RIO MADEIRA GROUPED REDD+ PROJECT

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1 PROJECT DETAILS

1.1 Summary Description of the Project

In Brazil, 58.39% of its entire 851,034,553.8 ha territory (IBGE, 2021[1]) is covered by forests, representing almost 497 million hectares of forest area (FAO, 2020[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 (FAO, 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 Rio Madeira Grouped REDD+ Project is located in the municipalities of Porto Velho, Rondônia state and Lábrea, south of Amazonas state, in the Northern region of Brazil. The region is surrounded by many rivers and its borders having direct contact with Rio Madeira.

The pre-project scenario can be viewed on the highway closest to the project, the BR-364, which is one of the longest Brazilian highways. Along its route, cattle ranching can be found, which is the main agent of deforestation in the region[4][5], demonstrating the pressure of deforestation and the common practice in the region. Imazon data from September 2021 places Rondônia as the 3rd State in the deforestation ranking, with 17,800 hectares within one year. The same study points Porto Velho as the 2nd municipality with the most deforestation rate in September 2021[6].

The main objective of the Rio Madeira Grouped REDD+ Project is to avoid unplanned deforestation (AUD) of a region within the municipalities of Porto Velho and Lábrea. The first three Project activity instances have 52,274.05 ha project area, which belongs to three private owners: two in Porto Velho municipality, owned by Grupo ROVEMA and Grupo Leite, and one owner in Lábrea municipality, owned by Grupo Tupá, consisting of 100% Amazon rainforest.

The Project Activity consists in conservation measures in the Project Area's properties ensuring the security of the Project, in order to monitor suspicious and/or illegal activities and control the entrance and exit within the area's boundaries.

The surveillance contractor service was the first action taken by landowner from Instance 1 (Grupo ROVEMA) to support forest conservation and avoid encroachment. Since the service was

[1] IBGE – Instituto Brasileiro de Geografia e Estatística. Brasil. 2021. 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] WWF-Brasil. Perfil socioeconômico e ambiental do sul do estado do Amazonas: Subsídios para Análise da Paisagem. 2017. Available at: <https://d3nehc6yl9qzo4.cloudfront.net/downloads/perfil_sul_amazonas.pdf>.
[5] https://www.scielo.br/j/neco/a/jZHjd9B8ZghY7tG9G7qchTk/?lang=pt Last visit on 27-December-2023
[6] Available at: < https://imazon.org.br/wp-content/uploads/2021/10/SAD_Setembro21.pdf> Last visit on December 22nd, 2022

initiated when the Contract was signed, this date is considered the first action in terms of initiating the present REDD project and thus been designated this date as its project start date. The project's crediting period start is 23-October-2019.

Instances 1 and 3 have been developing sustainable forest management plans (SFMP) prior to the start of the project. According to the Ministry of the Environment definition, "Sustainable Forest Management is the administration of the forest to obtain economic, social and environmental benefits, respecting the support mechanisms of the ecosystem being managed and considering, cumulatively or alternatively, the use of multiple timber species, multiple non-timber products and by-products, as well as the use of other forest goods and services"[7]. SFMP does not guarantee deforestation reduction, which is aggressive in the region. The SFMP cycle involves removing part of the trees, while another part (including high-value trees) remains in the forest, in order to promote natural recovery. However, since the regeneration process includes remaining trees with high value, the land is subject to land grabbers. In addition, SFMP is carried out on annual plots during the dry season (3-4 months of the year), with only a small area being exploited each year, i.e. there is a small presence in the area, which forms a condition for land grabbers. Thus, despite de benefits of SFMP, it cannot assure forest conservation in a region with high deforestation rates.

The implementation of the project activity is being monitored by continuous monitoring activities, such as surveillance teams hired by the owners, satellite images, and extraction of non-timber forest products with local communities' involvement, which also contribute to monitoring the forest area by maintaining a presence in the area.

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

It is worth mentioning that other REDD project instances could be inserted into this grouped project activity in the future, as long as they comply with the eligibility criteria defined in sections below.

Besides the ecological and carbon benefits of the project, a proportion of the carbon credits generated will be dedicated to improving social and environmental conditions for the local community around the project area, specifically contributing to environmental education and other social activities. The contribution to sustainability is being monitored applying the SOCIALCARBON® Standard, which is based in six key indicators: Biodiversity; Natural; Financial; Human; Social and Carbon Resources.

The Rio Madeira Grouped REDD+ Project is expected to avoid a predicted 34,681.91 ha of deforestation, equating to an average annual of 535,121 tCO2e in emissions reductions and 16,053,622 tCO2e over the 30-year project lifetime (23-October-2019 to 22-October-2049).

[7] Available at: https://antigo.mma.gov.br/florestas/manejo-florestal-sustent%C3%A1vel.html. Last visit on December, 08th, 2023

Table 1. Project audit history

Audit Type	Period	Program	VVB Name	Number of years
Validation	June-2023	Verified Carbon (VCS)	RINA S.p.A.	30
Verification	23-October-2019 to 31-December-2021	VCS and SOCIALCARBON®	RINA S.p.A.	2 years and 70 days
Total	23-October-2019 to 18-October-2049	VCS	To be defined	30 years

1.2 Sectoral Scope and Project Type

14. Agriculture, Forestry, Land Use.

Reducing Emissions from Deforestation and Degradation (REDD) through Avoided Unplanned Deforestation.

This is a grouped project.

1.3 Project Eligibility

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

Table 2. Justification of eligibility

VCS Standard v4	
Requirements	**Rio Madeira Grouped REDD+ Project Justification of Eligibility**
General Requirement	
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. The project is in line with the principles (Relevance, completeness, consistency, accuracy, transparency, conservativeness) throughout the VCS PD.

[8] Available at < https://verra.org/wp-content/uploads/2022/12/VCS-Methodology-Requirements-v4.3-FINAL.pdf >
[9] Available at <VCS-Standard-v4.4-FINAL.pdf (verra.org)>

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 3.14.1. The list of methodologies and their validity periods is available on the Verra website.	Applied methodology is VM0015 – Methodology for Avoided Unplanned Deforestation, v1.1. Applied AFOLU Non-Permanence Risk Tool, v4.0, as mentioned on section 2.2 of the VCS PD. Applied VT001 – Tool for the demonstration and assessment of additionality in VCS AFOLU Project activities, v3.0, as detailed on the section 3.5 of the VCS PD.
Projects shall apply the latest version of the applicable methodology in all cases unless a grace period applies to the project as set out in 3.21 below. Projects must update to the latest version of the methodology when reassessing the baseline and renewing a crediting period.	Applied methodology is VM0015, v1.1. Applicability conditions are detailed on section 3.2 of the VCS PD.
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 forest, including sustainable forest management plan in two out of three instances. These activities are eligible under the Brazilian law according to conditions set out in section 1.14 and 3.5 of the present PD.
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.

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 VM0015 methodology, in addition to the VT0001 for Additionality assessment.
Where the rules and requirements under an approved GHG program conflict with the rules and requirements of the VCS Program, the rules and requirements of the VCS Program shall take precedence.	The project applies 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 conform with any specified capacity limits 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 methodology 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 VCS Program rules, the effective dates of these requirements are set out in Appendix 3 Document History and Effective Dates or equivalent for other program documents and are listed in a companion Summary of Effective Dates document which corresponds with each update.	Project was designed under VCS Standard version 4.4, VM0015 version 1.1. Any new requirements shall be adhered to at project crediting period renewal (i.e six years from Project Start Date).
AFOLU-Specific Matters	
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	This project is an eligible AFOLU project category under the VCS Program: Reduced Emissions from Deforestation and/or Degradation (REDD).

management (IFM), reduced emissions from deforestation and degradation (REDD), avoided conversion of grasslands and shrublands (AcoGS), and wetland restoration and conservation (WRC). Further specification with respect to eligible activities which may be included within methodologies approved under the VCS Program can be found in the VCS Program document VCS Methodology Requirements.	
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 as detailed in section 1.11.
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.	Implementation partners are described in the project description and sections 1.5 and 1.6 of the present PD.
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. The onus is upon	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, as described on section 3.4 of the present PD.

the project proponent to demonstrate this, failing which the project shall not be eligible.	
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. The onus is upon the project proponent to demonstrate this, failing which the project shall not be eligible.	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, Avoiding Planned Deforestation and Degradation (APDD) (except where the agent is unknown), Restoring Wetland Ecosystems (RWE), Avoiding Planned Wetland Degradation (APWD), Avoiding Planned Conversion (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 Avoiding Unplanned Deforestation and Degradation (AUDD), APDD (where the agent is unknown), Avoiding Unplanned Conversion (AUC), and Avoiding Unplanned Wetland	The baseline reassessment will be conducted every six years as this is an AUDD project.

Degradation (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.	
Baseline projections for deforestation and/or degradation, land conversion, forest management plans, wetland hydrological changes, and agricultural land management beyond the baseline reassessment period defined above are not likely to be realistic because rates of change in land-use and/or land or water management practices are subject to many factors that are difficult to predict over the long term, hence the need for periodic reassessment of the baseline.	Baseline reassessment will be carried out as required, every six years as this is an AUDD project.
Where ARR, ALM, IFM or REDD project activities occur on wetlands, the project shall adhere to both the respective project category requirements and the WRC requirements, unless the expected emissions from the soil organic carbon pool or change in the soil organic carbon pool in the project scenario is deemed below de minimis or can be conservatively excluded as set out in the VCS Program document VCS Methodology 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	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. It is worth highlighting the Non-Permanence Risk was compiled in one single report. Nevertheless, it was carried out risk assessments for each instance of the project. Each instance obtained a score, according to the NPRR Calculation Tool. After this analysis, the more conservative score

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.	was adopted. Thus, the NPRR explains the analysis for three initial instances, but considers the worst-case scenario score to assure conservativeness.
VCS Methodology Requirements v4.3	
Eligibility Conditions	**Rio Madeira Grouped REDD+ Project Justification of Eligibility**
Reduced Emissions from Deforestation and Degradation (REDD)	
Eligible REDD activities are those that reduce net GHG emissions by reducing deforestation and/or degradation of forests. Deforestation is the direct, human-induced conversion of forest land to non-forest land. Degradation is the persistent reduction of canopy cover and/or carbon stocks in a forest due to human activities such as animal grazing, fuelwood extraction, timber removal or other such activities, but which does not result in the conversion of forest to non-forest land (which would be classified as deforestation), and qualifies as forests remaining as forests, such as set out under the IPCC 2003 Good Practice Guidance. 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 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 forests that have been cleared and have recovered naturally and that are at least 10 years old and meet the lower bound	The Project Area is composed of 100% native forest. The area is considered forest as per the definition of forest adopted by FAO[10]: Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10%, or trees able to reach these thresholds in situ.

[10] 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

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.	
Avoiding deforestation and/or degradation can affect GHG emissions and removals in several ways. The main effect is on carbon emissions that are reduced by preventing the conversion of forest lands with high carbon stocks to non-forest lands with lower carbon stocks. Where the forest is young or degraded, stopping its further degradation and deforestation also allows for additional sequestration of carbon on the land as the forest re-grows (with or without assisted regeneration). Avoiding conversion of forests to cropland or pasture can reduce emissions of N2O and CH4 that are associated with biomass burning used to clear the land, fertilizer use and other agricultural practices that would have occurred if the forests had been converted.	The project agrees since it avoids the conversion of forests into non-forests, avoiding carbon emissions. Activities will be developed with local communities as outlined in section 1.18.
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) 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	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, when applicable.

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 3.6.2.	
Eligible REDD activities include: 1) Avoiding 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. 2) Avoiding Unplanned Deforestation and/or Degradation (AUDD): This category includes activities that reduce net GHG emissions by stopping deforestation and/or degradation of degraded to mature forests that would have occurred in any forest configuration.	The Rio Madeira Grouped REDD+ Project is within category AUDD - Avoided Unplanned Deforestation and/or Degradation.

1.4 Project Design

This project is designed as a Grouped Project Activity. The expansion of the project scope is allowed by the inclusion of new project activity instances after its validation. The inclusion of new instances shall take place by the time of each verification event.

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 this is a grouped project, all instances implemented after validation shall meet the elements mentioned in sections 3.5.15 and 3.5.16 of VCS Standard. In addition, new aeras 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 3. Grouped Project eligibility criteria

VCS Standard Eligibility criteria for the inclusion of new project activity instances	Rio Madeira Grouped Project	Instance 1 (Grupo ROVEMA)	Instance 2 (Grupo Leite)	Instance 3 (Grupo Tupá)
Projects shall meet the applicability conditions set out in the methodology applied to the project.	The GHG emission reductions shall be calculated according to the approved VCS Methodology VM0015: Methodology for Avoided Unplanned Deforestation, version 1.1, published on 03-December-2012.	The Instance 1 – Grupo ROVEMA Project Activity complies with this requirement because it adopts the Methodology VM0015: Methodology for Avoided Unplanned Deforestation, version 1.1, published on 03-December-2012.	The Instance 2 – Grupo Leite Project Activity complies with this requirement because it adopts the Methodology VM0015: Methodology for Avoided Unplanned Deforestation, version 1.1, published on 03-December-2012.	The Instance 3 – Grupo Tupá Project Activity complies with this requirement because it adopts the Methodology VM0015: Methodology for Avoided Unplanned Deforestation, version 1.1, published on 03-December-2012.
Projects shall use the technologies or measures specified in the project description. Projects shall apply the technologies or measures in the same manner as specified in the project description.	All new instances shall use and apply the same technologies or measures specified in the Project description - forest conservation by avoiding unplanned deforestation, with or without forest management in project scenario.	The Grupo ROVEMA Project Activity complies with this criterion because it was the instance that originated the baseline scenario and the development of the Rio Madeira Grouped REDD+ Project Also, this instance is in the same reference region described in the VCS PD. Instance 1 applies the same technologies or measures specified in the Project description: forest conservation by avoiding unplanned deforestation, with forest management combined with additional activities to promote social benefits and forest conservation in project scenario.	The Grupo Leite Project Activity complies with this criterion because it was the instance that originated the baseline scenario and the development of the Rio Madeira Grouped REDD+ Project. Also, this instance is in the same reference region described in the VCS PD. Instance 2 applies the same technologies or measures specified in the Project description: forest conservation by avoiding unplanned deforestation, without forest management in project scenario, implementing additional activities to promote social benefits and forest conservation in project scenario.	The Grupo Tupá Project Activity complies with this criterion because it was the instance that originated the baseline scenario and the development of the Rio Madeira Grouped REDD+ Project. Also, this instance is in the same reference region described in the VCS PD. Instance 3 applies the same technologies or measures specified in the Project description: forest conservation by avoiding unplanned deforestation, with forest management combined with additional activities to promote social benefits and forest conservation in project scenario in project scenario.

Projects are subject to the baseline scenario determined in the project description for the specified project activity and geographic area.	The Project shall be in accordance with the same baseline scenario established in Section 3.4. of the VCS PD: "In the baseline scenario, forest is expected to be converted to non-forest by the agents of deforestation acting in the reference region, project area and leakage belt. Therefore, the project falls into the AFOLU-REDD".	Instance 1 Project Activity complies with this criterion because it was the instance that originated the baseline scenario and the development of the Rio Madeira Grouped REDD+ Project. Therefore, this instance is in accordance with the same baseline scenario determined in Section 3.4 of the VCS PD.	Instance 2 Project Activity complies with this criterion because it was the instance that originated the baseline scenario and the development of the Rio Madeira Grouped REDD+ Project. Therefore, this instance is in accordance with the same baseline scenario determined in Section 3.4 of the VCS PD.	Instance 3 Project Activity complies with this criterion because it was the instance that originated the baseline scenario and the development of the Rio Madeira 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. In this case, the project activity may or may not include Sustainable Forest Management Plan. In additionality assessment, each instance shall determine the appropriate analysis method, according to STEP 2 of VCS VT001 v 3.0 tool. Simples cost analysis shall be applied as sub-step 2b for all instances where the project brings no financial or economic benefit other than VCS related revenues. This shall be assessed by	The additionality analysis follows VCS VT001 v 3.0, as detailed at section 3.5. The project activity does not increase the revenues or saving of the existing sources of incomes, such as existing SFMP at instance 1. The SFMP operation is carried out by third party company and logging activities could be maintained regardless the AFOLU project, as detailed in section 3.5.	The additionality analysis follows VCS VT001 v 3.0, as detailed at section 3.5. The project activity does not generate new or additional revenue for the instance 2 landowners except for the generation and sale of VCUs.	The additionality analysis follows VCS VT001 v 3.0, as detailed at section 3.5. The project activity does not increase the revenues or saving of the existing sources of incomes, such as existing SFMP at instance 3. The SFMP operation is carried out by third party company and logging activities could be maintained regardless the AFOLU project, as detailed in section 3.5.

	demonstrating that the project: ● Does not generate new or additional revenue stream for the landowners except for the generation and sale of VCUs; and ● Does not increase the revenues or saving of the existing sources of incomes, such as existing SFMPs or other economic activities existing in the Project Area. In case the VCS AFOLU project does bring other financial or economic benefit to the landowners, procedures provided on VCS VT001 v 3.0 tool shall be applied and either investment comparison or benchmark analysis shall be used for sub-step 2b.			
New Project Activity Instances shall occur within one of the designated geographic areas specified in the project description.	Current and future project activity instances 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	The area referring to instance 1 is located within the project's reference region as described in section 3.3 of the VCS PD.	The area referring to instance 2 is located within the project's reference region as described in section 3.3 of the VCS PD.	The area referring to instance 3 is located within the project's reference region as described in section 3.3 of the VCS PD.

	public areas such as Conservation Units. - As per the VCS Standard, new AFOLU Non-Permanence Risk assessments shall be carried out for each geographic area specified in the project description (for requirements related to geographic areas of grouped projects, see the VCS Standard). Where risks are relevant to only a portion of each geographic area, the geographic area shall be further divided such that a single total risk rating can be determined for each geographic area. Where a project is divided into more than one geographic area 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	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 new project activity.	Instance 2 complies with all eligibility criteria for the inclusion of new project activity.	Instance 3 complies with all eligibility criteria for the inclusion of new project activity.

sets of eligibility criteria is insufficient.				
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.	Instance 2 complies with this criterion, as it is included in this Joint PD as the second project activity instance.	Instance 3 complies with this criterion, as it is included in this Joint PD as the third 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.	Instance 2 complies with this criterion, as it is included in this Joint PD as the second project activity instance.	Instance 3 complies with this criterion, as it is included in this Joint PD as the third project activity instance.
New Project Activity Instances must have evidence of project ownership, in respect of each project activity instance, held by the project proponent from the respective start date of each project activity instance (i.e., the date upon which the project activity instance began reducing or removing GHG emissions).	All Project activity instances must provide evidence of Project ownership (land title and related documents) and Project start date (agreements, protection or management plan, or others in accordance with the applicable VCS Standard definitions).	Instance 1 is in accordance with this criterion. The evidence of Project ownership and Project start date were provided, as described in sections 1.7 and 1.8 of the VCS PD.	Instance 2 is in accordance with this criterion. The evidence of Project ownership and Project start date were provided, as described in sections 1.7 and 1.8 of the VCS PD.	Instance 3 is in accordance with this criterion. The evidence of Project ownership and Project start date were provided, as described in sections 1.7 and 1.8 of the VCS PD.

New Project Activity Instances must have a start date that is the same as or later than the grouped project start date	The start date of the activity of each instance shall be the same as or after the start date of the grouped project, as established in Section 1.8 of the VCS PD.	This instance 1 (Grupo ROVEMA) Project Activity has the same start date of the grouped Project, as described in section 1.8 of the VCS PD.	This instance (Grupo Leite) Project Activity has a posterior start date of the grouped Project, as described in section 1.8 of the VCS PD.	This instance 3 (Grupo Tupá) Project Activity has a posterior 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 has the same start and end date of the grouped Project, as described in section 1.8 of the VCS PD.	Instance 2 has a posterior start date of the grouped Project, as described in section 1.8 of the VCS PD. Nevertheless, the end of the instance 2 crediting period is limited by instance 1.	Instance 3 has a posterior start date of the grouped Project, as described in section 1.8 of the VCS PD. Nevertheless, the end of the instance 3 crediting period is limited by instance 1.

1.5 Project Proponent

Organization name	Future Carbon International LLC
Contact person	Gabriel Fernandes de Toledo Piza Luciane Cristina Lazzarin Lyara Carolina Montone Amaral Marcelo Hector Sabbagh Haddad Mayara do Nascimento Yasmin Villa Nova Mascarenhas
Title	Marcelo Hector Sabbagh Haddad – Head of Forest Gabriel Fernandes de Toledo Piza – Technical Coordinator Luciane Cristina Lazzarin – Technical Analyst Lyara Carolina Montone Amaral – Technical Coordinator Mayara do Nascimento – Technical Analyst Yasmin Villa Nova Mascarenhas – Socioenvironmental Analyst
Address	150 SE 2nd Ave, Suite 906 Miami - Florida, United States Postal Code: 33131
Telephone	+55 11 3045-3474
Email	forest@futurecarbon.com.br

1.6 Other Entities Involved in the Project

Organization name	Grupo ROVEMA
Role in the project	Project Activity Instance 1 owner
Contact person	Lediana Ghedin
Title	Lediana Ghedin - CEO
Address	Av. Calama, 1383 – São João Bosco – Porto Velho RO Postal Code – 76803-705
Telephone	+55 69 3216-9600
Email	lediana@ceo.grupoROVEMA.com.br

Organization name	Grupo Leite
Role in the project	Project Activity Instance 2 owner
Contact person	José Marcos Leite Junior

Title	José Marcos Leite Junior - CEO
Address	BR-364 km 904 Porto Velho - RO Postal Code – 78900-000
Telephone	+55 68 9218-9393
Email	joseleitejunior@gmail.com

Organization name	Grupo Tupá
Role in the project	Project Activity Instance 3 owner
Contact person	Tulio Villela Lemos Batista da Costa
Title	Tulio Villela Lemos Batista da Costa - CEO
Address	BR 364 km 135 Lábrea - AM Postal Code – 69830-000
Telephone	+ 55 68 8111-1000
Email	ciatupa@uol.com.br

1.7 Ownership

The Grouped Project covers a region in the municipalities of Porto Velho, in the State of Rondônia, and Lábrea, in the State of Amazonas, both in north of Brazil. The areas are located within three instances as follows:

Instance	Property name	Land registry number	Property area (ha)
1- Grupo ROVEMA	Fazenda Rio Madeira	7509	24,821.48
	Fazenda Serra Verde Lote 62	9793	233.87
	Fazenda Serra Verde Lote 62A	9794	229.98
	Fazenda Serra Verde Lotes 42 e 43A	5674	1,002.63
	Fazenda Serra Verde Lote 59	23479	793.60
	Fazenda Serra Verde Lote 61B	9795	233,86
	Fazenda Serra Verde Lote 41B	23477	370.59
2- Grupo Leite	Fazenda Santa Carmem	593	7,494.21
	Fazenda Santa Carmem I	592	6,899.29
	Fazenda Santa Carmem II	591	5,501.60
3- Grupo Tupá	Fazenda Beleza	1686	6,057
	Fazenda Fronteira	2054	4,211.67
	Fazenda Iracema I	1922	4,881.74
	Fazenda Iracema II	1921	4,211
	Fazenda Seringal Novo A	1201	15,280.70
	Fazenda Seringal Novo B	1202	2,877.41

The location of the properties and the respective land titles are presented in the maps below:

Figure 1. Instance 1 location and land titles



Figure 2. Instance 1 location and land titles

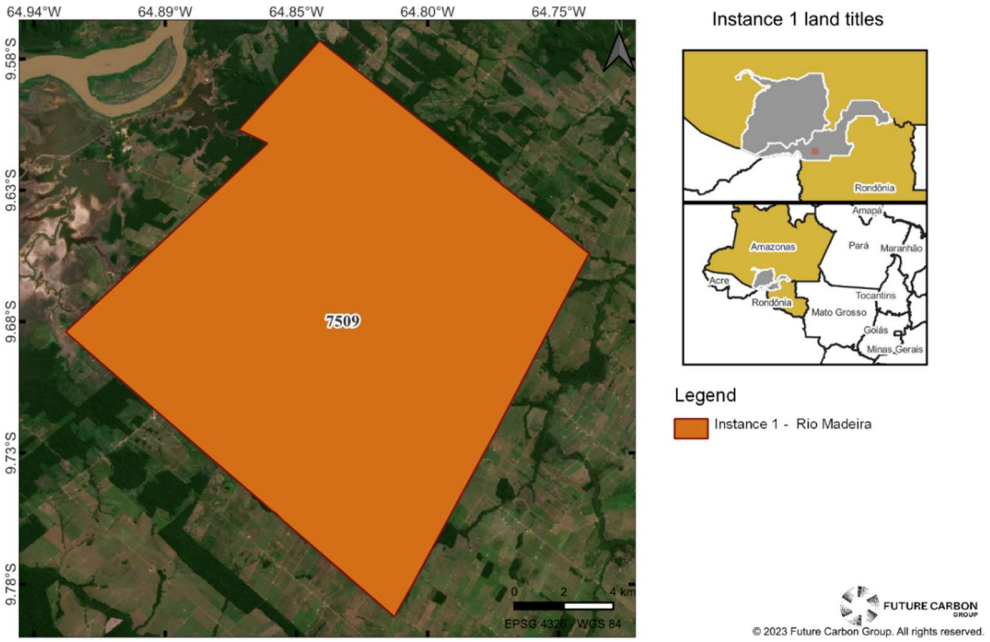


Figure 3. Instance 2 location and land titles

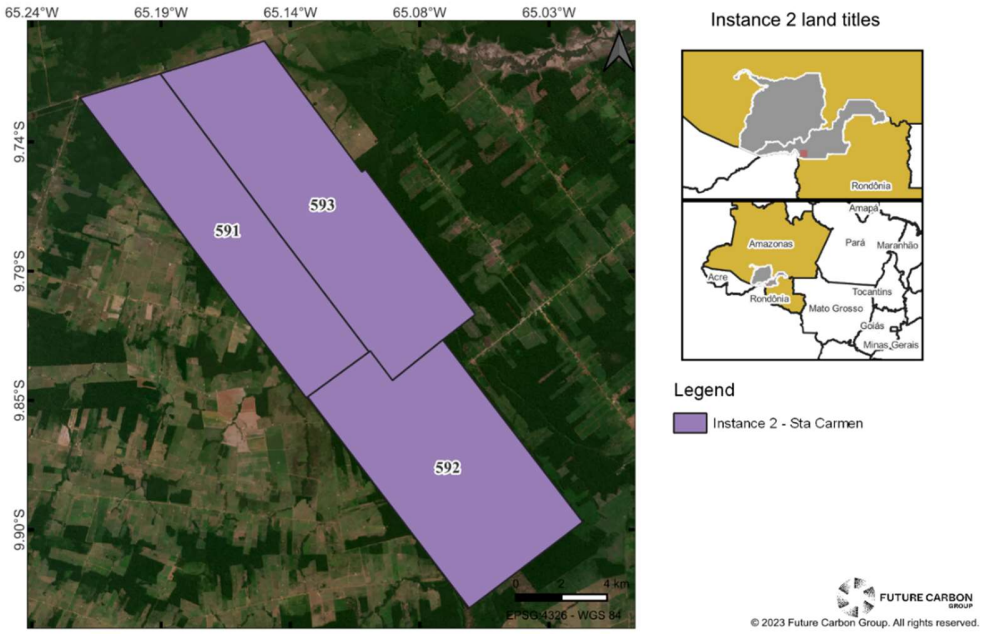
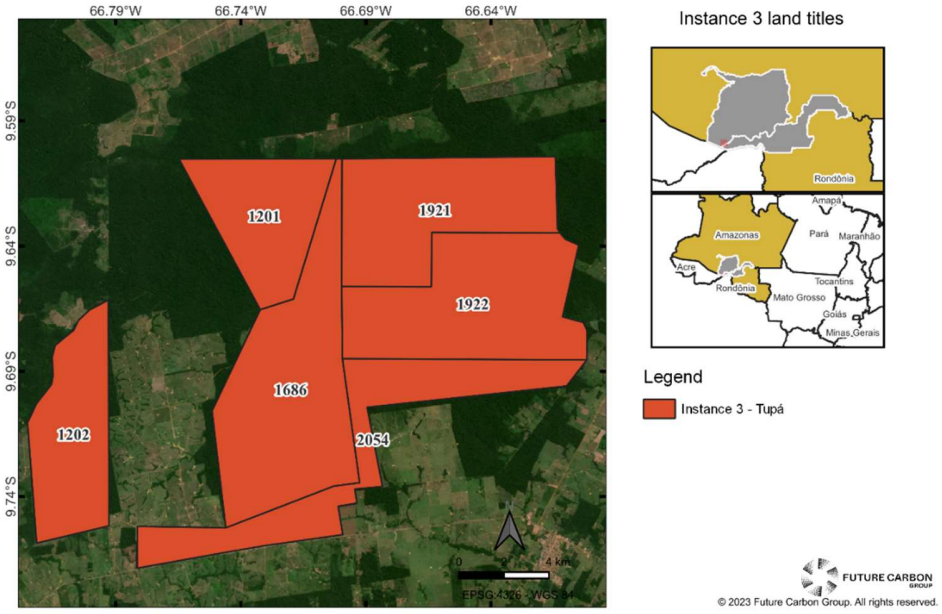


Figure 4. Instance 3 location and land titles



These properties are owned as per informed in the section 1.6. The legal documents proving the land title and ownership of the property (Environmental Registry for Rural Properties, Land Registry Certificate, Certificate from the Institute for Agrarian Reform) will be made available to the auditors during the validation process. The areas belonging to the project have a regular situation, and this statement can be proven both by the certificate of full content, whose purpose is the faithful transcription of all records contained in the registration of the property, and by the

certificate of dominial chain, which is the document that contemplates the chronological sequence and registration of all transfers that occurred on the same land. This certificate contains the list of all owners of the property, from its original title held by the Government to the current owner. All these documents are meticulously analyzed during the negotiations that precede the signing of the partnership contract for the development of environmental assets.

As per the rules stated at Section 3.7 Ownership of the VCS Standard, an enforceable and irrevocable agreement was set between *instances owners* – the holder 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 Group, which vests project ownership in the project proponent (Future Forest[11]). Evidence of such agreement will also be made available at the audit.

A FAR (Forward Action Request) was raised by the VVB during the Joint validation and verification regarding ownership, requesting additional clarification regarding CAR and land tittle with mortgage. The owners have already started the process of applying for regularization with the responsible bodies and are awaiting the appropriate analysis and updates, however, this situation does not present any risk of ownership, vesting project ownership in the project proponent, according to the evidence provided to the VVB.

Evidence mentioned in the present section will also be applicable for new instances.

1.8 Project Start Date

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

Therefore, the project start date is 23/October/2019, and it was defined taking into consideration the date on which the Grupo ROVEMA started a patrolling routine in the property named Rio Madeira. Such service includes security agents in order to avoid land encroachers and wood grabbers, as an action to help forest conservation due to the numerous invasions that are common in other farms in the region. Evidence was presented for the audit period, where Grupo ROVEMA signed a contract with a monitoring team ("S.S.M – Serviços de Segurança Eireli") to increase surveillance activities and thus guarantee the conservation of the forest areas.

The other two Project Activity Instances are nearby and suffer from the same invasion risks. Thus, the Grupo Leite (instance 2), on 08/January/2020, hired an assessor ("Verine Projetos e

[11] Future Forest (Future Carbon Consultoria e Projetos Florestais Ltda.) and Future Carbon International LLC are companies controlled by Future Carbon Group. Evidence of carbon credits rights are available at the project website in the VERRA registry database.

Assessoria Ltda – ME") which is specialized in forest coverage satellite images monitoring service. Thus, with such intel service, it was possible to prevent encroachers.

Grupo Tupá (instance 3) signed a contract with a security service provider ("Elzo Santos de Oliveira"), on 02/January/2020. Such professional is an expert on identifying tracks and settlements in the forest and stablished a routine of patrolling Grupo Tupá borders in order to prevent invasions and consequent forest coverage loss.

Thus, briefly, below is the project start date of the 3 instances:

Instance	Project Start Date
Grupo ROVEMA	23/October/2019
Grupo Leite	08/January/2020
Grupo Tupá	02/January/2020

These actions were the first step to the conservation of the project area due to the increase of invasions within the properties.

1.9 Project Crediting Period

The project has a crediting period of 30 years, starting from 23-October-2019 until 22-October-2049.

This version of VCS PD covers the first baseline period of the Rio Madeira Grouped REDD+ Project, from 23-October-2019 to 22-October-2025.

According to VCS requirements[12], the baseline must be reassessed every 6 years for ongoing unplanned deforestation once deforestation projections are difficult to predict over the long term.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	
Large project	X

[12] Available at <https://verra.org/wp-content/uploads/2022/12/vcs-standard-v4.4-final.pdf> Last visit on 29/December/2022

Year	Estimated GHG emission reductions or removals (tCO_2e)
From 23rd October to 31st December 2019	55,580
2020	460,913
2021	594,206
2022	656,308
2023	703,283
2024	732,854
2025	777,139
2026	803,302
2027	837,224
2028	856,872
2029	865,756
2030	877,307
2031	841,934
2032	793,737
2033	734,684
2034	683,224
2035	655,122
2036	595,078

2037	527,588
2038	489,592
2039	432,001
2040	393,332
2041	338,016
2042	290,753
2043	256,939
2044	213,219
2045	182,600
2046	144,629
2047	116,803
2048	96,711
From January 1st to October 22nd 2049	46,916
Total estimated ERs	16,053,622
Total number of crediting years	30
Average annual ERs	535,121

1.11 Description of the Project Activity

The main objective of the present grouped REDD project is the conservation of a region within the municipalities of Porto Velho in the State of Rondônia and Lábrea, in the south of Amazonas State. This will be achieved through avoidance of unplanned deforestation. The three first instance of this Grouped Project presents a 52,274.05 ha of forest area within the Grupo ROVEMA

(20,232.05 ha), Grupo Leite (13,204.20 ha) and Grupo Tupá (18,837.60) forest areas. In the future, new instances may be added to the project, expanding the conservation of the forest.

The main mitigation action of the project is to avoid unplanned deforestation through the expansion of monitoring of the area, mapping of deforestation, establishment of partnerships with education and research institutions and the insertion of the surrounding communities in the project activities, aiming to minimize invasions and illegal deforestation, offering alternative income, education, and professional training.

It is important to note that this grouped project is not located within a jurisdiction covered by a jurisdictional REDD+ program. There are several ways to operationalize REDD+ as a financing instrument. In Brazil, the National REDD+ Commission is responsible for coordinating the elaboration of the requirements for access to REDD+ payments by results. As per the Federal Decree[13] that created such Commission, there are still regulation to be performed.

The State of Tocantins is the Brazilian State with more advanced public policies regarding Jurisdictional REDD initiative[14] [15]. However, as informed by the State of Tocantins official website[16], one of the upcoming steps is signing of the investment contract to make the Tocantins Jurisdictional REDD+ Program viable. Thus, the more advanced Brazilian State on such subject does not have an implemented Jurisdiction REDD Program. It can be concluded the other Brazilian States (such as Amazonas and Rondônia where the Rio Madeira Grouped REDD+ Project is located) have no public policies that recognize REDD+ at the project level and currently do not have the technical and regulatory framework necessary for the implementation of a Jurisdictional regime with carbon credits.

In recent years, the project region has been deforested for the expansion of agricultural and livestock activities, mainly due to the advancement of the so-called arc of deforestation from the south of the Amazon biome. This pressure is expected to continue, given the globalization of markets in the Amazon region and international development policies planned for the region[17].

Although some instances may present Sustainable Forest Management Plan (SFMP), as implemented by instances 1 and 3, it is important to note that the practice is not sufficient to avoid deforestation, especially in a region with high deforestation rates, as the operation takes place only in a part of the property, while the rest is still vulnerable to wood and land grabbers. In addition, the SFMP has a considerably short period to finish, thus failing to generate income

13 Available at <https://www.planalto.gov.br/ccivil_03/_ato2023-2026/2023/decreto/D11548.htm> Last visit on 06-May-2023
14 Available at <https://www.to.gov.br/noticias/tocantins-e-o-primeiro-estado-do-brasil-a-negociar-creditos-de-carbono-no-mercado-internacional/6gg4pips3omj> Last visit on 16-September-2023
15 Available at <https://www.to.gov.br/semarh/noticias/redd-jurisdicional-do-tocantins-se-torna-referencia-para-outros-estados/33am9kxv946h> Last visit on 11-September-2023
16 Available at <https://www.to.gov.br/secom/noticias/tocantins-apresenta-redd-jurisdicional-do-estado-aos-representantes-da-uniao-de-parlamentares-sul-americanos-e-do-mercosul/6wu114rkqizz> Last visit on 16-September-2023
17 Nepstad, D. C.; C. M. Stickler e O. T. Almeida. 2006. Globalization of the Amazon Soy and Beef Industries: Opportunities for Conservation. Conservation Biology 20(6):1595-1603.

and protect the forest effectively. Please find additional deforestation assessment within SFMPs at section 3.4 and 3.5.

As part of the Governance Structure of Rio Madeira Grouped REDD+ Project and Community Engagement, the project activities were designed based on social assessments such as household surveys and interviews with different groups of stakeholders, which includes local communities and organizations. For the Rio Madeira Project, in order to maintain and improve the benefits for the climate, community and biodiversity for the duration of the Project and beyond its lifetime, the project focuses on the following forest conservation and socioenvironmental strategies:

- Strengthen patrimonial surveillance by implementing and intensifying surveillance, local patrolling and satellite monitoring in the project area in order to guarantee forest integrity. In addition, training for farms workers will be offered with the aim of developing capacities and skills to take appropriate action in cases of illegal activities in the project area. In this sense, the project intends to strengthen local partnerships, especially with environmental fiscalization bodies, to assist in combating illegal activities within the properties and facilitate communication for possible reports of complaints. In addition, placards will be installed at the property entrances and at its borders to inform about the project and restrictions within the forest area (such as access, hunting, and fire), as well as landmark will be set to properly demarcate the properties' boundaries and the limits between neighboring properties. These measures are intended to prevent illegal invasion and illegal practices within the project area.
- Implement a Fire Prevention and Control Program that will involve measures designed to detect, prevent, and suppress fires, as well as mitigate their effects, and train a qualified fire brigade. The Forest Fire Prevention and Combat Plan (PPCIF, acronym in Portuguese) will be structured and implemented as a risk management and contingency instrument for fires that may affect the project area.
- Implement and strengthen a communication channel with farm neighbors, aiming to establish a contact network to warn about deforestation, invasions and fires, allowing joint action to reduce these actions and optimize resources.
- Enhance community livelihoods and improve infrastructure to support economic development and human well-being. Project activities aim to develop local businesses, promote income-generating activities and food security, which are critical components of a long-term low-carbon economy by strengthening of sustainable productive value chains. In this sense, the project will establish partnerships to provide technical training and ensure financial and productive independence of nut harvesters, cooperatives, associations, and other parties involved. Furthermore, the project will implement social and recreational spaces for employees who live on the farms, aiming to improve their well-being and encourage social events among them. The project also plans to improve infrastructure of public schools and promote educational activities for young people. In addition, the project will offer training courses and workshops for women in order to promote new skills, leisure activities and additional income, based on themes previously mapped out as demands (such as cookery, nutrition, baking and confectionery).

- Engage communities and strengthen governance will generate autonomy and social empowerment, as well as improvement of community engagement in decision-making on environmental and social demands. Communication channels and committees will be set up with the participation of local community representatives. In addition, project activities will promote the participation of community groups in the design and implementation of project activities. Therefore, during the implementation phase of activities, strategies to promote community participation will be taken into consideration, especially for women and vulnerable people.

  Develop scientific knowledge about local biodiversity and implement monitoring and protection mechanisms. In this sense, diagnosis of fauna and flora and continuous monitoring to assess species richness and presence of species with some degree of vulnerability according to IUCN will be conducted. In addition, participatory environmental education activities will be developed in partnership with local schools and communities, in order to strengthen good biodiversity conservation practices by combating illegal hunting, burning and deforestation in the project region.

Table 4. Project Activities of the Rio Madeira Grouped REDD+ Project

Project Activity	Objectives	Beneficiary Groups	Implementation Schedule	SocialCarbon Indicators
Implement and intensify patrimonial surveillance, local patrolling and remote satellite monitoring in the project area.	Guarantee forest integrity and prevent illegal invasion and illegal practices.	N/A	Since Project Start Date	1. Conflict management 2. Land tenure 3. Quality control
Structure and implement the Forest Fire Prevention and Combat Plan (PPCIF).	Detect, prevent, and suppress fires, as well as mitigate their effects. Train a qualified fire brigade. Promote forest integrity. Maintain carbon stocks.	N/A	From 2024 onwards	1. Buffer reduction 2. Quality control
Implement and strengthen a communication channel with farm neighbors.	Establish a contact network to warn about deforestation, invasions, and fires, allowing joint action to reduce these actions and	Landowners and farm neighbors	From 2024 onwards	1. Conflict management 2. Land tenure

	optimize resources.			
Establish partnerships to provide technical training.	Develop local businesses, promote income-generating activities and food security and ensure financial and productive independence for local stakeholders.	Nut harvesters, employees and local communities	From 2023 onwards	1. Community education and training 2. Alternative income sources 3. Social and environmental investments 4. Non-timber forest products (NTFPs)
Implement social and recreational spaces and improve infrastructure of public schools.	Promote satisfactory well-being and economic development.	Local schools and farm workers	From 2023 onwards	1. Expansion of community activities 2. Carbon credit benefits 3. Social and environmental investments
Promote educational opportunities activities for young people.	Ensure access to inclusive, quality, and equitable education, and promote learning opportunities.	Young people in the communities	From 2024 onwards	1. Expansion of community activities 2. Community education and training 3. Carbon credit benefits 4. Social and environmental investments
Offer training courses and workshops for women.	Promote new skills, leisure activities and additional income for women	Women living on the project farms and in the surrounding community	From 2024 onwards	1. Women inclusion 2. Community education and training 3. Alternative income sources 3. Carbon credit benefits 4. Social and environmental investments
Set up communication channels and committees with the participation of local	Stakeholders engagement through access to information and	Local communities and farm workers	Since Project Start Date, but the procedure and standardization	1. Stakeholder consultation 2. Conflict management 3. Land tenure

community representatives.	participation in project activities.		of these communication flows will be completed in 2023.	4. Associations and Cooperatives
Conduct fauna and flora diagnosis.	Increase knowledge and monitoring of the biodiversity of local species	Local fauna and flora	From 2023 onwards	1. Biodiversity monitoring 2. Impact on remaining flora
Continuous species monitoring, especially with some degree of vulnerability (IUCN).	Increase knowledge and monitoring of the biodiversity of local species	Local fauna and flora	From 2024 onwards	1. Biodiversity monitoring 2. Impact on remaining flora
Develop participatory environmental education activities.	Strengthen good biodiversity conservation practices to combat illegal hunting, burning and deforestation in the project region	Local communities and employees	From 2024 onwards	1. Expansion of community activities 2. Community education and training 3. Social and environmental investments

Besides forest conservation, the present project aims to improve and quantify its social and environmental benefits through application of the SOCIALCARBON® Methodology. This methodology is an innovative concept developed by the Ecológica Institute to measure the contribution of carbon projects to sustainability. The SOCIALCARBON® Methodology is based on six main resources: Biodiversity; Natural; Financial; Human; Social and Carbon Resources and aims to deliver high-integrity benefits in each. This plan will be based on the monitoring parameters, in addition to being verified in every Social Carbon Report.

The Social Carbon methodology drives continuous improvement in the local community through prospects (at least one per resource, totaling 6 improvement actions), in which the project owner undertakes to implement them until the next monitoring period.

To guarantee the evolution of the socioenvironmental scenario in the region, Social Carbon Standard requires that at least 50% of the actions suggested in the previous Point must be implemented, under the risk of losing the Standard. The monitoring period for Social Carbon should be the same as the monitoring period for the Carbon Accounting Standard. Key elements of successful relationships with community stakeholders include, explaining project activities in a meaningful way, respecting local and traditional decision making and conflict resolution processes, transparent co-benefit activities, development of inclusive activities, monitoring and

adaptive management, as well as timely fulfilment of commitments made to communities since the project start date. The landowners have a friendly relationship with the communities even before the Project, where they often assisted financially in some actions, and had an active participation in the choice of communities that are in the action plan.

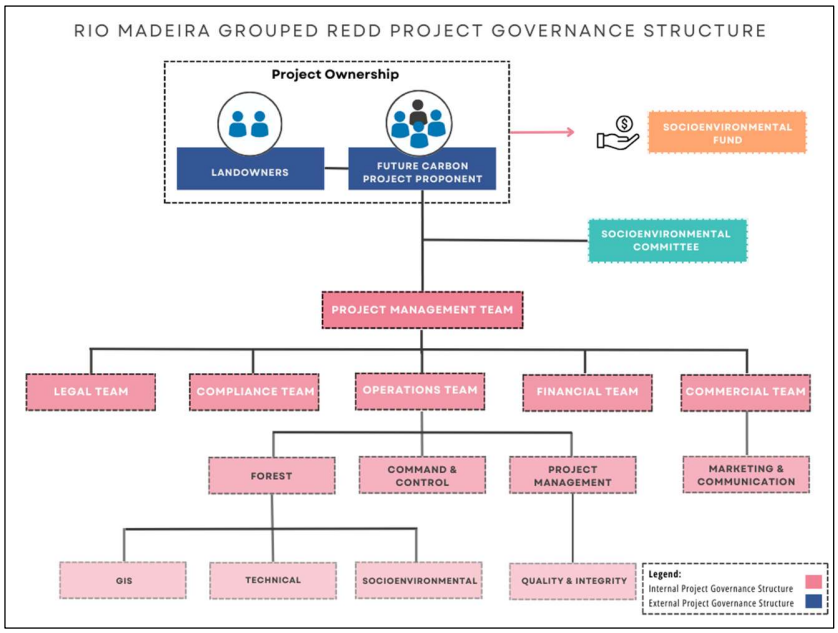
As part of the Governance Structure of Rio Madeira Grouped REDD+ Project, the project activities were designed based on information collected during interviews with the project owners, employees within 4 private properties, and local stakeholders.

The socioenvironmental activities will be operated under the guidance of the Future Carbon Group Technical Team. When necessary, third-party providers may be hired to perform services that require technical specifications, however, Future Carbon will be responsible for selecting, contracting and monitoring the services of these providers, ensuring the efficient and successful implementation of the project. The project also plans to establish partnerships with institutions (public and/or private) to carry out some of the activities, especially activities related to the development of the Brazil nut chain and good management practices but is not limited to these topics.

Regarding protection and surveillance activities to guarantee forest integrity, these activities are the responsibility of the owners. They are responsible for hiring the private surveillance company or employee to provide the service. They are also responsible for other activities to ensure the implementation and continuity of monitoring activities, such as maintenance of bases, acquisition and maintenance of vehicles, improvements to local infrastructure, etc.

The project governance structure organizational chart below describes the roles and responsibilities team members divided into interconnected areas:

Figure 5. Project Governance Structure



As presented in the above figure, Future Carbon and the landowners are partners and proponents of the project, all being responsible for the project, and this partnership agreement is demonstrated through a contract signed by all parties. Both proponents are also responsible to manage the Socioenvironmental Fund, which will be created to allocate part of the resources arising from the sale of credits to develop socio-environmental activities, aiming to promote co-benefits and prevent leakage. This fund will be governed by the premises described in Future Carbon's internal document called "General Guidelines for Management of the Socio-Environmental Fund", which is available for the VVB. The Socioenvironmental team of Future Carbon are responsible for planning socio-environmental activities, monitoring implementation and indicators, and evaluating the effectiveness of actions (Table 6).

The table below provides information about the responsibilities of the parties involved in the project governance structure.

Table 5. Parties involved in the Rio Madeira governance structure, their roles and responsibilities.

Roles	Responsibilities
Project Proponent	Future Carbon Group is responsible for the coordination of all activities required for the preparation of the Project Design Document (PDD), including socio-economic and environmental assessment and activity planning, monitoring the implementation of socio-environmental and leakage prevention activities, baseline studies and carbon stock estimation, initial financing, monitoring and implementation of proposed GHG emission reduction/mitigation activities, dissemination of project documentation, project validation/verification, delivery of monitoring results to stakeholders, commercialization of generated credits, and co-management of the project throughout its duration.
Landowners	Grupo Leite, Rovema and Tupá are the owners who own the land titles, all property assurance of rights are recognized, are linked to the project through conservation agreements signed between each property instance and the project proponent; responsible for implementing surveillance and monitoring the project area to avoid any invasions, changes in the biome or any other activity that could lead to deforestation, leakage and loss of biodiversity; responsible for conducting operations in the field and providing logistical support for on-site technical visits; provide investment in the protection of project area and socio-environmental development; link field staff to management team, report to project management team any deforestation outbreak in the project area.

Co-Investors	Companies that become investor in early-stage project development that require up-front funding to be built and then receive their portion of the credits as they are issued over time. Alternatively, the company may wish to invest in early-stage project without purchasing the credits if they simply like what the project is trying to accomplish. This is particularly helpful in the early stages of project development, as many projects and project developers require additional financial support as they scale up to meet the project's goals and provide benefits to the community. Equity investments can also help companies build trust and a long-term relationship with project developers. In addition, companies become part of the project governance structure to ensure the delivery of high-quality carbon credits.

The Future Carbon team is made up of different areas with diverse expertise to ensure quality management, planning, and implementation of the project, as detailed in the table below.

Table 6. Future Carbon departments and their responsibilities

Department	Functions
Forest - Technical	Forest's technical department coordinates the day-to-day activities that are required to develop and sustain a high-carbon project. Develops the PDD, executes and monitors the evolution of the project, providing technical knowledge and support where necessary. It is also the focal point for relationships with owners.
Forest - Socioenvironmental	The socio-environmental department is part of Forest's technical team and is responsible for the project's socio-environmental activities, such as consultation with stakeholders, development of activities together with the community (co-benefits), safeguards management, and monitoring and enhancement of biodiversity. It is also the focal point for relationships with communities. They are responsible for planning socio-environmental activities, monitoring execution, monitoring indicators, and evaluating the effectiveness of actions.
Forest - GIS	Coordinates and executes GIS mapping activities, develops and selects the baseline model, generates and analyzes monitoring information on land use and deforestation rates.
Operations – Command & Control (CI3C)	Department focused on risk management and ensuring the permanence of carbon projects. Performs field analysis, risk mapping, and develops action plans for management and protection of the area, including satellite monitoring, firefighting plans, safety training, and maintenance of the area.

Operations – Project Management	It represents a management structure that standardizes project-related governance processes and facilitates the sharing of resources, tools and activities between the departments involved. They are responsible for improving project management in terms of schedule, costs, quality, risk and other variables.
Operations – Quality & Integrity	Department focuses on meeting high levels of quality performance and project integrity. Through the Quality and Integrity Management Plan, it carries out quality control and quality assurance activities, identifying opportunities for improvement and training the technical department to meet them.
Legal	Establishes a quality standard for all legal agreements formalized for project development, including with the owner, service providers involved and other interested parties. Manages established contracts, ensuring compliance with all proposed requirements.
Compliance	Responsible for conducting Due Diligence processes before contract signing, and mapping and managing compliance risks throughout project development.
Financial	Responsible for ensuring that financial operations are conducted in a legal, efficient and transparent manner. Manages the company's financial resources and the Socio-Environmental Fund, including payment of expenses, debts and income.
Commercial	The commercial department is responsible for conducting market research, prospecting new potential partners and negotiating commercial agreements for the sale of credits. Works closely with other departments to ensure that projects meet the needs and requirements established by clients.
Commercial – Marketing & Communication	Supports engagement and communication processes with the project's various stakeholders, developing materials for dissemination and transparency of information about the projects.

The ex-ante estimate for the predicted avoided deforestation within the first three instances project area over the 30-year project lifetime would be 34,681.91 ha. The expected emissions reductions are 16,053,622 tCO2e over the 30-year project lifetime (23-October-2019 to 22-October-2049), equating to an average annual of 535,121 tCO2e.

1.12 Project Location

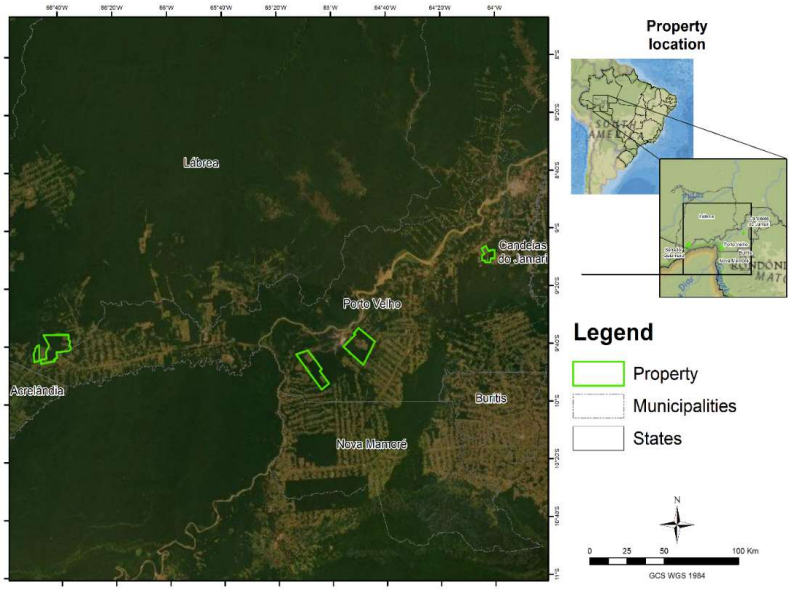
The Rio Madeira Grouped REDD+ Project is situated in the municipalities of Porto Velho in State of Rondônia and Lábrea, in State of Amazonas, both in the north of Brazil, a region known as Southern Amazon. Belonging to the South-Amazonian Mesoregion and Microregion of Madeira, Porto Velho and Lábrea's population, according to the Brazilian Institute of Geography and Statistics (IBGE) in 2021, had about 596,000 inhabitants. Their territorial areas sum up to

around 102,352 km², which makes them among the largest municipalities in Brazil in the territorial area.[18]

The area of the first project activity instance comprehensively belongs to Grupo ROVEMA, the second project activity instance belongs to Grupo Leite and the third belongs to Grupo Tupá[19] (Figure below). In accordance with VCS requirements, stipulated in Approved VCS Methodology VM0015, version 1.1, they are areas which include only "forest"[20] for a minimum of ten years prior to the project start date'. To define the project area, areas within the three properties that were defined as forest for ten years prior to the project start date were identified and utilized to compose the project area.

Table and figure below show the location of the project area (detailed coordinates are described in Appendix I):

Figure 6. Project Activity Instances location



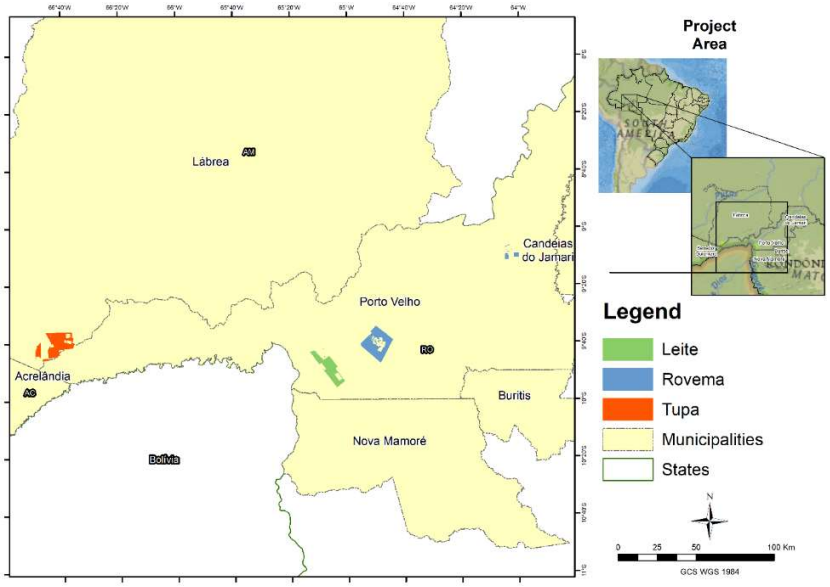
18 Brazilian Institute of Geography and Statistics (IBGE) < https://www.ibge.gov.br/cidades-e-estados/ro/porto-velho.html>
19 More information about the split properties, see section "1.7 - Ownership"
20 The applied definition of forest is from the FAO: "Land with tree crown cover (or equivalent stocking 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>

Table 7. Centroid location coordinates by property

Ownership	Properties	Centroid location coordinates
Grupo ROVEMA	Fazenda Rio Madeira	9°40'41.22"S ; 64°49'40.57"W
	Fazenda Serra Verde	9°07'33.76"S ; 64°03'21.22"W
Grupo Leite	Fazenda Santa Carmem	9°46'01.89"S ; 65°07'25.50"W
	Fazenda Santa Carmem I	9°52'20.83"S ; 65°04'24.96"W
	Fazenda Santa Carmem II	9°46'39.08"S ; 65°09'42.32"W
Grupo Tupá	Fazenda Beleza	9°41'38.45"S ; 66°43'15.96"W
	Fazenda Fronteira	9°43'04.65"S ; 66°41'39.67"W
	Fazenda Iracema I	9°39'33.69"S ; 66°38'49.99"W
	Fazenda Iracema II	9°37'16.84"S ; 66°39'45.12"W
	Fazenda Seringal Novo A	9°37'25.59"S ; 66°43'54.66"W
	Fazenda Seringal Novo B	9°42'43.80"S ; 66°48'33.02"W

The location of each instance that compose the grouped project can be visualized at the following Figure:

Figure 7. Initial instances that compose the project



1.13 Conditions Prior to Project Initiation

The present project activity has not been implemented to generate GHG emissions for the purpose of their subsequent reduction, removal, or destruction. On the other hand, the project aims to combine REDD and socioenvironmental activities, which will promote forest conservation combined with alternative income generation from sustainable practices, associated with a greater surveillance against deforestation encroachers.

It is worth highlighting the project area is formed forest areas for 10 years before the project start date, despite the pressure for land-use change in the zone. Furthermore, despite being subject

to deforestation and the common economic activities such as forest management plan, livestock, among others, such activities were not carried out in the project area for the last 10 years prior to the project start date. Thus, the project activity meets the VCS criteria as described at the VM0015 Applicability conditions: "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 general characteristics of the project area are described below:

Climate

The project region is classified as Tropical rainforest climate type – category Am – in the Köppen climate classification[21]. This means that it has no dry season, and the average annual rainfall is high, averaging between 2,000mm and 2,500mm year^{-1} in the project area. The relative humidity average in the region is 85%[22].

These conditions combined make excellent conditions for biomass to thrive, leading to the high levels of biomass described below. The Am climate type is defined as Humid or sub-humid tropical climate. It is a transition between the Af and Aw climate type. It is characterized by having an average temperature of the coldest month always above 18ºC, presenting a dry season of short duration which is compensated by high total rainfall.[23]

The annual precipitation in the project area is around 1809,77 mm (Figure 3)[24], while the reference region is around 1879.3 mm (Figure 4) [25]. This means that the amount of rainfall in the project area is within the description around 10% of the rest of the reference region, that varies between 1691.8 mm e 2067.76 mm.

21 KÖPPEN, W.; GEIGER, R. Klimate der Erde. Gotha: Verlag Justus Perthes. 1928. Available at: <https://www.britannica.com/science/Koppen-climate-classification> Access on 29/12/2021.
22 CLIMATE DATE.ORG – Porto Velho Relative Humidity. Available at: <https://pt.climate-data.org/america-do-sul/brasil/Rondônia/porto-velho-3120/> Access on 29/12/2021
23 EMBRAPA – Am climate definitons. Available at: <https://www.cnpf.embrapa.br/pesquisa/efb/clima.htm>
24 WorldClim – Annual rainfall in the project area Rio Madeira Grouped REDD+ Project. Available at: <https://www.worldclim.org/data/worldclim21.html>
25 WorldClim – Annual rainfall in the reference region Rio Madeira Grouped REDD+ Project. Available at: <https://www.worldclim.org/data/worldclim21.html >

Figure 8. Variation of annual precipitation in the Project Area

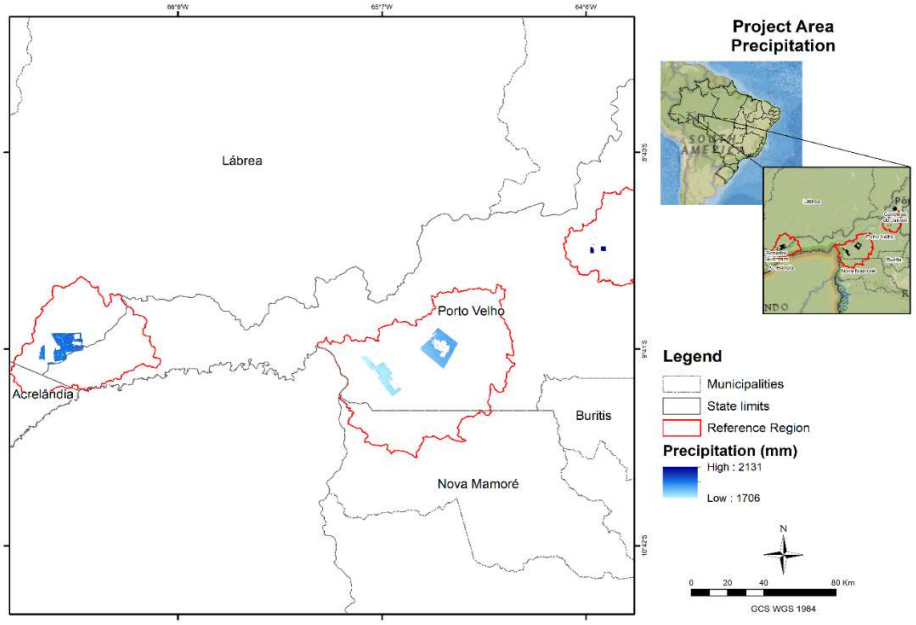
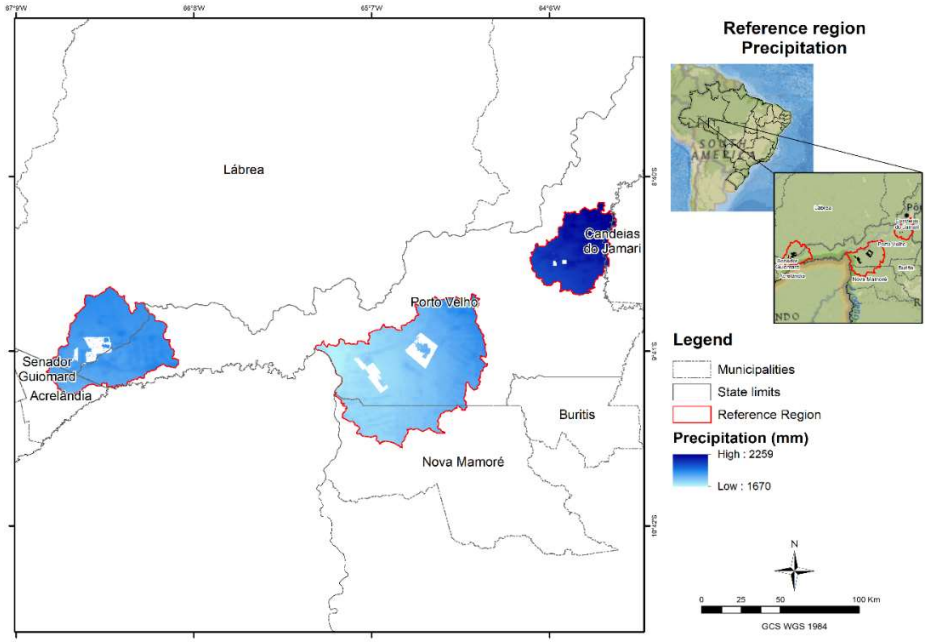


Figure 9. Variation of annual precipitation in the Reference Region



Geology, Topography and Soils

The distribution of soils types within the reference region and project area was obtained in IBGE solos database[26], and is available in the following images:

[26] Available at <https://geoftp.ibge.gov.br/informacoes_ambientais/pedologia/vetores/escala_250_mil/> Last visit on 15/January/2023

Figure 10. Soil types within the reference region

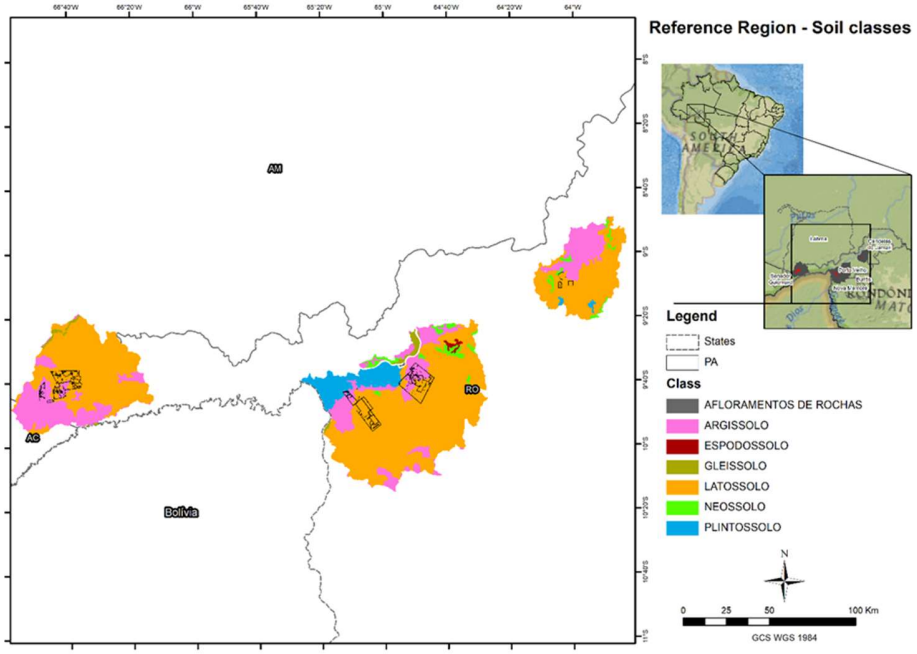
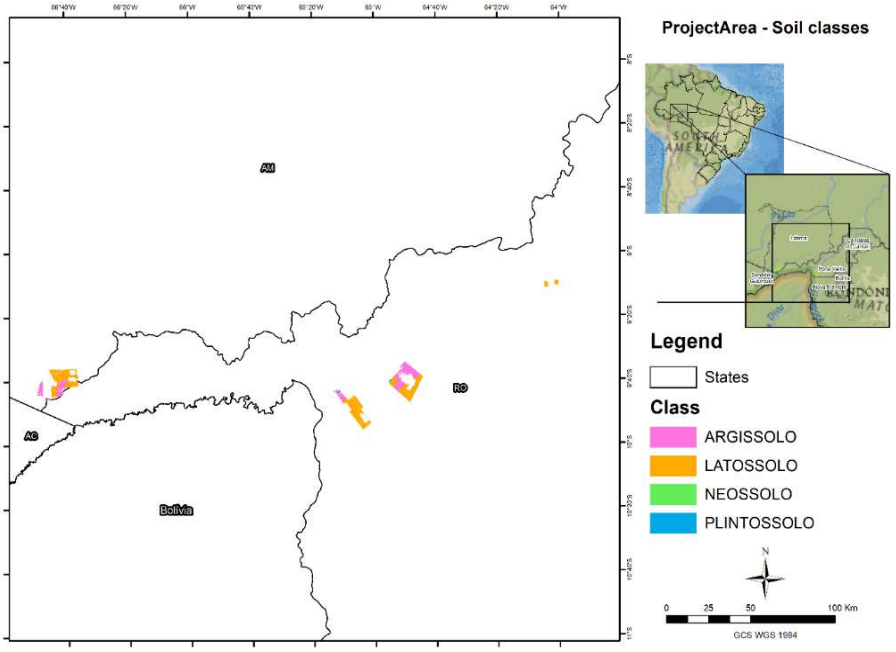


Figure 11. Soil types within the project area



As per mentioned IBGE data source, the soil types present in the project area are: Latosoil, Argisoil, Plintosoil, Gleisoil, and Neosoil.

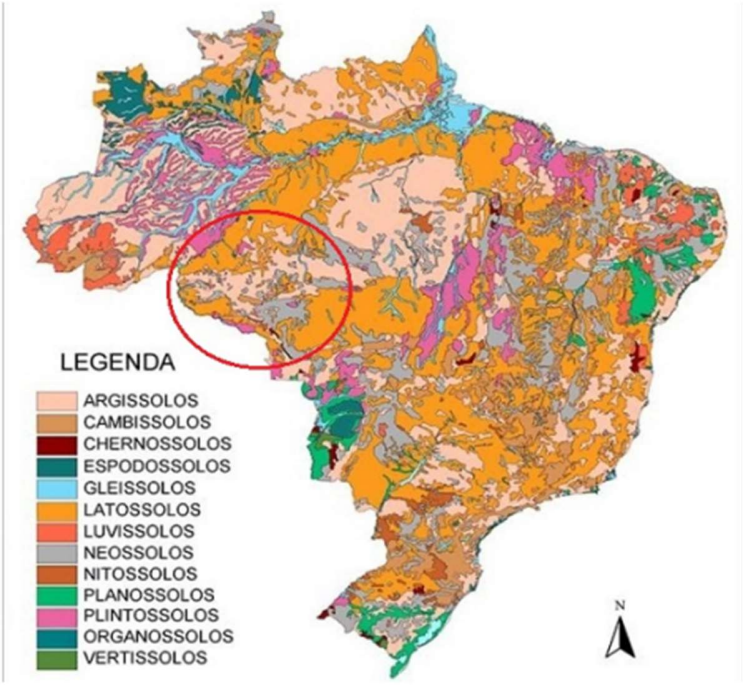
In order to assure methodology compliance, it was analyzed the presence of peatlands. For such assessment, it was used the mentioned IBGE soil database where vector files with soil types

within Brazil are available, and the Embrapa solos[27] (Brazilian Corporation for Agriculture Research) database. Embrapa solos points the occurrence of peatlands is not typical at mineral soil types, and also informs the soil types present in the project area are mineral, thus without peat. The occurrence of peats in specific types of soils is also reinforced by IBGE, by its publication named Pedology Technical Manual[28]. In this manual, peats are related to organic soil types, a soil type which in not presented in the Project Area, as shown in the soil image above.

Thus, the occurrence of peatlands, which is typical of organic material soil types, is not present within the project area.

From a national perspective, the soil distribution is available below:

Figure 12. Soils in Brazil (red circle in the reference region surroundings)



Regarding the suitability of land use in Rondônia, studies show that 59% of the territory has soils suitable for farming at different levels of use. The aptitude of uses with cultivated pastures add up to 16% of the territory, as the native pastures have potential suitability for use, make up 5% of the territorial area. The areas destined for preservation remain corresponding to 20% of the territorial area.

27 Available at: <https://www.embrapa.br/solos/busca-de-publicacoes/-/publicacao/1094003/sistema-brasileiro-de-classificacao-de-solos Last visit on 25/January/2023>
28 Available at <https://biblioteca.ibge.gov.br/visualizacao/livros/liv95017.pdf> Last visit on 26/January/2023

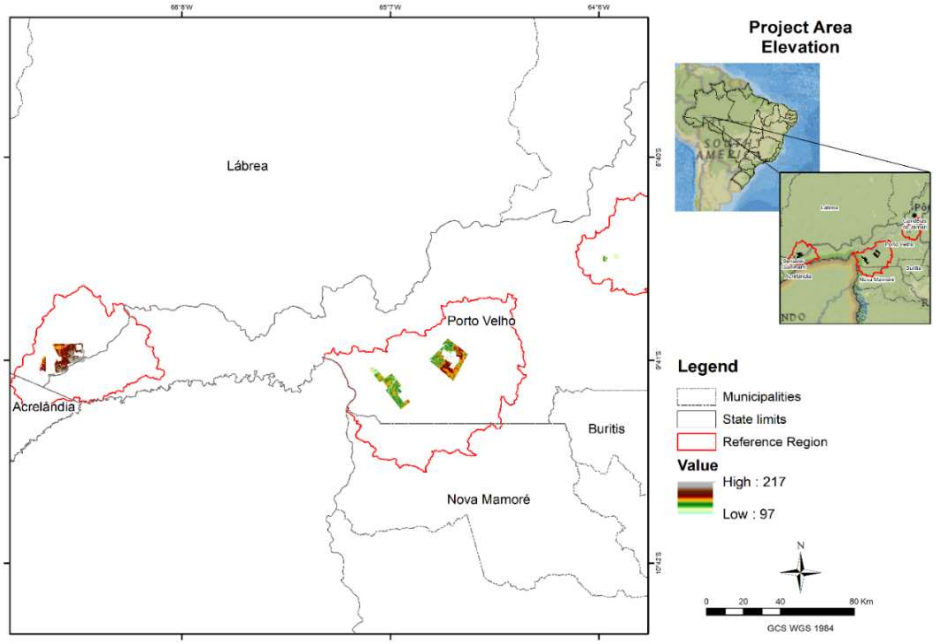
Most of the soils in the State of Rondônia were originally covered by the Amazon Forest that kept them protected. despite low fertility natural, had high relative productivity, mainly due to recycling of nutrients and the preservation of organic matter, which provides good soil quality, due to its physical, chemical and biological characteristics, thus forming a balanced and efficient system.

The relief of the State of Rondônia is basically composed of plains and plateaus low, these have on average, altitudes ranging from 90 to 1000 meters in relation to sea level. Thus, the type of relief that predominates in the territory varies. From 100 to 600 meters, this is approximately 94% of the entire state area, the rest reach elevations in excess of 600 meters. However, the relief shown is constituted by four geomorphological units: Amazonian Plain, North of the Brazilian Plateau, Chapada dos Parecis and Paacás Novos and Guaporé-Mamoré Valley.

The State of Amazonas territory is almost fully covered by flat landscapes, which barely does not reach 200 m altitude. The central formation of the state was modeled by the hydrographic network, responsible for disaggregating the transport and deposition of materials. The Amazonian Plain covers almost the entire state of Amazonas. However, it is limited in the southern portion by the Central Plateau and in the northern portion by the Guiana Plateau[29].

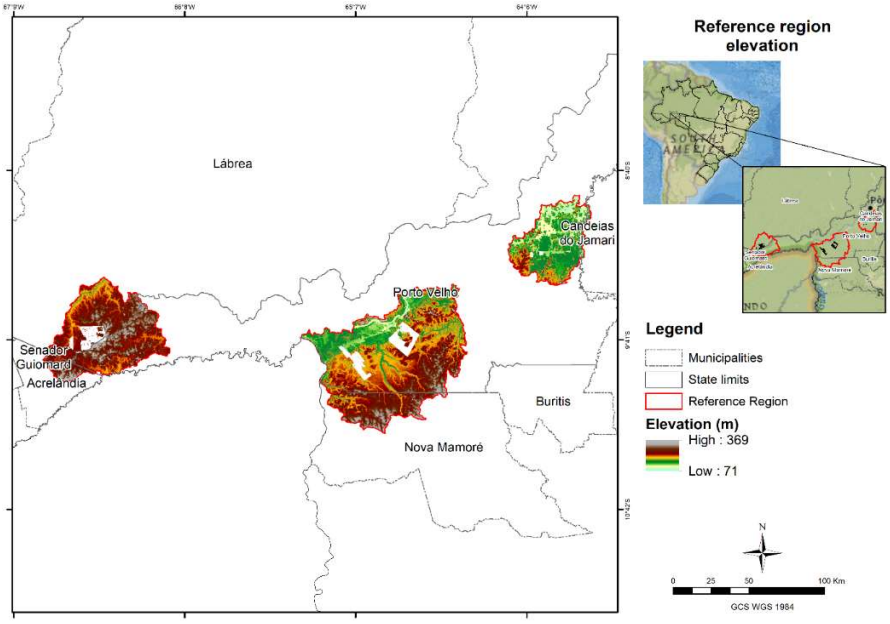
The altitude in the project area varies from 97 to 217m (Figure 13), these values are within 100% of the remaining position of the reference region (Figure 14).

Figure 13. Rio Madeira REDD Project area elevation



29 Available at: <https://www.infoescola.com/geografia/geografia-do-amazonas/#relevo >. Last visit on 29/December/2022.

Figure 14. Rio Madeira REDD Project Reference region elevation



The average slope in the project area is 4.86 percent, while in the rest of the reference region is 4.77 percent, as per figures below.

Figure 15. Project area Slope variation

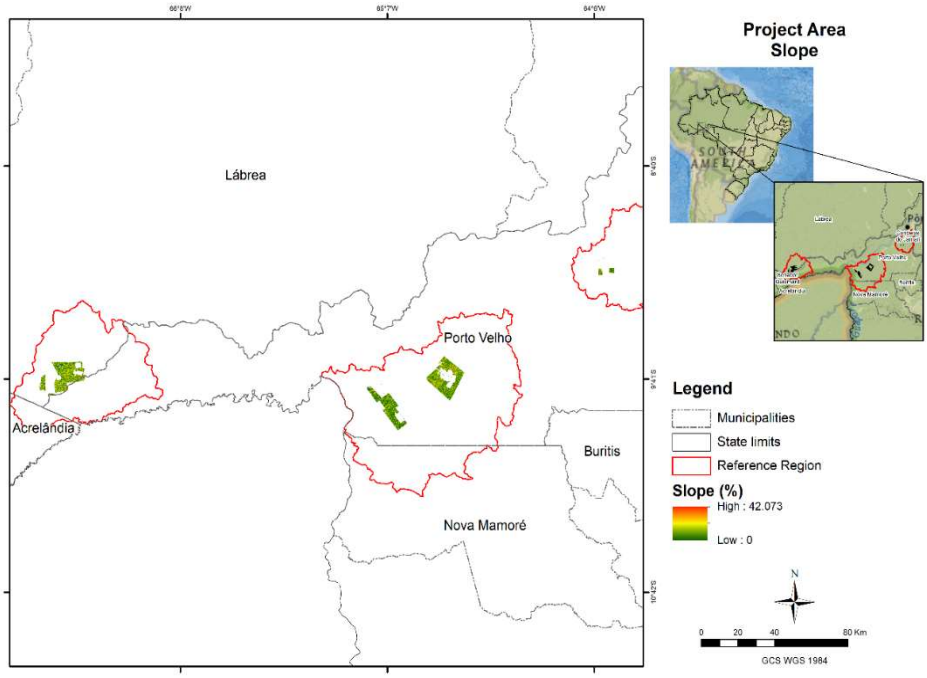
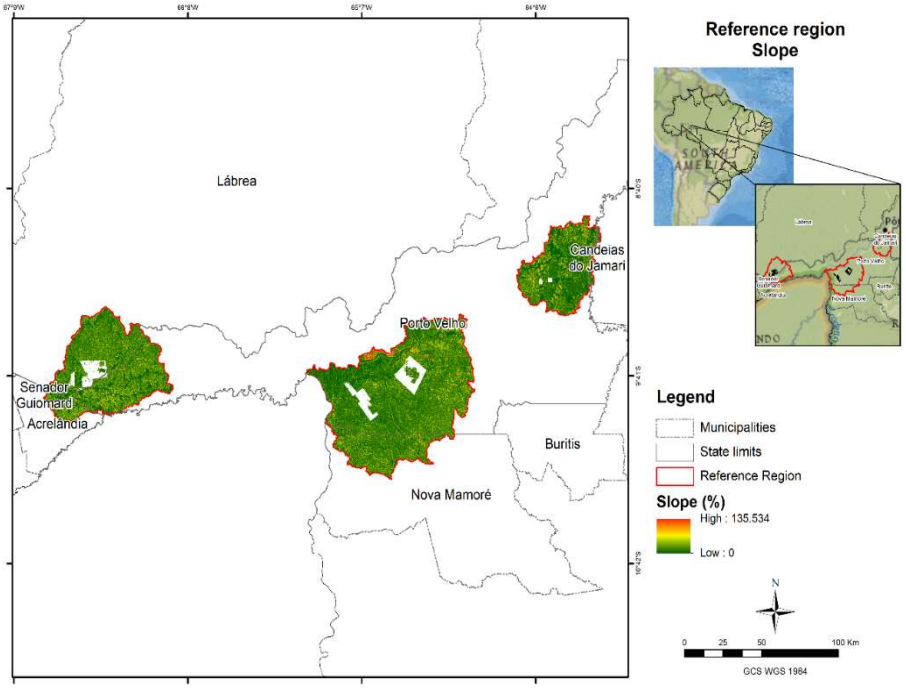


Figure 16. Reference region Slope variation



Socio-economic conditions

The socio-economic conditions of the 3 municipalities that compose the project area are described below[30]:

- Lábrea - AM

Population	Brazilian Census (2010): 37,701 habitants Estimated (2021): 47,685 habitants
Land occupation	The demographic density is 0.55 hab/km²
Economy	The GDP per capita of the municipality is R$10,994.24. The average income is of 1.9 minimum wages, and 4.6% of the population is categorized to carry out a professional activity (formal or informal, paid or not). This puts the city in the State ranking, 11/62 and 45/62, respectively. 52,7% of the population lives in families with monthly income of up to half a minimum wage per person.
Education	The municipality has 85,7% of its 6-14 years population in school.
Health	The average infant mortality rate in the city is 19.98 deaths per thousand livebirths.
Infrastructure	Only 18% of households have adequate sanitation; 64.4% of urban households are located on public roads with trees and 9.4% on public roads with adequate urbanization (presence of manhole, sidewalk, paving and curb).

30 All information provided in this section is from IBGE surveys and may be consulted in <https://cidades.ibge.gov.br/ >.

HDI	0.531

- Porto Velho – RO

Population	Brazilian Census (2010): 428,527 habitants Estimated (2021): 548,952 habitants
Land occupation	The demographic density is 12.57 hab/km²
Economy	The GDP per capita of the municipality is R$33,825.46. The average income is of 3.3 minimum wages, and 30.6% of the population is categorized to carry out a professional activity (formal or informal, paid or not). This puts the city in lower positions in the State ranking, 1/52 and 1/52, respectively. 34 % of the population lives in families with monthly income of up to half a minimum wage per person.
Education	The municipality has 95.4% of its 6-14 years population in school.
Health	The average infant mortality rate in the city is 17.61 deaths per thousand livebirths.
Infrastructure	Only 42.8% of households have adequate sanitation; 40% of urban households are located on public roads with trees and 21.7 % on public roads with adequate urbanization (presence of manhole, sidewalk, paving and curb).
HDI	0.736

- Nova Mamoré - RO

Population	Brazilian Census (2010): 22,546 habitants Estimated (2021): 32,184 habitants
Land occupation	The demographic density is 2.24 hab/km²
Economy	The GDP per capita of the municipality is R$17,305.73. The average income is of 1.8 minimum wages, and 6.7% of the population is categorized to carry out a professional activity (formal or informal, paid or not). This puts the city in lower positions in the State ranking, 28/52 and 48/52, respectively. 44.5 % of the population lives in families with monthly income of up to half a minimum wage per person.
Education	The municipality has 92.8% of its 6-14 years population in school.
Health	The average infant mortality rate in the city is 7.09 deaths per thousand livebirths.
Infrastructure	Only 8.2% of households have adequate sanitation; 2.9% of urban households are located on public roads with trees and 0.1 % on public roads with adequate urbanization (presence of manhole, sidewalk, paving and curb).
HDI	0.587

Biodiversity

As stated in the present document, the project is located in private properties within two Brazilian States: Rondônia and Amazonas, both located in the southern Amazon. Nevertheless, in terms

of biodiversity, States boundaries can be ignored, thus biodiversity data can be Southern Amazon-related.

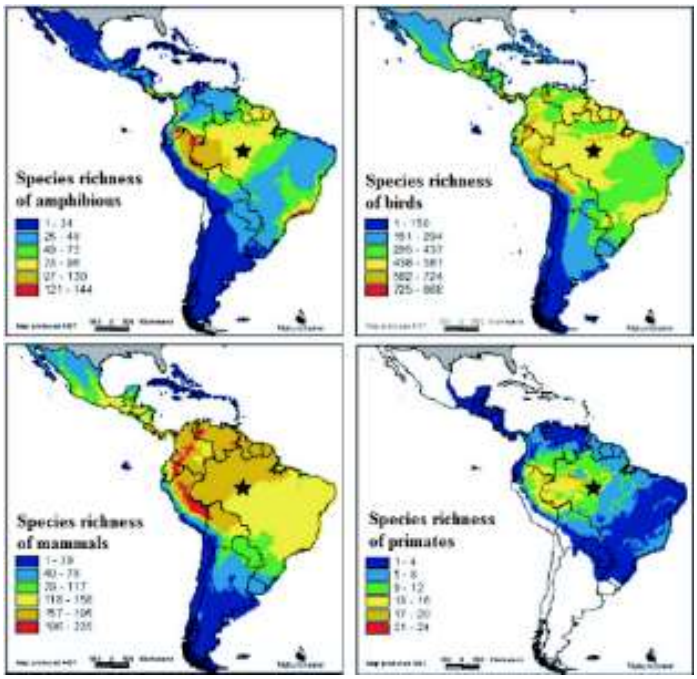
The Brazilian Government Ministry for the environment (Ministério do Meio Ambiente) included the project region in its 2018 survey of Brazil's 900 priority areas for conservation[31]. The Project Area is classed within the ministry's "extremely high" and "high" classes, as demonstrated in the Figure below. The report classified the priority actions in the area as "inspection and control of illegal activities" and "regularization of degrading activity".

The Southern Amazon Mosaic is located in a well-preserved region within the Legal Amazon, noting its high biological importance. However, this is also one of the least scientifically known regions of Brazil and therefore considered a priority area for wildlife inventories[32].

In the regional context, the Southern Amazon Mosaic is within areas of high richness of birds, mammals and amphibian species, according to Figure below. Although scientific research is scarce in the region, it is very likely that the existing biodiversity assessments underestimate the reality. A recent example was a new primate species found in the region, named Zogue-zogue fire tail (Callicebus miltoni)[33].

Figure 17. Space richness of amphibians, birds, mammals, and primates within the project region

31 MMA (2018): <http://areasprioritarias.mma.gov.br/2-atualizacao-das-areas-prioritarias> Access on 29/12/2020.
32 WWF (Brasil). Mosaico da Amazônia Meridional: Vencendo limites geográficos e integrando gestão. Brasília-DF: WWF, 2014. 136 p. Available at: http://d3nehc6yl9qzo4.cloudfront.net/downloads/mam_livro_vencendo_limites_geograficos_final.pdf . Access on 29/12/2020
33 O ESTADO DE SÃO PAULO. Sustentabilidade. Nova espécie de primata é descoberta na Amazônia. March 11th, 2015. Available at: http://sustentabilidade.estadao.com.br/noticias/geral,nova-especie-de-primata-e-descoberta-na-amazonia,1648925 . Last visit on: July 09th, 2020.



In addition, it is estimated that there are at least 13 threatened species of fauna, ten of these being mammals. Among those of great conservation interest are the Golden-White Tassel-ear Marmoset (Mico chrysoleucus), the Giant Armadillo (Priodontes maximus), the Brazilian Tapir (Tapirus terrestris), the Red Brocket (Mazama americana), and the Azara's Agouti (Dasyprocta azarae). Furthermore, there are several other species expected to be at some grade of risk, such as the Golden Parakeet (Guaruba guarouba) and the Hyacinth Macaw (Anodorhynchus hyacinthinus), both within the vulnerable category, according to the International Union for Conservation of Nature - IUCN. In addition, the present project contributes to the preservation of species that require large areas, such as the Jaguar (Panthera onca)[34]. It can be observed that the present project helps to preserve at least 2% of the Brazilian threatened species, most of them being mammals.

Regarding flora biodiversity, the presence of the Amazon and Cerrado (Savannah) biomes makes the region a complex environment with a great diversity of species and vegetation types. Three forest inventories have been carried out in protected areas within the region, revealing a great flora biodiversity[35]:

Therefore, the current situation indicates that the rainforests of the Southern Amazon are critically endangered, as well as their great biological diversity and presence in several environment types, in addition to the presence of endemic species of extreme importance to the

34 IUCN 2014. The IUCN Red List of Threatened Species. Version 2014. Available at: http://www.iucnredlist.org . Last visit on: July 09th, 2020.

35 Government of the State of Amazonas. Plano de gestão do mosaico de unidades de conservação do Apuí. Manaus: WWF - Brasil, 2010. 246 p.

conservation of Amazon biodiversity. Amazonas state has one of the largest priority areas in Brazil, with most of the extremely high priority areas of the country[36].

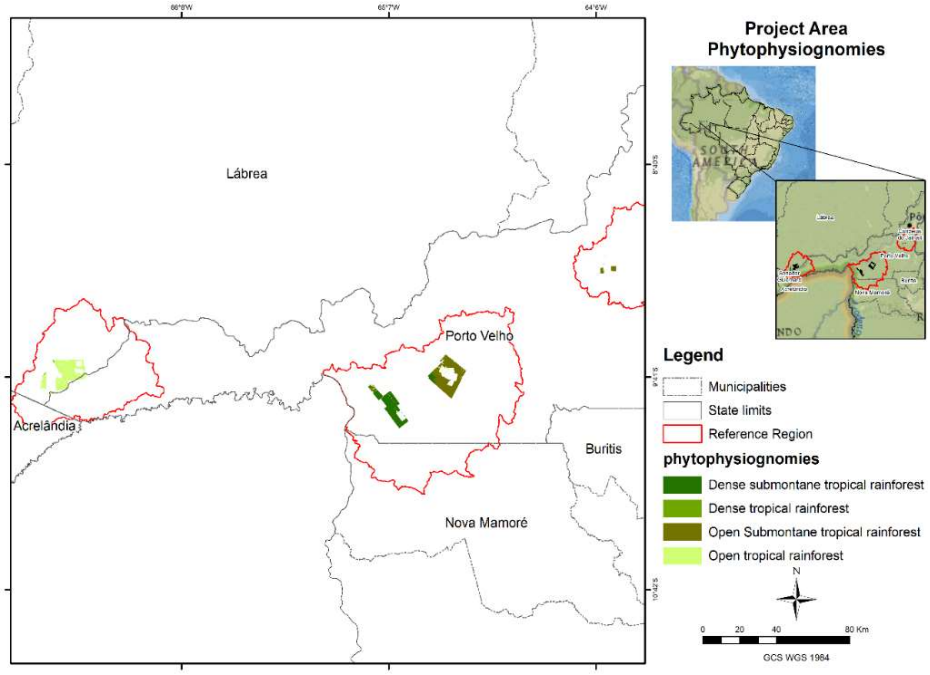
Vegetation Cover

The Project Area has a general forest cover characterized as Open ombrophylous forest (As, according to Brazilian Vegetation Map, IBGE).

Open Ombrophilous Forest: it is considered a transitional type of dense rainforest, characterized by climatic gradients with more than 60 dry days. It has four floristic facades: with vine, in the areas of circular depressions of the Precambrian basement; with palm trees, in sandstone terrain that occurs throughout the Amazon and even beyond; with bamboo, it occurs from the western part of the Amazon to the southern plateau of the State of Paraná (usually occupying the areas where noble species were explored); with sororoca (*Phenakosperma guyanensis*) in the south of the Amazon basin, in the middle Xingu river, occurring in depressions that are temporarily flooded and in small areas where soils of the Red Latosol type predominate.

The phytophysiognomies present in the project area are: Open submontane tropical rainforest (with around 38% coverage within PA), Open tropical rainforest (36%), Dense submontane tropical rainforest (25%), and Dense tropical rainforest (1%), as shown in Figure below.

Figure 18. Phytophysiognomies in the Project Area



Within the reference region, nine phytophysiognomies were identified, as illustrated below. The percentages of coverage are: Open Submontane Tropical Rainforest (around 32%), Open Tropical Rainforest (31%), Dense Submontane Tropical Rainforest (24%), Dense Tropical Rainforest (10%),

36 WWF, MMA, 2015.. Áreas Prioritárias para Uso Sustentável e Repartição dois Benefícios da Biodiversidade da Amazônia.

and Seasonal Parkland Savannah (2%). The rest of the phytophysiognomies are Seasonal Forested Savannah, Dense Alluvial Tropical Rainforest, Contact between Savannah and Rainforest, and Open Alluvial Tropical Rainforest, which did not reach 1% of reference region coverage.

Figure 19. Phytophysiognomies in the Reference Region

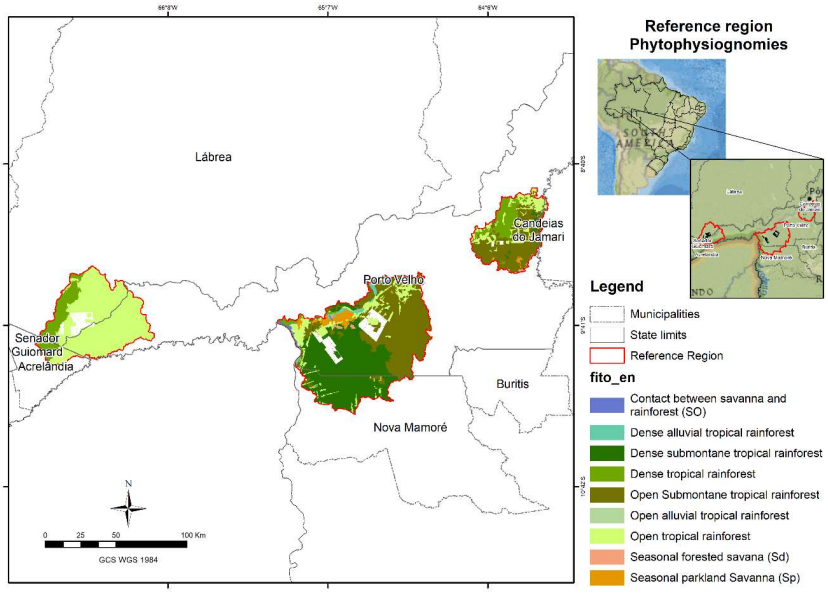
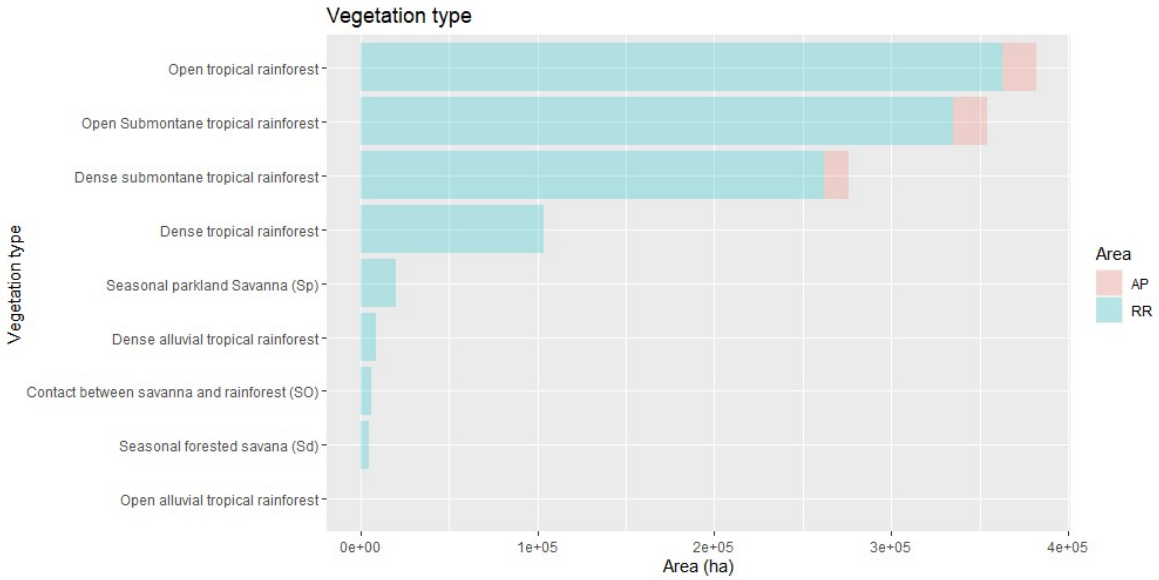


Figure 20. Distribution of Phytophysiognomies (ha) in the Reference Region (RR) and in the Project Area (PA)



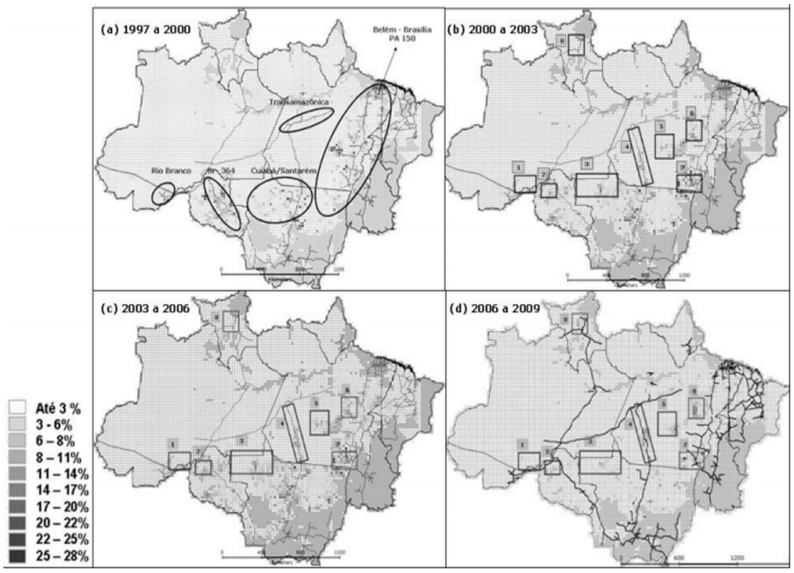
In recent years, the project region has been deforested for the livestock activities, mainly due to the advancement of the so-called arc of deforestation from the south of the Amazon biome. This

pressure is expected to continue, given the globalization of markets in the Amazon region and international development policies planned for the region[37].

According to NASA, deforestation in the Amazon Rainforest is occurring most rapidly along a curve that hugs the southeastern edge of the forest that scientists and resource managers have come to call the "Arc of Deforestation." The land is cleared for cattle ranching, small-scale subsistence farming, logging, and, increasingly, soybean production for world markets[38].

Image below shows that deforestation occurred, in the period of 1997 to 2009, in a concentrated pattern mainly along roads and in colonization projects, covering mainly the states of Pará, Maranhão, Mato Grosso, Rondônia and the south of Amazonas.

Figure 21. Arc of Deforestation in the Amazon Rainforest



This tendence is still observed nowadays, the region being the main route for cattle raising in the Amazon region. Map below presents the location of the project area in the to the arc of deforestation, estimated from the pattern of deforestation observed in the Amazon.

Thus, conservation actions are essential in the region, establishing a barrier against the advancement of deforestation, making an important contribution to the conservation of Southern Amazon biodiversity and also to climate regulation in Brazil and South America.

37 Nepstad, D. C.; C. M. Stickler e O. T. Almeida. 2006. Globalization of the Amazon Soy and Beef Industries: Opportunities for Conservation. Conservation Biology 20(6):1595-1603. Available at < http://www.rmpcecologia.com/disciplinas/comunidades/Artigos_2007/nepstad_ecs2007.pdf>

38 Deforestation patterns in the Amazon – Available at < https://www.earthobservatory.nasa.gov/images/4385/deforestation-patterns-in-the-amazon> Last visited on 24/03/2022.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

According to the Brazilian Forest Code (Law N° 12.651, 25/05/2012[39]), all rural estates located in forest zones should have:

I – Permanent preservation area: 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, protect the soil and ensure the well-being of human populations.

II – Legal Reserve (LR): an area located within a rural property or possession, except for the permanent preservation, necessary 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[40], eighty percent (80%) of a rural property should be preserved as LR.

One of the main ways to combat deforestation in Brazil are the command-and-control mechanisms, such as effective monitoring, requiring compliance with environmental legislation along with a greater state presence. However, this does not seem effective in most regions of the country, because the failure of the government to fulfil these responsibilities in comparison with other social goals and economic interests has put Brazil among the world's largest deforesters[41].

Despite the legal provisions intended to preserve at least 80% of the Amazon Forest coverage, 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 complete disregard of the mandatory provisions of the Forest Code. 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[42].

According to Article 41 of the Forest Code, the federal Executive power is authorized to institute, without prejudice to compliance with environmental legislation, a program to support and encourage environmental conservation, as well as the adoption of technologies and good practices that reconcile agricultural and forestry productivity with a reduction in environmental impacts, as a way of promoting ecologically sustainable development, always observing the criteria of progressiveness, covering the following categories and lines of action:

[39] BRASIL. Law nº. 12.651, of 25 May 2012. Forest Code. Diário Oficial da República Federativa do Brasil, Brasília, DF, 25 May 2012.

[40] 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.

41 Food And Agriculture Organization Of The United Nations (FAO) (2011), "State of the World's Forests 2011." FAO Forestry Paper. Rome, Italy.

42 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.

> I - payment or incentive to environmental services as a monetary or non-monetary retribution for activities of conservation and improvement of ecosystems and that generate environmental services, such as, individually or cumulatively:
>
> (a) the sequestration, conservation, maintenance and increase of the stock and the decrease of the flow of carbon.

Therefore, although there is a Legal Reserve Area to be conserved, the Forest Code recognizes the importance of economic mechanisms to compensate landowners that carry out conservation measures. Furthermore, around 52% of the reference region of this project activity was composed of deforested areas in 2019, showing a general non-compliance with the Brazilian Forest Code in region. Thus, the baseline scenario considers the potential of unplanned deforestation in the project area to surpass the limits stipulated by the Law.

Although no overlap with indigenous lands has yet been identified, it is important composing the legislative scope of this document, it is worth mentioning decree No. 10,088, of November 5, 2019, which aims to create a binding international instrument dealing specifically with the rights of culturally traditional people. The basic concepts, which guide the interpretation of the provisions of the Convention, are the consultation and participation of the people concerned and their right to decide on their own development priorities as it affects their lives, beliefs, institutions, values spiritual and the land they occupy or use.

Annex LXXII to the decree provides for ILO Convention No. 169 on Indigenous and Tribal Peoples, recognizing the right to possession and property and provides measures to be taken to safeguard the rights related to the land and territory that traditional communities inhabit or use collectively.

Recognizing, thus, the aspirations of these communities to take control of their own institutions and habits and their economic development, and to maintain and strengthen their identities, languages, and religions, within the scope of the States where they live.

According to PART II - Lands, Article 13, item 2, “The use of the term" lands "in Articles 15 and 16 should include the concept of territories, which covers the entire habitat of the regions that the people concerned occupy or use.

According to Article 14, item 1: “The people concerned should be given the property and possession rights over the lands they traditionally occupy. In addition, in appropriate cases, measures should be taken to safeguard the right of interested people to use land that is not exclusively occupied by them, but which they have traditionally had access to for their traditional and subsistence activities. In this regard, special attention should be paid to the situation of nomadic peoples and itinerant farmers”.

It is also worth mentioning decree No. 6,040, of February 7, 2007, which institutes the 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.

Regarding local regulation, it is important to mention the State of Rondônia and Amazonas forestry exploitation mechanisms. The Environmental Agencies from the State of Rondônia (Secretaria de Estado do Desenvolvimento Ambiental – SEDAM) and Amazonas (Instituto de Proteção Ambiental do Amazonas – IPAAM) are the bodies responsible for SFMP licensing. In Rondônia, the Decree 23.481/2018[43] defines technical procedures regarding SFMP, while in Amazonas the Resolution Cemaam nº 7/2011[44] defines procedures for small scale forest exploitation and Law 3.785/2012[45] stablishes permitting process for forest exploitation for areas greater than four fiscal modules.[46] Conama Resolution nº 406/2009[47] stablishes technical parameters for SFMP at the Amazonian biome.

The SFMP adopted by instances 1 and 3, as defined by regulation mentioned at the previous paragraph, adopts a polycyclic cultural system, using machines to drag logs. Such system considers around 30-year cutting cycles, in which mature trees are harvested in intermediate cuts. As for regeneration, the "Natural Regeneration" method was chosen due to its greater suitability for the conditions of tropical forests in the Amazon region. In this method, the management area is left for regeneration until the next cutting cycle, allowing the natural regeneration of forest biomass. The rest period is estimated based on IBAMA Normative Instruction 05-2006[48], being one year for every 1.0 m^3 extracted per hectare. Considering the estimated productivity of 0.86 m^3/ha/year mentioned as reference at the Conama Resolution nº 406/2009, the usual cycle (around 30 years) allows a maximum extraction of 25.00 m^3/ha, in accordance with legislation.

As per the abovementioned, Rio Madeira Grouped REDD+ project includes Sustainable Forest Management Plan (PMFS). Evidence of compliance are available for audit team.

With that said, it is worth mentioning that the project respects the provisions of the law and does not interfere with the rights of indigenous peoples.

1.15 Participation under Other GHG Programs

43 Available at <http://www.sedam.ro.gov.br/wp-content/uploads/2020/02/Decreto_Estadual_n._23.481_2018._Procedimentos_tecnicos_para_elaboracao_de_PMFS_em_Rondonia.pdf> Last visit on 09/08/2022.

44 Available at <http://meioambiente.am.gov.br/wp-content/uploads/2018/02/07.-RESOLU%C3%87%C3%83O-007-11-DOU-PMFS-PEQUENA-ESCALA-PMFSPE.pdf> Last visit on 09/08/2022.

45 Available at < https://sapl.al.am.leg.br/media/sapl/public/normajuridica/2012/8240/8240_texto_integral.pdf> Last visit on 09/08/2022.

46 Fiscal module is an area portion defined by National Institute of Agrarian Issues (INCRA) and can vary for each state. Available at < https://www.embrapa.br/codigo-florestal/area-de-reserva-legal-arl/modulo-fiscal> Last visit on 09/08/2022.

47 https://www.sedam.ro.gov.br/wp-content/uploads/2020/02/RESOLUCAO_CONAMA_N__406_2009._Parametros_tecnicos_para_PMFS_POA_no_bioma_Amazonia.pdf Last visit on 29-December-2023

48 https://www.ibama.gov.br/sophia/cnia/legislacao/MMA/IN0005-111206.PDF Last visit on 29-December-2023

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 is not requesting registration in any other GHG Programs nor has the project 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 neither has nor intends to generate any other form of GHG-related environmental credit for GHG emission reductions or removals claimed under the VCS Program. The VCS Program has a central project database, which lists each approved project. The VCS Project Database is the central storehouse of information on all projects validated to VCS criteria and all Verified Carbon Units issued under the program. Every VCU can be tracked from issuance to retirement in the database, allowing buyers to ensure every credit is real, additional, permanent, independently verified, uniquely numbered and fully traceable online. This project has not been registered under any other credited activity, and no VCUs have been assigned to the project area so far. Thus, any possibility of double counting of credits is eliminated.

1.16.2 Other Forms of Environmental Credit

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

The project will also monitor its contribution to sustainability by the application of the SOCIALCARBON® Standard, which is an additional standard based on six main indicators: Biodiversity; Natural; Financial; Human; Social and Carbon Resources. The use of such Standard is for sustainability monitoring only, thus does not generate extra credits to be sold.

1.16.3 Supply Chain (Scope 3) Emissions

As per section 3.23 of the VCS Standard, this project falls within items 3.23.8 and 3.23.9 where a project GHG emissions reductions are in a supply chain, and the retailers of the impacted good or service are not involved in the project.

Instances 1 and 3 conduct Sustainable Forest Management Plan in the Project Area, and all three instances conduct cattle ranching and grain production in the properties. A public statement is available at the Project Page in Future Carbon's website[49]. In addition, landowners have notified their partners in order to avoid potential risk of Scope 3 emissions double claiming.

[49] Available at: https://futurecarbon.com.br/projeto-rio-madeira/

1.17 Sustainable Development Contributions

1.17.1 Sustainable Development Contributions Activity Description

The primary objective of the Rio Madeira Grouped REDD+ Project is to avoid the unplanned deforestation (AUD) of the project area, consisting of 100% Amazon rainforest at the project start date. In addition, the project aims to positively impact the local community by generating social, economic, and environmental benefits.

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) and the Nationally Determined Contribution (NDC)[50].

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. 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, especially private projects, therefore, the contributions foreseen by the project will not be counted towards the priority national goals, as there is no monitoring and reporting mechanism established. Progress at the national level can be accompanied by the synthesis report carried out by IBGE and by the IPEA reports[51].

The Project main planned contributions to the Sustainable Development Goals[52] are listed below. These contributions are monitored by the parameters defined by the REDD+ project, and will also be monitored by additional standard, CCB, aimed for this project.

Table 8. Sustainable Development Goals and Project Contributions

Sustainable Development Goal	Target	Project contributions
SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture	2.3 "By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including	The Rio Madeira Grouped REDD+ Project will promote income diversification and disseminate good management practices to communities by providing

[50] UN's Sustainable Development Goals and targets available at: <https://sdgs.un.org/goals> Last visited on 04/01/2021.
[51] Available at <https://www.ipea.gov.br/ods/index.html>
[52] Available at: <https://odsbrasil.gov.br>

	through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment". 2.4 "By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality".	rural technical assistance and technical training on proper management. In this sense, the project expects to positively impact productivity and incomes of small-scale local food producers, as well as ensure sustainable food production systems and implement resilient agricultural practices in the communities.
SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	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". 4.a "Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all".	The Rio Madeira Grouped REDD+ Project will provide educational opportunities for the scholar communities to improve students' capacities and skills. In addition, special attention will be dedicated to young adult in order to provide technical qualification. Farm workers, nut harvesters and adults from the local communities will also be positively impacted by education and training opportunities offered by the project. In addition, infrastructure improvements will be made to reduce the deficit of spaces and facilities for socializing and leisure activities that directly impact the quality of life of communities, especially for schools and workers.
SDG 13: Take urgent action to combat climate change and its impacts	13.0 Tonnes of greenhouse gas emissions avoided or removed 13.3 "Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation,	One of the main objectives of the Rio Madeira Grouped REDD Project is to reduce greenhouse gas emissions through the conservation of standing forest. Thus, the project contributes to

	impact reduction and early warning"	combat climate change and its effects. In addition, the project provides environmental education activities and technical training for local communities and workers to improve knowledge and skills related to sustainable practices and forest monitoring.
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.	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"	The project is based on the conservation and restoration of forests in the Amazon biome, guaranteeing forest services, preservation of natural resources and biodiversity. The project adopts VM0015 Methodology for avoided unplanned deforestation (AUD) preventing 34,681.91 ha from being deforested.

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 Rio Madeira 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;

53 Brazil's Nationally Determined Contribution towards achieving the objective of the United Nations Framework Convention on Climate Change can be accessed in full at: http://www4.unfccc.int/submissions/INDC/Published%20Documents/Brazil/1/BRAZIL%20iNDC%20english%20FINAL.pdf . Last visited on December 10th, 2019.

- Enhancing sustainable native forest management systems, through georeferencing and tracking systems applicable to native forest management, with a view to curb illegal and unsustainable practices.

1.17.2 Sustainable Development Contributions Activity Monitoring

Table 9. Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	2.3	2.3.2 Average income of small-scale food producers, by sex	Implemented activities to increase	During this monitoring period, no contributions related to this SDG Target were implemented.	The Rio Madeira Grouped REDD+ Project will promote income diversification and disseminate good management practices to communities by providing rural technical assistance and technical training on proper management. In this sense, the project expects to positively impact productivity and incomes of small-scale local food producers, as well as ensure sustainable food production systems and implement resilient agricultural practices in the communities.

2)	2.4	2.4.1 Proportion of agricultural area under productive and sustainable agriculture	Implemented activities to increase	During this monitoring period, no contributions related to this SDG Target were implemented.	The Rio Madeira Grouped REDD+ Project will promote income diversification and disseminate good management practices to communities by providing rural technical assistance and technical training on proper management. In this sense, the project expects to positively impact productivity and incomes of small-scale local food producers, as well as ensure sustainable food production systems and implement resilient agricultural practices in the communities.

3)	4.7 4.a	Based on indicator 4.7.1: Number of extracurricular activities carried out on environmental education Based on indicator 4.a.1[54]: Number of improvements carried out per school and type	Implemented activities to increase	Instances have close relationship and plan to develop partnerships with education centers such as Flor do Cupuaçu School (Instance 1) and Marechal Rondon School (instance 2). During this monitoring period, no contributions related to this SDG Target were implemented.	The Rio Madeira Grouped REDD+ Project will provide educational opportunities for the scholar communities to improve students capacities and skills related to environmental education. Farm workers, nut harvesters and adults from the local communities will also be positively impacted by education and training opportunities offered by the project. In addition, infrastructure improvements will be made to reduce the deficit of spaces and facilities for socializing and leisure activities that directly impact the quality of life of communities, especially for schools and workers.
4)	13.0	Total of greenhouse gas emissions avoided or removed	Implemented activities to decrease	During this monitoring period, the Rio Madeira Grouped REDD+ Project reduced 1,423,035 tCO_2e.	The Rio Madeira Grouped REDD+ Project is expected to avoid 16,053,622 tCO_2e in emission reductions over the 30-year life of the project, with an annual average of 535,121 tCO_2e.

[54] Goal 4.a: https://www.ipea.gov.br/ods/ods4.html

5)	13.3	Based on the indicator 13.3.1, number of activities implemented to improve education and awareness-raising on climate change.	Implemented activities to increase	During this monitoring period, no contributions related to this SDG Target were implemented.	The Rio Madeira Grouped REDD+ Project provides environmental education activities and technical training for local communities and workers to improve knowledge and skills related to sustainable practices, forest monitoring and climate change adaptation.
6)	15.1	15.1.1 Forest area as a proportion of total land area	Implemented activities to increase	During the first monitoring period (23-October-2019 to 31-December-2021), more than 3,000 hectares were prevented from being deforested in the native forest of the Amazon biome in the project area.	Avoid 34,681.91 ha hectares of deforestation in the native forest of the Amazon biome on the project area during the 30-year life of the project.

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 Area

The leakage management area (LMA) complies non-forest areas located outside the project boundary in which the project proponent intends to implement the activities which reduce the risk of leakage in the project scenario. The LMAs selection was made with the landowners participation, based on previous relationships and knowledge with surrounding communities and stakeholders. During such selection, the landowners indicated the LMAs with most needs, potential do leverage forest conservation and positive social impact. The LMAs include communities, schools and cooperatives, acting as beneficiaries and partners.

The areas selected as LMA are predominantly occupied by small farmers, making the project area vulnerable to illegal deforestation mainly for opening areas intended for livestock and agricultural expansion. Therefore, the project will seek to implement activities aimed at: a) technical training b) rural assistance c) income diversification d) implementation of good management practices, among others.

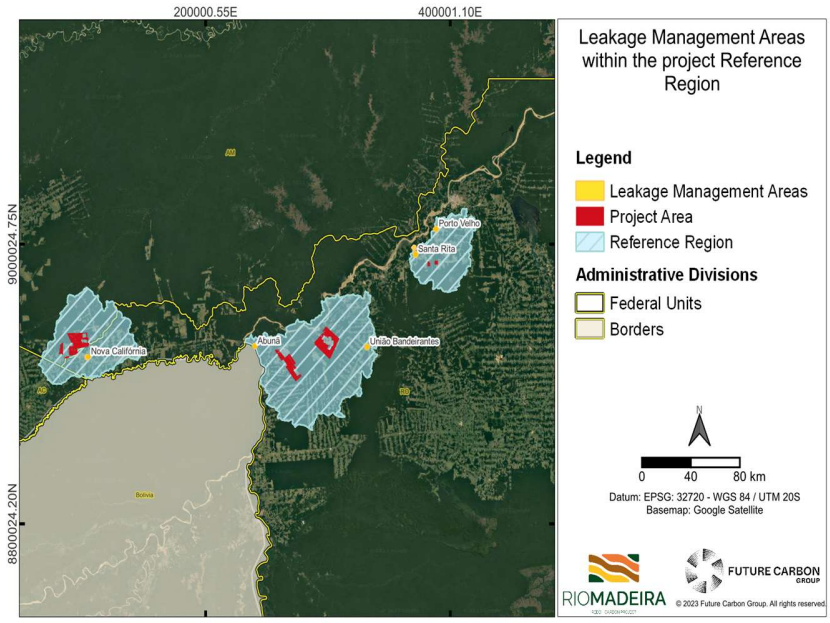
These activities must include the agents of deforestation and involve seeking new sources of income which contribute to forest conservation. To reduce deforestation pressure, the project aims to enhance livestock and management techniques and practices by establishing technical training and partnerships between local associations and research and rural assistance institutions. This is expected to lead to better land use efficiency, which can help to reduce the need for expanding to new areas. The training initiatives are also intended to broaden the horizons of both young people and adults regarding other production chains. This is aimed at introducing alternative sources of income that are compatible with forest conservation.

The main condition for the implementation of these activities is the approval and validation of the Rio Madeira REDD+ project, which will be another important benchmark for the engagement of all potential private landowners in the region.

The Leakage Management Area was defined as a portion of 372.5 hectares of non-forest land cover nearest the communities of instances 1, 2, and 3. There are 5 communities located in the LMA and in section 1.11 describe all the activities that will be developed by the Rio Madeira REDD+ Project with these local stakeholders.

Figure below presents the location of the LMA:

Figure 22. Leakage Management Area



The entire LMA will be monitored as part of the project´s monitoring plan. More information on the characteristics of these stakeholders is available in section 2.

<u>Leakage Management Plan</u>

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 the success of this business plan will generate an increased number of sustainably managed areas with REDD+. This Leakage Management plan will be based on the monitoring parameters, in addition to being verified in every Social Carbon Report. The SOCIALCARBON methodology is currently being applied and it will serve as a plan and guideline for carrying out activities and achieving goals, in addition to assessing progress in each monitoring period. In this way, the owners are committed and add value to the carbon project with each action taken, encouraging long-term sustainable development. The Social Carbon methodology drives continuous improvement in the local community through prospects (at least one per resource, totaling 6 improvement actions), in which the project owner undertakes to implement them until the next monitoring period. To guarantee the evolution of the socioenvironmental scenario in the region, Social Carbon Standard requires that at least 50% of the actions suggested in the previous Point must be implemented, under the risk of losing the Standard. The monitoring period for Social Carbon should be the same as the monitoring period for the Carbon Accounting Standard.

The landowners registered their will to perform several activities to promote social impact with the Rio Madeira REDD+ Project in an agreement. Such agreement includes the following partners and actions: Marechal Rondon school, located at Abunã district, Flor do Cupuaçu school, Santa Rita health center, RECA association, União Bandeirantes district, and farm-school FIMCA. Target audiences may be expanded or changed as the project progresses in implementing activities. Throughout the operationalization of the leakage management plan, feedback from participants on the activities will be collected, allowing the assessment of interest, engagement and effectiveness of the proposed actions. Active listening will also be an important mechanism for collecting suggestions and perceptions from these groups to improve activities.

The proposed activities are detailed in the Table below. It is worth mentioning such activities are connected to the underlying causes of deforestation (such as poverty, available at section 3.4). Therefore, strengthening small producers' association and local communities is a proper way to generate alternative incomes and reduce deforestation practices outside the project area. The commitment to carry out these activities was signed by the owners and shared with VVB.

Table 10. Leakage Management Plan Activities

Activities	Goal	Target Public
Promotion of technical training and rural assistance.	It is expected that through technical training and rural assistance farmers will be able to increase productivity, reducing the need for area expansion and increasing income generation through the efficient use of resources.	Small farmers and ranchers; nut collectors
Identification of the agricultural potential of other cultivars and promotion of the diversification of agricultural products	The project hopes to encourage the development of other agricultural crops, aiming to diversify sources of income and food available for family subsistence	Small farmers and ranchers
Promotion of environmental education	The project believes that through environmental education aimed especially at young people, they will be able to develop a conservationist perspective on natural resources and will be more connected with climate change	Schools, employees and surrounding communities

	issues. Young people are important multipliers, as they share their knowledge with their families. They may also feel more motivated to work with activities that are more aligned with environmental protection.	

Commercially Sensitive Information

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

Further Information

Not applicable.

2 SAFEGUARDS

2.1 No Net Harm

Rio Madeira Grouped REDD+ Project has conducted a social and environmental assessment within the Leakage Management Area. The performance of the socio-environmental diagnosis and in-site consultation with local stakeholders will happen during the project's validation. In addition, literature research was also performed to enhance information collected during the onsite visit that were vague or incomplete.

The social diagnosis included villages and education centers identified as Leakage Management Area.

In addition to the acknowledgment of the socioenvironmental conditions of the communities, the SOCIALCARBON certifications also may be applied to quantify the main potential environmental and socio-economic risks. The applicable SOCIALCARBON indicators for this grouped project are "Indicators for REDD + SFMP Projects"[55], and will be applied as guidance for monitoring of social, economic and environmental impacts of the project.

Table below provides details on the identified potential risks:

Table 11. Main social, economic and environmental impacts of Rio Madeira Grouped REDD+ Project

55 Available at <https://static1.squarespace.com/static/6161c89d030b89374bec0b70/t/618a268beb78197f4e78ba15/1636443793807/Template_Submission_of_new_indicators_REDD%2BSFMP_v1.2_EN11.pdf> Last visit on August 24th, 2022

Activity	Aspect	Impact	Effect		Comments/ Observation
			Beneficial	Adverse	
REDD: Carbon credit project	Environmental – Conservation of Amazon Rainforest	Greenhouse Gas Emissions Reductions	X		Monitored by the Carbon resource: ● Project performance Monitored by the Natural resource: ● Quality control
REDD: Carbon credit project	Environmental – Conservation of Amazon Rainforest	Monitoring and supervision to avoid deforestation of forest within the project area	X		Monitored by the Biodiversity resource: ● Impact on remaining flora Monitored by the Natural resource: ● Quality control
REDD: Carbon credit project	Social – Conservation of Amazon Rainforest	Conflict management with communities in the project area, due to banning of timber product extraction		X	Monitored by the Carbon resource: ● Stakeholder consultation Monitored by the Human resource: ● Conflict management
REDD: Carbon credit project	Social/ Economic - empowerment	Increased independence of the communities in the project area.	X		Monitored by the Social resource: ● Associations and cooperatives ● Expansion of community activities ● Women inclusion Monitored by the Human resource: ● Community education and training Monitored by the Financial resource: ● Alternative income sources Monitored by the Natural resource: ● Social and environmental investments

					Monitored by the Biodiversity resource: ● Non timber forest products (NTFPs)
REDD: Carbon credit project	Social/economic - Application of the Social Carbon methodology	Encouragement and investment in social, economic, and environmental aspects in the project region.	X		Monitored by the Social resource: ● Expansion of community activities Monitored by the Human resource: ● Community education and training Monitored by the Financial resource: ● Carbon credit benefits Monitored by the Natural resource: ● Social and environmental investments Monitored by the Carbon resource: ● Project performance

The identified impacts will be monitored through the indicators described on the last column of the table above. Regarding the adverse effect identified, a possible action to mitigate is the encourage sources of income with non-timber forest products, as described in table below.

In addition to the risks described above, it has been identified other risks that could affect the project activity, which are also described by the SOCIALCARBON indicators. These risks are described on Table below:

Table 12. Significant risks to the project

Activity	Aspect	Risk	Mitigation action	Indicators that will monitor the identified potential risks
REDD carbon project	Environmental - Uncertainties relating to standing forest in the future.	Non permanence of carbon: Time which carbon will remain stocked in live biomass, without being emitted into the atmosphere. Due to the uncertainties related to what will happen to the forest in future, there is a risk of non-permanence of forest carbon.	Encourage sources of income with non-timber forest products, since it is an activity that also generates income while the forest is conserved. This initiative is in place at instance 3 and could be expanded to other instances.	Monitored by the Carbon resource: ● Buffer reduction
REDD carbon project	Environmental - Conflict management with communities	Conflicts with communities in the project area, due to banning of timber product extraction	Encourage sources of income with non-timber forest products, since it is an activity that also generates income while the forest is conserved. This initiative is in place at instance 3 through the harvesting of non-timber products and could be expanded to other instances.	Monitored by the Carbon resource: ● Stakeholder consultation Monitored by the Human resource: ● Conflict management
REDD carbon project	Environmental/ Social - Land demarcation process	Risk of land invasion by deforestation agents	Surveillance activities will be carried out in the project area, as well as monitoring with satellite images. In addition, there will be activities involving sustainable income generation including the local population	Monitored by the Natural resource: ● Land Tenure Monitored by the Human resource: ● Conflict management
REDD	Environmental- Sustainable Forest management plan	Risk of non-performance of the sustainable forest management plan	After the end of the management cycle, the revenue from credits will be the only source of income. Therefore, it is possible that the credits are an incentive to maintain the conserved areas, as it guarantees the existence of income until the next management cycle.	Monitored by the Financial resource: ● Alternative income sources Monitored by the Biodiversity resource: ● Non timber forest products (NTFPs)

Patrimonial Surveillance	Armed Patrol	Risk associated with strengthening patrimonial surveillance	Strick protocols are implemented to mitigate this risk: • Obligation to handle weapons in specific locations and always facing the ground; • Obligation for available weapons to be inside the vehicles used for patrols, out of people's sight; • Contracted company must provide periodic training for its employees	Service provider company is duly qualified and authorized to carry out armed surveillance.
Patrimonial Surveillance	Network of neighbors	No risks associated with the contact network between neighbors and farm workers were identified so far, as participation in this network is voluntary and aims to disseminate information about fires, invasions and other events that could impact forest protection. This communication allows neighbors to mobilize resources, when appropriate, to act collaboratively, such as to put out a forest fire. Currently, this communication is done informally between neighbors. In other words, they send messages through applications on their cell phones or make calls to report an incident or potential threats.	n/a	n/a

Regarding the risks associated with armed patrol, in Brazil, companies that provide private security services are authorized, controlled and supervised by the Federal Police, which regulates everything from the opening of the company, research into its owners, quantity of weapons and ammunition and, mainly, the training of its members. Specifically, regarding training, the Federal Police accredits and supervises Security Guard Training Schools, including their instructors, whose minimum curriculum also meets a federal standard.

Furthermore, landowners are not responsible for training professionals who work in their areas, as service provision contracts do not happen with each professional individually, but rather with private security companies that meet all requirements provided for by law. The contracted company is responsible for providing all licenses to prove that it is authorized and regularized to provide the service. Such documents will be made available to the VVB.

Therefore, it is important to point out some regulations of Ordinance No. 18,045 of April 17, 2023[56], which regulates the private security service:

a) According to Ordinance No. 18,045 of 17-April-2023, private security activities are:

- I - Authorized, controlled and supervised by the Federal Police; and
- II - Complementary to public security activities under the terms of specific legislation.

b) The surveillance company must meet several criteria to be authorized to provide the service, such as:

- Art. 8 Companies that wish to obtain authorization to operate private security activities must have physical facilities approved by the regional executive delegate of the respective unit of the Federation, after carrying out an inspection by DELESP[57] or UCV[58]
- Art 12. § 1 Security guards must have training, retraining and life insurance within the validity period.
- Art 13. § 4 The permits issued will be valid for one year, from the date of their publication in the Official Gazette of the Union, authorizing the company to operate within the limits of the Federation unit to which they were issued.

c) Basic training and practice in using firearms is adopted in accordance with Art.150. "*In order to exercise the profession, the security guard must - with documentary evidence - fulfill the following requirements*":

- II - Be at least twenty-one years old;

[56] Ordinance No. 18,045 of April 17, 2023. Available at https://www.gov.br/pf/pt-br/assuntos/seguranca-privada/legislacao-normas-e-orientacoes/portarias/portaria-18045-dou.pdf/view

[57] Delegacias de Controle de Segurança Privada (Delesp); Private Security Control Offices (free translation): regional units linked to the Federal Police superintendencies in the States and the Federal District, responsible for monitoring and controlling private security activities

[58] Unidades de Controle e Vistoria (UCV); Control and Inspection Units (free translation): units linked to decentralized Federal Police stations, responsible for supervising and controlling private security activities, within the scope of their jurisdictions, directed by a federal police officer and composed of at least two additional members and their respective substitutes.

- IV - Have passed a security guard training course, carried out by a duly authorized training course company;
- V - Have passed physical, mental health and psychological aptitude exams
- VI: Have proven suitability by presenting negative criminal record certificates without records of indictment in a police investigation; no record of being criminally prosecuted; or without records of having been convicted in criminal proceedings (in the place where they live, as well as in the place where the training, recycling or extension course was carried out)

d) Security guards who will carry out armed surveillance must be duly authorized by the Federal Police and pass the Security Guard Training Course, a refresher course every 2 (two) years and a complementary shooting course, in accordance with Ordinance No. 18.045/2023.

e) Armed guards must strictly follow the rules for the use of firearms, including safety procedures, rules of engagement and progressive use of force.

f) Armed security guards are permitted to use weapons only in situations of self-defence of themselves or others, or in defence of property under their responsibility, when there is an imminent threat of aggression. The use of weapons, according to Brazilian legislation, is the last resort to protect life and can only be used in this circumstance. This topic is also covered in the Security Guard Training Course under the name "progressive use of force".

g) According to the Ordinance No. 18,045/2023, "Art. 133. *Specialized security companies will communicate to the Federal Police, by any appropriate means, any occurrences of theft, theft, loss, misplacement or recovery of weapons, ammunition or ballistic protection vests belonging to them, within one business day of the incident*."

- §3º Other incidents involving weapons, ammunition and other controlled products must also be reported to DELESP[59] or UCV[60] within fifteen days of the incident.

h) The weapons made available for work are generally weapons belonging to the companies and remain at the teams' locations. According to the Ordinance No. 18,045/2023, Art. 132, "*Weapons, ammunition, ballistic protection vests and other controlled products*

[59] Delegacias de Controle de Segurança Privada (Delesp); Private Security Control Offices (free translation): regional units linked to the Federal Police superintendencies in the States and the Federal District, responsible for monitoring and controlling private security activities

[60] Unidades de Controle e Vistoria (UCV); Control and Inspection Units (free translation): units linked to decentralized Federal Police stations, responsible for supervising and controlling private security activities, within the scope of their jurisdictions, directed by a federal police officer and composed of at least two additional members and their respective substitutes.

owned by specialized security companies are stored in a secure location, in their establishment, with restricted access to people outside the service."

- §3º Firearms, ammunition and equipment for controlled use stored at service stations must be stored in a metal box or other similar container sufficient to protect and store all equipment and weapons safely, in addition to being resistant and being anchored or concreted in such a way that it cannot be moved or transported easily, as long as they have padlocks or key or password locks, which will be in the possession of the security guards or the private security company.

i) The use of weapons, according to Brazilian legislation, is the last resort to protect life and can only be used in this circumstance. This topic is also covered in the training course curriculum[61], under the name "Progressive Use of Force" and detailed in the Table 13. The Brazilian Penal Code contains justifications or causes that legally support the use of force. According to Decree Law Nº 2848, of December 7, 1940[62], "Art 23. *There is no crime when the agent commits the act*":

I - in a state of need;

II - in self-defense;

III - in strict compliance with legal duty or in the exercise regular law.

Table 13. Levels of Force according to the Theory of Progressive Use of Force

Force Level	Description
Level 1 - Physical Presence	The mere presence of the security guard can be, in most cases, enough to contain a crime or even prevent a future crime, as well as prevent actions by people with bad intentions.
Level 2 - Verbalization	This level is based on the security guard's communication skills, supported by the population's general acceptance of authority. It is used in conjunction with the physical presence (Level 1) of the security guard and can usually achieve the desired results.

[61] Manual do Vigilante – Curso de Formação (Security Guard Manual – Training Course). Booklet approved by the Federal Police and used to train security guards. Document was made available to VVB.
[62] Decree Law Nº 2848, of December 7, 1940. Available at https://www.planalto.gov.br/ccivil_03/decreto-lei/del2848compilado.htm

	NOTE: This strength level can and should also be used in conjunction with all other strength levels
Level 3 - Contact control or hands-free control	It involves the use of physical contact skills by the security guard, to achieve control of the situation. This will happen when the possibilities for verbalization are exhausted due to the worsening of the attitude of the contender (conflicting individual). If there is a need to physically dominate the suspect, only free hands are used at this level, including immobilization and leading techniques.
Level 4 - Submission techniques	It is the use of sufficient force to overcome the active resistance of the individual, remaining vigilant for signs of more aggressive behaviour that requires the use of higher levels of response. At this level, appropriate free hands techniques can be used.
Level 5 - Non-lethal defensive tactics	Once confronted with the aggressive attitudes of the individual, it is justifiable for the vigilante to take appropriate measures to immediately stop the aggressive action, as well as to gain and maintain control of the individual, after submission has been achieved. It is the use of all non-lethal methods, such as forcing joints and using impact equipment. This also includes situations involving the use of firearms, as long as cases of shooting with lethal intent are excluded.
Level 6 – Lethal force	When the situation escalates to an imminent risk that puts the life of the security guard, or a third party, at risk.

Reinforcing the guidelines and requirements on private security in Brazil, it is important to highlight that instance 2 hired surveillance company named “IMPACTUAL VIGILÂNCIA E SEGURANÇA LTDA” in 2021 to provide surveillance within property. The company holds the necessary licenses and protocols to operate surveillance in the project areas. In addition, all permits and operating certificates were renewed and remain in force. It is also important to highlight the surveillance company uses the security guard manual, a guide that has all the necessary specifications for handling firearms and security procedures, to mitigate the risks of patrols. The documents provided by the surveillance company were presented to the VVB team:

- CNPJ (VAT) card from the company IMPACTUAL VIGILÂNCIA E SEGURANÇA LTDA
- Permit issued by the Federal Police and by Porto Velho City Hall

- Permit issued by the Fire Department
- Security Guard Manual

All the risks mentioned in the

Table 12 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 SOCIALCARBON Indicator described on the last column of the table above, in addition to any other applicable social-environmental additional standard.

Any social conflict regarding the Project will be assessed following Future Carbon Code of Conduct and NRD's Declaration of Human Rights Compliance. The Project Proponents work to resolve conflicts based on dialogue and the promotion of basic and environmental education. In this way, the REDD project itself and the expansion of the socio-environmental activities conducted by the company are effective ways of mitigating conflicts and maintaining a good relationship with the communities.

2.2 Local Stakeholder Consultation

As preconized in VCS standard, the project proponent conducted an assessment of the local stakeholders that are potentially impacted by the project. Information on local stakeholders at the start of the project are included in this section of the VCS PD.

Local entities having some influence and activities developed in the Reference Region were chosen through a process to identify them and their impact on the project activity. Stakeholders chosen for local consultation also included potentially impacted communities and neighbors.

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

Table 14. Project Stakeholders

Stakeholder Classification	Stakeholder	Justification
Government agency and/or representatives - Direct public administration (State and Municipality)	Prefeitura Municipal de Porto Velho	The carbon project is believed to be in the public sector's interest as it can help the state and municipalities achieve their goals of mitigating greenhouse gas emissions and illegal deforestation. In addition, partnerships with the public sector are very important for the development of activities throughout the project.
	SEDEC – Secretaria de Estado do Desenvolvimento Econômico do Estado de Rondônia	
	SEDAM – Secretaria de Estado do Desenvolvimento Ambiental de Rondônia	
	SEMA-Secretaria de Estado do Meio Ambiente do Amazonas	
	SEMA – Secretaria Municipal de Meio Ambiente e Desenvolvimento Sustentável de Porto Velho	
	SEMAD – Secretaria Municipal de Administração de Porto Velho	
	SENAR – Serviço Nacional de Aprendizagem Rural de Rondônia	
Public Administration Company (Autarchy)	Coordenação Regional do ICMBio 1 - Porto Velho (RO)	These are agencies that are related to the project activity. ICMBio is an institution linked to the Ministry of the Environment that works in the administration and conservation of protected areas.
	CEPAAM ICMBio – Manaus (AM)	
	INCRA - Instituto Nacional da Colonização e Reforma Agrária – Porto Velho (RO)	

	EMATER-RO – Empresa Estadual de Assistência Técnica e Extensão Rural do Estado de Rondônia	INCRA is the institute responsible for regulating all rural properties and public lands. EMATER is a branch of Rondônia State Government and is responsible for fostering agriculture techniques and rural credit. FUNAI is the indigenous national foundation and is responsible for indigenous culture preservation, rights, etc.
	FUNAI - Fundação Nacional do Índio (Brasília – DF)	
	FUNAI - Fundação Nacional do Índio (Manaus – AM)	
Unions	FAPERON – Federação da Agricultura e Pecuária do Estado de Rondônia	The participation of unions is important to spread knowledge of the carbon market and include the vision of employees and workers in the region in the development of the project.
Universities and education institutes	RIOTERRA – Centro de Estudos da Cultura e do Meio Ambiente da Amazônia	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.
	UNIR – Universidade Federal de Rondônia	
	Instituto Federal de Educação, Ciência e Tecnologia de Rondônia REITORIA	
NGOs	IDAM-Instituto de Desenvolvimento Agropecuário e Florestal Sustentável do Amazonas	NGOs are entities focused on the population's objectives, whether social, environmental or economic, without ties to public governmental entities. Thus, they bring a different point of view to the activity, and communication with these entities brings transparency to the project. In addition, they are key agents for the development of partnerships to strengthen the project activity and enhance socio-environmental co-benefits.
	IDESAM-Instituto de Conservação e Desenvolvimento	
	ECOPORÉ - Ação Ecológica Guaporé	
	FAPERO – Fundação de Amparo ao Desenvolvimento	

	das Ações Científicas e Tecnológicas e a Pesquisa de Rondônia	
	Fundação Vitória Amazônica	
	IPAAM – Instituto de Proteção Ambiental do Amazonas	
	ISA – Instituto Socioambiental (Manaus – AM)	
	WWF Brasil	
	Kanindé - Associação de Defesa Etnoambiental	
Communities within the Reference Region	Instance 1: Santa Rita and União Bandeirantes communities Instance 2: Abunã community Instance 3: RECA Cooperative (Nova Califórnia community)	Communities that have some type of relationship with the project area are essential for the development of a project consistent with the region and socio-environmental actions that help mitigate deforestation and promote improvements in the surrounding area.

As required in VCS standard item 3.18.16, 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 project team is further detailed as part of the Non-permanence Risk Analysis.

As required in VCS standard, item 3.18.18, for the "Local Stakeholder Consultation", a comprehensive project summary was actively presented to the communities and other stakeholders in Portuguese in the field, by project agents. In both consultation modalities, the project proponent communicated in a didactic way:

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 project design, implementation, monitoring and evaluation throughout the project lifetime. Therefore, complying with VCS Standard, a communication channel was 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 is the project proponent and project owners' email, as disclaimed in the local stakeholder consultation, where the following emails were shared: tecnica@futurecarbon.com.br, lediana@ceo.grupoROVEMA.com.br, joseleitejunior@gmail.com, and ciatupa@uol.com.br. It is worth mentioning such emails are also available in the sections 1.5 and 1.6 of the present VCS PD.

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 Feedback and Grievance Redress Procedure has three stages (VCS Standard; item 3.18.19):

- 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;
- Any grievances that are not resolved by amicable negotiations shall be referred to mediation by a neutral third party;
- 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 is dependent on local jurisdiction delays.)

The Stakeholder consultation was divided into two events: an online meeting that was held on September 5th, 2022, at 4pm (Brasília time zone), and on-site consultations with the local community that resides near the project area, this one accompanied by the VVB representants, where the leakage management area was defined, held on during the site visit.

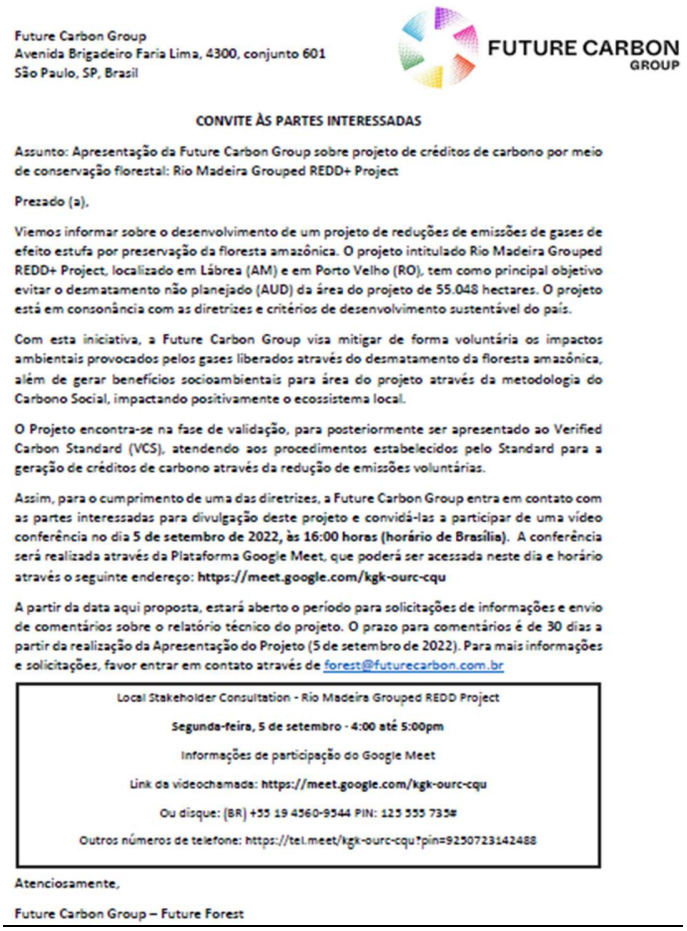
Regarding the stakeholders located in urban areas, which are mostly government agencies, an explanatory e-mail and a letter were sent, briefly presenting the project and inviting them to the remote consultation. This presentation was a summary of the proposed activities regarding project implementation and monitoring.

The presentation summarized the proposed activities of the project implementation and monitoring, explaining information of the carbon project, such as the carbon project development

process, deforestation monitoring and projection methods, project area, reference region, leakage belt, etc. In addition, the presentation introduced the Social Carbon Standard, its co-benefits, monitoring methods and methodology, as well as the relationship with the UN's Sustainable Development Goals.

Contact information for Future Carbon was made available at the beginning and at the end of the meeting, where the communication can be carried out via letter or email or telephone.

Figure 23. Invitation letter sent for the online consultation



Future Carbon Group
Avenida Brigadeiro Faria Lima, 4300, conjunto 601
São Paulo, SP, Brasil

FUTURE CARBON GROUP

CONVITE ÀS PARTES INTERESSADAS

Assunto: Apresentação da Future Carbon Group sobre projeto de créditos de carbono por meio de conservação florestal: Rio Madeira Grouped REDD+ Project

Prezado (a),

Viemos informar sobre o desenvolvimento de um projeto de reduções de emissões de gases de efeito estufa por preservação da floresta amazônica. O projeto intitulado Rio Madeira Grouped REDD+ Project, localizado em Lábrea (AM) e em Porto Velho (RO), tem como principal objetivo evitar o desmatamento não planejado (AUD) da área do projeto de 55.048 hectares. O projeto está em consonância com as diretrizes e critérios de desenvolvimento sustentável do país.

Com esta iniciativa, a Future Carbon Group visa mitigar de forma voluntária os impactos ambientais provocados pelos gases liberados através do desmatamento da floresta amazônica, além de gerar benefícios socioambientais para área do projeto através da metodologia do Carbono Social, impactando positivamente o ecossistema local.

O Projeto encontra-se na fase de validação, para posteriormente ser apresentado ao Verified Carbon Standard (VCS), atendendo aos procedimentos estabelecidos pelo Standard para a geração de créditos de carbono através da redução de emissões voluntárias.

Assim, para o cumprimento de uma das diretrizes, a Future Carbon Group entra em contato com as partes interessadas para divulgação deste projeto e convidá-las a participar de uma vídeo conferência no dia **5 de setembro de 2022, às 16:00 horas (horário de Brasília)**. A conferência será realizada através da Plataforma Google Meet, que poderá ser acessada neste dia e horário através o seguinte endereço: **https://meet.google.com/kgk-ourc-cqu**

A partir da data aqui proposta, estará aberto o período para solicitações de informações e envio de comentários sobre o relatório técnico do projeto. O prazo para comentários é de 30 dias a partir da realização da Apresentação do Projeto (5 de setembro de 2022). Para mais informações e solicitações, favor entrar em contato através de forest@futurecarbon.com.br

Local Stakeholder Consultation - Rio Madeira Grouped REDD Project

Segunda-feira, 5 de setembro - 4:00 até 5:00pm

Informações de participação do Google Meet

Link da videochamada: **https://meet.google.com/kgk-ourc-cqu**

Ou disque: (BR) +55 19 4560-9544 PIN: 125 555 735#

Outros números de telefone: https://tel.meet/kgk-ourc-cqu?pin=9250723142488

Atenciosamente,

Future Carbon Group – Future Forest

The on-site consultation with stakeholders (local communities) took place where the presence of housing is located. The meeting had a simplified presentation about the project, a map was used to explain where all project activities are located and its repercussions are and/or will be located, exposing the risks and benefits resulting from the project activities for the population.

The on-site consultation with stakeholders took place from 31/August/2022 to 02/September/2022, visiting the communities and agencies as shown in the table below. The meeting had a simplified presentation about the project, exposing the impacts resulting from the project activities for the general population and specific for that groups. The project's location, context of climate change and the threat of deforestation were discussed with the communities

in an informal conversation, where stakeholders could share their perceptions and experiences on the subject. The report with the summary of the meeting and comments are detailed as follows:

Table 15. Summary of on-site stakeholder consultation

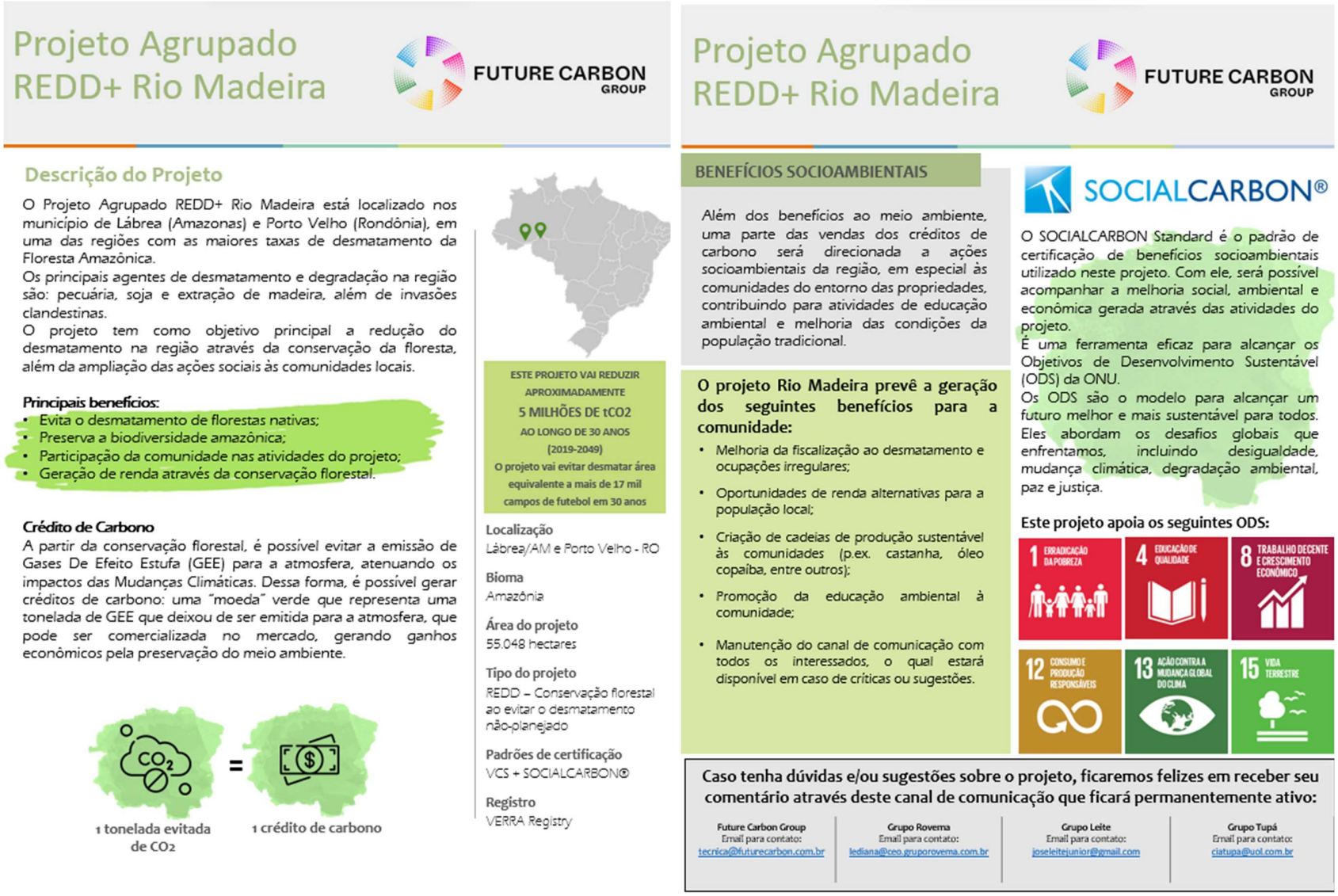
Date	Stakeholders	Comments
30/August/2022	Secretaria Municipal de Meio Ambiente e Desenvolvimento Sustentável–SEMA (Porto Velho Environmental Agency)	Both meetings with city and state Environmental Agencies were set up and carried out in Grupo ROVEMA (instance 1) head office. The REDD project was introduced to the attendees, who identified the challenge and importance of such conservation initiatives. In addition, both Agencies identified the project as a positive initiative, and hope that similar projects could spread in the region. Attendees from SEMA: Mrs. Joana Oliveira, Mrs. Juliana Infante, Mr. Roberval Zuniga, Mrs. Renata de Paula Afonso, and Mr. Kelves Sousa Silva. SEDAM attendees: Mr. Leandro Barbosa and Mr. Diogo Marting Rosa.
	Secretaria Estadual de Desenvolvimento Sustentável–SEDAM (Rondônia State Environmental Agency)	
30-31/August/2022	Escola municipal Flor do Cupuaçu (public school)	Since the school was not operating due to maintenance problem with the school bus, the meeting was held in two parts. The first meeting with the school Director (Mrs. Maria Elena Oliveira) was held in the Grupo ROVEMA office, where positive comments were provided by the school Director. The second meeting occurred while the school was closed, where the security responsible shared her perceptions of the project and the school needs. Again, positive feedbacks were provided about the project.
31/August/2022	UBS Santa Rita (health center)	The health center was operating with three employees and two patients who could attend the presentation. It was explained that part of the carbon credits income will be shared with the communities and some needs were shared by the attendees, such as the high number diabetes and hypertension, which could be prevented with well-being structure. In addition, positive comments were given by the attendees.
31/August/2022	Comunidade União Bandeirantes (local community)	The meeting was set up by instance 1 representatives and was carried out in the community leader's house (Mr Mario de Oliveira). The project details were shared to him, who also explained the context of the community, which economics is based on familiar agriculture and milk production. Besides agreeing with the project and recognizing its benefits, Mr. Mario also listed the main demands, such as the lack of schools, health centers, and quality of roads.
01/September/2022	Escola municipal Marechal Rondon (public school)	The meeting was organized by instance 2 representatives and was held in the school secretariat, where administrative routine is taken

		to coordinate the school that counts with 200 elementary students. After introducing the project to the school Director (Mrs. Nézia Braz Martins), school administrative lead (Mrs. Edilma Oliveira de Mesquita) and Abunã community leader (Mr. Edgar Lacerda de Souza), a sequence of positive feedbacks was provided by the audience. In addition, they pointed out that the deforestation is aggressive and related to criminals. Furthermore, several needs were detailed, such as the lack of books, school court and vest structure, and school lunch.
02/September/2022	Cooperativa RECA (association of non-timber producers)	The meeting was set up by instance 3 representative and occurred in RECA head office. The REDD project details was shared with RECA representatives (Mr. Dielison Fortunato and Mr. João Paulo Mastrangelo), where both recognized the importance of the Rio Madeira Grouped REDD Project. They also listed the lack of technology in RECA association and the importance of updating their production system in order to keep RECA competitive and attractive to next generations. Although the RECA plant was not operating due to the off-season, a site-tour was taken, and it was possible to observe the whole process with several non-timber products that are carried out by RECA.

A permanent communication channel with the local stakeholders was created in order to receive any comments or suggestions regarding the present REDD project. Emails addresses were made available through a folder if they want to contact the project proponents. It is important to note that the same contact information made available is also part of the grievance mechanism, where all comments will be received, and outcomes will be documented and stored in digital format. It is worth highlighting the project has received several positive comments during presentations, besides community needs as shown in the table above.

The following image details the folder which was distributed during on-site consultation with several information about the project, including co-benefits and communication channel:

Figure 24. Folder Rio Madeira REDD+ Grouped Project



The SOCIALCARBON methodology will also analyze the frequency and methods used for addressing the outcomes of each local stakeholder consultation, which will be analyzed at each verification event.

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[63], the location of a hugely diverse fauna and flora, spreads over almost 50% of the Brazilian territory. 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[64]. To quantify further, this biome holds the biggest variety of species in the world, and deforestation and degradation of tropical forests are the main causes of global biodiversity loss[65].

A further benefit, as mentioned in previous sections of this PD, is that the Rio Madeira 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 high-pressure cattle ranching region. This creates a high urgency situation in which levels of pressure and priority for conservation are high.

The Sustainable Forest Management Plan (SFMP) conducted in part of the instances follows all the applicable legislation and comply with all the environmental rules requested for the approval of the licenses.

2.4 Public Comments

During the public comment period (April 5th to May 5th, 2022), comments were received by Verra, and the same can be found at Appendix II.

During the VCS Pipeline Listing, only a Draft PD is required, which was the document made available at the time. As stated on the VCS Registration and Issuance Process v4.0, in force at the time of listing, the mandatory Sections to compose a Draft PD, besides the cover page, were

63 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/ .
64 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 .
65 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 .

the following: 1.1, 1.2, 1.3, 1.5, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14, 3.1, 3.2, 3.3, 3.4 and 3.5, all of which Future Forest complied with.

Considering that, as per the aforementioned document, the "indicative information is sufficient (e.g., the proposed approach for establishing project ownership, rather than the full rationale and evidence that will be submitted for validation)", the Draft PD was approved by Verra's Office team when reviewed, and therefore, submitted to pipeline.
All information requested by the commentors was addressed in the present and finished VCS Joint PD+MR, as the sections have been completed and now include the inquiries raised, such as mapping information and project boundaries, in addition to the complete additionality analysis and calculations.

It is worth mentioning that, as informed in the Table 5 at section 2.2, positive comments were also provided during on-site stakeholders' consultation.

2.5 AFOLU-Specific Safeguards

Local Stakeholder Identification and Background

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

1. According to the VCS Standard, section 3.18 Safeguards requirements for AFOLU projects, the project proponent shall conduct a thorough assessment of the local stakeholders that will be impacted by the project, including:

   The process of identification of the local stakeholders likely impacted by the project was based on the following criteria:

   - Geographic location: stakeholders located in the Reference Region and federal/state/municipal bodies with actuation in the Region;
   - Social relevance: especially social groups (communities, producers associations, schools) in the immediate surroundings with easy access by land and have good logistic conditions for work;
   - Technical relevance: entities who have key roles related with forest conservancy and sustainable development actions.

   Then, the stakeholders identified were primarily analyzed based on their influence, rights, interests, and relevance to the Project, to ensure that the Rio Madeira REDD+ Project is properly aligned with the stakeholders.

   The communities are located around the project area surround the region, as presented in figure below. The main local stakeholders considered in this project are listed in table below.

Figure 25. Communities within the project Reference Region

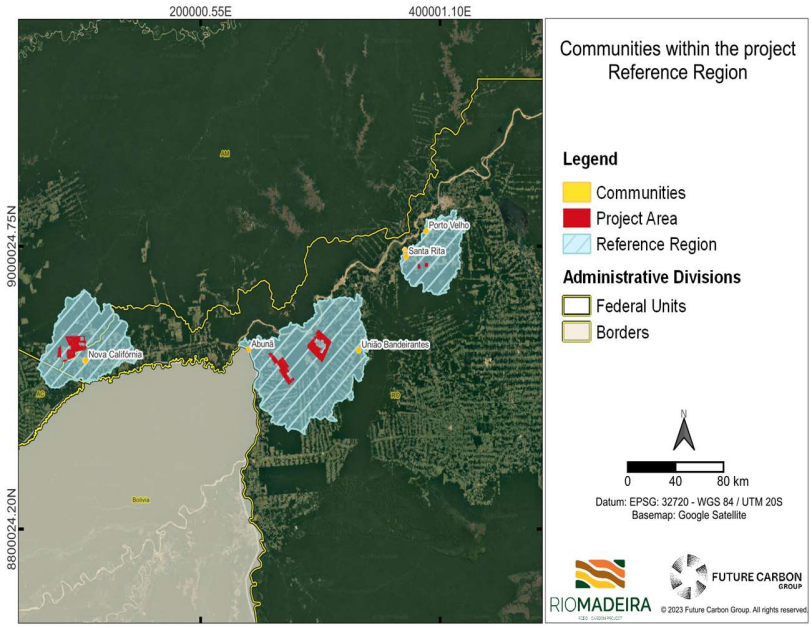


Table 16. Stakeholders identified by the project

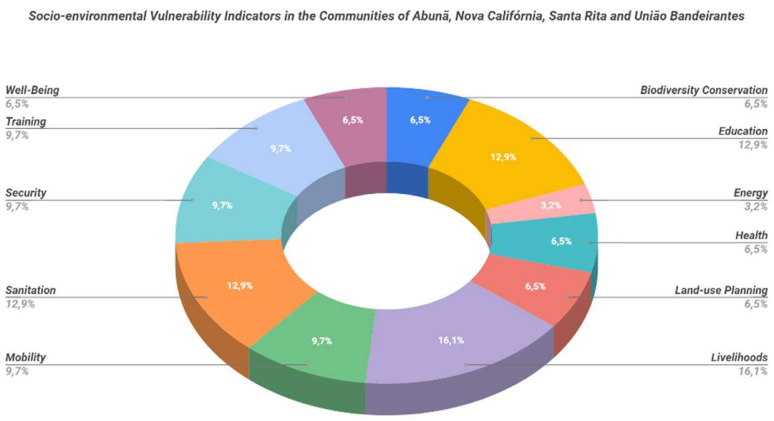
Stakeholder	Role	Sector Group	Community
FIMCA Porto Velho	Education Institution	Public Sector	Porto Velho
EMEF Flor do Cupuaçu	Education Institution	Public Sector	Reassentamento Santa Rita
UBS Santa Rita	Public Health Institution	Public Sector	Reassentamento Santa Rita
Local Leader	Civil Society	Third Sector	União Bandeirantes
EMEF Marechal Rondon	Education Institution	Public Sector	Abunã
Cooperativa RECA	Cooperative	Third Sector	Nova Califórnia

The Future Carbon management team carried out in the five social community centers the analysis of the scenario of these communities through the assessment of socio-environmental vulnerabilities, as well as the identification and prioritization of the problems encountered in these regions through consultations with local stakeholders, who were asked about their impressions on the expected impacts related to Rio Madeira activities, held on separate occasions, carried out from 30-August to 02-September-2022.

According to the assessment carried out in 4 of the 5 communities consulted around the project area, at the time of the study, Abunã, Nova Califórnia, and Santa Rita have points of vulnerabilities (weakness) in common, particular related to livelihoods, including material and social resources required for a means of living for those communities, that can be directly linked to the capacity to establish alternative income sources that do affect the conservation of the forest. It was also noted that all four communities were more vulnerable in terms of sanitation and education issues, which can be linked to the lack of sewage treatment and the Insufficient

supply of educational services such as the lack of human and material resources to ensure quality education.

Figure 26. Socio-environmental Vulnerability Indicators



In addition, as part of the SOCIALCARBON Indicators, a Social and Environmental Impact Assessment will be carried out by an independent consultant who will conduct interviews with local communities surrounding the project area to complement the identification of potential social and environmental impacts.

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. The landowners recognize the presence of the communities around the project area and take efforts to maintain a healthy relationship with them. These communities have no land ownership inside the project area or conflicts with the owner.

   On July 13, 2006, the Commission for the Sustainable Development of Traditional Communities was instituted in Brazil by decree[66] and updated in 2016[67], with the objective of implementing a national policy especially directed at such communities.

   The Decree No. 6,040 of February 7, 2007[68], 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[69].

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

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 also the objectives 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)[70].

Specially regarding indigenous people's rights, Brazil has the Indigenous Statute (Law 6.001/73), which regulates the legal situation of indigenous communities, with the purpose of preserving their culture and integrating them, progressively and harmoniously, with the national communion. The Statute guarantees that the protection of the country's laws is extended to the Indians and the indigenous communities, in the same terms as they apply to other Brazilians, safeguarding indigenous uses, customs and traditions, as well as their peculiar conditions, recognized by Law.

It is important to highlight that in Brazilian constitution, it is defined in article 231 that indigenous people are recognized for their social organization, customs, languages, beliefs and traditions, and their original rights over the lands they traditionally occupy, which the Union is responsible for demarcating, protecting and ensuring respect for all their assets. Demarcated indigenous lands are owned by the Federal Government, and, according to the federal constitution, inalienable and unavailable, and the rights over them, imprescriptible.

In addition, in the internal regulations of the National Indigenous Foundation (FUNAI), isolated tribes are guaranteed "the exercise of their freedom and traditional activities without the obligation to contact them". In this sense, it is up to the Official Indigenist Body, in the exercise of police power, to discipline the entry and transit of third parties in areas where the presence of isolated Indians is found, as well as to take the necessary measures to protect these groups (art. 7, Decree No. 1,775 / 96), by restricting the entry of third parties in these areas.

Studies on the location and monitoring of isolated indigenous people follow some basic guidelines, in the context of the constitutional guarantee of their protection, which is the basis of the Policy for Isolated Indians, namely[71]:

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

71 Available in < https://www.gov.br/funai/pt-br/atuacao/povos-indigenas/povos-indigenas-isolados-e-de-recente-contato-2/povos-isolados-1> Last visited on December 03rd, 2021.

a) To guarantee isolated and recently contacted indigenous the full exercise of their freedom and traditional activities;

b) Ensure that the finding of the existence of isolated indigenous people does not determine the obligation to contact them;

c) Promote systematic field actions aimed at geographically locating and obtaining information about isolated indigenous people;

d) Promote the regularization and protection of lands inhabited by isolated indigenous people, including all the natural resources existing in them;

e) Ensure priority and special attention to the health of isolated and recently contacted indigenous, due to their situation of particular vulnerability;

f) Ensure the protection and preservation of the culture of isolated people, in their various forms of manifestation;

g) Prohibit, within areas inhabited by isolated people, any and all economic and/or commercial activity (Ordinance No. 281 / PRES / FUNAI, of April 20, 2000).

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

Thus, the project is not based on or planning the removal or alteration of these people's way of life, guaranteeing land use and subsistence production, in addition to traditional customs and methodologies.

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 involve from government agencies social groups located as communities, producers associations in the Reference Region. Thus, by applying different forms of consultation, it is considered that the project covers the social, economic, and cultural diversity of the different stakeholders.

For government agencies, private agencies and NGOs, communication was carried out in writing and orally, with the presentation of the project, its impacts and monitoring methodologies, accounting for credits and actions in the region via online. In a different way, for the communication of the project to the traditional communities located in the reference region and project area, a consultation was carried out considering their particularities for planning the future of the project. Communications were adapted according to the audience to ensure a better understanding of the information, respecting local customs

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

4. Any significant changes in the makeup of local stakeholders over time:

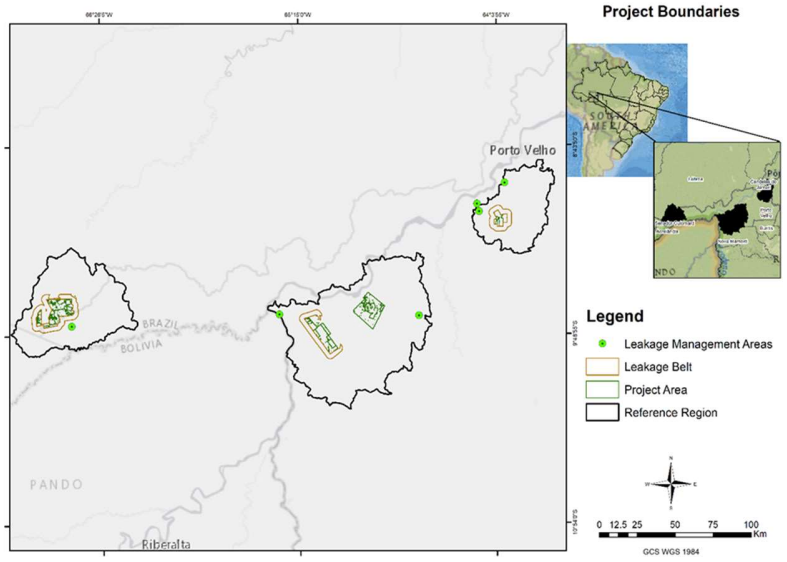
No changes were identified among the stakeholders involved with the project. Any future significant changes will be informed in this section.

5. The expected changes in well-being and other stakeholders' 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 in the No Net Harm section, designing mitigation strategies for each impact observed. No alteration of the community area, methodology or way of life in general is predicted. It is planned that the project's revenue will be invested in more socio-environmental programs to involve the local community and minimize damage to the environment and illegal deforestation. In addition, as an expected output of the implementation of the Project Activities, strengthen local governance and capacity building through environmental education workshops to promote alternative income sources that fulfill the goals of conservation and preservation of the area.

6. The location of communities, local stakeholders and areas outside the project area that are predicted to be impacted by the project. The communities and institutions that will benefit from the project activities, and that are predicted to be impacted by the project, were included in the leakage management area, as shown in the map below:

Figure 27. Project boundaries and communities' location



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

   The area used by the communities is included on the Leakage Management Area and 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 stakeholder's doubts. Considering this, the table below presents potential risks and impacts to local stakeholders and measures taken to mitigate those.

Table 17. Risks to Local Stakeholders

Aspect	Impact	Effect		Comments/ Observation
		Beneficial	Adverse	
Sustainable Forest Management Plan	Logging		X	For the properties which have a Sustainable Forest Management Plan, exploring a volume within the authorized by the Exploitation License. Monitored by the Biodiversity resource: ● Impact on remaining flora Monitored by the Natural resource: ● Quality Control
Sustainable Forest Management Plan	Reduced access to land due to expansion of exploration		X	No communities live within the Management Plan, and therefore will not be affected by logging activities. In any case, the expansion of the exploration is not foreseen, and, if any, it will be communicated and carried out in order to avoid the displacement of residents or limitation of land access. Monitored by the Natural resource: ● Quality Control ● Land Tenure
Resources	Withdrawal of natural, economic and cultural resources (water, food, alternative income, cultural events, etc.) from families		X	The region where the communities live is not within the Management Plan, and therefore will not be affected by logging activities. The project's objective is to guarantee financial resources to maintain sustainable and certified wood management and also to expand the socio-environmental benefits for the communities within and around the Project Area. Thus, certifications and the use of Social Carbon are a guarantee that there will be no reduction in access

				and/or withdrawal of resources from impacted families. Monitored by the Biodiversity resource: ● Non-timber forest products (NTFPs) Monitored by the Carbon resource: ● Stakeholder consultation Monitored by the Financial Resource: ● Alternative income sources
Land access	Reduced access to traditional areas		X	The management plan area does not include communities' access regions, and therefore, they will not be affected by the maintenance of activities. There are no plans to expand the management area, and communities are guaranteed access to customary land. Monitored by the Natural resource: ● Quality Control ● Land Tenure
Land use	Displacement of families due to project activity		X	Families will not be removed from the area currently used. The project owner maintains a relationship with the families, and one of the objectives of the carbon project is to expand social and environmental benefits. Monitored by the Human resource: ● Conflict management Monitored by the Natural resource: ● Land Tenure
Food Security	Withdrawal of land used for food		X	The management plan area does not include communities' access regions,

	production or income generation			and therefore, they will not be affected by the maintenance of activities. The areas for planting / ranching for subsistence or for selling for income generation will not be included in the management plan and the removal of these lands is not planned. Monitored by the Biodiversity resource: ● Non-timber forest products (NTFPs) Monitored by the Natural resource: ● Land Tenure
Climate change adaptation	Adaptations and impacts related to the climate crisis	X		The main objective of the project is forest conservation, avoiding unplanned deforestation. The maintenance of the standing Forest is essential to mitigate the effects of the climate crisis and the maintenance of natural resources for the population. The project also contributes to achieving climate justice, since the groups that suffer most from climate change are the vulnerable and traditional communities. Monitored by the Financial resource: ● Carbon Credit Benefits Monitored by the Natural resource: ● Social and environmental investments Monitored by the Carbon resource: ● Project performance
Discrimination or sexual harassment	Involvement of project proponent or any other entity in any form of		X	The project activity doesn't endorse any form of discrimination based on gender. Project instances go through a due diligence performed by Future Carbon to assure that proponents are not involved in

	discrimination or sexual harassment			any form of discrimination or sexual harassment. Brazil has ratified ILO Conventions 45 (Underground Work (Women) Convention) and 111 (Discrimination (employment and occupation) Convention[72]. In addition, Grupo Rovema[73] and Future Carbon each have an internal code of conduct, to guarantee the ethics and safety of its workers and activities.
Armed Patrols	Use of weapons during patrols		x	Introductory, it is necessary to point out that armed private security teams are practically invisible to the eyes of visitors or third parties passing through or visiting the areas where they are present, as they occupy accommodation outside the concentration of housing or operational areas of the farms. The work of these teams is concentrated along the perimeter and in specific points that have been mapped as possible locations where an eventual invasion could occur. There is not and will not be any need for these teams to be openly armed outside the context of their operations. Farm employees are aware that there is armed surveillance on the Santa Carmen farm at specific points. The surrounding communities are aware of the patrolling carried out on the farm. However, armed surveillance occurs within the instance 2 property, which is a private land where no access is allowed by third parties. Hence, since there is a low presence of community members, the risk of encounters is low. Nevertheless, if a community member is identified within the property for any reason, the levels of force procedure detailed at Section 2.5 will be applied. The use of weapons, according to Brazilian legislation, is the last resort to protect life and can only be used in this circumstance. Most of the time, the invasions of areas carried out by these groups are characterized by a lot of

[72] Available at < https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:11200:0::NO::P11200_COUNTRY_ID:102571>
73 Download available at <https://gruporovema.com.br/grupo>

				violence, they generally carry sharp weapons, if not machetes, hoes, and sickles which, if used against anyone, are very powerful weapons. However, no record of any situation that came even close to this during the entire time of the project. Realistically, the awareness that there is armed surveillance serves more as an inhibiting factor. It is important to make it clear that these professionals are trained to develop the skills of: handling and using weapons, negotiation skills, control of civil disturbances and other skills necessary to work in a scenario like the one we have. Another measure to be implemented that mitigates the possibility of an accidental shooting occurring when on patrol, with the risk of reaching people nearby, will be the obligation for available weapons to always be inside the vehicles used for patrols, which are easily accessible for an eventuality.

The measures needed to mitigate the identified risks mentioned above are described in section 2.1

Table 12.

Regarding the item 3.18.15 of the VCS Standard V 4.4, the project proponent or any other entity involved in the project shall not be involved in any form of discrimination or sexual harassment.

Future Carbon Group has an internal Code of Conduct designed to bring together the principles and values adopted by the organization. Future Carbon does not tolerate any kind of harassment within its business units or in any other place where managers and employees are present. The Code of Conduct applies to all companies that are part of the Future Carbon group, covers all administrators, employees and people who act, even occasionally, as performers of activities related to the company, and must be widely disclosed to customers, investors, employees, and the general public. All administrators, directors, managers or any other leaders must ensure compliance with this Code and disseminate it, to inform all employees of its content and help them understand and comply with its guidelines.

Therefore, threats of any kind or unethical pressure are not tolerated, especially those aimed at obtaining undue advantages. Abuse of any nature among managers and employees is not tolerated, and any verbal or physical conduct of humiliation, aggression, coercion, or threat to company members, or that results in a hostile work environment, is unacceptable. Politeness and cordiality must prevail in the work environment.

Sexual harassment is not only morally unacceptable but also a punishable crime under the Brazilian Penal Code. Apart from the company's internal disciplinary actions, the perpetrator's behavior will be reported to the appropriate public authorities.

Any suspicion of deviant behavior or violations of the law or the rules established here must be reported to the Ethics Channel, via the link contatoseguro.com.br/futurecarbon.

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.

The project owner intends to offer benefits and training for the local community, including health related benefits, in addition to providing education for children and women, as stablished and monitored by the Social Carbon methodology.

No community member has been or will be removed from their land, on the contrary, communities will be supported through programs and incentives the project proponent will instigate. In addition, the project did not introduce any invasive species or allow an invasive species to thrive through project implementation. No project activity foresees the use of non-native species. Furthermore, the project does not foresee the use of fertilizers, chemical pesticides, biological

control agents and other inputs. If these products are used in the future in any activity related to the leakage management area, the project will duly justify the use and possible adverse effects.

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. All communication and consultation will be conducted in a culturally appropriate manner, which includes language and gender sensitivity, with local stakeholders or their legitimate representatives when appropriate, as explained in the section 2.2.

As described above, the project intends to carry out local stakeholders' consultations (in loco or online), which will be monitored by social-environmental certification by additional standards. 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, were discussed with communities through online and on-site stakeholders consultations.

As stated in section 2.2, the on-line consultation was carried out in 05/September/2022, while the on-site consultations were representatives of VVB were present, as detailed in the section 2.2, Table 5.

Furthermore, a permanent communication channel with local stakeholders was created through tecnica@futurecarbon.com.br and landowners emails' (lediana@ceo.grupoROVEMA.com.br, joseleitejunior@gmail.com, and ciatupa@uol.com.br) in order to receive and store comments or suggestions regarding the present REDD project. All communities received Future Carbon contact channel 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. The grievance redress procedure follows the guidance of the VCS Standard V4.4 and is detailed in the section 2.2

The third-party verification checks if the project activities were based on the Cancun Safeguards, agreed under the United Nations Framework Convention on Climate Change (UNFCCC), that establishes principles for the implementation of REDD+ by addressing transparency, participation of stakeholders, protection of biodiversity and ecosystem services, and respect for rights of indigenous and local communities.

The Resolution nº 15/2008 of CONAREDD[74] enables Brazil to incorporate the Cancun Safeguards into a national framework by means of guidelines and steps for operationalizing their safeguards. Also, the project seeks to comply with local laws, which there are safeguards already in place by the State Law nº 4.266/2015[75], that aims to maximize the positive impacts and reduce any negative impacts related to REDD+ actions, including promoting and supporting the full and effective participation of stakeholders, in particular indigenous peoples, and local communities.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

This Grouped project utilizes the approved VCS Methodology VM0015: Methodology for Avoided Unplanned Deforestation, version 1.1, published on 03-December-2012.[76]

Furthermore, the following tools were used:

- VT0001 – Tool for demonstration and assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities, v3.0, published on 01-February-2012.[77]
- AFOLU Non-Permanence Risk Tool v4.0, published on 19-September-2019.[78]

3.2 Applicability of Methodology

Applicability Conditions	Rio Madeira Grouped REDD+ Project Justification of Applicability	Instance 1 – Grupo ROVEMA Project Activity Justification of Applicability	Instance 2 – Grupo Leite Project Activity Justification of Applicability	Instance 3 – Grupo Tupá Project Activity Justification of Applicability
a) Baseline activities may include planned or unplanned logging for timber, fuel-wood collection, charcoal production,	All instances may have baseline activity that includes planned or unplanned logging for timber, fuel-wood collection,	None of the baseline land-use conversion activities are legally designated or sanctioned for forestry or deforestation, and	None of the baseline land-use conversion activities are legally designated or sanctioned for forestry or deforestation,	None of the baseline land-use conversion activities are legally designated or sanctioned for forestry or deforestation,

74 Available at: < http://redd.mma.gov.br/images/conaredd/SEI_MMA---0335920---Resoluo-15.pdf>
75 Available at: < https://online.sefaz.am.gov.br/silt/Normas/Legisla%E7%E3o%20Estadual/Lei%20Estadual/Ano%202015/Arquivo/LE%204.266_15.htm>.
76 Available at <https://verra.org/methodology/vm0015-methodology-for-avoided-unplanned-deforestation-v1-1> Last visit on 09/08/2022.
77 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/> Last visit on 09/08/2022
78 Available at <https://verra.org/wp-content/uploads/2019/09/AFOLU_Non-Permanence_Risk-Tool_v4.0.pdf> Last visit on 09/08/2022

agricultural and grazing activities as long as the category is unplanned deforestation according to the most recent VCS AFOLU requirements.	charcoal production, agricultural and grazing activities as long as the category is unplanned deforestation according to the most recent VCS AFOLU requirements.	hence the project activity qualifies as avoided unplanned deforestation. This is in accordance with the definition of unplanned deforestation under the VCS Standard. The primary land uses in the baseline scenario consists of two activities: illegal logging for timber collection, clearing of the area and subsequent cattle ranching, as mentioned on section 3.4 of the PD. Therefore, the present criteria are fulfilled.	and hence the project activity qualifies as avoided unplanned deforestation. This is in accordance with the definition of unplanned deforestation under the VCS Standard. The primary land uses in the baseline scenario consists of two activities: illegal logging for timber collection, clearing of the area and subsequent cattle ranching, as mentioned on section 3.4 of the PD. Therefore, the present criteria are fulfilled.	and hence the project activity qualifies as avoided unplanned deforestation. This is in accordance with the definition of unplanned deforestation under the VCS Standard. The primary land uses in the baseline scenario consists of two activities: illegal logging for timber collection, clearing of the area and subsequent cattle ranching, as mentioned on section 3.4 of the PD. Therefore, 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 grouped project falls within category C, “Avoided Deforestation without Logging” or D, “Avoided Deforestation with Logging” in the Project Activity	The first project instance contains forest and degradation is not included in either the baseline or project scenario. Since the first instance presents a Sustainable Forest Management Plan (SFMP), it falls into category “D”.	The second project instance contains forest and degradation is not included in either the baseline or project scenario. Since this instance no longer executes SFMP, which activities ended before the project PSD, it falls into category “C”	The third project instance contains forest and degradation is not included in either the baseline or project scenario. Since the third instance presents SFMP, it falls into category “D”.

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 agro-forestry systems meeting the definition of "forest".	All instances that compose the Rio Madeira Grouped REDD+ Project could include different types of forest, such as, but not limited to, old growth forest, degraded forest, among others since meeting the definition of "forest".	The REDD project instance area is 100% made up of forest, as described in the section Conditions Prior to Project Initiation of the present VCS PD. No deforested, degraded or areas otherwise modified by humans were included in the project area at Project Start Date.	The REDD project instance area is 100% made up of forest, as described in the section Conditions Prior to Project Initiation of the present VCS PD. No deforested, degraded or areas otherwise modified by humans were included in the project area at Project Start Date.	The REDD project instance area is 100% made up of forest, as described in the section Conditions Prior to Project Initiation of the present VCS PD. 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.	For all instances of this grouped project is a requirement that the project area shall include only land qualifying as "forest" for a minimum of 10 years prior to the project start date.	The project instance area consisted of 100% tropical rainforest 10 years prior to project start date – all of which conformed to the Brazilian definition of forest[79]. This was ascertained using satellite images, as described in the section Project Location of the present VCS PD.	The project instance area consisted of 100% tropical rainforest 10 years prior to project start date – all of which conformed to the Brazilian definition of forest[80]. This was ascertained using satellite images, as described in the section Project Location of the present VCS PD.	The project instance area consisted of 100% tropical rainforest 10 years prior to project start date – all of which conformed to the Brazilian definition of forest[81]. This was ascertained using satellite images, as described in the section Project Location of the present VCS PD.

[79] 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 .

[80] 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 .

[81] 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 .

e) The project area can include forested wetlands (such as bottomland forests, flood plain 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 a forested wetlands growing on peat (e.g. peat swamp forests), this methodology is not applicable.	As a criteria for this item, none of the instances of this grouped project will be aloud to maintain regions grows on peat. Apart of the exception above the project area can include forested wetlands (such as bottomland forests, flood plain forests, mangrove forests)	As described in the section 1.13 of the present VCS PD, soil types are Latosol, thus, mineral. Therefore, none of the project region grows on peat, satisfying this applicability criterion.	As described in the section 1.13 of the present VCS PD, soil types are Latosol, thus, mineral. Therefore, none of the project region grows on peat, satisfying this applicability criterion.	As described in the section 1.13 of the present VCS PD, soil types are Latosol, thus, mineral. Therefore, none of the project region grows on peat, satisfying this applicability criterion.

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 landowners must present 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 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.

3.3 Project Boundary

Spatial Boundaries

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

Name	Area (ha)
Project Area – Instance 1	20,232.25
Project Area – Instance 2	13,204.20
Project Area – Instance 3	18,837.60
Leakage Belt	60,258.95
Reference Region	1,155,116.88

- **Project Area**

  Project Area is composed by Instance 1, Instance 2 and Instance 3.

  The three first project activity instances areas are composed of three main properties as described in section "1.12 Project Location". Given that the coordinates represented by these properties are extensive, the area contour coordinates of the properties composing the Rio Madeira Grouped REDD+ Project are presented in the Appendix I.

  In accordance with VCS requirements stipulated in the Approved VCS Methodology VM0015, version 1.1, the project area may only include areas composed of "forest"[82] for a minimum of ten years prior to the project start date. Therefore, satellite images between 2009 and 2019 were analyzed and classified. The areas within the properties that were defined as forest in 2009 and in 2019 were identified and utilized to compose the project area. In addition, some non-forest areas were excluded, such as rivers, rocks, wetlands, and non-forest vegetation.

  It is worth highlighting the exclusion of wetlands assures the non-peatlands requirement within the project area, since Brazilian peatlands are associated with extensive flood extensions.[83][84][85]

[82] Brazilian Forestry Service. Brazil adopts 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." http://www.florestal.gov.br/snif/recursos-florestais/index.php?option=com_k2&view=item&layout=item&catid=14&id=158 .

[83] Available at https://www.teses.usp.br/teses/disponiveis/3/3134/tde-17122001-110912/publico/tde.pdf Last visit on 25/January/2023

[84] Available at https://www.scielo.br/j/aa/a/cHRVRBkgp7hdryqmPYhQ94w/?format=pdf&lang=pt Last visit on 25/January/2023

[85] Available at https://repositorio.usp.br/item/001607704 Last visit on 25/January/2023

In addition, as detailed in section 1.13, the soil types present in the project area are mineral soils, in which peat does not naturally occur.

Therefore, the estimated Project Area, including the three initial instances, is located within the properties' boundaries, totaling 52,274.05 ha, as displayed below:

Figure 28. Rio Madeira Grouped REDD+ Project area

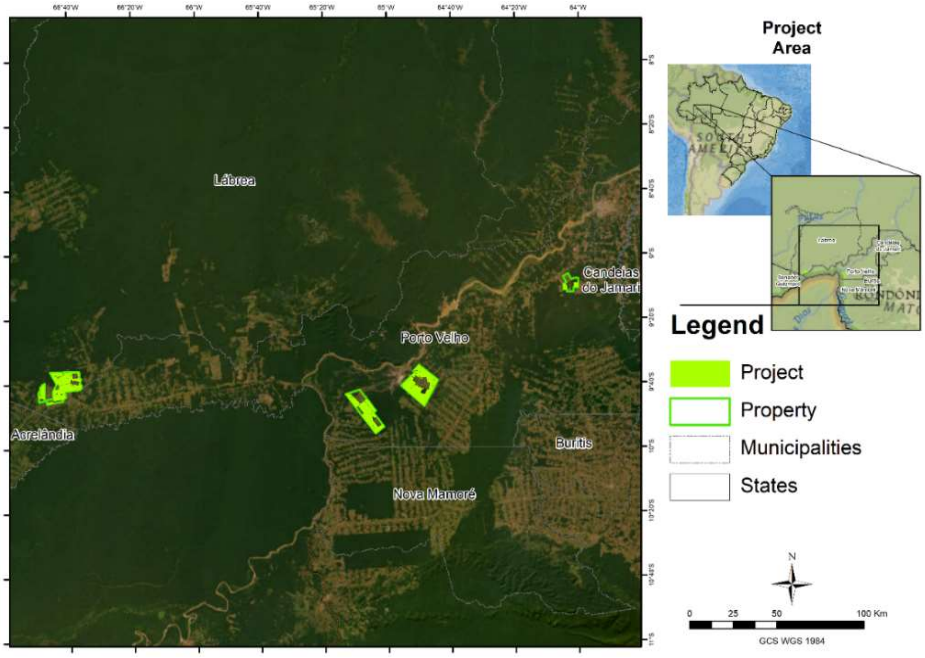


Figure 29. Rio Madeira Grouped REDD+ Project instances

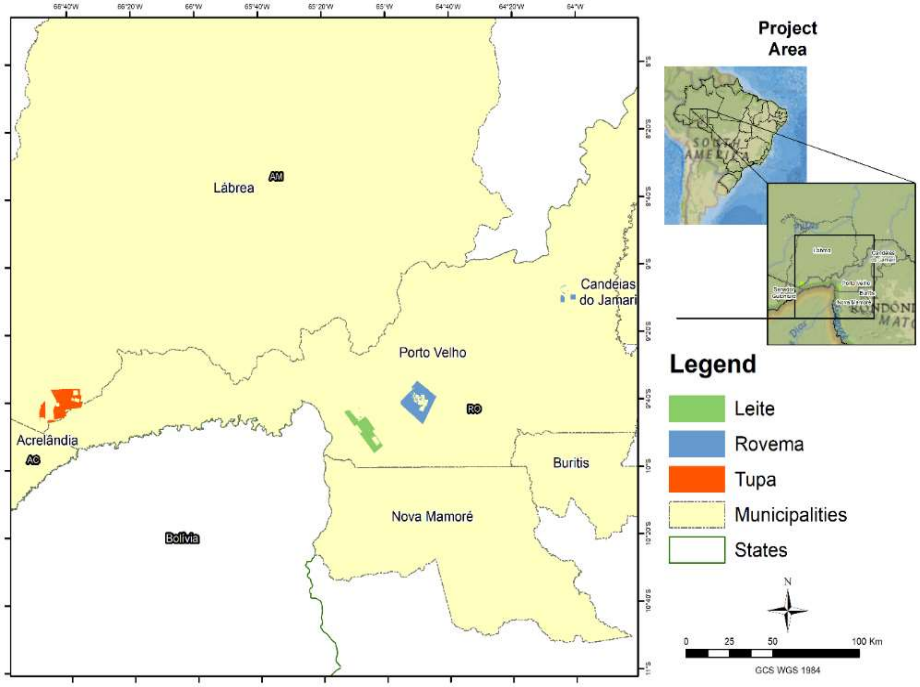
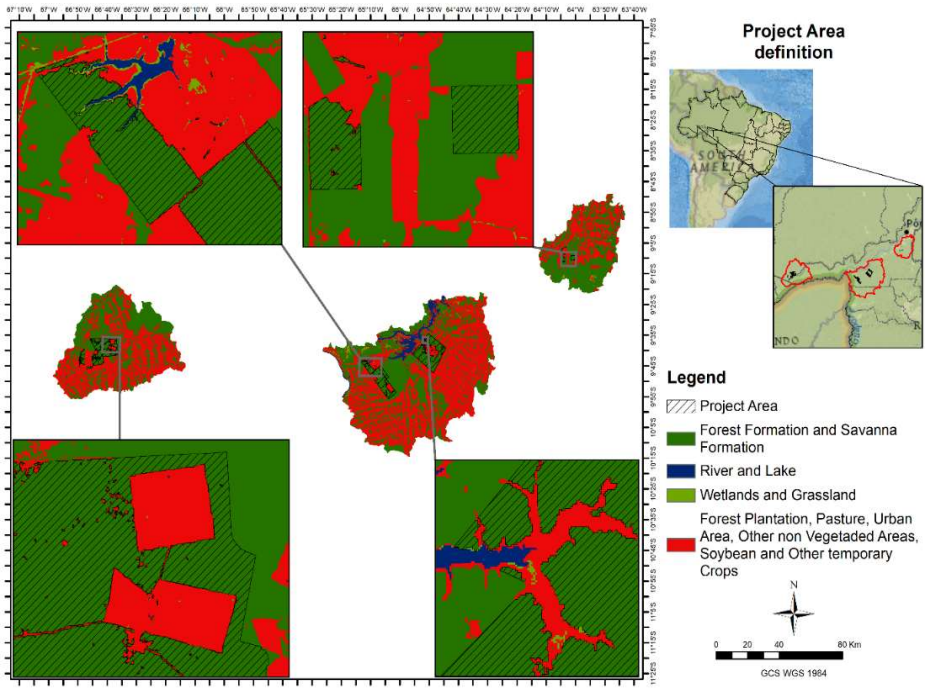


Figure 30. Rio Madeira Grouped REDD+ Project area definition



- <u>Reference Region</u>

  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 first instance's start date, i.e. 2009 to 2019, was determined, representing a credible proxy for possible future deforestation patterns in the project area.

  The RR will be 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 identified in the beginning of the project or that might be mapped during project lifetime). 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.

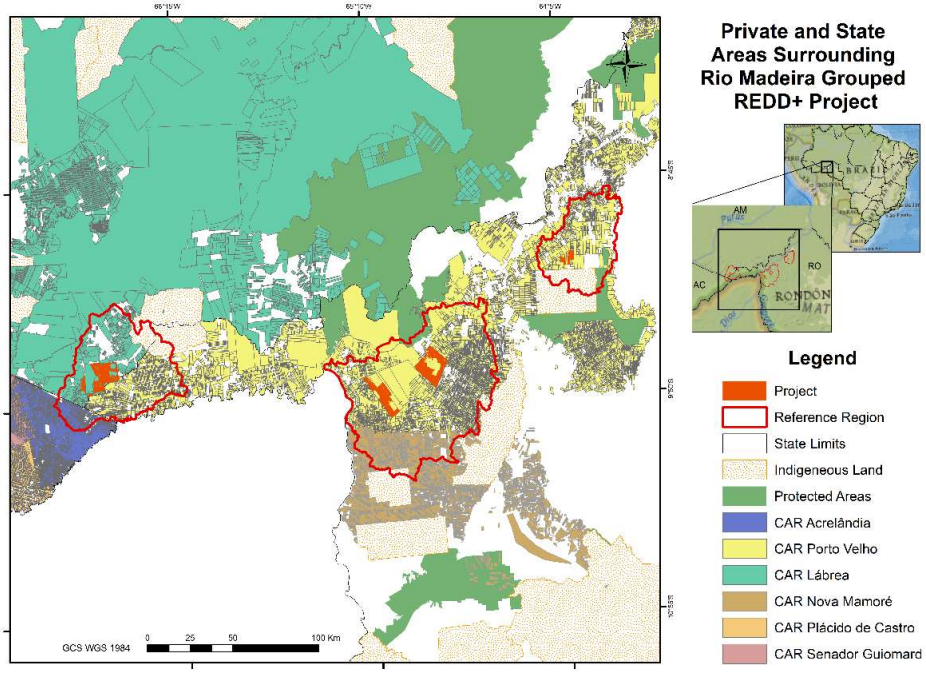
In addition, according to the methodology, three main criteria are relevant to demonstrate that the conditions determining the likelihood of deforestation within the project area are similar or expected to become similar to those found within the reference region:

Agents and drivers of deforestation: Cattle ranching is an important economic activity within the reference region. As detailed in section 3.4, the main agent of deforestation (cattle ranching), is considered a threat 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". 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. It is worth mentioning that, although there are indigenous lands and unit conservations within the reference region, it was chosen not excluding such lands and, thus, assuring a conservative approach. These policies are detailed in section 1.14. Data presented is the private areas available at Brazil's Environmental Rural Registration[86], National Protected Areas[87]:

[86] Available at < https://www.car.gov.br/publico/imoveis/index>
[87] Available at http://mapas.mma.gov.br/i3geo/datadownload.htm

Figure 31. Private and state areas surrounding the project area

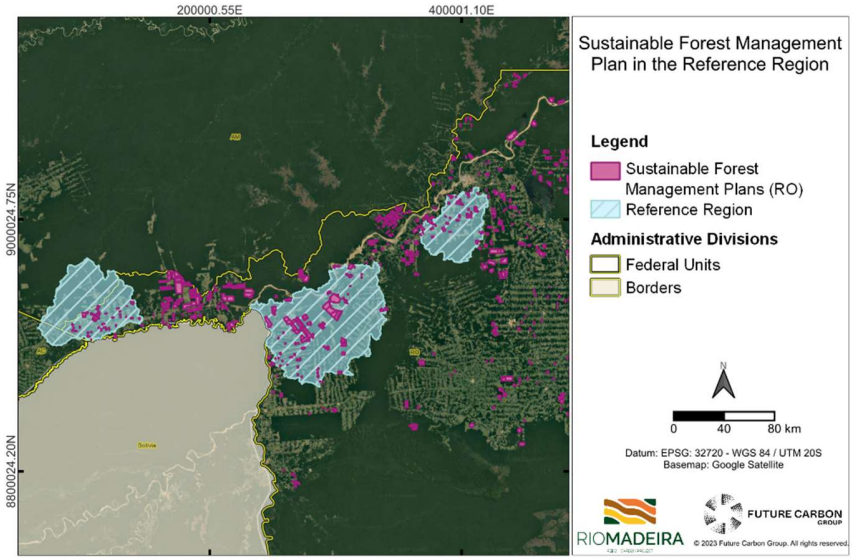


Furthermore, it is also important to highlight that SFMP is present in surrounding areas. The map below shows the distribution of areas with SFMP[88] in the State of Rondônia[89]. It is worth noting that 3,880 SFMP polygons were identified within the State of Rondônia Geoportal, which demonstrates the common use of land for forest management in the region.

88 Data available at <https://geoportal.sedam.ro.gov.br/>

89 Data from the states of Amazonas and Acre, included in the project's Reference Region, are not publicly available. However, it is worth highlighting that the total area of the Reference Region amounts to approximately 1,155,066.8121 hectares. Of these, 28,947.4694 (2.51%) are located in the state of Acre, 170,535.0650 (14.81%) in the state of Amazonas and 954,571.5706 (82.68%) in the state of Rondônia. Therefore, the evaluation of only the portion of the State of Rondônia is considered representative.

Figure 32. Sustainable Forest Management Plans in the State of Rondônia



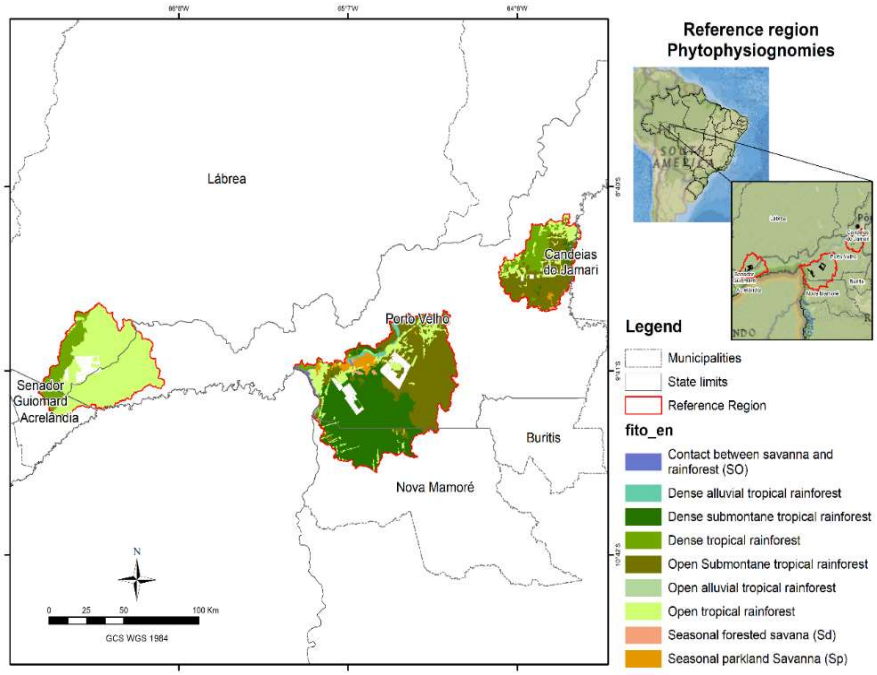
Landscape configuration and ecological conditions: To define the Reference Region, hydrographic basins were used within an area of 27,839,964.62 hectares around the project area, from the drainage network produced by the SRTM digital elevation model. For each of these basins, the average values of elevation, slope and precipitation and the percentages of different types of vegetation were determined. Based on these values, basins that presented values close to these parameters to the values of the project area were selected. Then, an attempt was made to select basins until reaching an extension of approximately twenty times the size of the project area.

From the definition of this area, which has 1,155,116.88 ha, the criteria related to the type of vegetation, elevation, slope and precipitation were tested to verify the similarity to the project area and the rest of the reference region. For the four variables, the values meet the criteria, indicating the adequacy of the reference region. The results are presented below:

Vegetation: four vegetation types were found to be present in the project area: Dense Submontane Tropical Rainforest, Dense Tropical Rainforest, Open Submontane Tropical Rainforest and Open Tropical Rainforest. In the reference region, these phytophysiognomies occupy around 97%. Other vegetation types present within the reference region with less than 3% coverage are Dense Alluvial Tropical Rainforest, Open alluvial Tropical Rainforest, Seasonal Forested Savana, Seasonal Parkland Savana, and Contact Between Savanna and Rainforest. Vegetation types are provided by IBGE natural resources mapping (MRN)[90].

[90] Natural Resources Mapping (MRN). Available at https://geoftp.ibge.gov.br/informacoes_ambientais/vegetacao/vetores/escala_250_mil/DOCUMENTACAO_TECNICA_MRN.pdf . Last visit on 08/January/2023.

Figure 33. Vegetation cover of the Reference Region



Regarding the forest classes criterion, the phytophysiognomies data used in the project originates from the IBGE natural resources mapping (MRN)[91], which compiles data on geology, geomorphology, pedology and vegetation within the Brazilian national territory. The history of this data starts with the incorporation of the RADAMBRASIL Project to IBGE in 1989, which carried out the data survey with radar area images and field information. In 1997, IBGE along with the Amazon Surveillance System Project (SIVAM) [92] updated the data with orbital images and field information about the Legal Amazon. In 2007, the mapping of the entire Brazilian territory was completed. Thus, the Vegetation data of the MRN is characterized by the mapping of land use and land cover according to the regional distribution of the natural vegetation physiognomies found throughout the national territory. It is worth mentioning that this data follows the IBGE's Vegetation Classification System, made available in the Vegetation Technical Manual (2nd edition) [93].

The processing of the vegetation data at the scale 1:250,000 for the Rio Madeira Grouped REDD+ project was carried out in the following steps:

- Step 1, data download from the IBGE MRN site;

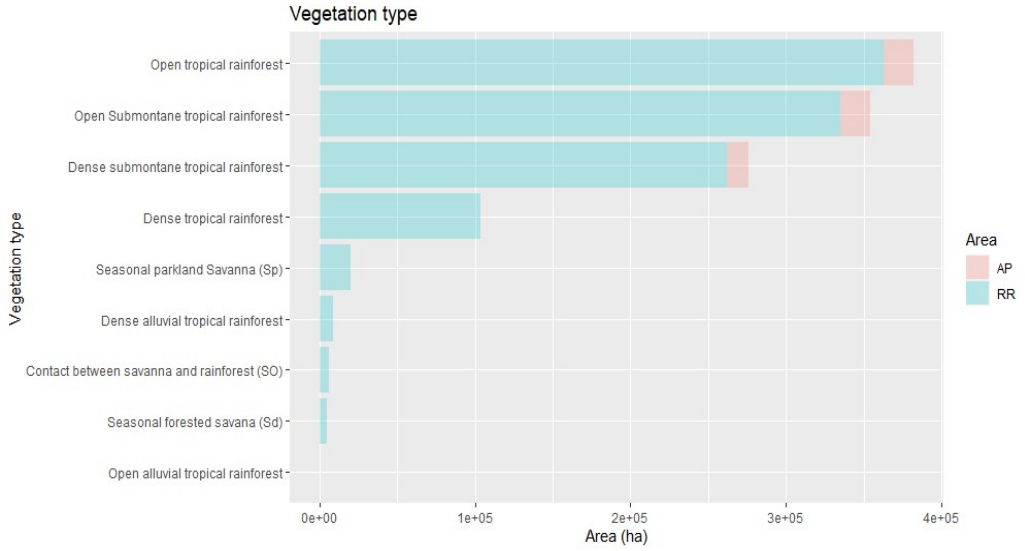
[91] Natural Resources Mapping (MRN). Available at https://geoftp.ibge.gov.br/informacoes_ambientais/vegetacao/vetores/escala_250_mil/DOCUMENTACAO_TECNICA_MRN.pdf . Last visit on 08/January/2023.

[92] Amazon Surveillance System Project (SIVAM) .Available at https://ambientes.ambientebrasil.com.br/florestal/programas_e_projetos/projeto_sivam_sistema_de_vigilancia_da_amazonia.html . Last visit on 08/January/2023.

[93] Vegetation Technical Manual. Available at https://www.ibge.gov.br/geociencias/informacoes-ambientais/vegetacao/15826-manual-tecnico-em-geociencias.html?=&t=publicacoes . Last visit on 08/January/2023.

- Step 2, correction of the anthropic use classes to phytophysiognomies, using the previous vegetation data of this anthropic use.

Figure 34. Distribution of vegetation types, in hectares, in the Reference Region and in the Project Area



It is worth mentioning that, although several forest classes were identified in the project area, no stratification was carried out. According to the proportions available at the spreadsheets, the Open Tropical Rainforest was the phytophysiognomy adopted, using representativeness and conservativeness principles. More information of forest types at VCS PD Calculations spreadsheets and at VCS PD section 5.

Altitude: The altitude in the project area ranges from 97 to 217m and these values are within 100% of the variation in the rest of the reference region, as show in figures below.

Figure 35. Altitude variation in the Reference Region of the Rio Madeira Grouped REDD Project. Source: SRTM

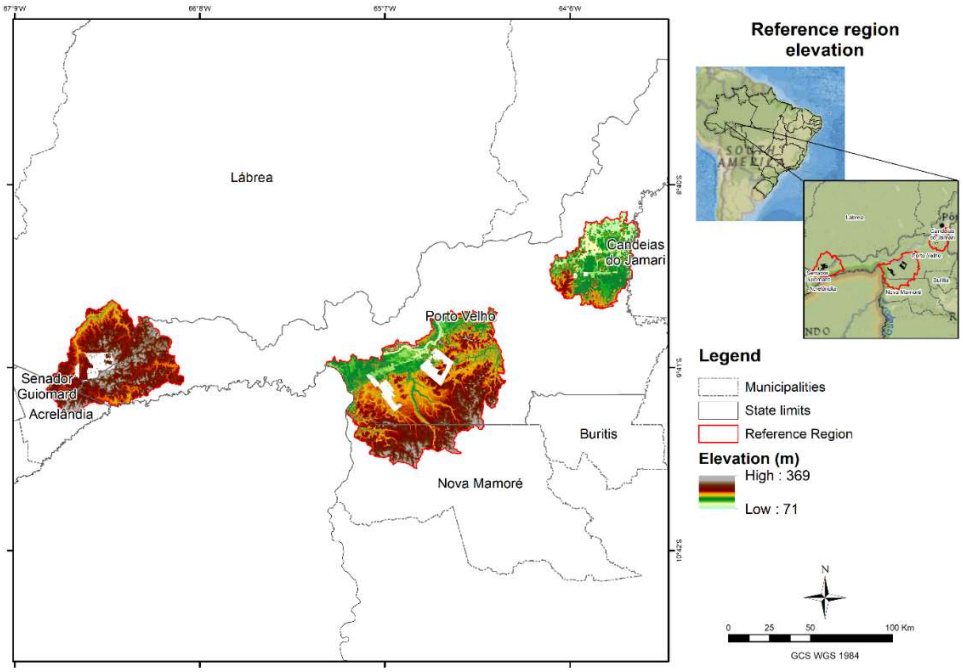
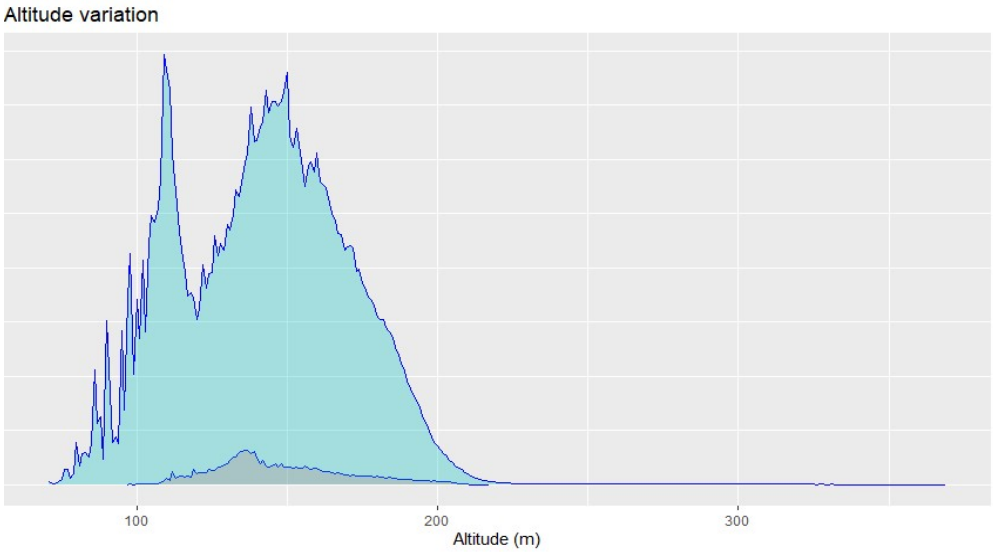


Figure 36. Altitude distribution (m), in number of pixels, in the Reference Region (RR) and in the Project Area (PA)



Slope: the average slope in the project area is 4.86% while in the rest of the reference region it is 4.77% (Figure 28). Therefore, the mean value of 100% of the project area is within the range of ± 10% of the mean in the reference region, which is between 4.29 and 5.25%.

Figure 37. Slope variation in the Rio Madeira Grouped REDD Project Reference Region. Altitude source: SRTM

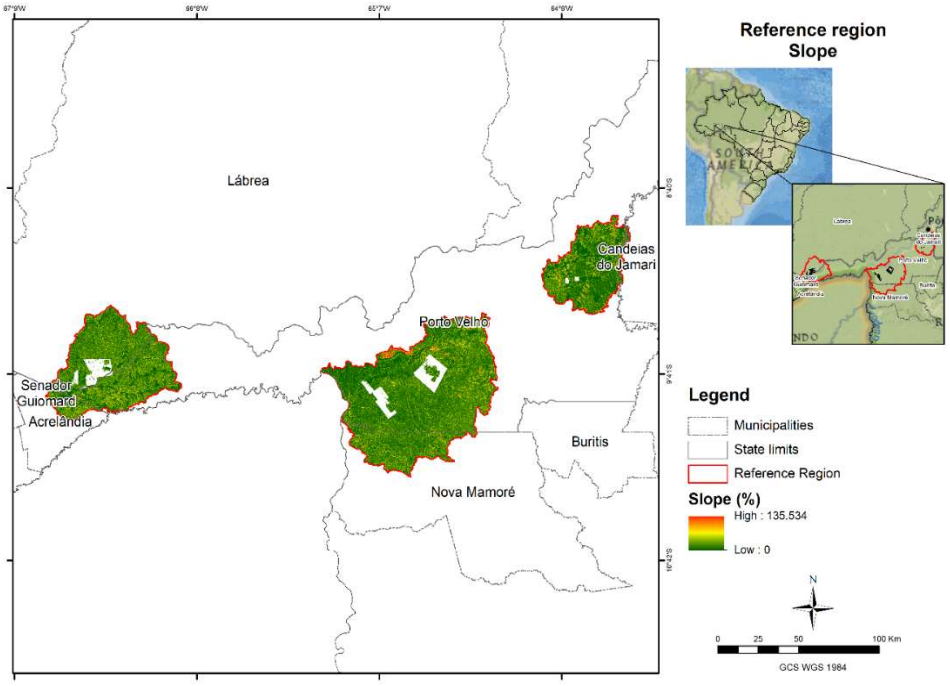
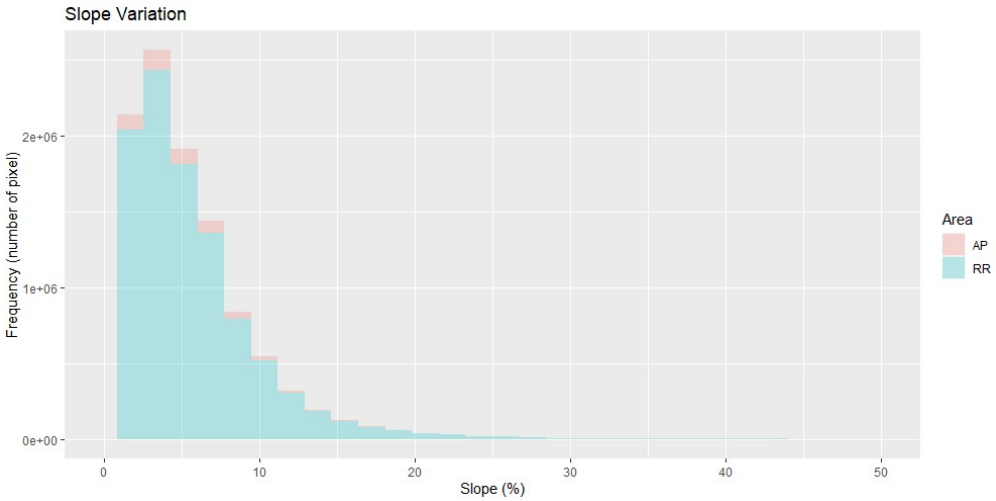


Figure 38. Slope distribution (degrees), in number of pixels, in the Reference Region and in the Project Area



Rainfall: The annual rainfall in the project area is, on average, 1,809.77 mm, while in the rest of the reference region it is 1,879.78 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 1,691.80 and 2,067.76 mm.

Figure 39. Variation of annual precipitation in the Reference Region[94]

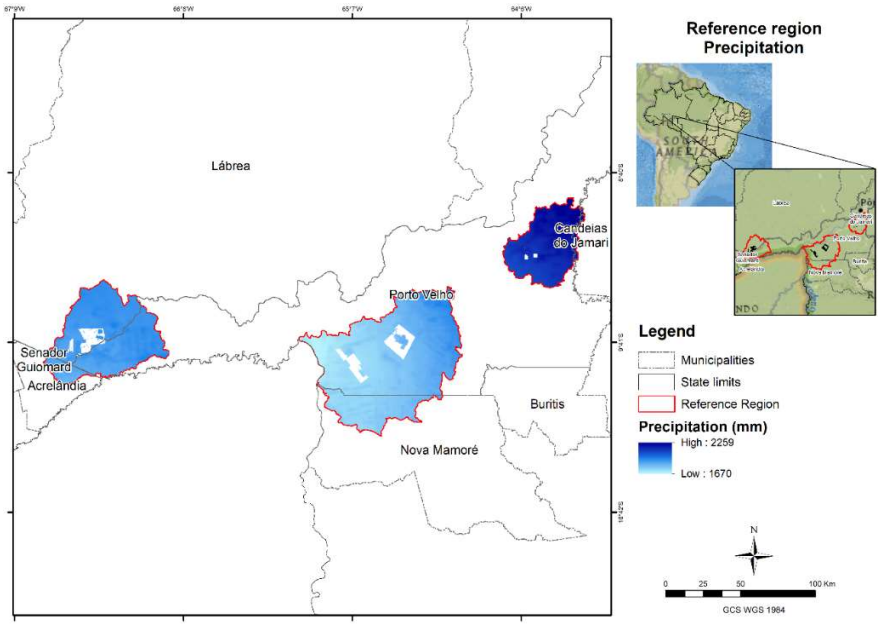
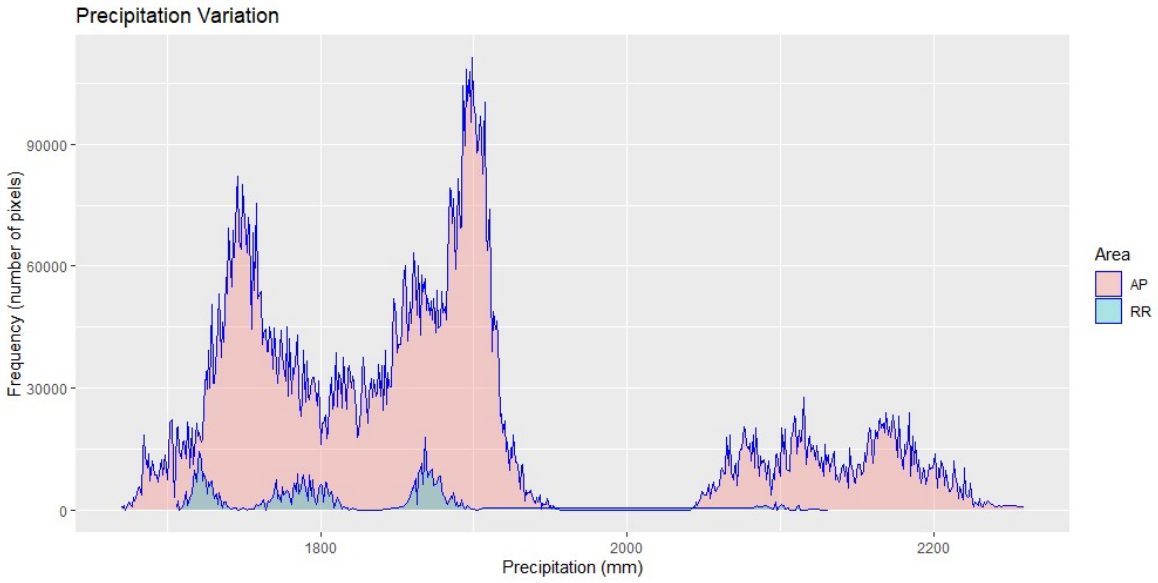


Figure 40. Distribution of annual precipitation (mm), in number of pixels, in the Reference Region (RR) and in the Project Area (PA)



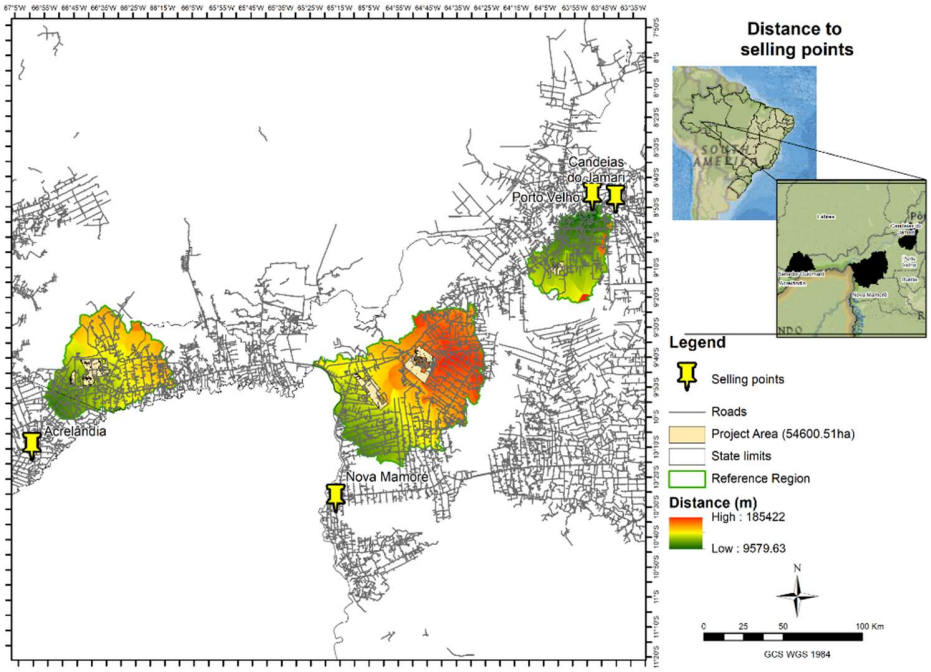
[94] Rainfall data available at <https://www.worldclim.org/data/worldclim21.html>

- **Leakage Belt**

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 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. Figure below represents the total distance in the reference region.

Figure 41. Surface distances (m) to the nearest commercial centers in the Reference Region and Project Area



For the monetary costs related to transport, it was considered the information in the Normative Instruction nº 036/2022/GAB/CRE[95]. According to the Instruction, the freight values must be calculated using the following equation:

$$Freight\ cost = Fuel\ Cost \times Load\ weight \times Index$$

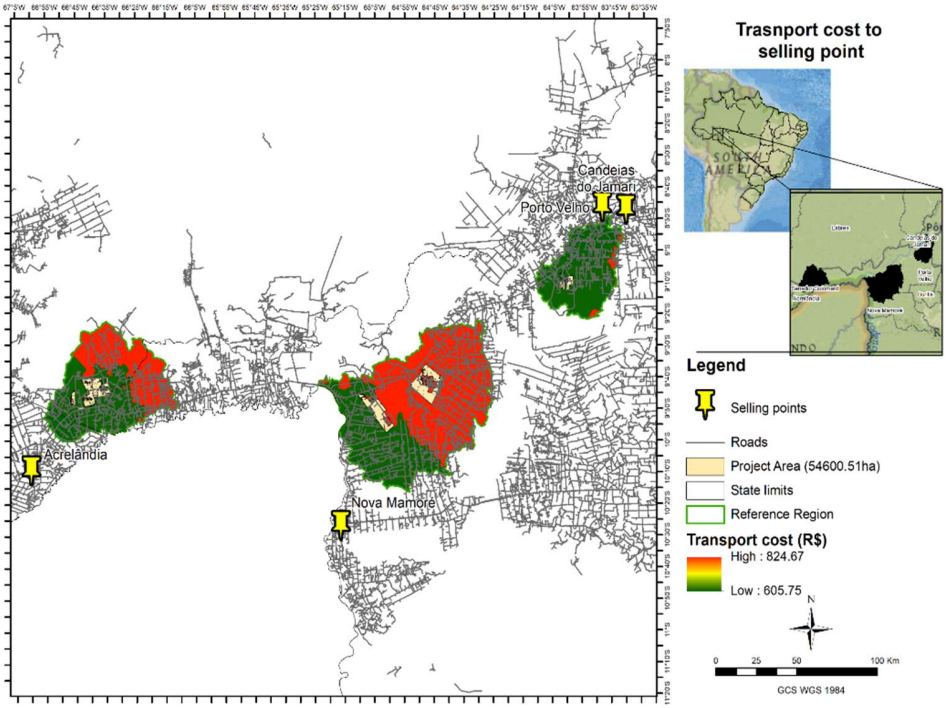
The value of diesel (Fuel Cost) used was sourced from ACT COTEPE/PMPF No. 38, OF OCTOBER 22, 2021[96] in force to date, as recommended by the Normative Instruction.

[95] Available at <https://www.sefin.ro.gov.br/portalsefin/anexos/IN22---036-Institui-a-pauta-fiscal-de-mercadorias-e-produtos-e-da-outras-providencias.pdf>

[96] Available at <https://www.confaz.fazenda.gov.br/legislacao/atos-pmpf/2021/pmpf038_21>

For the weight of the load, 12.75 tons was considered, which is equivalent to an amount of 25 heads of cattle (510 kg). This number is also equivalent to the transport capacity of a “Carreta Baixa” model truck. For the index, the "Table of Indexes for Road Freight Calculation" was used, also present in Normative Instruction No. 036/2022/GAB/CRE. Figure below illustrates the freight values that would be paid at each point of the reference region.

Figure 42. Surface costs (R$) for road transportation to the nearest commercial centers in the Reference Region and Project Area



For production costs, a conservative scenario was considered, where the animal unit (AU) per hectare is equal to 1, and the birth rate is 70%. Thus, according to (FILHO et al., 2005) the production cost in reais per arroba is R$ 74.20.

For the sale price, the Tax Tariff of Minimum Prices of Livestock Products for the state of Rondônia was used, also present in Normative Instruction No. 036/2022/GAB/CRE. According to her, the sale value of a fat cattle head (510 kg) is R$ 4,693.00.

All these values were corrected by the Broad National Consumer Price Index (IPCA) for the project start date. Combining these data, we have that the entire reference region is in an economically viable area for livestock production, where the sum of revenues minus total costs is positive.

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

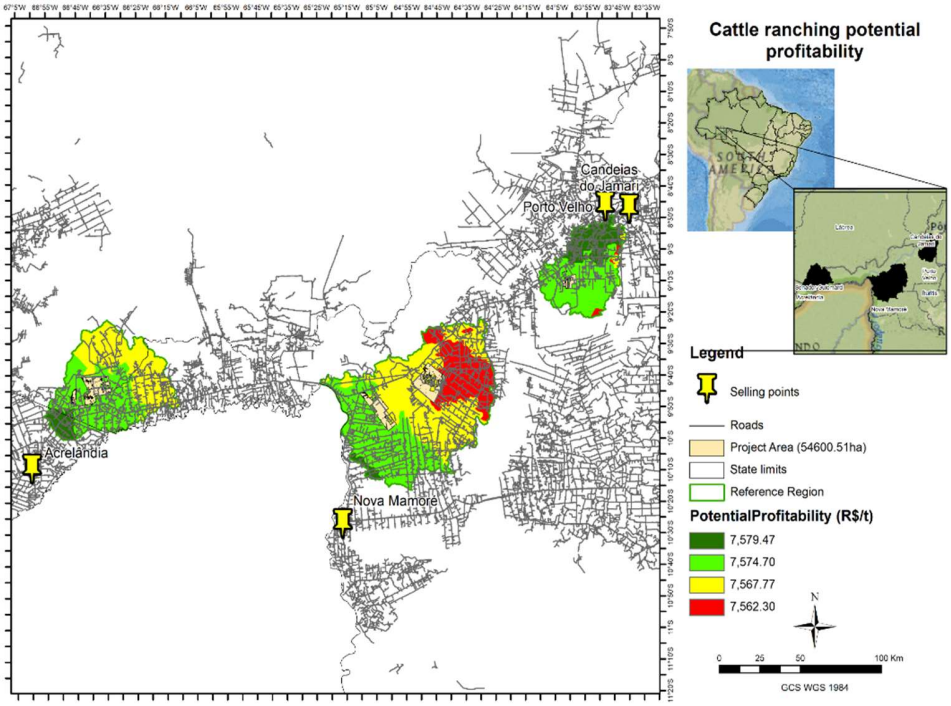
TDv: Transport distance on land, river or road of type v; km

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

The location of these areas is illustrated in the Figure below.

Figure 43. Potential profitability areas for cattle ranching within the Reference Region (RR) and the Project Area (PA)



With these considerations taken, the remaining areas with the highest profitability value would be more attractive for the activity. Thus, the less profitable areas (represented in yellow and red at the previous Figure) were excluded. Furthermore, it was considered that areas adjacent to the project area that are viable according to the opportunity cost analysis. It is worth highlighting the adjacent areas were considered since there is a higher influence caused by the project instances.

Several radius scenarios were projected, and it was selected the one that generated a Leakage Belt more similar to the Project Area in terms of hectares, The following Table illustrates the different radius scenarios, where the 3km radius is more similar to the project area, which covers around 52 thousand hectares as detailed below.

Table 18. Different ranges for Leakage Belt definition

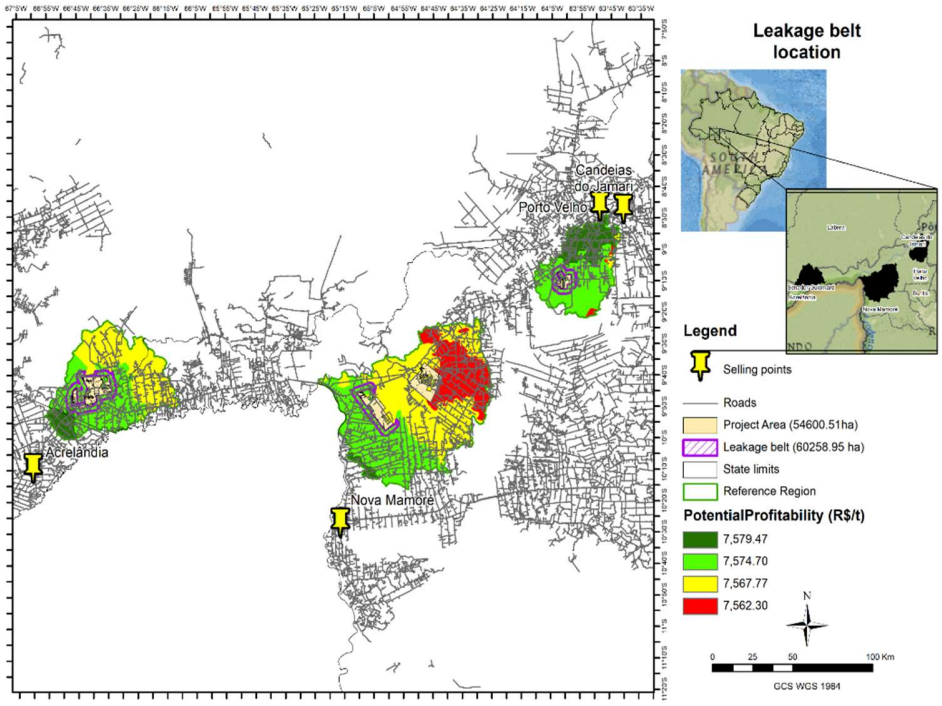
LB radius (km)	LB area (ha)	Project area (ha)
2	39,259.04	52,274.05
3	60,258.95	
4	81,631.30	
5	104,180.20	

Afterwards, after selecting the radius, it was overlapped the project area buffer with the areas with the greatest profitability potential, a leakage belt area of 60,258.95 ha was defined.

Finally, in order to assure no high profitable areas were properly excluded from the Leakage Belt beyond the 3km, an additional analysis was carried out. It was assessed the amount of forest and non-forest areas beyond the Leakage Belt and it was found that most of the high profitable areas are already non-forest beyond the 3km. Leakage Belt analysis was shared with VVB team.

In summary, the leakage belt is composed of areas in a 3km radius from the Project Area that present higher economic profitability to cattle ranching.

Figure 44. Leakage Belt definition criteria



To assess overlapping areas between Rio Madeira Grouped REDD+ Project leakage belt with other project boundaries, it was analyzed VCS database and assessed surrounding projects. It

was confirmed overlay between project ID2508 leakage belt and two spatial boundaries of Rio Madeira Grouped REDD+ Project: its project area, and also leakage belt. In order to manage such overlays, it was followed the adopted methodology VM0015 section 1.1.3, as follows:

Regarding the overlay between the Rio Madeira Grouped REDD+ Project area and project ID2508 leakage belt, the project ID2508 developer should follow the requirements defined at the methodology regarding such overlay.

Regarding the overlay between leakage belts from Rio Madeira Grouped REDD+ Project and project ID2508, the proponents did not agree on how to split the overlapping leakage belt areas. Thus, following the adopted methodology VM0015 section 1.1.3 option e), each project will have to include in its leakage belt the overlapping areas.

- Leakage Management Area

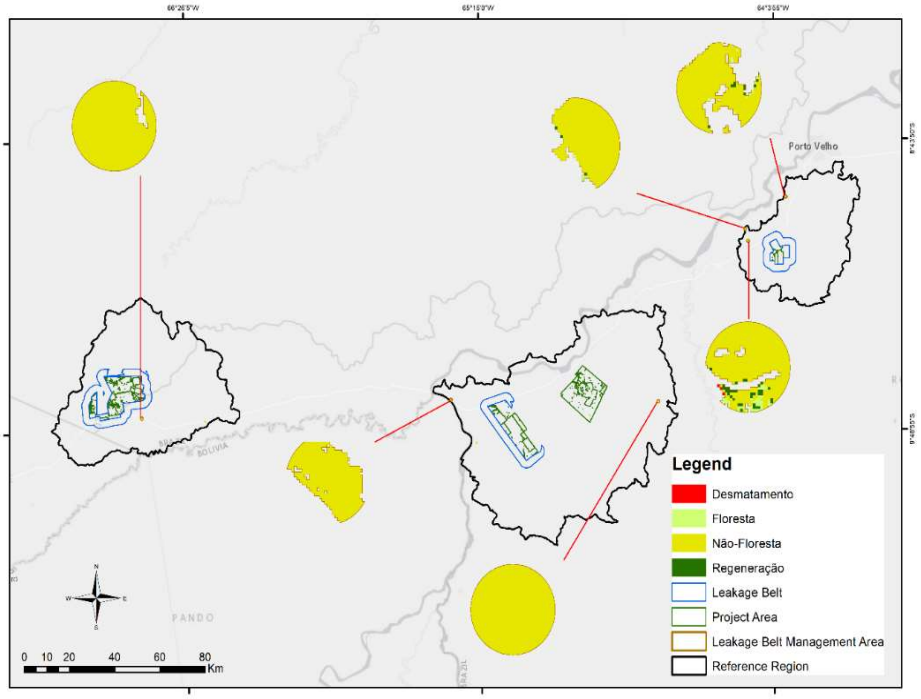
The leakage management area (LMA) complies non-forest areas located outside the project boundary in which the project proponent intends to implement the activities which reduce the risk of leakage in the project scenario. These activities must include the agents of deforestation and involve seeking new sources of income which contribute to forest conservation. Leakage management could involve agricultural, agroforestry, reforestation, education, or other activities.

According to landowners, there are intentions to perform several partnerships to promote social impact with the Rio Madeira REDD+ Project: Abunã district, Flor do Cupuaçu school, Santa Rita health center, RECA association, União Bandeirantes district, and farm-school FIMCA. Activities includes renovation, books providing, technology inclusion, and environmental education in order to promote environmental awareness, avoid deforestation, and improve people´s life.

The Leakage Management Area was defined by the landowners as close by communities of instance 1, 2, and 3 which are within the Reference Region. After the on-site visits, where the landowners could participate or set up the meetings, the landowners developed a leakage management plan in order to register their plans to develop environmental and social activities within such areas. Such plan was made available to the VVB team.

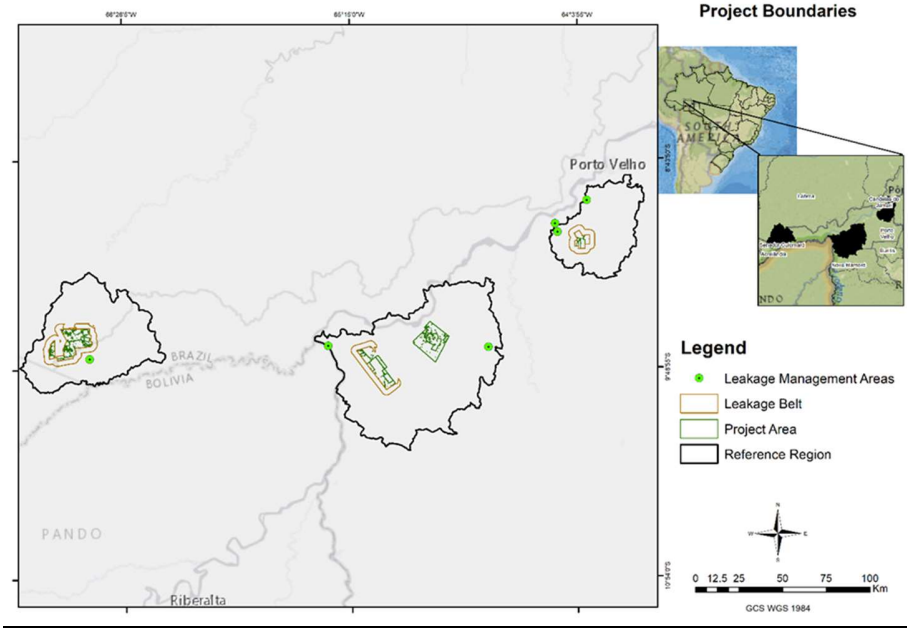
The defined non-forest area is 372.5 ha. Figure below presents the location of the LMAs:

Figure 45. Leakage Management Area



More information on the characteristics of these stakeholders is available in sections 1.18 and 2.

Figure 46. Leakage management areas location



Project boundaries

Forest

According to the Brazilian Forests at a Glance 2019[97], 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[98]. 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 30x30 m (0.09 ha), therefore falling easily to the methodology requirement. Details on data and image processing will be available at Appendix I.

Temporal Boundaries

As this is a grouped project, it is important to consider the Project Start Date of all the included project activity instances (detailed in section 1.8). It is worth highlighting the first instance Project Start date defined the grouped PSD. In addition, the first PSD occurred prior to other instances start dates, as summarized in the following table:

Ownership	Project Start Date
Grupo ROVEMA	23-October-2019
Grupo Leite	08-January-2020
Grupo Tupá	02-January-2020

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

  The adopted historical reference period is November 2009 to October 2019.

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

  The project has a crediting period of 30 years, starting from 23-October-2019 until 22-October-2049.

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

[97] Available at <https://www.florestal.gov.br/documentos/publicacoes/4262-brazilian-forests-at-a-glance-2019/file> . Last visited on August 3rd, 2021

[98] 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/>

The first baseline period is from 23-October-2019 to 22-October-2025.

- **Monitoring period**

  The next monitoring periods will comply with the criteria established in the applied methodology, which states that the minimum time-frame of the monitoring period is one year, and the maximum time-frame is one fixed baseline period.

Carbon Pools

The applied methodology considers six carbon pools listed in the table below. Their inclusion or exclusion within the boundary of the proposed AUD project activity, as well as the respective justification/explanation, are described in the table below.

Table 19. 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	Excluded in carbon stocks estimates since adopted carbon stock (Silva, 2014) does not specify non trees in the above ground biomass
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[99], [100]
Harvested wood products	Excluded	Stock change in this pool is not considered in baseline and project scenarios. This is conservative as project scenario includes logging through a sustainable forest management plan.
Litter	Excluded	Excluded as it does not lead to a significant over-estimation of the net anthropogenic GHG emission reductions of the AUD project activity. This exclusion is conservative.
Soil organic carbon	Excluded	Recommended when forests are converted to cropland. Not to be measured in conversions to pasture grasses and perennial crop according to VCS Methodology Requirements, 4.2.

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

[99] Available at <https://amazoniareal.com.br/o-desmatamento-da-amazonia-brasileira-13-degradacao-extrema/>.
[100] Available at <https://www.jstor.org/stable/2388588?origin=JSTOR-pdf>

decreases in carbon pools and increases in emissions that may be neglected shall be less than 5% of the total decreases in carbon pools and increases in emissions, or less than 5% of net anthropogenic removals by sinks, whichever is lower. The spreadsheets with the results of the significance test were presented as evidence.

This analysis allowed to conclude that the sum of decreases in carbon pools and increases in emissions due to baseline logging activities represents less than 5% of the total decrease in carbon pools and increase in emissions (2.92%) and less than 5% of net anthropogenic removals by sinks (3.16%). An average was taken of all the areas earmarked for forest management in instances 1 and 3 where a post-management report already exists to obtain this number. Individual analyses were also carried out on each plot, showing results of less than 5%, as shown in the tables below:

Table 20. Analysis of the significance based on net anthropogenic GHG emission reductions by sinks - POA 4 (Instance 1)

Carbon pools	tCO2e/ha	RCi (Relative contribution of each source i in carbon pools)
Net baseline carbon stock change in the project area	30,196,005.49	97.1%
Carbon stock change from the timber that could be illegally harvested in the baseline	895,907.81	2.9%
TOTAL	31,091,913.29	

Table 21. Analysis of the significance based on net anthropogenic GHG emission reductions by sinks - POA 5 (Instance 1)

Carbon pools	tCO2e/ha	RCi (Relative contribution of each source i in carbon pools)
Net baseline carbon stock change in the project area	30,196,005.49	98.1%
Carbon stock change from the timber that could be illegally harvested in the baseline	590,773.98	1.9%
TOTAL	**30,786,779.47**	

Table 22. Analysis of the significance based on net anthropogenic GHG emission reductions by sinks - UPF 1 (Instance 3)

Carbon pools	tCO2e/ha	RCi (Relative contribution of each source i in carbon pools)
Net baseline carbon stock change in the project area	30,196,005.49	96.3%
Carbon stock change from the timber that could be illegally harvested in the baseline	1,157,737.25	3.7%
TOTAL	**31,353,742.74**	

Table 23. Analysis of the significance based on net anthropogenic GHG emission reductions by sinks - UPF 2 (Instance 3)

Carbon pools	tCO2e/ha	RCi (Relative contribution of each source i in carbon pools)
Net baseline carbon stock change in the project area	30,196,005.49	97.6%
Carbon stock change from the timber that could be illegally harvested in the baseline	738,587.74	2.4%
TOTAL	30,934,593.23	

Table 24. Analysis of the significance based on net anthropogenic GHG emission reductions by sinks - UPF 3 (Instance 3)

Carbon pools	tCO2e/ha	RCi (Relative contribution of each source i in carbon pools)
Net baseline carbon stock change in the project area	30,196,005.49	96.6%
Carbon stock change from the timber that could be illegally harvested in the baseline	1,077,147.40	3.4%
TOTAL	31,273,152.89	

Table 25. Analysis of the significance based on net anthropogenic GHG emission reductions by sinks - UPF 4 (Instance 3)

Carbon pools	tCO2e/ha	RCi (Relative contribution of each source i in carbon pools)
Net baseline carbon stock change in the project area	30,196,005.49	96.5%
Carbon stock change from the timber that could be illegally harvested in the baseline	1,080,816.86	3.5%
TOTAL	31,276,822.34	

Furthermore, 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 Baseline Emissions.

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 project activity, as well as the respective justification/explanation, are described in the Table below.

Table 26. 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.
	Livestock emissions	CO_2	Excluded	Not a significant source
		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	No livestock agriculture increase is predicted to occur in the project scenario compared to the baseline case. Therefore considered insignificant.
		Other	Excluded	No other GHG gases were considered in this project activity.

3.4 Baseline Scenario

In the baseline scenario, forest is expected to be converted to non-forest by the agents of deforestation (cattle ranching and others to be mapped during the project lifetime) 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 project proponents have excluded areas of planned deforestation in the baseline case from the project area in conformance with VM0015, v1.1, Part 2, Step 1.1.1, Footnote 7. 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

To map the dynamics of land use in the reference region, images from 2009 to 2018 produced by MapBiomas (collection 6.0) were used, made available in raster format on the program's website[101], and supervised classifications using Google Earth Engine for the period from January to October 2019. This classifier is the same one used in MapBiomas, allowing a closer approximation of the methodology.

In order to compose the entire reference region, six Landsat scenes per year (orbit/point: 232/66, 232/67, 233/66, 233/67, 01/66, and 01/67) from the reference period were required, as per section 3.3. The final mapping resolution was 30 m pixel.

MapBiomas is a multi-institutional initiative of the Greenhouse Gases Emissions Estimation System[102] promoted by the Climate Observatory. The MapBiomas creation involves NGOs, universities, and technology companies. In MapBiomas, the image classification methodology utilizes 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 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 behavior 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

[101] Available at <http://www.mapbiomas.org > Last visited on August 10th, 2022
[102] SEEG website. Available at: http://seeg.eco.br/en/ Last visited on August, 10th, 2022

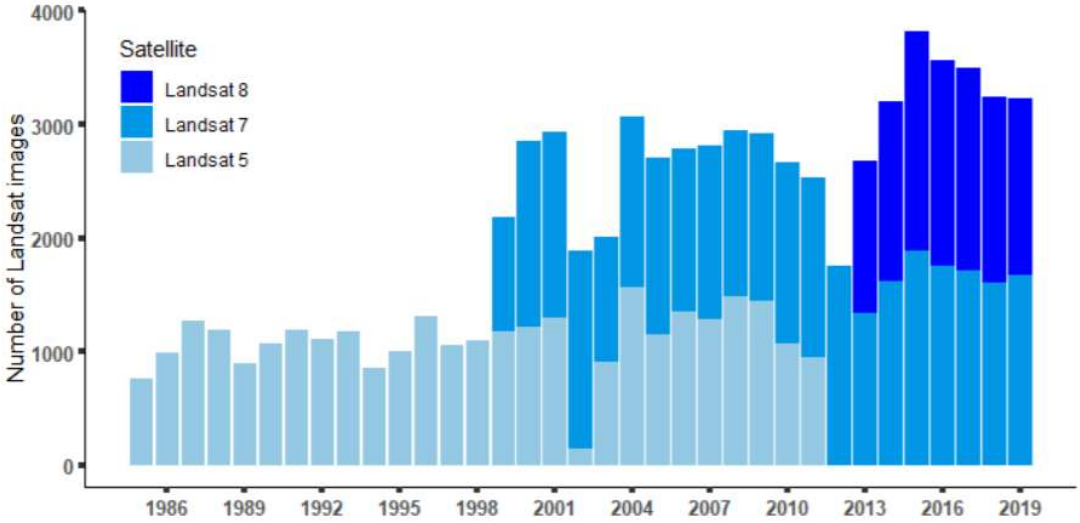
classify as a single map per class. This classification then goes through the stages of the spatial filter, applying neighborhood rules and temporal filters, in particular changes in coverage and use that are impossible or not allowed, to reduce spatial and temporal inconsistencies.

For the supervised classification of October 2019, 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. Then the spatial filter with the Majority Filter tool from ArcGIS was applied using an 8-pixel neighborhood. This filter is used in MapBiomas in order to avoid unwanted modifications on the edges of pixel groups (blobs).

Table 27. Data used for historical LU/LC change analysis

Vector	Sensor	Resolution		Coverage	Acquisition date	Scene	
		Spatial (m)	Spectral (µm)	(Km²)	Year	Path	Row
Satellite	Landsat TM	30	0.45-2.35 µm	34,225	2009 to 2019	232	66
Satellite	Landsat TM	30	0.45-2.35 µm	34,225	2009 to 2019	232	67
Satellite	Landsat TM	30	0.45-2.35 µm	34,225	2009 to 2019	233	66
Satellite	Landsat TM	30	0.45-2.35 µm	34,225	2009 to 2019	233	67
Satellite	Landsat TM	30	0.45-2.35 µm	34,225	2009 to 2019	01	66
Satellite	Landsat TM	30	0.45-2.35 µm	34,225	2009 to 2019	01	67

Figure 47. Number of Landsat images for mapping the Amazon. Source: MapBiomas



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

Following the VM00015 Methodology requirements, the LU/LC maps have been conducted using satellite images. There are 2 surveys available in Brazil for deforestation and forest mapping: INPE (PRODES) and Mapbiomas. However, none of them separates by forest classes.

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 from 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. For the correct accuracy of this information, a field survey would be necessary, which is costly and complicated to be carried out in the timeline of a carbon project.

Nine vegetation types were found within the reference region, and, according to this analysis, the Open Tropical Rainforest is the main forest type present within the project area, with around 63% of the total forest cover. Out of the 63%, the forest classes can be divided in Open Submontane Tropical Rainforest (32%) and Open Tropical Rainforest (31%). Thus, after verifying that most of the project boundaries were composed of only one phytophysiognomy (table below), the mapping and modeling of the project proceeded without stratification.

In addition, the mean carbon stock within the project area calculated through weighed average with other forest classes showed a similarity of around 98.54% to the Open Tropical Rainforest and Open Submontane Tropical Rainforest carbon stocks. Thus, due to the high representativeness of this forest type within the project area, and the very high similarity in terms of carbon stocks in relation to the mean, the forest class was not stratified, i.e., the "Forest" class includes just one stratum due to the low difference in average carbon stocks within the project area.

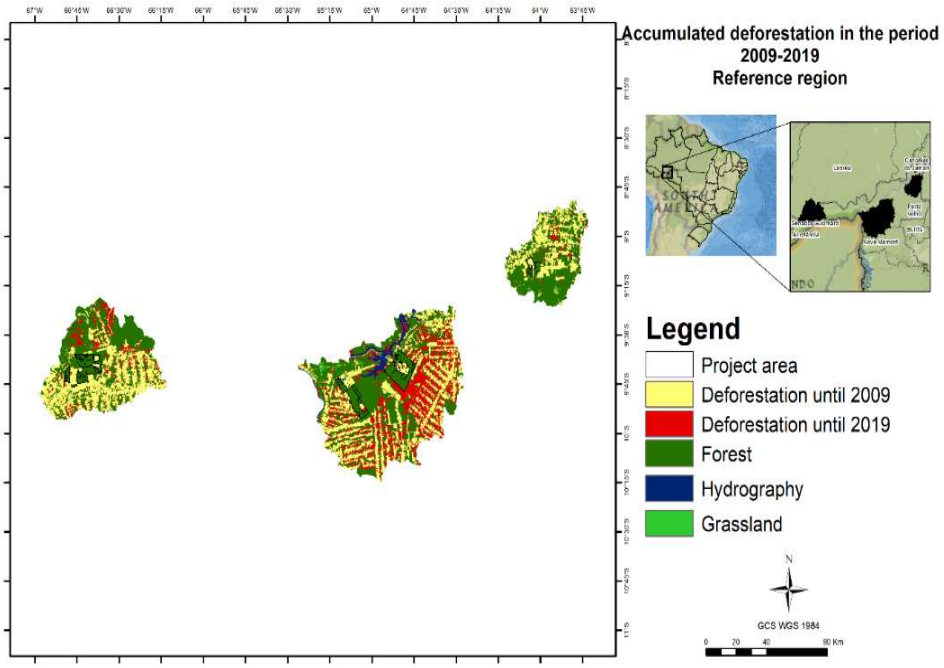
Table 28. Vegetation types found in the project boundaries

Forest class	Presence in the RR (%)	Presence in the PA (%)	Presence in the LB (%)
Dense Submontane Tropical Rainforest	24%	25%	17%
Dense Tropical Rainforest	10%	1%	18%
Open Submontane Tropical Rainforest	32%	38%	25%
Open Tropical Rainforest	31%	36%	38%
Seasonal Parkland Savannah	2%	-	1%
Open Alluvial Tropical Rainforest	0.1%	-	-
Seasonal Forested Savannah	1%	-	-
Dense Alluvial Tropical Rainforest	0.4%	-	-
Contact between Savannah and Rainforest	0.2%	-	-

Thus, 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.

Satellite images were used to generate the land-use and land-cover map in 2019 shown in the figure below.

Figure 48. Land use and land cover map comparing 2009 and 2019



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 29. List of land use and land cover change categories

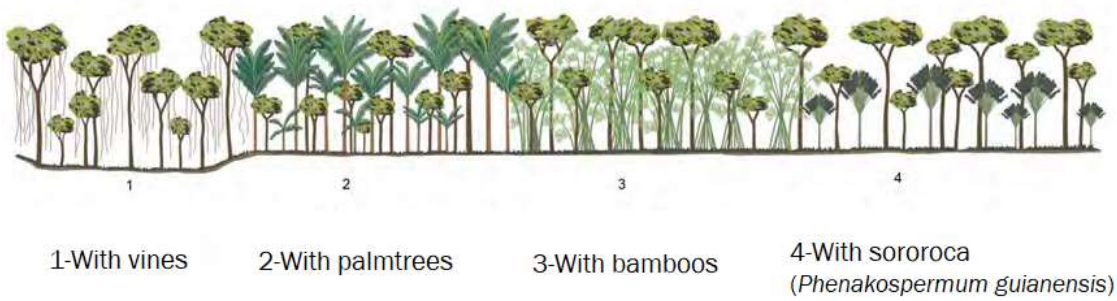
Class identifier		Trend in carbon stock[1]	Presence in[2]	Baseline activity[3]			Description (including criteria for unambiguous boundary definition)
IDcl	Name			LG	FW	CP	
1	Forest	Constant	RR, PA, LK	yes	no	no	According to official classification of the types of vegetation of Brazil (SIVAM) and the 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.

The main forest type present in RR, PA and LB is described below, according to the Technical Manual of the Brazilian Vegetation[103]:

The Open Tropical Rainforest, which surrounds the southern part of the Amazon Basin and occurs in numerous disjoint clusters in the northern and eastern parts of the Amazon region, is characterized by three facies dominated by typical genera, located suggestively in less humid areas. They are: *Attalea speciosa* Mart. Ex Spreng. (babaçu) and *Attalea maripa* (Aubl.) Mart (inajá), which make up the "palm forest"; *Guadua superba* (similar to bamboo), which forms the "bamboo forest"; and *Phenakospermum guianensis* (A. Rich.) Endl. Ex Miq.) (sororoca), which, when gregarious, constitutes small disjunctions throughout the Amazon, integrating the "forest-of-sororoca". In addition to these typical facies, one more can be observed, located predominantly in the shallow and circular depressions of the Precambrian scorched lands, usually soaked during the heavy rains. It is facies densely populated by woody lianas that surround a few surviving macrophanerophytes, giving them the appearance of leafy towers from the base. These disjunctions of the Open Tropical Rainforest, more frequent in the south of the State of Pará, are known as "vine forest", also existing on the slopes of dissected relief that occur in the Amazon, but with the aspect of "vine forest". These woody lianas, with a predominance of genera from the Fabaceae and Bignoniaceae families, are widely dispersed within forests, but are sometimes found in greater numbers in the bright, open environments of the Amazon basin.

[103] Available at https://www.terrabrasilis.org.br/ecotecadigital/pdf/manual-tecnico-da-vegetacao-brasileira.pdf Last visit on 30/December/2022

Figure 49. Open Tropical Rainforest profile. Adapted from IBGE[104]



The Open tropical rainforest is considered the more representative since it is 31% present in the reference region, 36% in the project area, and 38% in the leakage belt. If summed with the very similar class named Open Submontane Tropical Rainforest, the coverage proportion increases to 63% in the reference region, 74% within the project area, and 63% in the leakage belt. In addition, the carbon stock weighted average among all forest classes identified is very similar to the Open tropical rainforest: the mean biomass stock within the project area calculated through weighed average corresponds to 302.72 Mg/ha, while the Open Tropical Rainforest class stock is 294.16 Mg/ha, a high similarity around 97%. Thus, due to the high representativeness of this forest types within the project area, and the very high similarity in terms of biomass stock in relation to the mean, the forest class was not stratified, i.e., the "Forest" class included only one stratum due to the low difference in average biomass stocks within the project area.

In order to be conservative, the weighted average biomass stocks will not be used, thus it will be adopted the biomass stock value for Open tropical rainforest and Open Submontane Tropical Rainforest (294.16 Mg/ha). It is also important to note that the study for the predominant forest classes within PA was conducted in Rondônia State, in a region close to the project area. Thus, using the Open Tropical Rainforest and Open Submontane Tropical Rainforest biomass stock values can be considered reasonable and conservative. VCS PD calculation spreadsheet details the above-mentioned proportions.

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

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 are shown in 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.

[104] Available at <https://www.terrabrasilis.org.br/ecotecadigital/pdf/manual-tecnico-da-vegetacao-brasileira.pdf> Last visit on 30/December/2022

In order to contextualize the deforestation profile in the States of Rondônia and Amazonas, MapBiomas Alerta[105] platform was assessed. The analysis is particular for each State, since the Environmental Agencies in Brazil are managed at State level.

For the State of Rondônia, Mapbiomas Alerta crosses the deforestation permits issued since 2018 by the local Environmental Agency (SEDAM) and the deforested areas identified by Mapbiomas. Thus, such analysis informs the portion of legal and illegal deforestation. For the State of Rondônia, Mapbiomas Alerta pointed that 99.8% of deforested areas was illegal. When assessing at municipal level also available at Mapbiomas Alerta, the illegal deforestation corresponds to 100% of all deforestation alerts in Porto Velho and Nova Mamoré municipalities (where most of the reference region is located), which makes the unplanned deforestation the predominant category in the region.

For the State of Amazonas, Mapbiomas Alerta cannot provide similar analysis once the Environmental Agency (IPAAM) does not disclosure its permits databases. Based on the context similarity of land use change between Lábrea municipality (where instance 3 is located) and State of Rondônia, the illegal deforestation can be considered its majority. In addition, several episodes of illegal deforestation are known at Lábrea[106] [107] [108]. Such assessment reinforces the alarming illegal deforestation rates in both States. The project is located in a region known as AMACRO (acronym for the States of Amazonas, Acre and Rondônia), where deforestation is a common reality for both States[109] [110] [111].

Furthermore, it was analyzed the deforestation dynamics within and outside SFMP areas, using deforestation data from Mapbiomas[112] and SFMP data from Geoportal[113], provided by the State of Rondônia Environmental Agency (SEDAM).

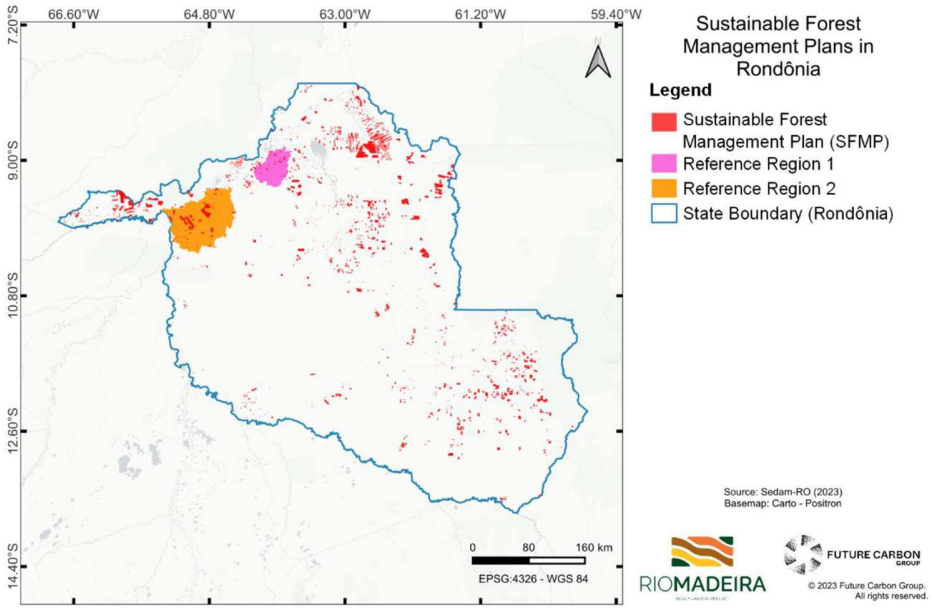
Regarding the spatial boundaries, the analysis considered the State of Rondônia and the Reference Region polygons located at the State of Rondônia. The third polygon was excluded since the Environmental Agency from the State of Amazonas (IPAAM) does not disclosure its SFMP databases. Nevertheless, due to the proximity and access conditions, it can be assumed the deforestation dynamics at Amazonas are very similar to the State of Rondônia as mentioned above.

[105] Available at: <https://plataforma.alerta.mapbiomas.org/monitor-da-fiscalizacao> Last visit on 26/March/2023
106 Available at <https://reporterbrasil.org.br/2019/08/abandonada-por-autoridades-terra-de-ninguem-na-amazonia-e-dominada-pela-madeira-ilegal-pelo-fogo-e-pela-grilagem/> Last visit on 27-December-2023
107 Available at <https://www.mpf.mp.br/am/sala-de-imprensa/noticias-am/mpf-denuncia-duas-pessoas-por-desmatamento-e-invasao-de-terras-da-uniao-em-labrea-am> Last visit on 27-December-2023
[108] Available at https://www.brasildefato.com.br/2023/06/23/pecuaria-fogo-e-grilagem-conheca-labrea-am-o-novo-epicentro-do-desmatamento-na-amazonia Last visit on 27-December-2023
[109] Available at https://g1.globo.com/fantastico/noticia/2023/06/05/amacro-regiao-entre-tres-estados-do-norte-e-conhecida-como-fronteira-do-desmatamento.ghtml Last visit on 10-January-2024
[110] Available at https://oeco.org.br/analises/amacro-a-nova-velha-fronteira-do-desmatamento-na-amazonia/ Last visit on 10-January-2024
[111] Available at https://www.gov.br/sudam/pt-br/release-amacro Last visit on 10-January-2024
[112] Mapbiomas LULC collection available <https://brasil.mapbiomas.org/colecoes-mapbiomas/>
[113] SFMP data available at <https://geoportal.sedam.ro.gov.br/>

For the temporal boundaries, there is a lack of information at the State of Rondônia regarding the dates when SFMP were implemented and the period when they were operational. The Geoportal platform does not contain data prior to 2020 because this was the year when Geoportal became operational. Therefore, due to this limitation and in order to conduct a complete and accurate analysis, it was assumed that all SFMP areas in the State of Rondônia were updated in the platform only after 2020. In addition, the 2020-2022 period corresponds to the more recent available years, which makes this analysis more accurate and likely to capture the deforestation dynamics for the coming years, since the political and economic context from the recent years is more similar than the context from older years.

The assessed polygons were named RR1, RR2, and the whole State of Rondônia, and are distributed as per the following image:

Figure 50. SFMPs polygons analyzed



When assessing the deforestation within SFMP areas at the Reference Region 1 and 2, the following was observed:

Table 30. Deforestation rates within SFMP areas at Reference Region

Year	Deforestation within SFMP areas at RR1 and RR2 (ha)	Forest coverage within SFMP areas at RR1 and RR2 (ha)	Deforestation rate within SFMP areas at RR1 and RR2 (%/year)
2022	2,169	36,691	5.91%
2021	1,796	38,860	4.62%
2020	1,592	40,657	3.92%

When assessing the deforestation outside SFMP areas at the Reference Region 1 and 2, the following was observed:

Table 31. Deforestation rates outside SFMP areas at Reference Region

Year	Deforestation outside SFMP areas at RR1 and RR2 (ha)	Forest coverage outside SFMP areas at RR1 and RR2 (ha)	Deforestation rate outside SFMP areas at RR1 and RR2 (%/year)
2022	17,286	288,519	5.99%
2021	14,842	305,805	4.85%
2020	12,214	320,646	3.81%

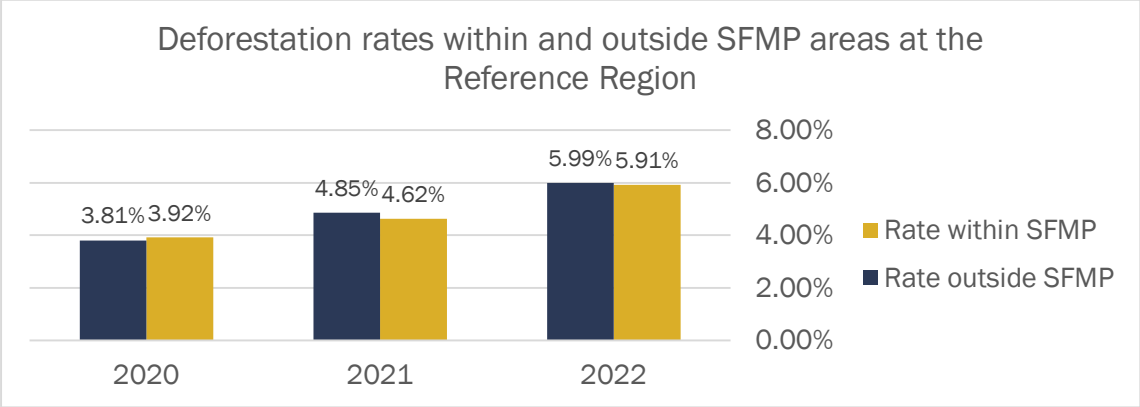
As per the previous tables, the deforestation rates within and outside the SFMP areas at the Reference Region are summarized at the following Table:

Table 32. Deforestation rates within and outside SFMP areas at Reference Region

Year	Deforestation rate within SFMP areas at RR1 and RR2 (%/year)	Deforestation rate outside SFMP areas at RR1 and RR2 (%/year)
2022	5.91%	5.99%
2021	4.62%	4.85%
2020	3.92%	3.81%

The Table above shows the deforestation rates are very similar. In addition, the analysis demonstrates the deforestation rate is increasing, as illustrated in the following image:

Figure 51. Deforestation rates comparison within and outside SFMP areas at Reference Region



In order to include the deforestation within and outside SFMPs at the state level, it was also assessed the deforestation rates within and outside SFMP areas at the State of Rondônia, which is described at the following Table:

Figure 52. Deforestation rates within and outside SFMP area at the State of Rondônia

Year	Deforestation rate within SFMP areas at the State of Rondônia (%/year)	Deforestation rate outside SFMP areas at the State of Rondônia (%/year)
2022	3.93%	1.90%
2021	3.11%	1.58%
2020	2.37%	1.29%

It is worth noting that, at State level, the deforestation rates within SFMP areas are even higher than outside SFMP areas, which points that SFMP does not assure forest conservation. Instead, it presents alarming rates even within SFMP at the State of Rondônia. Thus, as per the analysis, it can be observed the SFMP areas at the Reference Region and at the State of Rondônia represent similar deforestation dynamics.

Hence, it is possible to conclude that SFMP is not effective for avoiding deforestation. The analysis at State and Reference Region levels points out that forest conservation is not assured even with SFMP.

The Tables below display deforestation across the whole crediting period. As shown in tables below, degradation was not considered in any of the LU/LC classes.

Table 33. Potential land-use and land-cover change

		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	11,471.81	0.00
	Non Forest in the PA	40,802.24	0.00

	LB	Initial LU/LC class	
	Idcl	Forest	Non Forest in the LK
Final Class	Forest	6,579.66	0.00
	Non Forest in the LK	21,466.17	31,822.81

PROJECT SCENARIO

	PA	Initial LU/LC class	
	Idcl	Forest	Non Forest in the PA
Final Class	Forest	46,153.71	0.00
	Non Forest in the PA	6,120.34	0.00

	LB	Initial LU/LC class	
	Idcl	Forest	Non Forest in the LK
Final Class	Forest	459.32	0.00
	Non Forest in the LK	27,586.51	37,943.15

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

Table 34. 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

The annual deforestation dynamics in the Reference Region during the historical reference period can be seen in the figures and tables below.

Figure 53. Deforestation dynamics, 2009 and October 2019, in the reference region (RR). Source: MapBiomas

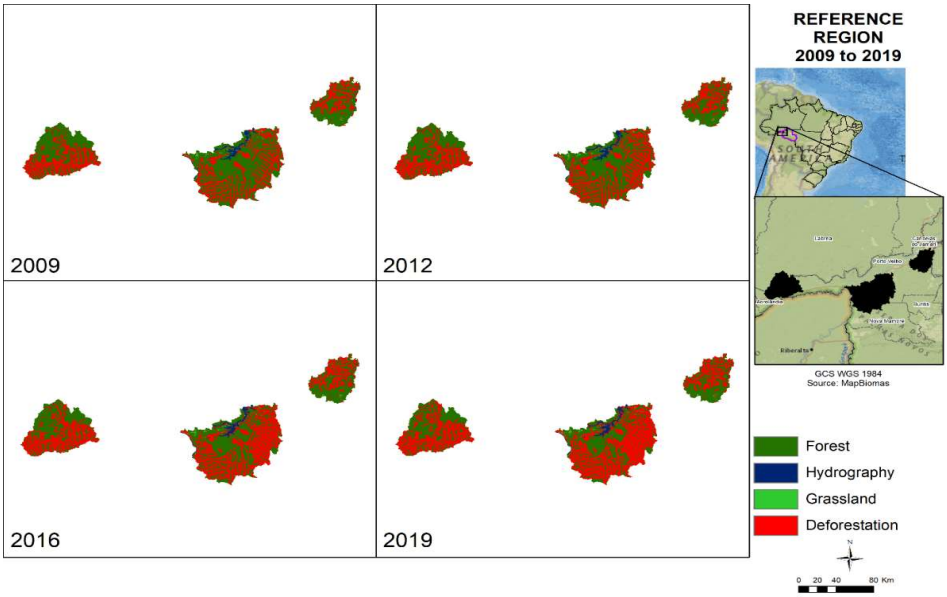


Table 35. Annual deforestation in the Reference Region from 2009 to October 2019

Year	Accumulated deforestation (ha)	Deforestation per year (ha)
2009	401,115.78	14,735.34
2010	414,286.92	13,171.14
2011	436,084.11	21,797.19
2012	454,831.83	18,747.72
2013	467,803.35	12,971.52
2014	489,297.87	21,494.52
2015	510,000.93	20,703.06
2016	537,222.96	27,222.03
2017	557,535.69	20,312.73
2018	575,213.76	17,678.07
2019	592,860.42	17,646.66

Map accuracy assessment

The results of MapBiomas undergo an accuracy assessment, which for the entire Amazon Biome is on average 95%. However, to meet the particularities of the region, an independent evaluation was carried out for the reference region for the years 2009 to 2018.

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, and it was possible to determine the land use of the sample points drawn.

For the supervised classification in October 2019, it was drawn 321 random points over the reference region, 107 in each class (forest, hydrography and deforestation). It is noteworthy that for this year only the deforestation classification information was considered.

The table below shows the accuracy analysis carried out for each year and each land use class.

Table 36. Summary of confusion matrices from the evaluation of MapBiomas from 2009 to 2019[114]

	Producer accuracy				User accuracy			
Year	Forest	Hydrography	Pioneer vegetation	Deforestation	Forest	Hydrography	Pioneer vegetation	Deforestation
2009	81.63%	100.00%	95.65%	100.00%	100.00%	98.75%	82.50%	92.50%
2010	80.81%	98.77%	95.59%	100.00%	100.00%	100.00%	81.25%	90.00%
2011	84.04%	96.39%	96.97%	97.40%	98.75%	100.00%	80.00%	93.75%
2012	83.52%	98.75%	95.52%	92.68%	95.00%	98.75%	80.00%	95.00%
2013	80.85%	100.00%	94.12%	90.24%	95.00%	95.00%	80.00%	92.50%
2014	92.77%	98.77%	95.06%	98.67%	96.25%	100.00%	96.25%	92.50%
2015	88.76%	83.33%	96.97%	100.00%	98.75%	100.00%	80.00%	86.25%
2016	98.75%	98.70%	91.57%	95.00%	98.75%	95.00%	95.00%	95.00%
2017	91.86%	95.24%	91.78%	90.91%	98.75%	100.00%	83.75%	87.50%
2018	94.05%	89.77%	93.06%	97.37%	98.75%	98.75%	83.75%	92.50%
2019	88.64%	97.44%	91.67%	84.15%	97.50%	95.00%	82.50%	86.25%

ANALYSIS OF AGENTS, DRIVERS, AND UNDERLYING CAUSES OF DEFORESTATION

As specified in the methodology, it is necessary to understand "who" the deforesting agent is and what drives land-use decisions ("drivers" and "underlying causes"). This analysis is important for two main reasons: (i) Estimating the quantity and location of future deforestation; and (ii) Designing effective measures to address deforestation, including leakage prevention measures[115].

Identification of agents of deforestation

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.

[114] Although the assessment was developed through 2009-2019, years 2007 and 2008 were used for calibration of the model and to ensure that the forested areas in 2020 are at least 10 years old, as defined by the methodology.

[115] VM0015: STEP 3: Analysis Of Agents, Drivers And Underlying Causes Of Deforestation And Their Likely Future Development, page 37. Available at: <https://verra.org/wp-content/uploads/2018/03/VM0015-Methodology-for-Avoided-Unplanned-Deforestation-v1.1.pdf>.

Thus, it is important to understand that illegal deforestation in the project location occurs by one major agent: cattle ranching. Unplanned deforestation can occur in public and private areas. According to National Environmental Agency (IBAMA), cattle ranching is the main use for illegal land after illegal deforestation[116] in the Amazon region. Although cattle ranching can be combined with illegal logging once valuable trees are extracted without control, the main agent is cattle ranching.

- Cattle ranching is the main reason for deforestation, since the standing forest without economic activity is seen as unproductive or without an owner, vulnerable to encroachment.

  According to a MapBiomas survey[117], the area deforested with evidence of illegality was 98.9% in Brazil. Furthermore, as detailed in Section 3.4 (subsection 'Definition of categories of land-use and land-cover change (LU/LC-change'), Mapbiomas Alerta points out that most of deforestation at State of Rondônia is illegal. The same also occurs at the municipalities of Porto Velho and Nova Mamoré (where most of the reference region is located), where it was identified that illegal deforestation corresponds to most of deforestation alerts. Section 3.4 also points that deforestation is increasing, both within and outside SFMP areas.

  Such assessment composes a scenario that illegal deforestation is a common practice in the region and is connected to the deforestation agent as follows:

  a) **Ranchers (Cattle ranching)**

  i. **Main social, economic, cultural and other relevant features of agent group**

  The representativeness of livestock in the Brazilian occupation is large both in terms of culture and economy. The colonization process in the region took place during the depletion of mines in central Brazil, and livestock was the main agent of formation and restructuring of the center region of the country. In addition, after the Paraguay War, the region began to be restructured, receiving new residents who sought to rebuild areas affected by the war and to occupy pastures for raising cattle. The activity also helped to reduce the distance that separated the State from the large population centers, as the expansion of large cattle ranches and the occupation of fertile areas for agriculture created new population centers[118]. Thus, the economic base of the Middle-West region gradually transmuted from mining to agro-pastoral activity.

  The livestock sector gained further relevance in the 1970s, when the Brazilian military government decided to occupy the Amazon, and cattle once again accompanied the colonizers, resulting in an explosive expansion of pastures and herds. While the Brazilian herd increased by 60% between 1987 and 2013, the herd in the Amazon states (Mato Grosso, Pará, Acre, Rondônia, Roraima, Amazonas, Tocantins, Amapá, and Maranhão)

[116] Available at https://www.ibama.gov.br/noticias/422-2017/1064-ibama-fiscaliza-aquisicao-de-gado-de-areas-desmatadas-ilegalmente-na-amazonia Last visit on 27-December-2023

[117] Available at <https://s3.amazonaws.com/alerta.mapbiomas.org/rad2020/RAD2020_FactSheet_FINAL_PT.pdf>

[118] Available in <https://periodicos.ufms.br/index.php/AlbRHis/article/download/5100/3781/> Last visited on December 3rd, 2021

practically tripled (280%), because livestock became the cheapest means of occupying the cleared land.[119]

The occupation of the State of Rondônia was related to the military dictatorship period in Brazil (1964-1985). In such period, social movements with agrarian components fostered the government to push them to lands distant to urban centers. The INCRA (National Institute for Colonization and Agrarian Reform) was the administrative entity created in the decade of 1970 to organize the agrarian reform at that time. The BR-364 highway is also another relevant component for the colonization of the State of Rondônia. This highway connects the States of Mato Grosso and Acre, both also know for high deforestation rates. Nowadays, Rondônia is placed in the first ranking positions on deforestation rates and cattle ranching[120]. World Bank (2003)[121] study and Franco (2017)[122] confirm the mentioned colonization movement is a definitive factor for land use change background in the State of Rondônia and Lábrea municipality. Franco also highlights the BR-364 highway as a catalyzer for deforestation. It is worth mentioning the three initial instances of Rio Madeira Grouped REDD+ are close to the BR-364 highway. Once the land use change is complete, the next economic activity is the intense cattle ranching, usually with high technology techniques.

In summary, Brazilian beef cattle farming developed through the expansion of the agricultural frontier (which occurs through deforestation in regions lacking infrastructure) and through the use of lands depleted by agriculture. The activity has contributed decisively, since colonial times, to the occupation of the Brazilian territory.

Given the historical context, it is relevant to emphasize the economic importance of livestock in Brazil. In 2019, Brazil's GDP was R$ 7.3 trillion, a nominal growth of 6.8% compared to the previous year. Part of this growth was due to the GDP of livestock, which in the same period registered a slight growth, from 8.3% to 8.5% of the total GDP, with this participation in an increasing trend since 2013, as shown in the graph below.

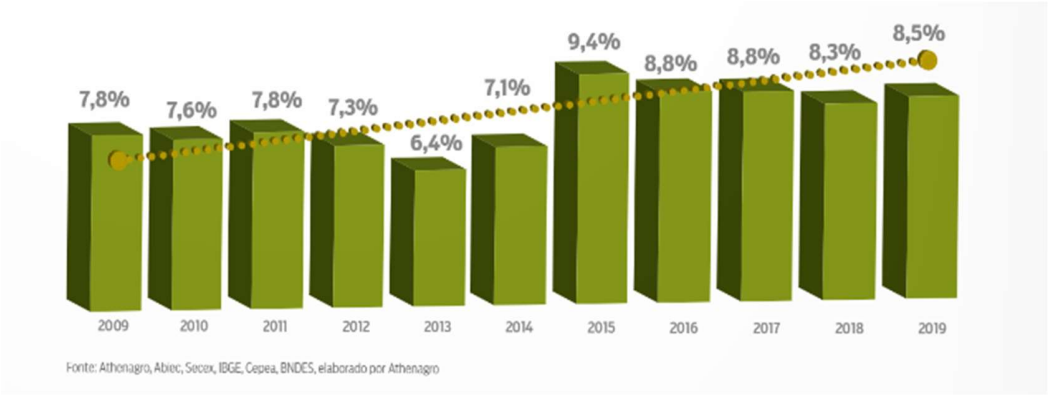
119 Available in <https://csr.ufmg.br/pecuaria/portfolio-item/historico-3/> Last visited on December 3rd, 2021

120 Available at <https://ri.ufmt.br/bitstream/1/3131/1/DISS_2019_Eliane%20Teodoro%20Gomes.pdf> Last visit on 18/August/2022

121 BANCO MUNDIAL. Causas do Desmatamento da Amazônia Brasileira - 1ª edição – Brasília, 2003. Available at <https://www.terrabrasilis.org.br/ecotecadigital/pdf/causas-do-desmatamento-da-amazonia-brasileira.pdf> Last visit on August 10th 2022

122 Franco, M.H.M. Conflito social e a criação de reservas extrativistas no município de Lábrea – AM. Viçosa, 2017. Available at <https://www.locus.ufv.br/bitstream/123456789/13398/1/texto%20completo.pdf> Last visit on August 12th, 2022

Figure 54. Evolution of the participation of the beef cattle on the total Brazilian GDP[123]



According to ABIEC (Brazilian Beef Exporters Association), the state of Rondônia[124] is the 6th producer of cattle in Brazil, with a share of 6.54 % of the total Brazilian herd, with a growth of 21.16% in the last 10 years[125], while the Amazonas State presented a growth of 2.63%.

It is worth mentioning that the livestock industry relates to other groups responsible for deforestation, as follows:

- Land grabbers: the practice of land grabbing is one of the main deforesters in the Amazon region, since huge lands are not regularized. Because they are legally vulnerable, these areas are invaded by land grabbers who take them from the current owners, deforest the remaining forests and use livestock farming to try to mask the irregularity. It is a criminal activity, generally accompanied by violence, disrespect for human rights, drugs and arms trafficking, among other illegal practices[126]. These lands then go through a regularization process, led by companies created specifically for this purpose[127]. The Rural Environmental Registry (CAR), a self-declaratory mechanism to provide information to the State regarding the use of land to define public policies, is one of the devices of the land grabbing process, where invaders declare themselves owners of the land[128].

123 Available at <https://abiec.com.br/wp-content/uploads/SUM%C3%81RIO-BEEF-REPORT-2020_NET-4.pdf> Last visit on August 15th, 2022

124 Although Lábrea municipality is not in Rondônia State, the analysis considered only Rondônia, once Amazonas (the largest Brazilian State of Brazil) has different contexts along its coverage. In addition, Lábrea is a boundary municipality, therefore different State of Rondônia analysis along the present section can be considered reasonable also for Lábrea.

125 Available at https://abiec.com.br/wp-content/uploads/SUM%C3%81RIO-BEEF-REPORT-2020_NET-4.pdf Last visit on August 15th, 2022

126 https://www.cnmp.mp.br/portal/todas-as-noticias/15970-desmatamento-e-grilagem-em-terras-publicas-da-amazonia-sao-temas-de-evento-que-reune-representantes-do-ministerio-publico-sociedade-civil-e-instituicoes-interessadas Last visit on 26-December-2023

127 A grilagem de terras públicas na Amazônia brasileira. Available at: https://antigo.mma.gov.br/estruturas/225/_arquivos/9___a_grilagem_de_terras_pblicas_na_amaznia_brasileira_225.pdf. Last visit on 21-December-2023

128 Available at https://www12.senado.leg.br/noticias/materias/2022/11/01/relatorio-aponta-desmonte-de-orgaos-e-grilagem-na-amazonia-com-dados-do-car#:~:text=Registros%20sobrepostos&text=%E2%80%94%20Como%20o%20CAR%20%C3%A9%20autodeclarat%C3%B3rio,possuem%2C%20conforme%20a%20legisla%C3%A7%C3%A3o%20atual. Last visit on 28-December-2023

Nevertheless, it is worth emphasizing that land grabbing may occur in either public lands, irregular private lands, or even in regular private lands. The sense of impunity promotes land grabbing once criminals identify a proper environment to operate both in public and private areas.[129] Such context was confirmed when CI3C[130] assessed project area and concluded landgrabbers are the main threat for forest conservation within the reference region. Evidence was shared with VVB team.

- **Illegal landowners**: in the above-mentioned context of real estate speculation, where land is deforested and sold to illegal landowners, the buyers assume the risk when purchasing a land that has not yet been regularized. Furthermore, illegal owners continue to be subject to new actions by land grabbers, as they do not have land documentation. [131]
- **Regular landowners**: this group is formed by owners that can prove the ownership of the land, since there are land titles issued by official notary officers. Therefore, since there is a link between the land and the landowner, there is a risk of criminal penalties[132] when deforestation is promoted by such regular landowners. In addition, illegal deforestation may imply into market banning and loss of rural credits for regular landowners.[133]

Given this, attributing responsibility for deforestation is extremely complex. Although it can be attributed to illegal and legal landowners, Federal Prosecutor points that most of deforestation is carried out by land grabbers[134], promoting deforestation as previously mentioned. It is worth emphasizing that the Federal Prosecution mentions land grabbing is active at Porto Velho and Lábrea municipalities (where the project is located), among others surrounding municipalities.

In addition, irregular landowners may also act as land grabbers and/or cause deforestation outside their properties, which makes it difficult to separate these sub-groups in terms of advancement of illegal deforestation. When relying in the official property registry, the current governmental data systems on land data (especially SICAR) do not disclose the ownership of rural land areas, which makes it impossible to determine if deforestation was carried out by either regular landowners, irregular landowners or land

[129] https://comunidade.transparenciainternacional.org.br/grilagem-de-terras?_gl=1*1y9871*_ga*MTUyMjg3NTQ2Mi4xNjc1ODcyMzA0*_ga_E136MXN2HN*MTcwNDQ2MDIwNC4xLjAuMTcwNDQ2MDIwNC42MC4wLjA. Last visit on 04-January-2024

[130] Please see section 1.11 for CI3C role and responsibility in the Project Activity

[131] https://comunidade.transparenciainternacional.org.br/grilagem-de-terras?_gl=1*1y9871*_ga*MTUyMjg3NTQ2Mi4xNjc1ODcyMzA0*_ga_E136MXN2HN*MTcwNDQ2MDIwNC4xLjAuMTcwNDQ2MDIwNC42MC4wLjA. Last visit on 04-January-2024

[132] Available at https://www.tjdft.jus.br/institucional/imprensa/campanhas-e-produtos/direito-facil/edicao-semanal/desmatar-cortar-arvore-ou-destruir-floresta-protegida-e-crime Last visit on 08-January-2024

[133] Available at https://www.bndes.gov.br/wps/portal/site/home/imprensa/noticias/conteudo/bndes-aprova-nova-regra-e-amplia-veto-a-clientes-com-embargo-por-desmatamento-ilegal/!ut/p/z0/tY8xTwMxDIV_C0NGK1E5KIwnqFTRViwglSyVLw2pyyVOc-5B_31DYWZjsWT5fe89a6vX2iYcKaAQJ-zr_mZvN8v7xWzePJuluXlpTPt4PW1epzOzuJvoJ23_FlSHSVk9rIK2GWUHlN5Zr7u09QNgLjwipO9RfCgIHjDmnhBGLwwIriefpEodR_CxwxlYMheoeETBWK8M1PvwU5b2h4NttXVcqS_5DdpQGoTk6C5PKbPj6JWhmItPAyqTWMgRDspcuOOWlfmXhvnDdqfP9uoM8uCjTg!!/ Last visit on 08-January-2023

[134] https://www.brasildefato.com.br/2020/07/02/quem-sao-os-desmatadores-da-amazonia Last visit on 26-December-2023

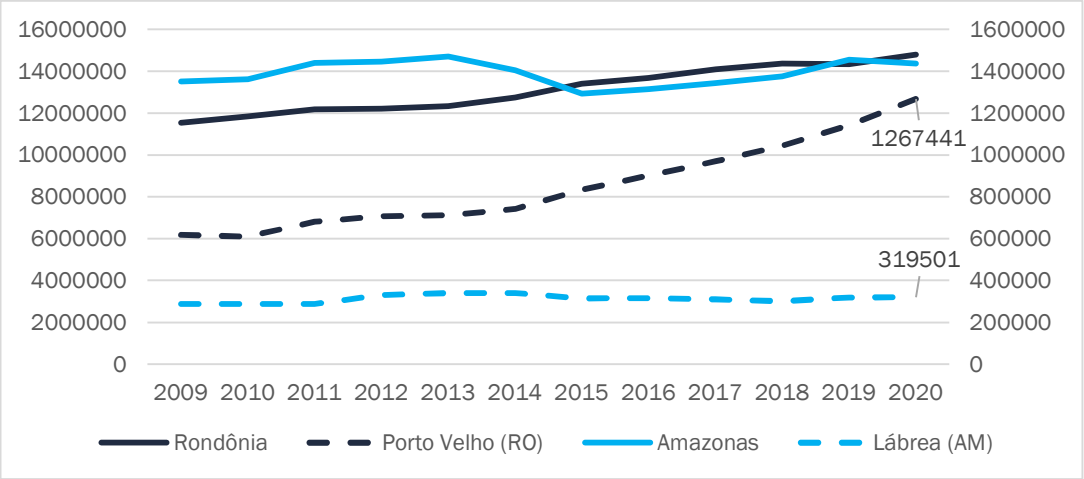
grabbers, also not making it possible to determine the areas that belong to each of the aforementioned sub-groups.

Therefore, land grabbers and illegal landowners compose together the main deforestation sub-group in the reference region. Such scenario is not general for Amazon, but specifically applicable for the region where the project is located.

ii. **Brief assessment of the most likely development of the population size of the identified main agent groups in the reference region, project area and leakage belt**

Thus, as commented in previous sections, cattle ranching is of great importance in the formation of the State of Rondônia, as a result of profitability and convenience, and pasture is the most common land use in deforested areas in Legal Amazon. The figure below shows the growth of the cattle herd in municipalities of the Project Area and Reference Region:

Figure 55. Cattle herd in the project municipalities and states between 2009 and 2020[135]



In this sense, with the increase in the price of the dollar and exports, in addition to domestic consumption, the forecast is for an increase in animal production for the national cattle herd production[136]. In addition, as this is the main activity in the region, population increase is also linked with the increase in the activity, as will be described in the "Drivers of Deforestation" section. As informed by National Environmental Agency (IBAMA)[137], most of deforested areas is followed by cattle ranching. Thus, it is reinforced the connection between deforestation and cattle ranching activity.

iii. **Statistics on historical deforestation attributable to each main agent group in the reference region, project area and leakage belt**

[135] Available at https://cidades.ibge.gov.br/brasil/ro/porto-velho/pesquisa/18/16459?localidade1=130240&localidade2=110033&tipo=grafico&indicador=16533 Last visit on 27-December-2023

[136] Available in < https://www.imea.com.br/imea-site/view/uploads/relatorios-mercado/R405_Apresenta%C3%A7%C3%A3o_MT_e_Outlook_Portugu%C3%AAs.pdf> Last visited on December 03rd, 2021.

[137] https://www.ibama.gov.br/noticias/422-2017/1064-ibama-fiscaliza-aquisicao-de-gado-de-areas-desmatadas-ilegalmente-na-amazonia Last visit on 26-December-2023

As presented above, the municipalities in the Reference Region are important players in livestock activities in the Amacro (Amazonas, Acre and Rondônia) Region. In addition to this being the main activity in the states, it is the main activity in the RR and surroundings of the project area.

The dynamics of land use demonstrates that the conversion of forest occurs, in the majority, to prepare the land for cattle ranching:

Maps and data from MapBiomas show that Brazil lost 87.2 million hectares of native vegetation areas, from 1985 to 2019. This is equivalent to 10.25% of the national territory. The pace of native vegetation loss accelerated in Brazil between 2018 and 2020. Of all the loss of natural vegetation in Brazil, including forest, savannah, fields and mangroves, at least 90% was occupied by agriculture and pasture use, whose expansion was 78 million hectares (43% growth since 1985)[138]. Pasture is the main rural land use in the municipalities within the Reference Region, as presented below[139]:

Table 37. Land use in the municipalities within the Reference Region

	Forest (ha)	Agriculture (ha)	Pasture (ha)	Agroforestry System (ha)	Area (ha)
Lábrea	124,892	3,046	205,901	7,170	682,626
Porto Velho	317,059	14,454	351,535	46,297	340,909

According to MapBiomas data, most of the deforested area in Rondônia is converted into pasture – 96%[140]. In the 2015-2020 period, the converted forest area in Lábrea was 177,970 ha, and 244,928 ha in Porto Velho. In 2020 alone, this area was equal to 42,759 ha in Lábrea and 5,162 ha in Porto Velho[141].

As previously mentioned at topic (i), Federal Prosecution points out that grabbed lands compose the majority of deforested areas in the Amazon region[142,143], which is afterwards mainly occupied by livestock[144]. This is also the common practice in the reference region, where most of deforested lands are occupied by illegal land grabbers, acting both in private and public lands, who implement cattle ranching after carrying out deforestation activities.

[138] Available at <https://mapbiomas.org/noticias#:~:text=De%20toda%20a%20perda%20de,%25%20de%20crescimento%20desde%201985>

[139] Data from Lábrea and Porto Velho, from Agricultural Census 2017. Available at <https://cidades.ibge.gov.br/brasil/ro/porto-velho/pesquisa/24/76693> and <https://cidades.ibge.gov.br/brasil/am/labrea/pesquisa/24/76693>

[140] Analysis available at <https://us.eia.org/wp-content/uploads/2023/02/EIA_US_Brazil_Leather_report_1022_PORTUGUESE_v6.pdf>

[141] Data available at <https://plataforma.brasil.mapbiomas.org/>

[142] https://www.mpf.mp.br/atuacao-tematica/ccr4/dados-da-atuacao/eventos/encontros/nacionais-da-4a-ccr/ix-encontro-tematico/documentos/caso_carne_legal_daniel.pdf Last visit on 26-December-2023

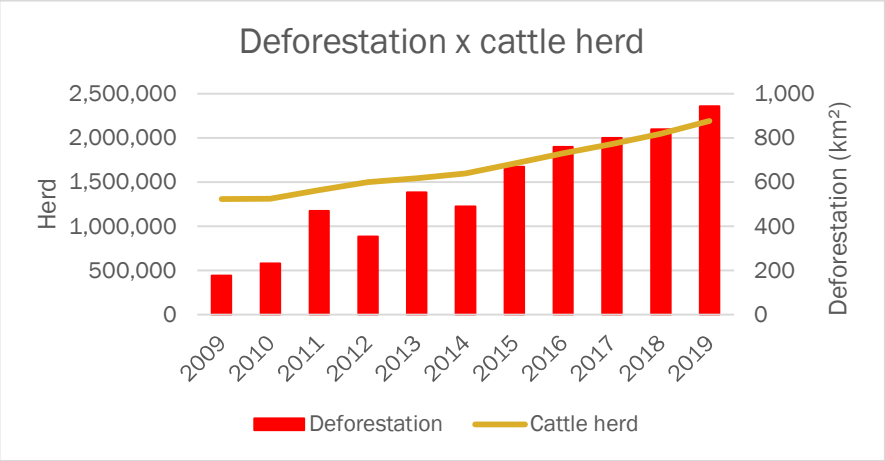
[143] https://www.brasildefato.com.br/2020/07/02/quem-sao-os-desmatadores-da-amazonia Last

[144] https://www.ibama.gov.br/noticias/422-2017/1064-ibama-fiscaliza-aquisicao-de-gado-de-areas-desmatadas-ilegalmente-na-amazonia Last visit on 28-December-2023

As per the mentioned references and according to local assessment developed by CI3C team, it is possible to state land grabbers have relevant operations in the region, promoting deforestation. CI3C assessment was shared with VVB team.[145]

In addition, when crossing data from the municipalities that compose the reference region during the historical reference period, regarding deforestation (available at PRODES[146]) and cattle herd (provided by IBGE[147]), there is a very strong correlation of 96% between these variables. The following Figure illustrates the clear relation between cattle ranching and deforestation, corroborating that this activity is the main responsible for deforestation within the project region.

Figure 56. Deforestation and cattle herd in the municipalities of the RR



Identification of drivers of deforestation

Furthermore, according to the methodology, after analyzing the main deforestation agents acting within the reference region during the historical reference period, it is necessary to identify the main drivers affecting the amount of deforestation in the reference region.

Some of the factors that characterize, and drive deforestation and subsequent cattle ranching are the low cost of the forested area; soil fertility and favorable weather; well-structured soil and mainly flat conditions of the area; tradition of farming existing in the municipalities and the meat market of the region.

Key driver variables are detailed in the section below.

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

1) Population growth

[145] CI3C and other teams responsibilities are available at section 1.11.
[146] Available at http://www.dpi.inpe.br/prodesdigital/prodesmunicipal.php Last visit on 28-December-2023
[147] Availabe at https://cidades.ibge.gov.br/brasil/ro/porto-velho/pesquisa/18/16459?localidade1=130240&localidade2=110033&tipo=grafico&indicador=16533 Last visit on 27-December-2023

a. Impact on each agent group's decision to deforest

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 studies for the Amazon biome[148,149,150] mention that deforestation rates may increase because of population growth and the need for more land for food, fuelwood, timber, or other forest products. The number of people and their socio-economic conditions both have a significant impact on deforestation.

As agriculturally based population density increases in and near forested areas, the strongest relationship between population growth and deforestation occurs, as local people and young migrant families arrive at the forest frontier and clear land to provide more area for subsistence farming. Therefore, besides addressing the population numbers, policies that impact the socio-economic conditions of the people are needed if deforestation is to be delayed or forests are to be sustained.

From 2010 Census and the 2021 estimate provided by IBGE[151], it is possible to note that the population in all municipalities grew, as shown in the following table.

Table 38. Population growth

Municipality	Population - 2010	Estimated population - 2021
Porto Velho, RO	428,527	548,952
Lábrea, AM	37,701	47,685
Nova Mamoré, RO	22,546	32,184

The increase in population indicates an increase in labor for the main activities in the region. In this case, as it is a mostly rural region, with low population density and an economy based on livestock and forestry, migration becomes attractive for the purchase of land and employment in the production chain.

Thus, it is possible to see that, in addition to the need for infrastructure and food, which drives deforestation to support population growth in the municipalities of the RR, the drivers also influence the migratory movement, due to the financial interest and opportunities of the activities.

[148] ANGELSEN; KAIMOWITZ. Rethinking the Causes of Deforestation: Lessons from Economic Models. The World Bank Research Observer, vol. 14, no. 1 (February 1999), pp. 73–98. Available at <https://www.researchgate.net/publication/11117669_Rethinking_the_Causes_of_Deforestation_Lessons_from_Economic_Models>. Last visit on August 15th, 2022

[149] ASHOK K.; JAGDISH C.; DAVID K. Understanding the Role of Population in Deforestation. Journal of Sustainable Forestry Vol. 7, Iss. 1-2, 1997 Available at <https://doi.org/10.1300/J091v07n01_03> Last visit on August 15th, 2022.

[150] MEYERSON, F. A. B. Population Growth and Deforestation: A Critical and Complex Relationship. Population Bulletin 58, no. 3. 2003 Available at <https://www.prb.org/resources/population-growth-and-deforestation-a-critical-and-complex-relationship> Last visit on August 15th, 2022

[151] Database available for each municipality at https://cidades.ibge.gov.br/. Last visit on August 16th, 2022.

b. Information about key driver variable's likely future development

It is expected that the expansion of animal production, as reported throughout the PD tends to attract migratory flows[152]. Thus, in addition to the influence of agents, the population increase in the region for work generates pressure on infrastructure and housing.

c. Project measures that will be implemented to address them, if applicable

The project has no means to address population growth directly. However, the proposed activities will work on raising awareness and generating alternative sources of income with non-timber forest products and job creation for the region's population. In general, it will aim promoting social development and forest conservation. In addition, monitoring and surveillance activities will be performed to identify risks of invasion and deforestation and to manage conflicts with local residents and newcomers appropriately.

2) Prices livestock per arroba

a. Impact on agent group's decision to deforest

As previously described above, the prices of *arroba* (livestock) are the main reason why the cattle herd increased in the period, reaching in 2020 more than 2,300,00 animals in the municipalities composing the reference region (Porto Velho/RO, Lábrea/AM, and Nova Mamoré/RO).

In addition, according to Razera, given the large increase in pastureland property values, creation of new areas for livestock raising has been stimulated and intensified, raising cattle numbers and, consequently, increasing deforestation.

Furthermore, forested property values are almost 4 times cheaper than established pasturelands[153]. Thus, this disparity promotes the purchase of new forested areas, deforestation, and further creation of new pasturelands.

In Rondônia State, the average price of cattle soared in 2022, an overvaluation that made the "arroba" (15kg unit use to count the animal's weight) reaching more than R$ 260,00 in the first week of August, 2022, as per Rondônia State Entity for Technical Extension and Rural Extension (EMATER-RO)[154] weekly survey.

Thus, partly due to the expansion of globalization, deforestation rates in Amazonia appear to be linked to the growth of the international market, especially of beef[155].

b. Information about the key driver variable's likely future development

[152] Available at <https://repositorio.ipea.gov.br/bitstream/11058/8154/1/BRU_n17_Agroneg%C3%B3cio.pdf>

[153] 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: <https://web.archive.org/web/20171031104223/ttp://www.gestaodaterra.com.br/arquivos/O_desmatamento_da_floresta_amazonia_causas_e_solucoes.pdf>. Last visited on: July 7th, 2021.

[154] 'Boi gordo' data, available at <http://www.emater.ro.gov.br/ematerro/wp-content/uploads/2022/08/20220808-08-1-semana-de-agosto_2022.pdf> Last visit on August 16th, 2022.

[155] Fearnside, P. M. 2005. Deforestation in Brazilian Amazonia: history, rates and consequences. Conservation Biology 19(3):680-688. Available at <https://www.jstor.org/stable/3591054>

As previously discussed, livestock is the main activity in the state and region. The increase in the beef price directly impacts the decision to deforest, since it becomes increasingly advantageous for the agent of deforestation.

c. Project measures that will be implemented to address them, if applicable

The project has no means to address cattle prices directly. However, the proposed activities will work on raising awareness and generating alternative sources of income with non-timber forest products and job creation for the region's population, aiming at promoting social development and forest conservation simultaneously. In addition, monitoring and surveillance activities will be performed to identify risks of invasion and deforestation and to manage local conflicts appropriately.

b) Driver variables explaining the location of deforestation:

The main drivers of deforestation related to the location of impact in the project region are:

1) Distance to deforested areas

a. Impact on each agent group's decision to deforest

The presence of "non-forest" is a driver variable predicting quantity and location of future deforestation. Forested areas are influenced by their proximity to areas that have already been deforested. This driver has been considered in every modelling option, as to be detailed in the next section.

The distance from previously deforested areas is one of the major causes of forest degradation in the Amazon biome and their spatio-temporal dynamics are highly influenced by annual deforestation patterns. Degradation may not be a precursor to deforestation in that exact location, but it can serve as an alert that that region will be the target of deforestation practices coming in the near future. There are indications that the portion of degradation that occurs through local deforestation or in the surroundings grew between 2013 and 2015 (final years of the study sample) in all land categories. This can point to a growing relevance of degradation as a precursor and, therefore, an indicator of deforestation[156].

Previously deforested areas are also related to the accessibility of the area. They usually precede infrastructure – buildings, roads, yards, etc. When assessing an accessibility zone within a radius of previously deforested areas for official and unofficial roads across the Amazon, this zone was approximately 1.4 million km², 35.2% of the Brazilian Amazon, and encompassed 94.9% of all deforestation.

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

In addition, forest fragmentation results from deforestation and disturbance, with subsequent edge effects extending deep into remaining forest areas[157,158].

b. Information about key driver variable's likely future development

It is expected, due to a direct consequence, that the increase in deforestation will increase the edge and fragmentation effect, facilitating access to new areas. The tendency is for the increase in these areas to follow the deforestation rates in the region.

c. Information about key driver variable's likely future development

The conservation of the project area itself will be a form of mitigation, with the maintenance of the forest area in order to minimize the fragmentation caused by deforestation. Monitoring more vulnerable regions, such as property boundaries and rivers, will also contribute to the reduction of encroachments, protecting access areas to the property. In addition, socio-environmental activities involve raising awareness and generating alternative income with non-timber forest products, highlighting the importance of the forest for the region's population.

2) Proximity to rivers

a. Impact on each agent group's decision to deforest

Waterways remain the overwhelmingly predominant means of transport and access to forest products. The reference region is located in one of Brazil's richest areas in terms of waterways, which historically determined the locations of settlements in relation to extraction of non-timber forest products (NTFPs) and timber. Waterways remain the overwhelmingly predominant means of transport and access to forest products. Furthermore, the small sawmills to which timber is taken for processing are located on riverbanks. For these reasons, the majority of the regional population is located in small settlements on the banks of the rivers.

b. Information about key driver variable's likely future development

The Madeira River is a navigable river that has been used to access the eastern portion of the Project Area and is a valuable way for land-grabbers to easily invade the property and clear forests for logging and pasture. In the case of navigable rivers, the number of paths will be invariable across the project lifetime, as the creation of new navigable rivers is highly unlikely. It is worth mentioning the name Rio Madeira (Wood River) comes from a natural phenom, on which water floods its margin and wooden pieces are carried downstream by the water flow.[159]

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[157] BROADBENT et al. Forest fragmentation and edge effects from deforestation and selective logging in the Brazilian Amazon. Biological Conservation. Volume 141, Issue 7, July 2008, Pages 1745–1757 Available at <https://www.researchgate.net/publication/285152230_Forest_fragmentation_and_edge_effects_from_deforestation_and_selective_logging_in_the_Brazilian_Amazon>

[158] IMAZON. Carbon emissions from deforestation and forest fragmentation in the Brazilian Amazon. 2011. Available at: http://imazon.org.br/publicacoes/carbon-emissions-from-deforestation-and-forest-fragmentation-in-the-brazilian-amazon/?lang=en . Last visit on: August 6th, 2021.

[159] Available at <https://portalamazonia.com/amazonia/portal-amazonia-responde-por-que-o-rio-madeira-tem-este-nome> Last visit on August 16th, 2022.

c. **Project measures that will be implemented to address them, if applicable**

The project activity results 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, as a mitigation action.

3) Slope, altitude and terrain conditions

a. **Impact on each agent group's decision to deforest**

Slope is a geographic variable that is present in Brazilian legislation as a limiting factor for traditional agribusiness use. In the agricultural and livestock land use capacity system, slope levels are directly related to the permissible use intensity class[160]. The relief can influence the quality of the pasture in many aspects, among which mechanization (feasibility of using machines) and erosion stand out[161]. Altitude can influence the growth of grasses and cattle management.

b. **Information about key driver variable's likely future development**

Slope and altitude can also be considered relevant significant factors, since the establishment of pasture and agriculture operations are more likely on flat landscapes, as pointed by Marchesan (2016)[162]. Moreira and Valeriano (2013)[163] also observed that the agroindustry is more likely to stablish its borders in flat lands for several reasons, including productivity, machinery access, and legal compliance. It is worth mentioning the Brazilian Forest Code stablishes 45°slope as, thus the land use is more competitive in flatter and lower lands.

In this way, it is understood that flatter areas and at mild altitudes are more sought after for cattle ranching, in addition to the influence of their accessibility.

c. **Project measures that will be implemented to address them, if applicable**

Not applicable.

4) Distance to urban areas

a. **Impact on each agent group's decision to deforest**

As well as the accessibility drivers (rivers and roads) and proximity to deforested areas, the distance to urban centers is an important parameter as it provides infrastructure and drainage for the area that will suffer deforestation. Urban centers act as an agglomeration of other drivers, and therefore collaborate with the location of deforestation.

[160] Eder Paulo Moreira, Márcio de Morisson Valeriano. Relação entre diferentes usos e coberturas da terra e declividade do terreno: implicações em conservação do solo - Anais XVI Simpósio Brasileiro de Sensoriamento Remoto - SBSR, Foz do Iguaçu, PR, Brasil, 13 a 18 de abril de 2013, INPE.

[161] Available at <https://www.teses.usp.br/teses/disponiveis/8/8135/tde-10112009-143737/publico/LEONARDO_RODRIGUES_A_C.pdf>

[162] MARCHESAN, J. et al. Análise da relação entre a evolução florestale a declividade utilizando imagens Landsat. UFSM, 2016. Available at <https://periodicoscientificos.ufmt.br/ojs/index.php/nativa/article/view/3247/pdf>. Last visit on 27/January/2023.

[163] MOREIRA, E.P., VALERIANO, M.M. Relação entre diferentes usos e coberturas da terra e declividade do terreno: implicações em conservação do solo. Instituto Nacional de Pesquisas Espaciais – INPE. Available at <http://marte2.sid.inpe.br/archive.cgi/dpi.inpe.br/marte2/2013/05.29.00.10> Last visit on 27/January/2023.

The analyzed studies showed that urban sprawl occurs mostly in portions that have already been deforested, specifically in areas of cultivation. Not being an immediate cause of change in forest cover, therefore not having a causal link, urbanization is at the same time a land use class and a propelling space of underlying factors that circumstantial decision-making, inciting multiscale dynamics that are structured in a cyclical and retroactive system. Urban driving forces for deforestation are guided, in some way, by a spatial relationship, increasing in intensity and impact with the proximity from urban centers[164].

The studies also showed that the inclusion of this factor in deforestation projections to estimate its location was significant and with a positive sign, as initially expected, corroborating the hypothesis that the further the municipality is from the capital, the lower its availability of access to urban infrastructure, as well as the institutional apparatus, which regulates activities that promote deforestation[165].

b. Information about key driver variable's likely future development

The influence of proximity to urban areas can be evaluated in two ways: the direct association with deforestation, with the construction of roads, reservoirs and infrastructure, or the indirect one, with the ex-ante and ex-post effects of urbanization in the region. As evaluated in other drivers, the ex-ante impact is due to the attractiveness of job creation during the works, in addition to the new economic network created by other economic activities that also exert an effect of attraction on the population of other municipalities. And the ex-post effect, which occurs largely due to the dynamism of the municipal economy when they acquire operating conditions, as well as the population that migrated and was absorbed as labor during the work, but which starts to reside in the municipality and create other economic activities for their survival. In addition to enhancing the attraction for future immigrants[166].

Thus, the proximity to urbanization and infrastructure tends to be an important driver of deforestation, contributing to the increase tendency observed in the region.

c. Project measures that will be implemented to address them, if applicable

Monitoring more vulnerable regions, such as property boundaries and rivers, will contribute to the reduction of encroachments, protecting access areas to the property. In addition, socio-environmental activities involve raising awareness and generating alternative income with non-timber forest products, highlighting the importance of the forest for the region's population.

5) Distance to Protected Areas and Indigenous Lands

a. Impact on each agent group's decision to deforest

[164]The interface between deforestation and Urbanization in the Brazilian Amazon. Available at <https://www.scielo.br/j/asoc/a/ns5jQPmxbPFdy79PckdGXvv/?format=pdf&lang=pt>

[165] Short term dynamics of deforestation the Legal Amazon: Analysis of the role of public policies in the period from 2000 to 2010. Available at < https://www.revistas.usp.br/ecoa/article/download/141292/160766/407969>

[166] Short term dynamics of deforestation the Legal Amazon: Analysis of the role of public policies in the period from 2000 to 2010. Available at <https://www.revistas.usp.br/ecoa/article/download/141292/160766/407969>

There are protected areas and indigenous lands within and around the Reference Region. The closest areas are listed below:

- Indigenous lands:
  - TI Karitiana
  - TI Karipuna
  - TI Igarapé Lage
  - TI Igarapé Ribeirão
  - TI Kaxarari
- Conservation Units:
  - Floresta Nacional do Bom Futuro
  - Parque Nacional Mapinguari
  - Floresta Nacional do Iquiri
  - RESEX Jaci-Paraná

There is a duality in the pattern of deforestation observed in protected areas. The presence of protected areas in the surroundings of the project area would in theory decrease the likelihood of deforestation, affecting the location of future deforestation. As a result, the deforestation that would have occurred in such protected areas occurs in non-protected areas in the region (leakage from displaced deforestation). On the other hand, an increase in deforestation within protected areas has also been verified.

Between 2012 and 2015, 237.3 thousand hectares were deforested within Conservation Units (UCs) in the Amazon. During that period, the occupants may have obtained a gross income of R$ 300 million from the sale of timber illegally harvested from the protected areas, which created an enormous investment potential for deforestation, with logging being the main agent of deforestation[167].

In addition to public protected areas, in Brazil, private properties are also legally enforced to have protected areas, called Permanent Preservation Areas (*Áreas de Preservação Permanente – APP*) and Legal Reserve (*Reserva Legal – RL*)[168]. The reality, however, is that these areas are also under deforestation pressure, vulnerable to encroachment and land grabbers. In 2019, 55% of deforestation alerts issued by MapBiomas were associated within Legal Reserves in Brazil, and specifically in the Amazon Biome, 51% of deforestation alerts occurred within Legal Reserves. Therefore, it is important to note that more than half of the deforestation alerts in the Amazon region took place within Legal Reserve areas in 2019[169].

[167] Available in https://imazon.org.br/imprensa/novo-estudo-do-imazon-alerta-para-tendencia-de-aumento-do-desmatamento-em-unidades-de-conservacao-da-amazonia-e-identifica-as-50-mais-desmatadas-entre-2012-e-2015/

[168] Brazilian legislation further described in section 1.14.

[169] MapBiomas Annual Deforestation Report in Brazil. Available at <(https://s3.amazonaws.com/alerta.mapbiomas.org/relatrios/MBI-relatorio-desmatamento-2019-FINAL5.pdf>

The deforestation within the reference region surpassed the 80% threshold established by the Brazilian Forest Code for the proportion of land designated as Legal Reserves in the properties located in Amazon region. Notably, approximately 52% of the Reference Region was composed of deforested areas by 2019, further emphasizing the illegality of these actions and demonstrating a general non-compliance with the Brazilian Forest Code.

It is, however, necessary to consider the availability and quality of land and properties data in Brazil.

For private properties, the main source of information of this data is the SICAR (Brazilian National Rural Environmental Registry System) platform, where each landowner provides data on the property and Legal Reserve boundaries in a self-declaratory way, which results in a low accurate database. Furthermore, a significant limitation arises from the fact that less than 0.4% of these Rural Environmental Registry (CAR) data were analyzed in Brazil, according to WWF[170].

Even when relying on self-declared Legal Reserve data available in SICAR (last visited on April 4th, 2024) for the three Brazilian states where the Reference Region is located, only a small percentage (0.75% in Rondônia, 0.39% in Amazonas, and 0.04% in Acre) of the CARs have undergone complete analysis without any pending legal issues, in accordance with the requirements of the Brazilian Forest Code (Brazilian Law nº 12,651/2012). Specifically, within the reference region only a fraction of the CARs (0.48%) has undergone complete analysis without any pending legal issues, in accordance with the requirements of the Brazilian Forest Code (Brazilian Law nº 12,651/2012). Therefore, more than 99.5% of the analyzed CARs in the reference region present some type of legal issues, which could be related to Legal Reserve delineation and/or conservation.

Thus, based on current available data, it can be concluded that the CAR (Rural Environmental Registry) represent fragile data that does not provide reliable information that could be used as an explanatory variable in the deforestation model, particularly regarding the presence or absence of legal reserves.

b. Information about key driver variable's likely future development

Deforestation has increased within some protected areas and the percentage share of deforestation in conservation units in the total deforested in the Legal Amazon doubled from 6% to 12% between 2008 and 2015. In 2015, deforestation within conservation units was 79% higher than in 2012. In the last 4 years, the area of devastated forest in conservation units in the Legal Amazon rose 80%, against 35% of deforestation in general.

In more recent years, between 2018 and 2019, deforestation at the conservation units grew 35% between August 2018 and July 2019 (going from 767 km² to 1,035 km²). The

[170] Available at <https://www.wwf.org.br/?82509/Em-10-anos-cadastro-ambiental-so-regulariza-04-dos-imoveis-rurais>

growth rate of deforestation in these units was higher than that recorded in the entire Amazon biome (29.5%).[171]

The year of 2020 was the second worst year for Indigenous Lands and Conservation Units since 2008, in terms of forest conservation. The 188 thousand hectares of forests destroyed in these territories are second only to the almost 200 thousand hectares registered in 2019. In addition, they represent 90% more than the average between 2009 and 2018[172].

It is important to highlight the scarcity of remaining forest cover in the Reference Region. As depicted in the land use dynamics map, the largest forest areas lying beyond Legal Reserve boundaries are encompassed within Protected Areas, and Indigenous Territories. Consequently, due to the absence of forest areas suitable for land conversion for human activities (such as pasture conversion in this region), there is an increasing deforestation tendency in legal reserve areas within the reference region during the last seven years from the historical reference period.

Therefore, it is concluded that, although in theory the presence of conservation units is an indication of areas extremely protected by law, it has been demonstrated that, in practice, the opposite occurs, leaving large areas of native forests exposed to encroachment, exploitation and illicit sales, facilitated by lack of inspection and public policies, making the area around it also vulnerable to this type of activity.

In view of the analysis of underlying agents and the Brazilian environmental political scenario, the trend is for an increase and maintenance of high deforestation rates in these regions [173].

Identification of underlying causes of deforestation

According to the definition of the section in the methodology, the agents' characteristics and decisions are themselves determined by broader forces, the underlying causes of deforestation, such as: Land-use policies and their enforcement; Population pressure; Poverty and wealth; War and other types of conflicts; Property regime.

Due to being in a region of large cattle ranchers, settlements and protected areas, the reference region has a considerable social conflict issue, primarily land conflict. Land is occasionally illegally occupied by squatters and illegal loggers[174],[175],[176]. Thus, the main underlying causes of deforestation within the reference region are associated with land conflicts (tenure issues), and

[171] Available in < https://oeco.org.br/reportagens/desmatamento-em-unidades-de-conservacao-atinge-maior-indice-dos-ultimos-10-anos/>
[172] Available in < https://www.socioambiental.org/pt-br/noticias-socioambientais/destruicao-de-areas-protegidas-na-amazonia-explode-com-bolsonaro>
[173] Deforestation in Conservation Units reaches the highest rate in the last 10 years. Available at <https://oeco.org.br/reportagens/desmatamento-em-unidades-de-conservacao-atinge-maior-indice-dos-ultimos-10-anos/>
[174] Available at https://g1.globo.com/natureza/noticia/2019/09/04/invasoes-grilagem-e-queimadas-ameacam-areas-protegidas-na-amazonia.ghtml
[175] Available at < https://acervo.socioambiental.org/sites/default/files/documents/prov0227_0.pdf>
[176] Available at https://www.bbc.com/portuguese/brasil-56211156

the lack of social programs and deforestation control public policies that could promote sustainable alternatives to combat deforestation and degradation activities.

- Governmental policies and lack of control

  In Brazil, the political scenario is crucial to define agents and drivers of deforestation, since both environmental protection measures and the definition of prices for products such as wood and meat, social actions and public policies are directly influenced by the characteristics of the current government. Despite the country's strong environmental legislation, it is evidenced in its timeline attempts to extinguish restrictions in anti-environmentalist governments.

  The low presence of Governance and lack of land-tenure documentation, with thousands of rural producers owning non-documented properties, promotes a scenario of forest destruction for exploration of natural resources and creation of pastureland, driving the tendency for the frontier to grow[177].

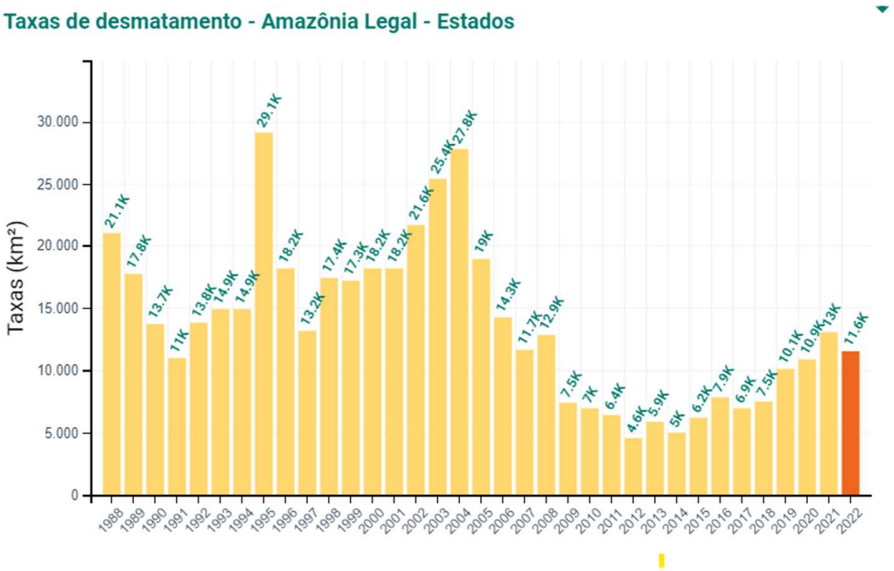
  Environmental governance in Brazil can be divided into three major periods: 2000 - 2008, where the main improvements in environmental governance were established, 2009 – 2012, period of main decrease in deforestation and the start of the weakening of the Forest Code; and after 2012, when governance suffered a gradual erosion with the large amnesty granted to past illegal deforesters in the revision of the Forest Code and a return of deforestation rates to the peak levels of the last decade.

  After the flexibilization of the Forest Code - the central piece of legislation regulating land use and management on private properties - in 2012, the deforestation rates in the country, which had been declining since 2005, increased again in the Brazilian Amazon, with a breakpoint in 2014, as shown in the graph below[178]:

[177] INSTITUTO DE CONSERVAÇÃO E DESENVOLVIMENTO SUSTENTÁVEL DO AMAZONAS (IDESAM). Reduções de Emissões do Desmatamento e Degradação Florestal (REDD+): Estudo de Oportunidades para a Região Sul do Amazonas. Manaus: Idesam, 2011. 45 p. (Relatórios Técnicos nº1). 141 Available in < https://idesam.org/publicacao/REDD_Estudo_de_Oportunidades_Sul_Amazonas.pdf> Last visited on March 23, 2022.

[178] Available at https://terrabrasilis.dpi.inpe.br/app/dashboard/deforestation/biomes/legal_amazon/rates

Figure 57. Deforestation in the Legal Amazon



The following years accounted for a severe political crisis in the country, with the impeachment of Dilma Roussef and the transition to a ruralist government. During this period, Brazil was the stage for a series of acts against the environmental area, such as cutting budgets for protected areas monitoring, reducing the protection of more than 600,000 ha of Amazon and Atlantic Forest biomes[179], and reduction of federal agents responsible for tackling deforestation.

In exchange of political support, the government offered landholders to increase deforestation, and the signature of provisionary measures and decrees lowering environmental licensing requirements, suspending the ratification of indigenous lands, reducing the size of protected areas and facilitating land grabbers to obtain the deeds of illegally deforested areas[180].

Following the anti-environmental trend, Jair Bolsonaro was elected in 2019, along with other right-wing politicians, making it clear in the first few months what the profile of his government would be like, with major changes and cuts in the environmental agenda.

As a consequence, the deforestation in the Amazon Rainforest was widely reported in 2019, as it was the third largest in history, with an increase of 29.5% in comparison to 2018. In total, 9,762 km² were deforested during that year[181]. In August, during the peak of fire warnings in the forest, fact that caused climate effects in São Paulo, 2,790 km away from the Amazon[182], the government tried to deviate attention from

[179] CROUZEILLES, R., FELTRAN-BARBIERI, R., FERREIRA, M. S. & STRASSBURG, B. B. N. Hard times for the Brazilian environment. Nat. Ecol. Evol. 1, 1213 (2017).

[180] ROCHEDO, P. RR; SOARES-FILHO, B; SCHAEFFER, R. VIOLA, E. SZKLO, A; LUCENA, A.F.P; KOBERLE, A; DAVIS, J.L; RAJÃO, R; RATHMANN, R. The threat of political bargaining to climate mitigation in Brazil. **Nature Climate Change,** vol 8, August 2018, pg. 695–69.

[181] Available in < http://www.inpe.br/noticias/noticia.php?Cod_Noticia=5294> Last visited on December 6th, 2021

[182] Available in https://www.economist.com/the-americas/2019/08/22/forest-fires-in-the-amazon-blacken-the-sun-in-sao-paulo Last visited on December 6th, 2021

the fires, claiming they were fake news[183]. The number of fires in Brazilian forests increased 70% in 2019, the highest rate in 7 years. According to National Spatial Research Institute (INPE), the most affected biome was the Amazon, with 51.9%[184].

Even though fire alerts increased in the period between 2019 and 2020, the Brazilian Government reduced the budget for forest fire prevention and control personnel. A reduction of 58% reached the brigade teams, with budget ranging from 23.78 million reais in 2019 to 9.99 million in 2020[185].

Government agencies such as INPE and IBAMA, responsible for deforestation monitoring have suffered funding cutoffs, dismissals and had their functions and increasing deforestation data publicly questioned and denied by the government[186].

The quantity of national parks protected areas and indigenous lands in the country was already questioned by Bolsonaro, that intended to extinguish those by decree[187], an unconstitutional action, after announcing the intention to review the protected areas' law (SNUC) and the existing units[188]. In addition, the Minister of the Environment during Bolsonaro's administration spoke publicly, in a video released during investigations, of his intention to take advantage of the Covid-19 pandemic to approve several controversial changes to environmental protection and avoid critics and lawsuits[189].

Experts affirm that, with the current pace of dismantling of the inspection structure and environmental legislation demonstrated since the first 6 months of the current government, the forest destruction can reach an irreversible limit in 4 to 8 years. Recent scientific research shows that if an area of 40% of the original forest gets deforested, the rest cannot sustain the functioning of the tropical rainforest, and in this scenario, part of the forest may not be able to sustain itself. The Amazon has so far lost approximately 20% of its original coverage.[190]

Political problems have persistent consequences, and, even if there is a change of position in new elections, it is estimated that the increasing trend of deforestation will remain, since new actions take time to be implemented and effective.

[183] Available in https://www.theguardian.com/environment/2019/sep/09/amazon-fires-brazil-rainforest Last visited on December 6th, 2021

[184] Available in <https://noticias.uol.com.br/meio-ambiente/ultimas-noticias/redacao/2019/08/19/numero-de-queimadas-cresce-70-e-e-o-maior-desde-2013-amazonia-lidera.htm> > Last visited on December 6th, 2021

[185] Available in <https://g1.globo.com/natureza/noticia/2020/09/12/em-um-ano-governo-bolsonaro-corta-verba-para-brigadistas-em-58.ghtml> Last visited on December 6th, 2021

[186] Available in < https://g1.globo.com/natureza/noticia/2019/08/02/cronologia-reacao-do-governo-ao-uso-de-dados-sobre-desmatamento-leva-a-exoneracao-de-diretor-do-inpe.ghtml > Last visited on December 6th, 2021

[187] Available in < http://www.ihu.unisinos.br/78-noticias/589958-em-live-bolsonaro-reclama-que-nao-consegue-extinguir-parques-por-decreto> Last visited on December 6th, 2021

[188] Available in https://oeco.org.br/noticias/ricardo-salles-quer-rever-todas-as-unidades-de-conservacao-federais-do-pais-e-mudar-snuc/#:~:text=A%20lei%20do%20SNUC%20determina,extinguir%20uma%20unidade%20de%20conserva%C3%A7%C3%A3o Last visited on December 6th, 2021

[189] Available in < https://g1.globo.com/politica/noticia/2020/05/22/ministro-do-meio-ambiente-defende-passar-a-boiada-e-mudar-regramento-e-simplificar-normas.ghtml> Last visited on December 6th, 2021

[190] Available in https://www.bbc.com/portuguese/brasil-48805675 > Last visited on December 6th, 2021

The development of REDD projects and a new culture of sustainable development and production, in addition to the profit from carbon credit sales, to encourage the maintenance of standing forest, goes against the non-environmental policy currently adopted by the country. Despite having since 2015 the National Commission for REDD+, established by decree, which is responsible for coordinating and monitoring the implementation of the National REDD+ Strategy in Brazil, it can be noticed that the main effort comes from private landowners and project developers, since there is no guideline or effective planning from the government to amplify the development of new projects.

- Poverty and social inequality

  Another important underlying agent of deforestation is the poverty and wealth inequality, also influenced by the political situation. According to IBGE statistics on the municipality of Lábrea/AM, Porto Velho/RO, and Nova Mamoré/RO available in section 1.13, the percentage of the population living in families with monthly income of up to half a minimum wage per person is 52.7%, 34%, and 44.5% respectively. 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 initiatives. In addition, environmental education activities for local public schools will be performed, promoting environmental conservation for underprivileged children and their families living around the Project Area.

Analysis of chain of events leading to deforestation

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

Based on the historical evidence collected, the relations between main agent groups, key drivers and underlying causes of deforestation explain the sequence of events that typically has led and most likely will lead to deforestation within the reference region.

It is possible to correlate the deforestation curve to the increase in livestock in the region, which is clearly increasing. Such land-use change agent (cattle ranching) is the main deforestation

agent in the region, mainly performed illegally as previously mentioned. The profit from cattle industry is considerably higher than the production of other NFTP in the region, such as Brazil nuts and *açaí*.[191]

The socioeconomic conditions of the population of the region, the fact that it is predominantly dominated by large properties landowners (with political and historical contributions that made the region an important livestock region), and the demographic growth implies the need for new infrastructure projects and the arrival of new habitants coming from other regions of the country, attracted by the favorable conditions of production in low-cost forested areas. This increases the pressure on the forests in the project area.

The recent history of polemics and anti-environmentalism actions of the Brazilian government, in addition to not tackling the direct causes, minimizing monitoring and restrictions in critical environmental areas, and no investments in sustainable management and farming methods end up influencing and even motivating deforestation, illegal occupation and non-compliance with environmental laws.

In fact, when analyzing the rates of deforestation during the Historical Reference Period, it is possible to observe that there is an increase in the deforestation rate, largely attributable to all the facts and context described in this section. Similarly to the Amazon Biome deforestation trend, there is an increase in deforestation starting in 2014. As described as an underlying cause of deforestation, the impact of the change in the country's ideology after the alteration of the Forest Code can be seen in the national, state, municipal and reference region deforestation charts. The large increase in deforestation from 2014 is strongly linked to the political scenario and the attempts to make Brazilian Environmental legislation more flexible, resulting in the inefficiency for surveillance and command and control and public policies that could stop this increase, combined with the cattle market opportunities.

There is no strong environmental policy, and even with good advances, Brazilian laws have gaps that are taken in advantage by landowners, intensified by weakened controlling mechanisms that have been dismantled by the Government, making the conservation of the extensive Brazilian biomes even more difficult.

Conclusion

The conduction of the VM0015 Step 3 –Analysis of agents, drivers and underlying causes of deforestation and their likely future development, and available evidence allows to analyze that the most likely future deforestation trend within the reference region and project area is conclusive and increasing.

Through the sections presented above, it may be concluded that the hypothesized relationships between agent groups, driver variables, underlying causes and historical levels of deforestation can be verified at hand of statistical tests, literature studies, or other verifiable sources of information, such as documented information provided by local experts, communities,

[191] https://cidades.ibge.gov.br/brasil/ro/porto-velho/pesquisa/16/12705?localidade1=110033&localidade2=130240 Last visit on 08-January-2023

deforestation agent data base and other groups with good knowledge about the project area and the reference region.

The increasing deforestation rate, added to the region's cattle ranching advancement (which presents a very strong correlation to deforestation in the region), the population growth rate increase, and other deforested areas, and also due to the lack of effective governmental control and environmental planning are clear evidence that the overall deforestation trend is increasing and will continue to increase in future baseline deforestation rates, and this demonstrates the need for conservation measures that encourage a change in the business and production model in the region.

3.5 Additionality

The VCS Tool for the Demonstration and Assessment of Additionality in VCS Agricultural, Forestry and Other Land Use (AFOLU) Project Activities - VT0001 version 3.0[192] must be applied for all project activities instances.

In 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.

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

In case the project activity generates no financial or economic benefits other than the VCS related income (as it is the case for all three instances included in the project at this time):

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

In case the project activity, by any means, generates other financial or economic benefits other than the VCS related income:

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

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

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

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

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

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

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

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

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

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 may or may not involve sustainable forest management plans within the project boundaries of the proposed VCS REDD project, depending on the historical land use of each instance.

Where no SFMP are developed, which is the case for Instance 2 (Grupo Leite), the current (pre-project) land use scenario is the maintenance of forest areas with no economic activities and no active measures to prevent deforestation, mostly due to lack of incentives and other factors explained on this VCS PD. Under this scenario, the social and environmental activities, as well as activities aimed at reducing unplanned deforestation would not be performed. Hence, forest areas would be subject to unplanned deforestation drivers, regardless of their legal status (APP or legal reserve) or the existence of sustainable forest management plans. On the other hand, Instance 1 (Grupo ROVEMA) and Instance 3 (Grupo Tupá) conduct sustainable forest management plans (SFMP) within the project area. Even though SFMP can contribute for the conservation of forest carbon stocks due to sustainable logging, it is important to highlight that the development of Sustainable Forest Management activities is not similar to the measures proposed by the REDD project. The project measures are specifically targeted at preventing illegal deforestation from third parties, as described under Section 3.4. Such measures include increased surveillance, monitoring and control by satellite images, REDD+ technical studies, social and environmental activities aimed at promoting social development and forest conservation simultaneously while addressing the drivers of deforestation in the region, as described on this VCS PD.

The contributions of SFMP to the conservation of forest carbon stocks occurs mainly due to the use of reduced impact logging techniques, increased presence in the area and the promotion of responsible value chains that generate income from forest products produced in a sustainable manner. However, SFMP are not aimed at preventing illegal

deforestation and, given the context analyzed in the Reference Region of this Project Activity, are not effective to address the drivers of deforestation, as explained below:

Reduced impact logging techniques are effective to ensure that the portion of forest that is managed is capable to recover its carbon stock and vegetation cover following a period where plots are not managed and left to recover naturally. While this is a consolidated practice for sustainable forest management, it has no effects in preventing the manifestation of deforestation drivers, such as land grabbing, illegal timber harvesting and conversion to pasture by external agents.

The increased presence in the area resulting from SFMP is temporary, since forest management techniques only occur in part of the year, typically during the dry season when local conditions are more favorable to forest management operations and the use of roads and machinery[193]. In addition, the presence is also concentrated in the forest plots that are actively being managed at a given time, leaving the majority of the forest (the unmanaged plots) with little or no presence. Also, as stated previously, the SFMP cycle considers removing a fraction of existing trees, where the main part remains in the forest in order to promote natural recovery. The remaining trees include specimens with high economic value for timber extraction. Therefore, the interest of wood grabbers is not eliminated within SFMP areas. Finally, SFMP are typically performed by third party companies and not by the landowners themselves. Such companies have no responsibility to prevent deforestation or other forms of forest degradation by external agents.

In regard to promoting responsible value chains, this is still far from a reality in the Amazon region. 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.

The Action Plan for Prevention and Control of Deforestation in the Legal Amazon (PPCDAm, or *Plano de Ação para Prevenção e Controle do Desmatamento na Amazônia Legal*, in Portuguese) includes the promotion of sustainable forest management as one of the alternatives to prevent deforestation in the Amazon. However, the document also describes the current challenges for establishing an incentive structure that recognizes implementation costs and values positive externalities. According to the same source, it is necessary to advance in the design of policies and programs, in the regulation and review of standards that stimulate the economic sectors that protect the forest[194].

[193] In the two instances adhering to the management plan, activities take place between March and August, after the rainy season in the Amazon region. This can be evidenced on the Reports on SFM activities, as for example, the Report "Fazenda Rio Madeira AMF 01 – POA 5 - AUTEX 2011.2.2021.47259", which provides the conclusive report of one managed area belonging to Grupo ROVEMA. Such report, on Section 5.1.5.2 provides a schedule of activities from March to August 2023.

[194] Brasil. Ministério do Meio Ambiente e Mudança do Clima. Plano de Ação para a Prevenção e Controle do Desmatamento na Amazônia Legal (PPCDAm) : 5ª fase (2023 a 2027) [recurso eletrônico] / Subcomissão Executiva do PPCDAm. Brasília, DF: MMA, 2023. Document available at: <https://www.gov.br/mma/pt-br/assuntos/prevencao-e-controle-do-desmatamento/amazonia-ppcdam-1/5a-fase-ppcdam.pdf>. Information on Page 76.

Also, despite the requirements to mitigate social impacts, social and environmental activities for the communities surrounding SFMP areas are not required by law. According to Ribeiro (2020)[195], 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 communities from management activities in private areas.

Hence, SFMP is currently not an effective policy to prevent illegal logging and deforestation from being a profitable activity, especially when combined with the conversion of land to pasture and cattle ranching, as previously explained on this VCS PD.

Therefore, despite the contribution to forest preservation and carbon stock maintenance, it is reasonable to consider that SFMP areas are at risk of unplanned deforestation and loss of carbon stock due to external agents, in a similar manner as those areas where SFMP are not performed in the baseline scenario.

Moreover, it was observed deforestation rates within and outside SFMP areas in the Reference Regions at Porto Velho municipality, where most of the project is located. By analyzing data available at Geoportal platform[196] of the local Environmental Agency (SEDAM[197]) and MapBiomas land use[198], it was possible to conclude that the existence of SFMP is not enough to guarantee the preservation of forest areas.

When comparing the deforestation rates within and outside the SFMP areas at the Reference Region polygons inside the State of Rondônia, the dynamic is very similar. As detailed at the VCS PD section 3.3, the rates within and outside forest management areas are similar and are summarized at the following Figure:

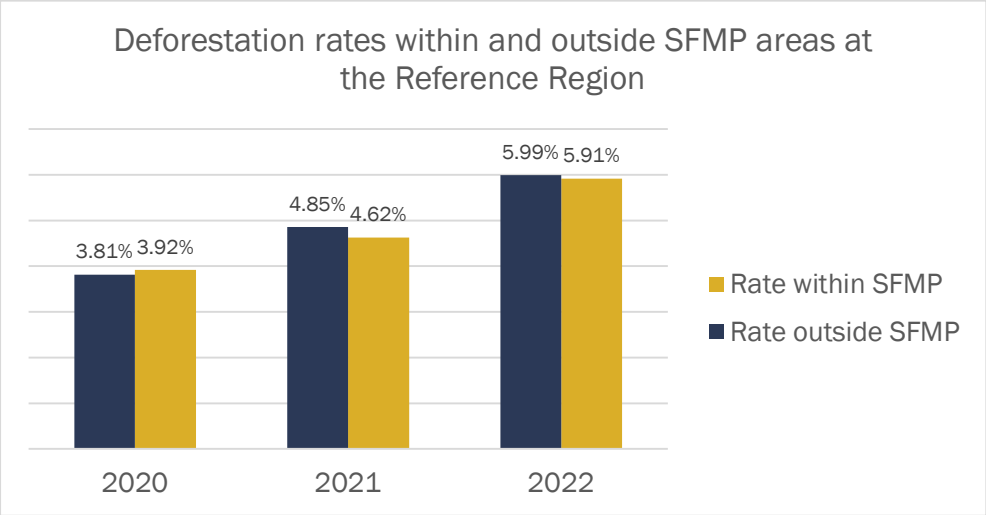
Figure 58. Deforestation rates at Reference Region

[195] 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 .

[196] Available at: < https://geoportal.sedam.ro.gov.br/>. Last visited on August 15, 2023

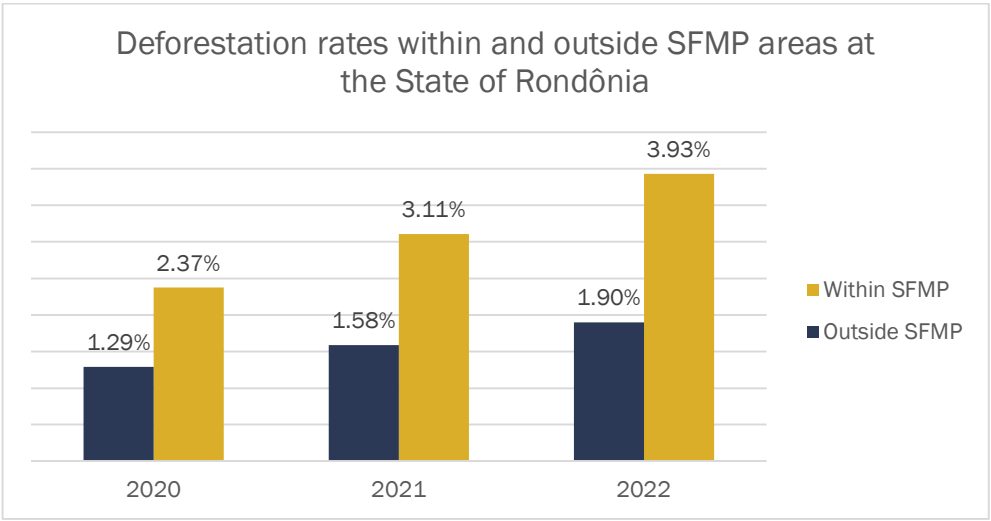
[197] Similar platform is not available at Environmental Agency from State of Amazonas (IPAAM). However, although instance 3 is in the State of Amazonas, its deforestation context can be considered similar to State of Rondônia.

[198] Available at: < https://plataforma.brasil.mapbiomas.org/cobertura>.



For analyzing the deforestation rate within and outside SFMP areas at the State of Rondônia, it was observed the overall SFMP polygons at the Geoportal. In such assessment, the deforestation dynamic is even higher within SFMP areas, as illustrated in the following Figure:

Figure 59. Deforestation rates at State of Rondônia



Besides the clear similarity between rates within and outside SFMP areas at the Reference Region, it is also worth noting that:

- From a State level perspective, the deforestation rates at SFMP are even more aggressive, presenting two times higher;
- All rates are increasing, regardless within or outside SFMP;

It is worth mentioning timber harvesting within sustainable forest management plans is selective, i.e. a specific number of trees per hectare are removed and small clearings are left which cannot be detected by satellite images.

The analysis provided above indicates many of SFMP areas were subject to intense deforestation that are probably the result of illegal deforestation, thus corroborating the rational that SFMP areas are subject to the same drivers of deforestation in the Project region.

II. **Implementation of the Project activity on the land within the project boundary, performed without being registered as the VCS AFOLU project:** 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 a combination of the current (pre-project) land use scenario combined with the measures to avoid deforestation, such as increased surveillance, monitoring and control by satellite images, REDD+ technical studies, social and environmental activities aimed at promoting social development and forest conservation simultaneously.

The investments required to avoid deforestation are not performed by the Brazilian Government, nor are part of sustainable forest management plans (when these are present on the area), as they are financially unattractive and not required by law. Therefore, the economic feasibility of this scenario would be reduced without additional revenues from the sale of VCUs. This is further explained in the sections below of the demonstration of additionality.

At the end of sub-step 1a, credible land use scenarios to the proposed VCS AFOLU project activity have been identified, namely the continuation of pre-project land use scenarios and the Implementation of the Project activity on the land within the project boundary, performed without being registered as the VCS AFOLU project.

The current land use scenario for instances 1 and 3 (Grupo ROVEMA and Grupo Tupá) involves the use of SFMP, which is expected to continue even during part of the crediting period. Instance 2 (Grupo Leite) has developed SFMP historically (within ten years prior to the project start date)[199]. However, SFM operations were concluded in 2016 and are not expected to occur during the project crediting period.

[199] The last AUTEX issued was shared with VVB as evidence

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

Scenario I – as previously explained, scenario 1 involves either SFMP or the maintenance of forest areas with no economic activities by the landowners. The Project compliance with Laws, Statutes and Other Regulatory Frameworks is described under Section 1.14 of the VCS PD and the same conditions described under this section apply to scenario I.

This means scenario 1 is in full compliance with enforced mandatory applicable laws and regulations. Where SFMP are performed (such as Instances 1 and 3), these activities are regulated and in compliance with all applicable requirements.

As it does not contain social and environmental activities to control deforestation coming from external agents, scenario I may lead to deforestation from activities that are illegal or of uncertain legal status, not being enforced namely due to the lack of control and government capacity. This type of illegal deforestation, apart from planned deforestation, occurs mainly due to social and economic pressure and low levels of social development in the Amazon regions. The expected unplanned deforestation in the Project Areas would occur despite the legal protection status of the forest areas (such as APP and legal reserve) due to the lack of law enforcement and institutional capacity by local authorities[200] along with the underlying causes of deforestation previously described, especially on Section 3.4.

Scenario II - As Scenario II is the combination of current (pre-project) land use with the addition of social environmental activities, as presented above, this scenario is also in compliance with all applicable legal and regulatory requirements. The measures proposed by the project do not require any licensing or permits from governmental authorities. Thus, scenario II is complying with all applicable laws and regulations.

At the end of sub-step 1b, it is possible to conclude that both land use scenarios identified are credible when considering enforced mandatory applicable laws and regulations.

Sub-step 1c. Selection of the baseline scenario

The most plausible baseline scenario was identified in section 3.4 above according to procedures provided on the applied methodology. The main agent and drivers that promoted or stimulated deforestation within the reference region during the historical reference period were:

- Livestock production;
- Distance to rivers and urban areas, slope, altitude, and other relevant drivers as detailed at section 3.4.

Those agent and drivers, combined with underlying causes present in the region, will most likely continue to cause deforestation in the future. The future trend for baseline

[200] 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.

scenario is that the deforestation in the reference region will probably continue, as detailed in the deforestation agent analysis at section 3.4.

The most plausible baseline scenario is the continuation of the pre project activities. Under this scenario, there are insufficient incentives and resources for landowners to develop measures to prevent unplanned deforestation. Therefore, forest areas are exposed to invasion and illegal deforestation, and activities such as cattle raising would advance without any control within the project area.

STEP 2. Investment Analysis

Step 2 is performed to determine whether the proposed project activity, without the revenue from the sale of GHG credits is economically or financially less attractive than at least one of the other land use scenarios. This will be performed according to the applied tool (VT0001, version 3.0).

Sub-step 2a. Determine appropriate analysis method

As the development of the project does generates no financial or economic benefits other than VCS related income, simple cost analysis (Option I) will be applied as sub-step 2b. This condition is valid for all three instances included in the project at this time. No financial or economic benefits are derived by the project, because:

- The project does not create any new or additional revenue stream for the landowners except for the generation and sale of VCUs.
- The project brings no economic benefit (increased revenues or savings) for the existing sources of revenue at the project area, such as those generated by SFMPs available on Instances 1 and 3.

No economic benefits are expected for Instances 1 and 3, where SFMP are operational, mainly because these operations are outsourced to third party companies at a fixed price arrangement and also because it is reasonable to assume SFMP could be maintained for long periods even with the projected deforestation under the baseline scenario, as explained below.

Under the contracts signed between Grupo Rovema (instance 1) and Grupo Tupá (Instance 3) and logging companies, a fixed price is defined based on conditions approved under the Exploitation Licenses for sustainable forest management (called AUTEX, in Portuguese)[201]. This means any financial upsides from the project activity (such as additional timber volumes from preventing deforestation or price premiums on the price of timber due to the carbon project and/or additional certification) would benefit the companies in charge of the SFMP, instead of the landowners.

Despite existing contractual arrangements, it is unlikely that preventing deforestation would bring financial benefits for instances where SFMP are developed. SFMP are authorized on small portions of the forest area at each time, as per conditions defined on the AUTEX. The authorized area represents around 3% to 8% of the total forest area

[201] Contracts between landowners and logging companies were provided as evidence

of each instance[202]. Therefore, between 92% to 97% of the project area does not include any annual SFMP operations and therefore, it is reasonable to assume that the major portion of the project area is totally unoccupied and subject to the drivers and agents of illegal deforestation.

Also, it is reasonable to assume that Grupo Rovema and Grupo Tupá would be able to carry out SFMP even with the projected deforestation of the baseline scenario, because:

- Even in 2029 (nearly 10 years after the Project Start Date for this instance), the forest area at Grupo Rovema would be more than seven thousand hectares[203], which is 4.2x larger than the average Production Unit for Grupo Rovema. Hence, Grupo Rovema would still be able to profit from SFMP on existing forest areas for a considerable period.
- In addition, the last Production Unit (POA 06 of the current AUTEX) will be harvested in 2024. After harvesting POA 06, all of the forest area will be left for natural regeneration for at least thirty years (since the date each plot was harvested)[204]. This means that, after 2024, Grupo Rovema will have no financial incentives on the project area for a long period, hence, the projected deforestation would not affect any sources of revenue[205].
- In Grupo Tupá, even in 2029 (10 years after the Project Start Date), the forest area would be more than twelve thousand hectares[206], which is 21.7x larger than the average Production Unit for Grupo Tupá. Hence, Grupo Tupá would also be able to profit from SFMP on existing forest areas for a considerable period.

Therefore, as described above, despite the existence of SFMP in the Project Area (as it occurs on instances 1 and 3), the VCS AFOLU project does generate no financial or economic benefits other than VCS related income. For instance 2, where no economic activity is performed on the Project Area, the VCS AFOLU project also does not generate financial or economic benefits. Hence, simple cost analysis is considered the appropriate analysis method for all three instances, as described below[207].

[202] The SFMP of Grupo Rovema divided the total forest area into 12 Production Units, meaning 1/12th (8.33% or 1.686 hectares) should be explored, on average, at each time, considering the Forest Area of Grupo Rovema before the Project Start Date. The SFMP of Grupo Tupá divided the area into 5 Production Units with an average size of 556.361 hectares, or 2.95% of the Forest Area of Grupo Tupá before the Project Start Date.

[203] As per the projected deforestation provided on the VCS-PD calculation spreadsheet. Information available on Table 8 PA Projection, cell C27.

[204] According to the map of Production Units for Fazenda Rio Madeira, which was part of the SFMP of Grupo Rovema. This map indicates Production Unit 06 is the last area to be harvested for Grupo Rovema. Document made available for the VVB.

[205] Grupo Rovema would be able to apply SFMP in the long term (2041 onwards). However, this would mean efforts and investments would have to be made consistently since 2019 to secure a revenue that would only materialize after more than 20 years. This is highly unlikely and would be subject to significant financial viability risk, taking in consideration the criteria available on item 2.2.2 of the AFOLU Non-permanence Risk Tool (version 4.0).

[206] As per the projected deforestation provided on the VCS-PD calculation spreadsheet. Information available on Table 8 PA Projection, cell F27.

[207] As per the applied Tool (VT001 v. 3.0), If the VCS AFOLU project generates no financial or economic benefits other than VCS related income, then apply the simple cost analysis

Sub-step 2b. Simple Cost Analysis

Instance 1 (Grupo Rovema)

As previously explained, the Project will bring no financial or economic benefit for Grupo ROVEMA, other than the VCS related income. Table below provides an estimate of expenses for the landowner, without considering the costs involved for the VCS project and the certification of VCUs:

Table 39. Estimated costs for the REDD Project at Grupo Rovema[208]

Costs considering no project development expenses	Estimated costs (R$)
TOTAL EXPENSES	**-R$ 4,564,823.85**
Property taxes	-R$ 151,974.40
Surveillance costs	-R$ 2,516,695.43
Socio environmental activities	-R$ 1,896,154.02

Instance 2 (Grupo Leite)

As previously explained, the Project will bring no financial or economic benefit for Grupo Leite, other than the VCS related income. Table below provides an estimate of yearly expenses for the landowner, without considering the costs involved for the VCS project and the certification of VCUs:

Table 40. Estimated costs for the REDD Project at Grupo Leite[209]

Costs considering no project development expenses	Estimated costs (R$)
TOTAL EXPENSES	**-R$ 28,320,842.66**
Property taxes	-R$ 263,541.85
Surveillance costs	-R$ 26,453,336.00
Socioenvironmental activities	-R$ 1,245,175.77
Satellite images monitoring consultancy	-R$ 358,789.04

Instance 3 (Grupo Tupá)

As previously explained, the Project will bring no financial or economic benefit for Grupo Tupá, other than the VCS related income. Table below provides an estimate of yearly

[208] Costs were estimated based on the quotes provided by the respective service providers, according to the available cashflow.
[209] Costs were estimated based on the quotes provided by the respective service providers, according to the available cashflow.

expenses for the landowner, without considering the costs involved for the VCS project and the certification of VCUs:

Table 41. Estimated costs for the REDD Project at Grupo Tupá[210]

Costs considering no project development expenses	Estimated costs (R$)
TOTAL EXPENSES	**-R$ 1,960,454.67**
Property taxes	-R$ 102,799.50
Surveillance costs	-R$ 158,000.00
Socio environmental activities	-R$ 1,699,655.17

In addition to the costs described above, which were based on costs applicable to each instance, Future Carbon has developed an Impact Plan and a Project Monitoring and Protection Plan with additional activities to be developed once the revenues from VCUs are available. These plans bring additional activities to promote stakeholder engagement, positive community and biodiversity impacts, appropriate leakage management and the monitoring and surveillance of the Project Area based on effective local presence and remote monitoring, as described on this VCS PD, especially on Section 6.

The implementation of these Plans will bring additional costs, which are expected to be fully funded by the revenues from VCUs. Investments for the period between January 2024 and December 2026 are estimated at R$9,190,680.00 (annual average cost of more than R$ 3 million).

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

STEP 4. Common practice analysis

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 Rio Madeira 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.

[210] Costs were estimated based on the quotes provided by the respective service providers, according to the available cashflow.

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[211].

The context of the region, and the fact that the project is located in a reference area for both logging and cattle ranching of the State offer risks to the continuation of forest conservation activities. As mentioned previously, other Sustainable Forest Management Plans and logging authorizations are present in the reference region and in the municipalities of the initial project instances. However, these measures are not focused at preventing unplanned deforestation and it is reasonable to consider SFMP are not similar to the Project activity, as previously explained on Section 3.4 and on sub-step 1a of this Section.

The practice of conservation of privately-owned forest areas in the Rondônia State as a whole, is extremely rare. Conservation activities in larger areas are usually made in public areas, such as Conservation Units, federal and state protected areas. Even in such areas, there are many challenges to guarantee the permanence of forest areas and their effective social and environmental protection. Many conservation areas located in the Amazon biome 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[212],[213].

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[214], and illegal exploitation of wood (degradation) has occurred in many of them.

The creation of protected areas is proven to be one of the most effective tools for 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, even when involving

[211] "The Rotten Apples of Brazil's Agribusiness" Available at <https://www.researchgate.net/publication/343017296_The_rotten_apples_of_Brazil's_agribusiness>.

[212] VERÍSSIMO, A. *et al* (Org.). **Áreas Protegidas na Amazônia brasileira:** avanços e desafios. Belém : Imazon ; São Paulo : Instituto Socioambiental, 2011. 90 p.

[213] 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/ .

[214] Available at < https://imazon.org.br/a-impunidade-de-infratores-ambientais-em-areas-protegidas-da-amazonia/#:~:text=Crimes%20Ambientais%20nas%20%C3%81reas%20Protegidas%20da%20Amaz%C3%B4nia&text=Entretanto%2C%20cresce%20a%20preocupa%C3%A7%C3%A3o%20com,em%20%C3%81reas%20Protegidas%5B1%5D>

legally protected areas, because REDD+ projects bring improvements on deforestation monitoring and control and the promotion of social, economic and environmental benefits in the region.

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

- **Private Reserve of Natural Heritage (RPPN)** [215]**:** it is a category of conservation unit created voluntarily by the landowner. When the area is categorized as RPPN, the owner is committed to nature conservation, without land expropriation. The benefits of the private reserve are preference in the analysis of applications to acquire rural credit, tax benefits and the possibility of cooperation with private and public entities in the protection and management of the land, but no revenue is generated as it is on REDD+ projects due to the sale of verified carbon units. In Rondônia State, there are 10 registered RPPNs and two of them are located in Porto Velho. However, these are much smaller properties compared to the Project Areas (the sum of the 10 RPPN areas reach a total of 2,918.62 ha)[216].

  Due to their considerable smaller size in comparison with the size of a REDD+ project area, which often requires a minimum area of 10,000 hectares to be financially feasible in order to generate enough VCUs to compensate the implementation and management costs, RPPN management tends to be much more affordable than REDD+ projects, as well as its implementation, which is near costless.

- **Payment for Environmental Services (PES)** [217]**:** PES is a transaction of voluntary nature, through which a buyer of environmental services grants the provider of these services with financial resources or other form of payment, under the agreed conditions, in compliance with the relevant legal and regulatory provisions, so the provider can maintain, restore or improve the environmental conditions of ecosystems. Regulation regarding this type of service in Brazil is at its early stages, as it has recently been approved, on January 13, 2021, when Law n° 14.119 was sanctioned. The aforementioned law establishes the National Policy on Payment for Environmental Services and amends other laws to adapt to the new policy. However, the financial incentive is usually determined by the State, and it is commonly applied in taxes discounts, not representing an income to invest in other activities or in the maintenance of the area.

It is possible to note that, for the aforementioned reasons, the project does not characterize as a common practice due to the presented barriers, such as the lack of investment capacity and opportunity cost from other land uses. During the attempt to identify similar projects, the

215 Available at <https://www.icmbio.gov.br/portal/images/stories/comunicacao/downloads/perguntaserespostasrppn.pdf>
216 Available at <https://sistemas.icmbio.gov.br/simrppn/publico/rppn/RO/>
217 Available at <http://www.planalto.gov.br/ccivil_03/_ato2019-2022/2021/lei/L14119.htm>

essential distinctions between REDD+ projects compared in terms of area, challenges, monitoring costs, among other aspects, greatly diverge from the alternative initiatives identified.

For all instances, it is worth mentioning the Forest Code[218] provides in its Article 41 the payment or incentive to environmental services as monetary or non-monetary retribution for activities of conservation and improvement of ecosystems that generate environmental services, such as: the sequestration, conservation, maintenance, and increasing the stock and decreasing the flow of carbon. The Article also defines that such activities can be performed within Legal Reserve Areas and Permanent Preservation Areas (APP). More information at section 1.14. This means local regulations allow landowners to benefit and receive economic incentives from forest conservation and emission reductions on Legal Reserves and APP, which is the case for this REDD+ Project.

The significant difference between the present REDD+ project and similar conservation practices in the region, regarding both size and financial obstacles, makes it possible to conclude that the project is not a common practice in the region. Therefore, it is considered the project is additional for all three instances included at this time. Revenues from the sales of VCUs are a very important component to ensure forest conservation and the successful and continuous development of the project measures.

Funding the investments described on Sub-step 2b without the REDD+ project would be unrealistic, as landowners would face investment barriers and have no economic incentive to do so. However, such investments represent a small fraction of the revenues that shall be generated by the sale of VCUs. The Project is expected to generate more than 4.5 million VCUs from 2019 to 2024, which are expected to provide the required funding for the project implementation from 2024 to 2026. At current market prices, this represents more than USD 45 million, or more than R$ 224 million[219]. It is also important to emphasize Future Carbon and the landowners have actively been engaged to obtain the certification of emission reductions and to secure funding for the project through the sale of VCUs. Such measures reinforce the importance of carbon credits to support project development and forest conservation activities.

3.6 Methodology Deviations

No methodology deviations were applied.

[218] Available at http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/L12651compilado.htm Last visit on 15-August-2023

[219] This estimate considered a VCU market price of USD 10.08, taken from Table 8 of the Forest Trends' Ecosystem Marketplace. 2023. State of the Voluntary Carbon Markets. 2023. Washington DC: Forest Trends Association. Document available at <https://www.ecosystemmarketplace.com/publications/state-of-the-voluntary-carbon-market-report-2023/>. Also, an exchange rate of R$4.9573 per USD was taken from Brazil Central Bank, available at: <https://www.bcb.gov.br/conversao>. Exchange rate valid for 13-December-2023.

4 IMPLEMENTATION STATUS

4.1 Implementation Status of the Project Activity

The VCS PD is being validated along with the monitoring report, since the present project is a Joint PD. Validation and verification is being done by Validation and Verification Body (VVB) RINA Services S.p.A. The first monitoring period includes data from 19-October-2019 to 31-December-2021.

During the monitoring period, the deforestation within the Reference Region was higher than the projected deforestation. In other words, it can be concluded the baseline was not overestimated, as illustrated at the following Table:

Table 42. Ex-ante and ex-post deforestation within Reference Region analysis

Ex-ante deforestation (ha)	Ex-post deforestation (ha)
47,628.23	48,692.79

The project activity includes banning of illegal logging, socioeconomic activities and supervision of deforestation by a management team and through satellite images.

Instance 1: ROVEMA

Regarding Instance 1 (Grupo ROVEMA), there is a surveillance contract with private company since 23-October-2019, being the Project Start Date of Rio Madeira Project, to carry out patrols in the project area.

Instance 2: Leite

Instance 2 has had a surveillance and security company since 19-May-2021, and also has a satellite monitoring service in order to monitor deforestation within and around the property, which was signed on 8-January-2020 and still in force.

Instance 3: Tupá

The project activities include supervision of deforestation by a management team, signed on 8-January-2020 which is still in force today.

Also, there are socio-economic activities taking place on Fazenda Nova Fronteira, involving the collection of Brazil nuts by residents of the local communities. The owner authorizes the harvesting of nuts at no additional cost, generating profit and encouraging sustainable development through non-timber products, thus contributing to the reduction of emissions, since it avoids the deforestation that could occur driven by commercial interests in the timber species present in the region, for example. This action is in the process of being formalized but has been taking place since the beginning of the project.

Regarding all the three instances, as these are security services contracted by the owners, there is a guarantee that the work will be carried out as planned. This activity guarantees the security of the property and the project area, ensuring that the forest is conserved, and emissions reduced.

Table 43.Forest conservation implemented activities

Project Activity	Monitoring	Impact in the GHG emission reductions or removals	Implementation Schedule
Implement and intensify patrimonial surveillance, local patrolling	As these are security services contracted by the owners, there is a guarantee that the work will be carried out as planned through a contract and payment invoices.	This activity guarantees the security of the property and the project area, ensuring that the forest is conserved and emissions reduced.	Since Project Start Date (Instances 1 and 3)
Satellite monitoring in the project area	As these are security services contracted by the owners, there is a guarantee that the work will be carried out as planned through a contract and payment invoices, as well the resulting maps.	This activity makes it possible to monitor deforestation periodically, in order to avoid possible invasions and, consequently, deforestation of the project area.	Since Project Start Date (Instance 2)
Enhance community livelihoods and improve infrastructure to support economic development and human well-being, through the collection of Brazil nuts.	In order to control the collectors access within the property, it is necessary to pass in front of the farm manager house, named Carlos Alberto Santos, which avoids the movement of unknown persons or authorized people grabbing illegal material.	This activity avoids the deforestation that could occur due to commercial interests in the wood species present in the region, because of the constant presence of collectors.	Since 2022 (Instance 3)

The other actions described in section 1.11 are in the planning stage and will be implemented in the coming monitoring periods.

5 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

PROJECTION OF FUTURE DEFORESTATION

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

- **Selection of Baseline Approach**

According to the VM0015 methodology, to project future deforestation three baseline approaches are available: historical average, time function and modelling approach.

The selection of the best baseline approach depends on the decision criteria presented in the methodology, and different approaches may be used in different strata of the reference region, where appropriate.

As described, the deforestation rates measured in different historical sub-periods in the reference region reveal a clear trend, and this trend is an increase of the deforestation rate. The analysis of presented evidence related to the main deforestation agent (cattle ranching) and drivers, in addition to underlying causes, allows to conclude that the deforestation is due to the action of such agents, and it is likely that this trend will increase in the future. Thus, the best fitting approach for the Rio Madeira Grouped REDD+ Project is approach "b" (Time Function approach).

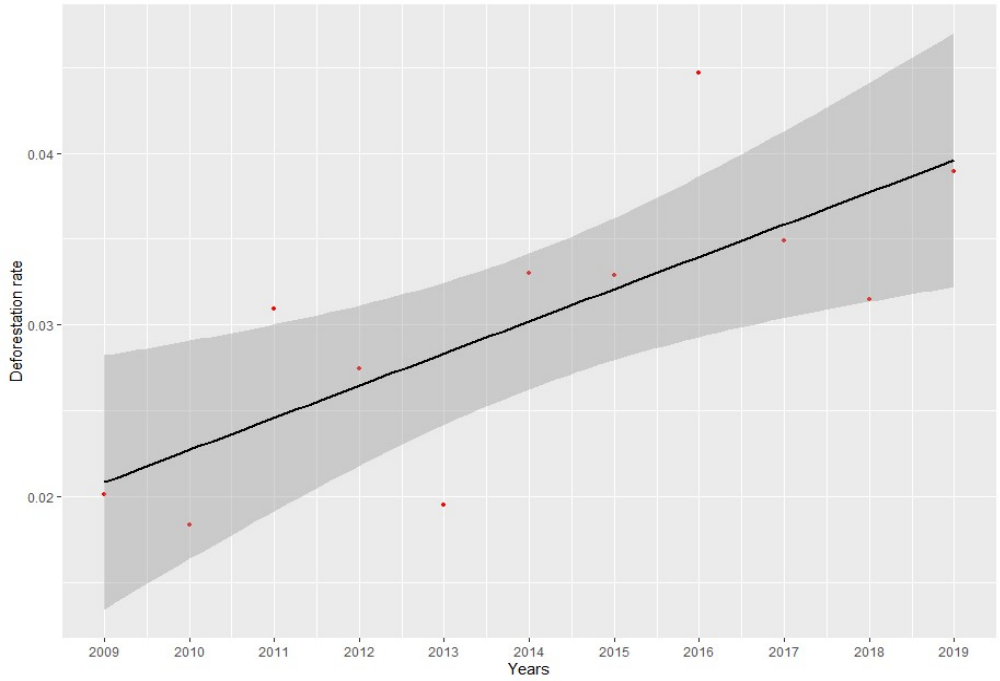
With this approach, the rate of baseline deforestation is estimated by extrapolating the historical trend observed within the reference region (or its strata) as a function of time using either linear regression, logistic regression or any other statistically sound regression technique. This approach requires multiple deforestation measurements during the past 10-15 years.

For the deforestation baseline, a linear simple regression model of the deforestation between 2009 and October 2019 was used. According to the analysis, there was a deforestation of 191,744.64 ha in the reference region, with an average oscillation of approximately 19,174.46 ha/year. The graph shows a clear trend of increase, statistically (R^2 = 0.56 and p = 0.0079). The equation that describes this increase is:

$$y = 0.001877x - 3.749587$$

This is presented in the graph below:

Figure 60. Variation in the deforestation rate in the reference region during the historical reference period. Source: MapBiomas



The steps to project the baseline annual deforestation areas in the reference region when selecting the time function approach were followed. As mentioned in the VM0015, if ABSLRRt decreases as a function of time, Toptimal is the period during which ABSLRRt yields a positive value. As shown in the Table below, ABSLRRt decreases as a function of time, keeping the area of forest land suitable for conversion to non-forest land (optimal area) positive throughout the period until the baseline reassessment (Toptimal > 6 years), as well as during the project crediting period.

To analyze if the ABSLRRt decreases as a function of time, the Mann-Kendall test was carried out. The purpose of the Mann-Kendall (MK)[220] test is to statistically assess if there is a monotonic upward or downward trend of the variable of interest over time. The MK test was applied to the baseline projected deforestation years in the ABSLRRt. The results showed that there is a trend in the ABSLRRt time series ($p= 1.28 \times 10^{-14}$) and that it is decreasing over time (z= -7.70, slope= -612.88, intercept= 24,922.78).

Based on the results of the Mann-Kendall test, there is strong statistical evidence of a decreasing trend in the time series of analyzed annual deforestation projections. The very low p-value suggests that the observed trend in the time series of annual deforestation projections is very unlikely under the null-hypothesis, i.e., there is sufficient evidence to conclude the decreasing trend.

[220] Mann, H.B. 1945. Non-parametric tests against trend, Econometrica 13:163-171.
Kendall, M.G. 1975. Rank Correlation Methods, 4th edition, Charles Griffin, London.

As described in section 3.4, deforestation occurs both in private and public lands, protected and unprotected areas, both present within the Reference Region and composing the land use dynamics of the region.

Therefore, considering the previous discussion on agents, drivers and underlying causes of deforestation, and that:

- There is no comprehensive verification process to ensure that the deforestation dynamics inside and outside Legal Reserves in the Reference Region are equivalent, nor sufficient data to allow the stratification of the deforestation rate within the Reference Region by each deforestation sub-group, and;

- Time function is the approach that better describes the deforestation pattern in the region.

A conservative discount factor was attributed to the projection of deforestation in the Project Area and Leakage Belt, based on the following assumption:

- Around 26% of the existing forestlands within the reference region in 2009 were deforested during the historical reference period;
- Around 21% of the existing forestlands within legal reserves in the reference region in 2009 were deforested during the historical reference period;
- The comparison between these figures is equivalent to around 80% (21%/26% = 80%).

Therefore, a conservative 20% (which comes from 1 - 80%) discount factor was applied to the projected annual areas of baseline deforestation in the Project Area and Leakage Belt, as the project area is mainly composed of Legal Reserve areas. This factor was adopted to the annual values of deforestation described in the sub-sections below.

- **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 time function approach tables below show the results of the projection in reference region, leakage belt and project area, including the previously mentioned discount.

Table 44. Annual areas of baseline deforestation in the reference region

Project year t	Stratum i in the reference region (ha)	Total (ha)	
	Forest	annual $ABSLRR_t$	cumulative ABSLRR
2019	4,154.25	4,154.25	4,154.25
2020	21,737.22	21,737.22	25,891.47
2021	21,736.76	21,736.76	47,628.23
2022	21,667.80	21,667.80	69,296.03
2023	21,511.38	21,511.38	90,807.41
2024	21,316.31	21,316.31	112,123.72
2025	21,020.00	21,020.00	133,143.72
2026	20,672.00	20,672.00	153,815.72
2027	20,255.61	20,255.61	174,071.33
2028	19,817.73	19,817.73	193,889.06
2029	19,301.10	19,301.10	213,190.15
2030	18,752.64	18,752.64	231,942.79
2031	18,158.34	18,158.34	250,101.13
2032	17,560.30	17,560.30	267,661.43
2033	16,908.36	16,908.36	284,569.79
2034	16,244.72	16,244.72	300,814.51
2035	15,557.24	15,557.24	316,371.75
2036	14,881.95	14,881.95	331,253.70
2037	14,176.44	14,176.44	345,430.14
2038	13,476.41	13,476.41	358,906.54
2039	12,771.60	12,771.60	371,678.15
2040	12,091.32	12,091.32	383,769.47
2041	11,400.49	11,400.49	395,169.96
2042	10,727.93	10,727.93	405,897.88
2043	10,064.96	10,064.96	415,962.84
2044	9,433.99	9,433.99	425,396.83
2045	8,807.17	8,807.17	434,204.01
2046	8,206.28	8,206.28	442,410.28
2047	7,624.09	7,624.09	450,034.37
2048	7,076.86	7,076.86	457,111.24
2049	5,367.17	5,367.17	462,478.41

Table 45. Annual areas of baseline deforestation in the project area

Project year t	Stratum i in the project area (ha)			Total (ha)	
	Grupo Rovema	Grupo Tupá	Grupo Leite	annual $ABSLPA_t$	cumulative ABSLPA
2019	167.16	0.00	0.00	167.16	167.16
2020	926.37	355.62	60.77	1,342.77	1,509.93
2021	1,159.14	422.24	92.01	1,673.39	3,183.31
2022	1,224.50	455.08	132.01	1,811.59	4,994.90
2023	1,222.65	521.02	164.25	1,907.92	6,902.82
2024	1,138.63	575.00	243.35	1,956.99	8,859.81
2025	1,113.23	599.78	331.13	2,044.13	10,903.95
2026	1,059.33	610.89	412.03	2,082.25	12,986.20
2027	963.69	647.38	529.21	2,140.27	15,126.47
2028	879.83	646.02	633.98	2,159.83	17,286.31
2029	811.10	677.92	664.13	2,153.15	19,439.46
2030	774.03	719.19	677.35	2,170.57	21,610.03
2031	654.29	698.69	715.85	2,068.83	23,678.86
2032	598.25	693.89	644.61	1,936.75	25,615.61
2033	508.64	672.02	598.70	1,779.36	27,394.96
2034	451.75	674.44	518.77	1,644.96	29,039.92
2035	403.65	688.25	483.43	1,575.32	30,615.25
2036	318.09	641.05	463.91	1,423.06	32,038.30
2037	271.89	572.66	413.98	1,258.53	33,296.83
2038	242.59	550.14	378.66	1,171.39	34,468.22
2039	196.21	518.93	318.63	1,033.77	35,501.99
2040	187.48	471.16	289.62	948.26	36,450.25
2041	149.88	411.21	257.55	818.64	37,268.88
2042	120.07	359.59	230.55	710.21	37,979.09
2043	99.59	316.26	220.67	636.52	38,615.61
2044	98.03	265.37	172.43	535.84	39,151.44
2045	78.14	214.67	177.34	470.14	39,621.59
2046	69.27	189.71	124.85	383.82	40,005.41
2047	52.16	163.72	107.22	323.10	40,328.51
2048	47.66	136.36	98.38	282.40	40,610.91
2049	34.82	91.20	65.32	191.34	40,802.24

Table 46. Annual areas of baseline deforestation in the leakage belt

Project year t	Stratum i in the leakage belt (ha)	Total (ha)	
	Forest	annual $ABSLLK_t$	cumulative ABSLLK
2019	144.36	144.36	144.36
2020	779.17	779.17	923.53
2021	883.43	883.43	1,806.96
2022	918.13	918.13	2,725.09
2023	1,000.98	1,000.98	3,726.07
2024	1,007.48	1,007.48	4,733.55
2025	979.59	979.59	5,713.14
2026	978.89	978.89	6,692.03
2027	964.31	964.31	7,656.34
2028	918.34	918.34	8,574.68
2029	933.93	933.93	9,508.61
2030	911.81	911.81	10,420.42
2031	919.90	919.90	11,340.32
2032	898.93	898.93	12,239.25
2033	849.35	849.35	13,088.60
2034	828.15	828.15	13,916.76
2035	766.92	766.92	14,683.68
2036	742.47	742.47	15,426.15
2037	725.17	725.17	16,151.32
2038	670.08	670.08	16,821.39
2039	672.03	672.03	17,493.43
2040	609.71	609.71	18,103.14
2041	545.82	545.82	18,648.96
2042	511.39	511.39	19,160.36
2043	460.66	460.66	19,621.02
2044	406.88	406.88	20,027.89
2045	371.88	371.88	20,399.77
2046	335.52	335.52	20,735.29
2047	290.84	290.84	21,026.14
2048	257.06	257.06	21,283.19
2049	182.98	182.98	21,466.17

- **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 (2009 to 2019) through the Business-as-usual scenario.

- Assigning weightings to change agents

The predictive variables considered to have the potential to influence the risk of deforestation in the region are the proximity to roads, proximity to cities, slope, altitude, proximity to settlements, presence of protected areas, proximity to small rivers and 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[221], 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

[221] Dinamica Ego Software. Available at: https://csr.ufmg.br/dinamica/ . Last visited on august 5th, 2021.

positive or negative, indicate greater weight to positively or negatively influence the calculation of the probability of deforestation in an area.

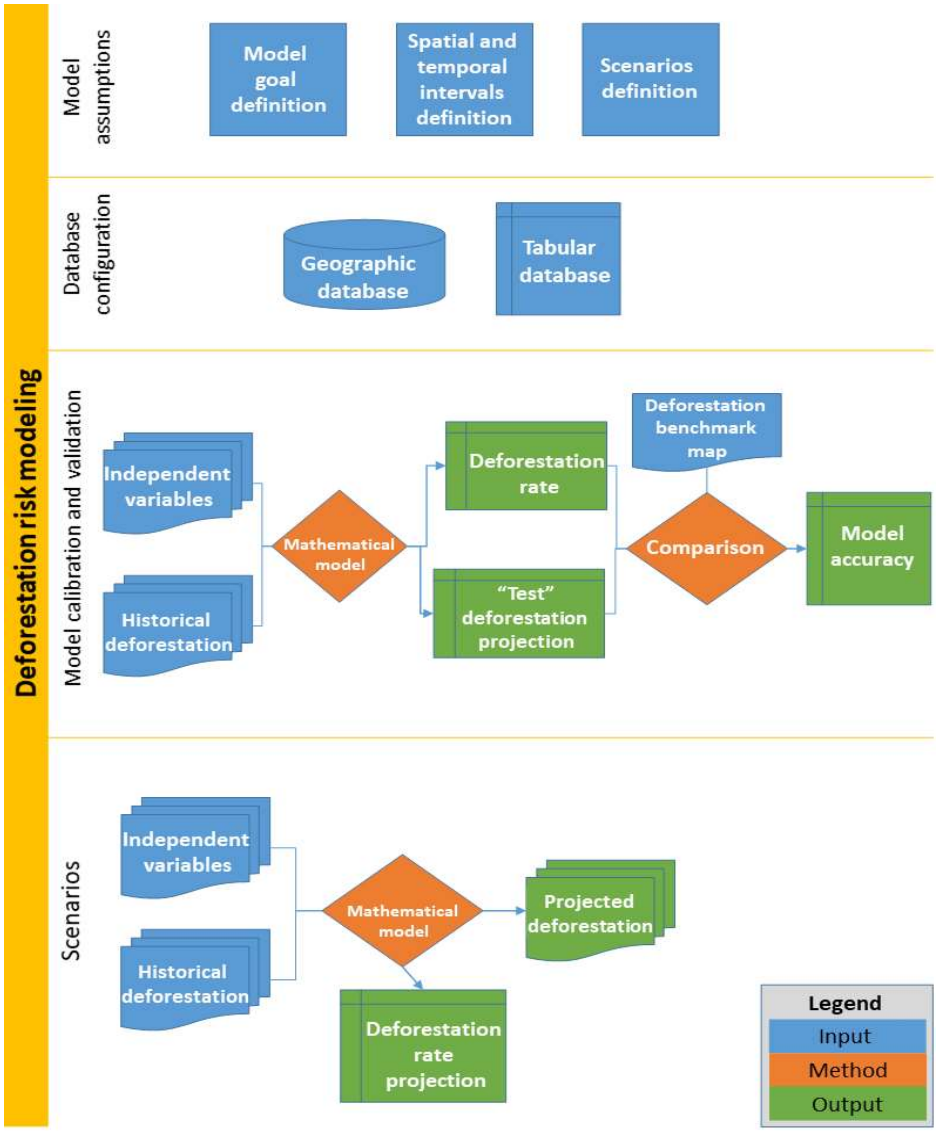
Based on the weights of the evidence, the transition probability of each forest pixel to become other types of anthropic use is calculated. This probability is calculated based on the sum of all the weights of evidence that overlap on a given pixel and are dependent on the combinations of all static and dynamic maps[222].

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.

[222] 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>. Last visited on August 5th, 2021.

Figure 61. 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 47. 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	File Name		
1	d_estradas.tif	IBGE/Imazon	Meters	Distances to paved and unpaved roads	0	11,299.5	Lower values indicate greater proximity	d_MERGE_estradas.tif	Euclidean Distance (ArcGIS 10.8)	Quantitative variable
2	d_assentamentos.tif	INCRA		Distances to rural settlements	0	45,909.8	Lower values indicate greater proximity	d_Assentamento_INCRA.tif	Euclidean Distance (ArcGIS 10.8)	Quantitative variable
3	d_rios_mbiomas.tif	MapBiomas	Meters	Distance to rivers mapped by MapBiomas	0	38,842.4	Lower values indicate greater proximity	d_RiosMapBiomas_edit.tif	Euclidean Distance (ArcGIS 10.6)	Quantitative variable
4	d_rios.tif	ANA	Meters	Distance to rivers	0	18,359.7	Lower values indicate greater proximity	d_Rios_ANA.tif	Euclidean Distance (ArcGIS 10.6)	Quantitative variable
5	d_urbana.tif	IBGE	Meters	Distance to urban centers	5,587.82	126,902	Lower values indicate greater proximity	d_Cidades_IBGE.tif	Euclidean Distance (ArcGIS 10.6)	Quantitative variable
6	dem.tif	SRTM	Meters	Average altitude change	71	369	Lower values indicate lower altitude	DEM_FIL.tif		Quantitative variable
7	slope_perc.tif	SRTM	Percentage	Average variation of land slope	0	135.534	Lower values indicate less slope	Slope_Percent.tif	Slope (ArcGIS 10.8)	Quantitative variable
8	TIs.tif	FUNAI		Indigenous lands	1	2	1 means external, while 2 means internal within indigenous land	TIs.tif		Categorical variable
9	UCs.tif	MMA		Conservation units	1	2 and 3	1 means non-UC lands; 2 means integrity use UCs, while 3 means UCs for integrity protection	UCs.tif		Categorical 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. Tables below describe the rule used to build classes and the deforestation likelihood assigned to each distance class.

Table 48. Variation of the weights of evidence according to deforestation distance ranges

Distance to deforestation		Weight of evidence
0	100	0.76
100	200	0.26
200	300	0.11
300	400	0.01
400	500	-0.07
500	700	-0.22
700	900	-0.36
900	1100	-0.52
1100	1400	-0.69
1400	1700	-0.87
1700	2000	-1.06
2000	3300	-1.29
3300	3500	-1.57
3500	3700	-1.89
3700	6800	-2.312115251

Table 49. Variation of the weights of evidence according to the distance from roads

Distance from roads		Weight of evidence
0	100	0.699520399
100	300	0.513185576
300	500	0.424098835
500	700	0.358954719
700	900	0.277898359
900	1100	0.174743417
1100	1300	-0.007380556
1300	1400	-0.154668684
1400	1500	-0.293691504
1500	1600	-0.458189983
1600	1800	-0.625030805
1800	2000	-0.808957812
2000	2200	-0.985147162
2200	3200	-1.162130594
3200	4700	-1.467595727
4700	4800	-2.339549492
4800	11300	-2.361687093

Table 50. Variation of the weights of evidence according to the distance from rivers

Distance from rivers		Weight of evidence
0	100	-0.07
100	500	-0.10
500	900	-0.03
900	1100	0.16
1100	1500	0.24
1500	2000	0.22
2000	2500	0.19
2500	3100	0.16
3100	3700	0.17
3700	4400	0.16
4400	5200	0.07
5200	6100	-0.02
6100	7200	-0.08
7200	8700	-0.06
8700	9800	-0.22
9800	10900	-0.37
10900	11000	-0.68
11000	12100	-0.86
12100	12200	-1.24

12200	14000	-1.47
14000	18400	-1.37

Table 51. Variation of the weights of evidence according to the distance from large rivers

Distance from large rivers		Weight of evidence
0	500	0.30
500	1000	-0.60
1000	2500	-0.84
2500	4500	-0.58
4500	6500	-0.49
6500	8500	-0.26
8500	10500	0.06
10500	12500	-0.04
12500	14500	-0.07
14500	17000	0.09
17000	19500	0.17
19500	22000	-0.01
22000	24500	0.11
24500	27500	0.58
27500	32500	0.77
32500	39000	0.95

Table 52. Variation of the weights of evidence according to slope

Slope		Weight of evidence
0	2	-0.054318379
2	3	-0.006526673
3	4	0.014515198
4	5	0.031343019
5	6	0.044929817
6	7	0.051084199
7	9	0.039873765
9	12	-0.001999458
12	35	-0.169851275
35	36	-1.345238038
36	136	-1.286506012

Table 53. Variation of the weights of evidence according to altitude

Altitude		Weight of evidence
0	75	-1.425900295
75	78	-1.003508598
78	79	-0.712787328
79	80	-0.405141301
80	81	-1.486060194
81	82	-0.810869108

82	83	-1.472288625
83	84	-0.72440964
84	93	-0.513573275
93	99	-0.158525914
99	100	0.230538093
100	101	-0.292283234
101	109	-0.350275063
109	110	-0.720034216
110	113	-0.97119752
113	120	-0.949377754
120	122	-0.722004282
122	126	-0.424612935
126	127	-0.162206227
127	133	-0.154538098
133	138	-0.131894979
138	142	0.097354454
142	147	0.289396548
147	152	0.329463924
152	158	0.343314481
158	164	0.430864416
164	172	0.454590632

172	181	0.269109643
181	193	0.099385416
193	370	-0.059772632

Table 54. Variation of the weights of evidence according to Protected Areas categories

Protected areas	Weight of evidence
1	0.05
2	-2.64
3	-1.71008596

Table 55. Variation of the weights of evidence according to Indigenous Land

Indigenous land	Weight of evidence
2	0.12
3	-2.65

Table 56. Variation of the weights of evidence according to distance from urban areas

Distance from urban areas		Weight of evidence
0	6000	-1.159462705
6000	6500	-0.074293487
6500	8000	-0.856934124
8000	8500	-1.702373105
8500	9000	-1.181650019
9000	11000	-1.920479319
11000	12500	-1.311823962

Distance from urban areas		Weight of evidence
12500	13000	-0.568554289
13000	13500	-0.832244812
13500	14000	-0.355688018
14000	14500	-0.674529345
14500	15000	-1.006288025
15000	19500	-0.735668166
19500	20500	-1.269693923
20500	21000	-2.214291288
21000	21500	-1.49237438
21500	22000	-1.050882223
22000	23000	-0.691606348
23000	24000	-0.424795094
24000	29000	-0.220661951
29000	29500	0.346453446
29500	30000	-0.701942196
30000	30500	-1.152408808
30500	31000	-0.802584674
31000	31500	-0.453821947
31500	33000	-0.665896703
33000	33500	-0.225499108

Distance from urban areas		Weight of evidence
33500	35000	0.036023689
35000	35500	0.256076931
35500	37500	0.021968276
37500	38000	-0.596973942
38000	40500	-0.402366298
40500	43000	-0.197223198
43000	50000	-0.209079141
50000	50500	-0.561059314
50500	51500	-0.357636589
51500	57000	-0.409789631
57000	61500	-0.460582558
61500	66000	-0.398259239
66000	66500	-0.07811606
66500	71500	-0.166107025
71500	76000	-0.234489164
76000	76500	-0.632064744
76500	81500	-0.720831049
81500	83500	-0.500801302
83500	84000	-0.077355407
84000	86000	0.176366923

Distance from urban areas		Weight of evidence
86000	86500	0.412576301
86500	90500	0.525773384
90500	94500	0.477094185
94500	100000	0.5244039
100000	109000	0.733916406
109000	109500	1.23278985
109500	114500	0.779412168
114500	115000	-0.11032166
115000	116500	0.198585316
116500	127000	0.241913728

Table 57. Variation of the weights of evidence according to the distance from settlements

Distance from settlements		Weight of evidence
0	100	-0.11
100	200	-0.39
200	1300	-0.20
1300	1400	0.01
1400	3900	0.06
3900	4400	0.25
4400	6800	0.22

Distance from settlements		Weight of evidence
6800	8800	0.12
8800	10600	0.16
10600	12300	-0.02
12300	12400	-0.23
12400	14300	-0.29
14300	14400	-0.10
14400	16300	-0.03
16300	16400	0.35
16400	18300	0.29
18300	20100	0.25
20100	22100	0.12
22100	23000	-0.07
23000	23100	-0.33
23100	24500	-0.17
24500	24600	0.01
24600	30100	-0.04
30100	30200	-0.26
30200	30500	-0.42
30500	33300	-0.57
33300	33400	-1.24

Distance from settlements		Weight of evidence
33400	34600	-1.48
34600	41000	-1.80
41000	41100	-2.78
41100	41300	-2.13
41300	42000	-1.63
42000	42100	-0.79
42100	42500	-1.18
42500	42600	-3.44
42600	42800	-2.22
42800	46000	-2.88

Furthermore, the factor maps used to create the deforestation risk map are presented below.

Figure 62. Distance from roads risk map

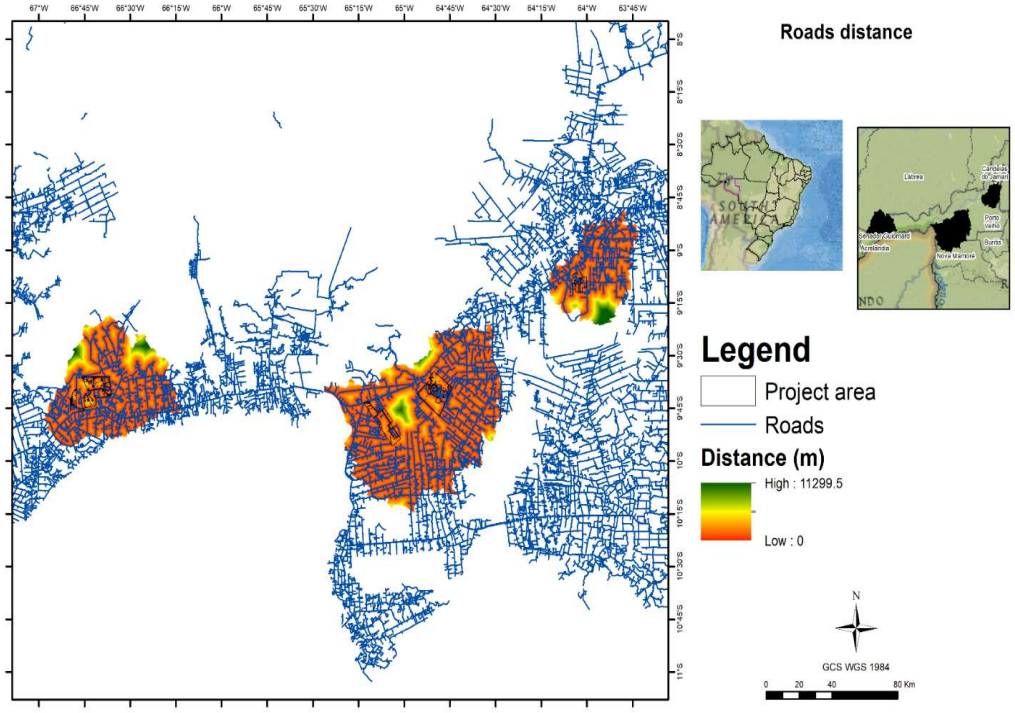


Figure 63. Distance from urban areas risk map

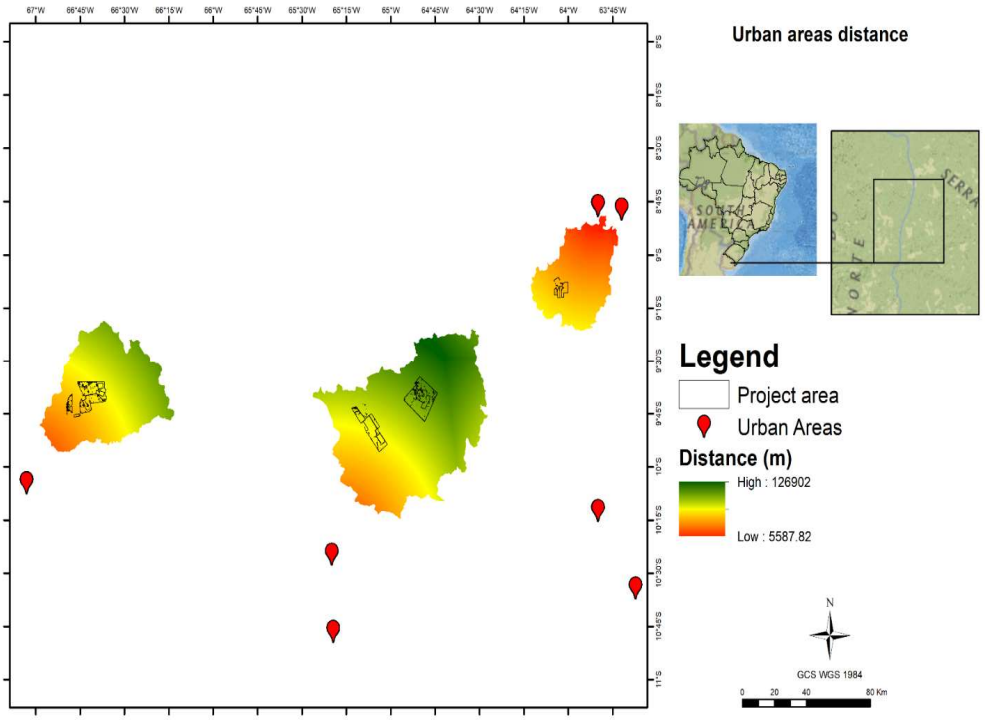


Figure 64. Distance from settlements

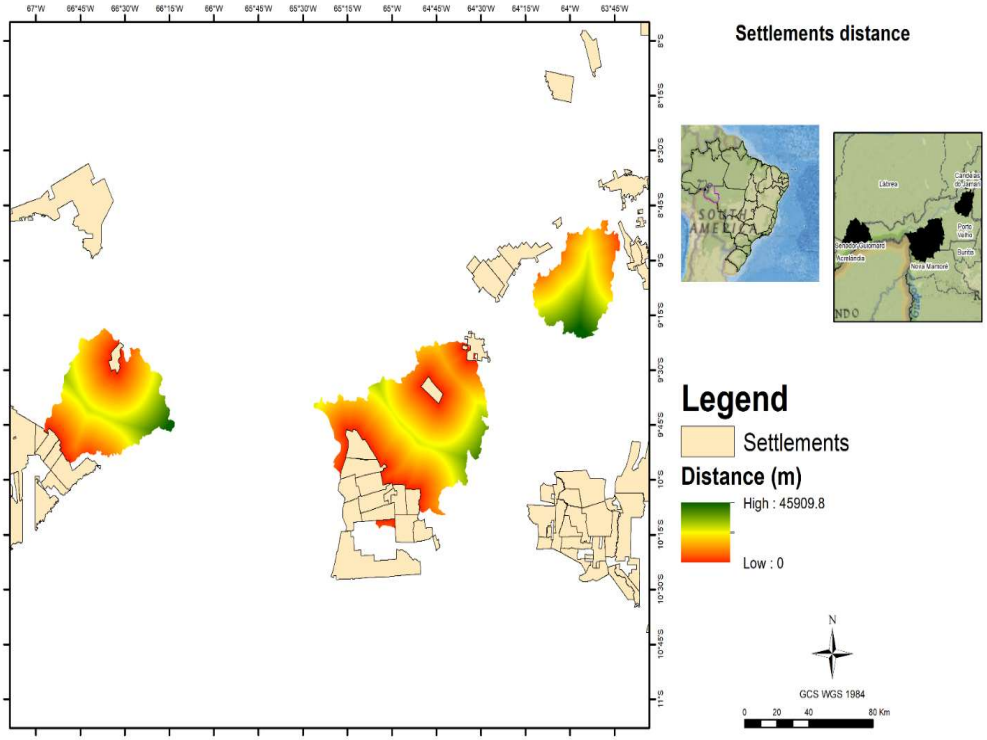


Figure 65. Presence of protected areas

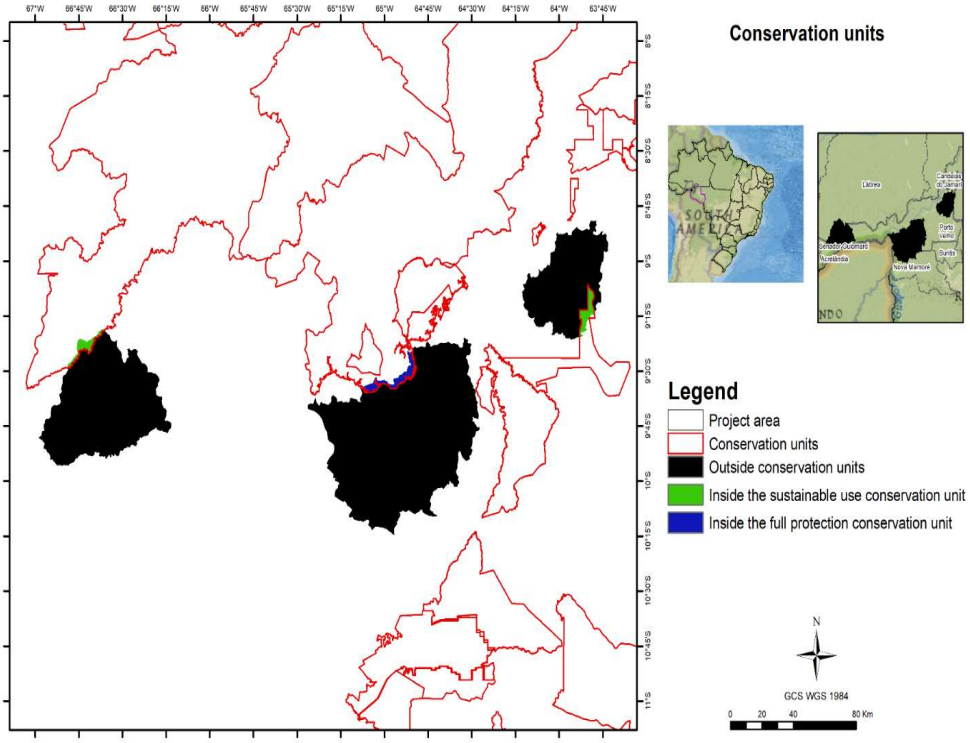


Figure 66. Presence of Indigenous Land

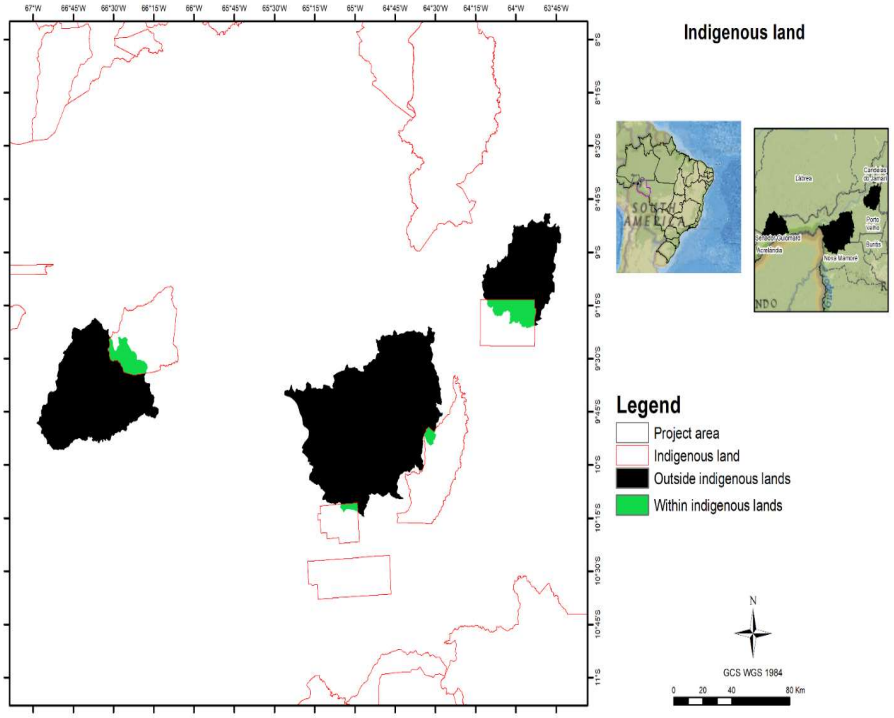


Figure 67. Proximity to small rivers

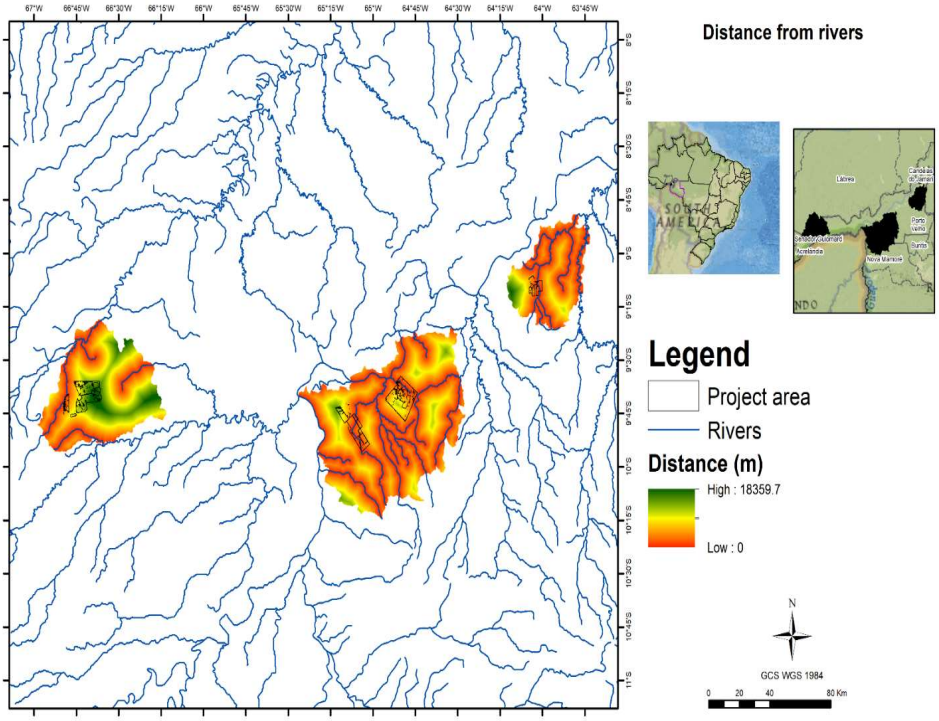


Figure 68. Proximity to large rivers mapped by MapBiomas

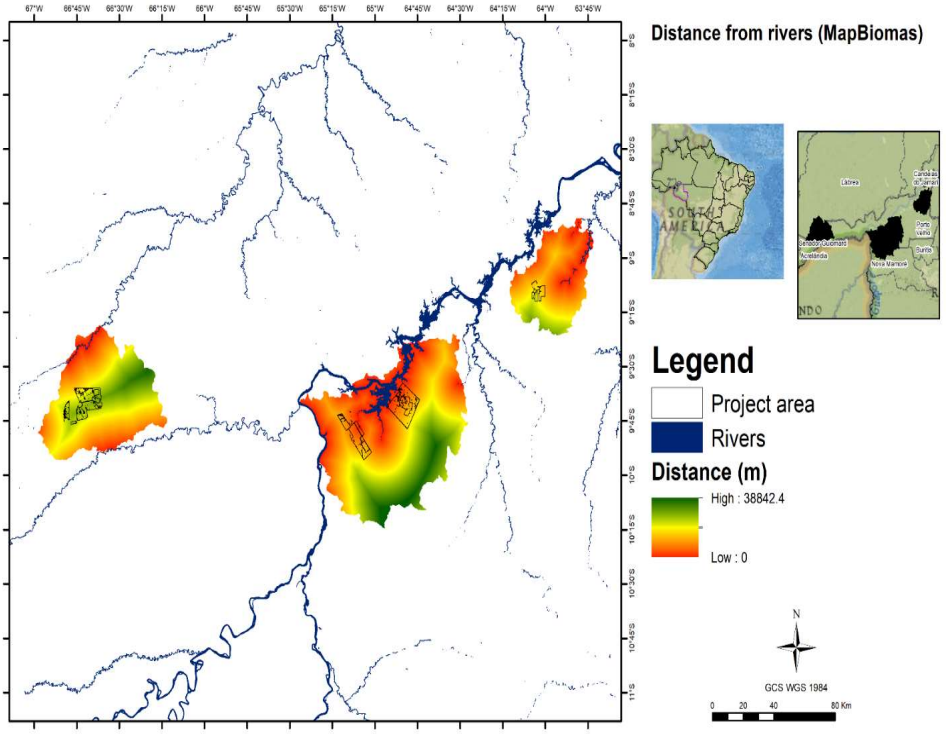
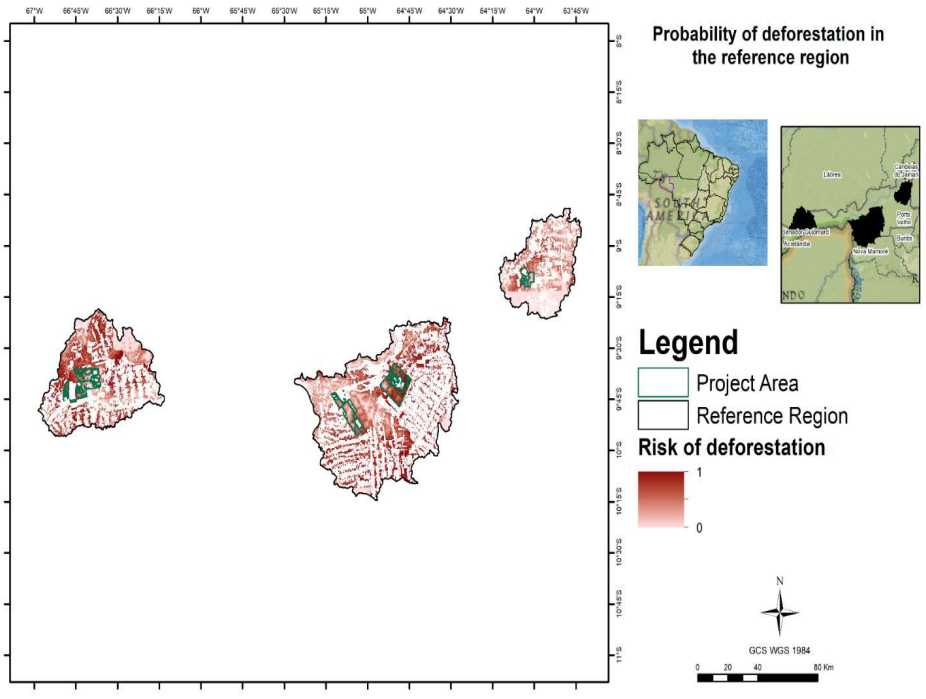


Figure 69. Deforestation risk map



- **Selection of most accurate deforestation risk map**

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

For that, simulations of the deforestation projection were made, taking three dates as reference: 2009, 2014 and 2019. The period of 2009-2014 was used to generate the correlations between the deforested areas and the predictor variables, calculating the adjustment parameters of the models. After that a projection from 2014 to 2019 was made, developing reference region scenario for this date. Therefore, the deforestation map for the period of 2014 to 2019 and two 2019 scenarios, real and projected, were developed. These scenarios were compared regarding the degree of similarity considering the exponential decay. The higher the similarity, the better the prediction of the model. The average similarity values of the models ranged between 0.431 and 0.492, as presented in Table 31.

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 m09). 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 (m10 to m17). Through this procedure it is possible to guarantee that all the best models could be assessed. 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.

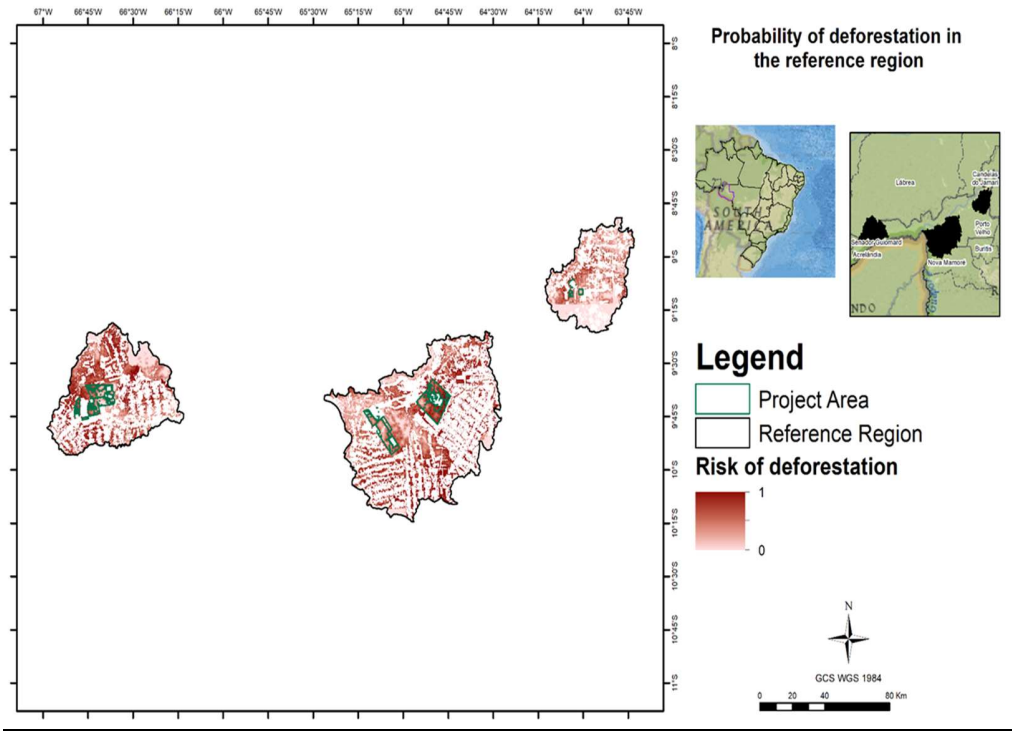
The best model was m17, with an average similarity of 0.492. This model applies all the variables, except for the “Distance to roads”. Thus, it was selected to project the future deforestation.

Table 58. Best deforestation projection models from 2009 to October 2019. Each line corresponds to a model and was evaluated by the degree of Similarity

Model	Similarity 01	Similarity 02	Average	Settlement	TI	UCs	Distance to roads	Distance to rivers	Distance to large rivers	Distance to urban areas	Slope	Altitude
m00	0.541	0.416	0.479	1	1	1	1	1	1	1	1	1
m01	0.543	0.417	0.480	0	1	1	1	1	1	1	1	1
m02	0.532	0.411	0.472	1	0	1	1	1	1	1	1	1
m03	0.537	0.412	0.474	1	1	0	1	1	1	1	1	1
m04	0.561	0.418	0.489	1	1	1	0	1	1	1	1	1
m05	0.531	0.407	0.469	1	1	1	1	0	1	1	1	1
m06	0.529	0.403	0.466	1	1	1	1	1	0	1	1	1
m07	0.526	0.400	0.463	1	1	1	1	1	1	0	1	1
m08	0.535	0.414	0.474	1	1	1	1	1	1	1	0	1
m09	0.526	0.404	0.465	1	1	1	1	1	1	1	1	0
m10	0.489	0.372	0.431	0	0	0	0	0	0	1	0	0
m11	0.504	0.377	0.440	0	0	0	0	0	0	1	0	1
m12	0.515	0.384	0.449	0	0	0	0	0	1	1	0	1
m13	0.526	0.395	0.461	0	0	0	0	1	1	1	0	1
m14	0.556	0.421	0.489	0	1	0	0	1	1	1	0	1
m15	0.560	0.420	0.490	0	1	0	0	1	1	1	1	1
m16	0.562	0.419	0.491	0	1	1	0	1	1	1	1	1
m17	0.564	0.421	0.492	1	1	1	0	1	1	1	1	1

In addition, for the most accurate model and similarity analysis with multiple increasing Windows was Applied, in which for each pixel it looks at a window in the surroundings and compares the degree of accuracy between the simulated map and the map with real deforestation. Therefore, the larger the window, the greater the chance of success. According to Barni, a degree of success above 50% is considered satisfactory, which happens when the window is 11x11 in size.

Figure 70. Deforestation risk map



- Mapping of locations of future deforestation

The mapping of the location of future deforestation until 2050 was carried out through Dinamica Ego. Figures below show the results in the reference region, project area and leakage belt.

Figure 71. Projection of deforestation in the reference region, using Dinamica EGO

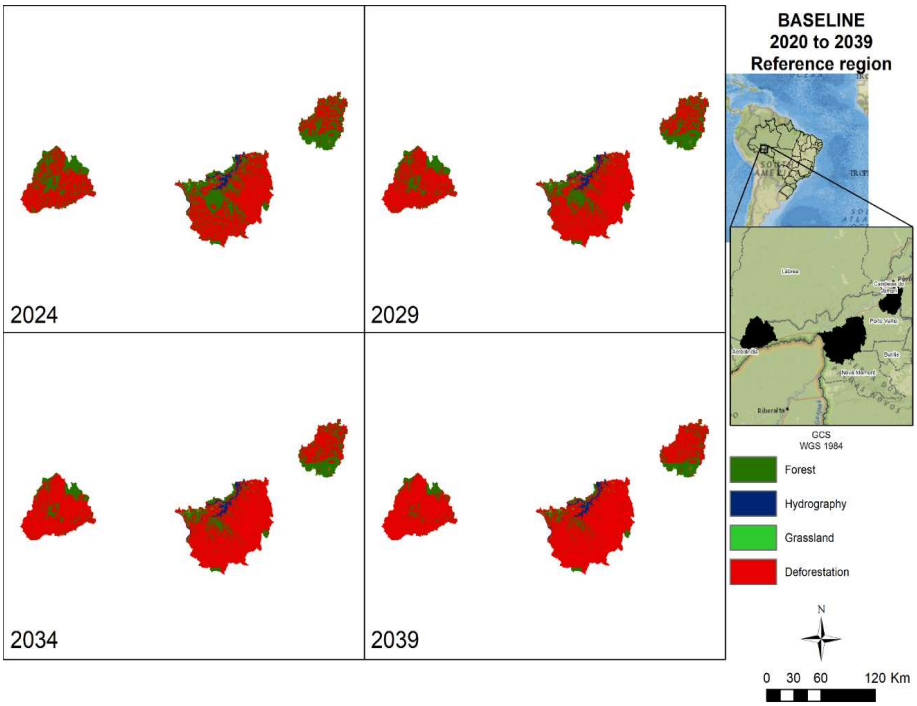


Figure 72. Projection of deforestation in the reference region, using Dinamica EGO

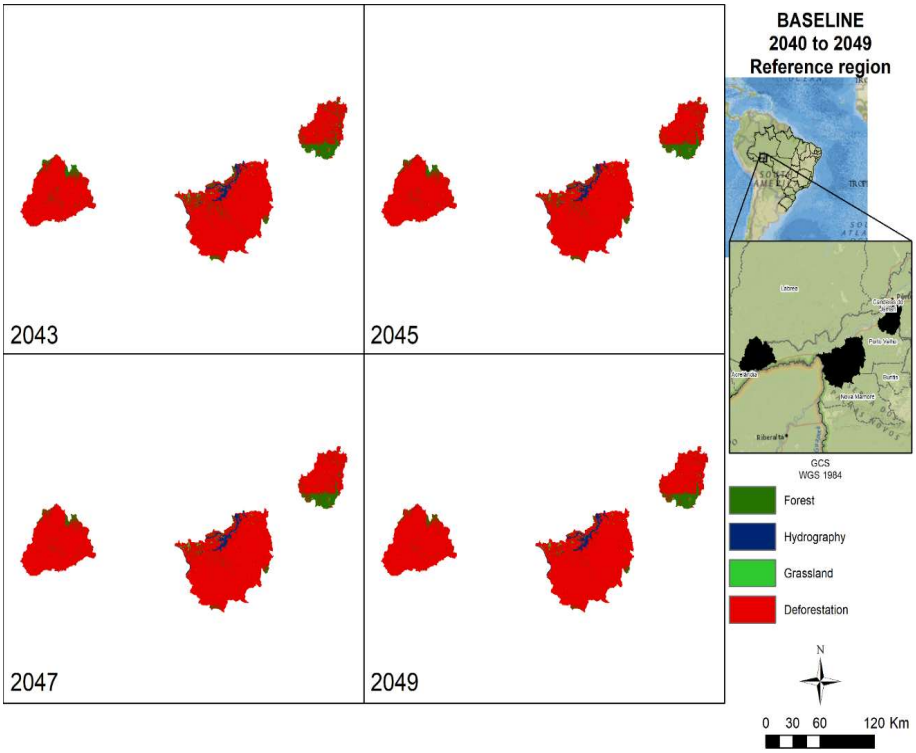


Figure 73. Projection of deforestation in the Project Area, using Dinamica EGO

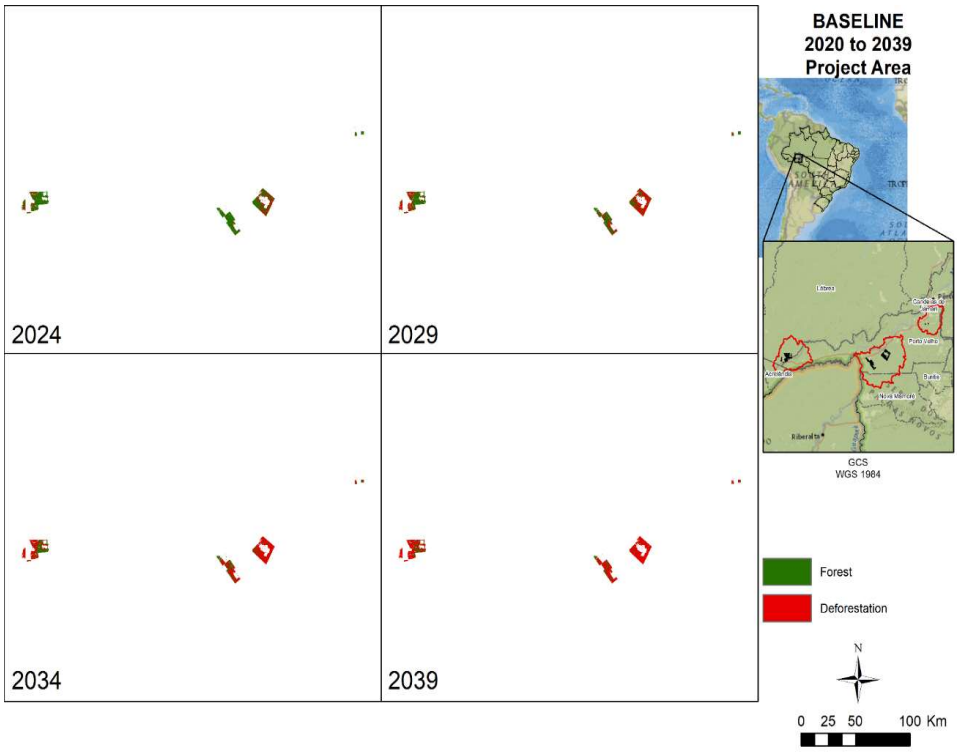


Figure 74. Projection of deforestation in the Project Area, using Dinamica EGO

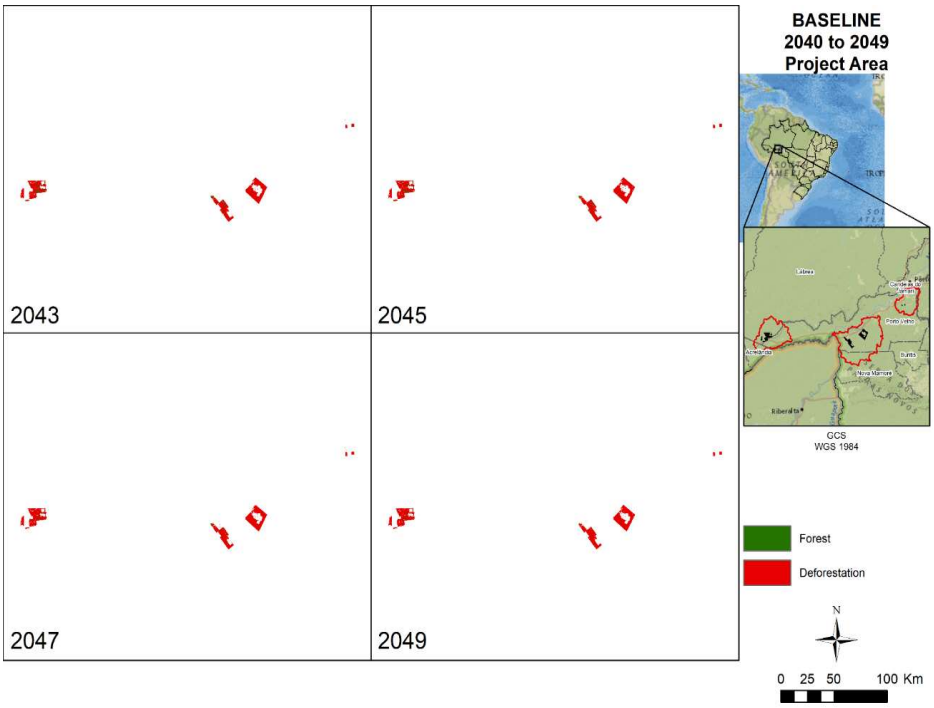


Figure 75. Projection of deforestation in the leakage belt, using Dinâmica EGO

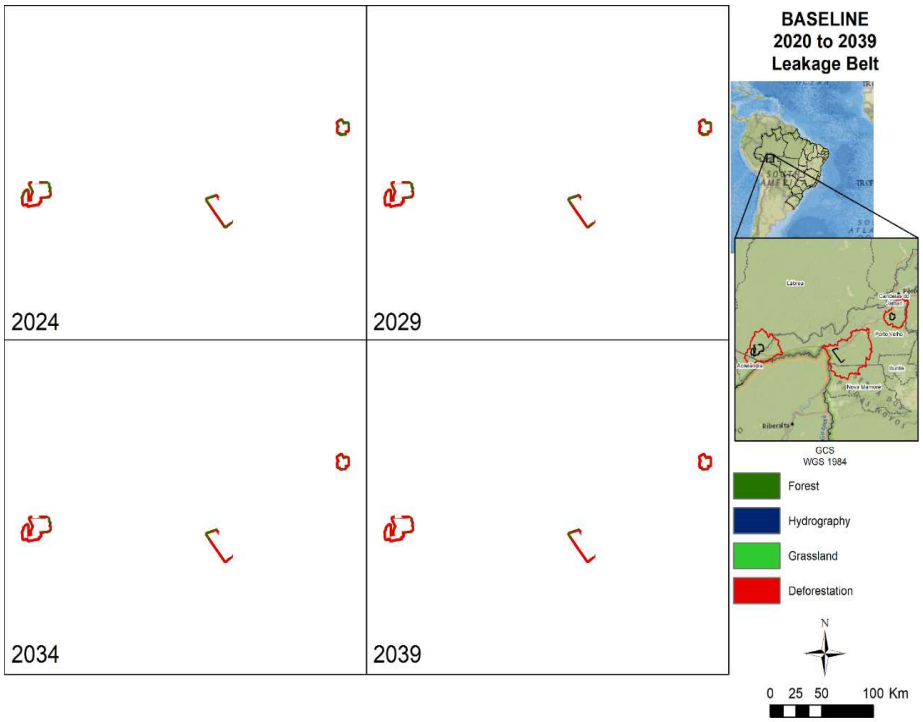


Figure 76. Projection of deforestation in the leakage belt, using Dinâmica EGO

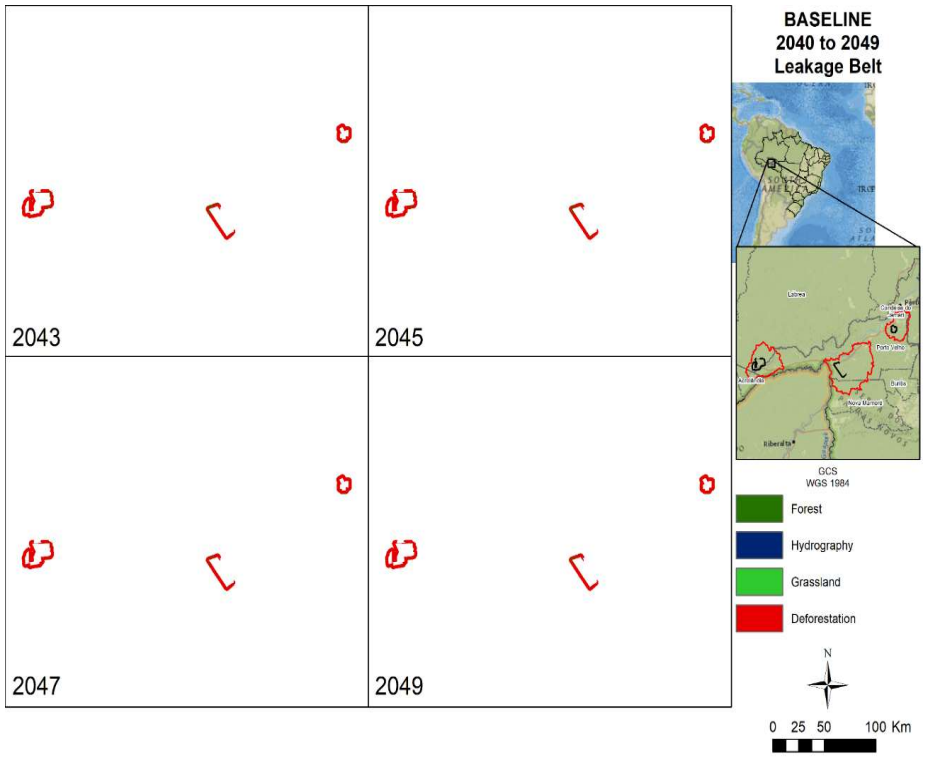


Figure 77. Deforestation projection in the reference region, year by year (2020-2029)

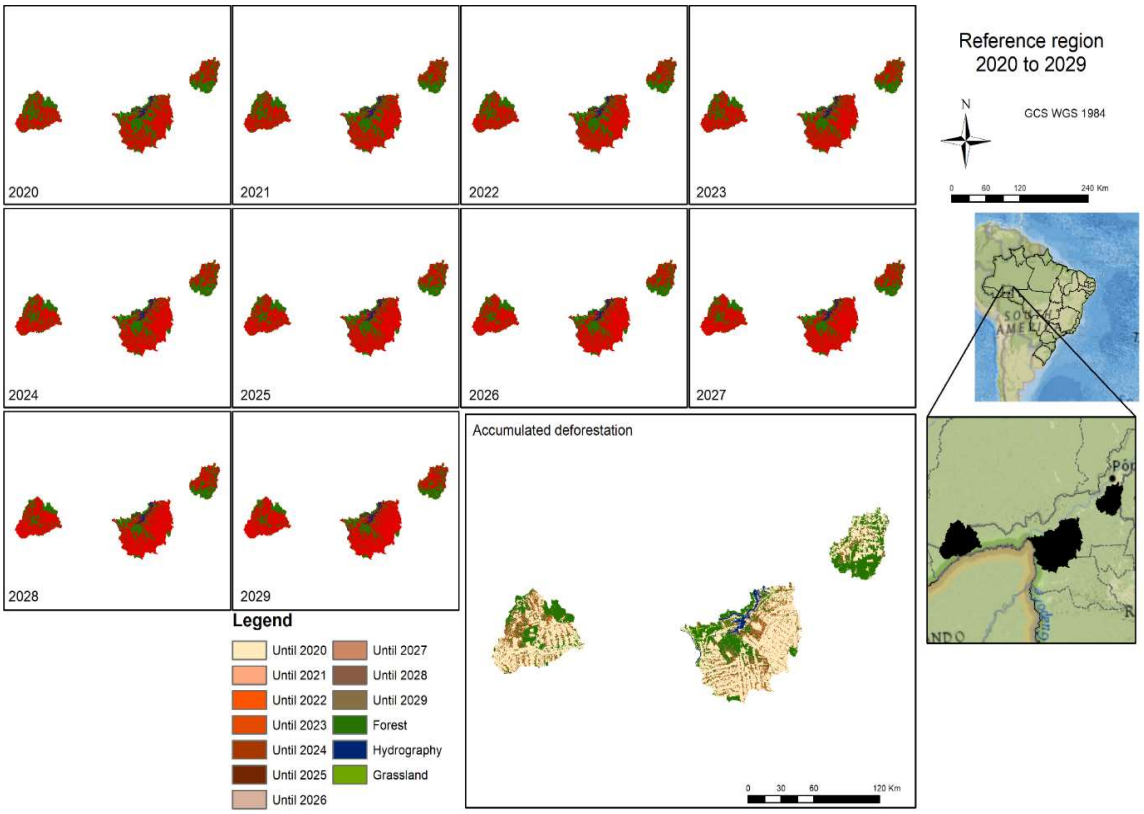


Figure 78. Deforestation projection in the reference region, year by year (2030-2039)

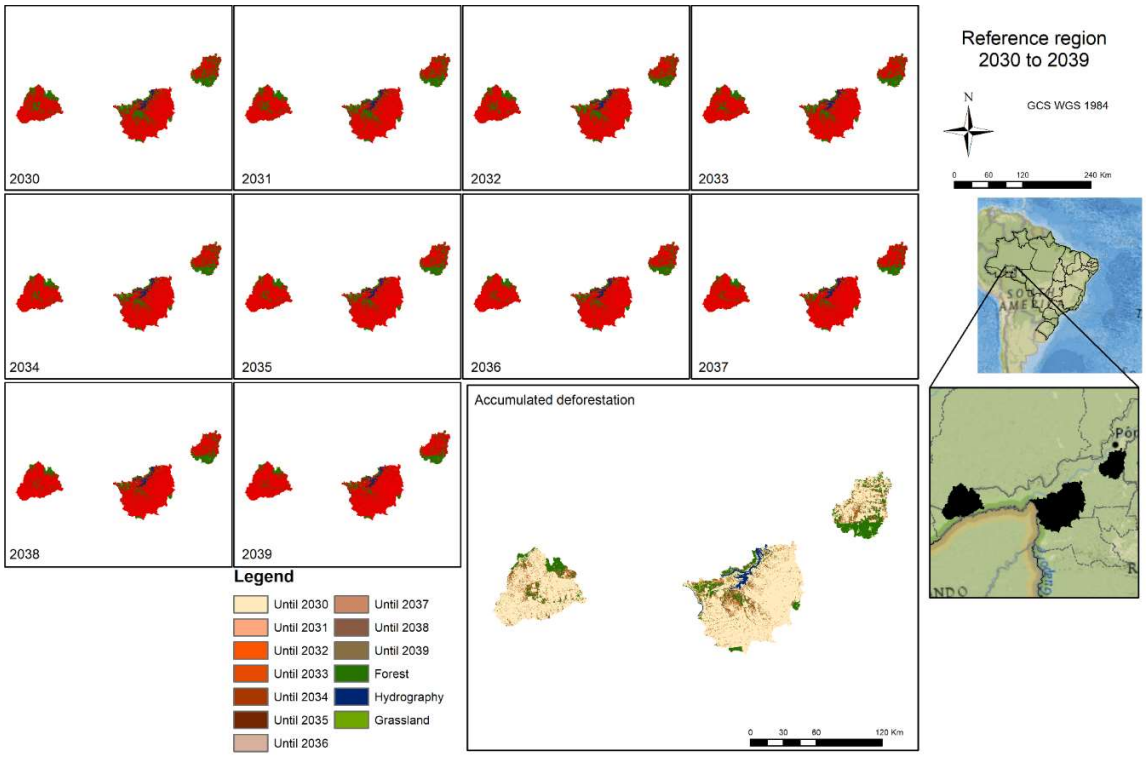


Figure 79. Deforestation projection in the reference region, year by year (2040-2049)

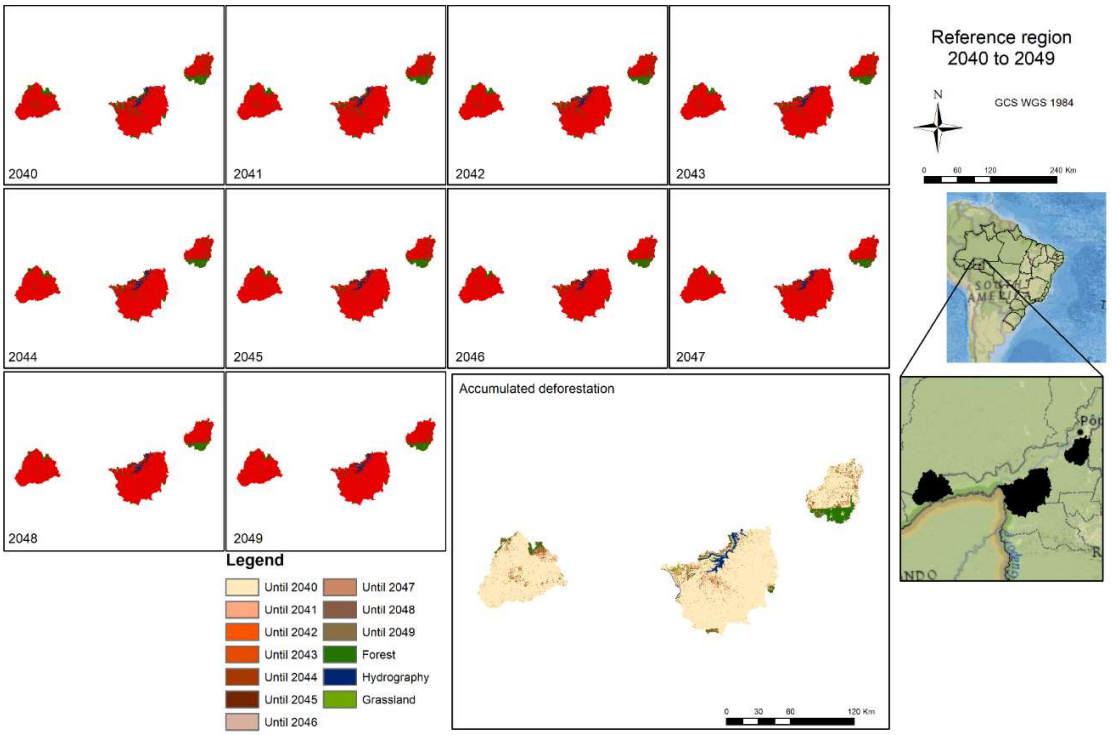


Figure 80. Deforestation projection in the project area, year by year (2020-2029)

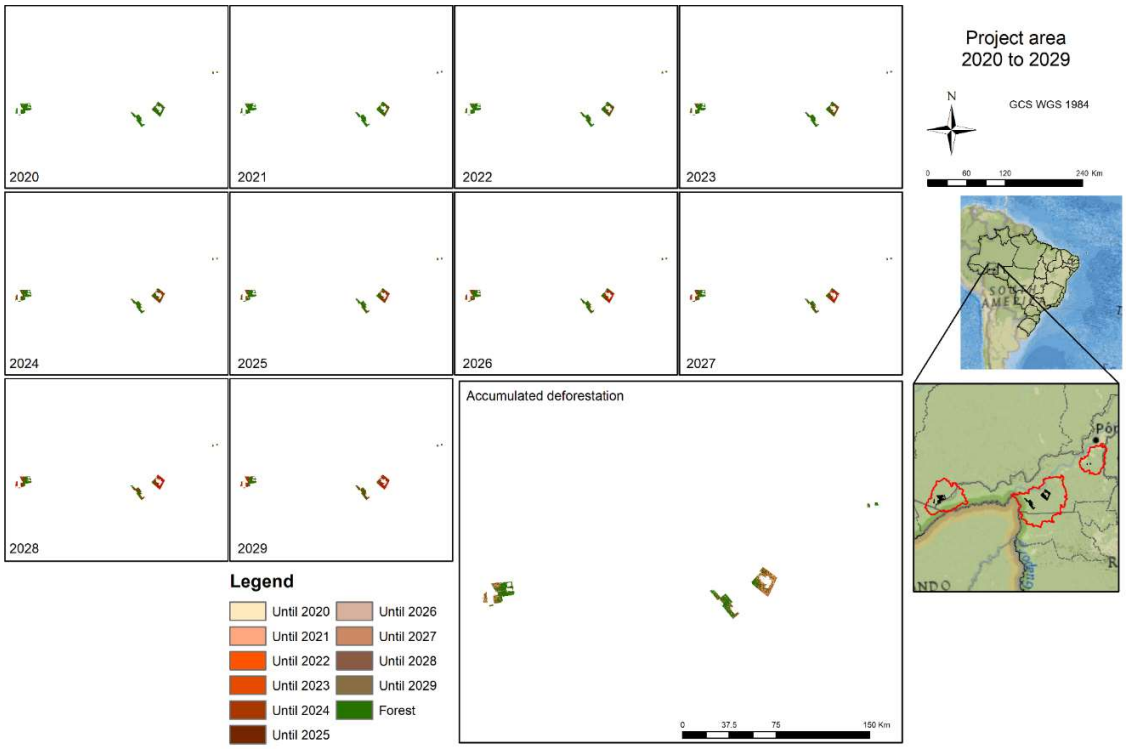


Figure 81. Deforestation projection in the project area, year by year (2030-2039)

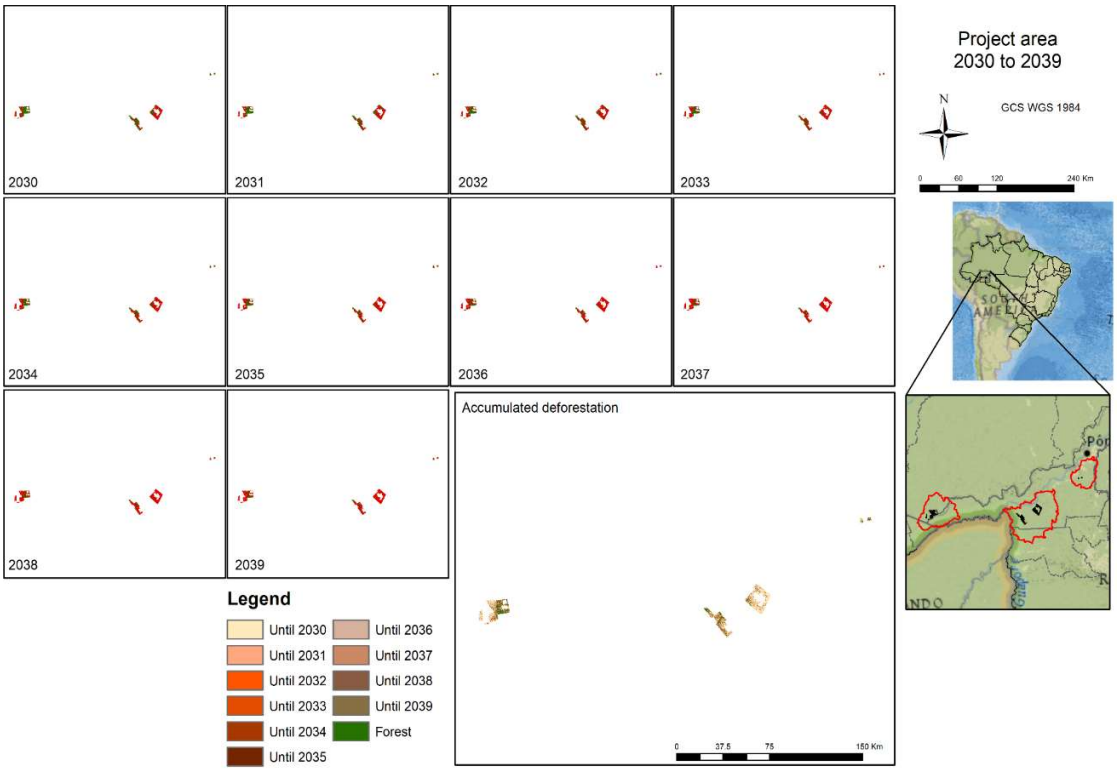


Figure 82. Deforestation projection in the project area, year by year (2040-2049)

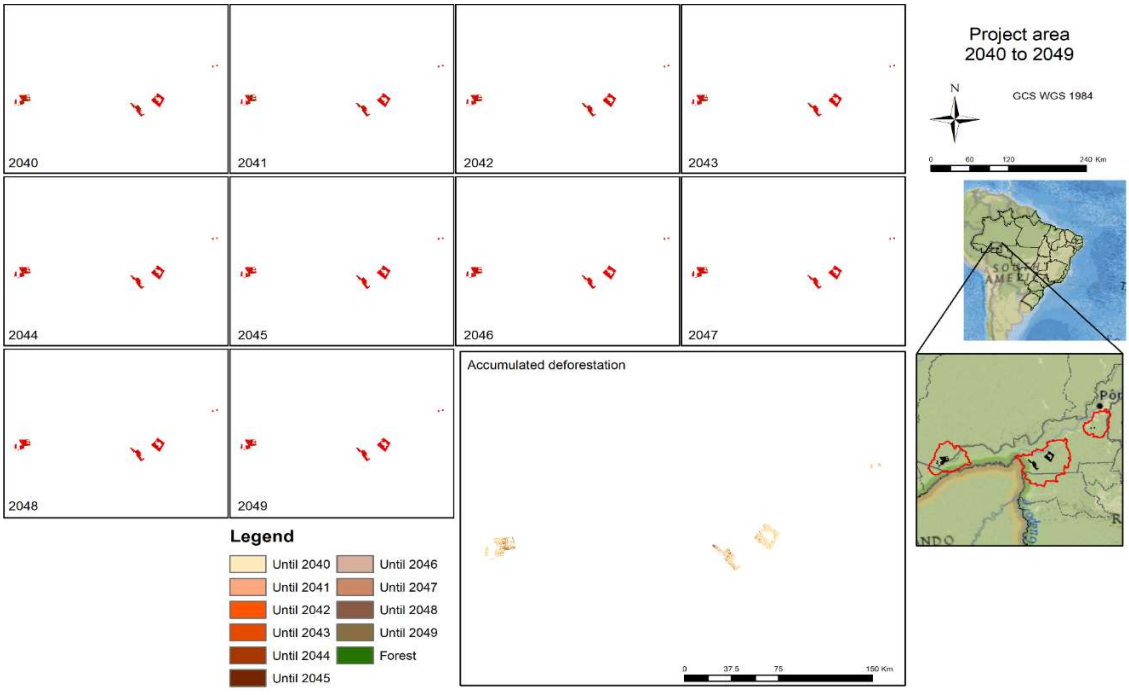


Figure 83. Deforestation projection in the leakage belt, year by year (2021 - 2030)

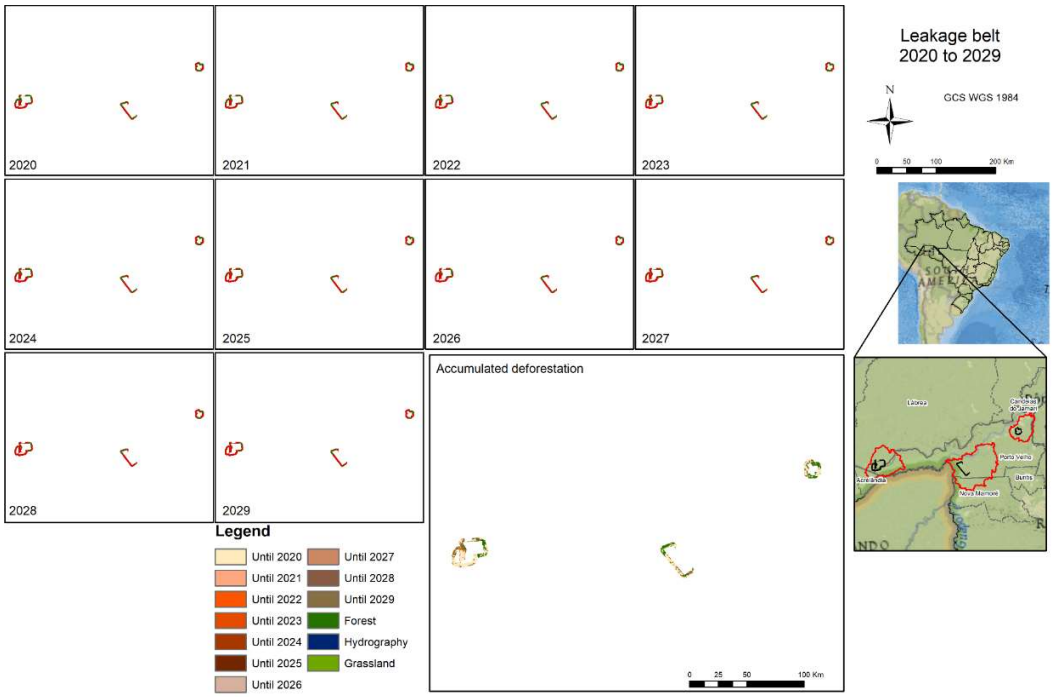


Figure 84. Deforestation projection in the leakage belt, year by year (2030 - 2039)

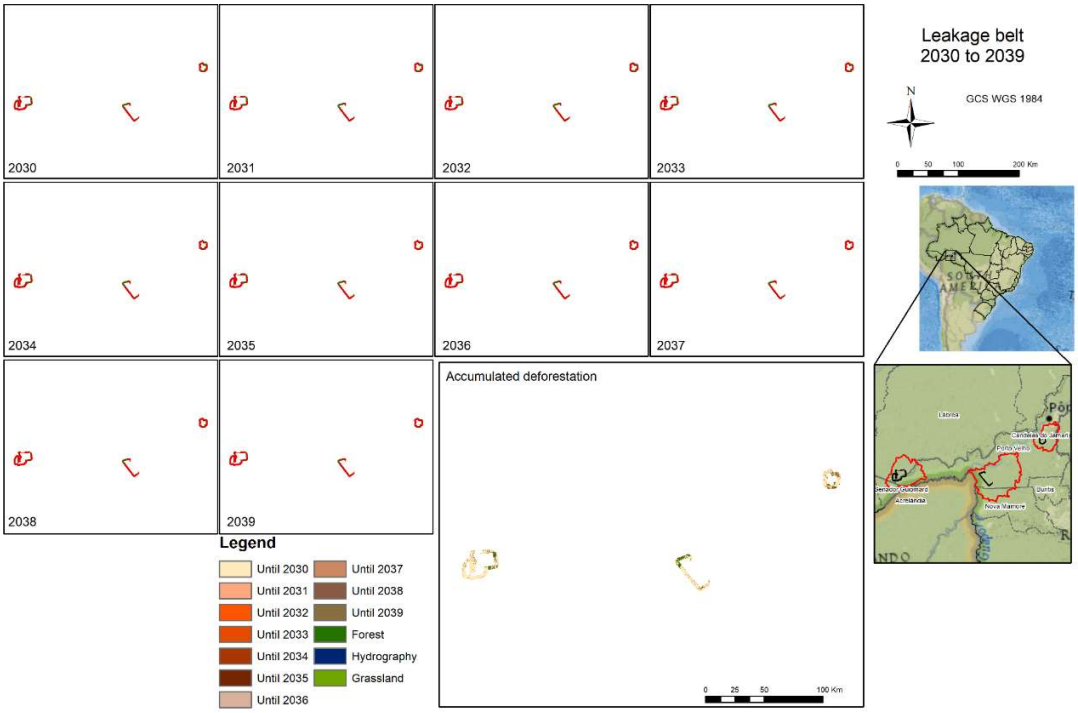
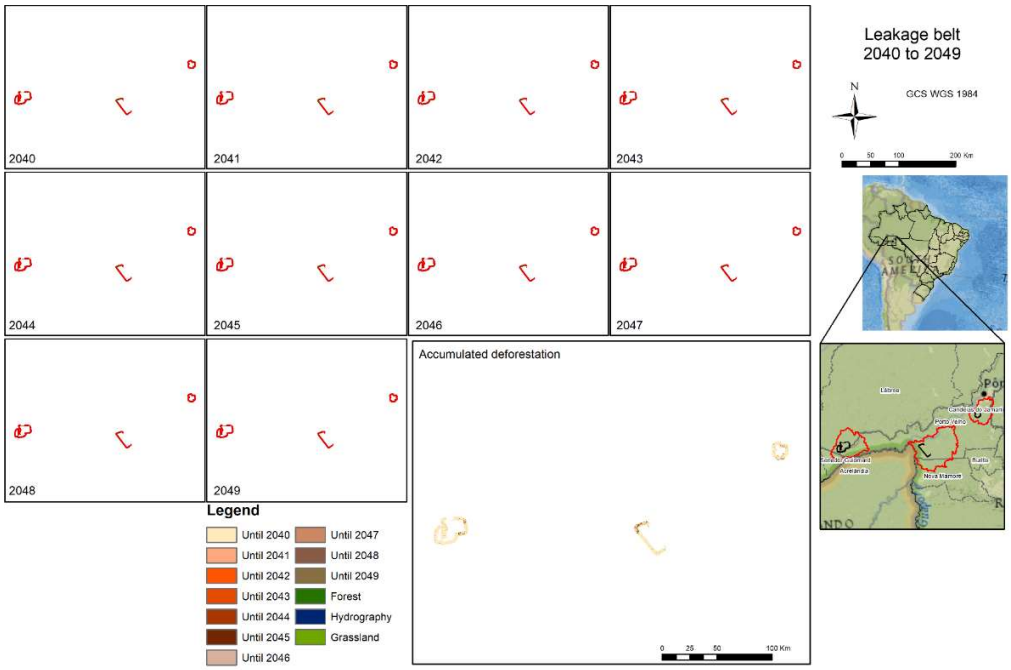


Figure 85. Deforestation projection in the leakage belt, year by year (2040 - 2049)



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

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

In accordance with analysis achieved through the procedure described above, the quantity of baseline LU/LC-change was projected throughout the 1st baseline period, in the reference region, project area and leakage belt in each stratum. This is in accordance with step 5 of the methodology "Definition of the land-use and land-cover change component of the baseline".

- Calculation of baseline activity data per forest class

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

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

Table 59. Annual areas deforested within the reference region in the baseline scenario

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		
2019	4,154.25	4,154.25	4,154.25
2020	21,737.22	21,737.22	25,891.47
2021	21,736.76	21,736.76	47,628.23
2022	21,667.80	21,667.80	69,296.03
2023	21,511.38	21,511.38	90,807.41
2024	21,316.31	21,316.31	112,123.72
2025	21,020.00	21,020.00	133,143.72
2026	20,672.00	20,672.00	153,815.72
2027	20,255.61	20,255.61	174,071.33
2028	19,817.73	19,817.73	193,889.06
2029	19,301.10	19,301.10	213,190.15
2030	18,752.64	18,752.64	231,942.79
2031	18,158.34	18,158.34	250,101.13
2032	17,560.30	17,560.30	267,661.43
2033	16,908.36	16,908.36	284,569.79
2034	16,244.72	16,244.72	300,814.51
2035	15,557.24	15,557.24	316,371.75
2036	14,881.95	14,881.95	331,253.70
2037	14,176.44	14,176.44	345,430.14
2038	13,476.41	13,476.41	358,906.54
2039	12,771.60	12,771.60	371,678.15
2040	12,091.32	12,091.32	383,769.47
2041	11,400.49	11,400.49	395,169.96
2042	10,727.93	10,727.93	405,897.88
2043	10,064.96	10,064.96	415,962.84
2044	9,433.99	9,433.99	425,396.83
2045	8,807.17	8,807.17	434,204.01
2046	8,206.28	8,206.28	442,410.28
2047	7,624.09	7,624.09	450,034.37
2048	7,076.86	7,076.86	457,111.24
2049	5,367.17	5,367.17	462,478.41

Table 60. Annual areas deforested per instance within the project area in the baseline scenario

Area deforested per florest class icl within the project area				Total baseline deforestation in the project area	
IDicl	1	1	1	annual ABSLPAt (ha)	ABSLPA cumulative (ha)
Name	Grupo Rovema	Grupo Tupá	Grupo Leite		
Project year *t*	ha	ha	ha		
2019	167.16	0.00	0.00	167.16	167.16
2020	926.37	355.62	60.77	1,342.77	1,509.93
2021	1,159.14	422.24	92.01	1,673.39	3,183.31
2022	1,224.50	455.08	132.01	1,811.59	4,994.90
2023	1,222.65	521.02	164.25	1,907.92	6,902.82
2024	1,138.63	575.00	243.35	1,956.99	8,859.81
2025	1,113.23	599.78	331.13	2,044.13	10,903.95
2026	1,059.33	610.89	412.03	2,082.25	12,986.20
2027	963.69	647.38	529.21	2,140.27	15,126.47
2028	879.83	646.02	633.98	2,159.83	17,286.31
2029	811.10	677.92	664.13	2,153.15	19,439.46
2030	774.03	719.19	677.35	2,170.57	21,610.03
2031	654.29	698.69	715.85	2,068.83	23,678.86
2032	598.25	693.89	644.61	1,936.75	25,615.61
2033	508.64	672.02	598.70	1,779.36	27,394.96
2034	451.75	674.44	518.77	1,644.96	29,039.92
2035	403.65	688.25	483.43	1,575.32	30,615.25
2036	318.09	641.05	463.91	1,423.06	32,038.30
2037	271.89	572.66	413.98	1,258.53	33,296.83
2038	242.59	550.14	378.66	1,171.39	34,468.22
2039	196.21	518.93	318.63	1,033.77	35,501.99
2040	187.48	471.16	289.62	948.26	36,450.25
2041	149.88	411.21	257.55	818.64	37,268.88
2042	120.07	359.59	230.55	710.21	37,979.09
2043	99.59	316.26	220.67	636.52	38,615.61
2044	98.03	265.37	172.43	535.84	39,151.44
2045	78.14	214.67	177.34	470.14	39,621.59
2046	69.27	189.71	124.85	383.82	40,005.41
2047	52.16	163.72	107.22	323.10	40,328.51
2048	47.66	136.36	98.38	282.40	40,610.91
2049	34.82	91.20	65.32	191.34	40,802.24

Table 61. Annual areas deforested within the leakage belt in the baseline scenario

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		
2019	144.36	144.36	144.36
2020	779.17	779.17	923.53
2021	883.43	883.43	1,806.96
2022	918.13	918.13	2,725.09
2023	1,000.98	1,000.98	3,726.07
2024	1,007.48	1,007.48	4,733.55
2025	979.59	979.59	5,713.14
2026	978.89	978.89	6,692.03
2027	964.31	964.31	7,656.34
2028	918.34	918.34	8,574.68
2029	933.93	933.93	9,508.61
2030	911.81	911.81	10,420.42
2031	919.90	919.90	11,340.32
2032	898.93	898.93	12,239.25
2033	849.35	849.35	13,088.60
2034	828.15	828.15	13,916.76
2035	766.92	766.92	14,683.68
2036	742.47	742.47	15,426.15
2037	725.17	725.17	16,151.32
2038	670.08	670.08	16,821.39
2039	672.03	672.03	17,493.43
2040	609.71	609.71	18,103.14
2041	545.82	545.82	18,648.96
2042	511.39	511.39	19,160.36
2043	460.66	460.66	19,621.02
2044	406.88	406.88	20,027.89
2045	371.88	371.88	20,399.77
2046	335.52	335.52	20,735.29
2047	290.84	290.84	21,026.14
2048	257.06	257.06	21,283.19
2049	182.98	182.98	21,466.17

- **Calculation of baseline activity data per post deforestation forest class**

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

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

Table 62. 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	863,594.19	77%	863,594.19	77%
Total area of each class *fcl*		863,594.19	77%	863,594.19	77%

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 63. Annual areas deforested in the Reference Region in the baseline case

Area established after deforestation per zone within the reference region		Total baseline deforestation in the reference region	
ID_{fcl}	1	$ABSLRR_t$	$ABSLRR$
Name	Non forest	annual	cumulative
Project year	ha	ha	ha
2019	4,154.25	4,154.25	4,154.25
2020	21,737.22	21,737.22	25,891.47
2021	21,736.76	21,736.76	47,628.23
2022	21,667.80	21,667.80	69,296.03
2023	21,511.38	21,511.38	90,807.41
2024	21,316.31	21,316.31	112,123.72
2025	21,020.00	21,020.00	133,143.72
2026	20,672.00	20,672.00	153,815.72
2027	20,255.61	20,255.61	174,071.33
2028	19,817.73	19,817.73	193,889.06
2029	19,301.10	19,301.10	213,190.15
2030	18,752.64	18,752.64	231,942.79
2031	18,158.34	18,158.34	250,101.13
2032	17,560.30	17,560.30	267,661.43
2033	16,908.36	16,908.36	284,569.79
2034	16,244.72	16,244.72	300,814.51
2035	15,557.24	15,557.24	316,371.75
2036	14,881.95	14,881.95	331,253.70
2037	14,176.44	14,176.44	345,430.14
2038	13,476.41	13,476.41	358,906.54
2039	12,771.60	12,771.60	371,678.15
2040	12,091.32	12,091.32	383,769.47
2041	11,400.49	11,400.49	395,169.96
2042	10,727.93	10,727.93	405,897.88
2043	10,064.96	10,064.96	415,962.84
2044	9,433.99	9,433.99	425,396.83
2045	8,807.17	8,807.17	434,204.01
2046	8,206.28	8,206.28	442,410.28
2047	7,624.09	7,624.09	450,034.37
2048	7,076.86	7,076.86	457,111.24
2049	5,367.17	5,367.17	462,478.41

Table 64. Annual areas deforested within the Project Area in the baseline case

Area established after deforestation per zone within the project area		Total baseline deforestation in the project area	
ID_{fcl}	1	$ABSLPA_t$	$ABSLPA$
Name	Non forest	annual	cumulative
Project year	ha	ha	ha
2019	167.16	167.16	167.16
2020	1,342.77	1,342.77	1,509.93
2021	1,673.39	1,673.39	3,183.31
2022	1,811.59	1,811.59	4,994.90
2023	1,907.92	1,907.92	6,902.82
2024	1,956.99	1,956.99	8,859.81
2025	2,044.13	2,044.13	10,903.95
2026	2,082.25	2,082.25	12,986.20
2027	2,140.27	2,140.27	15,126.47
2028	2,159.83	2,159.83	17,286.31
2029	2,153.15	2,153.15	19,439.46
2030	2,170.57	2,170.57	21,610.03
2031	2,068.83	2,068.83	23,678.86
2032	1,936.75	1,936.75	25,615.61
2033	1,779.36	1,779.36	27,394.96
2034	1,644.96	1,644.96	29,039.92
2035	1,575.32	1,575.32	30,615.25
2036	1,423.06	1,423.06	32,038.30
2037	1,258.53	1,258.53	33,296.83
2038	1,171.39	1,171.39	34,468.22
2039	1,033.77	1,033.77	35,501.99
2040	948.26	948.26	36,450.25
2041	818.64	818.64	37,268.88
2042	710.21	710.21	37,979.09
2043	636.52	636.52	38,615.61
2044	535.84	535.84	39,151.44
2045	470.14	470.14	39,621.59
2046	383.82	383.82	40,005.41
2047	323.10	323.10	40,328.51
2048	282.40	282.40	40,610.91
2049	191.34	191.34	40,802.24

Table 65. Annual areas deforested within the Leakage Belt in the baseline case

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
2019	144.36	144.36	144.36
2020	779.17	779.17	923.53
2021	883.43	883.43	1,806.96
2022	918.13	918.13	2,725.09
2023	1,000.98	1,000.98	3,726.07
2024	1,007.48	1,007.48	4,733.55
2025	979.59	979.59	5,713.14
2026	978.89	978.89	6,692.03
2027	964.31	964.31	7,656.34
2028	918.34	918.34	8,574.68
2029	933.93	933.93	9,508.61
2030	911.81	911.81	10,420.42
2031	919.90	919.90	11,340.32
2032	898.93	898.93	12,239.25
2033	849.35	849.35	13,088.60
2034	828.15	828.15	13,916.76
2035	766.92	766.92	14,683.68
2036	742.47	742.47	15,426.15
2037	725.17	725.17	16,151.32
2038	670.08	670.08	16,821.39
2039	672.03	672.03	17,493.43
2040	609.71	609.71	18,103.14
2041	545.82	545.82	18,648.96
2042	511.39	511.39	19,160.36
2043	460.66	460.66	19,621.02
2044	406.88	406.88	20,027.89
2045	371.88	371.88	20,399.77
2046	335.52	335.52	20,735.29
2047	290.84	290.84	21,026.14
2048	257.06	257.06	21,283.19
2049	182.98	182.98	21,466.17

Calculation of baseline emissions

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

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

Where,

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

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

Where,

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

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

$$\Delta CBSLPAt = \Delta CabBSLPAicl,t + \Delta CbbBSLPAicl,t$$

Where,

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

$$\Delta C_{abBSLPAicl,t} = ABSLPA_{icl,t} * \Delta C_{abicl}$$

Where,

$\Delta C_{abBSLPAicl,t}$	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
ΔC_{abicl}	Average carbon stock change factor per hectare in the above-ground biomass carbon pool of initial forest class icl; $tCO_2e\ ha^{-1}$

$$\Delta C_{bbBSLPAicl,t} = ABSLPA_{icl,t} * \Delta C_{bbicl}$$

Where,

$\Delta C_{bbBSLPAicl,t}$	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
ΔC_{bbicl}	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, 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 is 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 is sampled from good coverage of the classes over which they will be extrapolated.

The Open Submontane Tropical Rainforest and the Open Tropical Rainforest are the main forest type present within the project area, with around 74% of the total forest cover. In addition, the mean biomass stock within the project area calculated through weighted average corresponds to 302.72 Mg/ha, while the predominant forest classes are 294.16 Mg/ha, a high similarity around 97%. Thus, due to the high representativeness of this forest types within the project area, and the very high similarity in terms of biomass stock in relation to the mean, the forest class was not stratified, i.e., the "Forest" class included only one stratum due to the low difference in average biomass stocks within the project area.

In order to be conservative, the weighted average biomass stocks will not be used, thus it will be adopted the biomass stock value for Open tropical rainforest and Open Submontane Tropical Rainforest (294.16 Mg/ha). It is also important to note that the study for the predominant forest classes within PA was conducted in Rondônia State, in a region close to the project area. Thus, using the Open Tropical Rainforest and Open Submontane Tropical Rainforest biomass stock values can be considered reasonable and conservative.

Thus, carbon stocks were calculated on the basis of biomass values from the study from Silva, 2014[223]. The study fulfills the criteria mentioned above.

The data will be updated and may be stratified if new and more updated references for the 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 the study is summarized below:

[223] SILVA, Jéssika Luane. Danos florestais e estimativa da redução no estoque de carbono em áreas de manejo florestal sob concessão pública: Floresta Nacional do Jamari. 2014. Disertação (mestrado) - INPA, Manaus, 2014. Available at: <https://repositorio.inpa.gov.br/handle/1/5065>. Last visit on 09/December/2022.

SILVA, Jéssika Luane. Danos florestais e estimativa da redução no estoque de carbono em áreas de manejo florestal sob concessão pública: Floresta Nacional do Jamari. 2014.[224]

The research was carried out at the Unit Conservation named Floresta Nacional do Jamari, also located in the State of Rondônia. The purpose was to evaluate forest damage and the reduction of aboveground biomass (AGB) and carbon (C) stock resulting from forest management applied in areas under public concession. It also detailed in the study that the main forest classes within Floresta Nacional do Jamari are the Open Submontane Tropical Rainforest (Floresta Ombrófila Aberta Submontana) and Dense Tropical Rainforest (Floresta Ombrófila Densa Submontana) (IBGE, 2006).

Estimates were made in terms of installation of logging infrastructure (roads, patios, drag branches and clearings), forest damage and reduction of AGB and C stock in the areas of the Annual Production Unit (UPA) 1 of the Forest Management Units (FMUs) I and III. Data collection on damage, canopy openness, diameter at breast height (DBH) and botanical identification of species was carried out in 72 plots (36 in each FMU, 9 in each type of infrastructure).

The aboveground biomass estimate of each individual was performed using the equation proposed by Chave et al. (2005) and used by Mazzei et al. (2010) as follows:

$$AGB = \rho * exp\,(-1{,}499 + 2{,}148\ ln(DAP) + 0{,}207\ (ln(DAP))^2 - 0{,}0281\ (ln(DAP))^3)$$

where:

AGB = above ground biomass (kg)
ρ = wood density (g/cm^3)
DAP = diameter at breast high (DBH)

In this research, estimates of belowground biomass and necro mass (dead biomass) were not contemplated. The equation above was chosen because it requires DBH as an independent variable, which is easy to measure in the field and reduces sampling error (HIGUCHI et al., 1998) and considers the wood density value, an important variable for the improvement of the estimated loss in inventory of carbon from interventions in forests (CHAVE et al., 2005; FEARNSIDE, 1997b; NOGUEIRA et al., 2007).

The carbon estimate stored in the trees' biomass was obtained based on the water and carbon contents in the tree and its components (thick branch, thin branch, trunk, leaf, flower and/or fruit), already existing and established by Higuchi and Carvalho Jr. (1994) and Fearnside (2009). Thus, the carbon pool does not consider the non-tree above biomass as defined in section 3.3, item carbon pools.

[224] SILVA, Jéssika Luane. Danos florestais e estimativa da redução no estoque de carbono em áreas de manejo florestal sob concessão pública: Floresta Nacional do Jamari. 2014. Disertação (mestrado) - INPA, Manaus, 2014. Available at: <https://repositorio.inpa.gov.br/handle/1/5065>. Last visit on 09/December/2022.

After the logging activities and applying the method summarized above, the above ground biomass stock reduced from 384 to 294.16 Mg.ha-1 +- 5.47. Thus, the biomass stock adopted for the forest classes Open Submontane Tropical Rainforest and Dense Tropical Rainforest is 294.16 Mg.ha-1. 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 the following table were used. Regarding the factor (0.48) utilized to convert from biomass to carbon, it can be considered consistent since such conversion factor was used by Silva (2014), which is the adopted reference for carbon stock for the Rio Madeira REDD+ Project. Moreover, this study was carried out in the State of Rondônia (southern Amazon), where properties are located. In addition, Silva (2014) is more recent when compared to IPCC (2003) or IPCC (2006). Furthermore, the National Forestry Service (SNIF)[225] reinforces the adoption of 0.48 as conservative conversion factor since SNIF informs carbon represents 50% of biomass.

Table 66. Biomass to CO2 conversion factors

Conversion Factors***	
Biomass to Carbon[226]	0.48
C to CO_2[227]	3.6667

[225] Available at https://snif.florestal.gov.br/pt-br/estoques-das-florestas/162-florestas-e-recursos-florestais/dados-complementares-estoques-das-florestas Last visit on 23/May/2023

[226] SILVA, Jéssika Luane. Danos florestais e estimativa da redução no estoque de carbono em áreas de manejo florestal sob concessão pública: Floresta Nacional do Jamari. 2014. Disertação (mestrado) - INPA, Manaus, 2014. Available at: <https://repositorio.inpa.gov.br/handle/1/5065>. Last visit on 09/December/2022

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

Table 67. Biomass values used for the "forest" classes within the reference region

REFERENCE REGION										
Forest class	% of the RR	Aboveground*			Belowground**			TOTAL		
		Biomass (Mg ha^{-1})	Biomass to Carbon (tC/ha)	Cab_{icl} (tCO_2/ha)	Biomass (Mg ha^{-1})	Biomass to Carbon (tC/ha)	Cbb_{icl} (tCO_2/ha)	Total biomass (Mg ha^{-1})	Biomass to Carbon (tC/ha)	$Ctot_{icl}$ (tCO_2/ha)
Dense Submontane Tropical Rainforest	23.88%	327.40	157.15	576.22	78.58	37.72	138.29	405.98	194.87	714.52
Dense Tropical Rainforest	9.72%	327.40	157.15	576.22	78.58	37.72	138.29	405.98	194.87	714.52
Open Tropical Rainforest	31.11%	294.16	141.20	517.73	70.60	33.89	124.25	364.76	175.09	641.99
Open Submontane Tropical Rainforest	32.37%	294.16	141.20	517.73	70.60	33.89	124.25	364.76	175.09	641.99
Seasonal Parkland Savannah	1.77%	13.92	6.68	24.49	2.78	1.34	4.90	16.70	8.02	29.39
Open Alluvial Tropical Rainforest	0.05%	234.85	112.73	413.34	56.37	27.06	99.20	291.22	139.79	512.55
Seasonal Forested Savannah	0.56%	69.40	33.31	122.14	13.88	6.66	24.43	83.28	39.97	146.56
Dense Alluvial Tropical Rainforest	0.38%	273.13	131.10	480.70	65.55	31.46	115.37	338.68	162.56	596.07
Contact between Savannah and Rainforest	0.16%	49.63	23.82	87.34	9.93	4.76	17.47	59.55	28.58	104.81
Weighted average		**298.60**	**143.33**	**525.54**	**71.63**	**34.38**	**126.08**	**370.23**	**177.71**	**651.61**

Table 68. Biomass values used for the "forest" classes within the Project area

PROJECT AREA										
Forest class	% of PA	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)
Dense Submontane Tropical Rainforest	25.2%	327.40	157.15	576.22	78.58	37.72	138.29	405.98	194.87	714.52
Dense Tropical Rainforest	0.6%	327.40	157.15	576.22	78.58	37.72	138.29	405.98	194.87	714.52
Open Tropical Rainforest	36.0%	294.16	141.20	517.73	70.60	33.89	124.25	364.76	175.09	641.99
Open Submontane Tropical Rainforest	38.2%	294.16	141.20	517.73	70.60	33.89	124.25	364.76	175.09	641.99
Weighted average		**302.73**	**145.31**	**532.82**	**72.66**	**34.88**	**127.88**	**375.39**	**180.19**	**660.70**

Table 69. Biomass values used for the "forest" classes within the Leakage belt

LEAKAGE BELT										
Forest class	% of LB	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)
Dense Submontane Tropical Rainforest	17.0%	327.40	157.15	576.22	78.58	37.72	138.29	405.98	194.87	714.52
Dense Tropical Rainforest	18.3%	327.40	157.15	576.22	78.58	37.72	138.29	405.98	194.87	714.52
Open Tropical Rainforest	38.0%	294.16	141.20	517.73	70.60	33.89	124.25	364.76	175.09	641.99
Open Submontane Tropical Rainforest	25.5%	294.16	141.20	517.73	70.60	33.89	124.25	364.76	175.09	641.99
Seasonal Parkland Savannah	1.2%	13.92	6.68	24.49	2.78	1.34	4.90	16.70	8.02	29.39
Weighted average		**302.45**	**145.18**	**532.31**	**72.58**	**34.84**	**127.74**	**375.03**	**180.01**	**660.05**

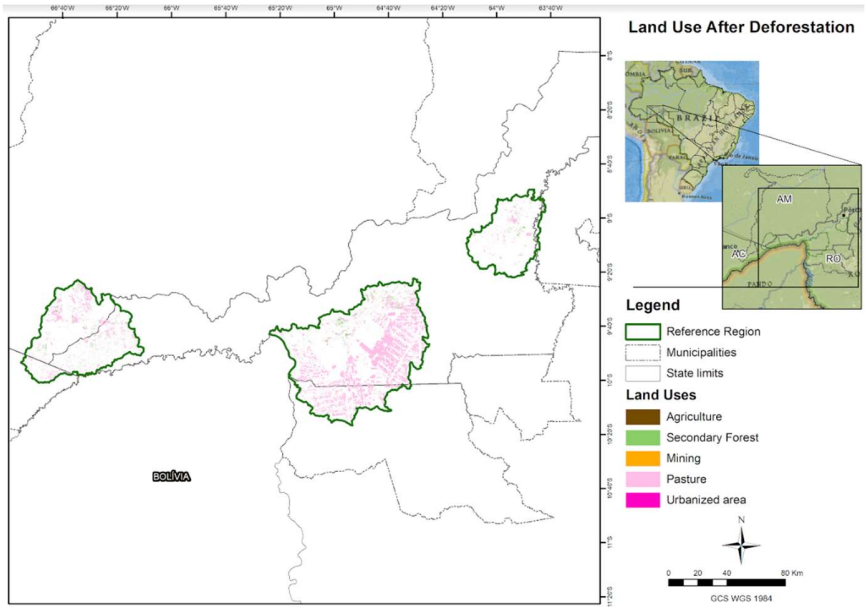
Average carbon stocks of post-deforestation classes

The average classification of post-deforestation land-uses within the reference region during the historical reference period (2009-2019) was conducted through MapBiomas, which is detailed below:

Land Use	Area (%)
Pasturelands	87.22%
Secondary Forests	12.76%
Agriculture	0.01%
Minning	0.00%
Urban Area	0.00%

Therefore, most of the post-deforestation land uses within the reference region is composed by pasturelands, with more than 87%, as available in the following image:

Figure 86. Post-deforestation land use within reference region



In order to estimate the post-deforestation carbon stocks, the average carbon stocks of pasturelands, agriculture and other land uses were taken from the National GHG Emissions Communication of Brazil to the UNFCCC (2019)[228].

For secondary forests, a regional study was conducted. Most secondary forests in the Brazilian Amazon are young. In 2017, 65% of secondary forests was ≤10 years old. On average, 35% of annual land abandonment to secondary forests was re-cleared within 5 years, and 57% within

[228] Available at: <https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/publicacoes/comunicacoes-nacionais-do-brasil-a-unfccc/arquivos/3tcn_volume_3.pdf>

10 years[229]. The half-life of secondary forests is 8 years, on average, which is also the same value found by other study that concludes that more than 50% of the secondary forests in the Amazon biome have less than 8 years old[230].

According to a study conducted in the Amazon Forest that analyzed the carbon stocks of a secondary forest with 14 years old, the average carbon stock in above ground biomass is around 19 tC/ha[231]. Below ground biomass was estimated through the root-to-shoot ratio from the applied methodology. Therefore, the average value for secondary forests is around 22.8 tC/ha.

It was also considered the uncertainties involved in the mentioned studies, according to the adopted methodology. Thus, the post-deforestation carbon stock with after discounts due to uncertainty was applied. It is worth highlighting that, according to the adopted methodology, if uncertainty is higher than 10%, the lower boundary of the 90% confidence interval should be considered for final non-forest class in the leakage belt. In the other hand, the same error condition implies that the higher boundary of the 90% confidence interval should be considered for final non-forest class in the project area, as follows:

Table 70. Average post-deforestation carbon stock +-90% CI

Land Use	Average post-deforestation carbon stock +-90% CI			
	Estimated carbon stock (tCO_2e/ha)	Uncertainty (tCO_2e/ha)	$Ctot_{fcl}$ +90% (within PA)	$Ctot_{fcl}$ -90% (within LB)
Pasturelands	27.76	7.45	35.21	20.30
Secondary Forests	83.59	4.04	83.59	83.59
Agriculture	77.00	20.68	97.68	56.32
Minning	0.00	0.00	0.00	0.00
Urban Area	0.00	0.00	0.00	0.00

Therefore, the weighted average carbon stock is summarized at the following Table.

Table 71. Weighted average post-deforestation carbon stock

Land Use	Area (%)	$Ctot_{fcl}$ +90% (within PA)	$Ctot_{fcl}$ -90% (within LB)
Pasturelands	87.22%	35.21	20.30
Secondary Forests	12.76%	83.59	83.59
Agriculture	0.01%	97.68	56.32
Minning	0.00%	0.00	0.00
Urban Area	0.00%	0.00	0.00
Weighted average of post-deforestation carbon stocks		**41.39**	**28.38**

229 Sâmia Nunes et al 2020 Environ. Res. Lett. 15 034057. Available at: <https://iopscience.iop.org/article/10.1088/1748-9326/ab76db>

230 Silva Junior, C.H.L., Heinrich, V.H.A., Freire, A.T.G. et al. Benchmark maps of 33 years of secondary forest age for Brazil. Sci Data 7, 269 (2020). Available at: <https://doi.org/10.1038/s41597-020-00600-4>

231 Pereira, Izaura Cristina Nunes. Estoque de biomassa e carbono florestal em unidades de paisagem na Amazônia: uma análise a partir da abordagem metodológica. Universidade Federal do Pará, , Belém, 2013. Available at: <https://ppgdstu.propesp.ufpa.br/ARQUIVOS/teses/TESES/2013/IZAURA%20CRISTINA%20NUNES%20PEREIRA.pdf>

Uncertainty assessment for project area carbon stock

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

Silva, for the Open tropical and submontane rainforest, was conducted with an error of 1.85% and present an uncertainty level less than 10% of the average carbon stock value.

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

Table 72. 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	Open Tropical Rainforest				
	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	517.73	9.58	124.25	2.30	641.99	11.88
Leakage Belt	517.73	9.58	124.25	2.30	641.99	11.88

Table 73. 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	Open Tropical Rainforest				
		ID_{icl}	1				
		Cab_{icl}		Cbb_{icl}		$Ctot_{icl}$	
		C stock	C stock change	C stock	C stock change	C stock	C stock change
		tCO2e/ha	tCO2e/ha	tCO2e/ha	tCO2e/ha	tCO2e/ha	tCO2e/ha
Initial forest class	Project Area	517.73	517.73	124.25	124.25	641.99	641.99
Final forest class		517.73	517.73	124.25	124.25	641.99	641.99
Initial forest class	Leakage Belt	517.73	517.73	124.25	124.25	641.99	641.99
Final forest class		517.73	517.73	124.25	124.25	641.99	641.99

Carbon stock change factors

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

a) Above-ground biomass:

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

b) Below-ground biomass:

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

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

Table 74. Carbon stock change factors for initial forest classes (icl) in the reference region (Method 1)

Forest (Open Tropical Rainforest)			
Year after deforestation		$\Delta Cab_{icl,t}$	$\Delta Cbb_{icl,t}$
		tCO_2/ha	tCO_2/ha
1	t*	-517.73	-12.43
2	t*+1	0	-12.43
3	t*+2	0	-12.43
4	t*+3	0	-12.43
5	t*+4	0	-12.43
6	t*+5	0	-12.43
7	t*+6	0	-12.43
8	t*+7	0	-12.43
9	t*+8	0	-12.43
10	t*+9	0	-12.43
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 75. Carbon stock change factors for initial forest classes (icl) in the Project Area (Method 1)

Forest (Open Tropical Rainforest)			
Year after deforestation		$\Delta Cab_{icl,t}$	$\Delta Cbb_{icl,t}$
		tCO_2/ha	tCO_2/ha
1	t*	-517.73	-12.43
2	t*+1	0	-12.43
3	t*+2	0	-12.43
4	t*+3	0	-12.43
5	t*+4	0	-12.43
6	t*+5	0	-12.43
7	t*+6	0	-12.43
8	t*+7	0	-12.43
9	t*+8	0	-12.43
10	t*+9	0	-12.43
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 76. Carbon stock change factors for initial forest classes (icl) in the Leakage Belt (Method 1)

Forest (Open Tropical Rainforest)			
Year after deforestation		$\Delta Cab_{icl,t}$	$\Delta Cbb_{icl,t}$
		tCO_2/ha	tCO_2/ha
1	t*	-517.73	-12.43
2	t*+1	0	-12.43
3	t*+2	0	-12.43
4	t*+3	0	-12.43
5	t*+4	0	-12.43
6	t*+5	0	-12.43
7	t*+6	0	-12.43
8	t*+7	0	-12.43
9	t*+8	0	-12.43
10	t*+9	0	-12.43
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 77. 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	4.60
3	t*+2	4.60
4	t*+3	4.60
5	t*+4	4.60
6	t*+5	4.60
7	t*+6	4.60
8	t*+7	4.60
9	t*+8	4.60
10	t*+9	4.60
11	t*+10	0
12	t*+11	0
13	t*+12	0
14	t*+13	0
15	t*+14	0
16	t*+15	0
17	t*+16	0
18	t*+17	0
19	t*+18	0
20	t*+19	0
21-T	t*+20…	0

Calculation of baseline carbon stock changes

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

Table 78. Baseline carbon stock change in the reference region

Carbon stock change in the above-ground biomass per initial forest class *icl*		Total carbon stock change in the above-ground biomass of initial forest class in the reference region	
ID_{cl}	1	$\Delta CabBSLRR_{icl,t}$	$\Delta CabBSLRR_{icl}$
Name	Forest	annual	cumulative
Year	tCO_2e	tCO_2e	tCO_2e
2019	2,150,792	2,150,792	2,150,792
2020	11,254,083	11,254,083	13,404,875
2021	11,253,845	11,253,845	24,658,720
2022	11,218,145	11,218,145	35,876,865
2023	11,137,157	11,137,157	47,014,022
2024	11,036,163	11,036,163	58,050,185
2025	10,882,754	10,882,754	68,932,940
2026	10,702,585	10,702,585	79,635,525
2027	10,487,006	10,487,006	90,122,531
2028	10,260,297	10,260,297	100,382,828
2029	9,992,821	9,992,821	110,375,649
2030	9,708,866	9,708,866	120,084,516
2031	9,401,178	9,401,178	129,485,694
2032	9,091,551	9,091,551	138,577,244
2033	8,754,024	8,754,024	147,331,268
2034	8,410,431	8,410,431	155,741,699
2035	8,054,501	8,054,501	163,796,200
2036	7,704,883	7,704,883	171,501,083
2037	7,339,613	7,339,613	178,840,696
2038	6,977,185	6,977,185	185,817,882
2039	6,612,285	6,612,285	192,430,167
2040	6,260,081	6,260,081	198,690,247
2041	5,902,412	5,902,412	204,592,659

Carbon stock change in the below-ground biomass per initial forest class *icl*		Total carbon stock change in the below-ground biomass of initial forest class in the reference region	
ID_{cl}	1	$\Delta CbbBSLRR_{icl,t}$	$\Delta CbbBSLRR_{icl}$
Name	Forest	annual	cumulative
Year	tCO_2e	tCO_2e	tCO_2e
2019	51,618	51,618	51,618
2020	321,710	321,710	373,328
2021	591,796	591,796	965,123
2022	861,025	861,025	1,826,149
2023	1,128,311	1,128,311	2,954,460
2024	1,393,173	1,393,173	4,347,633
2025	1,654,353	1,654,353	6,001,986
2026	1,911,209	1,911,209	7,913,195
2027	2,162,892	2,162,892	10,076,087
2028	2,409,133	2,409,133	12,485,220
2029	2,648,956	2,648,956	15,134,175
2030	2,560,253	2,560,253	17,694,429
2031	2,515,790	2,515,790	20,210,219
2032	2,464,753	2,464,753	22,674,972
2033	2,407,559	2,407,559	25,082,532
2034	2,344,543	2,344,543	27,427,075
2035	2,276,667	2,276,667	29,703,742
2036	2,204,723	2,204,723	31,908,465
2037	2,129,188	2,129,188	34,037,653
2038	2,050,395	2,050,395	36,088,047
2039	1,969,264	1,969,264	38,057,311
2040	1,886,495	1,886,495	39,943,806
2041	1,802,526	1,802,526	41,746,332

Carbon stock changes in above-ground biomass per post-deforestation zone z		Total carbon stock change of post deforestation zones in the reference region	
ID_{lz}	1	$\Delta CBSLRR_{z,t}$	$\Delta CBSLRR_{z}$
Name	Non-forest	annual	cumulative
Year	tCO_2e	tCO_2e	tCO_2e
2019	0	0	0
2020	19,106	19,106	19,106
2021	119,077	119,077	138,182
2022	219,045	219,045	357,228
2023	318,697	318,697	675,925
2024	417,629	417,629	1,093,554
2025	515,665	515,665	1,609,219
2026	612,337	612,337	2,221,556
2027	707,409	707,409	2,928,965
2028	800,566	800,566	3,729,530
2029	872,603	872,603	4,602,134
2030	861,399	861,399	5,463,533
2031	847,675	847,675	6,311,208
2032	831,535	831,535	7,142,743
2033	813,364	813,364	7,956,106
2034	793,091	793,091	8,749,198
2035	771,129	771,129	9,520,327
2036	747,606	747,606	10,267,933
2037	722,892	722,892	10,990,825
2038	696,948	696,948	11,687,773
2039	670,160	670,160	12,357,932
2040	642,652	642,652	13,000,585
2041	614,750	614,750	13,615,334

Total net carbon stock change in the reference region	
$\Delta CBSLRR_{t}$	$\Delta CBSLRR$
annual	cumulative
tCO_2e	tCO_2e
2,202,410	2,202,410
11,556,687	13,759,097
11,726,564	25,485,661
11,860,124	37,345,786
11,946,771	49,292,557
12,011,707	61,304,264
12,021,443	73,325,706
12,001,458	85,327,164
11,942,489	97,269,653
11,868,864	109,138,518
11,769,173	120,907,691
11,407,720	132,315,412
11,069,293	143,384,705
10,724,769	154,109,474
10,348,219	164,457,693
9,961,883	174,419,577
9,560,038	183,979,615
9,162,000	193,141,615
8,745,908	201,887,524
8,330,633	210,218,156
7,911,389	218,129,545
7,503,923	225,633,469
7,090,188	232,723,657

2042	5,554,205	5,554,205	210,146,864
2043	5,210,964	5,210,964	215,357,828
2044	4,884,293	4,884,293	220,242,121
2045	4,559,766	4,559,766	224,801,888
2046	4,248,662	4,248,662	229,050,550
2047	3,947,246	3,947,246	232,997,795
2048	3,663,929	3,663,929	236,661,724
2049	2,778,765	2,778,765	239,440,489

2042	1,717,632	1,717,632	43,463,964
2043	1,632,600	1,632,600	45,096,565
2044	1,547,975	1,547,975	46,644,540
2045	1,464,103	1,464,103	48,108,643
2046	1,381,156	1,381,156	49,489,799
2047	1,299,741	1,299,741	50,789,540
2048	1,220,225	1,220,225	52,009,765
2049	1,128,222	1,128,222	53,137,987

2042	586,420	586,420	14,201,755
2043	557,996	557,996	14,759,751
2044	529,575	529,575	15,289,326
2045	501,414	501,414	15,790,739
2046	473,475	473,475	16,264,215
2047	446,018	446,018	16,710,233
2048	419,103	419,103	17,129,336
2049	392,913	392,913	17,522,249

6,685,417	239,409,074
6,285,569	245,694,642
5,902,693	251,597,335
5,522,456	257,119,791
5,156,343	262,276,134
4,800,968	267,077,102
4,465,050	271,542,153
3,514,074	275,056,227

Table 79. Baseline carbon stock change in the Project Area

Carbon stock change in the above-ground biomass per initial forest class *icl*				Total carbon stock change in the above-ground biomass of initial forest class in the project area	
ID_{cl}	1	1	1	$\Delta CabBSLPA_{icl,t}$	$\Delta CabBSLPA_{icl}$
Name	Grupo Rovema	Grupo Tupá	Grupo Leite	annual	cumulative
Year	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2019	86,545	0	0	86,545	86,545
2020	479,614	184,118	31,463	695,194	781,739
2021	600,125	218,607	47,636	866,368	1,648,107
2022	633,965	235,608	68,346	937,919	2,586,026
2023	633,004	269,751	85,039	987,794	3,573,820
2024	589,508	297,699	125,993	1,013,200	4,587,020
2025	576,356	310,524	171,437	1,058,317	5,645,337
2026	548,452	316,280	213,320	1,078,052	6,723,389
2027	498,934	335,168	273,989	1,108,091	7,831,480
2028	455,517	334,467	328,234	1,118,218	8,949,698
2029	419,933	350,981	343,844	1,114,758	10,064,456
2030	400,743	372,347	350,687	1,123,776	11,188,232
2031	338,749	361,733	370,620	1,071,102	12,259,333
2032	309,735	359,248	333,738	1,002,720	13,262,054
2033	263,338	347,927	309,966	921,231	14,183,285
2034	233,885	349,181	268,583	851,650	15,034,935
2035	208,982	356,329	250,287	815,598	15,850,533
2036	164,685	331,895	240,184	736,763	16,587,296
2037	140,764	296,486	214,332	651,582	17,238,878
2038	125,598	284,826	196,044	606,468	17,845,346
2039	101,584	268,665	164,968	535,217	18,380,563
2040	97,063	243,937	149,945	490,945	18,871,508
2041	77,596	212,897	133,342	423,835	19,295,344
2042	62,162	186,171	119,364	367,697	19,663,041
2043	51,560	163,738	114,248	329,546	19,992,586
2044	50,756	137,391	89,275	277,422	20,270,008
2045	40,454	111,140	91,815	243,409	20,513,417
2046	35,861	98,218	64,637	198,715	20,712,132
2047	27,004	84,765	55,513	167,282	20,879,414
2048	24,674	70,597	50,934	146,205	21,025,620
2049	18,027	47,218	33,817	99,062	21,124,682

Carbon stock change in the below-ground biomass per initial forest class *icl*				Total carbon stock change in the below-ground biomass of initial forest class in the project area	
ID_{cl}	1	1	3	$\Delta CbbBSLPA_{icl,t}$	$\Delta CbbBSLPA_{icl}$
Name	Grupo Rovema	Grupo Tupá	Grupo Leite	annual	cumulative
Year	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2019	2,077	0	0	2,077	2,077
2020	13,588	4,419	755	18,761	20,838
2021	27,990	9,665	1,898	39,554	60,392
2022	43,205	15,320	3,539	62,063	122,455
2023	58,397	21,794	5,579	85,770	208,225
2024	72,545	28,938	8,603	110,086	318,311
2025	86,377	36,391	12,718	135,485	453,796
2026	99,539	43,981	17,837	161,358	615,154
2027	111,514	52,025	24,413	187,951	803,105
2028	122,446	60,052	32,290	214,788	1,017,893
2029	130,447	68,475	40,542	239,464	1,257,357
2030	128,554	72,993	48,204	249,750	1,507,107
2031	122,281	76,428	55,955	254,664	1,761,771
2032	114,500	79,395	62,324	256,219	2,017,990
2033	105,628	81,271	67,722	254,621	2,272,611
2034	97,093	82,507	71,144	250,744	2,523,356
2035	88,276	83,606	73,037	244,919	2,768,275
2036	79,066	83,981	73,682	236,728	3,005,003
2037	70,470	83,052	72,250	225,772	3,230,776
2038	62,552	81,861	69,077	213,491	3,444,266
2039	54,912	79,885	64,784	199,582	3,643,848
2040	47,624	76,804	59,967	184,394	3,828,243
2041	41,357	73,232	54,272	168,860	3,997,103
2042	35,415	69,078	49,127	153,620	4,150,723
2043	30,332	64,658	44,430	139,420	4,290,144
2044	25,937	59,575	40,127	125,639	4,415,782
2045	21,893	53,690	36,324	111,907	4,527,689
2046	18,801	48,082	32,111	98,994	4,626,683
2047	16,071	43,001	28,299	87,371	4,714,054
2048	13,649	37,860	24,816	76,325	4,790,379
2049	11,644	32,545	21,669	65,857	4,856,236

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_{lz}	1	$\Delta CBSLPA_{z,t}$	$\Delta CBSLPA_{z}$	$\Delta CBSLPA_{t}$	$\Delta CBSLPA$
Name	Non-forest	annual	cumulative	annual	cumulative
Year	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2019	0	0	0	88,622	88,622
2020	769	769	769	713,187	801,809
2021	6,944	6,944	7,713	898,977	1,700,786
2022	14,640	14,640	22,353	985,342	2,686,128
2023	22,972	22,972	45,325	1,050,592	3,736,720
2024	31,747	31,747	77,072	1,091,539	4,828,259
2025	40,747	40,747	117,819	1,153,055	5,981,314
2026	50,148	50,148	167,967	1,189,262	7,170,576
2027	59,724	59,724	227,691	1,236,318	8,406,894
2028	69,568	69,568	297,259	1,263,438	9,670,332
2029	78,732	78,732	375,991	1,275,490	10,945,822
2030	82,459	82,459	458,450	1,291,067	12,236,889
2031	84,746	84,746	543,196	1,241,020	13,477,909
2032	85,929	85,929	629,124	1,173,010	14,650,919
2033	86,061	86,061	715,186	1,089,791	15,740,711
2034	85,244	85,244	800,430	1,017,150	16,757,860
2035	83,409	83,409	883,839	977,109	17,734,969
2036	81,077	81,077	964,916	892,415	18,627,384
2037	77,779	77,779	1,042,695	799,576	19,426,959
2038	73,633	73,633	1,116,328	746,325	20,173,285
2039	69,118	69,118	1,185,446	665,680	20,838,965
2040	63,890	63,890	1,249,336	611,450	21,450,415
2041	58,736	58,736	1,308,073	533,959	21,984,374
2042	53,594	53,594	1,361,667	467,723	22,452,097
2043	48,677	48,677	1,410,344	420,289	22,872,386
2044	44,039	44,039	1,454,383	359,021	23,231,407
2045	39,259	39,259	1,493,642	316,057	23,547,464
2046	34,876	34,876	1,528,518	262,833	23,810,297
2047	30,853	30,853	1,559,371	223,800	24,034,097
2048	26,952	26,952	1,586,323	195,578	24,229,675
2049	23,496	23,496	1,609,819	141,423	24,371,098

Table 80. Baseline carbon stock change in the leakage belt

Carbon stock change in the above-ground biomass per initial forest class *icl*		Total carbon stock change in the above-ground biomass of initial forest class in the leakage belt	
ID_{cl}	1	$\Delta CabBSLLK_{icl,t}$	$\Delta CabBSLLK_{icl}$
Name	Forest	annual	cumulative
Year	tCO_2e	tCO_2e	tCO_2e
2019	74,742	74,742	74,742
2020	403,400	403,400	478,141
2021	457,380	457,380	935,521
2022	475,347	475,347	1,410,868
2023	518,242	518,242	1,929,110
2024	521,606	521,606	2,450,717
2025	507,168	507,168	2,957,885
2026	506,802	506,802	3,464,687
2027	499,256	499,256	3,963,943
2028	475,455	475,455	4,439,398
2029	483,525	483,525	4,922,923
2030	472,076	472,076	5,394,999
2031	476,264	476,264	5,871,264
2032	465,404	465,404	6,336,668
2033	439,739	439,739	6,776,407
2034	428,762	428,762	7,205,169
2035	397,062	397,062	7,602,231
2036	384,402	384,402	7,986,633
2037	375,442	375,442	8,362,075
2038	346,921	346,921	8,708,996
2039	347,933	347,933	9,056,929
2040	315,669	315,669	9,372,598
2041	282,591	282,591	9,655,189
2042	264,765	264,765	9,919,954
2043	238,501	238,501	10,158,455
2044	210,653	210,653	10,369,108
2045	192,533	192,533	10,561,641
2046	173,712	173,712	10,735,353
2047	150,578	150,578	10,885,931
2048	133,087	133,087	11,019,018
2049	94,735	94,735	11,113,753

Carbon stock change in the below-ground biomass per initial forest class *icl*		Total carbon stock change in the below-ground biomass of initial forest class in the leakage belt	
ID_{cl}	1	$\Delta CbbBSLLK_{icl,t}$	$\Delta CbbBSLLK_{icl}$
Name	Forest	annual	cumulative
Year	tCO_2e	tCO_2e	tCO_2e
2019	1,794	1,794	1,794
2020	11,475	11,475	13,269
2021	22,452	22,452	35,721
2022	33,860	33,860	69,581
2023	46,298	46,298	115,879
2024	58,816	58,816	174,694
2025	70,988	70,988	245,682
2026	83,151	83,151	328,833
2027	95,132	95,132	423,965
2028	106,543	106,543	530,508
2029	116,354	116,354	646,862
2030	118,002	118,002	764,864
2031	118,455	118,455	883,319
2032	118,217	118,217	1,001,536
2033	116,332	116,332	1,117,868
2034	114,104	114,104	1,231,972
2035	111,462	111,462	1,343,434
2036	108,524	108,524	1,451,958
2037	105,553	105,553	1,557,511
2038	102,468	102,468	1,659,979
2039	99,214	99,214	1,759,193
2040	95,460	95,460	1,854,653
2041	90,812	90,812	1,945,465
2042	85,997	85,997	2,031,462
2043	81,167	81,167	2,112,630
2044	75,933	75,933	2,188,562
2045	71,024	71,024	2,259,587
2046	65,968	65,968	2,325,555
2047	60,571	60,571	2,386,126
2048	55,439	55,439	2,441,565
2049	49,363	49,363	2,490,928

Carbon stock changes in above-ground biomass per post-deforestation zone z		Total carbon stock change of post deforestation zones in the leakage belt	
ID_{lz}	1	$\Delta CtotBSLLK_{z,t}$	$\Delta CtotBSLLK_{z}$
Name	Non-forest	annual	cumulative
Year	tCO_2e	tCO_2e	tCO_2e
2019	0	0	0
2020	455	455	455
2021	2,912	2,912	3,368
2022	5,698	5,698	9,066
2023	8,594	8,594	17,660
2024	11,750	11,750	29,410
2025	14,928	14,928	44,338
2026	18,017	18,017	62,355
2027	21,104	21,104	83,459
2028	24,145	24,145	107,603
2029	26,586	26,586	134,189
2030	27,074	27,074	161,263
2031	27,163	27,163	188,426
2032	27,169	27,169	215,595
2033	26,847	26,847	242,442
2034	26,348	26,348	268,790
2035	25,871	25,871	294,661
2036	25,202	25,202	319,863
2037	24,503	24,503	344,366
2038	23,894	23,894	368,260
2039	23,061	23,061	391,321
2040	22,305	22,305	413,626
2041	21,327	21,327	434,953
2042	20,214	20,214	455,167
2043	19,148	19,148	474,315
2044	17,989	17,989	492,304
2045	16,853	16,853	509,157
2046	15,685	15,685	524,842
2047	14,456	14,456	539,298
2048	13,260	13,260	552,558
2049	11,951	11,951	564,509

Total net carbon stock change in the leakage belt	
$\Delta CtotBSLLK_{t}$	$\Delta CtotBSLLK$
annual	cumulative
tCO_2e	tCO_2e
76,535	76,535
414,420	490,955
476,919	967,874
503,509	1,471,383
555,946	2,027,329
568,672	2,596,001
563,228	3,159,229
571,936	3,731,165
573,285	4,304,449
557,853	4,862,303
573,293	5,435,596
563,004	5,998,600
567,556	6,566,157
556,452	7,122,608
529,225	7,651,833
516,518	8,168,351
482,653	8,651,004
467,724	9,118,728
456,492	9,575,220
425,496	10,000,716
424,085	10,424,801
388,824	10,813,625
352,076	11,165,701
330,548	11,496,250
300,520	11,796,770
268,597	12,065,367
246,703	12,312,071
223,995	12,536,066
196,694	12,732,759
175,266	12,908,026
132,147	13,040,172

Baseline non-CO2 emissions from forest fires

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

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

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

Where,

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

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

Where,

$EBBCO_{2icl,t}$	Per hectare CO_2 emission from biomass burning in slash and burn in forest class icl at year t; tCO_2e/ha
NCR	Nitrogen to Carbon Ratio (IPCC default value = 0.01); dimensionless
ER_{N2O}	Emission ratio for N_2O (IPCC default value = 0.007)
GWP_{N2O}	Global Warming Potential for N_2O (IPCC default value)[232]

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

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)

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

GWP_{CH4}	Global Warming Potential for CH_4 (IPCC default value) [233]

$$EBBCO_{2icl,t} = Fburnt_{icl} * (C_{picl,t} * Pburnt_{p,icl} * CE_{p,icl})$$

Where,

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

For the Fburnt, it was considered default value from MCTI (Science, Technology and Innovation Ministry)[234]. According to the governamental publication, the combustion factor for the phitophisionomy Open Tropical Rainforest (Aa, Ab, As) is 45%.

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 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%.

[233] According to the VCS Standard, the six Kyoto Protocol greenhouse gases and ozone-depleting substances shall be converted using 100 year global warming potentials derived from the IPCC's Fifth Assessment Report (GWP for CH_4 = 28).

[234] Value of "Biomass combustion factors by phytophysiognomies group in the Amazon biome" for Open Tropical Rainforest available at the Third National Communication from Brazil to the United Nations Frameworkd Convention on Climate Change Volume 3, Table A2.4, page 305 <http://www.ccst.inpe.br/publicacao/terceira-comunicacao-nacional-do-brasil-a-convencao-quadro-das-nacoes-unidas-sobre-mudanca-do-clima-portugues/>

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

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

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

Where,

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

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

Table 81. Parameters used to calculate non-CO2 emissions from forest fires

Initial Forest Class		Parameters								
IDcl	Name	$Fburnt_{icl}$	Cab	$Pburnt_{ab,icl}$	$CE_{ab,icl}$	ECO2-ab	EBBCO2-tot	$EBBN2O_{icl}$	$EBBCH4_{icl}$	$EBBtot_{icl}$
		%	tCO_2e/ha	%	%	tCO_2e/ha	tCO_2e/ha	tCO_2e/ha	tCO_2e/ha	tCO_2e/ha
1	Forest	45.00%	517.73	78%	50%	90.86	90.86	0.72	11.10	11.82

Table 82. 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	
	Grupo Rovema		Grupo Tupá		Grupo Leite		annual	cumulative
	$ABSLPA_{icl,t}$	$EBBBSLtot_{icl}$	$ABSLPA_{icl,t}$	$EBBBSLtot_{icl}$	$ABSLPA_{icl,t}$	$EBBBSLtot_{icl}$	$EBBBSLPA_t$	EBBBSLPA
	ha	tCO_2e/ha	ha	tCO_2e/ha	ha	tCO_2e/ha	tCO_2e	tCO_2e
2019	167.16	11.82	0.00	11.82	0.00	11.82	1,977	1,977
2020	926.37	11.82	355.62	11.82	60.77	11.82	15,877	17,853
2021	1,159.14	11.82	422.24	11.82	92.01	11.82	19,786	37,640
2022	1,224.50	11.82	455.08	11.82	132.01	11.82	21,420	59,060
2023	1,222.65	11.82	521.02	11.82	164.25	11.82	22,559	81,619
2024	1,138.63	11.82	575.00	11.82	243.35	11.82	23,140	104,759
2025	1,113.23	11.82	599.78	11.82	331.13	11.82	24,170	128,929
2026	1,059.33	11.82	610.89	11.82	412.03	11.82	24,621	153,550
2027	963.69	11.82	647.38	11.82	529.21	11.82	25,307	178,856
2028	879.83	11.82	646.02	11.82	633.98	11.82	25,538	204,394
2029	811.10	11.82	677.92	11.82	664.13	11.82	25,459	229,853
2030	774.03	11.82	719.19	11.82	677.35	11.82	25,665	255,518
2031	654.29	11.82	698.69	11.82	715.85	11.82	24,462	279,980
2032	598.25	11.82	693.89	11.82	644.61	11.82	22,900	302,881
2033	508.64	11.82	672.02	11.82	598.70	11.82	21,039	323,920
2034	451.75	11.82	674.44	11.82	518.77	11.82	19,450	343,370
2035	403.65	11.82	688.25	11.82	483.43	11.82	18,627	361,997
2036	318.09	11.82	641.05	11.82	463.91	11.82	16,826	378,823
2037	271.89	11.82	572.66	11.82	413.98	11.82	14,881	393,704
2038	242.59	11.82	550.14	11.82	378.66	11.82	13,851	407,554
2039	196.21	11.82	518.93	11.82	318.63	11.82	12,223	419,778
2040	187.48	11.82	471.16	11.82	289.62	11.82	11,212	430,990
2041	149.88	11.82	411.21	11.82	257.55	11.82	9,680	440,670
2042	120.07	11.82	359.59	11.82	230.55	11.82	8,398	449,067
2043	99.59	11.82	316.26	11.82	220.67	11.82	7,526	456,593
2044	98.03	11.82	265.37	11.82	172.43	11.82	6,336	462,929
2045	78.14	11.82	214.67	11.82	177.34	11.82	5,559	468,488
2046	69.27	11.82	189.71	11.82	124.85	11.82	4,538	473,026
2047	52.16	11.82	163.72	11.82	107.22	11.82	3,820	476,847
2048	47.66	11.82	136.36	11.82	98.38	11.82	3,339	480,186
2049	34.82	11.82	91.20	11.82	65.32	11.82	2,262	482,448

5.2 Project Emissions

The present REDD project includes instances with logging activities within the project area. These carbon stock changes are estimated ex ante and shall be measured ex post.

Instances 1 and 3 (Grupo Rovema and Grupo Tupá) have logging activities. Sustainable Forest Management Plan activities mainly includes implementation of infrastructure, such as opening of main and secondary roads, skidding trails[235], and timber yards in each annual production unit – APU (Unidade de Produção Anual, in Portuguese) within the project area, estimated to be around 1.50% of each APU. The total forest management area is 16,911.61 ha (Instance 1 – 13,961.97 ha and Instance 3 – 2,949.64 ha). After the harvesting activity, the area should be left for natural regeneration for 30 years. The average annual productive unit (APU) is estimated to have 465.40 ha (Instance 1) and 98.32 hectares (Instance 3). Instance 2 (Grupo Leite) does not have Sustainable Forest Management Plan.

Table below presents an *ex ante* estimated carbon stock decrease due to planned deforestation in the project area. The *ex ante* estimated carbon stock decrease due to planned deforestation in the project area was calculated using the following equation:

$$\Delta CPDdPA_t = \sum (APDPA_{icl,t} \times \Delta Ctot_{icl})$$

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

[235] 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.

Table 83. 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	
	Grupo Rovema (Forest)		Grupo Tupá (Forest)		Grupo Leite (Forest)		annual	cumulative
	$APDPA_{icl,t}$	$Ctot_{icl,t}$	$APDPA_{icl,t}$	$Ctot_{icl,t}$	$APDPA_{icl,t}$	$Ctot_{icl,t}$	$\Delta CPDdPA_t$	$\Delta CPDdPA$
	ha	tCO_2e/ha	ha	tCO_2e/ha	ha	tCO_2e/ha	tCO_2e	tCO_2e
2019	1.34	641.99	0.00	641.99	0.00	641.99	859.50	859.50
2020	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	6,288.02
2021	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	11,716.53
2022	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	17,145.04
2023	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	22,573.55
2024	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	28,002.07
2025	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	33,430.58
2026	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	38,859.09
2027	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	44,287.60
2028	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	49,716.12
2029	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	55,144.63
2030	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	60,573.14
2031	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	66,001.66
2032	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	71,430.17
2033	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	76,858.68
2034	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	82,287.19
2035	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	87,715.71
2036	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	93,144.22
2037	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	98,572.73
2038	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	104,001.24
2039	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	109,429.76
2040	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	114,858.27
2041	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	120,286.78
2042	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	125,715.29
2043	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	131,143.81
2044	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	136,572.32
2045	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	142,000.83
2046	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	147,429.34
2047	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	152,857.86
2048	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	158,286.37
2049	6.98	641.99	1.47	641.99	0.00	641.99	5,428.51	163,714.88

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 Mg C/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, ΔCwp_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:

$$\Delta CPLdPA_t = (APLPA_{icl,t} \times \Delta CLd_{icl,t}) - (APLPA_{icl,t}) \times \Delta Cwp_t$$

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
ΔCwp_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 84. 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	
	Grupo Rovema (Forest)		Grupo Tupá (Forest)		Grupo Leite (Forest)		annual	cumulative
	$APLPA_{icl,t}$	$\Delta CLd_{icl,t}$	$APLPA_{icl,t}$	$\Delta CLd_{icl,t}$	$APLPA_{icl,t}$	$\Delta CLd_{icl,t}$	$\Delta CPLdPA_t$	$\Delta CPLdPA$
	ha	tCO_2e/ha	ha	tCO_2e/ha	ha	tCO_2e/ha	tCO_2e	tCO_2e
2019	89.25	78.20	0.00	78.20	0.00	78.20	6,980	6,980
2020	465.40	78.20	98.32	78.20	0.00	78.20	44,082	51,062
2021	465.40	78.20	98.32	78.20	0.00	78.20	44,082	95,144
2022	465.40	78.20	98.32	78.20	0.00	78.20	44,082	139,227
2023	465.40	78.20	98.32	78.20	0.00	78.20	44,082	183,309
2024	465.40	78.20	98.32	78.20	0.00	78.20	44,082	227,391
2025	465.40	78.20	98.32	78.20	0.00	78.20	44,082	271,474
2026	465.40	78.20	98.32	78.20	0.00	78.20	44,082	315,556
2027	465.40	78.20	98.32	78.20	0.00	78.20	44,082	359,638
2028	465.40	78.20	98.32	78.20	0.00	78.20	44,082	403,721
2029	465.40	78.20	98.32	78.20	0.00	78.20	44,082	447,803
2030	465.40	78.20	98.32	78.20	0.00	78.20	44,082	491,885
2031	465.40	78.20	98.32	78.20	0.00	78.20	44,082	535,968
2032	465.40	78.20	98.32	78.20	0.00	78.20	44,082	580,050
2033	465.40	78.20	98.32	78.20	0.00	78.20	44,082	624,132
2034	465.40	78.20	98.32	78.20	0.00	78.20	44,082	668,215
2035	465.40	78.20	98.32	78.20	0.00	78.20	44,082	712,297
2036	465.40	78.20	98.32	78.20	0.00	78.20	44,082	756,379
2037	465.40	78.20	98.32	78.20	0.00	78.20	44,082	800,462
2038	465.40	78.20	98.32	78.20	0.00	78.20	44,082	844,544
2039	465.40	78.20	98.32	78.20	0.00	78.20	44,082	888,626
2040	465.40	78.20	98.32	78.20	0.00	78.20	44,082	932,709
2041	465.40	78.20	98.32	78.20	0.00	78.20	44,082	976,791
2042	465.40	78.20	98.32	78.20	0.00	78.20	44,082	1,020,873
2043	465.40	78.20	98.32	78.20	0.00	78.20	44,082	1,064,956
2044	465.40	78.20	98.32	78.20	0.00	78.20	44,082	1,109,038
2045	465.40	78.20	98.32	78.20	0.00	78.20	44,082	1,153,120
2046	465.40	78.20	98.32	78.20	0.00	78.20	44,082	1,197,203
2047	465.40	78.20	98.32	78.20	0.00	78.20	44,082	1,241,285
2048	465.40	78.20	98.32	78.20	0.00	78.20	44,082	1,285,367
2049	465.40	78.20	98.32	78.20	0.00	78.20	44,082	1,329,450

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 85. 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
2019	859.50	859.50	6,979.61	6,979.61	0.00	0.00	7,839.12	7,839.12
2020	5,428.51	6,288.02	44,082.33	51,061.94	0.00	0.00	49,510.84	57,349.96
2021	5,428.51	11,716.53	44,082.33	95,144.27	0.00	0.00	49,510.84	106,860.80
2022	5,428.51	17,145.04	44,082.33	139,226.61	0.00	0.00	49,510.84	156,371.65
2023	5,428.51	22,573.55	44,082.33	183,308.94	0.00	0.00	49,510.84	205,882.49
2024	5,428.51	28,002.07	44,082.33	227,391.27	0.00	0.00	49,510.84	255,393.33
2025	5,428.51	33,430.58	44,082.33	271,473.60	0.00	0.00	49,510.84	304,904.17
2026	5,428.51	38,859.09	44,082.33	315,555.93	0.00	0.00	49,510.84	354,415.02
2027	5,428.51	44,287.60	44,082.33	359,638.26	0.00	0.00	49,510.84	403,925.86
2028	5,428.51	49,716.12	44,082.33	403,720.59	0.00	0.00	49,510.84	453,436.70
2029	5,428.51	55,144.63	44,082.33	447,802.92	0.00	0.00	49,510.84	502,947.55
2030	5,428.51	60,573.14	44,082.33	491,885.25	0.00	0.00	49,510.84	552,458.39
2031	5,428.51	66,001.66	44,082.33	535,967.58	0.00	0.00	49,510.84	601,969.23
2032	5,428.51	71,430.17	44,082.33	580,049.91	0.00	0.00	49,510.84	651,480.07
2033	5,428.51	76,858.68	44,082.33	624,132.24	0.00	0.00	49,510.84	700,990.92
2034	5,428.51	82,287.19	44,082.33	668,214.57	0.00	0.00	49,510.84	750,501.76
2035	5,428.51	87,715.71	44,082.33	712,296.90	0.00	0.00	49,510.84	800,012.60
2036	5,428.51	93,144.22	44,082.33	756,379.23	0.00	0.00	49,510.84	849,523.44
2037	5,428.51	98,572.73	44,082.33	800,461.56	0.00	0.00	49,510.84	899,034.29
2038	5,428.51	104,001.24	44,082.33	844,543.89	0.00	0.00	49,510.84	948,545.13
2039	5,428.51	109,429.76	44,082.33	888,626.22	0.00	0.00	49,510.84	998,055.97
2040	5,428.51	114,858.27	44,082.33	932,708.55	0.00	0.00	49,510.84	1,047,566.81
2041	5,428.51	120,286.78	44,082.33	976,790.88	0.00	0.00	49,510.84	1,097,077.66
2042	5,428.51	125,715.29	44,082.33	1,020,873.21	0.00	0.00	49,510.84	1,146,588.50
2043	5,428.51	131,143.81	44,082.33	1,064,955.54	0.00	0.00	49,510.84	1,196,099.34
2044	5,428.51	136,572.32	44,082.33	1,109,037.87	0.00	0.00	49,510.84	1,245,610.19
2045	5,428.51	142,000.83	44,082.33	1,153,120.20	0.00	0.00	49,510.84	1,295,121.03
2046	5,428.51	147,429.34	44,082.33	1,197,202.53	0.00	0.00	49,510.84	1,344,631.87
2047	5,428.51	152,857.86	44,082.33	1,241,284.86	0.00	0.00	49,510.84	1,394,142.71
2048	5,428.51	158,286.37	44,082.33	1,285,367.19	0.00	0.00	49,510.84	1,443,653.56
2049	5,428.51	163,714.88	44,082.33	1,329,449.52	0.00	0.00	49,510.84	1,493,164.40

Forests that will be subject to planned logging activities under the project scenario have the potential to grow and accumulate significant carbon stocks after the periodical harvest cycle due

to natural regeneration. The mean annual increment of managed forests in Brazil is estimated to be 0.86 m^3/ha/year[236]

Due to the periodical harvesting, the projected increase in carbon stocks of each forest class in the project case is estimated by assuming that the maximum carbon stock is the long term average carbon stock (the average of a production cycle). Therefore, once a class reaches this level of carbon stock, no more carbon stock increase can be attributed to it.

Table below provides an *ex ante* estimate of carbon stock increase following planned logging activities in the project area, which is calculated as follows:

$$\Delta CPLiPA_t = (APLPA_{icl,t} \times \Delta CLi_{icl,t})$$

Where,

ΔCPLiPA_t	Total increase 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
$\Delta CLi_{icl,t}$	Average carbon stock increase due to sustainable logging activities in forest class *icl* at time *t*; tCO_2e/ha

[236] BRASIL. Conselho Nacional do Meio Ambiente (CONAMA). Estabelece parâmetros técnicos a serem adotados na elaboração, apresentação, avaliação técnica e execução de Plano de Manejo Florestal Sustentável - PMFS com fins madeireiros, para florestas nativas e suas formas de sucessão no bioma Amazônia. Resolução nº. 406, de 02 de fevereiro de 2009. Diário Oficial [da] República Federativa do Brasil, Brasília, DF, 06 fev. 2009

Table 86. Ex ante estimated carbon stock increase following planned logging activities in the project area

Project year *t*	Areas of planned logging activities x Carbon stock change (increase up to maximum long-term average)						Total carbon stock increase due to planned logging activities	
	Grupo Rovema		Grupo Tupá		Grupo Leite		annual	cumulative
	$APLPA_{icl,t}$	$\Delta CLi_{icl,t}$	$APLPA_{icl,t}$	$\Delta CLi_{icl,t}$	$APLPA_{icl,t}$	$\Delta CLi_{icl,t}$	$\Delta CPLiPA_t$	$\Delta CPLiPA$
	ha	tCO_2e/ha	ha	tCO_2e/ha	ha	tCO_2e/ha	tCO_2e	tCO_2e
2019	89.25	0.89	0.00	0.00	0.00	0.00	0	0
2020	465.40	0.89	98.32	0.89	0.00	0.00	80	80
2021	465.40	0.89	98.32	0.89	0.00	0.00	582	662
2022	465.40	0.89	98.32	0.89	0.00	0.00	1,085	1,746
2023	465.40	0.89	98.32	0.89	0.00	0.00	1,587	3,334
2024	465.40	0.89	98.32	0.89	0.00	0.00	2,090	5,423
2025	465.40	0.89	98.32	0.89	0.00	0.00	2,592	8,016
2026	465.40	0.89	98.32	0.89	0.00	0.00	3,095	11,111
2027	465.40	0.89	98.32	0.89	0.00	0.00	3,598	14,708
2028	465.40	0.89	98.32	0.89	0.00	0.00	4,100	18,808
2029	465.40	0.89	98.32	0.89	0.00	0.00	4,603	23,411
2030	465.40	0.89	98.32	0.89	0.00	0.00	5,105	28,516
2031	465.40	0.89	98.32	0.89	0.00	0.00	5,608	34,124
2032	465.40	0.89	98.32	0.89	0.00	0.00	6,110	40,234
2033	465.40	0.89	98.32	0.89	0.00	0.00	6,613	46,847
2034	465.40	0.89	98.32	0.89	0.00	0.00	7,115	53,963
2035	465.40	0.89	98.32	0.89	0.00	0.00	7,618	61,581
2036	465.40	0.89	98.32	0.89	0.00	0.00	8,121	69,701
2037	465.40	0.89	98.32	0.89	0.00	0.00	6,980	76,681
2038	465.40	0.89	98.32	0.89	0.00	0.00	6,980	83,660
2039	465.40	0.89	98.32	0.89	0.00	0.00	6,980	90,640
2040	465.40	0.89	98.32	0.89	0.00	0.00	6,980	97,620
2041	465.40	0.89	98.32	0.89	0.00	0.00	6,980	104,599
2042	465.40	0.89	98.32	0.89	0.00	0.00	6,980	111,579
2043	465.40	0.89	98.32	0.89	0.00	0.00	6,980	118,559
2044	465.40	0.89	98.32	0.89	0.00	0.00	6,980	125,538
2045	465.40	0.89	98.32	0.89	0.00	0.00	6,980	132,518
2046	465.40	0.89	98.32	0.89	0.00	0.00	6,980	139,497
2047	465.40	0.89	98.32	0.89	0.00	0.00	6,980	146,477
2048	465.40	0.89	98.32	0.89	0.00	0.00	6,980	153,457
2049	465.40	0.89	98.32	0.89	0.00	0.00	6,980	160,436

No significant unavoidable unplanned deforestation is expected in the project scenario, due to the present conservation measures and sustainable forest management practices adopted by

Rio Madeira 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

The project intends to implement various socio-environmental actions, as described in section 1.11, with the plan for the application of resources already defined and validated with the owners. The project is currently using the SOCIALCARBON Standard but will migrate to CCB. Through the actions being planned, such as socio-economic diagnosis, fauna and flora inventory, training to be carried out with the surrounding communities, among others, it is expected that the reduction in emissions will exceed what was planned. In addition, the project is expected to benefit the surrounding communities, which are relevant stakeholders to avoid deforestation.

According to the Rio Madeira Project's Theory of Change (developed as part of the CCB Project Description Document currently under validation), program activities were designed considering a clear cause-effect relationship between the unsatisfied basic needs of communities and each critical factor, such as unsustainable land use and limited knowledge of ecosystem services. These could be used as a strategy to mitigate and reduce illegal deforestation in the project area, based on the (1) adaptation and improvement of infrastructure, (2) continuous communication and stakeholder engagement, (3) conservation and monitoring of biodiversity and ecosystem resources, (4) capacity building and support to promote sustainable production practices, and (5) monitoring and forest integrity to achieve large positive impacts on climate, community and biodiversity in the short, medium and long term.

As many objectives overlap, the Project Proponent has developed broad program scopes under which individual project activities will operate. In the short-term, these activities will generate immediate outputs and short to medium-term outcomes, which, over the life of the project will together contribute to achievement of the expected climate, community, and biodiversity long-term impact of the Rio Madeira Grouped REDD+ Project, as briefly described next:

1. **Adaptation and Improvement of Infrastructure Program**: This program is directly related to community benefits, with the main goal of reducing the deficit of spaces and facilities for socializing and leisure activities that directly impact residents' quality of life in a given area. It also aims to improve management practices in public schools and enhance educational performance among young people. To achieve this, the program plans to develop adequate infrastructure, including cultural and leisure facilities for adults and children living in rural areas. Additionally, it aims to create conditions for young people to study in suitable spaces with electricity, internet access, tables, and chairs, thereby reducing the likelihood of school dropouts.
2. **Continuous Communication and Stakeholder Engagement Program** : The goal of this program is to enhance community participation in project decision-making. It focuses on effective communication mechanisms and accessible information for stakeholder engagement. Activities include ongoing socialization, consultation, and adaptive management with stakeholders, including the Socioenvironmental Committee. The program aims to create a collaborative communication channel for decision-making and project implementation, benefiting climate, community, and biodiversity.
3. **Conservation and Monitoring of Biodiversity and Ecosystem Resources Program** : The program aims to enhance scientific understanding of endangered species by monitoring environmental parameters. It focuses on maintaining biodiversity in critical areas like watersheds and riparian zones. This contributes to water regulation and ecosystem services. Additionally, it seeks to change stakeholders' perception of local biodiversity, reduce conflicts (e.g., illegal hunting), and promote environmental education for sustainable practices.
4. **Capacity Building and Support to Promote Sustainable Production Practices Program** : This program aims to enhance local economies and governance capacity. It focuses on developing businesses, income generation, and food security through sustainable value chains. The project ensures long-term benefits, including autonomy, social empowerment,

and stakeholder engagement. By reducing the agricultural border near forests, it promotes forest protection and minimizes risks for future generations.

5. **Monitoring and Forest Integrity Program**: Efficient Forest monitoring is crucial to prevent unplanned deforestation in the project area. By addressing invasions and degradation, it is possible to ensure long-term climate benefits through reduced greenhouse gas emissions. Surveillance activities include remote monitoring using satellite images and training farm workers to respond to illegal activities. Strengthening local partnerships with environmental authorities will aid in combating illegal actions and facilitate reporting of complaints.

The above-mentioned programs were designed to support forest protection by acting on deforestation drivers and by promoting local and institutional support to the Project Activity. These measures have been developed to improve initiatives that have initially been performed at some level by landowners. In particular, landowners have taken the following initiatives to prevent unplanned deforestation on their areas during the first monitoring period:

Instance	Brief description of activities and its start
Grupo Rovema	• Surveillance activities started in October-2019 and still in place
Grupo Leite	• Remote sense monitoring started in January-2020 and still in place • Surveillance activities started in May-2021 and still in place
Grupo Tupá	• Surveillance activities started on January-2020 and still in place

As monitored data from the 1st monitoring period demonstrates, the project measures were successful in preventing most of the expected deforestation within the project area. Project Proponents and landowners consider that surveillance and patrolling have been the most relevant of all measures in that period.

However, ensuring long-term conservation involves a complex range of factors that are dynamic and should be addressed using different yet complementary methods[237,238]. Hence, Project Proponents consider the effectiveness observed during the 1st monitoring period can only be maintained with continuous and improved measures that seek to promote durable changes to the project region and to the agents and drivers of deforestation. In addition, the Project initiatives should be expanded to address and prevent leakage emissions, especially by the

[237] Many studies indicate how complex is the long-term conservation of the Amazon. Supporting information is available on the following publication from IPAM: "Soluções para o desmatamento na Amazônia", dated March, 2023. This document provides a set of solutions to prevent deforestation that range from command and control measures to increasing agricultural productivity and increasing land tenure to prevent land grabbing, which are all complex initiatives. Document available at: https://ipam.org.br/wp-content/uploads/2023/03/Amazoniar-Solucoes-para-o-desmatamento-na-Amazonia-VF.pdf.

[238] Supporting information is also available on the following E-book: "ALENCAR, Ane et al. Desmatamento na Amazônia: indo além da "emergência crônica". Belém: IPAM, 2004. E-book. Section 8 of this document provides recommendations on how to control deforestation in the Amazon. A vast and complex set of measures are considered necessary. Document available at: https://www.researchgate.net/profile/Pablo-Pacheco-6/publication/283091315_Desmatamento_na_Amazonia_indo_alem_da_emergencia_cronica/links/5645ae5b08aef646e6ccfa04/Desmatamento-na-Amazonia-indo-alem-da-emergencia-cronica.pdf.

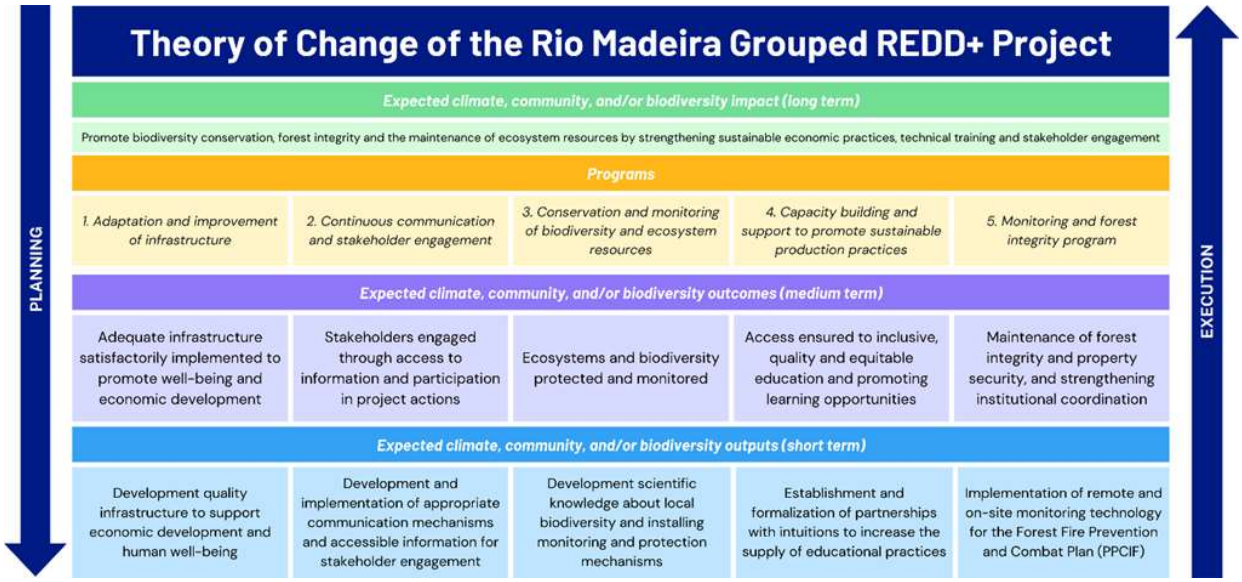
development of leakage management activities that can prevent deforestation from occurring outside the project area, but due to its implementation.

During the first monitoring period, the following was observed: out of the 3,183.31 hectares projected to be deforested inside the Project Area, 123.6 hectares were deforested, which corresponds to an average effectiveness of 96.1%.

To manage and prevent leakage emissions, a set of activities were executed in the Leakage Management Area since June-2023 and are also expected to continue as the project progresses. These initiatives include community engagement, conducting a socio-economic diagnostic and promoting workshops and forums on the project measures and related risks.

As a result of continuous engagement with stakeholders, and with the aim to promote effective long-term forest conservation and climate impacts from the Project Activity, the Project Proponent has developed a Theory of Change which can lead to lasting changes and net positive impacts, as presented below:

Figure 87. Theory of Change for Rio Madeira REDD+ Project (under validation)



At the present time, all the project activities suggested need to be fully consulted by stakeholders participation in decision making and implementation, in order to enhance the positive impacts and reduce the negative impacts related to project activities, in accordance with REDD+ Safeguards. This shall progress as the certification of the Project under the CCB Standard unfolds.

In regard to the Monitoring and Forest Integrity (Program 5), Future Carbon has a dedicated team responsible for establishing an effective monitoring and operational management of our REDD Projects. The Carbon Integrated Command and Control Center (CI3C) is responsible for monitoring and responding to adverse events. Comprising trained personnel, equipment, and technology, the CI3C operates comprehensively, involving any relevant capacity related to its

work. The implementation of a command and control system within Future Carbon arose from the need to improve measures developed by landowners to prevent deforestation, invasions, and forest fires.

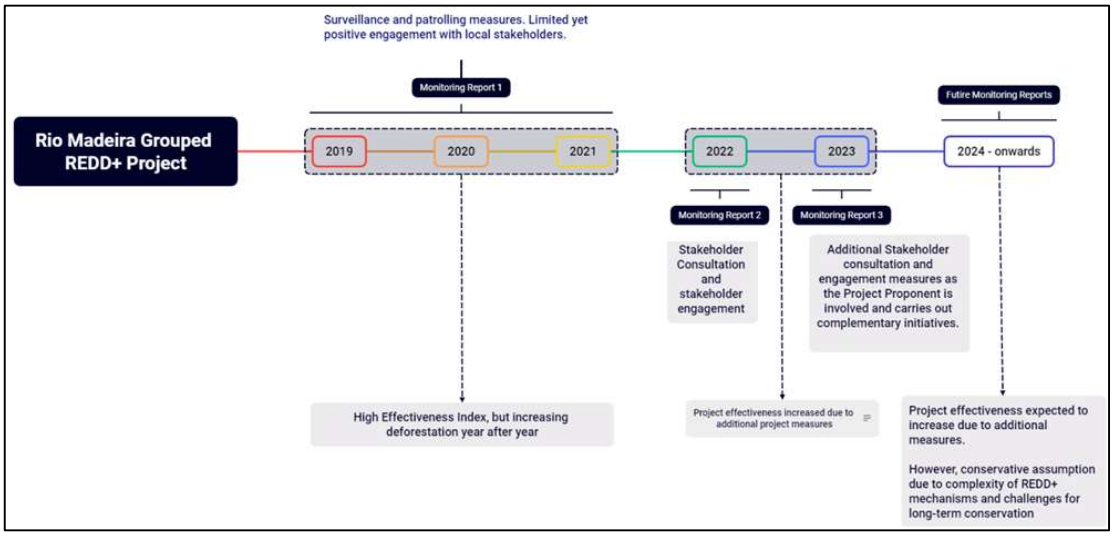
As mentioned above, these measures were previously carried out using landowners' own resources or with support from property staff or public security and environmental agencies. To ensure systematic operation and continuous effectiveness, the CI3C is equipped with satellite monitoring infrastructure and local field teams (or designated focal points) in each project area. This allows prompt identification of any forest loss event and enables on-site verification. All these actions are outlined in Event Response Protocols (PREs), which provide pre-established preventive and responsive measures for each identified risk, with a focus on preventing non-permanence risks.

Conceptually, preventive actions outlined in the PREs directly influence the likelihood of an occurring event. These actions create barriers for actors contributing to adverse events. The following measures fall within this category:

1. Periodic patrols at sensitive points on the properties serve to demonstrate presence and diligent activity by the landowners in caring for the area. Simultaneously, this measure deters potential detractors, preventing them from acting freely without interference.
2. Constant gathering of information on local news and events by field personnel allow the project personnel to be updated on potential threats in the project region. This enables the prompt action if any threat is imminent. In addition, establishing a communication mechanism fosters local communities to share their demands which may be connected to tackling deforestation causes.
3. Operation of an intelligence Working Group significantly contributes to knowledge production and provides insights to CI3C leadership for dissemination.
4. Fire brigade formation, led by instructors from State fire departments, equips farm employees with appropriate techniques for handling various fire incidents. Supported by a Forest Fire Prevention and Combat Plan, this proactive approach aims to prevent damage to project areas before they are affected by fire.
5. Satellite Monitoring: satellite monitoring generates deforestation alerts. This allows a direct response to the problem using dedicated personnel or with support from public security and environmental agencies. Immediate field agent presence upon detecting any deforestation traces also signals active surveillance to potential adverse events.

Finally, the scenario regarding the Project effectiveness is summarized in the diagram below.

Figure 88. Project timeline and project effectiveness



In summary, a high effectiveness index was observed in the 1st monitoring period, which was caused mainly by surveillance measures that led to positive, yet potentially, short term results, which contributed to an increasing deforestation within the Project Area from 2019 to 2021 (see table below).

It is important to note that after 2022, the Project Proponent and the landowners have developed complementary stakeholders' engagement activities. In addition, the Project Proponent and landowners developed programs to promote positive changes to local conditions, in a manner to contribute to forest conservation in the long term. It is expected that these activities will result in an increased effectiveness and reduced deforestation within the project area.

Table 87. Project effectiveness during the 1st Monitoring Period

Year	Projected deforestation (ex ante)	Actual deforestation (ex post)	Effectiveness Index
2019	167.16	4.6	97.3%
2020	1,342.77	52.9	96.1%
2021	1,673.38	66.1	96.0%
Total 1st Monitoring Period	**3,183.31**	**123.6**	**96.1%[239]**

Project initiatives will be fully implemented when the project be registered under the VCS and CCB Standards. Project certification will contribute to the deployment of solid programs and measures. In addition, the Project will be able to secure funding for the maintenance of proposed measures due to carbon financing.

[239] The EI calculation already takes into account the 20% discount applied to the baseline

Given the above, a very high project effectiveness can be reasonably expected. However, considering the complexity of REDD+ mechanisms and the importance of conservativeness, Project Proponents understand it is reasonable to consider an Effectiveness Index of 85% for all years of the crediting period. Hence, this value will be applied to the ex-ante estimate of net carbon stock change in the project area, as per methodology requirements. This parameter shall be reassessed at the next baseline reassessment, considering any additional methodological requirements and the ex post monitored results.

Therefore, the conservative effectiveness index was applied to the ex-ante estimate of net carbon stock change in the project area under the project scenario, shown in the table below:

Table 88. 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
2019	7,839	7,839	0	0	13,293	13,293	21,132	21,132
2020	49,511	57,350	80	80	106,978	120,271	156,409	177,542
2021	49,511	106,861	582	662	134,847	255,118	183,775	361,317
2022	49,511	156,372	1,085	1,746	147,801	402,919	196,227	557,544
2023	49,511	205,882	1,587	3,334	157,589	560,508	205,512	763,057
2024	49,511	255,393	2,090	5,423	163,731	724,239	211,152	974,209
2025	49,511	304,904	2,592	8,016	172,958	897,197	219,877	1,194,085
2026	49,511	354,415	3,095	11,111	178,389	1,075,586	224,805	1,418,891
2027	49,511	403,926	3,598	14,708	185,448	1,261,034	231,361	1,650,252
2028	49,511	453,437	4,100	18,808	189,516	1,450,550	234,926	1,885,178
2029	49,511	502,948	4,603	23,411	191,324	1,641,873	236,232	2,121,410
2030	49,511	552,458	5,105	28,516	193,660	1,835,533	238,066	2,359,476
2031	49,511	601,969	5,608	34,124	186,153	2,021,686	230,056	2,589,532
2032	49,511	651,480	6,110	40,234	175,952	2,197,638	219,352	2,808,884
2033	49,511	700,991	6,613	46,847	163,469	2,361,107	206,367	3,015,250
2034	49,511	750,502	7,115	53,963	152,572	2,513,679	194,968	3,210,218
2035	49,511	800,013	7,618	61,581	146,566	2,660,245	188,459	3,398,677
2036	49,511	849,523	8,121	69,701	133,862	2,794,108	175,252	3,573,930
2037	49,511	899,034	6,980	76,681	119,936	2,914,044	162,468	3,736,397
2038	49,511	948,545	6,980	83,660	111,949	3,025,993	154,480	3,890,877
2039	49,511	998,056	6,980	90,640	99,852	3,125,845	142,383	4,033,261
2040	49,511	1,047,567	6,980	97,620	91,717	3,217,562	134,249	4,167,509
2041	49,511	1,097,078	6,980	104,599	80,094	3,297,656	122,625	4,290,134
2042	49,511	1,146,588	6,980	111,579	70,158	3,367,815	112,690	4,402,824
2043	49,511	1,196,099	6,980	118,559	63,043	3,430,858	105,575	4,508,399
2044	49,511	1,245,610	6,980	125,538	53,853	3,484,711	96,384	4,604,783
2045	49,511	1,295,121	6,980	132,518	47,409	3,532,120	89,940	4,694,723
2046	49,511	1,344,632	6,980	139,497	39,425	3,571,545	81,956	4,776,679
2047	49,511	1,394,143	6,980	146,477	33,570	3,605,115	76,101	4,852,780
2048	49,511	1,443,654	6,980	153,457	29,337	3,634,451	71,868	4,924,648
2049	49,511	1,493,164	6,980	160,436	21,213	3,655,665	63,745	4,988,393

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

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

Where,

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

Furthermore, it is conservatively assumed that all unplanned deforestation within the project area will involve fire and all above ground biomass will be burnt. It is worth mentioning that the effect of fire on CO2 emissions is counted in the estimation of carbon stock changes in the parameter ΔCUDdPAt; therefore, CO2 emissions from forest fires should be ignored to avoid double counting.

Table 89. 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
2019	296.48	296.48
2020	2,381.54	2,678.02
2021	2,967.93	5,645.95
2022	3,213.05	8,859.00
2023	3,383.91	12,242.91
2024	3,470.94	15,713.85
2025	3,625.50	19,339.34
2026	3,693.10	23,032.45
2027	3,796.01	26,828.46
2028	3,830.70	30,659.16
2029	3,818.85	34,478.01
2030	3,849.74	38,327.75
2031	3,669.29	41,997.04
2032	3,435.04	45,432.08
2033	3,155.88	48,587.96
2034	2,917.51	51,505.48
2035	2,794.01	54,299.49
2036	2,523.95	56,823.43
2037	2,232.14	59,055.57
2038	2,077.59	61,133.16
2039	1,833.50	62,966.66
2040	1,681.84	64,648.51
2041	1,451.94	66,100.45
2042	1,259.63	67,360.07
2043	1,128.93	68,489.01
2044	950.37	69,439.37
2045	833.85	70,273.22
2046	680.74	70,953.97
2047	573.06	71,527.03
2048	500.86	72,027.89
2049	339.36	72,367.25

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 90. 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
2019	7,839	7,839	0	0	13,293	13,293	21,132	21,132	296	296
2020	49,511	57,350	80	80	106,978	120,271	156,409	177,542	2,382	2,678
2021	49,511	106,861	582	662	134,847	255,118	183,775	361,317	2,968	5,646
2022	49,511	156,372	1,085	1,746	147,801	402,919	196,227	557,544	3,213	8,859
2023	49,511	205,882	1,587	3,334	157,589	560,508	205,512	763,057	3,384	12,243
2024	49,511	255,393	2,090	5,423	163,731	724,239	211,152	974,209	3,471	15,714
2025	49,511	304,904	2,592	8,016	172,958	897,197	219,877	1,194,085	3,625	19,339
2026	49,511	354,415	3,095	11,111	178,389	1,075,586	224,805	1,418,891	3,693	23,032
2027	49,511	403,926	3,598	14,708	185,448	1,261,034	231,361	1,650,252	3,796	26,828
2028	49,511	453,437	4,100	18,808	189,516	1,450,550	234,926	1,885,178	3,831	30,659
2029	49,511	502,948	4,603	23,411	191,324	1,641,873	236,232	2,121,410	3,819	34,478
2030	49,511	552,458	5,105	28,516	193,660	1,835,533	238,066	2,359,476	3,850	38,328
2031	49,511	601,969	5,608	34,124	186,153	2,021,686	230,056	2,589,532	3,669	41,997
2032	49,511	651,480	6,110	40,234	175,952	2,197,638	219,352	2,808,884	3,435	45,432
2033	49,511	700,991	6,613	46,847	163,469	2,361,107	206,367	3,015,250	3,156	48,588
2034	49,511	750,502	7,115	53,963	152,572	2,513,679	194,968	3,210,218	2,918	51,505
2035	49,511	800,013	7,618	61,581	146,566	2,660,245	188,459	3,398,677	2,794	54,299
2036	49,511	849,523	8,121	69,701	133,862	2,794,108	175,252	3,573,930	2,524	56,823
2037	49,511	899,034	6,980	76,681	119,936	2,914,044	162,468	3,736,397	2,232	59,056
2038	49,511	948,545	6,980	83,660	111,949	3,025,993	154,480	3,890,877	2,078	61,133
2039	49,511	998,056	6,980	90,640	99,852	3,125,845	142,383	4,033,261	1,834	62,967
2040	49,511	1,047,567	6,980	97,620	91,717	3,217,562	134,249	4,167,509	1,682	64,649
2041	49,511	1,097,078	6,980	104,599	80,094	3,297,656	122,625	4,290,134	1,452	66,100
2042	49,511	1,146,588	6,980	111,579	70,158	3,367,815	112,690	4,402,824	1,260	67,360
2043	49,511	1,196,099	6,980	118,559	63,043	3,430,858	105,575	4,508,399	1,129	68,489
2044	49,511	1,245,610	6,980	125,538	53,853	3,484,711	96,384	4,604,783	950	69,439
2045	49,511	1,295,121	6,980	132,518	47,409	3,532,120	89,940	4,694,723	834	70,273
2046	49,511	1,344,632	6,980	139,497	39,425	3,571,545	81,956	4,776,679	681	70,954
2047	49,511	1,394,143	6,980	146,477	33,570	3,605,115	76,101	4,852,780	573	71,527
2048	49,511	1,443,654	6,980	153,457	29,337	3,634,451	71,868	4,924,648	501	72,028
2049	49,511	1,493,164	6,980	160,436	21,213	3,655,665	63,745	4,988,393	339	72,367

5.3 Leakage

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

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

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

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

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

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

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

Where,

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.

Table 91. 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
2019	0.00	0.00	0.00	0.00	0.00	0.00
2020	0.00	0.00	0.00	0.00	0.00	0.00
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

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[240]:

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

$$EgLK_t = ECH_4ferm_t + ECH_4man_t + EN_2Oman_t$$

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

According to the Local Stakeholder Consultation, it was considered that families located in the Leakage Management Area do not carry out cattle raising activities. Thus, emissions from grazing animals were not considered.

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

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

Activities that will cause deforestation within the project area in the baseline case could be displaced outside the project boundary due to the implementation of the AUD project activity. 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.

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

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

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

Where,

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

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

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

The DLF was estimated as 15%, based on default value of the VCS requirements, where the applied methodology requires the quantification of activity-shifting leakage.

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 used to estimate the decrease in carbon stocks, as follows.

$$EADLK_t = EBBBSPA_t * DLF$$

Where,

$EADLK_t$	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 92. 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
2019	13,293.27	13,293.27	296.48	296.48
2020	106,978.04	120,271.32	2,381.54	2,678.02
2021	134,846.56	255,117.87	2,967.93	5,645.95
2022	147,801.32	402,919.19	3,213.05	8,859.00
2023	157,588.84	560,508.04	3,383.91	12,242.91
2024	163,730.84	724,238.88	3,470.94	15,713.85
2025	172,958.21	897,197.09	3,625.50	19,339.34
2026	178,389.27	1,075,586.37	3,693.10	23,032.45
2027	185,447.73	1,261,034.10	3,796.01	26,828.46
2028	189,515.66	1,450,549.76	3,830.70	30,659.16
2029	191,323.56	1,641,873.31	3,818.85	34,478.01
2030	193,660.07	1,835,533.38	3,849.74	38,327.75
2031	186,152.94	2,021,686.32	3,669.29	41,997.04
2032	175,951.53	2,197,637.86	3,435.04	45,432.08
2033	163,468.72	2,361,106.58	3,155.88	48,587.96
2034	152,572.46	2,513,679.04	2,917.51	51,505.48
2035	146,566.29	2,660,245.33	2,794.01	54,299.49
2036	133,862.21	2,794,107.54	2,523.95	56,823.43
2037	119,936.36	2,914,043.90	2,232.14	59,055.57
2038	111,948.81	3,025,992.72	2,077.59	61,133.16
2039	99,852.06	3,125,844.77	1,833.50	62,966.66
2040	91,717.43	3,217,562.20	1,681.84	64,648.51
2041	80,093.91	3,297,656.11	1,451.94	66,100.45
2042	70,158.47	3,367,814.57	1,259.63	67,360.07
2043	63,043.28	3,430,857.85	1,128.93	68,489.01
2044	53,853.21	3,484,711.06	950.37	69,439.37
2045	47,408.53	3,532,119.59	833.85	70,273.22
2046	39,424.95	3,571,544.55	680.74	70,953.97
2047	33,569.98	3,605,114.53	573.06	71,527.03
2048	29,336.76	3,634,451.30	500.86	72,027.89
2049	21,213.46	3,655,664.75	339.36	72,367.25

Ex ante estimation of total leakage

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

$$\Delta CLK_t = \Delta CADLK_t + \Delta CLPMLK_t$$

Where,

ΔCLK_t Total decrease in carbon stocks within the leakage belt at year t; tCO_2e

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

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

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

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

$$ELK_t = EgLK_t + EADLK_t$$

Where,

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

$EgLK_t$ Emissions from grazing animals in leakage management areas at year t; tCO_2e

$EADLK_t$ Total *ex ante* increase in GHG emissions due to displaced forest fires at year t; tCO_2e

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

Table 93. 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	$\Delta CADLK_t$	$\Delta CADLK$	$\Delta CLPMLK_t$	$\Delta CLPMLK$	ΔCLK_t	ΔCLK	ELK_t	ELK
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2019	0.00	0.00	296.48	296.48	13,293.27	13,293.27	0.00	0.00	13,293.27	13,293.27	296.48	296.48
2020	0.00	0.00	2,381.54	2,678.02	106,978.04	120,271.32	0.00	0.00	106,978.04	120,271.32	2,381.54	2,678.02
2021	0.00	0.00	2,967.93	5,645.95	134,846.56	255,117.87	0.00	0.00	134,846.56	255,117.87	2,967.93	5,645.95
2022	0.00	0.00	3,213.05	8,859.00	147,801.32	402,919.19	0.00	0.00	147,801.32	402,919.19	3,213.05	8,859.00
2023	0.00	0.00	3,383.91	12,242.91	157,588.84	560,508.04	0.00	0.00	157,588.84	560,508.04	3,383.91	12,242.91
2024	0.00	0.00	3,470.94	15,713.85	163,730.84	724,238.88	0.00	0.00	163,730.84	724,238.88	3,470.94	15,713.85
2025	0.00	0.00	3,625.50	19,339.34	172,958.21	897,197.09	0.00	0.00	172,958.21	897,197.09	3,625.50	19,339.34
2026	0.00	0.00	3,693.10	23,032.45	178,389.27	1,075,586.37	0.00	0.00	178,389.27	1,075,586.37	3,693.10	23,032.45
2027	0.00	0.00	3,796.01	26,828.46	185,447.73	1,261,034.10	0.00	0.00	185,447.73	1,261,034.10	3,796.01	26,828.46
2028	0.00	0.00	3,830.70	30,659.16	189,515.66	1,450,549.76	0.00	0.00	189,515.66	1,450,549.76	3,830.70	30,659.16
2029	0.00	0.00	3,818.85	34,478.01	191,323.56	1,641,873.31	0.00	0.00	191,323.56	1,641,873.31	3,818.85	34,478.01
2030	0.00	0.00	3,849.74	38,327.75	193,660.07	1,835,533.38	0.00	0.00	193,660.07	1,835,533.38	3,849.74	38,327.75
2031	0.00	0.00	3,669.29	41,997.04	186,152.94	2,021,686.32	0.00	0.00	186,152.94	2,021,686.32	3,669.29	41,997.04
2032	0.00	0.00	3,435.04	45,432.08	175,951.53	2,197,637.86	0.00	0.00	175,951.53	2,197,637.86	3,435.04	45,432.08
2033	0.00	0.00	3,155.88	48,587.96	163,468.72	2,361,106.58	0.00	0.00	163,468.72	2,361,106.58	3,155.88	48,587.96
2034	0.00	0.00	2,917.51	51,505.48	152,572.46	2,513,679.04	0.00	0.00	152,572.46	2,513,679.04	2,917.51	51,505.48
2035	0.00	0.00	2,794.01	54,299.49	146,566.29	2,660,245.33	0.00	0.00	146,566.29	2,660,245.33	2,794.01	54,299.49
2036	0.00	0.00	2,523.95	56,823.43	133,862.21	2,794,107.54	0.00	0.00	133,862.21	2,794,107.54	2,523.95	56,823.43
2037	0.00	0.00	2,232.14	59,055.57	119,936.36	2,914,043.90	0.00	0.00	119,936.36	2,914,043.90	2,232.14	59,055.57
2038	0.00	0.00	2,077.59	61,133.16	111,948.81	3,025,992.72	0.00	0.00	111,948.81	3,025,992.72	2,077.59	61,133.16
2039	0.00	0.00	1,833.50	62,966.66	99,852.06	3,125,844.77	0.00	0.00	99,852.06	3,125,844.77	1,833.50	62,966.66
2040	0.00	0.00	1,681.84	64,648.51	91,717.43	3,217,562.20	0.00	0.00	91,717.43	3,217,562.20	1,681.84	64,648.51
2041	0.00	0.00	1,451.94	66,100.45	80,093.91	3,297,656.11	0.00	0.00	80,093.91	3,297,656.11	1,451.94	66,100.45
2042	0.00	0.00	1,259.63	67,360.07	70,158.47	3,367,814.57	0.00	0.00	70,158.47	3,367,814.57	1,259.63	67,360.07
2043	0.00	0.00	1,128.93	68,489.01	63,043.28	3,430,857.85	0.00	0.00	63,043.28	3,430,857.85	1,128.93	68,489.01
2044	0.00	0.00	950.37	69,439.37	53,853.21	3,484,711.06	0.00	0.00	53,853.21	3,484,711.06	950.37	69,439.37
2045	0.00	0.00	833.85	70,273.22	47,408.53	3,532,119.59	0.00	0.00	47,408.53	3,532,119.59	833.85	70,273.22
2046	0.00	0.00	680.74	70,953.97	39,424.95	3,571,544.55	0.00	0.00	39,424.95	3,571,544.55	680.74	70,953.97
2047	0.00	0.00	573.06	71,527.03	33,569.98	3,605,114.53	0.00	0.00	33,569.98	3,605,114.53	573.06	71,527.03
2048	0.00	0.00	500.86	72,027.89	29,336.76	3,634,451.30	0.00	0.00	29,336.76	3,634,451.30	500.86	72,027.89
2049	0.00	0.00	339.36	72,367.25	21,213.46	3,655,664.75	0.00	0.00	21,213.46	3,655,664.75	339.36	72,367.25

5.4 Estimated Net GHG Emission Reductions and Removals

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

$$\Delta REDD_t = (\Delta CBSLPA_t + EBBBSLPA_t) - (\Delta CPSPA_t + EBBPSPA_t) - (\Delta CLK_t + ELK_t)$$

Where:

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

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

$$VCU_t = \Delta REDD_t - VBC_t$$

$$VBC_t = (\Delta CBSLPA_t - \Delta CPSPA_t) * RF_t$$

Where:

VCUt	Number of Verified Carbon Units that can be traded at time t; t CO2e
ΔREDDt	Ex ante estimated net anthropogenic greenhouse gas emission reduction attributable to the AUD project activity at year t; tCO2e

VBCt	Number of Buffer Credits deposited in the VCS Buffer at time t; t CO2e
ΔCBSLPAt	Sum of baseline carbon stock changes in the project area at year t; tCO2e
ΔCPSPAt	Sum of ex ante estimated actual carbon stock changes in the project area at year t; tCO2e ha-1
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 12%.

The present REDD project is expected to avoid a predicted 34,681.91 ha of deforestation, equating to 16,053,622 tonCO_2e in emissions reductions over the 30-year project lifetime (23-October-2019 to 22-October-2049), with an annual average of 535,121 tCO_2e, considering the three instances.

Table 94. Ex ante estimated net anthropogenic GHG emission reductions (ΔREDDt) and Verified Carbon Units (VCUt)

Project year	Baseline carbon stock changes		Baseline GHG emissions from biomass burning		Ex ante project carbon stock changes		Ex ante project GHG emissions from biomass burning		Ex ante leakage carbon stock changes		Ex ante leakage GHG emissions		Ex ante net anthropogenic GHG emission reductions		Ex ante VCUs tradable		Ex ante buffer credits	
	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	$\Delta CBSLPA_t$	$\Delta CBSLPA$	$EBBBSLPA_t$	$EBBBSLPA$	$\Delta CPSPA_t$	$\Delta CPSPA$	$EBBPSPA_t$	$EBBPSPA$	ΔCLK_t	ΔCLK	ELK_t	ELK	$\Delta REDD_t$	$\Delta REDD$	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
2019	88,622	88,622	1,977	1,977	21,132	21,132	296	296	13,293	13,293	296	296	55,580	55,580	47,481	47,481	8,099	8,099
2020	713,187	801,809	15,877	17,853	156,409	177,542	2,382	2,678	106,978	120,271	2,382	2,678	460,913	516,493	394,100	441,581	66,813	74,912
2021	898,977	1,700,786	19,786	37,640	183,775	361,317	2,968	5,646	134,847	255,118	2,968	5,646	594,206	1,110,699	508,381	949,962	85,824	160,736
2022	985,342	2,686,128	21,420	59,060	196,227	557,544	3,213	8,859	147,801	402,919	3,213	8,859	656,308	1,767,006	561,614	1,511,576	94,694	255,430
2023	1,050,592	3,736,720	22,559	81,619	205,512	763,057	3,384	12,243	157,589	560,508	3,384	12,243	703,283	2,470,289	601,873	2,113,449	101,410	356,840
2024	1,091,539	4,828,259	23,140	104,759	211,152	974,209	3,471	15,714	163,731	724,239	3,471	15,714	732,854	3,203,143	627,208	2,740,657	105,646	462,486
2025	1,153,055	5,981,314	24,170	128,929	219,877	1,194,085	3,625	19,339	172,958	897,197	3,625	19,339	777,139	3,980,282	665,157	3,405,814	111,981	574,467
2026	1,189,262	7,170,576	24,621	153,550	224,805	1,418,891	3,693	23,032	178,389	1,075,586	3,693	23,032	803,302	4,783,584	687,567	4,093,381	115,735	690,202
2027	1,236,318	8,406,894	25,307	178,856	231,361	1,650,252	3,796	26,828	185,448	1,261,034	3,796	26,828	837,224	5,620,808	716,629	4,810,011	120,595	810,797
2028	1,263,438	9,670,332	25,538	204,394	234,926	1,885,178	3,831	30,659	189,516	1,450,550	3,831	30,659	856,872	6,477,680	733,451	5,543,462	123,421	934,218
2029	1,275,490	10,945,822	25,459	229,853	236,232	2,121,410	3,819	34,478	191,324	1,641,873	3,819	34,478	865,756	7,343,436	741,045	6,284,507	124,711	1,058,929
2030	1,291,067	12,236,889	25,665	255,518	238,066	2,359,476	3,850	38,328	193,660	1,835,533	3,850	38,328	877,307	8,220,743	750,947	7,035,453	126,360	1,185,290
2031	1,241,020	13,477,909	24,462	279,980	230,056	2,589,532	3,669	41,997	186,153	2,021,686	3,669	41,997	841,934	9,062,677	720,618	7,756,072	121,316	1,306,605
2032	1,173,010	14,650,919	22,900	302,881	219,352	2,808,884	3,435	45,432	175,952	2,197,638	3,435	45,432	793,737	9,856,414	679,298	8,435,370	114,439	1,421,044
2033	1,089,791	15,740,711	21,039	323,920	206,367	3,015,250	3,156	48,588	163,469	2,361,107	3,156	48,588	734,684	10,591,097	628,673	9,064,042	106,011	1,527,055
2034	1,017,150	16,757,860	19,450	343,370	194,968	3,210,218	2,918	51,505	152,572	2,513,679	2,918	51,505	683,224	11,274,322	584,563	9,648,605	98,662	1,625,717
2035	977,109	17,734,969	18,627	361,997	188,459	3,398,677	2,794	54,299	146,566	2,660,245	2,794	54,299	655,122	11,929,444	560,484	10,209,089	94,638	1,720,355
2036	892,415	18,627,384	16,826	378,823	175,252	3,573,930	2,524	56,823	133,862	2,794,108	2,524	56,823	595,078	12,524,522	509,019	10,718,108	86,059	1,806,414
2037	799,576	19,426,959	14,881	393,704	162,468	3,736,397	2,232	59,056	119,936	2,914,044	2,232	59,056	527,588	13,052,111	451,135	11,169,243	76,453	1,882,867
2038	746,325	20,173,285	13,851	407,554	154,480	3,890,877	2,078	61,133	111,949	3,025,993	2,078	61,133	489,592	13,541,703	418,571	11,587,814	71,021	1,953,889
2039	665,680	20,838,965	12,223	419,778	142,383	4,033,261	1,834	62,967	99,852	3,125,845	1,834	62,967	432,001	13,973,704	369,206	11,957,020	62,796	2,016,685
2040	611,450	21,450,415	11,212	430,990	134,249	4,167,509	1,682	64,649	91,717	3,217,562	1,682	64,649	393,332	14,367,036	336,068	12,293,088	57,264	2,073,949
2041	533,959	21,984,374	9,680	440,670	122,625	4,290,134	1,452	66,100	80,094	3,297,656	1,452	66,100	338,016	14,705,052	288,656	12,581,743	49,360	2,123,309
2042	467,723	22,452,097	8,398	449,067	112,690	4,402,824	1,260	67,360	70,158	3,367,815	1,260	67,360	290,753	14,995,805	248,149	12,829,893	42,604	2,165,913
2043	420,289	22,872,386	7,526	456,593	105,575	4,508,399	1,129	68,489	63,043	3,430,858	1,129	68,489	256,939	15,252,745	219,173	13,049,066	37,766	2,203,678
2044	359,021	23,231,407	6,336	462,929	96,384	4,604,783	950	69,439	53,853	3,484,711	950	69,439	213,219	15,465,963	181,702	13,230,768	31,516	2,235,195
2045	316,057	23,547,464	5,559	468,488	89,940	4,694,723	834	70,273	47,409	3,532,120	834	70,273	182,600	15,648,563	155,466	13,386,234	27,134	2,262,329
2046	262,833	23,810,297	4,538	473,026	81,956	4,776,679	681	70,954	39,425	3,571,545	681	70,954	144,629	15,793,192	122,923	13,509,158	21,705	2,284,034
2047	223,800	24,034,097	3,820	476,847	76,101	4,852,780	573	71,527	33,570	3,605,115	573	71,527	116,803	15,909,995	99,079	13,608,237	17,724	2,301,758
2048	195,578	24,229,675	3,339	480,186	71,868	4,924,648	501	72,028	29,337	3,634,451	501	72,028	96,711	16,006,706	81,866	13,690,103	14,845	2,316,603
2049	114,301	24,343,976	1,829	482,014	51,520	4,976,168	274	72,302	17,145	3,651,596	274	72,302	46,916	16,053,622	39,382	13,729,485	7,534	2,324,137

6 MONITORING

6.1 Data and Parameters Available at Validation

Data / Parameter	CF
Data unit	tC/tdm
Description	Default value of carbon fraction in biomass
Source of data	SILVA, Jéssika Luane. Danos florestais e estimativa da redução no estoque de carbono em áreas de manejo florestal sob concessão pública: Floresta Nacional do Jamari. 2014. Disertação (mestrado) - INPA, Manaus, 2014. Available at: <https://repositorio.inpa.gov.br/handle/1/5065>. Last visit on 09/December/2022.
Value applied	0.48
Justification of choice of data or description of measurement methods and procedures applied	Adopted data can be considered consistent since such conversion factor was used by Silva (2014), which is the adopted reference for carbon stock for the Rio Madeira REDD+ Project. Moreover, this study was carried out in the State of Rondônia (southern Amazon), where properties are located. In addition, Silva (2014) is more recent when compared to IPCC (2003) or IPCC (2006). Furthermore, the National Forestry Service (SNIF) reinforces the adoption of 0.48 as conservative conversion factor since SNIF informs carbon represents 50% of biomass.
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 tCO2e/ha

Source of data	The average classification of post-deforestation land-uses within the reference region during the historical reference period was conducted through MapBiomas. Average carbon stocks of pastureland, agriculture and other land uses – National GHG Emissions Communication of Brazil to the UNFCCC (2019) - Available at: https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/sirene/publicacoes/comunicacoes-nacionais-do-brasil-a-unfccc/arquivos/3tcn_volume_3.pdf Secondary Forest average carbon stocks - Pereira, Izaura Cristina Nunes. Estoque de biomassa e carbono florestal em unidades de paisagem na Amazônia: uma análise a partir da abordagem metodológica. Universidade Federal do Pará, , Belém, 2013. Available at: https://ppgdstu.propesp.ufpa.br/ARQUIVOS/teses/TESES/2013/IZAURA%20CRISTINA%20NUNES%20PEREIRA.pdf Belowground biomass – Root to shoot ratio available at VM0015. A weighted average of the post-deforestation carbon stocks was done, considering the % of area for each land use.
Value applied	$Ctot_{fcl}$ +90% (within PA): 41.39 $Ctot_{fcl}$ -90% (within LB): 28.38
Justification of choice of data or description of measurement methods and procedures applied	Most of post-deforestation land uses within the reference region is composed by pasturelands. In order to estimate the post-deforestation carbon stocks, the average carbon stocks of pasturelands, agriculture and other land uses were taken from the National GHG Emissions Communication of Brazil to the UNFCCC (2019) . For secondary forests, a regional study was conducted. Most secondary forests in the Brazilian Amazon are young. In 2017, 65% of secondary forests was ≤10 years old. On average, 35% of annual land abandonment to secondary forests was re-cleared within 5 years, and 57% within 10 years . The half-life of secondary forests is 8 years, on average, which is also the same value found by other study that concludes that more than 50% of the secondary forests in the Amazon biome have less than 8 years old. According to the referenced study, conducted in the State of Pará, that analyzed the carbon stocks of a secondary forest with 14 years old, the average carbon stock in above ground biomass is around 19 tC/ha. Below ground biomass was estimated through the root-to-shoot ratio from the applied methodology. Therefore, the average value for secondary forests is around 22,8 tC/ha. The applied value was obtained with the weighted average of the carbon stock and land use.

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. According to the adopted methodology, if uncertainty is higher than 10%, the lower boundary of the 90% confidence interval should be considered for final non-forest class in the leakage belt. In the other hand, the same error condition implies that the higher boundary of the 90% confidence interval should be considered for final non-forest class in the project area, as follows: Please see detailed calculation at VCSPD Spreadsheet Table 16p.

Data / Parameter	DLF
Data unit	%
Description	Displacement Leakage Factor
Source of data	According to VCS requirements, where the applied methodology requires the quantification of activity-shifting leakage, projects may apply the optional default activity-shifting leakage deduction of 15 percent to the gross GHG emission reductions and/or removals.
Value applied	15
Justification of choice of data or description of measurement methods and procedures applied	The DLF was estimated as 15%, based on default value of the VCS requirements, where the applied methodology requires the quantification of activity-shifting leakage
Purpose of Data	This parameter is used to calculate leakage emissions in the baseline scenario due to activity displacement leakage, providing an *ex ante* estimation of the decrease in carbon stocks and increase in GHG emissions. This value was calculated based on the percent of deforestation expected to be displaced outside the project boundary due to the implementation of the AUD project activity.
Comments	*Ex post* monitoring of the leakage belt will be done to determine deforestation rate outside the project area and the leakage emissions and carbon stock decrease. This parameter will be updated at each renewal of fixed baseline period.

Data / Parameter	Dm
Data unit	g/cm³
Description	Mean wood density
Source of data	NOGUEIRA, E. M. Densidade de Madeira e Alometria de Árvores em Florestas do 'Arco do Desmatamento': Implicações para Biomassa e Emissão de Carbono a partir de Mudanças de Uso da Terra na Amazônia Brasileira (Wood Density and Tree Allometry in 'Arc of Deforestation' Forests: Implications for Biomass and Carbon Emissions from Land Use Change in the Brazilian Amazon). 2008. 151 pages. Doctor Thesis - Tropical Rainforest Science Course, INPA, Manaus, 2008.
Value applied:	0.589
Justification of choice of data or description of measurement methods and procedures applied	The mean wood density presented in Nogueira (2008) was obtained from the Brazilian Amazon, where the project region is located. The value is for the Open Tropical Rainforest in the state of Rondônia. (Table 3 of the referred study).
Purpose of Data	This parameter is used to calculate baseline, project and leakage emissions through the conversion from m³ to tons for estimating above-ground biomass from local forest inventories.
Comments	Furthermore, it is also used to calculate project emissions from logging activities occurred in the project scenario due to sustainable forest management. Carbon stock decrease due to planned logging activities were calculated through multiplying the harvested volume by the mean wood density. Carbon stock increase due to natural regeneration after periodical harvest cycle can be calculated through multiplying the mean annual increment by the mean wood density.

Data / Parameter	$\Delta CBSLLK_t$
Data unit	tCO_2e
Description	Annual carbon stock changes in leakage management areas in the baseline case at year t

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

Data / Parameter	$EBBBSLPA_t$
Data unit	tCO_2e
Description	Sum of (or total) baseline non-CO2 emissions from forest fire at year t in the project area
Source of data	Remote sensing data and GIS, supervisor reports.
Value applied	16,081.61 (Annual average actual non-CO_2 emissions due to biomass burning within the project area during the crediting period)
Justification of choice of data or description of measurement methods and procedures applied	Slash-and-burn deforestation to clear the area is carried out for subsistence agriculture, which is the main cause of deforestation within the project area. Therefore, baseline deforestation in the project area involves fire and all above ground biomass is burnt. Non-CO_2 emissions from biomass burning are calculated according to requirements of methodology VM0015 v1.1. In order to estimate non-CO_2 emissions from forest fires, the average percentage of the area which contemplates the three municipalities within the RR that was cleared by burning for other land uses involving deforestation, such as cattle raising and

	farming (Fburnt), and the average of biomass that has commercial value, and could be removed prior to clear cutting and burning (Pburnt,p) were estimated, either for the baseline and project case. Baseline deforestation in the project area involves fire and all above ground biomass is burnt to clear the area. Therefore, this parameter is estimated as the multiplication of the annual area of deforestation of initial forest classes in the project area in the baseline scenario (ABSLPAicl,t) times the total GHG emission from biomass burning in initial forest classes (EBBtoticl,t).
Purpose of data	This parameter is used to calculate non-CO_2 emissions due to forest fires within the project area in the baseline scenario, providing an ex-ante estimation.
Comments	Ex post monitoring of forest fires and non-CO_2 emissions (EBBPSPAt) will be done to determine GHG emissions within the project area (when the forest fire was significant).

Data / Parameter	$Fburnt_{icl}$
Data unit	%
Description	Proportion of forest area burned during the historical reference period in the forest class.
Source of data	*Fburnt* data source: 3ª Comunicação nacional do Brasil à convenção-quadro das Nações Unidas sobre Mudança do Clima (3rd national communication to UNFCCC) – volume 3[241]
Value applied	45%
Justification of choice of data or description of measurement methods and procedures applied	Official data from Brazilian Government. The data considers the combustion factor for the phytophysiognomies "Florestas Ombrófilas Abertas", which can be considered similar to Open Submontane Tropical Rainforest.
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.

[241] Available at http://www.ccst.inpe.br/publicacao/terceira-comunicacao-nacional-do-brasil-a-convencao-quadro-das-nacoes-unidas-sobre-mudanca-do-clima-portugues/ Last visit on 24/October/2022

Data / Parameter	$Pburnt_{p,icl}$
Data unit	%
Description	Average proportion of mass burnt in the carbon pool in the forest class
Source of data	Measured or estimated from literature. *Pburnt data source:* Anderson LO, Aragão LE, Gloor M, et al. **Disentangling the contribution of multiple land covers to fire-mediated carbon emissions in Amazonia during the 2010 drought.** Global Biogeochem Cycles. 2015; 29 (10):1739-1753. Doi: 10.1002/2014GB005008. Available at <https://agupubs.onlinelibrary.wiley.com/doi/10.1002/2014GB005008>. Last visited on August 2022.
Value applied	78
Justification of choice of data or description of measurement methods and procedures applied	Pburnt was estimated using the average biomass per hectare that has commercial value and could be removed prior to clear cutting and burning. Based on literature, an average value of 61.6 m^3/ha was obtained, which would correspond to approximately 11% of the total biomass in 1 ha. In this way, the remaining is burned to clear the area, therefore, its new value is 88.6%. However, due to the lack of literature estimates, a study from the Brazilian Amazon in the Cerrado vegetation was used for the comparison. This study reported that the total biomass consumed by fires varies from 72% to 84% (average 78%) in denser Cerrado types, which is a forest vegetation. The most conservative value between these two estimates were used, i.e., Pburnt was estimated as 78%. It is important to note that slash and burn practices are commonly used in the Amazon region to clear the area for other land uses thus, when burning an area, the main objective is to completely remove all the remaining biomass. Therefore, assuming that 78% of the biomass is combusted, there would still be a 22% remaining biomass that shall be left to decompose, which also emits GHG to the atmosphere in this process.
Purpose of data	This parameter is the average of biomass that has commercial value, and could be removed prior to clear cutting and burning, and is used to calculate baseline and project non-CO_2 emissions from forest fire at year t in the project area (parameter EBBBSLPAt).

Comments	Monitoring is done only once at project start.

Data / Parameter	EI
Data unit	%
Description	*Ex ante* estimated effectiveness index
Source of data	Conservation implemented and short-term planned activities Observed deforestation data
Value applied	85%
Justification of choice of data or description of measurement methods and procedures applied	It was considered ex-ante and ex-post deforestation data within project area for the 1st monitoring period (2019-2021), where a relevant 96% index was achieved. Such performance can be attributed to area control activities, such as surveillance and remote sense activities. Additional approaches are to be implemented by Project Proponent and landowners, since complementary activities are recommended by literature to tackle deforestation in medium and long term[242]. The plan is based on five plans that integrate the Project's Theory of Change: • Adaptation and improvement of infrastructure • Continuous Communication and Stakeholder Engagement • Conservation and Monitoring of Biodiversity and Ecosystem Resources • Capacity Building and Support to Promote Sustainable Production Practices • Monitoring and Forest Integrity Considering the abovementioned programs implementation is in progress, a conservative index of 85% was applied.
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

[242] Many studies indicate how complex is the long-term conservation of the Amazon. Supporting information is available on the following publication from IPAM: "Soluções para o desmatamento na Amazônia", dated March, 2023. This document provides a set of solutions to prevent deforestation that range from command and control measures to increasing agricultural productivity and increasing land tenure to prevent land grabbing, which are all complex initiatives. Document available at: https://ipam.org.br/wp-content/uploads/2023/03/Amazoniar-Solucoes-para-o-desmatamento-na-Amazonia-VF.pdf.

	the project area, based on the effectiveness of the proposed project activities to reduce the deforestation.
Comments	*Ex post* monitoring of the project area will be done to determine deforestation rate and the project emissions. This parameter will be updated at each renewal of fixed baseline period.

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. 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. If new and more accurate harvest intensity data become available, these can be used to estimate project emissions.

6.2 Data and Parameters Monitored

Data / Parameter	ab_{icl}
Data unit	Mg/ha
Description	Average biomass stock per hectare in the above-ground biomass pool of initial forest class icl in Mg/ha.
Source of data	Average values for the above-ground biomass were taken from the following study: SILVA, Jéssika Luane. Danos florestais e estimativa da redução no estoque de carbono em áreas de manejo florestal sob concessão pública: Floresta Nacional do Jamari. 2014. Dissertação (mestrado) - INPA, Manaus, 2014.
Description of measurement methods and procedures to be applied	The following sources will be monitored: - Biomass stock surveys - Periodic reports from area supervisor - Local Forest Inventories
Frequency of monitoring/recording	Whenever current study should be replaced to meet methodology requirements.
Value applied	

	Above-ground biomass			
	ab_{icl} (Mg/ha)			
ID_{icl}	Vegetation	Reference Region	Project Area	Leakage Belt
1	Forest	294.16	294.17	294.17

Monitoring equipment	No monitoring equipment is used to determine this parameter.

QA/QC procedures to be applied	Data shall be in accordance with VM0015 v1.1 requirements
Purpose of data	This parameter is used to calculate baseline emissions, project emissions and leakage emissions in both baseline and project scenarios.
Calculation method	Following a literature search the above-ground biomass values of these studies were used as they were determined to accurately represent the values of vegetation within the project reference region.
Comments	The values will be reassessed every 6 years or when data is more than 10 years old, whichever occurs first.

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

	Below-ground biomass			
	bb_{icl} (Mg/ha)			
ID_{icl}	Vegetation	Reference Region	Project Area	Leakage Belt
1	Forest	70.60	70.60	70.60

Monitoring equipment	No monitoring equipment is used to determine this parameter.

QA/QC procedures to be applied	Data shall be in accordance to VM0015 v1.1 requirements
Purpose of data	This parameter is used to calculate baseline, project and leakage emissions in the baseline and project scenarios.
Calculation method	Calculation according to the applied methodology VM0015 v1.1, which estimates a root-to-shoot ratio of 0.24 for tropical rainforest having above ground biomass values above 125 tons/ha, and 0.20 for values below 125 tons/ha.
Comments	The values will be reassessed every 6 years or when data is more than 10 years old, whichever occurs first.

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, - Forest management team and other field data.
Description of measurement methods and procedures to be applied	In addition to field data from the management team, he following sources will also be monitored: - INMET[243] - INPE[244]
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: - INMET - INPE - Field data from the management team

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

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

Data / Parameter	$ABSLLK_t$
Data unit	Ha
Description	Annual average 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	The table below shows the annual average deforestation projected in the leakage belt during the crediting period.

Leakage Belt	$ABSLLK_t$ (ha)
Forest	715.54

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 ante* 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	The table below shows the annual average projected deforestation in the project area for each instance 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 values of the deforested area within the project area.
Calculation method	Analysis of satellite images and maps.
Comments	N/A

Instance	$ABSLPA_t$ (ha)
Grupo Rovema (Instance 1)	534.07
Grupo Leite (Instance 2)	340.69
Grupo Tupa (Instance 3)	485.31

Data / Parameter	$ABSLRR_t$

Data unit	Ha
Description	Annual average 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	The table below shows the annual average deforestation within the reference region during the crediting period.

Instance	$ABSLRR_t$ (ha)
Forest	15,415.95

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* value of the deforested area within the reference region.
Calculation method	Analysis of satellite images and maps.
Comments	N/A

Data / Parameter	APDPAicl,t
Data unit	Hectare
Description	Areas of planned deforestation in forest class icl at year t in the project area
Source of data	- Annual operational plan; - Annual post-harvesting report; - 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:	The table below shows the annual average planned deforestation expected to occur within the project area for each instance during the crediting period.

Instance	$APDPA_{icl,t}$ (ha)
Grupo Rovema (Instance 1)	7.03
Grupo Leite (Instance 2)	0.00
Grupo Tupá (Instance 3)	1.47

Monitoring equipment	- Remote sensing and GIS - Forest Management team, based on the Sustainable Forest Management Plan
QA/QC procedures applied	- Best practices in remote sensing. - Internal procedures required by the SFMP.
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 1.50% 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.

Data / Parameter	APLPAicl,t

<table>
<tr><td>Data unit</td><td>Hectare</td></tr>
<tr><td>Description</td><td>Areas of planned logging activities in forest class icl at year t in the project area</td></tr>
<tr><td>Source of data</td><td>- Annual operational plan;
- Annual post-harvesting report;
- Remote sensing and GIS.</td></tr>
<tr><td>Description of measurement methods and procedures applied</td><td>The planned logging activities in the project area that resulted in carbon stock increase or decrease shall be subjected to monitoring, when significant.</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>Annually</td></tr>
<tr><td>Value applied:</td><td>The table below shows the annual average planned logging areas expected to occur within the project area for each vegetation type during the crediting period.
<table>
<tr><th>Vegetation type</th><th>$APLPA_{icl,t}$ (ha)</th></tr>
<tr><td>Grupo Rovema (Instance 1)</td><td>465.40</td></tr>
<tr><td>Grupo Leite (Instance 2)</td><td>0.00</td></tr>
<tr><td>Grupo Tupa (Instance 3)</td><td>98.32</td></tr>
</table></td></tr>
<tr><td>Monitoring equipment</td><td>- Remote sensing and GIS
- Forest Management team, based on the Sustainable Forest Management Plan</td></tr>
<tr><td>QA/QC procedures applied</td><td>- Best practices in remote sensing.
- Internal procedures required by the SFMP.</td></tr>
<tr><td>Purpose of data</td><td>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.</td></tr>
<tr><td>Calculation method</td><td>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.

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</td></tr>
</table>

	regeneration of managed forests, and then by the mean wood density.
Comments	16,911.61 ha are subject to sustainable forest management (13,961.97 ha in instance 1 and 2,949.64 in instance 3). Considering that each annual productive unit (APU) shall be left for natural regeneration for 30 years after harvesting, the average size of each APU is around 465.40 hectares (instance 1) and 98.32 hectares (Instance 3). 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	Hectare
Description	Areas of unplanned deforestation in forest class icl at year t in the project area
Source of data	- Remote sensing and GIS. - 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:	The table below shows the annual average unplanned deforestation expected to occur within the project area for each Instance during the crediting period.

Instance	$AUDPA_{icl,t}$ (ha)
Grupo Rovema (Instance 1)	80.11
Grupo Leite (instance 2)	51.10
Grupo Tupá (Instance 3)	72.80
Total	**204.01**

Monitoring equipment	- Remote sensing and GIS - 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 15% of the projected deforestation (ABSLPAt) would occur within the project area, according to the Effectiveness Index parameter.
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	121,855.49 (Annual average projected decrease in carbon stocks due to displaced deforestation in the leakage belt during the crediting period)
Monitoring equipment	Remote sensing and GIS.
QA/QC procedures to be applied	Best practices in remote sensing.
Purpose of data	This parameter will be used to calculate leakage emissions in the project scenario. Provides the *ex post* value of the decrease in carbon stocks due to displaced deforestation in the leakage belt.

Calculation method	Emissions from deforestation at each forest class are estimated by multiplying the detected area of forest loss by the average forest carbon stock per unit area.
Comments	Where evidence can be collected that deforestation in the leakage belt is attributable to deforestation agents that are not linked to the project area, the detected deforestation may not be attributed to the project activity and therefore, not considered leakage.

Data / Parameter	ΔCPAdPAt
Data unit	tCO2e
Description	Total decrease in carbon stock due to all planned activities at year t in the project area
Source of data	Documents, remote sensing and GIS.
Description of measurement methods and procedures to be applied	The planned activities in the project area that result in carbon stock decrease will be subject to monitoring, when significant.
Frequency of monitoring/recording	Annually
Value applied	49,772.15 (Annual average decrease in carbon stocks due to all planned activities within the project area during the crediting period)
Monitoring equipment	Remote sensing and GIS SFMP reports, including the post-harvesting annual report.
QA/QC procedures to be applied	- Best practices in remote sensing. - Internal procedures required by the SFMP and forest certification
Purpose of data	This parameter is used to calculate project emissions in the project scenario. Provides the ex post value of the decrease in carbon stocks due to planned activities in the project area.
Calculation method	This parameter is the sum of: carbon stock decrease due to planned deforestation, carbon stock decrease due to planned logging activities, and carbon stock decrease due to planned fuel-wood and charcoal activities.
Comments	N/A

Data / Parameter	$\Delta CPSLK_t$
Data unit	tCO_2e
Description	Total annual carbon stock change in leakage management areas in the project case at year t
Source of data	- Activities report related to leakage prevention measures - Field assessment - Remote sensing and GIS
Description of measurement methods and procedures to be applied	The planned activities in leakage management areas that result in carbon stock decrease will be subject to monitoring, when significant.
Frequency of monitoring/recording	Annually
Value applied	0
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing.
Purpose of data	This parameter will be used to calculate leakage emissions in the project scenario. Provides the *ex post* value of the change in carbon stocks due to leakage prevention measures in the leakage management area.
Calculation method	Emissions from deforestation are estimated by multiplying the detected area of forest loss by the average forest carbon stock per unit area.
Comments	The leakage prevention measures proposed by the present project do not include decrease in carbon stocks due to activities implemented in the leakage management area.

Data / Parameter	$\Delta CUDdPA_t$
Data unit	tCO_2e
Description	Total actual carbon stock change due to unavoided unplanned deforestation at year t in the project area
Source of data	- Remote sensing and GIS

	- Field reports.
Description of measurement methods and procedures to be applied	Forest cover change due to unplanned deforestation will be monitored through periodic assessment of classified satellite imagery covering the project area.
Frequency of monitoring/recording	Annually
Value applied	121,855.49 (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	2,412.24

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

Data / Parameter	$EBBPSPA_t$
Data unit	tCO_2e
Description	Sum of (or total) of actual non-CO_2 emissions from forest fire at year t in the project area
Source of data	- Remote sensing data and GIS, - Forest management team and field data.
Description of measurement methods and procedures to be applied	If forest fires occur, these non-CO_2 emissions will be subject to monitoring and accounting, when significant. In addition to remote sensing data and GIS, which can identify the area affected by forest fire, the forest management team could also confirm the obtained data. No forest fire will be used by the project owner for conducting planned deforestation or timber harvesting activities. However, it is expected that some unplanned deforestation within the project area will occur during the crediting period, which conversion of forest to non-forest may involve fire. The effect of fire on carbon emissions is counted in the estimation of carbon stock changes in the parameter $\Delta CUDdPA_t$; therefore CO_2 emissions from forest fires were ignored to avoid double counting. However, non-CO_2 emissions (CH_4 and N_2O) from forest fires must be counted in the project scenario, when they are significant.

	In order to be conservative, it will be assumed that all unplanned deforestation within the project area will involve fire. Therefore, non-CO_2 emissions from forest fires will be quantified and deducted from emission reductions.
Frequency of monitoring/recording	Annually
Value applied	16,081.61 (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	<table><tr><th colspan="2">Initial Forest Class</th><th rowspan="2">EBBtot$_{icl}$ tCO$_2$e/ha</th></tr><tr><th>IDcl</th><th>Name</th></tr><tr><td>1</td><td>Forest</td><td>11.82</td></tr></table>
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$_2$e
Description	Emissions from grazing animals in leakage management areas at year t.
Source of data	- Activities report related to leakage prevention measures - Field assessment - Remote sensing data and GIS.
Description of measurement methods and procedures to be applied	GHG emissions from grazing animals in the leakage management area (i.e. enteric fermentation or manure management) will be subjected to monitoring, when significant.
Frequency of monitoring/recording	Annually
Value applied	0 (annual average for the crediting period)

Monitoring equipment	Remote sensing and GIS Field assessment data
QA/QC procedures to be applied	Best practices in remote sensing and GIS.
Purpose of data	This parameter will be used to calculate GHG emissions from activities implemented in the leakage management area in the project scenario, providing an *ex post* value.
Calculation method	Described in the methodology VM0015 v1.1, section 8.1.2: *Ex ante* estimation of CH_4 and N_2O emissions from grazing animals.
Comments	The community living within the leakage management area may practice grazing activities. Therefore, this shall be monitored during the crediting period. GWP for CH_4 and N2O were obtained according to the most recent version of the VCS Standard.

Data / Parameter	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	25
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. SFMP. Logging authorization from the Brazilian Environmental Agency.

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: Wood volume with bark (V) V (m³) $=\pi 4 * d2 * h * f$ Where, d = Diameter h = Height f = factor - 0.7395 Wood volume without bark (V) V (m3) $=\pi 4 * d2 * h * f * 0{,}90$ Where d = Diameter h = Height f = factor - 0.7395 0.90 = correction factor to determine volume without bark according to legislation 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 – Rio Madeira Grouped REDD+ Project;

	- Remote sensing data and GIS; - SFMP data; - Literature data.
Description of measurement methods and procedures to be applied	All sources of data from the VCS Non-Permanence Risk Report will be used to measure the various risk factors. Despite the Non-Permanence Risk Report was carried out in one single document, it was carried out a risk assessment for each project instance. Each instance obtained a score, according to the NPRR Calculation Tool. After this analysis, the more conservative score was adopted. Thus, the NPRR explains the analysis for three initial instances, but considers the worst case scenario score.
Frequency of monitoring/recording	Annually
Value applied	12
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

6.3 Monitoring Plan

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

Organizational structure

According to the contract stipulated between project proponent and the landowners, the landowners are responsible for the costing and implementation and/or maintenance of the project's forest management and activities to reduce deforestation and degradation,

surveillance, fire prevention, illegal extraction of wood, prevention of invasions, among others, implementation and maintenance of social and environmental activities to reduce leakage, decrease the risks of non-permanence of carbon and improve the results of SOCIALCARBON, or other Standard for the assessment of social and environmental co-benefits.

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

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

The project proponent 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 23/October/2025. The baseline will be reassessed every 6 years, and it will be validated at the same time as the subsequent verification.

Technical description of the monitoring task

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

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

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

Data to be collected

Data will be collected to comply with the parameters used in VM0015 version 1.1, listed in Appendix 5, or the most recent.

Overview of data collection procedures

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

Quality control and quality assurance procedures

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

Data archiving

All data sources and processing, classification and change detection procedures will be documented and stored in a dedicated long-term electronic archive maintained by the project owner. The project proponent 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

The project proponent (Future Carbon International LLC and its controlled companies) 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 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 methodology VM0015. New data on carbon stocks will only be used if they are validated by an accredited VVB.

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

All data sources and processing, classification and change detection procedures will be documented and stored in a dedicated long-term electronic archive maintained by the Project Proponent (Future Carbon International LLC or its controlled subsidiaries).

The Project Proponent 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 International LLC. 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)[245] and LANDSAT satellite images (or other available source accepted by the methodology), which will be subject to digital processing to perform the interpretation and classification of the land cover classes studied.

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

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.

The present REDD project will also implement the sustainability report following the SOCIALCARBON methodology, which was developed by *Instituto Ecológica* and focus on implementing environmental and social activities within the project area. This methodology follows the SOCIALCARBON Guidelines available at: http://www.socialcarbon.org/documents/.

In addition, the SOCIALCARBON Reports will be available on the VCS Registry once the project is registered.

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 Rio Madeira Grouped REDD+ Project; In-field verification, which basically consists of monitoring the procedures set out in the methodological guidelines and review of the monitoring reports prior to its delivery to the VVB, in order to confirm that the calculations, analysis and the conclusions are accurate and measured. This work is in charge of Future Carbon International LLC.

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

[245] Available at: <http://www.obt.inpe.br/OBT/assuntos/programas/amazonia/prodes> Last visited on 10/03/2021.

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

Satellite images and remote sensing monitoring

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

All reliable data collected and documented will be used as a technical support tool for decision making in order to improve project outcomes, and to adapt the project according to the current needs and reality. These decisions will be made during periodic meetings to review the Action Plan – that will be developed as part of the Social Carbon Methodology. 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.

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

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

In addition to the mentioned above, the 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 International LLC, Future Carbon Group or its controlled companies so that it can include the related impacts in the carbon project reports, updating the related parameters, including the buffer report. Where an event occurs that is likely to qualify as a loss event, the project proponent shall notify Verra within 30 days of discovering the likely loss event.

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

- Monitoring of Leakage

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

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

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

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

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

Deforestation in the leakage belt area above the baseline may be considered activity displacement leakage. Activity data for the leakage belt area will be determined using the same methods applied to monitoring deforestation activity data in the project area. Leakage will be calculated by comparing the *ex ante* and the *ex post* assessment. However, where strong evidence can be collected that deforestation in the leakage belt is attributable to deforestation agents that are not linked to the project area, the detected deforestation will not be attributed to the project activity, thus not considered leakage.

- **Organizational structure, responsibilities and competencies**

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

For all aspects of project monitoring, the project proponent will ensure that data collection, processing, analysis, management and archiving are conducted in accordance with the monitoring plan. The authority for the registration, monitoring, measurement and reporting will be Future Carbon Group[246] or its partners.

Table 95. Type of Monitoring and Party Responsible for Monitoring

Variables to be monitored	Responsible	Frequency
Reassessment of the baseline	Future Carbon Group or its subsidiaries and external institutions qualified for the GIS analysis and monitoring	Every 6 years
Monitoring Deforestation and Project Emissions	Instance owner together with Future Carbon Group or its subsidiaries and	Prior to each verification

[246] As mentioned in section 1.5, the Project Proponent (Future Carbon International LLC) is a company controlled by Future Carbon Group. Thus, other companies than Future Carbon International LLC also controlled by Future Carbon Group are responsible and technically aware of the project.

	external institutions qualified for the GIS analysis and monitoring	
Monitoring of non-CO_2 emissions from forest fires	Instance owner together with Future Carbon Group or its subsidiaries and external institutions qualified for the GIS analysis and monitoring	Prior to each verification
Monitoring Leakage emissions	Instance owner together with Future Carbon Group or its subsidiaries and external institutions qualified for the GIS analysis and monitoring	Prior to each verification
Monitoring of Natural Disturbance and catastrophic events	Instance owner	When a natural event occurs
Updating Forest Carbon Stocks Estimates	Instance owner	Whenever current literature source completes 10 years, as per methodology.

7 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

7.1 Data and Parameters Monitored

Data / Parameter	ab_{icl}
Data unit	Mg/ha
Description	Average biomass stock per hectare in the above-ground biomass pool of initial forest class icl in Mg/ha.
Value applied:	

	Above-ground biomass			
	ab_{icl} (Mg/ha)			
ID_{icl}	Vegetation	Reference Region	Project Area	Leakage Belt
1	Open Tropical Rainforest (Forest)	294.16	294.16	294.16

Comments	The values will be reassessed every 6 years or when data is more than 6 years old, whichever occurs first.

Data / Parameter	bb_{icl}
Data unit	Mg/ha
Description	Average biomass stock per hectare in the below-ground biomass pool of initial forest class icl in Mg/ha.
Value applied:	

	Below-ground biomass			
	bb_{icl} (Mg/ha)			
ID_{icl}	Vegetation	Reference Region	Project Area	Leakage Belt

	1	Open Tropical Rainforest (Forest)	70.60	70.60	70.60	
Comments	The values will be reassessed every 6 years or when data is more than 6 years old, whichever occurs first.					

Data / Parameter	$ACPA_t$
Data unit	Ha
Description	Annual area within the Project Area affected by catastrophic events at year t.
Value applied:	0
Comments	Decreases in carbon stocks and increases in GHG emissions (e.g. in case of forest fires) due to natural disturbances (such as hurricanes, earthquakes, volcanic eruptions, tsunamis, flooding, drought, fires, tornados or winter storms) or man-made events, including those over which the project proponent has no control (such as acts of terrorism or war), are subject to monitoring and must be accounted under the project scenario, when significant.

Data / Parameter	$ABSLLK_t$
Data unit	Ha
Description	Annual area of deforestation within the leakage belt at year t.
Value applied:	

Year	$ABSLLK_t$
2019	144.42
2020	755.13
2021	834.80
Total	1,734.35

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	$ABSLPA_t$
Data unit	Ha
Description	Annual area of deforestation in the project area at year t
Value applied:	

Year	$ABSLPA_t$ (ha)			
	Grupo Rovema (Instance 1)	Grupo Leite (Instance 2)	Grupo Tupá (Instance 3)	TOTAL
2019	4.56	0.00	0.00	4.56
2020	23.85	5.70	23.34	52.89
2021	27.97	0.00	38.17	66.14
Total	56.39	5.70	61.51	123.60

Comments	N/A

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

Year	$ABSLRR_t$ (ha)
	Forest
2019	3,812.99
2020	19,936.48
2021	24,943.32

	Total	48,692.79	
Comments	N/A		

Data / Parameter	$APDPA_{icl,t}$
Data unit	Hectare
Description	Areas of planned deforestation in forest class *icl* at year *t* in the project area
Value applied:	

Year	APDPA (ha)			
	Grupo Rovema (Instance 1)	Grupo Leite (Instance 2)	Grupo Tupá (Instance 3)	TOTAL
2019	17.77	0.00	0.00	17.77
2020	0.00	0.00	10.40	10.40
2021	35.50	0.00	0.00	35.50
Total	53.27	0.00	10.40	63.67

Comments	N/A

Data / Parameter	$APLPA_{icl,t}$
Data unit	Hectare
Description	Areas of planned logging activities in forest class *icl* at year *t* in the project area
Value applied:	

Year	APLPA (ha)			
	Grupo Rovema (Instance 1)	Grupo Leite (Instance 2)	Grupo Tupá (Instance 3)	TOTAL
2019	401.36	0.00	0.00	401.36

	2020	2,098.53	0.00	123.68	2,222.22
	2021	3,476.13	0.00	424.73	3,900.85
	Total	5,976.02	0.00	548.41	6,524.43
Comments	Three APU (one from Grupo Tupá and two from Grupo ROVEMA) were harvested during the MR, with a total area of 6,524.43 hectares.				

Data / Parameter	AUDPAicl,t
Data unit	Hectare
Description	Areas of unplanned deforestation in forest class icl at year t in the project area
Value applied:	

Year	AUDPA (ha)			
	Grupo Rovema (Instance 1)	Grupo Leite (Instance 2)	Grupo Tupá (Instance 3)	TOTAL
2019	4.56	0.00	0.00	4.56
2020	23.85	5.70	23.34	52.89
2021	27.97	0.00	38.17	66.14
Total	56.39	5.70	61.51	123.60

Comments	N/A

Data / Parameter	$APFPA_{icl,t}$
Data unit	Hectare
Description	Areas of fuel-wood collection and charcoal production activities in forest class icl at year t in the project area
Value applied:	0

Comments	No production of fuel wood or charcoal occurred during the monitoring period.

Data / Parameter	$\Delta CADLK_t$
Data unit	tCO_2e
Description	Total decrease in carbon stocks due to displaced deforestation at year t
Value applied:	

Year	$\Delta CADLK_t$ (tCO_2e)
2019	0.00
2020	0.00
2021	0.00
Total	0.00

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	$\Delta CPAdPA_t$
Data unit	tCO2e
Description	Total decrease in carbon stock due to all planned activities at year t in the project area
Value applied:	

Year	$\Delta CPAdPA_t$ (tCO_2e)
2019	44,986
2020	18,699
2021	178,773
Total	242,458

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
Value applied:	

Year	$\Delta CPSLK_t$ (tCO_2e)
2019	0.00
2020	0.00
2021	5.14
Total	**5.14**

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	$EADLK_t$
Data unit	tCO_2e
Description	Total *ex post* increase in GHG emissions due to displaced forest fires at year t.
Value applied:	

Year	$EADLK_t$ (tCO_2e)
2019	0.00
2020	0.00
2021	0.00
Total	0.00

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) actual non-CO_2 emissions from forest fire at year t in the project area
Value applied:	

Year	$EBBPSPA_t$ (tCO_2e)
2019	53.94
2020	625.38
2021	782.08
Total	**1,461.40**

Comments	N/A

Data / Parameter	$EBBtot_{icl,t}$
Data unit	tCO_2e/ha
Description	Total GHG emission from biomass burning in forest class icl at year t
Value applied:	

Initial Forest Class		$EBBtot_{icl}$ tCO2e/ha	
IDcl	Name	Baseline case	Project case
1	Open Tropical Rainforest	11.82	11.82

Comments	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 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

Data / Parameter	$EgLK_t$
Data unit	tCO_2e
Description	Emissions from grazing animals in leakage management areas at year t.
Value applied:	

Year	$EgLK_t$ (tCO_2e)
2019	0.00
2020	0.00
2021	0.00
Total	**0.00**

Comments	There were no project activities in the leakage management area that resulted in GHG emissions during the monitoring period. However, the community living within the leakage management area practices grazing activities, which were considered as $EgLK_t$.

Data / Parameter	$HI_{icl,t}$
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).
Value applied:	

$HI_{icl,t}$ (m^3/ha)			
Grupo Rovema (Instance 1)	Grupo Leite (Instance 2)	Grupo Tupá (Instance 3)	TOTAL
8.81	0.00	21,56	9.88

Comments	N/A

Data / Parameter	RF_t
Data unit	%
Description	Risk factor used to calculate VCS buffer credits
Value applied:	12
Comments	N/A

7.2 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*; tCO_2e 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 CO_2e

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

Where,

Cbb_{icl}	Average carbon stock per hectare in the below-ground biomass carbon pool of initial forest class *icl*; tCO_2e 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 CO_2e

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

$$\Delta \boldsymbol{CBSLPAt} = \Delta \boldsymbol{CabBSLPAicl,t} + \Delta \boldsymbol{CbbBSLPAicl,t}$$

Where,

$\Delta CBSLPAt$	Total baseline carbon stock changes in the project area at year *t*; tCO_2e
$\Delta CabBSLPA_{icl,t}$	Total baseline carbon stock change for the above-ground biomass pool in the project area for initial forest class at year *t*; tCO_2e
$\Delta CbbBSLPA_{icl,t}$	Total baseline carbon stock change for the below-ground biomass pool in the project area for initial forest class at year *t*; tCO_2e

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

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
ΔCab_{icl}	Average carbon stock change factor per hectare in the above-ground biomass carbon pool of initial forest class *icl*; $tCO_2e\ ha^{-1}$

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

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
ΔCbb_{icl}	Average carbon stock change factor per hectare in the below-ground biomass carbon pool of category *icl*; $tCO_2e\ ha^{-1}$

Project carbon stocks were calculated as presented in section 4.1.

Average carbon stocks of post-deforestation classes

The average classification of post-deforestation land-uses within the reference region during the historical reference period (2009-2019) was conducted through MapBiomas and the results are available below. It was considered the weighted average of post-deforestation land uses during the historical period.

Table 96. Post-deforestation land use within reference region

Reference Region			
Land Use	Area (ha)	Area (%)	Carbon stocks[247]
Pasturelands	167,243.76	87.22%	35.21
Secondary Forests	24,465.15	12.76%	83.59
Agriculture	27.72	0.01%	97.68
Minning	7.29	0.00%	-
Urban Area	0.72	0.00%	-
Total	191,744.64	100.00%	-
Weighted average post-deforestation carbon stocks			41.39

By using the weighted average from the Table above, the post deforestation carbon stock is summarized at the following Table:

Table 97. Long-term (20 years) average carbon stocks per hectare of post-deforestation LU/LC classes present in the reference region

Non-forest vegetation	$Ctot_{fcl}$ (tCO_2/ha)
Anthropic areas in equilibrium (post-deforestation class)	41.39

Calculation of baseline carbon stock changes

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

[247] Post-deforestation carbon stock detailed at VCSPD section 5.1 and at the VCSPD spreadsheet Table 16p.

Table 98. Ex post carbon stock change in the reference region

Carbon stock change in the above-ground biomass per initial forest class *icl*		Total carbon stock change in the above-ground biomass of initial forest class in the reference region	
ID_{cl}	1	$\Delta CabBSLRR_{icl,t}$	$\Delta CabBSLRR_{icl}$
Name	Forest	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e
2019	1,974,111	1,974,111	1,974,111
2020	10,321,781	10,321,781	12,295,892
2021	12,913,988	12,913,988	25,209,880

Carbon stock change in the below-ground biomass per initial forest class *icl*		Total carbon stock change in the below-ground biomass of initial forest class in the reference region	
ID_{cl}	1	$\Delta CbbBSLRR_{icl,t}$	$\Delta CbbBSLRR_{icl}$
Name	Forest	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e
2019	47,378	47,378	47,378
2020	295,095	295,095	342,472
2021	605,023	605,023	947,496

Carbon stock changes in above-ground biomass per post-deforestation zone z		Total carbon stock change of post deforestation zones in the reference region	
ID_{iz}	1	$\Delta CBSLRR_{z,t}$	$\Delta CBSLRR_{z}$
Name	Non-forest	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e
2019	0	0	0
2020	17,536	17,536	17,536
2021	109,225	109,225	126,762

Total net carbon stock change in the reference region	
$\Delta CBSLRR_{t}$	$\Delta CBSLRR$
annual	cumulative
tCO_2e	tCO_2e
2,021,489	2,021,489
10,599,340	12,620,828
13,409,786	26,030,615

Table 99. Ex post carbon stock change in the project area

Carbon stock change in the above-ground biomass per initial forest class *icl*				Total carbon stock change in the above-ground biomass of initial forest class in the project area	
ID_{cl}	1	1	1	$\Delta CabBSLPA_{icl,t}$	$\Delta CabBSLPA_{icl}$
Name	Grupo Rovema	Grupo Tupá	Grupo Leite	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2019	2,362	0	0	2,362	2,362
2020	12,349	12,082	2,952	27,383	29,745
2021	14,482	19,762	0	34,245	63,990

Carbon stock change in the below-ground biomass per initial forest class *icl*				Total carbon stock change in the below-ground biomass of initial forest class in the project area	
ID_{cl}	1	1	1	$\Delta CbbBSLPA_{icl,t}$	$\Delta CbbBSLPA_{icl}$
Name	Grupo Rovema	Grupo Tupá	Grupo Leite	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2019	57	0	0	57	57
2020	353	290	71	714	771
2021	701	764	71	1,536	2,306

Carbon stock changes in above-ground biomass per post-deforestation zone z		Total carbon stock change of post deforestation zones in the project area	
ID_{iz}	1	$\Delta CBSLPA_{z,t}$	$\Delta CBSLPA_{z}$
Name	Non-forest	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e
2019	0	0	0
2020	21	21	21
2021	264	264	285

Total net carbon stock change in the project area	
$\Delta CBSLPA_{t}$	$\Delta CBSLPA$
annual	cumulative
tCO_2e	tCO_2e
2,418	2,418
28,076	30,495
35,516	66,011

Table 100. Ex post carbon stock change in the leakage belt

Carbon stock change in the above-ground biomass per initial forest class *icl*		Total carbon stock change in the above-ground biomass of initial forest class in the leakage belt	
ID_{cl}	1	$\Delta CabBSLLK_{icl,t}$	$\Delta CabBSLLK_{icl}$
Name	Forest	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e
2019	74,773	74,773	74,773
2020	390,956	390,956	465,729
2021	432,203	432,203	897,932

Carbon stock change in the below-ground biomass per initial forest class *icl*		Total carbon stock change in the below-ground biomass of initial forest class in the leakage belt	
ID_{cl}	1	$\Delta CbbBSLLK_{icl,t}$	$\Delta CbbBSLLK_{icl}$
Name	Forest	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e
2019	1,795	1,795	1,795
2020	11,177	11,177	12,972
2021	21,550	21,550	34,522

Carbon stock changes in above-ground biomass per post-deforestation zone z		Total carbon stock change of post deforestation zones in the leakage belt	
ID_{iz}	1	$\Delta CtotBSLLK_{z,t}$	$\Delta CtotBSLLK_{z}$
Name	Non-forest	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e
2019	0	0	0
2020	455	455	455
2021	2,837	2,837	3,292

Total net carbon stock change in the leakage belt	
$\Delta CtotBSLLK_{t}$	$\Delta CtotBSLLK$
annual	cumulative
tCO_2e	tCO_2e
76,567	76,567
401,678	478,245
450,916	929,161

7.3 Project Emissions

As detailed in section 5.4, two out of the three instances within the Rio Madeira Grouped REDD Project have sustainable forest management plan implemented. This type of economic activity enables the harvesting of an economically feasible volume of forest products, however allowing the regeneration of the natural stock in accordance with the growth and recovery rates of the biome.

Two instances, Grupo Rovema and Grupo Tupá have Sustainable Forest Management Plan. During the current monitoring period, three APU was harvested, according to Tables below.

Grupo Rovema:

APU	Area (ha)	Initial date	Final date	Days	Volume (m³)	Volume/ha (m³/ha)
POA 4	2,499.89	23/10/2019	31/12/2019	70	10,734.69	4.29
		01/01/2020	31/12/2020	366	1,818.11	0.73
		TOTAL		436	12,552.80	5.02

APU	Area (ha)	Initial date	Final date	Days	Volume (m³)	Volume/ha (m³/ha)
POA 5	3,476.13	31/05/2021	31/12/2021	215	40,072.31	11.53
		TOTAL		215	40,072.31	11.53

Grupo Tupá:

APU	Area (ha)	Initial date	Final date	Days	2020	2021	Volume (m³)	Volume/ha (m³/ha)
UPF 3	548.41	16/09/2020	30/04/2021	226	106	120	2,026.38	3.69
		01/05/2021	31/12/2021	244		244	9,794.98	17.86
		TOTAL		470	106	364	11,821.36	21.56

The *ex post* carbon stock decrease due to planned deforestation in the project area was calculated using the following equation:

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

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

The *ex post* carbon stock decrease due to unplanned deforestation in the project area was calculated using the following equation:

$$\Delta CUDdPA_t = (AUDPA_{icl,t} \times \Delta Ctot_{icl})$$

Where,

$\Delta CPUdPA_t$	Total *ex post* actual carbon stock change due to unavoidable unplanned deforestation at year *t* in the project area; tCO_2e
$AUDPA_{icl,t}$	Areas of unplanned 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

Therefore, the total carbon stock decreases due to planned and unplanned deforestation in the project area could be calculated, as depicted in Table below.

Table 101. Ex post carbon stock decrease due to planned and unplanned 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		Areas of unplanned deforestation x Carbon stock change (decrease) in the project area						Total carbon stock decrease due to unplanned deforestation		Total carbon stock decrease due to planned and unplanned deforestation	
	Grupo Rovema	Grupo Tupá	Grupo Leite				annual	cumulative	Grupo Rovema	Grupo Tupá	Grupo Leite				annual	cumulative	annual	cumulative
	$APDPA_{icl,t}$	$Ctot_{icl,t}$	$APDPA_{icl,t}$	$Ctot_{icl,t}$	$APDPA_{icl,t}$	$Ctot_{icl,t}$	$\Delta CPDdPA_t$	$\Delta CPDdPA$	$AUDPA_{icl,t}$	$Ctot_{icl,t}$	$AUDPA_{icl,t}$	$Ctot_{icl,t}$	$AUDPA_{icl,t}$	$Ctot_{icl,t}$	$\Delta CUDdPA_t$	$\Delta CUDdPA$	tCO_2e	tCO_2e
	ha	tCO_2e/ha	ha	tCO_2e/ha	ha	tCO_2e/ha	tCO_2e	tCO_2e	ha	tCO_2e/ha	ha	tCO_2e/ha	ha	tCO_2e/ha	tCO_2e	tCO_2e		
2019	17.77	641.99	0.00	641.99	0.00	641.99	11,408.10	11,408.10	4.56	641.99	0.00	641.99	0.00	641.99	2,928.62	2,928.62	14,336.72	14,336.72
2020	0.00	641.99	10.40	641.99	0.00	641.99	6,673.69	18,081.79	23.85	641.99	23.34	641.99	5.70	641.99	33,955.11	36,883.73	40,628.80	54,965.52
2021	35.50	641.99	0.00	641.99	0.00	641.99	22,790.52	40,872.31	27.97	641.99	38.17	641.99	0.00	641.99	42,463.08	79,346.81	65,253.60	120,219.12

Figure 89. Deforestation dynamic in the project area during the monitoring period (October 2019 to 2021)

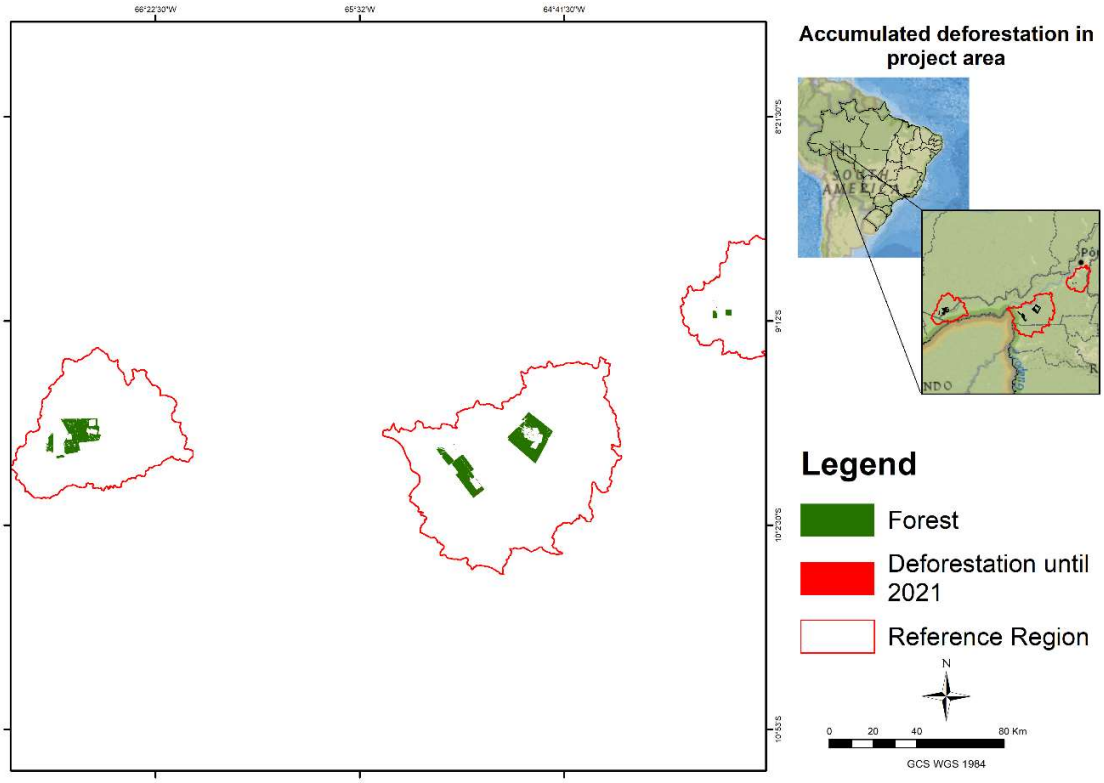


Figure 90. Cumulative deforestation in the project area between October 2019 and 2020 in Instance 1

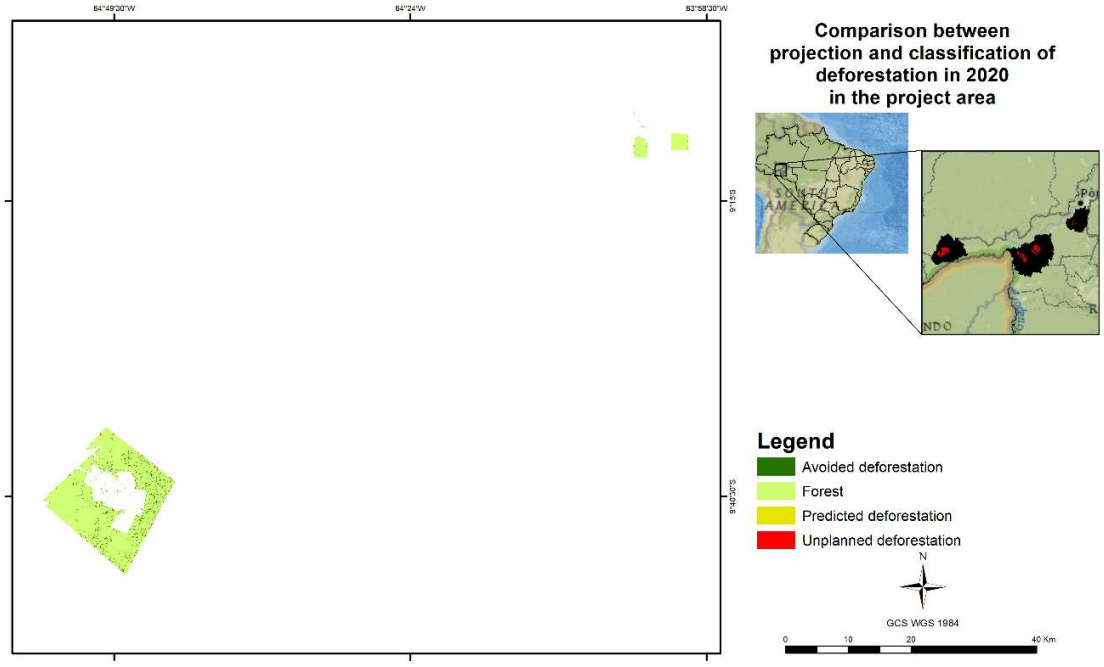


Figure 91. Cumulative deforestation in the project area between 2020 and 2021 in Instance 1

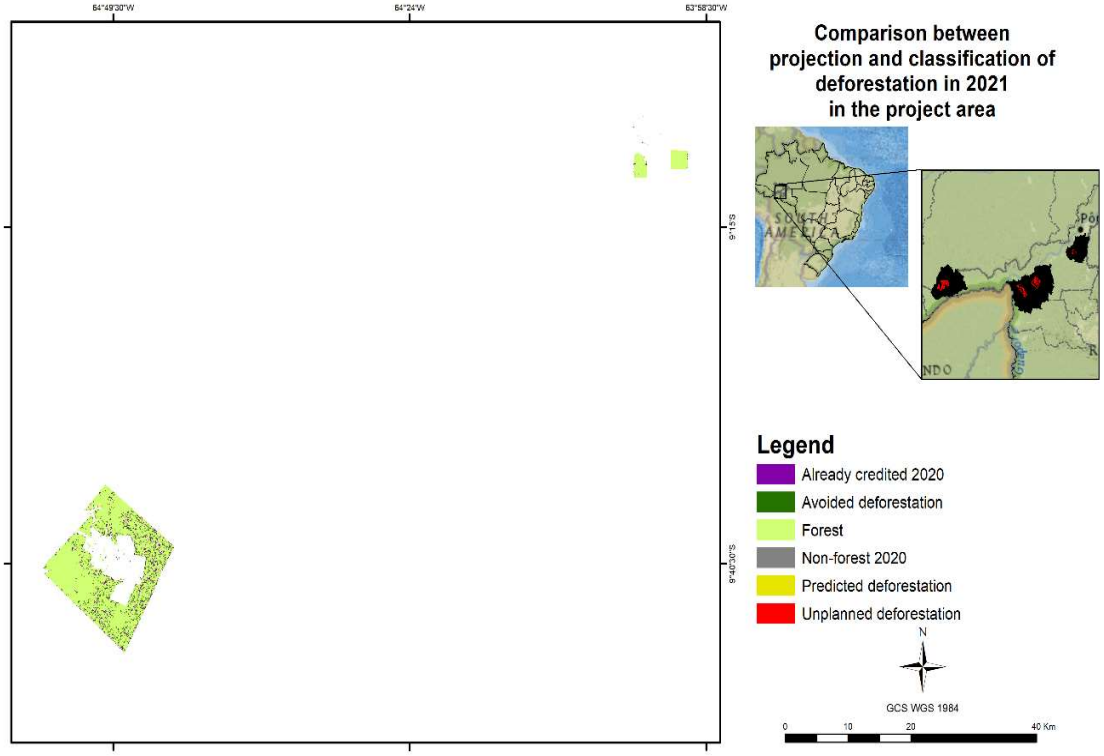


Figure 92. Cumulative deforestation in the project area in 2020 in Instance 2

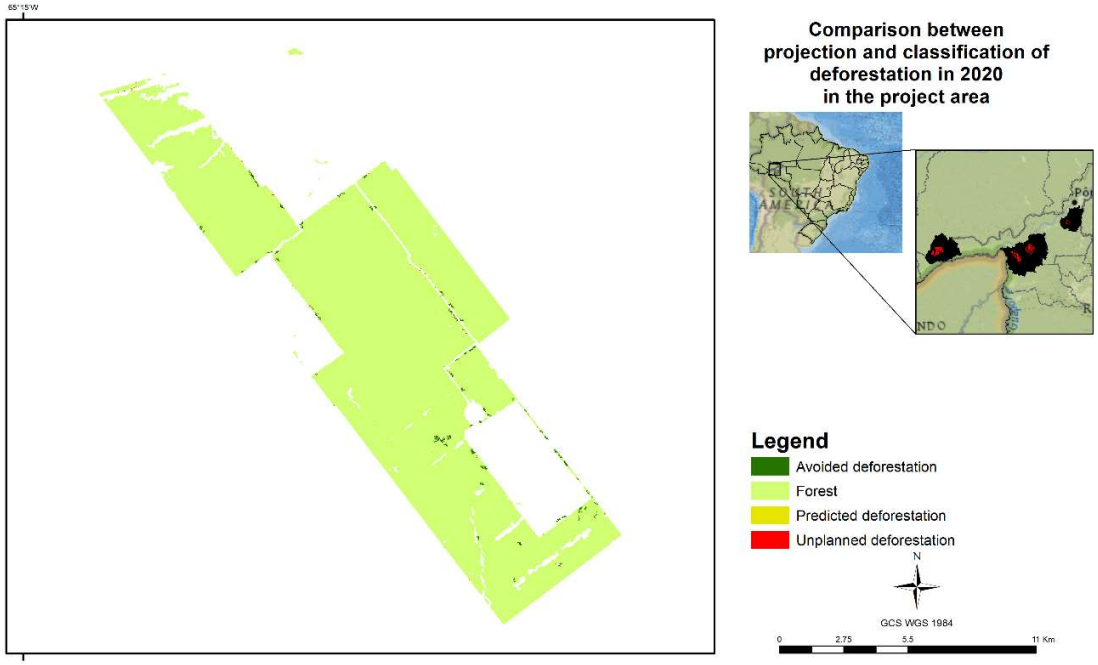


Figure 93. Cumulative deforestation in the project area between 2020 and 2021 in Instance 2

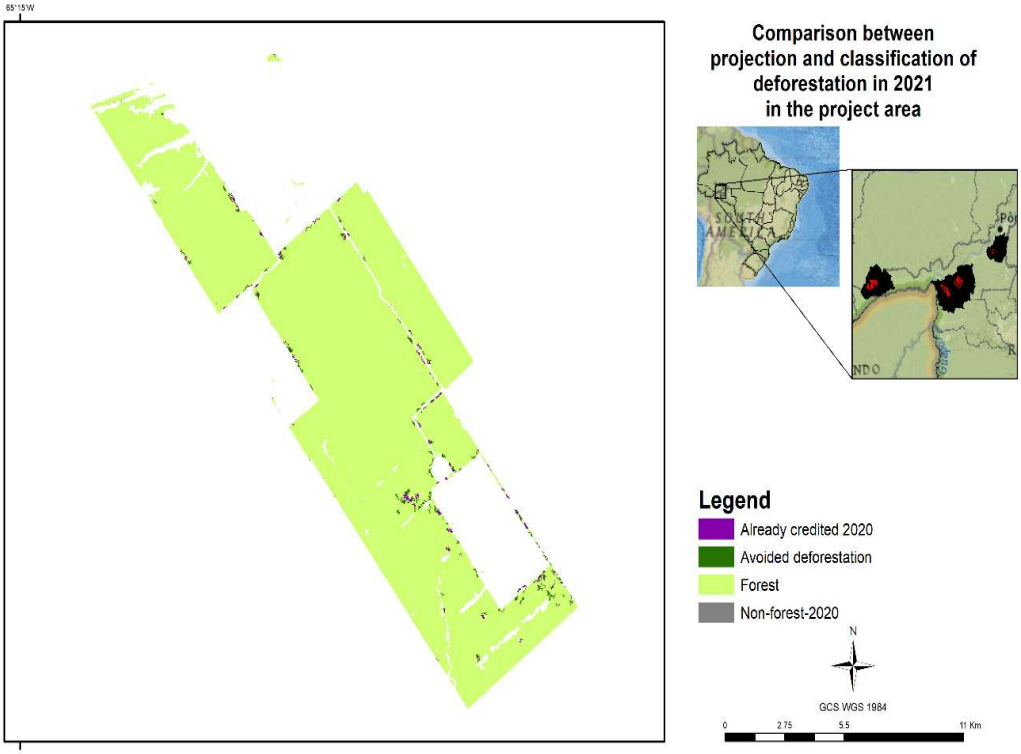


Figure 94. Cumulative deforestation in the project area in 2020 in Instance 3

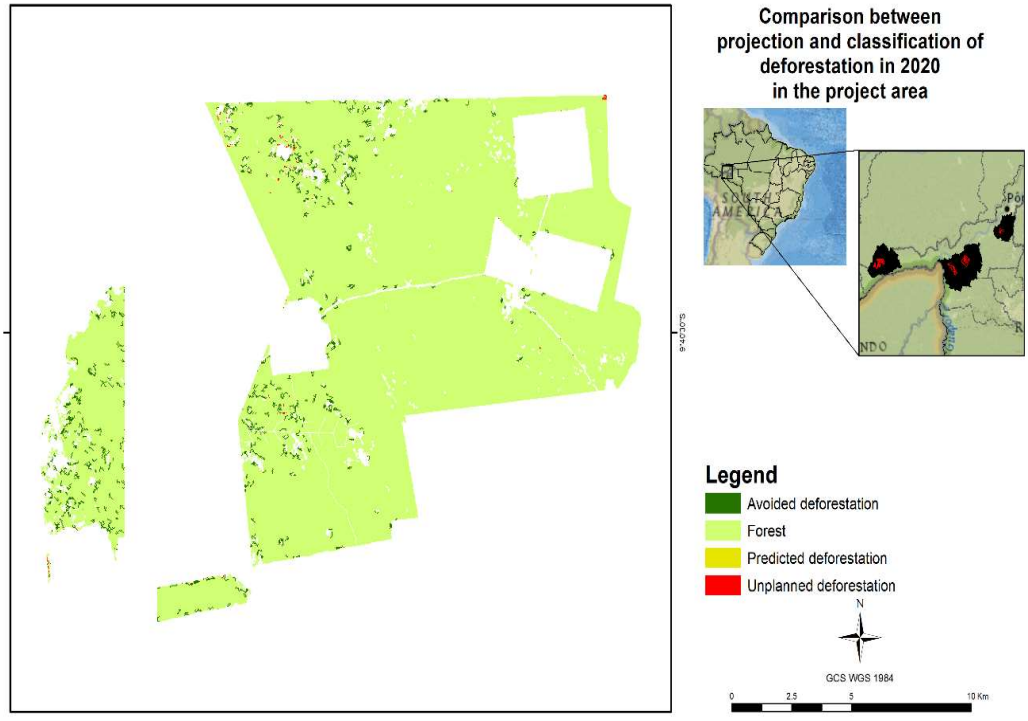


Figure 95. Cumulative deforestation in the project area between 2020 and 2021 in Instance 3

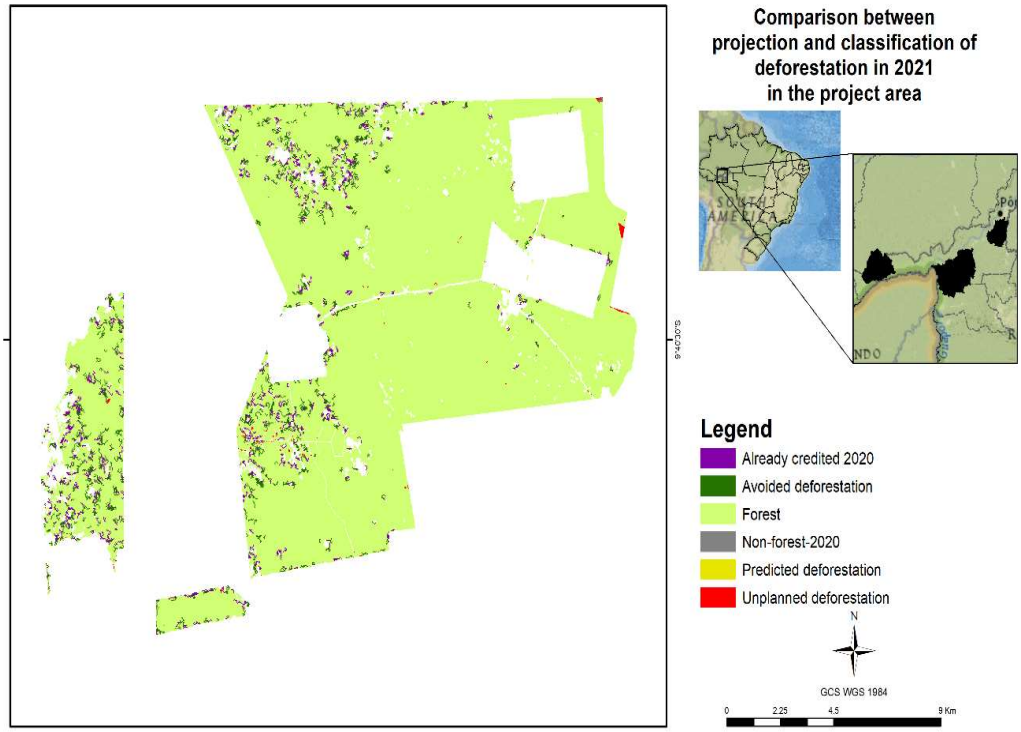


Figure 96. Cumulative deforestation in the Reference Region between 2019 and 2020

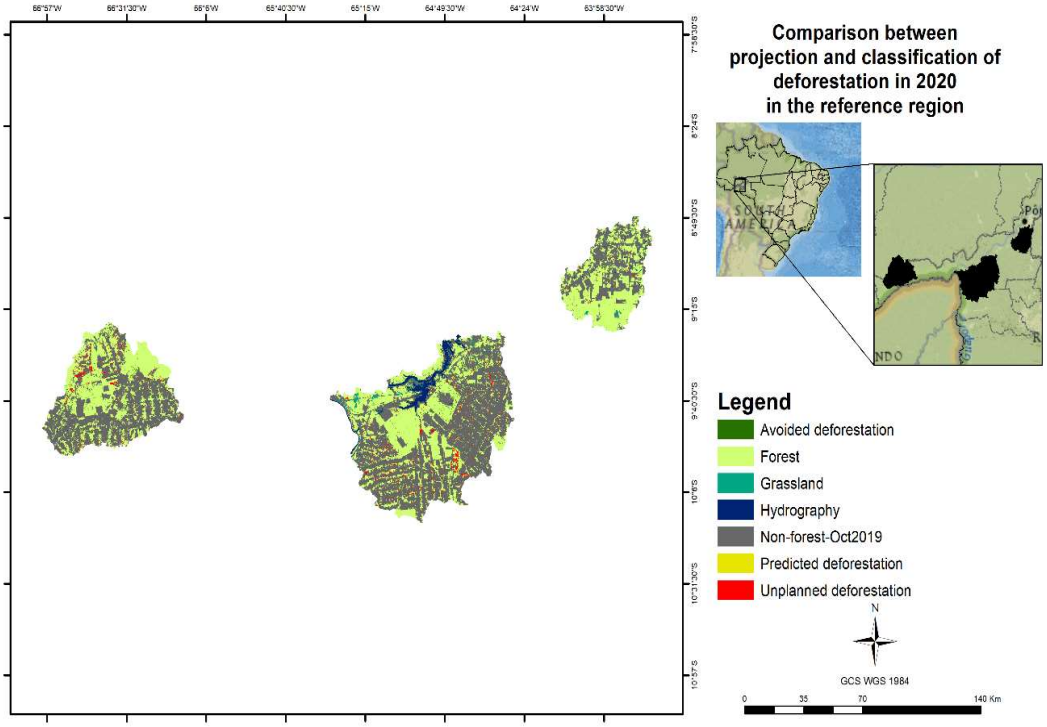
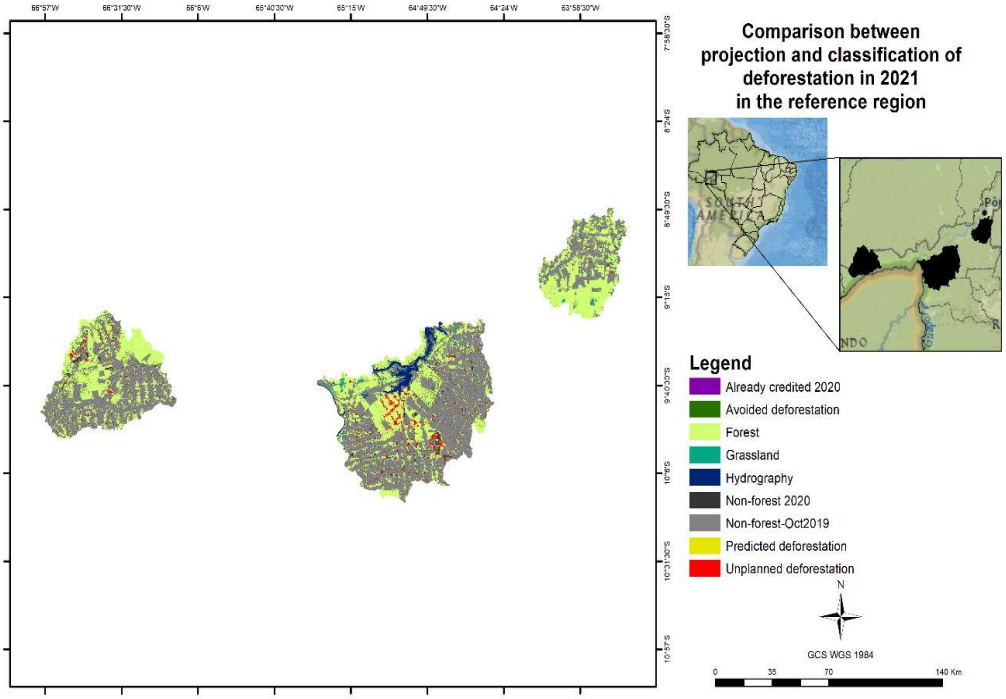


Figure 97. Cumulative deforestation in the Reference Region between 2020 and 2021



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 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.

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

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

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/ha
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 carbon pool. Therefore, the *ex post* carbon stock decrease due to planned logging activities in the project area was calculated using the following equation:

$$\Delta CPLdPA_t = (APLPA_{icl,t} \times \Delta CLd_{icl,t}) - (APLPA_{icl,t}) \times \Delta Cwp_t$$

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
ΔCwp_t	Average carbon stock per hectare in the harvested wood products carbon pool at time *t*; tCO_2e/ha

Thus, table below presents the *ex post* carbon stock decrease due to planned logging activities in the project area.

Table 102. Ex post 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	
	Grupo Rovema		Grupo Tupá		Grupo Leite		annual	cumulative
	$APLPA_{icl,t}$	$\Delta CLd_{icl,t}$	$APLPA_{icl,t}$	$\Delta CLd_{icl,t}$	$APLPA_{icl,t}$	$\Delta CLd_{icl,t}$	$\Delta CPLdPA_t$	$\Delta CPLdPA$
	ha	tCO_2e/ha	ha	tCO_2e/ha	ha	tCO_2e/ha	tCO_2e	tCO_2e
2019	401.36	83.66	0.00	0.00	0.00	0.00	33,577.66	33,577.66
2020	2,098.53	2.71	123.68	51.25	0.00	0.00	12,025.40	45,603.06
2021	3,476.13	36.06	424.73	72.14	0.00	0.00	155,982.78	201,585.84

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 occurred within the project area during the monitoring period.

Thus, table below presents the total *ex post* carbon stock decrease due to planned activities in the project area.

Table 103. Total ex post 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
2019	11,408	11,408	33,578	33,578	0	0	44,986	44,986
2020	6,674	18,082	12,025	45,603	0	0	18,699	63,685
2021	22,791	40,872	155,983	201,586	0	0	178,773	242,458

Neither planned protection of secondary/degraded forests without harvest nor production of fuel-wood and charcoal are expected to occur within the project area under the project scenario. Thus, carbon stock increase due to growth without harvest or due to planned fuel-wood and charcoal activities were not monitored. 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 change 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.

The calculation of the *ex post* net carbon stock change in the project area under the project scenario ($\Delta CPSPA_t$) is described as follows.

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

Where,

$\Delta CPSPA_t$ Sum of ex post 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 post actual carbon stock change due to unavoidable 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

Ex post carbon stock change in the project area under the project scenario is shown below.

Table 104. Ex post 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
2019	44,986	44,986	358	358	2,929	2,929	47,557	47,557
2020	18,699	63,685	2,229	2,586	33,955	36,884	50,426	97,982
2021	178,773	242,458	5,328	7,914	42,463	79,347	215,909	313,891

No forest fire was used by the landowner for carrying out planned deforestation or timber harvesting activities. However, there were around 123.60 ha of unplanned deforestation within the project area during the monitored period, which conversion of forest to non-forest could have involved fires.

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.
It was conservatively assumed that all unplanned deforestation within the project area involved fire and all above ground biomass was burnt. Therefore, non-CO_2 emissions from forest fires were quantified and deducted from emission reductions, as follows:

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

Where,

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

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

Where,

$EBBCO_{2icl,t}$	Per hectare CO_2 emission from biomass burning in slash and burn in forest class *icl* at year *t*; tCO_2e/ha
NCR	Nitrogen to Carbon Ratio (IPCC default value = 0.01); dimensionless
ER_{N2O}	Emission ratio for N_2O (IPCC default value = 0.007)
GWP_{N2O}	Global Warming Potential for N_2O[248]

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

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)

[248] According to the VCS Standard, the six Kyoto Protocol greenhouse gases and ozone-depleting substances shall be converted using 100 year global warming potentials derived from the IPCC's Fifth Assessment Report. GWP for N_2O = 265.

GWP_{CH4} Global Warming Potential for CH_4[249]

$$EBBCO_{2icl,t} = Fburnt_{icl} * (C_{picl,t} * Pburnt_{p,icl} * CE_{p,icl})$$

Where,

$EBBCO_{2icl,t}$ Per hectare CO_2 emission from biomass burning in the forest class *icl* at year *t*; tCO_2e/ha

$Fburnt_{icl}$ Proportion of forest area burned during the historical reference period in the forest class *icl*; %

$C_{picl,t}$ Average carbon stock per hectare in the carbon pool *p* burnt in the forest class *icl* at year *t*; tCO_2e/ha

$Pburnt_{p,icl}$ Average proportion of mass burnt in the carbon pool *p* in the forest class *icl*; % (conservatively assumed as 100%)

$CE_{p,icl}$ Average combustion efficiency of the carbon pool *p* in the forest class *icl*; dimensionless (IPCC default of 0.5 was used)

p Carbon pool that could burn, in the project case, above-ground biomass

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

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

Where,

$EBBPSPA_t$ Total actual non-CO_2 emissions from forest fire at year *t* in the project area; 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

[249] According to the VCS Standard, the six Kyoto Protocol greenhouse gases and ozone-depleting substances shall be converted using 100 year global warming potentials derived from the IPCC's Fifth Assessment Report. GWP for CH_4 = 28.

Table 105. Total ex post emissions of GHG due to forest fires in the project area

Project year t	Areas of unplanned deforestation x Carbon stock change (decrease) in the project area						Total carbon stock decrease due to unplanned deforestation	
	Grupo Rovema		Grupo Tupá		Grupo Leite		annual	cumulative
	$AUDPA_{icl,t}$	$EBBPSPA_{icl,t}$	$AUDPA_{icl,t}$	$EBBPSPA_{icl,t}$	$AUDPA_{icl,t}$	$EBBPSPA_{icl,t}$	$EBBPSPA_t$	EBBPSPA
	ha	tCO_2e/ha	ha	tCO_2e/ha	ha	tCO_2e/ha	tCO_2e	tCO_2e
2019	4.56	11.82	0.00	11.82	0.00	11.82	53.94	53.94
2020	23.85	11.82	23.34	11.82	5.70	11.82	625.38	679.32
2021	27.97	11.82	38.17	11.82	0.00	11.82	782.08	1,461.40

Total *ex post* project emissions for the project area

The *ex post* carbon stock changes and non-CO_2 emissions in the Project area during the monitoring period is summarized in Table below.

Table 106. Total ex post estimated actual net changes in carbon stocks and emissions of GHG gases in the project area

Project year *t*	Total *ex post* carbon stock decrease due to planned activities		Total *ex post* carbon stock increase due to planned activities		Total *ex post* carbon stock decrease due to unavoided unplanned deforestation		Total *ex post* carbon stock change		Total *ex post* 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
2019	44,985.76	44,985.76	357.82	357.82	2,928.62	2,928.62	47,556.56	47,556.56	53.94	53.94
2020	18,699.09	63,684.85	2,228.68	2,586.50	33,955.11	36,883.73	50,425.52	97,982.08	625.38	679.32
2021	178,773.30	242,458.15	5,327.68	7,914.18	42,463.08	79,346.81	215,908.69	313,890.78	782.08	1,461.40

7.4 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 post* 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.

In order to calculate the net carbon stock changes that the planned leakage prevention measures are expected to occasion during the monitoring period, the projected carbon stocks shall be estimated in the leakage management area under the baseline case and project scenario.

$$\Delta CLPMLK_t = \Delta CPSLK_t - \Delta CBSLLK_t$$

Where,

$\Delta CLPMLK_t$	Carbon stock decrease due to leakage prevention measures at year *t*; tCO_2e
$\Delta CBSLLK_t$	Annual carbon stock changes in leakage management areas in the baseline case at year *t*; tCO_2e
$\Delta CPSLK_t$	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 carried out by the Rio Madeira Grouped REDD+ Project in the baseline case, no decrease in carbon stocks due to activities implemented in the leakage management area were identified, thus $\Delta CBSLLK = 0$.

However, during the current monitoring period, there were carbon stock changes within the leakage management area due to deforestation of regenerated forests. The deforestation of 5.14 ha was detected in the LMA.

Therefore, the ex post carbon stock change in leakage management areas in the project case (ΔCPSLKt) was calculated as follows. The annual values are detailed in the Table below.

$$\Delta CPSLK_t = APSLK_{fcl,t} * \Delta Ctot_{cl}$$

Where,

$\Delta CPSLK_t$	Annual carbon stock change in leakage management areas in the project case; tCO_2e
$APSLK_{fcl,t}$	Annual area of class fcl with decreasing carbon stock in leakage management areas in the project case at year t; ha
$\Delta Ctot_{icl}$	Average carbon stock change of all accounted carbon pools in forest class icl at time t; tCO_2e/ha

Table 107. Ex post carbon stock change in leakage management areas in the project case

Project year	Carbon stock changes in leakage management area in the project case			
	ID_{fcl}	1	annual	cumulative
	APSLKfcl,t	$Ctot_{fcl,t}$	ΔCPSLKt	ΔCPSLK
	ha	tCO_2e/ha	tCO_2e	tCO_2e
2019	0.00	1.66	0.00	0.00
2020	0.00	10.36	0.00	0.00
2021	0.27	19.03	5.14	5.14

The table below shows that the net sum of carbon stock changes within the leakage management area during the current monitoring period is less than zero, i.e., leakage prevention measures are causing carbon stock decrease and therefore, are included as leakage emissions.

Table 108. Ex post 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
2019	0.00	0.00	0.00	0.00	0.00	0.00
2020	0.00	0.00	0.00	0.00	0.00	0.00
2021	0.00	0.00	5.14	5.14	5.14	5.14

Furthermore, leakage prevention measures carried out by the present project during the current monitoring period did not include agricultural intensification, fertilization, fodder production and/or other measures to enhance cropland and grazing land areas.

Therefore, the total *ex post* estimated carbon stock changes and increases in GHG emissions due to leakage prevention measures during this monitoring period is calculated as follows.

$$ELPMLK_t = EgLK_t + \Delta CLPMLK_t$$

Where,

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

Table 109. Ex post estimated total emissions above the baseline from leakage prevention activities

Project year	Carbon stock decrease due to leakage prevention measures		Total *ex ante* GHG emissions from increased grazing activities		Total *ex ante* increase in GHG emissions due to leakage prevention measures	
	annual	cumulative	annual	cumulative	annual	cumulative
	$\Delta CLPMLK_t$	$\Delta CLPMLK$	$EgLK_t$	$EgLK$	$ELPMLK_t$	$ELPMLK$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2019	0.00	0.00	0.00	0.00	0.00	0.00
2020	0.00	0.00	0.00	0.00	0.00	0.00
2021	5.14	5.14	0.00	0.00	5.14	5.14

<u>Ex post decrease in carbon stocks and increase in GHG emissions due to activity displacement leakage</u>

Activities that 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.

It is important to note that activity data for the leakage belt area was determined using the same methods applied to monitoring deforestation activity data in the project area. Leakage due to displacement activity was monitored by mapping forest cover change in the leakage belt.

As defined in the VCS Methodology VM0015 v1.1, if carbon stocks in the leakage belt area decrease more during project implementation than projected in the baseline case, this will be an indication that leakage due to displacement of baseline activities has occurred. 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 may not be attributed to the project activity and considered leakage.

From this perspective, it is possible to state that land-grabbing is a relevant phenom in the region that causes deforestation. Land-grabber is an illegal activity with the intention to have the land rights and make huge amounts of money selling areas that belong to the state or private owners[250]. Utilizes aggressive methods based on encroachment, illegal settlements, wood and cattle stealing, fire outbreaks, among other illegal methods to steal private or public lands as they are occupied. In some extreme cases, it is possible to have gun fights, facilities destruction, and tortures.

Once the land grabbers stablish in the intended area to be robbed, the usual practice is cattle ranching in order to create a productive environment and avoid different versions of the land succession rather than illegal practice[251]. When such episodes involve private areas, many times the landowners prefer to give up their lands and preserve their families and lives.

Generally, it is more likely to attack areas where the land titles are not fully legalized in notary and public authorities. Nevertheless, since the criminals are not always aware of the legal status of the land, the practice can also occur in fully legal properties.

Although the practice is undoubtedly illegal, there is no governmental efforts in order to stop it. Instead, there are political intentions to attenuate legal penalties for those who invade public

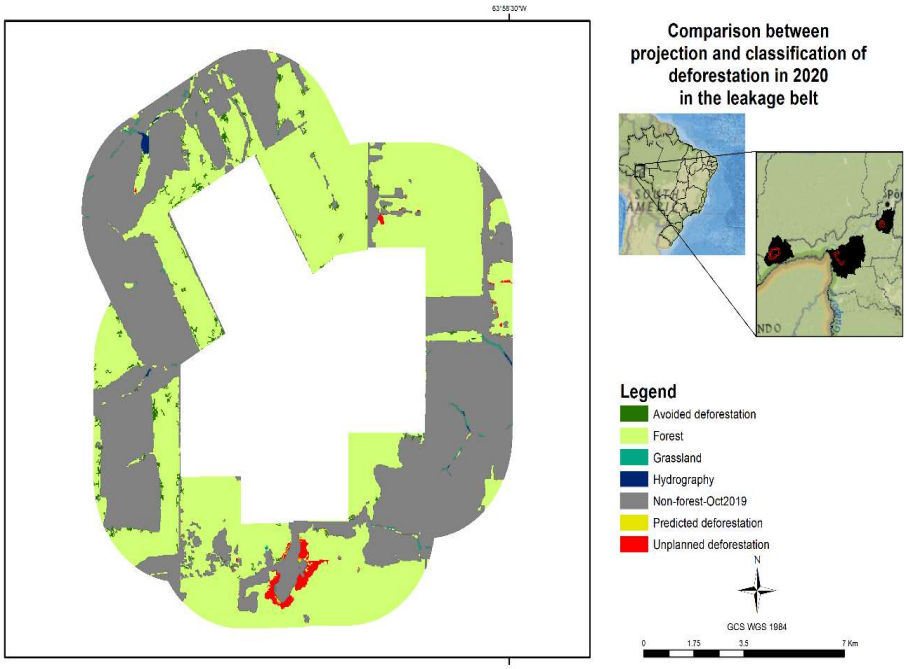
250 Available at https://theintercept.com/2022/12/01/profissionais-colocam-estado-a-servico-da-grilagem-de-terras-publicas-na-amazonia/ Last visit on 02/January/2023.
251 Available at http://www.bibliotecaflorestal.ufv.br/bitstream/handle/123456789/4031/Livro_A-grilagem-de-terras-publicas-na-Amazonia-Brasileira_MMA.pdf?sequence=1&isAllowed=y Last visit on 02/January/2023.

lands in Brazil[252]. The region where the project activity instances are located is known for this illegal practice, where several episodes were publicly announced recently[253] [254] [255] [256].

Regarding leakage emissions due to activity displacement, it is calculated as the difference between the ex ante and the ex post assessments.

Furthermore, the monitoring of increases in GHG emissions within leakage belt ($EADLK_t$) was also carried out.

Figure 98. Cumulative deforestation in the Leakage Belt of Instance 1 between 2019 and 2020



252 Available at https://www.greenpeace.org/brasil/blog/pl-da-grilagem-legaliza-o-desmatamento-e-o-roubo-de-terras-publicas-no-brasil/ Last visit on 02/January/2023.
253 Available at https://g1.globo.com/jornal-nacional/noticia/2022/08/18/grileiros-aproveitam-tempo-seco-para-abrir-novas-areas-na-floresta-ja-desmatada-no-sul-do-amazonas.ghtml Last visit on 02/January/2023.
254 Available at https://oeco.org.br/noticias/organizacao-criminosa-envolvida-com-grilagem-de-terras-em-rondonia-e-alvo-de-acao-policial/ Last visit on 03/January/2023.
255 Available at https://www.tudorondonia.com/noticias/policia-federal-deflagra-operacao-de-combate-a-grilagem-de-terras-publicas-federais,89592.shtml Last visit on 03/January/2023.
256 Available at https://www12.senado.leg.br/noticias/materias/2022/11/29/marcos-rogerio-denuncia-invasao-da-fazenda-norbrasil-em-rondonia Last visit on 02/January/2023.

Figure 99. Cumulative deforestation in the Leakage Belt of Instance 1 between 2020 and 2021

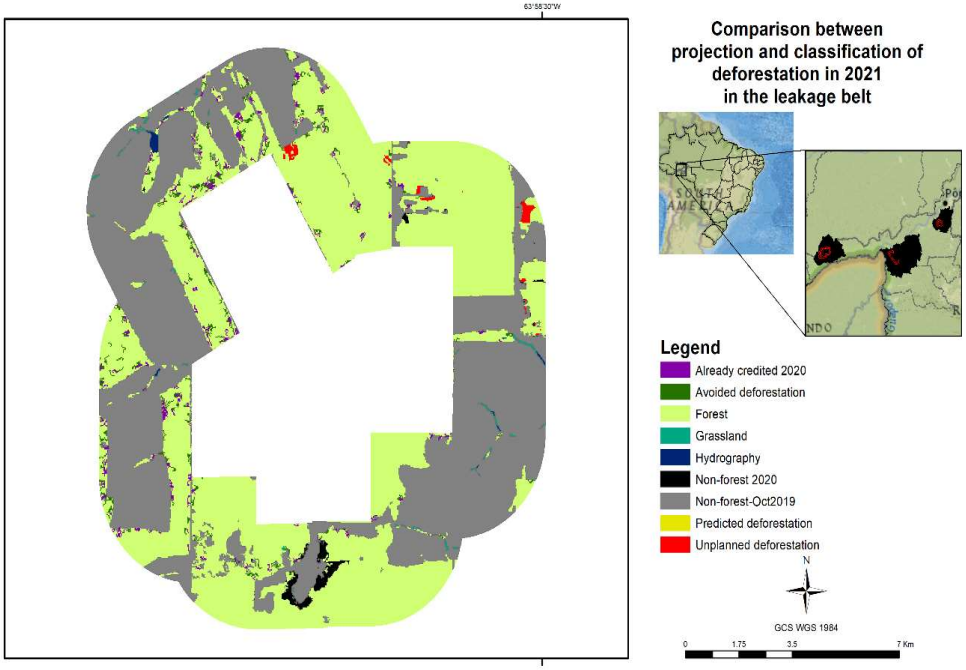


Figure 100. Cumulative deforestation in the Leakage Belt of Instance 2 in 2020

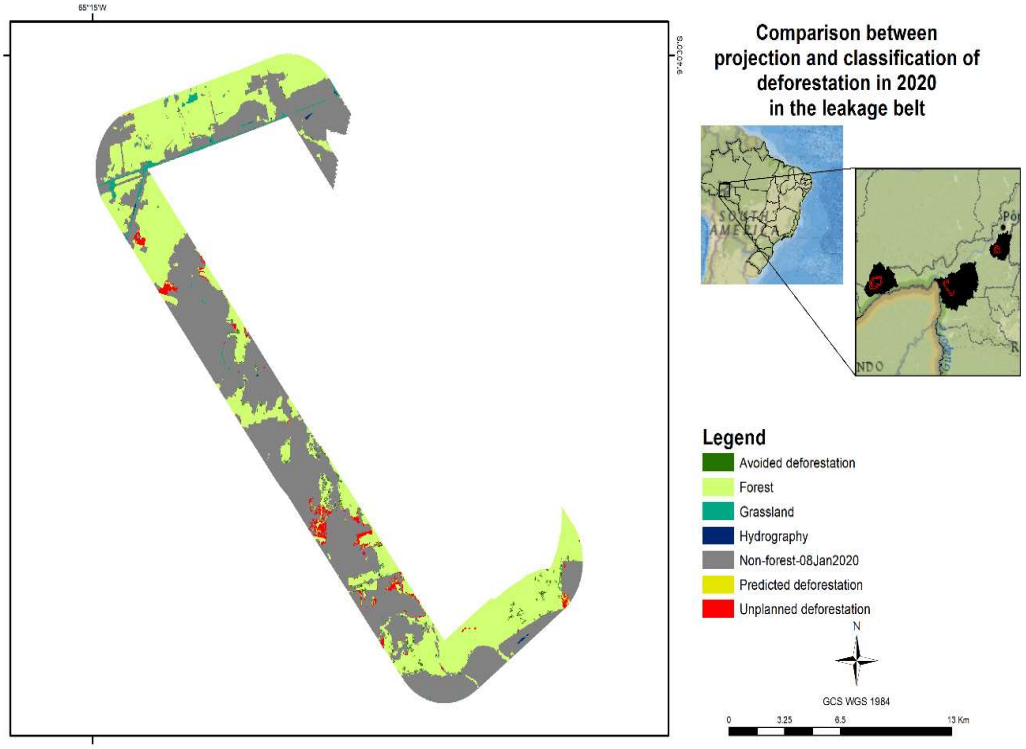


Figure 101. Cumulative deforestation in the Leakage Belt of Instance 2 in 2021

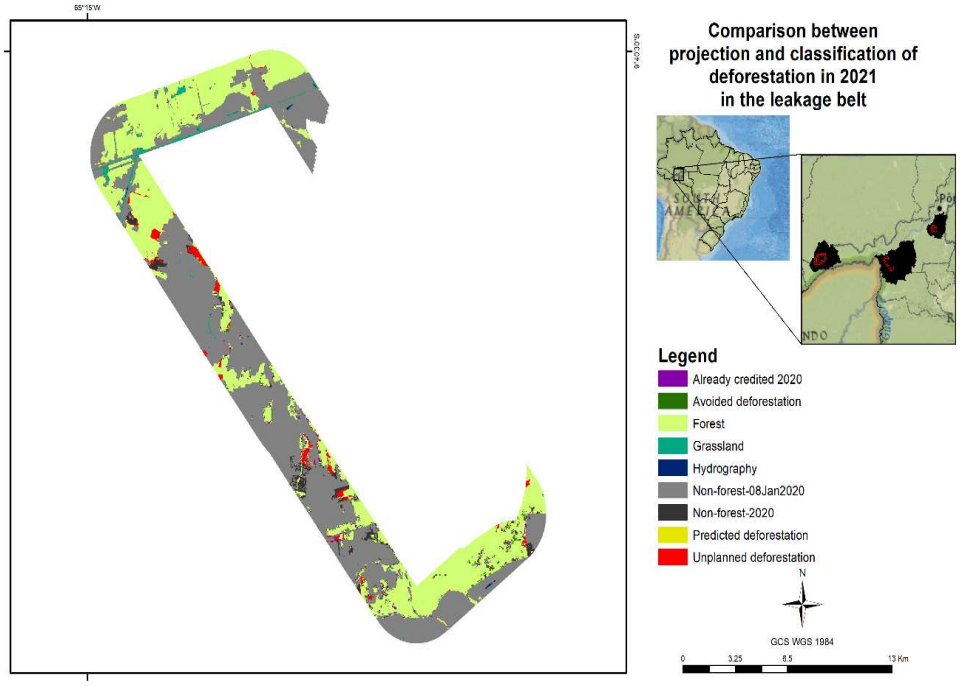


Figure 102. Cumulative deforestation in the Leakage Belt of Instance 3 in 2020

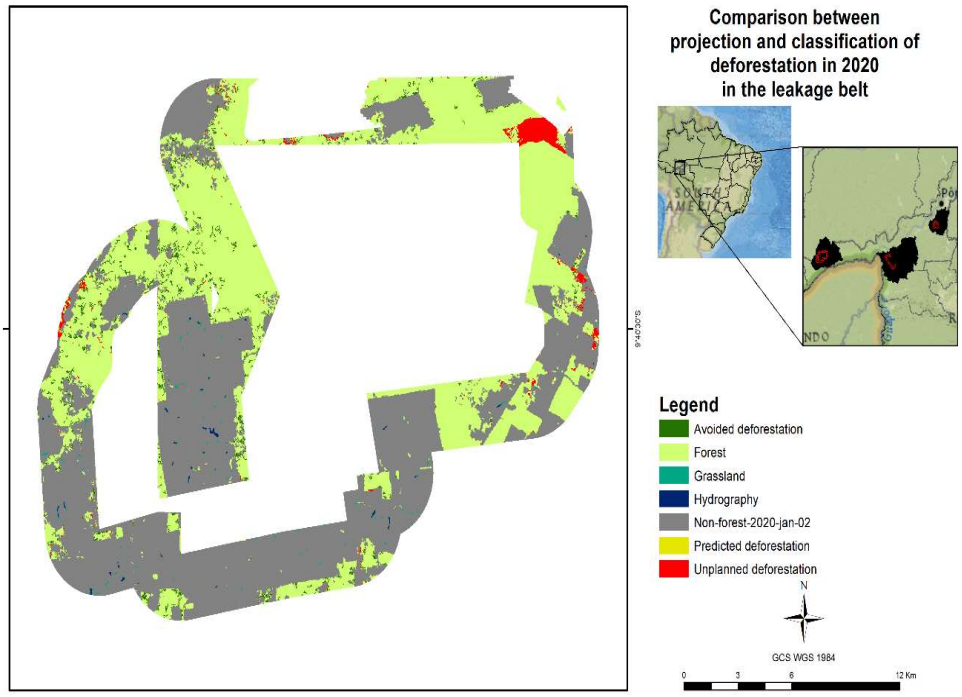
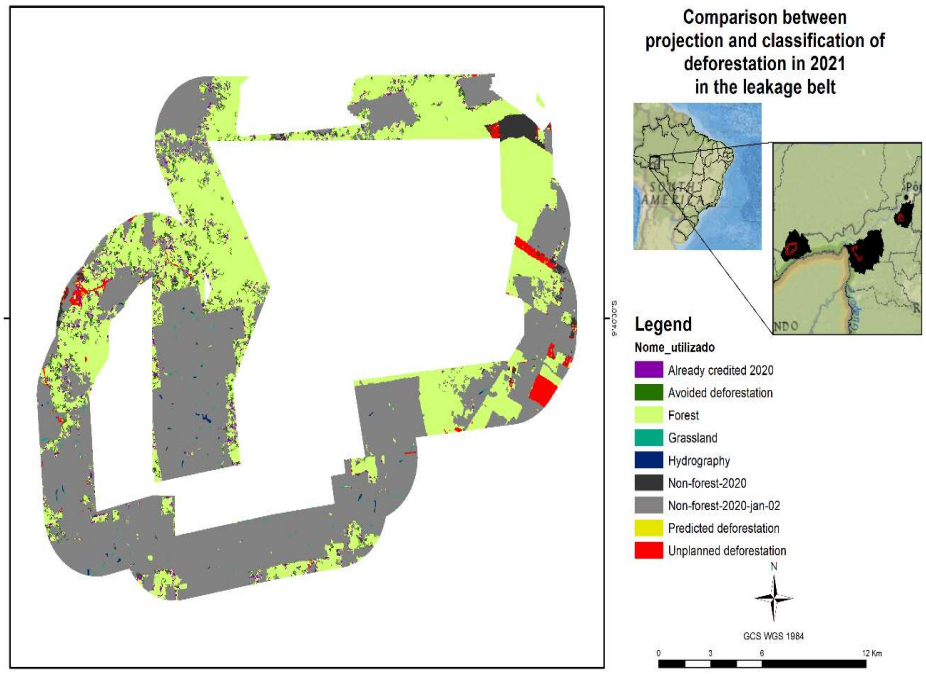


Figure 103. Cumulative deforestation in the Leakage Belt of Instance 3 in 2021



Ex post estimation of total leakage

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

$$\Delta CLK_t = \Delta CLPMLK_t + \Delta CADLK_t$$

Where:

ΔCLK_t	Total decrease in carbon stocks within the leakage belt at year t; tCO_2e
$\Delta CLPMLK_t$	Carbon stock decrease due to leakage prevention measures at year t; tCO_2e
$\Delta CADLK_t$	Total decrease in carbon stocks due to displaced deforestation at year t; tCO_2e

$$ELK_t = EgLK_t + EADLK_t$$

Where:

ELK_t	Sum of *ex post* leakage emissions at year t; tCO_2e
$EgLK_t$	Emissions from grazing animals in leakage management areas at year t; tCO_2e
$EADLK_t$	Total *ex post* increase in GHG emissions due to displaced forest fires at year t; tCO_2e

The results of all ex post estimations of leakage are summarized in the table below.

Table 110. Total net carbon stock change in the leakage belt

Project year	Total ex ante net baseline carbon stock change		Total ex post net actual carbon stock change		Total ex post leakage	
	ΔCBSLLKt annual	ΔCBSLLK cumulative	ΔCBSLLKt annual	ΔCBSLLK cumulative	ΔCBSLLKt annual	ΔCBSLLK cumulative
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2019	76,535	76,535	76,567	76,567	32	32
2020	414,420	490,955	401,678	478,245	0	32
2021	476,919	967,874	450,916	929,161	0	32

Table 111. Ex post total leakage

Project year	Total ex post GHG emissions from increased grazing activities		Total ex post increase in GHG emissions due to displaced forest fires		Total ex post decrease in carbon stocks due to displaced deforestation		Carbon stock decrease due to leakage prevention measures		Total net carbon stock change due to leakage		Total net increase in emissions due to leakage	
	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	$EgLK_t$	EgLK	$EADLK_t$	EADLK	$\Delta CADLK_t$	ΔCADLK	$\Delta CLPMLK_t$	ΔCLPMLK	ΔCLK_t	ΔCLK	ELK_t	ELK
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2019	0.00	0.00	0.72	0.72	32.06	32.06	0.00	0.00	32.06	32.06	0.72	0.72
2020	0.00	0.00	0.00	0.72	0.00	32.06	0.00	0.00	0.00	32.06	0.00	0.72
2021	0.00	0.00	0.00	0.72	0.00	32.06	5.14	5.14	5.14	37.20	0.00	0.72

7.5 Net GHG Emission Reductions and Removals

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

$$\Delta REDD_t = (\Delta CBSLPA_t + EBBBSLPA_t) - (\Delta CPSPA_t + EBBPSPA_t) - (\Delta CLK_t + ELK_t)$$

Where:

$\Delta REDD_t$ *Ex post* net anthropogenic greenhouse gas emission reduction attributable to the AUD project activity at year *t*; tCO_2e

$\Delta CBSLPA_t$ Sum of baseline carbon stock changes in the project area at year *t*; tCO_2e

$EBBBSLPA_t$ Sum of baseline emissions from biomass burning in the project area at year *t*; tCO_2e

$\Delta CPSPA_t$ Sum of *ex post* estimated actual carbon stock changes in the project area at year *t*; tCO_2e

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.

$EBBPSPA_t$ Sum of actual emissions from biomass burning in the project area at year *t*; tCO_2e

ΔCLK_t Sum of *ex post* estimated leakage net carbon stock changes at year *t*; tCO_2e

Note: If the cumulative sum of ΔCLK_t within a fixed baseline period is > *0,* ΔCLK_t shall be set to zero.

ELK_t Sum of *ex post* estimated leakage emissions at year *t*; tCO_2e

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 year *t* is calculated as follows:

$$VCU_t = \Delta REDD_t - VBC_t$$

$$VBC_t = (\Delta CBSLPA_t - \Delta CPSPA_t) \times RF_t$$

Where:

VCU_t Number of Verified Carbon Units that can be traded at time *t*; tCO_2e

Note: If VCUt < 0 no credits (VCUs) will be awarded to the proponents of the AUD project activity.

$\Delta REDD_t$ *Ex post* estimated net anthropogenic greenhouse gas emission reduction attributable to the AUD project activity at year *t*; tCO_2e

VBC_t Number of Buffer Credits deposited in the VCS Buffer at time *t*; tCO_2e

$\Delta CBSLPA_t$ Sum of baseline carbon stock changes in the project area at year *t*; tCO_2e

$\Delta CPSPA_t$ Sum of *ex post* carbon stock changes in the project area at year *t*; $tCO_2e\ ha^{-1}$

RF_t Risk factor used to calculate VCS buffer credits; %

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

The RF_t was estimated using the most recent version of the *VCS-approved AFOLU Non-Permanence Risk Tool* and the resulting value of RF_t for the present REDD project during the current monitoring period was 12%.

Despite the Non-Permance Risk Report has been compiled in one single report, it was carried out risk assessment for each instance of the project. Each instance obtained a score, according to the NPRR Calculation Tool. After this analysis, the more conservative score was adopted. Thus, the NPRR explains the analysis for three initial instances, but considers the worst-case scenario score to assure conservativeness.

The specific summary of GHG reductions and removals in the Rio Madeira REDD project during the current monitoring period is included in Table below. The latter table includes estimates of GHG emissions reduction ($REDD_t$), calculations of buffer and leakage, and the resulting calculation of tradable Verified Carbon Units (VCU_t).

Table 112. Ex post net anthropogenic GHG emissions reductions and VCUs

Project year	Baseline carbon stock changes		Baseline GHG emissions from biomass burning		Ex post project carbon stock changes		Ex post project GHG emissions from biomass burning		Ex post leakage carbon stock changes		Ex post leakage GHG emissions		Ex post net anthropogenic GHG emission reductions		Ex post VCUs tradable		Ex post buffer credits	
	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	$\Delta CBSLPA_t$	$\Delta CBSLPA$	$EBBBSLPA_t$	EBBBSLPA	$\Delta CPSPA_t$	$\Delta CPSPA$	$EBBPSPA_t$	EBBPSPA	ΔCLK_t	ΔCLK	ELK_t	ELK	$\Delta REDD_t$	$\Delta REDD$	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
2019	88,622	88,622	1,977	1,977	47,557	47,557	53.94	54	32	32	1	1	42,955	42,955	38,028	38,028	4,927	4,927
2020	713,187	801,809	15,877	17,853	50,426	97,982	625.38	679	0	32	0	1	678,013	720,968	598,482	636,510	79,531	84,458
2021	898,977	1,700,786	19,786	37,640	215,909	313,891	782.08	1,461	5	37	0	1	702,067	1,423,035	620,099	1,256,609	81,968	166,426

In addition, the net GHG emission reductions and removals in the Rio Madeira REDD Project are summarized in the table below.

Table 113. Net GHG emissions reductions and removals in the Rio Madeira Grouped REDD Project

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)	Buffer pool allocation	VCUs eligible for issuance
23/10/2019 - 31/12/2019	90,598	47,611	33	42,955	4,927	38,028
2020	729,064	51,051	0	678,013	79,531	598,482
2021	918,763	216,691	5	702,067	81,968	620,099
Total	1,738,426	315,352	38	1,423,035	166,426	1,256,609

APPENDIX I: METHODOLOGICAL PROCEDURES FOR LU/LC CHANGE ANALYSIS

According to the applied methodology, in order to achieve a consistent time-series of LU/LC-change data over the crediting period, the detailed methodological procedures used in pre-processing, classification, post classification processing, and accuracy assessment of the remotely sensed data shall be carefully documented in the VCS PD. Therefore, the information below describes the methodological procedures applied during the current monitored period.

Data sources and pre-processing

The historic deforestation of the reference region should be analyzed through maps from MapBiomas (version 6.0, which was the last available version), available in raster format, which can be downloaded from the *http://mapbiomas.org/* website. MapBiomas is a multi-institutional initiative of the Greenhouse Gas Emissions Estimation System (SEEG - http://seeg.eco.br/en/) promoted by the Climate Observatory. MapBiomas co-creation involves NGO's, universities and technology companies.

The forest dynamics data, the deforestation vectors and other base data from the studied region, which were used for the project's baseline construction, should be organized in a spatialized database. For this purpose, the software used in this baseline reassessment was the File Geodatabase format from ArcGIS 10.6. The files are stored in vector and matrix format (raster). In order to standardize spatial references, all data has been projected for the UTM and Datum WGS84, Zone 22S projection.

The MapBiomas methodology for land use classification uses 105 input variables, including the original Landsat bands, indexes, fractional and textural information derived from these bands, which are detailed in the table below:

Figure 104. Number of Landsat images for mapping the Amazon. Source: MapBiomas

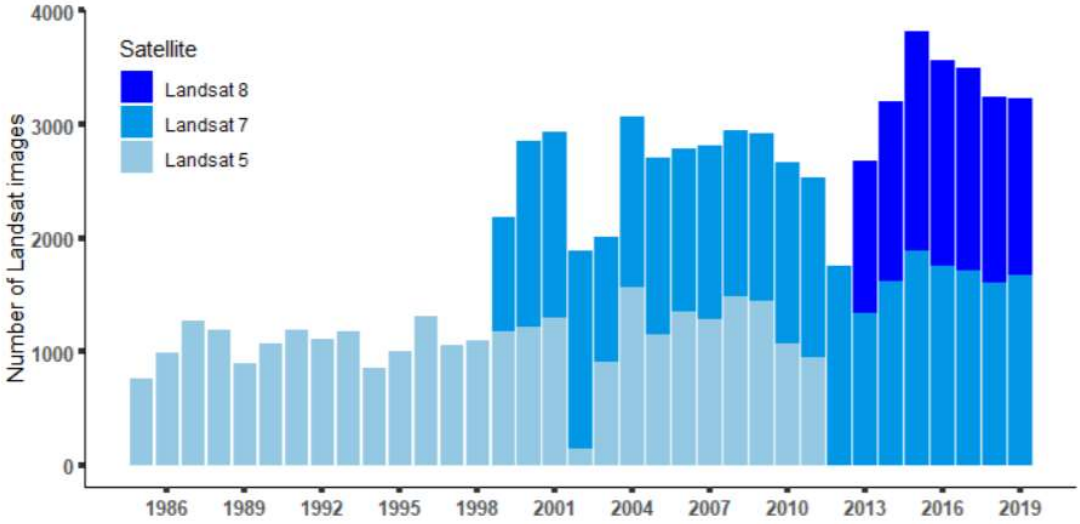


Figure 105. List, description and reference of bands, fractions and indexes available in the feature space

			Reducer						
	band or index name	formula	median	median_dry	median_wet	amplitude	std Dev	min	Reference
bands	blue	B1 (L5 e L7); B2 (L8)	■	■	■		■	■	■
	green	B2 (L5 e L7); B3 (L8)	■	■	■		■	■	■
	red	B3 (L5 e L7); B4 (L8)	■	■	■		■	■	■
	nir	B4 (L5 e L7); B5 (L8)	■	■	■		■	■	■
	swir1	B5 (L5 e L7); B6 (L8)	■	■	■		■	■	■
	swir2	B7 (L5); B8 (L7); B7 (L8)	■	■	■		■	■	■
	temp	B6 (L5 e L7); B10 (L8)	■				■	■	■
index	ndvi	(nir - red)/(nir + red)	■	■	■	■	■		
	evi2	(2.5 * (nir - red)/(nir + 2.4 * red + 1)	■	■	■	■	■		
	cai	(swir2 / swir1)	■	■	■		■		
	ndwi	(nir - swir1)/(nir +	■	■	■	■	■		
		swir1)	■	■	■	■	■		
	gcvi	(nir / green - 1)	■	■	■		■		
	hall_cover	(-red*0.017 - nir*0.007 - swir2*0.079 + 5.22)	■				■		
	pri	(blue - green)/(blue + green)	■	■	■		■		
	savi	(1 + L) * (nir - red)/(nir + red + 0,5)	■	■	■		■		
	textG	("median_green") .entropy(ee.Kernel .square({radius: 5}))	■						
fraction	gv	fractional abundance of green vegetation within the pixel	■			■	■		
	npv	fractional abundance of non-photosynthetic vegetation within the pixel	■			■	■		
	soil	fractional abundance of soil within the pixel	■				■		
	cloud	fractional abundance of cloud within the pixel	■			■	■		
	shade	100 - (gv + npv + soil + cloud)	■				■		
MEM index	gvs	gv / (gv + npv + soil + cloud)	■	■	■		■		
	ndfi	(gvs - (npv + soil))/(gvs + (npv + soil))	■	■	■	■	■		
	sefi	(gv+npv_s - soil)/(gv+npv_s + soil)	■	■	■	■	■		
	wefi	((gv+npv) - (soil+shade)) /((gv+npv) + (soil+shade))	■	■	■	■	■		
	fns	((gv+shade) - soil) / ((gv+shade) + soil)	■	■	■		■		
slope		ALOS DSM: Global 30m	■						

Where,

Median - Median of the pixel values of the best mapping period defined by each biome.

Median_dry = median of the quartile of the lowest pixel NDVI values.

Median_wet = median of the quartile of the highest pixel NDVI values.

Amplitude = amplitude of variation of the index considering all the images of each year.

stdDev = standard deviation of all pixel values of all images of each year.

Min = lower annual value of the pixels of each band.

In addition, Landsat Images used in MapBiomas were accessible via Google Earth Engine, and most of them are composed by the Collection 1 Tier 1 from USGS. This is the highest quality Level-1 products suitable for pixel-level time series analysis. These images are radiometrically calibrated and orthorectified using ground control points (GCPs) and digital elevation model (DEM) data to correct for relief displacement.

Data classification and post-processing

The LU/LC classes defined for this project activity were: Forest, Non-Forest and Hydrography. In addition, the established LU/LC-change categories were:

a) Forested areas that remains as forested areas (Conservation);

b) Forest that are converted to non-forested areas (Deforestation); or

c) Non-forested areas that remains as non-forested areas.

The image classification methodology for each year involves all Landsat images available for each period (Landsat 5 [L5], Landsat 7 [L7] and Landsat 8 [L8]) or other sensor available) with a cloud cover less than or equal to 50%, and in accordance with its 30m resolution, the minimum mapping unit was defined at 30x30m (0.09ha), therefore falling easily to the methodology requirement that the MMU cannot be larger than 1ha. Thus, a representative mosaic of each year could be generated, selecting cloud free pixels from the available images. Metrics should be extracted for each pixel that describes its behavior during the year and could contain up to 105 layers of information. The mapping should be done with an artificial intelligence classifier, such as the Randon Forest. The Landsat images acquisition could be made through Google Earth Engine, with data from NASA and USGS (U.S. Geological Survey).

The algorithm may use samples obtained by reference maps, stable collections from previous MapBiomas series and/or direct collection by visual interpretation of Landsat images in order to classify a single map per class. This classification should then go through spatial filter, applying neighborhood rules and temporal filters to reduce spatial and temporal inconsistencies. The software used in this baseline reassessment was the ArcGIS 10.6. In addition, high resolution images from Google Earth software (https://earth.google.com/) were also utilized to perform some LU/LC-change analysis.

Due to the pixel-based classification method and the long temporal series, the MapBiomas applies a chain of post-classification filters. The first post-classification action involves the application of temporal filters. Then, a spatial filter was applied followed by a gap fill filter. The application of these filters removes classification noises. These post-classification procedures were implemented in the Google Earth Engine platform and are described below:

Gap Fill

The Gap fill is a temporal filter used to fill possible no-data values. In a long time series of severely cloud-affected regions, it is expected that no-data values may populate some of the resultant median composite pixels. In this filter, no-data values ("gaps") are theoretically not allowed and are replaced by the temporally nearest valid classification

Spatial Filter

Spatial filter was applied to avoid unwanted modifications to the edges of the pixel groups (blobs), a spatial filter was built based on the "connectedPixelCount" function. This function locates connected components (neighbours) that share the same pixel value.

Temporal Filter

The temporal filter uses sequential classifications in a three-to-five-years unidirectional moving window to identify temporally non-permitted transitions. Based on generic rules (GR), the temporal filter inspects the central positions of three to five consecutive years, and if the extremities of the consecutive years are identical but the centre position is not, then the central pixels are reclassified to match its temporal neighbour class.

Frequency Filter

This filter takes into consideration the occurrence frequency throughout the entire time series. Thus, all class occurrence with less than given percentage of temporal persistence (eg. 3 years or fewer out of 33) are filtered out. This mechanism decreasing the number of false positives and preserving consolidated trajectories.

Incident Filter

An incident filter was applied to remove pixels that changed too many times in the 34 years of time spam. All pixels that changed more than eight times and are connected to less than 6 pixels were replaced by the MODE value of that given pixel position in the stack of years.

APPENDIX II: COMMENTS RECEIVED DURING PUBLIC CONSULTATION

Submitted to: Verra
Project under public consultation: Rio Madeira grouped REDD+ Project (ID 2878)

Public consultation response

Rio Madeira grouped REDD+ Project

The Nature-based Solutions Brazil Alliance aims to promote and stimulate an agenda to discourage deforestation and forest degradation through the creation of guidelines and good practices, generating a safe and reliable business environment. The NBS Brazil Alliance appreciates this opportunity to share input on the Arca REDD+ Project. The open consultation process and the possibility to participate actively is an opportunity to improve the integrity of the carbon credits.

As a non-profit association of project developers whose members are: Agrocortex, Bioassets, Biofílica, BR Carbon, BVRio, Carbonext, Ecosecurities, ERA Brazil, FAS, IDESAM, Instituto Ekos Brasil, Mirova Natural Capital – Althelia Funds, Permian and South Pole, it is great to see new carbon projects being developed.

The following aspects contained within the Project Description were seen as concerns:

Baseline assumptions

Modeling approach ("C) was selected in the draft document to quantify the future deforestation, according to the conclusive evidence in the increase of the rate of deforestation. But, the document does not present data on historic deforestation that support this.
Also, the delimitation of the reference region and eligible area is not defined, therefore it can not verify how was calculated *ex - ante* estimations (5,344,693 tCO2e during the crediting period).
The analysis of agents, drivers and underlying causes of deforestation does not present a clear causal sequence of the chain of events leading to deforestation thus it is not possible to corroborate if the project activities actually contribute to the reduction of deforestation.

Safeguards

This information is not available in the draft document. For projects with additional certifications such as Rio Madeira grouped REDD+, where Social Carbon standard it will be applied, preliminary information related to stakeholder identification, social characterization and prior consent should be requested.

The only information available on social topics is related to some data in the municipalities of projection of the cultivation of soybean and corn and heads of cattle.

Other comments

Ownership: the document does not describe the type of information that is used as support to prove landowner rights (deed, purchase agreements or others)
Eligible area: the draft document does not present the eligible area for the project. Also, it is not available the process and sources of information to quantify it.
Project activities: lack of detail in the description of project activities. It is necessary to clarify how project activities wil contribute with the reduction of deforestation according to the analysis of chain of events leading to deforestation.
Estimated GHG Emission Reductions: It is not clear how is estimate the reduction in deforestation of 17,720 ha, which is expected to reduce 5,344,693 tCO2e for the credit period.
Project Boundary: The reference region, leakage belt and project area (forest at start date) are not defined.
Project Start Date: the activity considered for to project start date does not explain how it contributes to reducing deforestation. In addition, if the activities are related to control and surveillance, how can the project ensure that invaders do not displace of deforestation and generate leakage?
Carbon rights: It is not clear what is the role of Carbon Asset (the project proponent company) in the project.
VCS standard: In section 1.4 the criteria of the VCS standard version 4.0 are taken into account and in section 1.8 the VCS standard version 4.2 is referenced. It should check which version applies.

The NBS Brazil Alliance appreciates this important opportunity to record our comments. We welcome the project proponents to reach-out directly with any questions or follow-up requests related to the comments shared above by contacting **NBS Brazil Alliance Coordinator, Victor Ferraz,** at **nbs@nbsbrazilalliance.com.**