2029 | 10,604.56 | 0.00 | 10,604.56 |
| 2030 | 10,604.56 | 0.00 | 10,604.56 |
| 2031 | 21,209.12 | 0.00 | 21,209.12 |
| 2032 | 21,209.12 | 0.00 | 21,209.12 |
| 2033 | 21,209.12 | 0.00 | 21,209.12 |
| 2034 | 21,209.12 | 0.00 | 21,209.12 |
| 2035 | 10,604.56 | 0.00 | 10,604.56 |
| 2036 | 10,604.56 | 0.00 | 10,604.56 |
| 2037 | 21,209.12 | 0.00 | 21,209.12 |
| 2038 | 10,604.56 | 0.00 | 10,604.56 |
| 2039 | 10,604.56 | 0.00 | 10,604.56 |
| 2040 | 15,906.84 | 0.00 | 15,906.84 |
| 2041 | 5,302.28 | 0.00 | 5,302.28 |
| 2042 | 5,302.28 | 0.00 | 5,302.28 |
| 2043 | 5,302.28 | 0.00 | 5,302.28 |

**Table 82. Net greenhouse gas emissions due to activity shifting leakage**

| Year | $\Delta C_{LK-AB,planned}$ | $\Delta C_{LK\ ME}$ | $\Delta C_{LK-REDD}$ |
|---|---|---|---|
| | tCO2 | tCO2 | tCO2 |
| 2022 | 0 | 10,605 | 10,605 |
| 2023 | 0 | 10,605 | 10,605 |
| 2024 | 0 | 10,605 | 10,605 |
| 2025 | 0 | 21,209 | 21,209 |
| 2026 | 0 | 21,209 | 21,209 |
| 2027 | 0 | 10,605 | 10,605 |
| 2028 | 0 | 21,209 | 21,209 |
| 2029 | 0 | 10,605 | 10,605 |
| 2030 | 0 | 10,605 | 10,605 |
| 2031 | 0 | 21,209 | 21,209 |
| 2032 | 0 | 21,209 | 21,209 |
| 2033 | 0 | 21,209 | 21,209 |
| 2034 | 0 | 21,209 | 21,209 |
| 2035 | 0 | 10,605 | 10,605 |
| 2036 | 0 | 10,605 | 10,605 |
| 2037 | 0 | 21,209 | 21,209 |
| 2038 | 0 | 10,605 | 10,605 |
| 2039 | 0 | 10,605 | 10,605 |
| 2040 | 0 | 15,907 | 15,907 |
| 2041 | 0 | 5,302 | 5,302 |
| 2042 | 0 | 5,302 | 5,302 |
| 2043 | 0 | 5,302 | 5,302 |

## 4.4 Net GHG Emission Reductions and Removals

### AUD – Avoided Unplanned Deforestation

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

| | |
|---|---|
| $\Delta CBSLPAt$ | 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 |
| $\Delta CPSPAt$ | 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 |
| $\Delta CLKt$ | 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 |
| $\Delta REDDt$ | 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 |
| $\Delta CBSLPAt$ | Sum of baseline carbon stock changes in the project area at year t; tCO2e |
| $\Delta CPSPAt$ | Sum of ex ante estimated actual carbon stock changes in the project area at year t; tCO2e ha-1 |
| Ft | 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 6,807.36 ha of deforestation, equating to 679,673 tCO2e in emissions reductions over the 30-year project lifetime (07-October-2020 to 06-October-2050), with an annual average of 22,656 tCO2e.

Table 83. Ex ante estimated net anthropogenic GHG emission reductions (ΔREDD$_t$) and Verified Carbon Units (VCU$_t$)

| 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 |
| | ΔCBSLPA$_t$ | ΔCBSLPA | EBBBSLPA$_t$ | EBBBSLPA | ΔCPSPA$_t$ | ΔCPSPA | EBBPSPA$_t$ | EBBPSPA | ΔCLK$_t$ | ΔCLK | ELK$_t$ | ELK | ΔREDD$_t$ | ΔREDD | VCU$_t$ | VCU | VBC$_t$ | VBC |
| | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ |
| 2021 | 180,144 | 180,144 | 7,243 | 7,243 | 63,289 | 63,289 | 396 | 396 | 27,022 | 27,022 | 1,086 | 1,086 | 95,594 | 95,594 | 78,065 | 78,065 | 17,528 | 17,528 |
| 2022 | 182,837 | 362,981 | 7,243 | 14,486 | 124,368 | 187,657 | 396 | 793 | 27,426 | 54,447 | 1,086 | 2,173 | 36,804 | 132,398 | 28,033 | 106,098 | 8,770 | 26,299 |
| 2023 | 185,531 | 548,512 | 7,243 | 21,730 | 124,515 | 312,172 | 396 | 1,189 | 27,830 | 82,277 | 1,086 | 3,259 | 38,946 | 171,344 | 29,794 | 135,892 | 9,152 | 35,451 |
| 2024 | 188,225 | 736,736 | 7,243 | 28,973 | 124,663 | 436,835 | 396 | 1,585 | 28,234 | 110,510 | 1,086 | 4,346 | 41,089 | 212,433 | 31,554 | 167,446 | 9,534 | 44,985 |
| 2025 | 190,918 | 927,655 | 7,243 | 36,216 | 124,810 | 561,645 | 396 | 1,981 | 28,638 | 139,148 | 1,086 | 5,432 | 43,231 | 255,664 | 33,314 | 200,760 | 9,916 | 54,901 |
| 2026 | 193,612 | 1,121,267 | 7,243 | 43,459 | 124,957 | 686,602 | 396 | 2,378 | 29,042 | 168,190 | 1,086 | 6,519 | 45,373 | 301,037 | 35,075 | 235,835 | 10,298 | 65,200 |
| 2027 | 178,291 | 1,299,558 | 6,519 | 49,978 | 124,119 | 810,722 | 357 | 2,734 | 26,744 | 194,934 | 978 | 7,497 | 32,613 | 333,650 | 24,487 | 260,322 | 8,126 | 73,325 |
| 2028 | 180,716 | 1,480,274 | 6,519 | 56,497 | 124,252 | 934,974 | 357 | 3,091 | 27,107 | 222,041 | 978 | 8,475 | 34,541 | 368,191 | 26,071 | 286,393 | 8,470 | 81,795 |
| 2029 | 183,140 | 1,663,414 | 6,519 | 63,016 | 124,385 | 1,059,358 | 357 | 3,448 | 27,471 | 249,512 | 978 | 9,452 | 36,469 | 404,660 | 27,655 | 314,048 | 8,813 | 90,608 |
| 2030 | 185,564 | 1,848,978 | 6,519 | 69,535 | 124,517 | 1,183,875 | 357 | 3,804 | 27,835 | 277,347 | 978 | 10,430 | 38,397 | 443,057 | 29,239 | 343,287 | 9,157 | 99,765 |
| 2031 | 183,767 | 2,032,745 | 6,519 | 76,054 | 124,419 | 1,308,294 | 357 | 4,161 | 27,565 | 304,912 | 978 | 11,408 | 36,967 | 480,024 | 28,065 | 371,352 | 8,902 | 108,668 |
| 2032 | 183,497 | 2,216,242 | 6,519 | 82,573 | 124,404 | 1,432,698 | 357 | 4,518 | 27,525 | 332,436 | 978 | 12,386 | 36,753 | 516,777 | 27,889 | 399,241 | 8,864 | 117,532 |
| 2033 | 167,015 | 2,383,257 | 5,867 | 88,440 | 123,502 | 1,556,200 | 321 | 4,839 | 25,052 | 357,489 | 880 | 13,266 | 23,126 | 539,904 | 16,599 | 415,840 | 6,527 | 124,059 |
| 2034 | 166,503 | 2,549,761 | 5,867 | 94,307 | 123,474 | 1,679,675 | 321 | 5,160 | 24,975 | 382,464 | 880 | 14,146 | 22,719 | 562,623 | 16,265 | 432,105 | 6,454 | 130,513 |
| 2035 | 165,991 | 2,715,752 | 5,867 | 100,174 | 123,446 | 1,803,121 | 321 | 5,481 | 24,899 | 407,363 | 880 | 15,026 | 22,312 | 584,936 | 15,930 | 448,035 | 6,382 | 136,895 |
| 2036 | 165,480 | 2,881,232 | 5,867 | 106,041 | 123,418 | 1,926,539 | 321 | 5,802 | 24,822 | 432,185 | 880 | 15,906 | 21,905 | 606,841 | 15,596 | 463,631 | 6,309 | 143,204 |
| 2037 | 165,390 | 3,046,622 | 5,867 | 111,908 | 123,413 | 2,049,953 | 321 | 6,123 | 24,809 | 456,993 | 880 | 16,786 | 21,834 | 628,675 | 15,537 | 479,168 | 6,296 | 149,500 |
| 2038 | 165,148 | 3,211,769 | 5,867 | 117,775 | 123,400 | 2,173,353 | 321 | 6,444 | 24,772 | 481,765 | 880 | 17,666 | 21,641 | 650,316 | 15,379 | 494,547 | 6,262 | 155,762 |
| 2039 | 150,314 | 3,362,083 | 5,280 | 123,055 | 122,589 | 2,295,941 | 289 | 6,733 | 22,547 | 504,312 | 792 | 18,458 | 9,377 | 659,694 | 5,218 | 499,765 | 4,159 | 159,921 |
| 2040 | 149,853 | 3,511,936 | 5,280 | 128,336 | 122,563 | 2,418,505 | 289 | 7,021 | 22,478 | 526,790 | 792 | 19,250 | 9,011 | 668,705 | 4,917 | 504,682 | 4,093 | 164,015 |
| 2041 | 149,392 | 3,661,328 | 5,280 | 133,616 | 122,538 | 2,541,043 | 289 | 7,310 | 22,409 | 549,199 | 792 | 20,042 | 8,645 | 677,349 | 4,616 | 509,298 | 4,028 | 168,043 |
| 2042 | 148,932 | 3,810,260 | 5,280 | 138,896 | 122,513 | 2,663,556 | 289 | 7,599 | 22,340 | 571,539 | 792 | 20,834 | 8,278 | 685,628 | 4,315 | 513,613 | 3,963 | 172,006 |
| 2043 | 148,851 | 3,959,111 | 5,280 | 144,177 | 122,509 | 2,786,064 | 289 | 7,888 | 22,328 | 593,867 | 792 | 21,626 | 8,214 | 693,842 | 4,262 | 517,875 | 3,951 | 175,957 |
| 2044 | 148,633 | 4,107,743 | 5,280 | 149,457 | 122,497 | 2,908,561 | 289 | 8,177 | 22,295 | 616,162 | 792 | 22,419 | 8,041 | 701,883 | 4,120 | 521,995 | 3,920 | 179,877 |
| 2045 | 135,282 | 4,243,026 | 4,752 | 154,209 | 121,766 | 3,030,327 | 260 | 8,437 | 20,292 | 636,454 | 713 | 23,131 | -2,997 | 698,886 | -5,024 | 516,971 | 2,027 | 181,905 |
| 2046 | 134,868 | 4,377,893 | 4,752 | 158,962 | 121,743 | 3,152,070 | 260 | 8,697 | 20,230 | 656,684 | 713 | 23,844 | -3,327 | 695,559 | -5,295 | 511,676 | 1,969 | 183,873 |
| 2047 | 134,453 | 4,512,346 | 4,752 | 163,714 | 121,721 | 3,273,791 | 260 | 8,957 | 20,168 | 676,852 | 713 | 24,557 | -3,656 | 691,903 | -5,566 | 506,110 | 1,910 | 185,783 |
| 2048 | 134,038 | 4,646,385 | 4,752 | 168,466 | 121,698 | 3,395,489 | 260 | 9,217 | 20,106 | 696,958 | 713 | 25,270 | -3,986 | 687,917 | -5,837 | 500,273 | 1,851 | 187,634 |
| 2049 | 133,966 | 4,780,351 | 4,752 | 173,218 | 121,694 | 3,517,184 | 260 | 9,477 | 20,095 | 717,053 | 713 | 25,983 | -4,044 | 683,873 | -5,884 | 494,389 | 1,841 | 189,475 |
| 2050 | 133,770 | 4,914,120 | 4,752 | 177,971 | 121,683 | 3,638,867 | 260 | 9,737 | 20,065 | 737,118 | 713 | 26,696 | -4,200 | 679,673 | -6,012 | 488,377 | 1,813 | 191,288 |

Table 84. Summary of net GHG Emission Reduction 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 ($tCO_2e$) |
|---|---|---|---|---|---|
| 2021 | 187,387 | 63,685 | 28,108 | 17,528 | 78,065 |
| 2022 | 190,080 | 124,764 | 28,512 | 8,770 | 28,033 |
| 2023 | 192,774 | 124,912 | 28,916 | 9,152 | 29,794 |
| 2024 | 195,468 | 125,059 | 29,320 | 9,534 | 31,554 |
| 2025 | 198,162 | 125,206 | 29,724 | 9,916 | 33,314 |
| 2026 | 200,855 | 125,354 | 30,128 | 10,298 | 35,075 |
| 2027 | 184,810 | 124,476 | 27,722 | 8,126 | 24,487 |
| 2028 | 187,235 | 124,609 | 28,085 | 8,470 | 26,071 |
| 2029 | 189,659 | 124,741 | 28,449 | 8,813 | 27,655 |
| 2030 | 192,083 | 124,874 | 28,813 | 9,157 | 29,239 |
| 2031 | 190,286 | 124,775 | 28,543 | 8,902 | 28,065 |
| 2032 | 190,016 | 124,761 | 28,502 | 8,864 | 27,889 |
| 2033 | 172,882 | 123,823 | 25,932 | 6,527 | 16,599 |
| 2034 | 172,370 | 123,795 | 25,856 | 6,454 | 16,265 |
| 2035 | 171,858 | 123,767 | 25,779 | 6,382 | 15,930 |
| 2036 | 171,347 | 123,739 | 25,702 | 6,309 | 15,596 |
| 2037 | 171,257 | 123,734 | 25,689 | 6,296 | 15,537 |
| 2038 | 171,015 | 123,721 | 25,652 | 6,262 | 15,379 |
| 2039 | 155,594 | 122,877 | 23,339 | 4,159 | 5,218 |
| 2040 | 155,133 | 122,852 | 23,270 | 4,093 | 4,917 |
| 2041 | 154,673 | 122,827 | 23,201 | 4,028 | 4,616 |
| 2042 | 154,212 | 122,802 | 23,132 | 3,963 | 4,315 |
| 2043 | 154,131 | 122,797 | 23,120 | 3,951 | 4,262 |
| 2044 | 153,913 | 122,785 | 23,087 | 3,920 | 4,120 |
| 2045 | 140,034 | 122,026 | 21,005 | 2,027 | -5,024 |
| 2046 | 139,620 | 122,003 | 20,943 | 1,969 | -5,295 |
| 2047 | 139,205 | 121,981 | 20,881 | 1,910 | -5,566 |
| 2048 | 138,791 | 121,958 | 20,819 | 1,851 | -5,837 |
| 2049 | 138,718 | 121,954 | 20,808 | 1,841 | -5,884 |
| 2050 | 138,522 | 121,943 | 20,778 | 1,813 | -6,012 |
| Total | **5,092,091** | **3,648,604** | **763,814** | **191,288** | **488,377** |

### APD – Avoided Planned Deforestation

Net GHG emission reduction estimates are based in VM0007 v1.6 according to the equation below:

$$NER_{REDD} = \Delta C_{BSL\text{-}REDD} - \Delta C_{WPS\text{-}REDD} - \Delta C_{LK\text{-}REDD}$$

Where:

$NER_{REDD}$ Total net GHG emission reductions of the REDD project activity up to year t (t CO2e).

$\Delta C_{BSL\text{-}REDD}$ Net GHG emissions in the REDD baseline scenario up to year t* (t CO2e).

$\Delta C_{WPS\text{-}REDD}$ Net GHG emissions in the REDD project scenario up to year t* (t CO2e).

$\Delta C_{LK\text{-}REDD}$ Net GHG emissions due to leakage from the REDD project activity up to year t*(t $CO_2$e).

**Table 85. Net GHG emission reduction estimates**

| Year | Estimated baseline emissions or removals | Estimated project emissions or removals | Estimated leakage emissions | Estimated net GHG emission reductions or removals |
|---|---|---|---|---|
| | $\Delta C_{BSL\text{-}REDD}$ | $\Delta C_{WPS\text{-}REDD}$ | $\Delta C_{LK\text{-}REDD}$ | $NER_{REDD}$ |
| | t CO2-e | t CO2-e | t CO2-e | t CO2-e |
| 2022 | 881,214 | 518,576 | 0.00 | 362,638 |
| 2023 | 881,214 | 518,576 | 0.00 | 362,638 |
| 2024 | 881,214 | 518,576 | 0.00 | 362,638 |
| 2025 | 1,024,972 | 615,817 | 0.00 | 409,155 |
| 2026 | 881,214 | 518,576 | 0.00 | 362,638 |
| 2027 | 881,214 | 518,576 | 0.00 | 362,638 |
| 2028 | 1,024,972 | 615,817 | 0.00 | 409,155 |
| 2029 | 881,214 | 518,576 | 0.00 | 362,638 |
| 2030 | 881,214 | 518,576 | 0.00 | 362,638 |
| 2031 | 1,024,972 | 615,817 | 0.00 | 409,155 |
| 2032 | 881,214 | 518,576 | 0.00 | 362,638 |
| Total | **9,243,414** | **5,477,482** | **0** | **3,765,932** |

The number of credits to be retained in the AFOLU Pooled Buffer Account is determined as a percentage of the total carbon stock benefits via the VCS-Risk-Report-Calculation-Tool-v4.0. The overall non-permanence risk rating of the Mamuriá Grouped REDD Project is 15%.

The uncertainty in the baseline estimates was estimated through an assessment of deforestation rates, stocks and changes in carbon stocks.

Step 1: Assess Uncertainty in Projection of Baseline Rate of Deforestation or Degradation.

For the uncertainty in the projection, it is assumed that there are no uncertainties in the reference rate of deforestation or degradation where the numbers are based on actual deforestation plans (BL-PL) as per the suppression permits for land use change.

$$\textit{Uncertainty}_{BSL,rate} = 0$$

Step 2: Assess Uncertainty of Emissions and Removals in Project Area in Baseline.

Uncertainty in combined carbon stocks and sources of greenhouse gas in the baseline:

$$U_{REDD-BSL,SS,i} = \frac{\sqrt{\sum_1^n (U_{REDD-BSL,SS,i,pool\#} \times E_{REDD-BSL,SS,i,pool\#})^2}}{\sum_1^n E_{REDD-BSL,SS,i,pool\#}}$$

Where:

| | |
|---|---|
| $U_{REDD\_BSL\_SS,I,}$ | Percentage uncertainty in the combined carbon stocks and greenhouse gas sources in the REDD baseline scenario in stratum *i* (%) |
| $U_{REDD\_BSL\_SS,I,pool\#}$ | Percentagem uncertainty for carbon stocks and greenhouse gas sources in the REDD baseline scenario in stratum *i* (%) |
| $E_{REDD\_BSL\_SS,I,pool\#}$ | Carbon stock or GHG sources in the REDD baseline scenario (tCO2e) |
| *I* | 1,2,3…M strata (unitless) |

Step 3: Estimate Total Uncertainty in REDD baseline scenario.

$$Uncertainty_{REDD-BSL,t*} = \sqrt{{Uncertainty_{BSL,RATE,t*}}^2 + {Uncertainty_{REDD-BSL,SS}}^2}$$

| | |
|---|---|
| $Uncertainty_{REDD\text{-}BSL,t*}$ | Cumulative uncertainty in REDD baseline scenario up to year *t** (%) |
| $Uncertainty_{REDD\text{-}BSL,RATEt*}$ | Cumulative uncertainty in the baseline rate of deforestation up to year *t* (%) |
| $Uncertainty_{REDD\text{-}BSL,SS}$ | Total uncertainty in the combined carbon stocks and greenhouse gas sources in the REDD baseline scenario (%) |
| *t* | 1,2,3…..t* time elapsed since the start of the project activity (years) |

**Uncertainty *Ex Post* in the REDD Project Scenario**

Area of deforestation or degradation in the project scenario should be tracked directly using the same accuracy assessment criterion as used in the baseline.

Where no *ex post* (re-)measurements of carbon pools or GHG sources have been made, ie, uncertainty from these sources is already included in *UncertaintyREDD-BSL,t**, is set equal to zero.

Total Error in the REDD Project Activity

Total project uncertainty is therefore equal to the combined uncertainty in baseline and project estimates for the REDD.

$$NER_{REDD+ERROR} = \sqrt{\left(Uncertainty_{REDDBSL,t*} \times \Delta C_{BSL-REDD,t*}\right)^2} \times \left(\frac{1}{\Delta C_{BSL-REDD,t*}}\right)$$

Where:

| | |
|---|---|
| $NER_{REDD+ERROR}$ | Cumulative uncertainty for the REDD+project activities up to year $t*$ (%) |
| $Uncertainty_{REDD-BSL,t*}$ | Cumulative uncertainty in REDD baseline scenario up to year $t*$ (%) |
| $\Delta C_{BSL-REDD,t*}$ | Net GHG emissions in the REDD baseline scenario up to year $t*$ (tCO2e) |

Where uncertainty exceeds 15% of *NERREDD+* at the 95% confidence level then the deduction must be equal to the amount that the uncertainty exceeds the allowable level.

$$Adjusted\_NER_{REDD+} = NER_{REDD} \times (100\% - NER_{REDD+ERROR} + 15\%)$$

| | |
|---|---|
| $Adjusted\_NER_{REDD+}$ | Total net GHG emission reductions of the REDD+ project activities up to year $t*$ adjusted to account for uncertainty (tCO2e) |
| $NER_{REDD}$ | Total net GHG emission reductions of the REDD project activity up to year $t*$ (tCO2e) |
| $NER_{REDD+ERROR}$ | Cumulative uncertainty for the REDD+project activities up to year $t*$ (%) |

**Table 86. Total net GHG emission reductions adjusted to account for uncertainty and Verified Carbon Units (ex-ante)**

| Year | Estimated net GHG emission reductions or removals | Total net GHG emission reductions adjusted to account for uncertainty | *ex ante buffer credits* | Verified Carbon Units |
|---|---|---|---|---|
| | NER REDD | $Adjusted\_NER_{REDD+}$ | *$Buffer_{planned}$* | VCUt |
| | t CO2-e | t CO2-e | t CO2-e | t CO2-e |
| 2022 | 362,638 | 311,512 | 46,727 | 264,785 |
| 2023 | 362,638 | 311,512 | 46,727 | 264,785 |

| | | | | |
|---|---|---|---|---|
| 2024 | 362,638 | 311,512 | 46,727 | 264,785 |
| 2025 | 409,155 | 351,471 | 52,721 | 298,750 |
| 2026 | 362,638 | 311,512 | 46,727 | 264,785 |
| 2027 | 362,638 | 311,512 | 46,727 | 264,785 |
| 2028 | 409,155 | 351,471 | 52,721 | 298,750 |
| 2029 | 362,638 | 311,512 | 46,727 | 264,785 |
| 2030 | 362,638 | 311,512 | 46,727 | 264,785 |
| 2031 | 409,155 | 351,471 | 52,721 | 298,750 |
| Total | **3,765,932** | **3,234,997** | **485,250** | **2,749,747** |

# 5 MONITORING

## 5.1 Data and Parameters Available at Validation

AUD – Avoided Unplanned Deforestation

| 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.<br>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.<br>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 | DLF was adopted as an average of displaced leakage in the Monitoring Reports of VM0015 projects developed in Brazil. An assessment of 15 verified projects located in Brazil was conducted, comparing leakage due to displaced deforestation on baseline and project scenarios. |
| Value applied | 15% |
| Justification of choice of data or description of measurement methods and procedures applied | 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. |
| 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.<br>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.<br>- Remote sensing and GIS. |
| Value applied | 0 |
| Justification of choice of data or description of | Leakage prevention activities generating a decrease in carbon stocks should be estimated *ex ante* and accounted. |

| | |
|---|---|
| measurement methods and procedures applied | 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.<br>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 | 5,932 (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.<br>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.<br>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 | Measured or estimated from literature.<br>*Fburnt data source:*<br>- Heat spots:<br>Data from the municipalities within the reference region during the historical reference period.<br><https://queimadas.dgi.inpe.br/queimadas/bdqueimadas><br>- Deforestation:<br>- <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 within the RR 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.<br><br>*Pburnt data source:*<br>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>. Last visited on August 2022. |
| Value applied | 78.00 |
| 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%.<br>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.<br>The most conservative value between these two estimates were used, i.e., Pburnt was estimated as 78%.<br>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 REDD projects verified 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.<br>This parameter will be updated at each renewal of fixed baseline period. |

| | |
|---|---|
| Data / Parameter | Logging damage factor (LDF) |
| Data unit | $m^3/m^3$ of harvested timber |

| | |
|---|---|
| Description | The logging damage factor (LDF) is a representation of the quantity of emissions that will ultimately arise per unit of extracted timber ($m^3$). These emissions arise from the non-commercial portion of the felled trees (the branched and stump) and trees incidentally killed during felling. |
| Source of data | Feldpausch et al. When big trees fall: Damage and carbon export by reduced impact logging in southern Amazonia. Forest Ecology and Management 219 (2005) 199–215 |
| Value applied: | 2.0174 |
| Justification of choice of data or description of measurement methods and procedures applied | This parameter is added to the harvested timber volume intensity in order to calculate carbon stock decrease from planned logging activities at each forest class.<br><br>The emissions resulting directly from logging are calculated by estimating the emissions resulting from dead wood created in each logging gap measured divided by the volume of wood created, adding skidder trails damage. According to Feldpausch et al. (2005), Table 6 pag 209, the mean Coarse woody debris returned to the soil as necromass following logging and damage in: (1) tree felling gap formation (trees killed by tree-fall), (2) residual canopy from the felled tree, (3) road, (4) deck construction (whole trees plowed to the ground) and (5) skid maneuvering during logging, is about 6.9 Mg C/ha. According to section 4.3 (pg 212) from this same study, this represents 2.4 times the carbon taken off site in logs. However, the MR already takes into account as planned deforestation the roads and decks constructions, which represent around 16% of the total damage. Therefore, the LDF is 2.4 * (1-0,159) = 2.0174. |
| Purpose of data | This parameter is used to calculate project emissions from logging activities occurred in the project scenario due to sustainable forest management, specifically for the calculation of the carbon stock decrease due to planned logging activities in the project area. |
| Comments | If no monitoring data is available, SFMP data shall be used.<br><br>If new and more accurate harvest intensity data become available, these can be used to estimate project emissions. |

APD – Avoided Planned Deforestation

| Data / Parameter | AAplanned,i,t |
|---|---|
| Data unit | ha |
| Description | Annual area of baseline planned deforestation for stratum i in year t. |
| Source of data | Calculated based on VMD0006 v1.3 equation 4 |
| Value applied | see table below |
| Justification of choice of data or description of measurement methods and procedures applied | Estimated based on total area of planned deforestation over baseline period. |
| Purpose of Data | Calculation of baseline emissions |
| Comments | - |

| Year | Open Lowland Tropical Rainforest | $AA_{planned,i,t}$ |
|---|---|---|
| | ha | ha |
| 2022 | 600.00 | 600.00 |
| 2023 | 600.00 | 600.00 |
| 2024 | 600.00 | 600.00 |
| 2025 | 712.51 | 712.51 |
| 2026 | 600.00 | 600.00 |
| 2027 | 600.00 | 600.00 |
| 2028 | 712.51 | 712.51 |
| 2029 | 600.00 | 600.00 |
| 2030 | 600.00 | 600.00 |
| 2031 | 712.51 | 712.51 |
| 2032 | 600.00 | 600.00 |
| 2033 | 600.00 | 600.00 |
| 2034 | 711.51 | 711.51 |
| 2035 | 600.00 | 600.00 |
| 2036 | 600.00 | 600.00 |
| 2037 | 712.51 | 712.51 |
| 2038 | 600.00 | 600.00 |
| 2039 | 600.00 | 600.00 |
| 2040 | 112.51 | 112.51 |
| 2041 | 300.00 | 300.00 |
| 2042 | 300.00 | 300.00 |
| 2043 | 34.51 | 34.51 |

| Data / Parameter | Aplanned, i |
|---|---|
| Data unit | ha |
| Description | Total area of planned deforestation |
| Source of data | Remote Sensing data and Official document AUTEX |
| Value applied | see table below |
| Justification of choice of data or description of measurement methods and procedures applied | VMD0006 BL-PL:<br>the suitability of the project area for conversion to alternative non-forest land use, the government approval for deforestation and a management plan for deforesting the project area. |
| Purpose of Data | Calculation of baseline emissions |
| Comments | N/A |

| Year | Open Lowland Tropical Rainforest | $AA_{planned,i}$ |
|---|---|---|
| | ha | ha |
| 2022 | 600.00 | 600.00 |
| 2023 | 600.00 | 600.00 |
| 2024 | 600.00 | 600.00 |
| 2025 | 712.51 | 712.51 |
| 2026 | 600.00 | 600.00 |
| 2027 | 600.00 | 600.00 |
| 2028 | 712.51 | 712.51 |
| 2029 | 600.00 | 600.00 |
| 2030 | 600.00 | 600.00 |
| 2031 | 712.51 | 712.51 |
| 2032 | 600.00 | 600.00 |
| 2033 | 600.00 | 600.00 |
| 2034 | 711.51 | 711.51 |
| 2035 | 600.00 | 600.00 |
| 2036 | 600.00 | 600.00 |
| 2037 | 712.51 | 712.51 |
| 2038 | 600.00 | 600.00 |
| 2039 | 600.00 | 600.00 |
| 2040 | 112.51 | 112.51 |
| 2041 | 300.00 | 300.00 |
| 2042 | 300.00 | 300.00 |
| 2043 | 34.51 | 34.51 |

| Data / Parameter | $\Delta C_{AB\_tree,i}$ |
|---|---|
| Data unit | $t\ CO_2e\ ha^{-1}$ |
| Description | Baseline carbon stock change in aboveground tree biomass in stratum i |
| Source of data | Calculated based on VMD0006 v1.3 |
| Value applied | Stratum/forest class: Open Lowland Tropical Rainforest; $C_{AB\_tree,bsl,i}$ (tCO2e/ha): 413.34; $C_{AB\_tree,post,i}$ (tCO2e/ha): 7.57; $\Delta C_{AB\_tree,i}$ (tCO2e/ha): 405.77 |
| Justification of choice of data or description of measurement methods and procedures applied | According to VMD0006 v1.3, estimated based on the forest carbon stock in aboveground tree biomass in stratum I (CAB_tree,bsl,i) and the post-deforestation carbon stock in aboveground tree biomass in stratum I (CAB_tree,post,i), |
| Purpose of Data | Calculation of baseline emissions |
| Comments | |

| Stratum/forest class | $C_{AB\_tree,bsl,i}$ | $C_{AB\_tree,post,i}$ | $\Delta C_{AB\_tree,i}$ |
|---|---|---|---|
| | tCO2e/ha | tCO2e/ha | tCO2e/ha |
| Open Lowland Tropical Rainforest | 413.34 | 7.57 | 405.77 |

| Data / Parameter | $\Delta C_{BB\_tree,i}$ |
|---|---|
| Data unit | $t\ CO_2e\ ha^{-1}$ |
| Description | Baseline carbon stock change in belowground tree biomass in stratum i |
| Source of data | Calculated based on VMD0006 v1.3 |
| Value applied | Stratum/forest class: Open Lowland Tropical Rainforest; $C_{BB\_tree,bsl,i}$ (tCO2e/ha): 99.20; $C_{BB\_tree,post,i}$ (tCO2e/ha): 6; $\Delta C_{BB\_tree,i}$ (tCO2e/ha): 93.20 |
| Justification of choice of data or description of measurement methods and procedures applied | According to VMD0006 v1.3, estimated based on the forest carbon stock in belowground tree biomass in stratum I ($C_{BB\_tree,bsl,i}$) and the post-deforestation carbon stock in belowground tree biomass in stratum I ($C_{AB\_tree,post,i}$), |
| Purpose of Data | Calculation of baseline emissions |

| Stratum/forest class | $C_{BB\_tree,bsl,i}$ | $C_{BB\_tree,post,i}$ | $\Delta C_{BB\_tree,i}$ |
|---|---|---|---|
| | tCO2e/ha | tCO2e/ha | tCO2e/ha |
| Open Lowland Tropical Rainforest | 99.20 | 6 | 93.20 |

| | |
|---|---|
| Comments | |

| | |
|---|---|
| Data / Parameter | $\Delta C_{AB\_non-tree,i}$ |
| Data unit | t $CO_2eha^{-1}$ |
| Description | Baseline carbon stock change in aboveground non-tree biomass in stratum i |
| Source of data | Calculated based on VMD0006 v1.3 |
| Value applied | <table><tr><td rowspan="2">Stratum/forest class</td><td>$C_{AB\_non-tree,bsl,i}$</td><td>$C_{AB\_non-tree,post,i}$</td><td>$\Delta C_{AB\_non-tree,i}$</td></tr><tr><td>tCO2e/ha</td><td>tCO2e/ha</td><td>tCO2e/ha</td></tr><tr><td>Open Lowland Tropical Rainforest</td><td>16.53</td><td>8.6</td><td>7.93</td></tr></table> |
| Justification of choice of data or description of measurement methods and procedures applied | According to VMD0006 v1.3, estimated based on the forest carbon stock in aboveground non-tree biomass in stratum I ($C_{AB\_non-tree,bsl,i}$) and the post-deforestation carbon stock in aboveground non-tree biomass in stratum I ($C_{AB\_non-tree,post,i}$), |
| Purpose of Data | Calculation of baseline emissions |
| Comments | |

| | |
|---|---|
| Data / Parameter | $\Delta C_{BB\_non-tree,i}$ |
| Data unit | t $CO_2eha^{-1}$ |
| Description | Baseline carbon stock change in belowground non-tree biomass in stratum i |
| Source of data | Calculated based on VMD0006 v1.3 |
| Value applied | <table><tr><td rowspan="2">Stratum/forest class</td><td>$C_{BB\_non-tree,bsl,i}$</td><td>$C_{BB\_non-tree,post,i}$</td><td>$\Delta C_{BB\_non-tree,i}$</td></tr><tr><td>tCO2e/ha</td><td>tCO2e/ha</td><td>tCO2e/ha</td></tr><tr><td>Open Lowland Tropical Rainforest</td><td>9.92</td><td>8.6</td><td>1.32</td></tr></table> |
| Justification of choice of data or description of | According to VMD0006 v1.3, estimated based on the forest carbon stock in belowground non-tree biomass in stratum I ($C_{BB\_non-tree,bsl,i}$) and the post-deforestation carbon stock in belowground tree biomass in stratum I ($C_{BB\_non-tree,post,i}$), |

| | |
|---|---|
| measurement methods and procedures applied | |
| Purpose of Data | Calculation of baseline emissions |
| Comments | |

| | |
|---|---|
| Data / Parameter | CF |
| Data unit | t C t d.m.$^{-1}$ |
| Description | Carbon fraction of dry matter in t C t$^{-1}$ d.m. |
| Source of data | Value from literature IPCC, 2003. Good practice guidance for land use, land-use change and forestry. Kanagawa: IGES, 2003 |
| 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 and project emissions from deforestation occurred in the baseline and project scenarios. |
| 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 | $C_{AB\_tree,i}$ |
| Data unit | t CO2eha$^{-1}$ |
| Description | Carbon stock in aboveground biomass in trees in the baseline in stratum i |
| Source of data | Values from FAO, Food and Agriculture Organization of the United Nations. Global Forest Resources Assessment 2020, Report, Rome, 2020 |
| Value applied | <table><tr><th>Stratum/forest class</th><th>Cab<br>tCO2e/ha</th></tr><tr><td>Open Lowland Tropical Rainforest</td><td>413.34</td></tr></table> |

| | |
|---|---|
| Justification of choice of data or description of measurement methods and procedures applied | The values for the carbon stock in aboveground biomass were adopted based on the literature, adopting the values obtained by FAO because the field results have presented values very different from those found in bibliographic references. |
| Purpose of Data | Calculation of baseline emissions |
| Comments | |

| | |
|---|---|
| Data / Parameter | $C_{BB\_tree,i}$ |
| Data unit | t CO2eha-1 |
| Description | Carbon stock in belowground biomass in trees in the baseline in stratum i |
| Source of data | Values from FAO, Food and Agriculture Organization of the United Nations. Global Forest Resources Assessment 2020, Report, Rome, 2020 |
| Value applied | Stratum/forest class: Open Lowland Tropical Rainforest; Cbb (tCO2e/ha): 99.20 |
| Justification of choice of data or description of measurement methods and procedures applied | The values for the carbon stock in belowground biomass were adopted based on the literature, adopting the values obtained by FAO because the field results have presented values very different from those found in bibliographic references. |
| Purpose of Data | Calculation of baseline emissions |
| Comments | |

| | |
|---|---|
| Data / Parameter | D%planned,i,t |
| Data unit | % year-1 |
| Description | Projected annual proportion of land that will be deforested in stratum *i* at year *t* |
| Source of data | Data obtained from IMAC - environmental agency responsible for issuing permits for deforestation in Acre |

| | |
|---|---|
| Value applied | 1.97% |
| Justification of choice of data or description of measurement methods and procedures applied | According to VMD0006 v1.3, where a valid verifiable plan exists for rate at which deforestation is projected to occur and must be used. |
| Purpose of Data | Calculation of baseline emissions |
| Comments | Parameter values to be updated if new empirically based peer-reviewed findings become available. |

| | |
|---|---|
| Data / Parameter | $C_{wp,i}$ |
| Data unit | $tCO_2e.ha^{-1}$ |
| Description | Baseline carbon stock change in wood in stratum i |
| Source of data | Calculated based on mean stock of extracted biomass carbon by class of wood product *ty* and wood waste. VMD0005 v1.1 equation 2 |
| Value applied | <table><tr><th rowspan="2">Stratum/forest class</th><th>$C_{WP,i}$</th></tr><tr><th>tCO2e/ha</th></tr><tr><td>Open Lowland Tropical Rainforest</td><td>0.24</td></tr></table> |
| Justification of choice of data or description of measurement methods and procedures applied | Calculated the biomass carbon extracted that enters the wood products pool at the time of deforestation. |
| Purpose of Data | Calculation of baseline emissions |
| Comments | N/A |

| | |
|---|---|
| Data / Parameter | $C_{XB,ty,i}$ |
| Data unit | $tCO_2e.ha^{-1}$ |
| Description | Mean stock of extracted biomass carbon by class of wood product *ty* from stratum *i*; t $CO_2$-e $ha^{-1}$ |

| | |
|---|---|
| Source of data | Calculated based on biomass carbon data and wood to be extracted from within stratum i. VMD0005 v1.1 equation 1 |
| Value applied | <table><tr><th></th><th>$CXB_{High\ density\ wood}$</th><th>$CXB_{medium\ density\ wood}$</th><th>$CXB_{Low\ density\ wood}$</th></tr><tr><td>**Total**</td><td>0.56</td><td>0.12</td><td>0.09</td></tr></table> |
| Justification of choice of data or description of measurement methods and procedures applied | Estimated based on wood product class ($V_{ex,ty,i}$), volume of timber extracted from stratum I by species j, mean of wood density j (Dj), carbon fraction (CF) and the area of stratum. |
| Purpose of Data | Calculation of baseline emissions |
| Comments | N/A |

| | |
|---|---|
| Data / Parameter | $OF_{ty}$ |
| Data unit | Dimensionless |
| Description | Fraction of wood products that will be emitted to the atmosphere between 5 and 100 years of timber harvest by class of wood product *ty* |
| Source of data | Winjun et al. 1998 |
| Value applied | 0.8 |
| Justification of choice of data or description of measurement methods and procedures applied | The source of data is the published paper of Winjum *et al*. 1998 |
| Purpose of Data | Calculation of baseline emissions |
| Comments | N/A |

| Data / Parameter | $V_{ex,ty,i}$ |
|---|---|
| Data unit | $m^3$ |
| Description | The volume of timber in m3 extracted from within the stratum (does not include slash left onsite), reported by wood product class and preferably species. |
| Source of data | Timber harvest records derived from suppression authorization |
| Value applied | 2,174.56 |
| Justification of choice of data or description of measurement methods and procedures applied | Data from the Forest Inventory and measurements of wood logs made for the request for the authorization of suppression of vegetation. |
| Purpose of Data | This parameter is used to calculate project emissions in the project scenario, specifically for calculations of harvested wood products carbon pool. Provides the *ex post* value of the final wood products volume due to planned logging activities in the project area. |
| Comments | N/A |

| Data / Parameter | $GHG_{BSL\text{-}E,i,t}$ |
|---|---|
| Data unit | t $CO_2e.yr^{-1}$ |
| Description | Greenhouse gas emissions as a result of deforestation activities within the project boundary in the baseline stratum i in year t. |
| Source of data | Calculated based on biomass emission by burn, $N_2O$ and fossil fuel emission. VMD0006 v1.3 equation 15 |
| Value applied | see table below |

| Project year *t* | Total GHG emissions annual TOTAL $GHG_{BSL\text{-}E,t}$ $tCO_2e$ |
|---|---|
| 2022 | 518,564 |
| 2023 | 518,564 |
| 2024 | 518,564 |
| 2025 | 615,803 |
| 2026 | 518,564 |

| | | |
|---|---|---|
| | 2027 | 518,564 |
| | 2028 | 615,803 |
| | 2029 | 518,564 |
| | 2030 | 518,564 |
| | 2031 | 615,803 |
| | 2032 | 518,564 |
| | 2033 | 518,564 |
| | 2034 | 614,939 |
| | 2035 | 518,564 |
| | 2036 | 518,564 |
| | 2037 | 615,803 |
| | 2038 | 518,564 |
| | 2039 | 518,564 |
| | 2040 | 97,239 |
| | 2041 | 259,282 |
| | 2042 | 259,282 |
| | 2043 | 29,826 |
| Justification of choice of data or description of measurement methods and procedures applied | The GHG emissions in the baseline within the project boundary calculated based on the other non-$CO_2$ emissions that may be emitted according to the activities carried out by the project. | |
| Purpose of Data | Calculation of baseline emissions | |
| Comments | For net $CO_2e$ emissions from fossil fuel combustion in stratum i in year t ($E_{FC,i,t}$) and direct $N_2O$ emissions as a result of nitrogen application in alternative land use within the project boundary in stratum i in year t ($N_2O_{direct\text{-}N,i,t}$) are conservatively excluded from the project scope and calculation of baseline estimates following the criteria of VM0007 v1.6 in section 5.4, table 7. | |

| | |
|---|---|
| Data / Parameter | $E_{BiomassBurn,i,t}$ |
| Data unit | t CO2-e |
| Description | Greenhouse gas emissions due to biomass burning in stratum *i* in year *t* of each GHG ($CO_2$, $CH_4$, $N_2O$) (t $CO_2e$) |
| Source of data | Calculated based on data from area burnt and combustion factors, according to VMD0013 v1.3 equation 1 |
| Value applied | |

| Project year *t* | Open Lowland Tropical Rainforest |
|---|---|
| | $E_{BiomassBurn,i,t}$ |

| | | |
|---|---|---|
| | | $tCO_2e$ |
| | 2022 | 518,564 |
| | 2023 | 518,564 |
| | 2024 | 518,564 |
| | 2025 | 615,803 |
| | 2026 | 518,564 |
| | 2027 | 518,564 |
| | 2028 | 615,803 |
| | 2029 | 518,564 |
| | 2030 | 518,564 |
| | 2031 | 615,803 |
| | 2032 | 518,564 |
| | 2033 | 518,564 |
| | 2034 | 614,939 |
| | 2035 | 518,564 |
| | 2036 | 518,564 |
| | 2037 | 615,803 |
| | 2038 | 518,564 |
| | 2039 | 518,564 |
| | 2040 | 97,239 |
| | 2041 | 259,282 |
| | 2042 | 259,282 |
| | 2043 | 29,826 |
| Justification of choice of data or description of measurement methods and procedures applied | Calculated based on:<br>• Area burnt<br>• Average aboveground biomass stock before burning stratum i, year<br>• Combustion factor for stratum i<br>• Emission factor for stratum i for gas g | |
| Purpose of Data | Calculation of baseline emissions | |
| Comments | N/A | |

| | |
|---|---|
| Data / Parameter | $A_{burn,i.t}$ |
| Data unit | ha |
| Description | Area burnt for stratum I in year t |
| Source of data | Equal to $AA_{planned,i,t}$ in the baseline case |

| | |
|---|---|
| Value applied | |

| Aburn | Open Lowland Tropical Rainforest |
|---|---|
| Project year $t$ | $Area_{burn,i,t}$ |
| | ha |
| 2022 | 600.00 |
| 2023 | 600.00 |
| 2024 | 600.00 |
| 2025 | 712.51 |
| 2026 | 600.00 |
| 2027 | 600.00 |
| 2028 | 712.51 |
| 2029 | 600.00 |
| 2030 | 600.00 |
| 2031 | 712.51 |
| 2032 | 600.00 |
| 2033 | 600.00 |
| 2034 | 711.51 |
| 2035 | 600.00 |
| 2036 | 600.00 |
| 2037 | 712.51 |
| 2038 | 600.00 |
| 2039 | 600.00 |
| 2040 | 112.51 |
| 2041 | 300.00 |
| 2042 | 300.00 |
| 2043 | 34.51 |

| | |
|---|---|
| Justification of choice of data or description of measurement methods and procedures applied | The burned area is considered equivalent to the annual deforested area $AA_{planned,i,t}$ considering that all deforestation is preceded by a fire to clear the land in the baseline case. |
| Purpose of Data | Calculation of baseline emissions |
| Comments | N/A |

| | |
|---|---|
| Data / Parameter | $COMF_i$ |
| Data unit | Dimensionless |
| Description | Combustion factor for stratum i |
| Source of data | Table 2.6 - 2006 IPCC Guidelines for National Greenhouse Gas Inventories |

| | |
|---|---|
| Value applied | 0.45 |
| Justification of choice of data or description of measurement methods and procedures applied | Combustion factor for stratum i |
| Purpose of Data | Calculation of baseline emissions |
| Comments | The combustion factor is a measure of the proportion of the fuel that is burned, which varies depending on the proportion of the matter that is burned, as tree stems will be burned compared to grass leaves. It also considers the moisture content of the fuel and the type of fire (ie, intensity and rate of spread). |

| | |
|---|---|
| Data / Parameter | $B_{i,t}$ |
| Data unit | t d.m/ha |
| Description | Average aboveground biomass stock before burning stratum *i*, year |
| Source of data | Calculated based on carbon stock according to VMD0013 v1.3 equation 2 |
| Value applied | <table><tr><th>Initial Forest Class</th><th>Parameters</th></tr><tr><th>Name</th><th>$B_{i,t}$<br>t d.m/ha</th></tr><tr><td>Open Lowland Tropical Rainforest</td><td>7,891</td></tr></table> |
| Justification of choice of data or description of measurement methods and procedures applied | According to VMD0013 v1.3 equation 2, the average aboveground biomass stock before burning was calculated based on carbon stock in aboveground biomass in trees in stratum i in year t ($C_{AB\_tree,i,t}$), Carbon stock in dead wood for stratum i in year t ($C_{DWi,t}$), Carbon stock in litter for stratum i in year t ($C_{LI,i,t}$) and Carbon fraction of biomass (CF). |
| Purpose of Data | Calculated of baseline emissions |
| Comments | For the three phytophysiognomies the values of $B_{i,t}$ was the same as they are open tropical rainforest. |

| | |
|---|---|
| Data / Parameter | $G_{g,i}$ |
| Data unit | kg $t^{-1}$ d.m. burnt |
| Description | Emission factor for stratum *i* for gas *g* |
| Source of data | Table 2.5 - 2006 IPCC Guidelines for National Greenhouse Gas Inventories |
| Value applied | $G_{N2O}$ 0.2<br>$G_{CH4}$ 6.8 |
| Justification of choice of data or description of measurement methods and procedures applied | Defaults can be found in Volume 4, Chapter 2, of the IPCC 2006 Inventory Guidelines in table 2.5 (see Appendix 2: emission factors for various types of burning for CH4 and N2O). Default values must be updated whenever new guidelines are produced by the IPCC. |
| Purpose of Data | Calculations of baseline emissions |
| Comments | N/A |

| | |
|---|---|
| Data / Parameter | $GWP_g$ |
| Data unit | t $CO_2$/t gas g |
| Description | Global warming potential for gas *g* |
| Source of data | Fifth Assessment Report (AR5), IPCC |
| Value applied | $GWP_{N2O}$ 265<br>$GWP_{CH4}$ 28 |
| Justification of choice of data or description of measurement methods and procedures applied | Default factor from Global Warming Potentials (GWP) |
| Purpose of Data | Calculation of baseline emissions |
| Comments | N/A |

| Data / Parameter | $\Delta C_{BSL,i,t}$ |
|---|---|
| Data unit | t $CO_2e$ |
| Description | Net carbon stock changes in all pools in the baseline stratum i in year t. |
| Source of data | Calculated based on annual area of planned deforestation from forest suppression authorization. |
| Value applied | (see table below) |
| Justification of choice of data or description of measurement methods and procedures applied | According to VMD0006 v1.3 equation 14, estimated based on the annual area of baseline planned deforestation for stratum i in year t ($AA_{planned,i,t}$), the baseline carbon stock change in aboveground tree biomass in stratum i ($\Delta C_{AB\_tree,i}$), the baseline carbon stock change in belowground tree biomass in stratum i ($\Delta C_{BB\_tree,i}$), the baseline carbon stock change in aboveground non-tree biomass in stratum ($\Delta C_{AB\_non-tree,i}$), the baseline carbon stock change in belowground non-tree biomass in stratum i ($\Delta C_{BB\_non-tree,i}$), the baseline carbon stock change in wood products in stratum i ($\Delta C_{WP,i}$), the baseline carbon stock change in dead wood in stratum i ($\Delta C_{DW,i}$), the baseline carbon stock change in litter in stratum i ($\Delta C_{LI,i}$) and the baseline carbon stock change in soil organic carbon in stratum i. |
| Purpose of Data | Calculation of baseline emissions |

| Year | $\Delta C_{BSL,i,t}$ annual $tCO_2e$ | $\Delta C_{BSL,i,t}$ cumulative $tCO_2e$ |
|---|---|---|
| 2022 | 362,650 | 362,650 |
| 2023 | 362,650 | 725,300 |
| 2024 | 362,650 | 1,087,950 |
| 2025 | 409,169 | 1,497,119 |
| 2026 | 362,650 | 1,859,769 |
| 2027 | 362,650 | 2,222,419 |
| 2028 | 409,169 | 2,631,588 |
| 2029 | 362,650 | 2,994,238 |
| 2030 | 362,650 | 3,356,887 |
| 2031 | 409,169 | 3,766,057 |
| 2032 | 362,650 | 4,128,706 |
| 2033 | 362,650 | 4,491,356 |
| 2034 | 408,756 | 4,900,112 |
| 2035 | 362,650 | 5,262,762 |
| 2036 | 362,650 | 5,625,412 |
| 2037 | 409,169 | 6,034,581 |
| 2038 | 362,650 | 6,397,231 |
| 2039 | 362,650 | 6,759,881 |
| 2040 | 161,089 | 6,920,969 |
| 2041 | 238,610 | 7,159,579 |
| 2042 | 238,610 | 7,398,189 |
| 2043 | 128,838 | 7,527,027 |

| | |
|---|---|
| Comments | For this project, carbon stock change values in dead wood, litter and soil organic carbon were not considered, as informed in the carbon pools spreadsheet. |

| | |
|---|---|
| Data / Parameter | $\Delta C_{BSL,planned}$ |
| Data unit | t $CO_2$e |
| Description | Net greenhouse gas emissions in the baseline from planned deforestation up to year *t* |
| Source of data | According to equation 1 from VMD0006 v1.3. Calculated based on net carbon stock changes in all pools in the baseline stratum i and greenhouse gas emissions as a result of deforestation |
| Value applied | (see table below) |
| Justification of choice of data or description of measurement methods and procedures applied | Estimated based on the net carbon stock changes in all pools in the baseline ($\Delta C_{BSL,i,t}$) and GHG emissions as a result of deforestation activities within the project boundary in the baseline stratum i in year t ($GHG_{BSL-E,i,t}$). |
| Purpose of Data | Calculation of baseline emissions |

| Project year | $\Delta C_{BSL,\ planned}$ annual tCO2e | $\Delta C_{BSL,\ planned}$ cumulative tCO2e |
|---|---|---|
| 2022 | 881,214 | 881,214 |
| 2023 | 881,214 | 1,762,428 |
| 2024 | 881,214 | 2,643,642 |
| 2025 | 1,024,972 | 3,668,614 |
| 2026 | 881,214 | 4,549,828 |
| 2027 | 881,214 | 5,431,042 |
| 2028 | 1,024,972 | 6,456,014 |
| 2029 | 881,214 | 7,337,228 |
| 2030 | 881,214 | 8,218,442 |
| 2031 | 1,024,972 | 9,243,414 |
| 2032 | 881,214 | 10,124,628 |
| 2033 | 881,214 | 11,005,842 |
| 2034 | 1,023,695 | 12,029,537 |
| 2035 | 881,214 | 12,910,751 |
| 2036 | 881,214 | 13,791,964 |
| 2037 | 1,024,972 | 14,816,937 |
| 2038 | 881,214 | 15,698,151 |
| 2039 | 881,214 | 16,579,364 |
| 2040 | 258,328 | 16,837,693 |
| 2041 | 497,892 | 17,335,584 |
| 2042 | 497,892 | 17,833,476 |
| 2043 | 158,664 | 17,992,140 |

| | |
|---|---|
| Comments | N/A |

| | |
|---|---|
| Data / Parameter | L-Di |
| Data unit | % |
| Description | Likelihood of deforestation in stratum *i* |
| Source of data | Analysis of land tenure, “matrículas”. |
| Value applied | 100% |
| Justification of choice of data or description of measurement methods and procedures applied | For all other planned deforestation areas (i.e. areas not both under government control and zoned for deforestation), L-Di must be equal to 100%. |
| Purpose of Data | Determination of baseline scenario |
| Comments | |

| | |
|---|---|
| Data / Parameter | SLFty |
| Data unit | Dimensionless |
| Description | Fraction of wood products that will be emitted to the atmosphere within 5 years of production by class of wood product *ty* |
| Source of data | Winjum et al, 1998. VMD0005 v1.1 |
| Value applied | 0.2 sawnwood |
| Justification of choice of data or description of measurement methods and procedures applied | Winjum *et al.* 1998 give the following proportions for wood products with short-term (<5 yr) uses after which they are retired and oxidized (applicable internationally): **Wood Product Class** / **SLF**<br>Sawnwood / 0.2 |

| | |
|---|---|
| | Woodbase panels \| 0.1<br>Other industrial roundwood \| 0.3<br>Paper and paperboard \| 0.4<br>Other classes of wood products \| 1 |
| Purpose of Data | Calculation of baseline emission |
| Comments | N/A |

| | |
|---|---|
| Data / Parameter | WWty |
| Data unit | Dimensionless |
| Description | WW = Fraction of extracted biomass effectively emitted to the atmosphere during production by class of wood product *ty.* |
| Source of data | Default value for developing countries: VMD0005 - CP-W -page 14. The source of data is the published paper of Winjum *et al*. 1998 |
| Value applied | 0.061 |
| Justification of choice of data or description of measurement methods and procedures applied | VMD0005 CP-W:<br>Winjum *et al*. 1998 indicate that the proportion of extracted biomass that is oxidized (burning or decaying) from the production of commodities to be equal to 19% for developed countries, 24% for developing countries. *WW* is therefore equal to *CXB,ty* multiplied by 0.19 for developed countries and 0.24 for developing countries |
| Purpose of Data | Calculation of baseline emissions |
| Comments | Parameter values to be updated if new empirically based peer-reviewed findings become available. |

## 5.2 Data and Parameters Monitored

AUD – Avoided Unplanned Deforestation

| 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 studies:<br>HIGUCHI, Francisco Gasparetto. Dinâmica de volume e biomassa da floresta de terra firme do Amazonas. 2015. 201 f. Tese (Doutorado) - Curso de Engenharia Florestal, Setor de Ciências Agrárias, Universidade Federal do Paraná, Curitiba, 2015. |
| Description of measurement methods and procedures to be applied | The following sources will be monitored:<br>- Biomass stock surveys<br>- Periodic reports from area supervisor<br>- Local Forest Inventories |
| Frequency of monitoring/recording | At each monitoring report. |
| Value applied | See table below |
| 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. |

| Above-ground biomass $ab_{icl}$ (Mg/ha) | | | |
|---|---|---|---|
| Vegetation | Reference Region | Project Area | Leakage Belt |
| Forest | 327.40 | 327.40 | 327.40 |

| | |
|---|---|
| Comments | The values will be reassessed every 6 years or when data is more than 6 years old, whichever occurs first. |

<table>
<tr><td>Data / Parameter</td><td>$bb_{icl}$</td></tr>
<tr><td>Data unit</td><td>Mg/ha</td></tr>
<tr><td>Description</td><td>Average biomass stock per hectare in the below-ground biomass pool of initial forest class icl in Mg/ha.</td></tr>
<tr><td>Source of data</td><td>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.</td></tr>
<tr><td>Description of measurement methods and procedures to be applied</td><td>The following sources will be monitored:<br>- Biomass stock surveys<br>- Periodic reports from area supervisor<br>- Local Forest Inventories</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>At each monitoring report.</td></tr>
<tr><td>Value applied</td><td>
<table>
<tr><th colspan="4">Below-ground biomass</th></tr>
<tr><th colspan="4">$bb_{icl}$ (Mg/ha)</th></tr>
<tr><th>Vegetation</th><th>Reference Region</th><th>Project Area</th><th>Leakage Belt</th></tr>
<tr><td>Forest (Dense Lowland Tropical Rainforest)</td><td>78.58</td><td>78.58</td><td>78.58</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>No monitoring equipment is used to determine this parameter.</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>Data shall be in accordance to VM0015 v1.1 requirements</td></tr>
<tr><td>Purpose of data</td><td>This parameter is used to calculate baseline, project and leakage emissions in the baseline and project scenarios.</td></tr>
<tr><td>Calculation method</td><td>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.</td></tr>
<tr><td>Comments</td><td>The values will be reassessed every 6 years or when data is more than 6 years old, whichever occurs first.</td></tr>
</table>

| | |
|---|---|
| Data / Parameter | $ACPA_t$ |
| 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,<br>- 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, the following sources will also be monitored:<br>- INMET[169]<br>- INPE[170] |
| 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:<br>- INMET<br>- INPE<br>- 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. |

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

| | |
|---|---|
| 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 | 178.09 (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 | 240.05 (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 | 6,933.45 (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 | APDPAicl,t |
| Data unit | ha |
| Description | Areas of planned deforestation in forest class icl at year t in the project area |
| Source of data | - Annual operational plan;<br>- Annual post-harvesting report;<br>- Remote sensing and GIS. |
| Description of measurement methods and procedures applied | The planned deforestation activities in the project area that result in carbon stock decrease will be subject to monitoring. The forest management team records such information according to procedures established in its sustainable forest management plan. |
| Frequency of monitoring/recording | Annually |
| Value applied: | 36.48 (Value of the annual average planned deforestation expected to occur within the project area for each vegetation type during the crediting period.) |
| Monitoring equipment | - Remote sensing and GIS<br>- Forest Management team, based on the Sustainable Forest Management Plan |
| QA/QC procedures applied | - Best practices in remote sensing.<br>- Internal procedures required by the SFMP and forest certification |
| Purpose of data | This parameter will be used to calculate project emissions in the project scenario. Provides the *ex post* value of the decrease in carbon stocks due to planned deforestation in the project area. |
| Calculation method | Emissions from deforestation at each forest class are quantified by multiplying the detected area of forest loss by the average forest carbon stock per unit area. For an *ex ante* estimation, it was |

| | |
|---|---|
| | considered that 1.18% of each annual production unit will be deforested for the implementation of SFMP infrastructure. |
| Comments | Planned deforestation mainly includes implementation of the forest management infrastructure, such as opening of main and secondary roads, skidding trails, and timber yards in each annual production unit within the project area. As Sustainable Forest Management only took place in the Open Lowland Tropical Rainforest, it adopted the value 0 (Zero) for the other phytophysiognomies |

| Data / Parameter | APLPAicl,t |
|---|---|
| Data unit | ha |
| Description | Areas of planned logging activities in forest class icl at year t in the project area |
| Source of data | - Annual operational plan;<br>- Annual post-harvesting report;<br>- Remote sensing and GIS. |
| Description of measurement methods and procedures applied | The planned logging activities in the project area that resulted in carbon stock increase or decrease shall be subjected to monitoring, when significant. |
| Frequency of monitoring/recording | Annually |
| Value applied: | 1,459.04 (Annual average of planned logging areas expected to occur within the project area) |
| Monitoring equipment | - Remote sensing and GIS<br>- Forest Management team, based on the Sustainable Forest Management Plan |
| QA/QC procedures applied | - Best practices in remote sensing.<br>- Internal procedures required by the SFMP and forest certification. |

| | |
|---|---|
| Purpose of data | This parameter will be used to calculate project emissions in the project scenario. Provides the *ex post* value of the increase or decrease in carbon stocks due to planned logging activities in the project area. |
| Calculation method | Carbon stock decrease from planned logging activities at each forest class are quantified by multiplying the detected area subject to logging by the harvested timber volume intensity, and then by the mean wood density.<br><br>Carbon stock increase from planned logging activities at each forest class are quantified by multiplying the detected area subject to logging by the mean annual increment due to natural regeneration of managed forests, and then by the mean wood density. |
| Comments | 51,066.42 ha are subject to sustainable forest management. The adopted rotation cycle is 35 years, thus each annual productive unit (APU) has around 1,459.04 hectares.<br><br>The SFMP provides guidance to the management team in order to harvest forest products/by-products in a consistent manner with the conservation of the local ecosystem. |

| | |
|---|---|
| Data / Parameter | AUDPAicl,t |
| Data unit | ha |
| Description | Areas of unplanned deforestation in forest class icl at year t in the project area |
| Source of data | - Remote sensing and GIS.<br>- Field reports |
| Description of measurement methods and procedures applied | The unplanned deforestation within the project area that result in carbon stock decrease will be subject to monitoring. |
| Frequency of monitoring/recording | Annually |
| Value applied: | 13.13 ha/year (Annual average unplanned deforestation expected to occur within the project area during the crediting period.) |

| | |
|---|---|
| Monitoring equipment | - Remote sensing and GIS<br>- Field reports |
| QA/QC procedures 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 decrease in carbon stocks due to unplanned deforestation in the project area. |
| Calculation method | Emissions from deforestation at each forest class are quantified by multiplying the detected area of forest loss by the average forest carbon stock per unit area. For an ex ante estimation, it was considered that around 5.47% of the projected deforestation (ABSLPAt) would occur within the project area, according to the Effectiveness Index parameter. |
| Comments | N/A |

| | |
|---|---|
| Data / Parameter | APFPAicl,t |
| Data unit | ha |
| Description | Areas of planned fuel-wood collection and charcoal production activities in forest class icl at year t in the project area |
| Source of data | - Authorization for the Use of Forest Raw Material document (Autorização de Utilização de Matéria-Prima Florestal-AUMPF, Portuguese) |
| Description of measurement methods and procedures applied | No production of fuel wood or charcoal is expected to occur within the project area during the crediting period.<br>*The methods must follow the legislation:*<br>• *State Legislation nº 698, 13/07/2021*<br>• *Federal Legislation nº 06, 07/04/2009* |
| Frequency of monitoring/recording | Annually |
| Value applied: | 0 (no production of fuel wood or charcoal is expected to occur) |
| Monitoring equipment | - Remote sensing and GIS<br>- Planned interventions proposed by the project proponent |

| | |
|---|---|
| QA/QC procedures applied | Best practices in remote sensing.<br>Internal audit of the AOP. |
| Purpose of data | This parameter was used to calculate project emissions in the project scenario. Provides the ex post value of the increase or decrease in carbon stocks due to planned fuel-wood collection and charcoal production activities in the project area. |
| Calculation method | Emissions at each forest class are quantified by multiplying the detected area subject to fuel wood collection or charcoal production by the harvested volume intensity, and then by the mean wood density. |
| 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 | 24,570.60 (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 | ∆CPAdPAt |
| 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 | 114,364.71 (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<br>SFMP reports, including the post-harvesting annual report. |
| QA/QC procedures to be applied | - Best practices in remote sensing.<br>- 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<br>- Field assessment<br>- 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<br>- 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 | 8,961.92 (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 | 889.85 (annual average) |
| 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,<br>- Forest management team and field data. |
| Description of measurement methods and procedures to be applied | If forest fires occur, these non-$CO_2$ emissions will be subject to monitoring and accounting, when significant.<br>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.<br>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.<br>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.<br>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 | 324.57 (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 | 24.71 |
| 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<br>- Field assessment<br>- 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<br>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.<br>GWP for $CH_4$ and N2O were obtained according to the most recent version of the VCS Standard. |

| | |
|---|---|
| Data / Parameter | Hlicl,t |
| Data unit | $m^3$/ha |
| Description | Harvesting intensity of timber in forest class icl at year t in the project area due to planned logging activities (i.e., sustainable forest management plan). |
| Source of data | Sustainable forest management activity reports, such as the annual operational plan and the annual post-harvesting report. |
| Description of measurement methods and procedures to be applied | Forest inventory and measurements of wood logs by the forest management team. Harvesting intensity followed procedures described in the Sustainable Forest Management Plan and Annual Operating Plan-AOP (POA, in Portuguese) |
| Frequency of monitoring/recording | Annually |
| Value applied | 15 |
| Monitoring equipment | The same equipment applied in the forest inventory. Each harvested timber log is measured by the forest management team and stored in a collector, which is linked to the SFMP and AOP data control. |
| QA/QC procedures to be applied | Control procedures applied to forest inventory.<br>SFMP and AOP internal audit.<br>Logging authorization from the Brazilian Environmental Agency[171]. |

[171] The responsible environmental agency in this case is the Environmental Agency of the State of Mato Grosso.

| | |
|---|---|
| Purpose of data | This parameter is used to calculate project emissions in the project scenario. Provides the ex post value of the harvested timber volume due to planned logging activities in the project area. |
| Calculation method | This parameter was calculated through the annual timber inventory and movement, which is carried out before harvesting and contains the timber volume from each Annual Productive Unit (APU). After harvesting operations, each harvested timber log is measured (diameter and height) by employees and stored in a collector, which automatically calculate the timber volume through the following equation:<br>Wood volume with bark (V)<br>$V$ (m³) $=\pi 4 * d2 * h * f$<br>Where,<br>d = Diameter<br>h = Height<br>f = factor - 0.7395<br><br>Wood volume without bark (V)<br>$V$ (m3) $=\pi 4 * d2 * h * f * 0{,}90$<br>Where<br>d = Diameter<br>h = Height<br>f = factor - 0.7395<br>0.90 = correction factor to determine volume without bark according to legislation<br><br>Carbon stock decrease from planned logging activities at each forest class are quantified by multiplying the detected area subject to logging by the harvested timber volume intensity (added to logging damage factor), and then by the mean wood density. |
| Comments | N/A |

| | |
|---|---|
| Data / Parameter | $RF_t$ |
| Data unit | % |
| Description | Risk factor used to calculate VCS buffer credits |
| Source of data | - VCS Non-Permanence Risk Report – Mamuriá Grouped REDD+ Project;<br>- Remote sensing data and GIS; |

| | |
|---|---|
| | - SFMP data;<br>- 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 |

APD – Avoided Planned Deforestation

| Data / Parameter | $A_{DefPA,i,u,t}$ |
|---|---|
| Data unit | ha |
| Description | Area of recorded deforestation in the project area in stratum I converted to land use u in year t. |
| Source of data | Mapbiomas database and Landsat |
| Description of measurement methods and procedures applied | The annual deforestation is carried out with remote sensing methods, using images generated by Mapbiomas, INPE (PRODES) 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 |
| Frequency of monitoring/recording | Annual |

| | |
|---|---|
| **Value applied:** | Ex-ante:<br><br>ADefPA,i,u,t<br><br>Year / Open Lowland Tropical Rainforest (t CO2-e):<br>2020: 0.00<br>2021: 0.00<br>2022: 0.00<br>2023: 0.00<br>2024: 0.00<br>2025: 0.00<br>2026: 0.00<br>2027: 0.00<br>2028: 0.00<br>2029: 0.00<br>2030: 0.00<br>2031: 0.00<br>2032: 0.00<br>2033: 0.00<br>2034: 0.00<br>2035: 0.00<br>2036: 0.00<br>2037: 0.00<br>2038: 0.00<br>2039: 0.00<br>2040: 0.00<br>2041: 0.00<br>2042: 0.00<br>2043: 0.00<br><br>Ex-post: N/A |
| **Monitoring equipment** | Mapbiomas database (http://www.obt.inpe.br/OBT/assuntos/programas/amazonia/prodes) |
| **QA/QC procedures applied** | The MapBiomas results undergo an accuracy assessment, which for the entire Amazon Biome is on average 95%. However, to meet the particularities of the project region, an independent evaluation was carried out for the reference region between 2008-2018.<br><br>In order to assess the accuracy of the maps produced by the MapBiomas methodology, a confusion matrix was generated by calculating the user's and producer's percentage of correct answers, errors of omission and commission. For that, 320 sample points were randomly drawn on the reference region, 80 in each class (forest, hydrography, pioneer vegetation and deforestation), and the degree of correctness classification was verified. As a reference, high resolution Landsat images were used, where it was |

ADefPA,i,u,t

| Year | Open Lowland Tropical Rainforest |
|---|---|
| | t CO2-e |
| 2020 | 0.00 |
| 2021 | 0.00 |
| 2022 | 0.00 |
| 2023 | 0.00 |
| 2024 | 0.00 |
| 2025 | 0.00 |
| 2026 | 0.00 |
| 2027 | 0.00 |
| 2028 | 0.00 |
| 2029 | 0.00 |
| 2030 | 0.00 |
| 2031 | 0.00 |
| 2032 | 0.00 |
| 2033 | 0.00 |
| 2034 | 0.00 |
| 2035 | 0.00 |
| 2036 | 0.00 |
| 2037 | 0.00 |
| 2038 | 0.00 |
| 2039 | 0.00 |
| 2040 | 0.00 |
| 2041 | 0.00 |
| 2042 | 0.00 |
| 2043 | 0.00 |

| | |
|---|---|
| | possible to visually determine the land use of the sample points drawn. |
| Purpose of data | Calculation of project emissions |
| Calculation method | MapBiomas is a multi-institutional initiative of the Greenhouse Gases Emissions Estimation System promoted by the Climate Observatory. Its creation involves NGOs, universities, and technology companies. In MapBiomas, the image classification methodology uses, for each year, all Landsat images available in each period (Landsat 5 [L5], Landsat [L7] and Landsat [L8]), with a cloud cover less than or equal to 50%. Thus, a representative mosaic of each year is generated by selecting cloudless pixels from the available images. For each pixel, metrics that describe its behaviour during the year are extracted and can contain up to 105 layers of information with an artificial intelligence classifier, Random Forest. The acquisition of Landsat images is done via Google Earth Engine, with sources from NASA (American Space Agency) and USGS (US Geological Survey). |
| Comments | N/A |

| Data / Parameter | $C_{P,post,u,i}$ |
|---|---|
| Data unit | t $CO_2$-e |
| Description | Carbon stock in all pools in post-deforestation land use u in stratum i. |
| Source of data | Calculated based on carbon stocks in the selected pools according to VMD0015, equation 6 |
| Description of measurement methods and procedures applied | Calculated based on Carbon stock in aboveground tree biomass in stratum i (CAB_tree,i), carbon stock in belowground tree biomass in stratum i (CBB_tree,i), carbon stock in aboveground non-tree vegetation in stratum (CAB_non-tree,i), carbon stock in belowground non-tree vegetation in stratum i (CBB_non-tree,i), carbon stock in dead wood in stratum i (CDW,i), carbon stock in litter in stratum i (CLI,i), mean post-deforestation stock in soil organic carbon in the post deforestation stratum i (CSOC,PD-BSL,i), |
| Frequency of monitoring/recording | In each baseline revalidation (6 years) |
| Value applied: | Ex-ante: |

| Stratum (i) | $C_{P,post,u,i}$ |
|---|---|
| | t CO2-e |
| Open Lowland Tropical Rainforest | 31 |

| | |
|---|---|
| | Ex-post: N/A |
| Monitoring equipment | N/A |
| QA/QC procedures applied | - |
| Purpose of data | Calculation of project emissions |
| Calculation method | Through the equation 6, VMD 0015 v2.2 |
| Comments | - |

| | |
|---|---|
| Data / Parameter | $C_{WP,i}$ |
| Data unit | t $CO_2$-e $ha^{-1}$ |
| Description | Carbon stock sequestered in wood products from harvests in stratum i |
| Source of data | Suppression authorization for land use change |
| Description of measurement methods and procedures applied | Calculated based on biomass carbon of the commercial volume extracted by wood product type *ty* from within the project boundary |
| Frequency of monitoring/recording | When another verification event is to be carried out, minimum frequency of 5 years |
| Value applied: | Ex-ante: 0<br>Ex-post: N/A |
| Monitoring equipment | . |
| QA/QC procedures applied | - |
| Purpose of data | Calculation of project emissions |
| Calculation method | See VMD0015 v2.2, equation 05. |

| | |
|---|---|
| Comments | N/A |

| | |
|---|---|
| Data / Parameter | $\Delta C_{pools,Def,u,i,t}$ |
| Data unit | t $CO_2$-e |
| Description | Net carbon stock changes in all pools as a result of deforestation in the project case in land use u in stratum i at time t. |
| Source of data | According to VMD0015 v2.2, equation 05 |
| Description of measurement methods and procedures applied | Calculated based on carbon stock in all pools in the baseline case in stratum I ($C_{BSL,i}$), carbon stock in all pools in post-deforestation land use u in stratum I ($C_{P,post,u,i}$) and carbon stock sequestered in wood products from harvests in stratum I ($C_{WP,i}$), according to VMD0015 v2.2, equation 05. |
| Frequency of monitoring/recording | 06 years (in each baseline revalidation) |
| Value applied: | Ex-ante:<br><table><tr><th rowspan="2">Stratum (i)</th><th>ΔCpools, Def,u,i.t</th></tr><tr><th>t CO2-e</th></tr><tr><td>Open Lowland Tropical Rainforest</td><td>481.54</td></tr></table><br>Ex-post: N/A |
| Monitoring equipment | N/A |
| QA/QC procedures applied | - |
| Purpose of data | Calculation of project emissions |
| Calculation method | See VMD0015 v2.2, equation 05. |
| Comments | - |

| | |
|---|---|
| Data / Parameter | $\Delta C_{P,DefPA,i,t}$ |
| Data unit | t $CO_2$-e |
| Description | Net carbon stock change as a result of deforestation in the project case in the project area in stratum i at time t. |
| Source of data | Calculated according to VMD0015 v2.2, equation 03 |

| | |
|---|---|
| Description of measurement methods and procedures applied | Calculated based on the area of recorded deforestation in the project area stratum i converted to land use u at time t ($A_{DefPA,u,i,t}$) and the net carbon stock changes in all pools in the project case in land use u in stratum i at time t ($\Delta C_{pools,Def,u,i,t}$), according to VMD0015 v2.2, equation 03. |
| Frequency of monitoring/recording | Before every verification event with a minimum frequency of 05 years. |
| Value applied: | Ex-ante: 0.00<br>Ex-post: |
| Monitoring equipment | - |
| QA/QC procedures applied | . |
| Purpose of data | Calculation of project emissions |
| Calculation method | See VMD0015 v2.2, equation 03. |
| Comments | The area of recorded deforestation in the project area is zero because there was no record of deforestation according to the mapping carried out. |

| | |
|---|---|
| Data / Parameter | $\Delta C_{P,DegW,i,t}$ |
| Data unit | t $CO_2$-e |
| Description | Net carbon stock changes as a result of degradation in stratum i in the project area in year t. |
| Source of data | Calculated according to VMD0015 v2.2, equation 08. |
| Description of measurement methods and procedures applied | Based on the area potentially impacted by degradation processes in stratum I (ADegW,i) and carbon from the biomass of trees cut and removed by the degradation process of plots measured in stratum i in year t (CDegW,i,t) and sample from total area of degradation plots in stratum I (APi), according to VMD0015 v2.2, equation 08. |
| Frequency of monitoring/recording | Annual |
| Value applied: | Ex-ante: 0.00<br>Ex-post: N/A |
| Monitoring equipment | N/A |
| QA/QC procedures applied | . |
| Purpose of data | Calculation of project emissions |

| | |
|---|---|
| Calculation method | See VMD0015 v2.2, equation 08. |
| Comments | $A_{,Deg,w,i}$ - the area was not delimited because the APD project will also have borders with the AUD project and with that there will be the action of the two projects to avoid illegal deforestation in the areas. The value is zero and therefore the net carbon stock changes as a result of degradation |

| | |
|---|---|
| Data / Parameter | $\Delta C_{P,SelLog,i,t}$ |
| Data unit | t $CO_2$-e |
| Description | Net carbon stock change as a result of degradation through selective logging of FSC certified forest management areas in the project area in the project case in stratum i in year t. |
| Source of data | Calculated - VMD0015 v2.2, equation 09. |
| Description of measurement methods and procedures applied | Calculated based on actual net project emissions arising in the logging gap in stratum i in year t ($C_{LG,i,t}$), actual net project emissions arising from logging infrastructure in stratum i in year t ($C_{LR,i,t}$) and the carbon stock in wood products pool from stratum i, in year t ($C_{WPi,t}$), according to VMD0015 v2.2, equation 09. |
| Frequency of monitoring/recording | Before every verification event with a minimum frequency of 05 years. |
| Value applied: | Ex-ante: 0<br>Ex-post: N/A |
| Monitoring equipment | N/A |
| QA/QC procedures applied | . |
| Purpose of data | Calculation of project emissions |
| Calculation method | See section 4.2 |
| Comments | GHG emissions due to selective logging in the project scenario are set as zero in ex-ante estimates |

| | |
|---|---|
| Data / Parameter | Aburn,i,t |
| Data unit | ha |
| Description | Area burnt for stratum i in year t. |
| Source of data | Equal to $A_{DistPA,q,i,t}$ + $A_{DefPA,i,u,t}$ in the project case. |

| | |
|---|---|
| Description of measurement methods and procedures applied | For the calculation of project emissions, the burned area is considered equivalent to burn scars monitored plus annual deforested area monitored, assuming that all deforestation is preceded by a fire to clear the land in the project case. |
| Frequency of monitoring/recording | Annual |
| Value applied: | Ex-ante:<br><br>(see table below)<br><br>Ex-post: N/A |
| Monitoring equipment | - |
| QA/QC procedures applied | . |
| Purpose of data | Calculation of project emissions |
| Calculation method | - |
| Comments | - |

| Aburn | Open Lowland Tropical Rainforest |
|---|---|
| Project year | $Area_{burn,i,t}$ |
| *t* | ha |
| 2022 | 600.00 |
| 2023 | 600.00 |
| 2024 | 600.00 |
| 2025 | 712.51 |
| 2026 | 600.00 |
| 2027 | 600.00 |
| 2028 | 712.51 |
| 2029 | 600.00 |
| 2030 | 600.00 |
| 2031 | 712.51 |
| 2032 | 600.00 |
| 2033 | 600.00 |
| 2034 | 711.51 |
| 2035 | 600.00 |
| 2036 | 600.00 |
| 2037 | 712.51 |
| 2038 | 600.00 |
| 2039 | 600.00 |
| 2040 | 112.51 |
| 2041 | 300.00 |
| 2042 | 300.00 |
| 2043 | 34.51 |

| Data / Parameter | $GHG_{BSL,E,i,t}$ |
|---|---|
| Data unit | t $CO_2e$ |
| Description | Greenhouse gas emissions as a result of deforestation activities within the within the project area in stratum i in year t. |
| Source of data | Based on VMD0006 v1.3 equation 15. |
| Description of measurement methods and procedures applied | Calculated based on the non-CO2 emissions due to biomass burning in stratum i in year t (EBiomassBurn,i,t), according to VMD0006 v1.3 equation 15. |
| Frequency of monitoring/recording | Before every verification event with a minimum frequency of 05 years. |
| Value applied: | Ex-ante: (see table below)<br>Ex-post: N/A |
| Monitoring equipment | - |

Ex-ante:

| Project year *t* | Total GHG emissions | |
|---|---|---|
| | annual TOTAL | cumulative |
| | $GHG_{BSL-E,t}$ | $GHG_{BSL-E,t}$ |
| | $tCO_2e$ | $tCO_2e$ |
| 2022 | 518,564 | 518,564 |
| 2023 | 518,564 | 1,037,128 |
| 2024 | 518,564 | 1,555,692 |
| 2025 | 615,803 | 2,171,495 |
| 2026 | 518,564 | 2,690,059 |
| 2027 | 518,564 | 3,208,623 |
| 2028 | 615,803 | 3,824,426 |
| 2029 | 518,564 | 4,342,990 |
| 2030 | 518,564 | 4,861,554 |
| 2031 | 615,803 | 5,477,358 |
| 2032 | 518,564 | 5,995,922 |
| 2033 | 518,564 | 6,514,486 |
| 2034 | 614,939 | 7,129,425 |
| 2035 | 518,564 | 7,647,989 |
| 2036 | 518,564 | 8,166,553 |
| 2037 | 615,803 | 8,782,356 |
| 2038 | 518,564 | 9,300,920 |
| 2039 | 518,564 | 9,819,484 |
| 2040 | 97,239 | 9,916,723 |
| 2041 | 259,282 | 10,176,005 |
| 2042 | 259,282 | 10,435,287 |
| 2043 | 29,826 | 10,465,113 |

Ex-post: N/A

| | |
|---|---|
| QA/QC procedures applied | . |
| Purpose of data | Calculation of project emissions |
| Calculation method | Calculated based on VMD0006 v1.3 equation 15 |
| Comments | For $E_{FC,i,t}$ the value considered was Zero (0), it is conservative to exclude according to VM0007 v1.6, table 7. The same for $N_2O_{direct-N,i,t}$ |

| | |
|---|---|
| Data / Parameter | $E_{BiomassBurn,i,t}$ |
| Data unit | t $CO_2e$ |
| Description | Greenhouse gas emissions due to biomass burning in stratum i in year t of each GHG ($CO_2$, $CH_4$, $N_2O$) |
| Source of data | Calculated based on VMD0013 v1.3 equation 1. |
| Description of measurement methods and procedures applied | Calculated based on area burnt for stratum i in year t ($A_{burn,i,t}$), average aboveground biomass stock before burning stratum i, in year t ($B_{i,t}$), combustion factor for stratum i (unitless) ($COMF_i$), emission factor for stratum i for gas g ($Gg_{,i}$) and the Global warming potential for gas g ($GWP_g$), according to VMD0013 v1.3 equation 1. |
| Frequency of monitoring/recording | Before every verification event with a minimum frequency of 05 years. |
| Value applied: | Ex-ante: |

| Project year *t* | Open Lowland Tropical Rainforest<br>$E_{BiomassBurn,i,t}$<br>$tCO_2e$ |
|---|---|
| 2022 | 518,564 |
| 2023 | 518,564 |
| 2024 | 518,564 |
| 2025 | 615,803 |
| 2026 | 518,564 |
| 2027 | 518,564 |
| 2028 | 615,803 |
| 2029 | 518,564 |
| 2030 | 518,564 |
| 2031 | 615,803 |
| 2032 | 518,564 |
| 2033 | 518,564 |
| 2034 | 614,939 |
| 2035 | 518,564 |
| 2036 | 518,564 |

| | |
|---|---|
| | 2037 \| 615,803<br>2038 \| 518,564<br>2039 \| 518,564<br>2040 \| 97,239<br>2041 \| 259,282<br>2042 \| 259,282<br>2043 \| 29,826<br><br>Ex-post: 0.0 |
| Monitoring equipment | - |
| QA/QC procedures applied | . |
| Purpose of data | Calculation of project emissions |
| Calculation method | Calculated based on VMD0013 v1.3 equation 1. |
| Comments | |

| | |
|---|---|
| Data / Parameter | $\Delta C_{WPS\text{-}REDD}$ |
| Data unit | t $CO_2$-e |
| Description | Net GHG emissions in the REDD project scenario up to year t. |
| Source of data | Calculated |
| Description of measurement methods and procedures applied | Calculated based on net carbon stock change as a result of deforestation in the project area in the project case in stratum i in year t ($\Delta C_{P,DefPA,i,t}$), Net carbon stock change as a result of degradation in the project area in the project case in stratum i in year t ($\Delta C_{P,Deg,i,t}$), Net carbon stock change as a result of natural disturbance in the project area in the project case in stratum i in year t ($\Delta C_{P,DistPA,i,t}$) and Greenhouse gas emissions as a result of deforestation and degradation activities within the project area in the project case in stratum i in year t ($GHG_{P\text{-}E,i,t}$). |
| Frequency of monitoring/recording | Before every verification event with a minimum frequency of 05 years. |
| Value applied: | Ex-ante:<br><br>Net GHG emissions in the REDD baseline scenario<br>Idi \| 1 \| $\Delta C_{BSL,\ REDD}$ \| $\Delta C_{BSL,\ REDD}$ |

| | | | | |
|---|---|---|---|---|
| | Name | Open Lowland Tropical Rainforest | annual | cumulative |
| | Project year | $tCO_2e$ | $tCO_2e$ | $tCO_2e$ |
| | 2022 | 881,214 | 881,214 | 881,214 |
| | 2023 | 881,214 | 881,214 | 1,762,428 |
| | 2024 | 881,214 | 881,214 | 2,643,642 |
| | 2025 | 1,024,972 | 1,024,972 | 3,668,614 |
| | 2026 | 881,214 | 881,214 | 4,549,828 |
| | 2027 | 881,214 | 881,214 | 5,431,042 |
| | 2028 | 1,024,972 | 1,024,972 | 6,456,014 |
| | 2029 | 881,214 | 881,214 | 7,337,228 |
| | 2030 | 881,214 | 881,214 | 8,218,442 |
| | 2031 | 1,024,972 | 1,024,972 | 9,243,414 |
| | 2032 | 881,214 | 881,214 | 10,124,628 |
| | 2033 | 881,214 | 881,214 | 11,005,842 |
| | 2034 | 1,023,695 | 1,023,695 | 12,029,537 |
| | 2035 | 881,214 | 881,214 | 12,910,751 |
| | 2036 | 881,214 | 881,214 | 13,791,964 |
| | 2037 | 1,024,972 | 1,024,972 | 14,816,937 |
| | 2038 | 881,214 | 881,214 | 15,698,151 |
| | 2039 | 881,214 | 881,214 | 16,579,364 |
| | 2040 | 258,328 | 258,328 | 16,837,693 |
| | 2041 | 497,892 | 497,892 | 17,335,584 |
| | 2042 | 497,892 | 497,892 | 17,833,476 |
| | 2043 | 158,664 | 158,664 | 17,992,140 |
| | Ex-post: N/A | | | |
| Monitoring equipment | N/A | | | |
| QA/QC procedures applied | | | | |
| Purpose of data | Calculation of project emissions | | | |
| Calculation method | VMD0015 v2.2, equation 01. | | | |
| Comments | - | | | |

| | |
|---|---|
| Data / Parameter | $\Delta C_{LK-REDD}$ |
| Data unit | t $CO_2e$ |
| Description | Net GHG emissions due to leakage from the REDD project activity up to year t* |
| Source of data | Calculated |

| | |
|---|---|
| Description of measurement methods and procedures applied | Calculated based on net GHG emissions due to activity shifting leakage for projects preventing planned deforestation up to year t (ΔCLK-AS,planned), and the Net GHG emissions due to market-effects leakage up to year t*( ΔCLK-ME), |
| Frequency of monitoring/recording | Before every verification event with a minimum frequency of 5 years. |
| Value applied: | Ex-ante: (see table below) Ex-post: N/A |
| Monitoring equipment | - |
| QA/QC procedures applied | . |
| Purpose of data | Calculation of leakage. |
| Calculation method | Calculated according to VMD0007 v1.6 equation 4. |
| Comments | |

Ex-ante:

| Year | $\Delta C_{LK-AB,planned}$ | $\Delta C_{LK\ ME}$ | $\Delta C_{LK-REDD}$ |
|---|---|---|---|
| | tCO2 | tCO2 | tCO2 |
| 2022 | 0 | 10,605 | 10,605 |
| 2023 | 0 | 10,605 | 10,605 |
| 2024 | 0 | 10,605 | 10,605 |
| 2025 | 0 | 21,209 | 21,209 |
| 2026 | 0 | 21,209 | 21,209 |
| 2027 | 0 | 10,605 | 10,605 |
| 2028 | 0 | 21,209 | 21,209 |
| 2029 | 0 | 10,605 | 10,605 |
| 2030 | 0 | 10,605 | 10,605 |
| 2031 | 0 | 21,209 | 21,209 |
| 2032 | 0 | 21,209 | 21,209 |
| 2033 | 0 | 21,209 | 21,209 |
| 2034 | 0 | 21,209 | 21,209 |
| 2035 | 0 | 10,605 | 10,605 |
| 2036 | 0 | 10,605 | 10,605 |
| 2037 | 0 | 21,209 | 21,209 |
| 2038 | 0 | 10,605 | 10,605 |
| 2039 | 0 | 10,605 | 10,605 |
| 2040 | 0 | 15,907 | 15,907 |
| 2041 | 0 | 5,302 | 5,302 |
| 2042 | 0 | 5,302 | 5,302 |
| 2043 | 0 | 5,302 | 5,302 |

Ex-post: N/A

## 5.3 Monitoring Plan

This monitoring plan has been developed according to the VCS Methodology VM0015 version 1.1 and VCS Methodology VM0007 version 1.6.

**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 social reports, 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, as well as complying with the social activities.

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, i.e. through October 06$^{th}$, 2026. 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.

As the present project presents two types of deforestation to be avoided, each project area will serve as a protection area for the other, thus avoiding unplanned deforestation, forest degradation, and other risks such as invasions of the areas.

The APD area will serve as a buffer zone for the AUD area, keeping the area preserved and thus avoiding the risk of degradation.

In turn, for sustainable forest management, the AUD area will continue to demonstrate occupation and activities in areas where the management team is present, preventing invasions and illegal deforestation both in the AUD area and in the APD.

Baseline monitoring task will be done in accordance with the applied methodology for each project area, VM0015, version 1.1, VM0007, version 1.6, and VMD0015, version 2.2, or the most recent.

Data to be collected

Data will be collected to comply with the parameters used in both methodology 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, VM0007 and VMD0015 methodologies.

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 project 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 project 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 project 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 methodologies. 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. 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)[172] 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 Methodologies for both project areas.

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 Mamuriá 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

[172] Available at: <http://www.obt.inpe.br/OBT/assuntos/programas/amazonia/prodes> Last visited on 10/03/2021.

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 landowner 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 developed with the owner. 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 project 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.

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

In addition to the mentioned above, the project 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 project 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.

- **Monitoring Proxy Areas**

Monitoring of the Proxy Areas will be carried out as in the project area to verify whether changes have occurred and whether it should be reassessed at the end of each baseline period. Baseline will be updated considering the methodological procedures.

- **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 87. Type of Monitoring and Party Responsible for Monitoring**

| 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 | Project proponent 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 | Project proponent together with Future Carbon and external institutions qualified for the GIS analysis and monitoring | Prior to each verification |
| Monitoring Leakage emissions | Project proponent 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 | Project proponent | When a natural event occurs |
| Updating Forest Carbon Stocks Estimates | Project proponent | At least, every 10 years, only if necessary. |