Amazon Biome Conservancy Grouped REDD+ Project

Document Prepared by Systemica Ltda.

Project Title	Amazon Biome Conservancy Grouped REDD+ Project
Version	1.1
Date of Issue	20-December-2022
Prepared By	Systemica Ltda.
Contact	Rua São Vicente de Paulo, 501, Santa Cecília, São Paulo – SP, Brazil Postal Code: 01.229-010 T: +55 (11) 9 9394-1980 munir@systemica.digital https://systemica.digital/

CONTENTS

FIGURES

TABLES

1 PROJECT DETAILS

1.1 Summary Description of the Project

The world has a forest area of 4.06 billion hectares (ha), which is 31% of the total land area. More than half (54%) of the world's forests are in just five countries and Brazil is in second place among nations with the most forest area worldwide, having in its territory 12% of the global forest area (FAO & UNEP, 2020). On the other hand, Brazil is one of the countries with the highest rates of forest loss (Tyukavina et al., 2017).

The Amazon Biome Conservancy Grouped REDD+ Project (hereinafter also referred to as “ABC”) has as its main objective to contribute to the preservation of the most extensive tropical forest in the world in the Brazilian territory while providing significant improvements in the social interface. Geographical boundaries were defined as the limits of the Brazilian Amazon Biome, then all instances must be within it. The project for this validation process has only one project activity instance (ABC-I1) located in the Itacoatiara municipality, the state of Amazonas, near its capital of Manaus. According to the geo-referencing data, the total area of the project is established at 5,140.20 ha, which is composed of native Amazon Rainforest vegetation, without the existence of secondary vegetation since the land has not been cleared of native ecosystems within the last 10 years before the project start date.

The project area consisting of the ABC project is equivalent to the 20% of the landowner property area that he could legally suppress, according to the Brazilian forest code (Law 12.651, 2012). He gave up the right to deforest the area, changing the source of revenue from business-as-usual activities that he would have (loggin activities, livestock followed or not by agriculture activities, for example) to the revenue from selling VCUs generated by maintaining the forest alive.

This project will be eligible under the Reducing Emissions from Deforestation and Forest Degradation (REDD) category, using the VM0007 methodology for Avoiding Planned Deforestation and Degradation (APDD). It also aims to be registered under the Verified Carbon Standard (VCS) combating the decreased carbon stock in the Brazilian Legal Amazon.

The crediting period of the project is 30 years. The start date is 19/11/2022 and the crediting period is expected to end on 18/11/2052. To execute the installation of this project and to achieve its objectives the VCU generation is very important. A reduction of 2,605,773.23 t $CO_{2\text{-}e}$ of GHG is expected over the next ten years for the first baseline developed and presented in this Project Description - PD (average of 260,577.32 t $CO_{2\text{-}e}$ per year).

The ABC project will accomplish its environmental benefits through a successful monitoring system by assessing satellite images and using them for remote geospatial analysis. It will also generate economic benefits through investments in local communities, teaching them sustainable ways to maintain their economic activities and improving social environment quality.

1.2 Sectoral Scope and Project Type

The ABC Grouped REDD+ Project is within the sectorial scope number 14 – Agriculture, Forestry and Other Land Use (AFOLU).

The project category is Reduced Emissions from Deforestation and Forest Degradation (REDD), more specifically, Avoiding Planned Deforestation and Degradation (APDD project activity).

This project is a grouped project.

1.3 Project Eligibility

According to the VCS Standard v4.3 and considering the ABC project characteristics, some topics presented in three main sections must be followed by this project so it can be eligible. All the bullet points of the next paragraphs have, in their beginning, the VCS Standard section that sets a specific requirement and then a brief description of how this project attends it.

Section 3.1 General Requirements

The project attends to all the applicable requisites of Section 3.1 listed below.

- Section 3.1.1: The project meets all applicable rules and requirements set out under the VCS program. More details about the methodologies used are given in Section 3.2 of Applicability of Methodology.
- Section 3.1.2: A methodology eligible under the VCS Program is applied in full, namely, the VM0007, REDD+ Methodology Framework v1.6.
- Section 3.1.3: Implementation is legal under Brazilian legislation. All laws considered during the compliance process are presented in Section 1.14 of this document.
- Section 3.1.7: Rules and requirements of the VCS program take precedence over other approved GHG Program when there is a conflict between them.

Section 3.2 AFOLU-Specific Matters

All applicable minor sections of the 3.2. section have requirements followed by the ABC project:

- Section 3.2.1. The project is within an AFOLU project category eligible under the VCS Program (Reduced Emissions from Deforestation and Degradation).
- Section 3.2.2: The project is not located within a region covered by a jurisdictional REDD+ program, then it is not necessary to follow the requirements related to nested projects set out in the VCS Program document called Jurisdictional and Nested REDD+ Requirements.
- Section 3.2.3: All implementation partners are identified in Section 1.6, Other Entities Involved in the Project, of this document.
- Section 3.2.4: Project activities do not convert native ecosystems to generate GHG credits. As stated in Section 1.13 and confirmed by geospatial data, the land has not been cleared of native

ecosystems within 10 years of the project start date. The geospatial analysis also concludes that fauna and flora of the project area are part of the Amazon Biome.

- Section 3.2.5: Project activities do not drain or degrade hydrological functions to generate GHG credits. Their resources are not used, and their riparian forest remains intact.
- Section 3.2.6. The project activities and its time implementation, which will be confirmed in each verification, are described in Section 5.3 of this PD.
- Section 3.2.7: The project is going to reassess the defined baseline every six years in order to consider possible methodologies updates and changes in the drivers and/or behavior of agents that cause changes in the reference area.
- Section 3.2.8: Project activities do not occur on wetlands, then specific requirements for WRC projects are not necessary to be followed.

Appendix 1 Eligible AFOLU Project Categories

Appendix 1 from the VCS Standard v4.3 details the eligibility criteria for every type of activity. Since the ABC is a Grouped REDD+ project, paragraphs A1.5 to A1.8 are the important ones for this project. The requirements attended by ABC are listed below.

- Reduce emissions from deforestation by avoiding legal logging activities.
- The eligible area is composed of qualified forests once they have more than 10 years of existence prior to the project start date.

The activities covered under the REDD project category have specifically the goal to avoid planned (designated and sanctioned) deforestation, configuring as an APDD kind of project.

1.4 Project Design

Following the template provided, ABC project design fits in the option marked below.

☐ The project includes a single location or installation only.

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

☒ The project is a grouped project.

Being a grouped project, it is possible to include in the next years new project activity instances after the validation process, which is composed by only one instance.

According to elements mentioned in Section 3.5 of the VCS Standard v4.3, new areas willing to become instances of the project shall comply not only with the applicability conditions of the selected methodology (Section 1.3), but also with a defined set of eligibility criteria.

Though this Section 1.4 or project design, Section 1.4.1 contains general requirements that grouped projects must follow and then, in Section 1.4.2 the set of eligibility criteria that every new PAI needs to attend so it can be included in the ABC project.

1.4.1 Eligibility Criteria for Grouped Projects

Table 1.1 contains the general requirements for grouped projects.

Table 1.1. General requirements for Grouped Projects.

VCS Standard Eligibility for Grouped Projects	ABC project Attendance
3.5.8. Grouped projects shall have one or more clearly defined geographic areas within which project activity instances may be developed.	This grouped project will include only project areas to compose its instances located inside the Brazilian Amazon Biome. For each project area, detailed information about its location is given in Section 1.12.
3.5.9. Determination of baseline scenario and demonstration of additionality are based upon the initial project activity instances.	The determinations of the baseline scenario and the additionality will be based upon the initial project activity instance described in this PD. Major class of deforestation agent is the landowner themselves, who have the legal rights to suppress 20% of the forest area in their properties. Most of them does that with the intention of implementing business as usual (BAU) activities, such as livestock and/or agriculture.
3.5.10. As with non-grouped projects, grouped projects may incorporate multiple project activities.	Although it could, this project does not have any other project activities besides the APDD.
3.5.11. The baseline scenario for a project activity shall be determined for each designated geographic area, in accordance with the methodology applied to the project. and 3.5.12. The additionality of the initial project activity instances shall be demonstrated for each	The ABC project at this validation process has only one project area inside the geographic area of the Brazilian Amazon Biome, then, additionality and the baseline scenario were assessed only once for this project instance. To the inclusion of new PAIs, their project areas needs to have very similar characteristics to the baseline scenario and additionality, presented in Sections 3.4 and 3.5 of this PD.

VCS Standard Eligibility for Grouped Projects	ABC project Attendance
designated geographic area, in accordance with the methodology applied to the project.	
3.5.13. Where factors relevant to the determination of the baseline scenario or demonstration of additionality require assessment across a given area, the area shall be, at a minimum, the grouped project geographic area.	All relevant factors necessary to the baseline scenario and additionality demonstration are assessed across the project area.
3.5.14. Where a capacity limit applies to a project activity included in the project, no project activity instance shall exceed such limit.	Not applicable. APDD project activity does not includes any kind of capacity limits described.
3.5.17. AFOLU non-permanence risk analyses, where required, shall be assessed for each geographic area specified in the project description.	The required non-permanence risk analyses is available together with this PD.

1.4.2 Instances attendance to the Set of Eligibility Criteria

The following Table 1.2 shows how the ABC-I1 defines and attends to the set of eligibility criteria.

Table 1.2. Set of Eligibility Criteria applied to the project activity instance one.

VCS Standard Eligibility for Grouped Projects	ABC project Activity Instance One
3.5.15. Grouped projects shall include one or more sets of eligibility criteria for the inclusion of new project activity instances. A set of eligibility criteria shall ensure that new project activity instances: 1) Meet the applicability conditions set out in the methodology applied to the project.	The main specific methodologies applied to this project are the VM0007 v1.6 and its VMD0006 v1.3 module. The ABC-I1 meet the applicability conditions by having the following characteristics: • There are no land areas registered under the CDM or under any other GHG program (both voluntary and compliance-oriented). • All its project area is covered by qualified forest vegetation for at least 10 years prior the project start date, following the definition of forest given by the Food and Agriculture Organization of the United Nations (FAO, 2020): "land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not

VCS Standard Eligibility for Grouped Projects	ABC project Activity Instance One
	include land that is predominantly under agricultural or urban land use". • Falls into the planned deforestation/degradation (APDD) VCS category. • Leakage avoidance activities does not include agricultural lands that are flooded to increase production nor intensified livestock production through the use of feed-lots and/or manure lagoons. • APDD activities are applicated under the condition that the conversion of forest lands to a deforested area must be legally permitted, authorized and documented to be converted to non-forest land.
3.5.15. 2) Use the technologies or measures specified in the project description. and 3) Apply the technologies or measures in the same manner as specified in the project description.	The definitions and measures described in the Section 5.3. of project activities of this project description are going to be used and applied in in the ABC-I1 in the same manner as specified in this project description. All of them with the objective to avoid planned deforestation.
3.5.15. 4) Are subject to the baseline scenario determined in the project description for the specified project activity and geographic area. and 5) 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,	The baseline scenario and the additionality analysis detailed in this project description for the ABC-I1 gives the conditions for the inclusion of futures instances in this project. All of them will be also located inside the Brazilian Amazon Biome under the APDD project activity.

VCS Standard Eligibility for Grouped Projects	ABC project Activity Instance One
technological and/or other barriers as the initial instances.	
3.5.16. New project activity instances shall: 1) Occur within one of the designated geographic areas specified in the project description.	The ABC-I1 is located inside the Brazilian Amazon Biome. Its geographic limits are well defined with detailed information and kml files as annex in Section 1.12.
3.5.16. 2) Comply with at least one complete set of eligibility criteria for the inclusion of new project activity instances.	It is assumed that the set of eligibility criteria is all the requirements presented in Section 1.4. of this PD. By accomplishing with the demands in this chapter, the instance will be eligible to the ABC project.
3.5.16. 3) Be included in the monitoring report with sufficient technical, financial, geographic, and other relevant information to demonstrate compliance.	The ABC-I1 is going to be included in the monitoring report with sufficient technical, geographic and any other relevant information to demonstrate the instance compliance, with the same quality employed in this PD.
3.5.16. 4) Be validated at the time of verification against the applicable set of eligibility criteria.	As already commented, the set of eligibility criteria is all the requirements presented in Section 1.4. of this PD. Being this first PAI defines the main guidelines for the addition of more instances are presented in this validation process. Then, by defining its guidelines it also self-validated.
3.5.16. 5) Have evidence of project ownership, in respect of each project activity instance.	Detailed information about the project ownership is available in Sections 1.5 and 1.6. Systemica, being the ABC project proponent and project owner has a contract with the landowner of the ABC-I1, securing his commitment with the forest preservation and the project monitoring activities.
3.5.16. 6) Have a start date that is the same as or later than the grouped project start date.	Being the project activity instance one, its start date also defines the ABC project. Then, is the same start date than the grouped project start date.

VCS Standard Eligibility for Grouped Projects	ABC project Activity Instance One
3.5.16. 7) Be eligible for crediting from the start date of the instance through to the end of the project crediting period (only).	Once the start date of this project activity instance one is same one as the grouped project, it is eligible for crediting from the start date. On the other hand, the ABC-I1 crediting period ends before the project crediting period, since the total project area of it would be deforested in 10 years according to the baseline scenario of it.
3.5.16. 8) Not leave one VCS project and subsequently enroll in another VCS project.	The ABC project ABC-I1 will not leave the VCS project and subsequently enroll another VCS project. This is also guaranteed between the accordance between the project proponent and the landowner.

1.5 Project Proponent

The project proponent detailed information is shown in Table 1.3.

Table 1.3. Project proponent detailed information.

Organization name	Systemica (MYS E JLFL TREINAMENTO GERENCIAL LTDA)[1]
Contact person	Munir Younes Soares
Title	Director
Address	Rua São Vicente de Paulo, nº 501, Apartamento 201, Santa Cecília, São Paulo, Brazil. Postal Code: 01229-010.
Telephone	+55 (11) 99394-1980
Email	munir@systemica.digital

1.6 Other Entities Involved in the Project

The entity involved detailed information is shown in Table 1.4

[1] Annex: Listing Representation.pdf

Table 1.4. Ricci e Santos Advogados entity detailed information.

Organization name	Ricci e Santos Advogados
Role in the project	Legal Advisory
Contact person	Thiago G. de O. Ricci
Title	Director
Address	Av. Eng. Luis Carlos Berrini, nº 1748, cj. 101/103, Itaim Bibi, SP, Brazil – CEP 04571-000.
Telephone	+55 (11) 98490-9830
Email	tgor@lawrs.com.br

Table 1.5. João Rogério de Souza entity datailed information.

Organization name	João Rogério de Souza
Role in the project	Landowner[2], Project Participant
Contact person	João Rogério de Souza
Title	Owner of the properties: *Lote 80*, *Lote 81*, *Lote 84*, *Lote 93*, *Lote 94*, *Lote 95* and *Lote Felicidade*
Address	Av. Comendador Luiz Meneghel, no 101, Centro, Nova Bandeirante, MT, Brazil - CEP 78565-000.
Telephone	+55 (66) 8409-8995
Email	jcmadeiras.nb@hotmail.com

Table 1.6. Márcio de Souza entity datailed information.

Organization name	Márcio Jose Dias Lopes
Role in the project	Jose Rogerio's business partner[3, 4]

[2] Annex: Systemica - João Rogério Contract.pdf

[3] Annex: CNPJ Rogério and Márcio – Status.pdf

[4] Annex: CNPJ Rogério and Márcio – Attributes.pdf

Contact person	Márcio Jose Dias Lopes
Title	Márcio Jose Dias Lopes
Address	Rua das Amendoeiras, 22, apartamento 1001, Sinop, MT, Brazil – CEP: 78550-076.
Telephone	+55 (66) 8409-8995
Email	marciojosediaslopes@hotmail.com

1.7 Ownership

Amazon Biome Conservancy Grouped REDD+ Project, in its first instance (ABC-I1), covers a region in the Itacoatiara and Silves municipalities, Amazonas state, Brazil. This project comprises seven properties whose names are *Lote 80*, *Lote 81*, *Lote 84*, *Lote 93*, *Lote 94*, *Lote 95*, and *Lote Felicidade*. João Rogério de Souza is the owner and has all the legal documents[5] that prove the land title and ownership of each property. So, the ABC-I1 ownership is defined by item 6, Section 3.6.1 of the VCS Standard v4.3 as "An enforceable and irrevocable agreement with the holder of the statutory, property or contractual right in the land, vegetation or conservational or management process that generates GHG emission reductions or removals which vests project ownership in the project proponent."

1.8 Project Start Date

The ABC Grouped REDD+ Project started on the 19th of November 2022. This date is the effective date on which the project began generating GHG emissions reduction in the project area.

Despite a lot of earlier conversations with landowners and project viability analysis, the 19th of November 2022 is the first date when local activities started to be implemented by Systemica. Evidence[6] shows that face-to-face meetings were held to present the ABC project, bring environmental education elements to local communities near the project area, and understand their opinion about it. This is one of the many activities proposed by the ABC project, which would not happen before the project start date. Engaging the local community helps spread the existence of REDD+ to them, which is still not popular among the larger households of the Amazon biome, and then shows them the benefits the project implementation can bring not only to the environment but also to the local communities.

The landowner is a logger and rancher, so the main activities in his areas are logging and cattle raising. The scenario of his land use before the project start date (19th of November 2022) involves planned deforestation to explore timber products and to practice other agricultural economic activities. Furthermore, it is crucial to enhance on the 29th of June 2022, the landowner (João Rogério de Souza)

[5] Annex: ABC Proof of Title.xlsx

[6] Annex: First project activity - Formigueiro Group.pdf

and his partner (Márcio José Dias Lopes) registered their timber company (R M Indústria e Comércio de Madeiras LTDA[7]) located in Itacoatiara, to increase and improve their forest business. So, the landowner would explore the project area if its activities were not started on the 19th of November 2022. He agreed to keep the project area's forest cover rather than clear it and convert it for other uses from the 19th of November 2022 onwards. Thus, he signed a long-term agreement[8] representing both beginning of the protection plan and the project activities' start date.

The project has additionality once there is a deforestation intention before the project start date. All details about it can be seen in Section 3.5 of this Project Description (PD).

1.9 Project Crediting Period

The ABC project has a crediting period of 30 years, starting on the 19th of November 2022 to the 18th of November 2052.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Based on the VCS Standard v4.3 (Section 3.9), the project scale is "Project" (Table 1.7) due to generating less than or equal to 300,000 tonnes of CO_{2-e} per year.

Table 1.7. Amazon Biome Conservancy Grouped REDD+ Project scale.

Project Scale	
Project	X
Large project	

The estimated net annual GHG emission reductions or removals for the project crediting period is estimated in this verification process by a 30-year period-based considering on the current deforestation pattern (Table 1.8).

Table 1.8. Estimated net GHG emission reductions or removals (t CO_{2-e}) for the project crediting period (2022 – 2051).

Year	Estimated net GHG emission reductions or removals (t CO_{2-e})
2022 – 2023	233,228.41
2023 - 2024	239,305.95
2024 – 2025	245,383.48

[7] Annex: CNPJ Rogério and Márcio – Status.pdf

[8] Annex: Systemica – João Rogério Contract.pdf

Year	Estimated net GHG emission reductions or removals (t CO_{2-e})
2025 – 2026	251,461.02
2026 – 2027	257,538.55
2027 – 2028	263,616.09
2028 – 2029	269,693.63
2029 - 2030	275,771.16
2030 – 2031	281,848.70
2031 – 2032	287,926.23
2032 – 2033	55,283.13
2033 – 2034	49,790.90
2034 – 2035	44,298.67
2035 – 2036	38,806.44
2036 – 2037	33,314.21
2037 – 2038	27,821.98
2038 – 2039	22,329.75
2039 - 2040	16,837.52
2040 – 2041	11,345.28
2041 – 2042	5,853.05
2042 – 2043	5,267.75
2043 – 2044	4,682.44
2044 – 2045	4,097.14
2045 – 2046	3,511.83
2046 – 2046	2,926.53
2047 – 2048	2,341.22
2048 – 2049	1,755.92
2049 – 2050	1,170.61
2050 – 2051	585.31

Year	Estimated net GHG emission reductions or removals (t CO_{2-e})
2051 – 2052	-
Total estimated ERs	2,937,792.88
Total number of crediting years	30
Average annual ERs	97,926.43

1.11 Description of the Project Activity

The Amazon Biome Conservancy Grouped REDD+ Project aims to conserve native ecosystems of the Brazilian Amazon Biome through income generation from carbon credits commercialization for the landowner. Its first instance (ABC-I1) is located in the Itacoatiara municipality, Amazonas state, Brazil, and is not located within a jurisdiction covered by a jurisdictional REDD+ program.

The ABC-I1 project activities work by avoiding planned deforestation on private properties, which would have part of its forest cover legally suppressed in the absence of these activities. It is because the owner is a logger and conducts logging activities on his properties. Therefore, the main project activities are mapping illegal deforestation, monitoring the area and carbon stock, controlling leakage, and others. More details are in the items below:

Satellite monitoring

The monitoring plan (including the forest cover condition, planned deforestation, and natural disturbances, as applicable, within and outside the project area) will use INPE (PRODES) satellite images and MapBiomas Alert data, which is a system that confirms and refines deforestation alerts with high-resolution images by integrating and analyzing multiple alert systems, such as DETER, PRODES, and others. It is widely adopted because it integrates and validates several products' alerts and increases the data's accuracy.

Patrolling and surveillance

The protection of the project area is the main activity and aims to avoid illegal deforestation. This way, the project landowner will implement and set up patrolling and surveillance. He will work monitoring the farms, as a strategy for looking after his property, and ensuring avoided entry of outsiders, hunters, fishers, and intruders, fire prevention (as applicable), support the work of the field inventory, cleaning of frontiers and its milestones, and internal organization of communication.

Forest inventory

The forest inventory shall conduct by monitories on permanent plots systematically installed over the project area. These plots will verify periodically throughout the project duration and will cooperate with monitoring the local flora and carbon stock. For a complete description of forest inventory methods see

Standard Operating Procedure (SOP)[9] document. Also, an estimate of carbon stocks using this forest inventory data will conduct to generate more accurate and assess carbon stock values.

Leakage control

Considering the project classification (APDD – Avoiding Planned Deforestation and Degradation), leakage is the legal deforestation attributable to the landowners (deforestation agent) in their other areas (outside the project area). Hence, the project proponent (Systemica) will set up alignments with the project's deforestation agent (landowner) to explain the effects that his future legal deforestations might have on the project's leakage control and encourage as well as monitor activities that mitigate the leakage risk. The proponent believes that with the implementation of project activities and the start of a financial return in form of VCUs, the landowner will understand the benefits that the REDD+ activities can bring to his properties and the communities surrounding.

Potential roll-out to other areas

The other landowners living around the project site may be interested and adhere to the project. In this sense, other places with the potential to be included in REDD+ projects have already been found, which will favor and encourage forest conservation using financial incentives obtained from reduced emission sales and supply social and environmental benefits to neighboring communities. We believe that the well-succeeded example of this business plan will generate an increased number of sustainably managed areas, which will create ancillary benefits around the project boundary.

1.12 Project Location

Amazon Biome Conservancy Grouped REDD+ Project is in the Brazilian Amazon Biome (Figure 1.1). Its first instance (ABC-I1) is within the municipality of Itacoatiara (Figure 1.2).

[9] Annex: SOP – Standard Operating Procedure.pdf

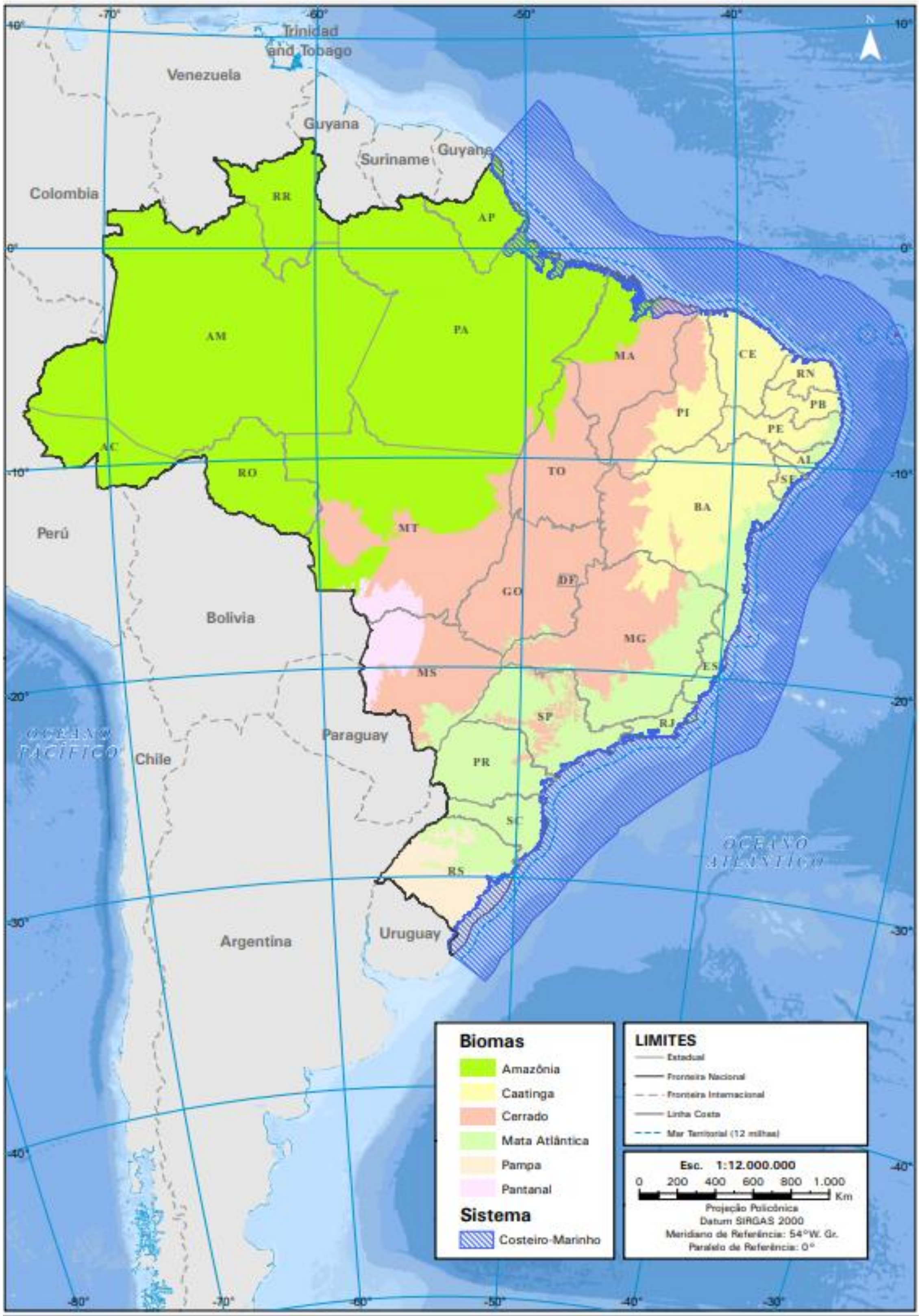

Figure 1.1. Brazilian Biomes according to IBGE data.

Following the VCS Methodology VM0007 v1. 6 (VERRA, 2020a), the project area may only include areas composed of forest for a minimum of ten years before the project start date, including mature forests, secondary forests, and degraded forests. According to FAO (2020), the definition of forest is: land spanning more than 0.5 hectares with trees higher than five meters and a canopy cover of more than ten percent or trees able to reach these thresholds in situ. It does not include land that is agricultural or urban use.

The ABC-I1 comprises seven properties summing a total of 26,920.60 ha (Table 1.9) located mainly in the Itacoatiara municipality and in a very small area in Silves, both in the Amazonas state, Brazil. The project area of ABC-I1 is located only inside the *Lote Felicidade*, one of the seven project properties. This property has 8,857.70 ha, being 5,140.20 ha designated to compose the project area, almost exactly 20% of the total 26,920.60 ha. Details about the properties and project area (instance, properties, total area, project area, and geodetic coordinates) are in Table 1.9.

Table 1.9. ABC project's information about both the properties area and project area.

Project Activity Instance	Properties	Total Area (ha)	Project Area (ha)	Geodetic coordinates	
				Longitude	Latitude
Instance 1	Lote 80	3 035.80	-	59° 1' 15.13'' W	2° 44' 56.78'' S
	Lote 81	2 985.70	-	59° 3' 10.23'' W	2° 47' 34.12'' S
	Lote 84	3 009.80	-	59° 1' 31.89'' W	2° 40' 43.07'' S
	Lote 93	3 008.60	-	59° 7' 31.66'' W	2° 44' 22.01'' S
	Lote 94	3 011.50	-	59° 9' 40.76'' W	2° 42' 44.42'' S
	Lote 95	3 011.50	-	59° 7' 46.06'' W	2° 40' 6.856'' S
	Lote Felicidade	8 857.70	5,140.20	59° 4' 46.47'' W	2° 43' 36.96'' S
	Total	**26 920.60**	**5,140.20**	-	-

Vectorized data of the project location is in the annex[10] as a KML file. João Rogério de Souza owns the seven properties, and the map with the properties' area boundary and the project area is in Figure 1.2.

[10] Annex: project_area_ABC.kml

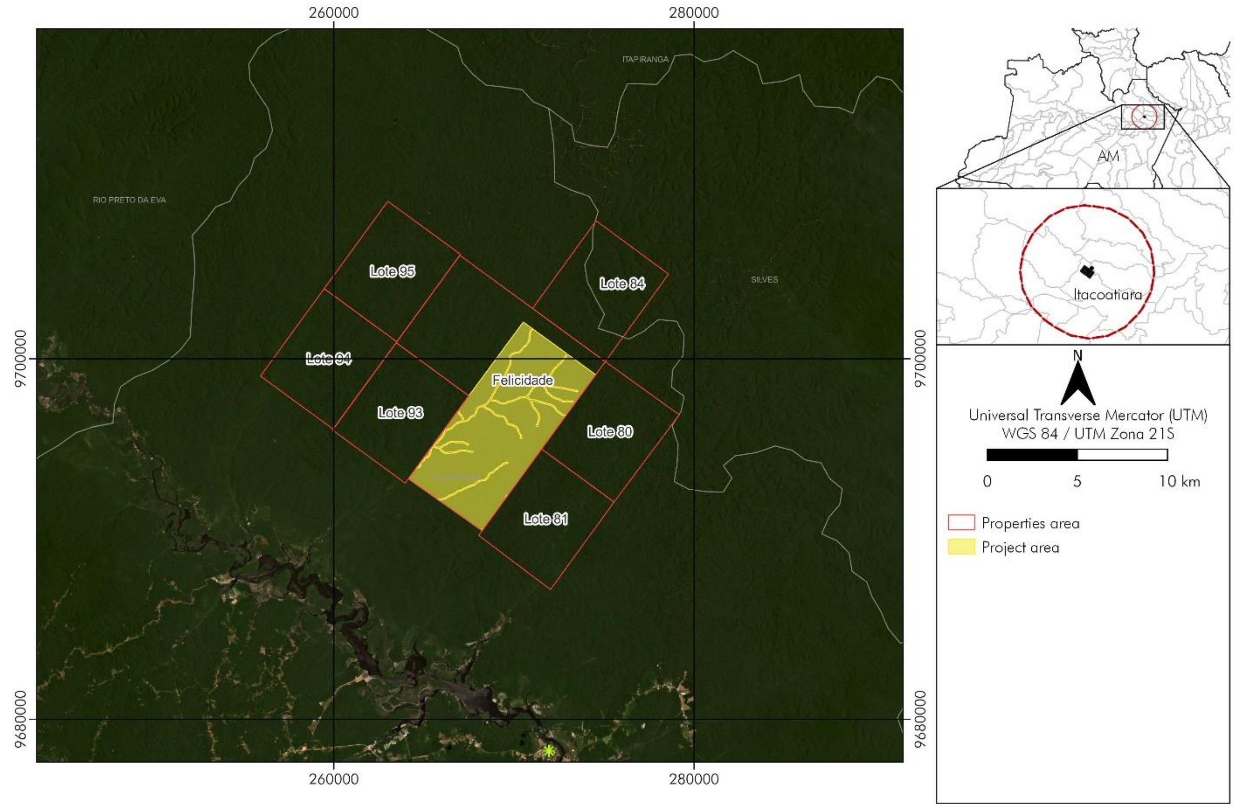

Figure 1.2. Properties area and project area.

1.13 Conditions Prior to Project Initiation

1.13.1 Current and historical land use

The Amazon Biome Conservancy Grouped REDD+ Project is going to be implemented in a conserved region. The landowner requested carbon incentives to continue conserving the area and avoid planned deforestation. The property's areas and project area are composed of native Amazon Rainforest vegetation, and was not found the existence of secondary vegetation. Also, in these areas, there has not been deforestation of native ecosystems in the last 20 (2002), 15 (2007), and 10 (2012) years from the start date of the project (2022), as seen in Figure 1.3.

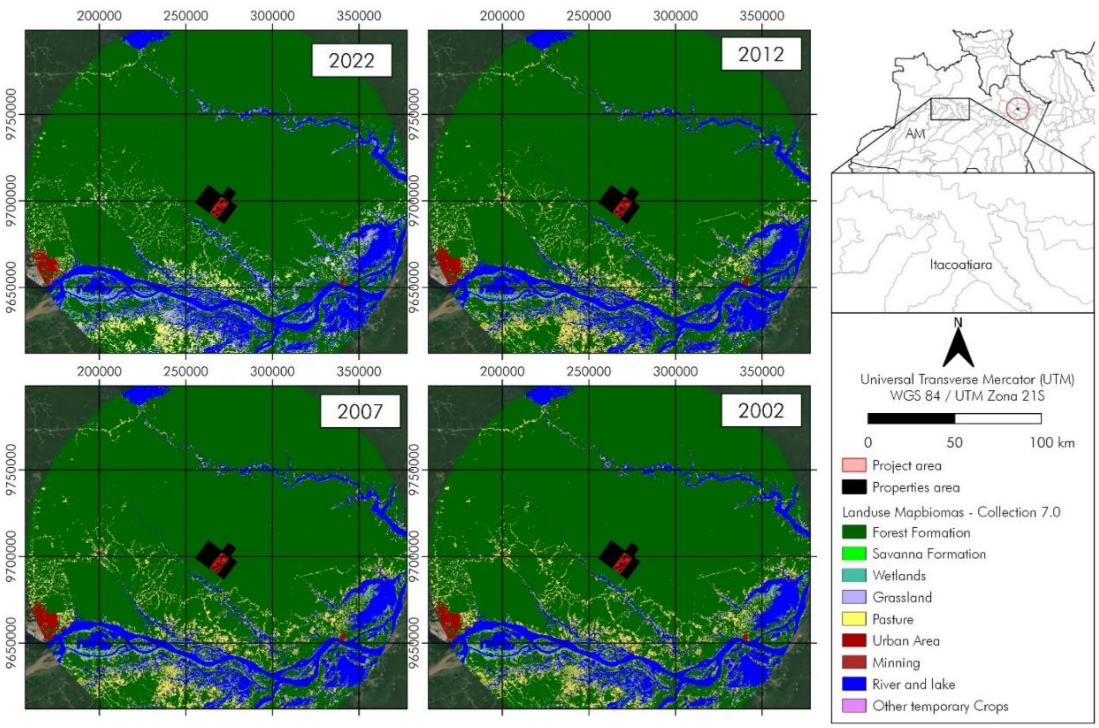

Figure 1.3. Forest cover in 2002, 2007, and 2012 twenty, fitting, and ten years before the project start date (2022), respectively.

The property areas of the project are in the municipalities of Itacoatiara and Silves. Most of these areas occupy the municipality of Itacoatiara, and only one of them, more specifically, the Northern part of *Lote 84*, is in Silves. The two municipalities are in Amazonas state, one of the nine states that belong to the Legal Amazon region. Overall, this state suffers from the pressure of deforestation, and from 2008 to 2021, deforested areas increased, mainly from 2016 onwards (Figure 1.4). The total area destroyed during that period (2008 to 2021) was 12,406.24 km² (TerraBrasilis, 2021). According to MapBiomas (2022b), Amazonas appeared in second place in the ranking, with 194,485 ha deforested (11.8% of the total). Despite the high deforestation rates recorded in Amazonas, Itacoatiara and Silves are well-conserved municipalities. From 2008 to 2021, the total area deforested in Itacoatiara was 157.61 km² and in Silves was 20.45 km², equivalent to 1.27% and 0.17% of the total deforested in the state, respectively (Figure 1.4).

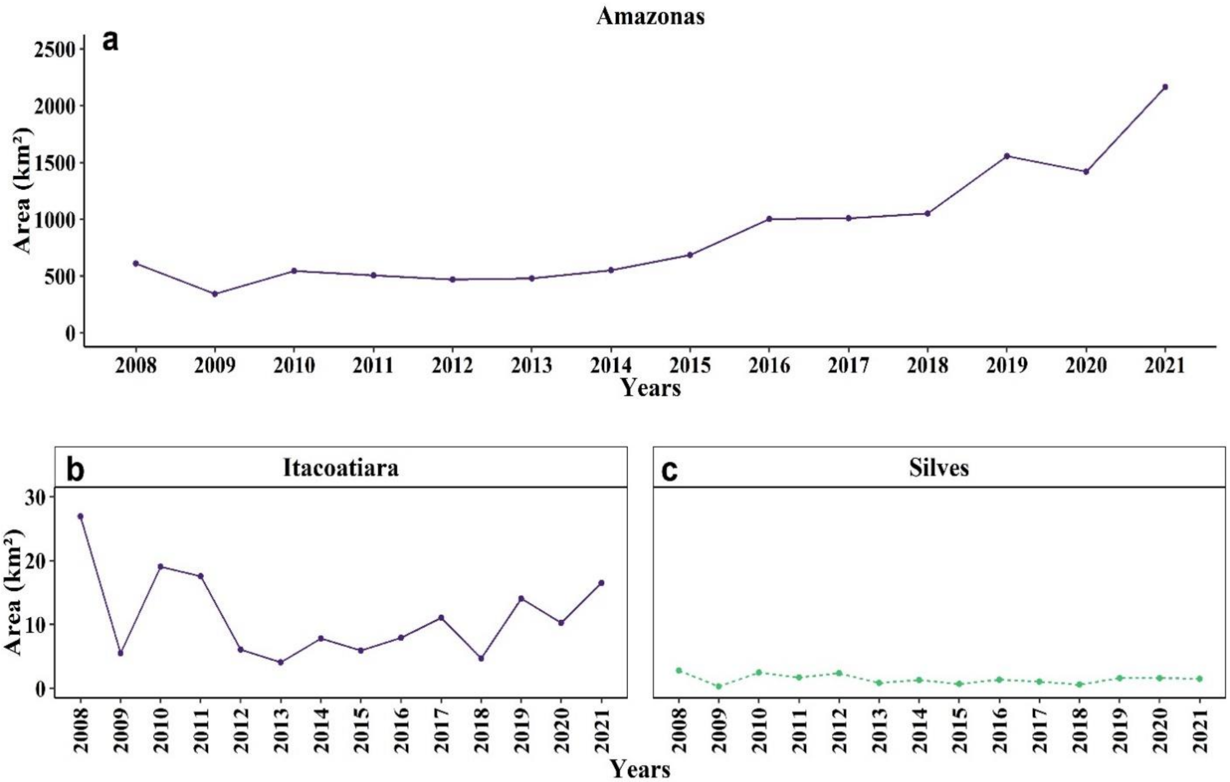

Figure 1.4. Deforested areas (km²) from 2008 to 2021 in the Amazonas state (a), and municipalities of Itacoatiara (b) and Silves (c). Data were taken from the site TerraBrasilis (2021).

The main activities that cause deforestation in the Legal Amazon region are livestock and logging when carried out intensively and without proper management practices (Ferreira et al., 2015; Morales et al., 2021). In these deforestation processes, the first step is normally clear-cutting and logging. It is estimated that only 35% (yield) of this timber is converted into long-term wood products (IBAMA, 2016). The non-merchantable timber that stays in the field is usually accumulated and burnt before the installation of pasture or agricultural activities. Most carbon emissions from baseline activities occur during this operation.

In the Itacoatiara and Silves municipalities, livestock and logging are important economic activities. According to the IBGE (2022), these regions are in the 7th and 22nd positions of the state ranking, with 39,622 ha and 5,974 ha (equivalent to 4.5% and 1.6% of the total municipalities' areas) occupied with pasture, respectively (MapBiomas, 2021). Furthermore, these two municipalities occupy the 4th and 6th positions of the state ranking due to their extraction of wood in the log being 85,000 m³ and 72,000 m³, respectively (IBGE, 2022). Notwithstanding, these activities are also the major agents that increase deforestation in regions.

Overall, on the properties where ABC project will apply, activities such as cattle raising, and logging are also usual due to the landowner being a cattle owner and a logger. So, eventually, these activities would be implemented in the selected areas for the project (still preserved, as seen in Figure 1.3). In this context, the project fits into the AFOLU REDD+ category and will avoid planned deforestation in these areas.

1.13.2 Ecosystem type

The region where the ABC project is going to be installed is situated in the Amazon Rainforest (Amazon Biome). This region is in the municipalities of Itacoatiara and Silves, including different phytophysiognomies such as Campinarana, Wetlands, Forest Transition, Ombrophilous Forest of Dense Canopy, and Ombrophilous Forest of Open Canopy, as seen in Figure 1.5. Nevertheless, the project areas are covered only by the Ombrophilous Forest of Dense Canopy (submontane). According to the BDiA (2022c), 46,73% and 66,91% of the Itacoatiara and Silves territories are composed of this vegetation type, respectively.

The Ombrophilous Forest of Dense Canopy vegetation is predominant throughout the Amazon (Nelson, 1992). It is characterized by its tall vegetation, with a canopy of 25 to 30 m, emergent trees of 40 m or more (Zappi et al., 2011), clear understory, presence of epiphytes, and high biomass (Pires & Prance, 1985). This vegetation also has shrubs, herbaceous, and lianas (SNIF, 2020).

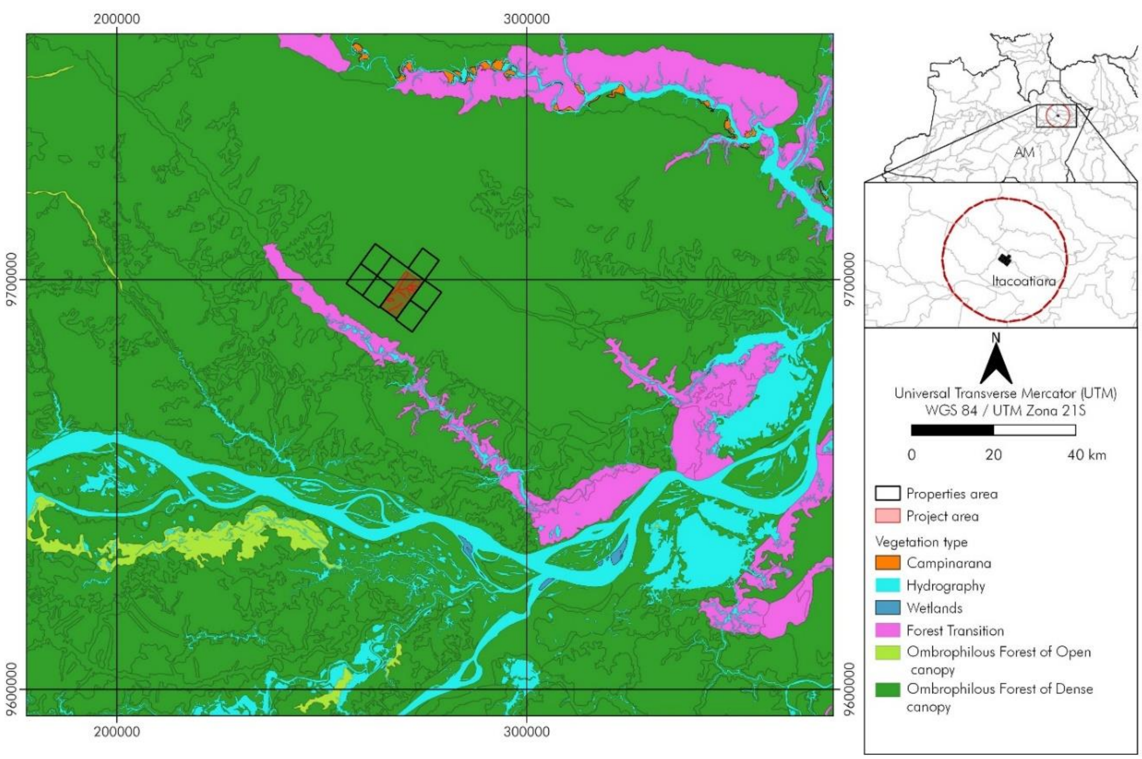

Figure 1.5. Vegetation type in Amazon Biodiversity Conservancy Grouped REDD+ Project region.

1.13.3 Climate

The project region's climate is classified as Equatorial rainforest (Af) and Equatorial monsoon (Am) according to the Köppen-Geiger classification (Kottek et al., 2006). However, all property areas' territory is covered only by Af climate (Figure 1.6). The total annual precipitation of this climate category exceeds

2,000 mm (McKnight & Hess, 2000), with monthly minimum rainfall over 60 mm, and temperatures above 18 °C (Brune, 2021). According to INMET (2022), the total precipitation between 1991 to 2020 was 2,543.80 mm, with the rainiest months being from December to May. The average temperature for the same period was 27.34 °C.

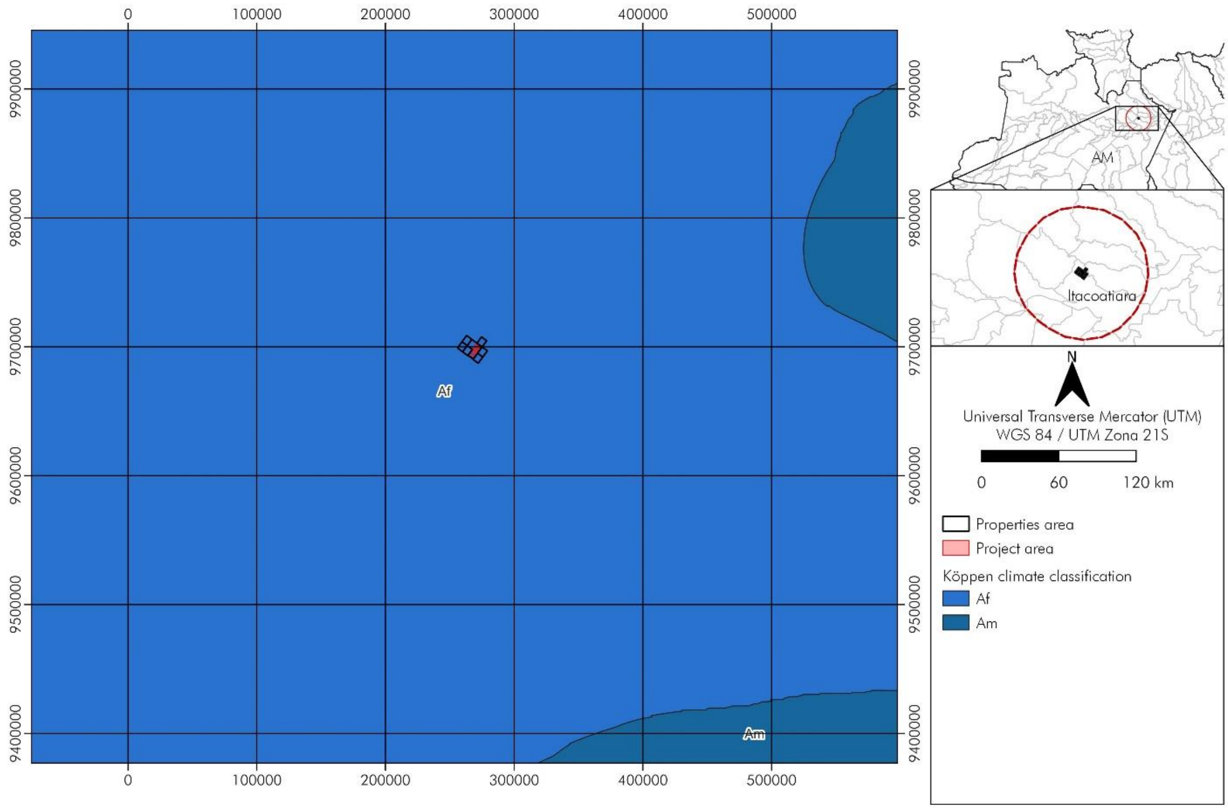

Figure 1.6. Predominant climate, according to Köppen-Geiger classification, in Amazon Biodiversity Conservancy Grouped REDD+ Project region.

1.13.4 Geology, topography, and soils

Itacoatiara and Silves municipalities, project region, are in the structural provinces (**i**) *Amazonas-Solimões* and (**ii**) Cenozoic Coverages, and in the sub-provinces (**i**) *Alter do Chão* and (**ii**) Indiscriminate Cenozoic Coverages. More than 80% of both municipalities' territories are covered by these sub-provinces (BDiA, 2022a). According to IPEAN (1969), the geological formation of these regions is given by sedimentary formations of the Tertiary and Quaternary periods, more specifically by the morphostructural domains (**i**) Phanerozoic Basins and Sedimentary Covers and (**ii**) Quaternary Sedimentary Deposits (BDiA, 2022b). Regarding the geomorphological units, more than 65% of both municipalities' territories are inserted in the *Rio Negro-Rio Uatumã* Dissected Plateau, and Amazon Plain (BDiA, 2022b).

The project region is formed by Argisoil, Gleisoil, Latosoil, Neosoil, and Plintosoil. However, the seven properties' areas and the project area are only formed by Latosoil (Figure 1.7). This soil type is typical of tropical regions and occupies around 39% of the total area of the country – Brazil. It is highly weathered soil with no clay increment in-depth, and Its colors vary from reddish, brownish, or yellowish (Embrapa, 2022).

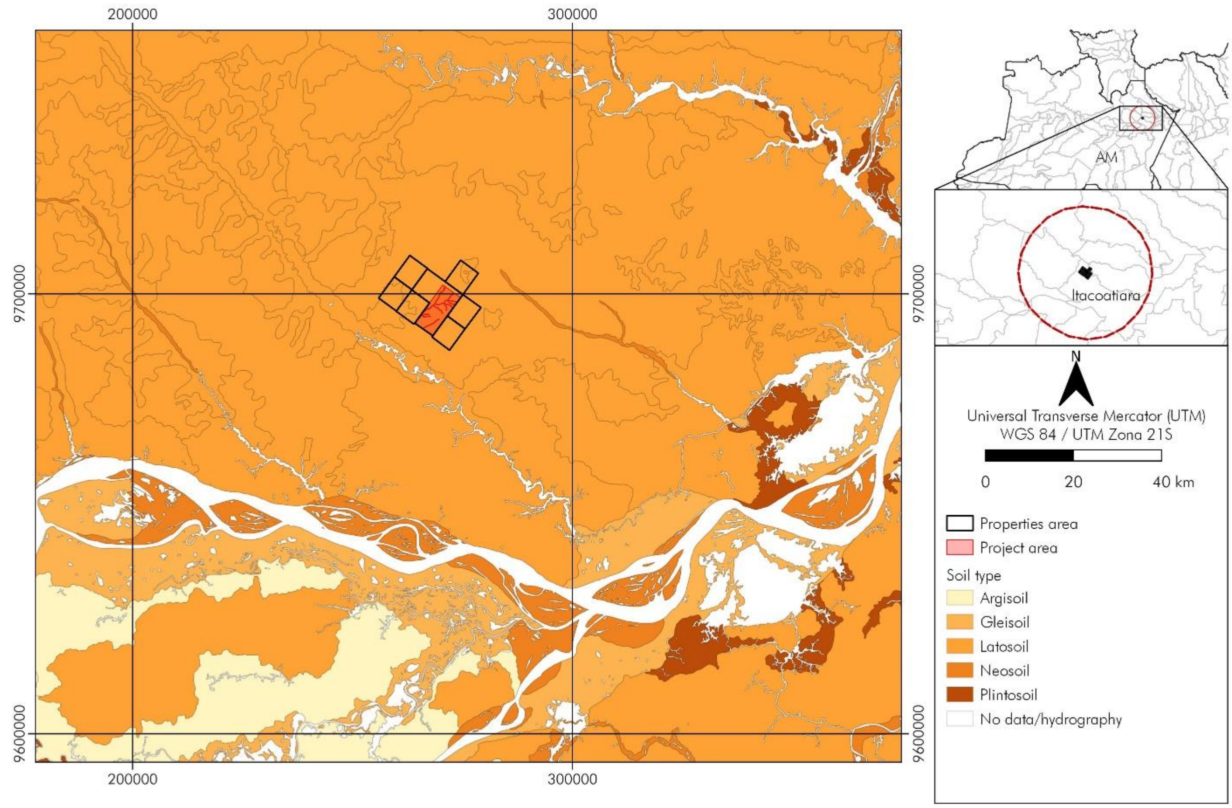

Figure 1.7. Soil types in Amazon Biodiversity Conservancy Grouped REDD+ Project region.

The properties areas' slope predominantly ranges from 5 to 15%, although slopes between 15 to 20% are found, mainly in the *Lote 84*. The elevation in the same area ranges from 0 to 210 meters (Figure 1.8). Topography is often related to physical and chemical soil variations that are often reflected by vegetation.

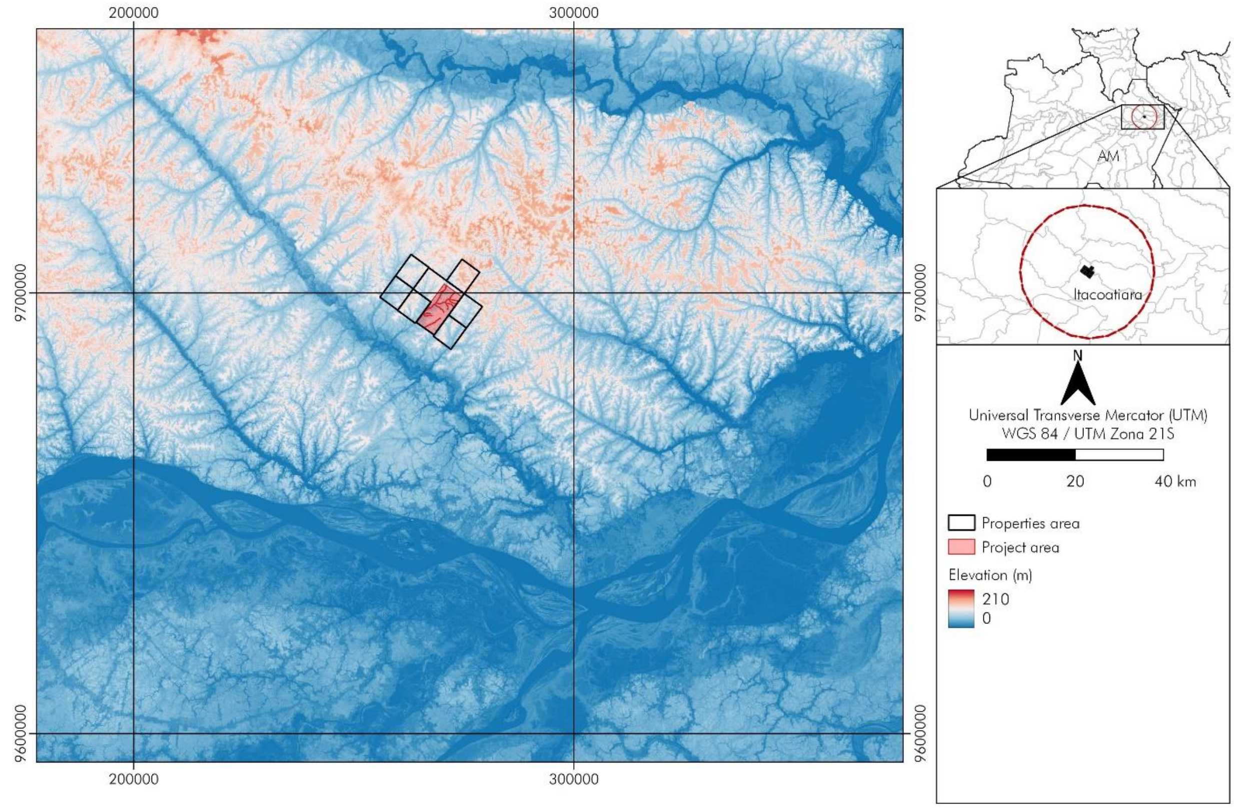

Figure 1.8. Elevation (m) in Amazon Biodiversity Conservancy Grouped REDD+ Project region.

1.13.5 Hidrography

The ABC project is in the Amazonas River Basin which covers a area of 7 million square kilometers, being the largest river in the world. It is responsible for about fifth of the total river flow in the world and the liquid fresh water. The Amazon River level depends mainly from the amount of precipitation, but also the melting of glaciers in the Andes mountain range. Its common in the region to cycle variation between the dry season between August to January and the flood season between February and July.

The ABC-I1 is located on the left bank of the Urubu River, a tributary of the Amazon River. The Urubu River has dark waters with similar characteristics to the Negro River. This is a result of organic acids combined with the decomposition of organic materials that kill bacteria and other parasites in the water, also contributing to a region with less mosquitoes. Urubu River has a wide biodiversity of ichthyofauna, being one of the best rivers for fishing and diving.

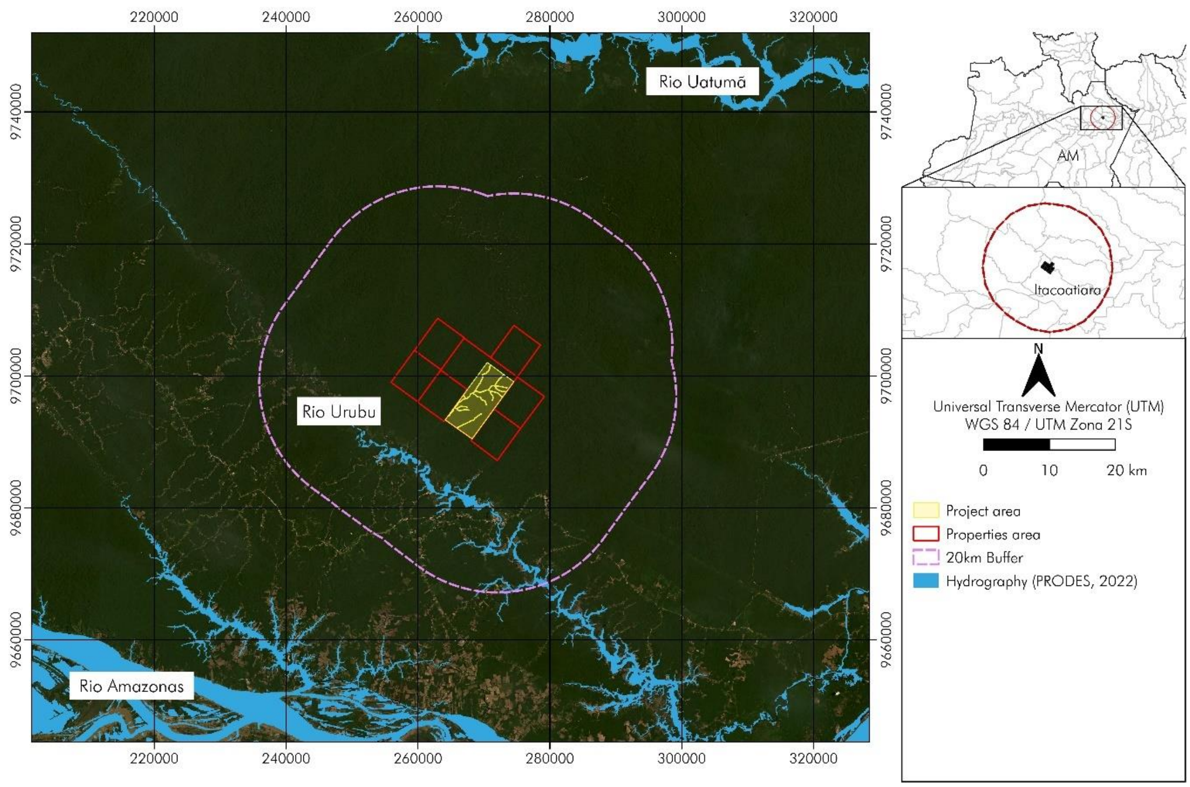

Figure 1.9. Hydrography in Amazon Biodiversity Conservancy Grouped REDD+ Project region.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The most important law for this project is Law Nº 12,651 of 2012 (Brasil, 2012b) which created the newest Brazilian Forest Code. There are some important articles and chapters to be considered that are replicated below.

"Article 3. For the effects of this law, the following definitions apply:

I. Legal Amazon (LA): States of Acre, Pará, Amazonas, Roraima, Rondônia, Amapá, and Mato Grosso, and the regions located to the North of parallel 13º S, in States of Tocantins and Goiás, and to the West of meridian 44º W, of the State of Maranhão.

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

III. Legal Reserve (LR): area located within a rural property or ownership, demarcated according to article 12, with the function of ensuring sustainable economic use of natural resources of rural property, assisting the conservation and rehabilitation of ecological processes, and promoting the conservation of biodiversity, as well as shelter and protection of wildlife and native flora.

IV. Sustainable Management (SM): management of natural vegetation to obtain economic, social, and environmental benefits, respecting the sustaining mechanisms of the ecosystem object of management and considering, cumulatively or alternatively, the use of multiple timber species or not, of multiple flora products and by-products, as well as the use of other goods and services.

V. Carbon Credits (CC): title to negotiable over tangible and intangible assets right (included by Law N° 12,727 of 2012 – Brasil (2012a)).

(...)

Article 12. All rural property must maintain an area with native vegetation cover, as a Legal Reserve, without prejudice to the application of the rules on Permanent Preservation Areas, observing the following minimum percentages in relation to the property area, except as specified in art. 68 of this Law (included by Law N° 12,727 of 2012 – Brasil (2012a)):

I. Located in the Legal Amazon:

a) 80% (eighty percent), in the property situated in forest area.

b) 35% (thirty-five percent), in the property situated in *Cerrado.*

c) 20% (twenty percent), in the property situated in areas of general fields.

II. Located in other regions of the country: 20% (twenty percent).

(...)

Article 29. Creates the Rural Environmental Registry (RER) within the scope of the National System Information on the Environment (NSIE) as a public electronic record on a national level, mandatory for all rural properties, to integrate environmental information of rural properties and possessions, composing a database for control, monitoring, environmental and economic planning and combating deforestation."

Even though the Brazilian Forest Code is the more specific environmental legislation on a national level, regarding the use of land in the Legal Amazon, other legislations are also necessary. Rural activities have several perspectives that are not resumed only by the environmental one. Here all other legislations consulted that guided and are assisted by the due diligence process of this project:

- Brazilian Federal Constitution of 1988 (Brasil, 1988).
- Brazilian Imperial Law - Law 601 of 1850 (Brasil, 1850).
- Rural Land Statute – Law 4,504 of 1964 (Brasil, 1964).
- Law of Public Records – Law 6,015 of 1973 (Brasil, 1973).
- Law of Civil Action - Law 7,347 of 1985 (Brasil, 1985).
- Law of Rural Property Tax - Law 9,393 of 1996 (Brasil, 1996).
- Federal Environmental Crimes Law - Law 9,605 of 1998 (Brasil, 1998).
- National Environmental Policy - Law 6,938 of 1981 (Brasil, 1981a).
- Brazilian Civil Code - Law 10,406 of 2002 (Brasil, 2002).

Together, all those laws have can be complex for those who are not familiar with them. But the main objective of them, in a simpler way, is to demand from the landowner: (i) proof of their legal right to have and possess their land for different government agencies, (ii) guarantee that financially all taxes are being paid, (iii) there are no legal or civil lawsuits that could compromise the landowner, (iv) guarantee the preservation/conservation of the environment. The complete documentation necessary to the ABC project be in accordance with current legislation framework and the attendance of each one of these laws is available in annex[11].

1.15 Participation under Other GHG Programs

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

The ABC project has not been both registered and 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 and has not been rejected by any other GHG Programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

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

☐ Yes ☒ No

The ABC project does not reduce GHG emissions from activities that are included in any emissions trading programs or any other mechanism that includes GHG allowance trading. This project and its activities of reducing emissions from the APDD category aim to generate credits only under the VERRA's VCS Program.

1.16.2 Other Forms of Environmental Credit

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

☐ Yes ☒ No

The project did not seek or receive any other form of GHG-related credit, including renewable energy certificates. This Project Description (PD) being submitted to VERRA is the first initiative to issue credits for reducing GHG emissions.

1.17 Sustainable Development Contributions

[11] Annex: ABC Proof of Title.xlsx

The ABC project (Amazon Biome Conservancy Grouped REDD+ Project) aims to achieve specifics Sustainable Development Goals (SDGs) set up by the United Nations General Assembly. To select the contributions of this project to the sustainable development goals were also considered the SDGs adapted to the Brazilian reality (IPEA, 2018). Furthermore, a part of the revenues generated by sales of VCUs shall be invested to implement positive actions for the local community and biodiversity. All project's sustainable development contributions are described in Table 1.10.

Table 1.10. ABC Sustainable Development Contributions.

SDG	National Goal	Project Activity
4	4.4. Increase the number of young people and adults who have the necessary skills, especially technical and professional, for employment, decent work, and entrepreneurship. 4.7. Ensure that people acquire the knowledge and skills needed to promote sustainable development.	The ABC project could help to strengthen and empower communities to take sustainable attitudes and develop productive alternatives that ensure the preservation of forest and local biodiversity.
8	8.3. Promote development by generating decent work; formalization; the growth of micro, small and medium-sized companies; entrepreneurship, and innovation. 8.9. Design and implement policies to promote sustainable and responsible tourism, accessible to all; and that generates employment and decent work, improves income distribution, and promotes local culture and products.	The project implementation will provide stakeholder consultation to identify the community priorities, look for decent job creation, and promote sustainable tourism, culture, and local products.
13	13.2. Integrate the National Policy on Climate Change into national policies, strategies, and plans. 13.3. Raise awareness and human and institutional capacity on climate change, its risks, mitigation, adaptation, impacts, and early warning.	The project is taking strategies to combat climate change and its impacts, as well as raising the community's awareness of the topic.
15	15.1. Conserve ecosystems and biomes to maintain biodiversity and ecosystem services. 15.5. Reduce natural habitat fragmentation, degradation, and loss. 15.7. Protect flora and fauna species, and avoid illegal practices (hunting, fishing, and trafficking). 15.a. Increase the return of financial resources to incentive ecosystem conservation.	The ABC project consists of implementing a REDD+ Grouped Project in the Amazon Rainforest biome, which will avoid planned deforestation in the project area. It will protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss. Also, it will protect and control illegal wildlife hunting due to keeping the project area under constant surveillance. Besides, it shall generate financial returns for the landowner.

1.18 Additional Information Relevant to the Project

1.18.1 Leakage Management

For a complete description of leakage management and monitoring, see Sections 1.11 and 5.3 of this Project Description (PD).

1.18.2 Commercially Sensitive Information

Not applicable. No commercially sensitive information has been excluded from the public version of the Project Description (PD). Throughout the entire Section 1 of this PD document, all relevant and necessary information about the project proponent and the conditions before the project implementation has been available.

1.18.3 Further Information

No further information.

2 SAFEGUARDS

2.1 No Net Harm

The municipality of Itacoatiara has an area of 8,891.9 Km² and an estimated population of 104,046 inhabitants and is considered the third largest municipality in the state of Amazonas (IBGE, 2022). It is in the metropolitan region of Manaus, about 270 km from the capital through the AM-010 highway, which is an important axis of regional development because it facilitates the flow of people, goods, and services throughout the central-eastern portion of the state. It has the third largest GDP of the state of Amazonas, behind only the municipality of Coari and the capital Manaus itself (IBGE, 2022). In 2022, the municipal GDP reached the amount of R$2 billion, 43% of these resources were concentrated in the agriculture and cattle raising sector, 37% in the services sector, and 20% in industry. According to Alho (2009), a researcher in Regional Development at the Federal University of Amazonas, Itacoatiara is a municipality with a great potential for growth, a scenario that becomes even more favorable due to its geographical location, on the banks of the Urubu River, a branch of the Amazon River, which houses a port and makes its economic dynamics even more powerful.

This opportunity for local development comes from: "the availability of natural resources (rivers, roads, forests, and land) that can be incorporated into the political-economic development, by big capital, or as a goal of government action" (Alho, 2009). Also, according to the author, in the international division of labor, the municipality presents itself as a center of agricultural production, although most of its workforce is allocated mainly in trade (55%) and industry (41%) (Alho, 2009). The primary sector is home to only 5% of the formal workers in the municipality, with soybeans and sugar cane being the main products grown on plantations and properties emerging along the AM-010 highway, which provides access between the two cities. The extraction of wood, rubber, and non-elastic gums is very representative of the local economy. Cattle raising is represented mainly by cattle and pigs, with meat and milk production destined for local consumption and export. Fishing is abundant, and the municipality stands out as a fishing entrepot, both for local consumption and for export.

Regarding the situation of the roads, it is worth mentioning that the AM-010 highway was completely asphalted in November 2022, within the period of the state elections, according to local residents. The improvement in the asphalt reduced by half the time required to travel between Manaus and Itacoatiara which takes an average of 2.5 hours by car. This reduction in travel time was confirmed by Systemica's research team, who witnessed part of the work in progress, during fieldwork carried out to produce this document. This facilitation of traffic on the highway has enormous potential in reducing the costs of production flow, increasing the flow of goods and services in the regional context, implying an opportunity to expand the generation of employment and income, with the potential to enable more efficient transport of the production coming from family farming, of great importance in reducing social and economic inequalities that affect the most vulnerable rural communities in the Amazon context.

The state production of pineapple, citrus, banana, *cupuaçu*, and more recently coffee is mostly promoted by small producers, with some initiatives that already focus on sustainable local development, associating economic growth, improvement of the quality of life of populations and communities, and forest preservation. Organic products, low carbon economy, and agroforestry systems have great potential for strengthening, given the increased environmental awareness of some of these producers who are moving to abandon culturally ingrained techniques, such as the use of fire to clear cultivable areas, and the use of chemicals and pesticides for soil correction and to combat pests. There is a movement towards the use of organic inputs, based on a culture of reuse, such as composting, avoiding the use of substances that negatively impact the quality of food, and that have great potential for contamination of the soil, rivers, and fish since fish production is crucial for the subsistence of a significant part of the riverside and fishing communities that inhabit the entire Amazon basin, as rich in water resources as in biodiversity. This ability of the municipality of Itacoatiara to attract many strategic projects that bring the premises of sustainable development is due to the "existence of infrastructure (port, airport, roads), the proximity to major international consumers and the prospect of new public and private investments" (Alho, 2009) that reinforce its position of relevance in relation to other municipalities in the Middle Amazon, having in the future the prospect of becoming a regional pole in the scope of environmentally and socially responsible projects, capable of attracting investments, reducing inequalities, improving the living conditions of local populations, such as basic sanitation, and the absence of public services, high rates of hospitalization for diarrhea and infant mortality.

Although Itacoatiara presents a good economic performance, in 2020, the average monthly salary was 1.8 minimum wage, occupying position 25 among the 62 Amazonian municipalities, which can be considered small in comparison with the size of the municipal GDP, the third in the state. Considering the domiciles with monthly incomes of up to half a minimum wage per person, Itacoatiara presented 45.2% of its population in these conditions, which places it in position 57 out of 62 among the cities in the state. It has only 19.7% of households with adequate sanitary sewage and only 11.9% with adequate urbanization, which includes the presence of culverts, sidewalks, paving, and curbs (IBGE, 2022). According to the Environmental Impact Assessment - EIA - related to the implementation of the Itacoatiara

Thermoelectric Plant (IPAAM, 2018), the process of urban expansion in the city took place largely in a disorderly manner, i.e., there was no planning prior to the construction of housing units, which caused the absence of infrastructure and public facilities (such as squares, health posts and schools) in most neighborhoods of the city.

The municipality has a demographic density of 9.77 inhabitants/km², low compared to the Brazilian average of 22.43 inhabitants/km², but higher than the state of Amazonas with 2.23 inhabitants/km², and the northern region itself with 4.12 inhabitants/km² (IBGE, 2022). The project is inserted in the Amazon biome, with emphasis on the Uatuama Sustainable Development Reserve, located 32 km from the ABC property. With respect to HDI, Itacoatiara presented in 2010, a Human Development Index of 0.644, which is below the state of Amazonas with 0.674, and the national average of 0.724 (IBGE, 2022).

In the Tupi-Guarani language Itacoatiara means painted stone, or drawn stone, such local name was given as a result of the existence of inscriptions and drawings engraved on stones along the Urubu River, a branch of the Amazon River, which had great importance in the colonization process that was initiated by the Jesuits, who settled along the indigenous communities that already inhabited the Amazon River basin, when the Portuguese arrived, still in the mid-seventeenth century. According to local historian Frank Chaves (2022), an employee of the Municipal Secretariat of Culture of Itacoatiara, who was interviewed by the research team and has a blog with relevant historical and cultural information about the municipality the installation of the original village took place in 1759, with the installation of the Abacaxis Mission, located on the river of the same name, a tributary of the Madeira, and which suffered constant attacks from the indigenous Mura ethnic group. According to the historian:

> On January 1, 1759, the installation of the village with the Portuguese name of SERPA took place, which would be under the protection of Our Lady of the Rosary of Serpa, whose image was brought from Portugal to the newly formed village. It was the 3rd installed Village of Amazonas. Due to its strategic geographical position, it exercised considerable influence in the region, and even the Lugar da Barra (today Manaus) came under its political dependence. The District of Serpa comprised approximately half of the Amazonas State area (Chaves, 2022).

The resilience of the Mura people in the region can be observed to this day as according to the National Indian Foundation (FUNAI) the two indigenous lands (ILs) existing in Itacoatiara belong to the Mura people: There are two regularized indigenous lands in the municipality of Itacoatiara, AM. Both are formed by people of the Mura ethnicity. They are the Rio Urubu and Paraná do Arauató Indigenous Lands, which are 31.3 and 66.6 km from the ABC project property, respectively.

Regarding the community closest to the ABC project area, the Nossa Senhora de Nazaré Community, also known as Lindóia Village, stands out. Located in an area of great scenic beauty, with waterfalls, streams, and a great potential for visitation, either through fishing or jungle tourism, which has developed along the banks of the Urubu River. According to Simonetti et al. (2010), the chair of Tourism and Environmental Management at the State University of Amazonas - UEA, in her article that assesses the tourist potential of the village: the basic infrastructure of Lindóia Village as in most Amazonian localities comes to be deficient, but as far as possible serves residents of the headquarters of the village, with electricity, piped water, health center, garbage collection, and other aspects, which is rare in rural areas of the Amazon interior.

> It was found that the existing economic activities in the community of Lindóia Village are: agriculture (*tucumã*, *açaí*, Brazil nut, *pupunha*) for subsistence; livestock farming; commerce with operations in grocery stores, mini-markets; vegetal and mineral extraction (coal); fishing; and tourism. Mineral extraction and commerce are the predominant economic activities. The natural conditions of the dystrophic soil justify the timid agricultural exploration in the area. Thus, tourism really presents itself as a potential vocation of the district, in view of its natural and cultural aspects, which lack organization to trigger an adequate exploitation (Simonetti et al., 2010)

According to information provided by members of the local basic health unit team, Lindóia Village has more than 3,000 inhabitants, distributed among several rural communities that have developed along the side roads, locally called "*ramais*", which are access routes from AM-010 to the interior of the territory on the banks of the Urubu River. No official population data were found, either through secondary data such as IBGE, Atlas Brasil, and the municipality, or primary data from the Systemica research team during the fieldwork in November 2022 (see social diagnosis documents in annex). In a visit to the Itacoatiara City Hall headquarters, including the Municipal Secretary of Environment and the Municipal Lands department, and at the IDAM office – Institute of Agricultural Development of Amazonas or "*Instituto do Desenvolvimento Agropecuário do Amazonas*" in Portuguese - and the IBGE in the municipality, no data were provided about the total size of the village territory, the number of inhabitants by gender and age group, nor about the agricultural production undertaken in the locality. During the field survey, the researchers identified the communities of Visconde de Mauá and Ramal Ajuricaba (Figure 2.1), whose main activity is family agriculture, with the varied production of fruits such as pineapple, oranges, passion fruit, watermelon, bananas, *cupuaçu*, as well as coffee, cassava, and vegetables. Both are within the 20 km buffer from the property and are not officially registered in the government's database. Within the 20 km buffer, the social mobilization was conducted by the researchers, and, therefore, the application of participative tools aimed at making the social diagnosis possible. Figure 2.1 shows the delimitation of the project area, including the location of the ABC-I1 properties, the buffer used as a base for the field incursion, and the communities of interest, where the diagnosis was made with the community leaders, namely: Lindóia Village, communities of Visconde de Mauá and Ramal Ajuricaba.

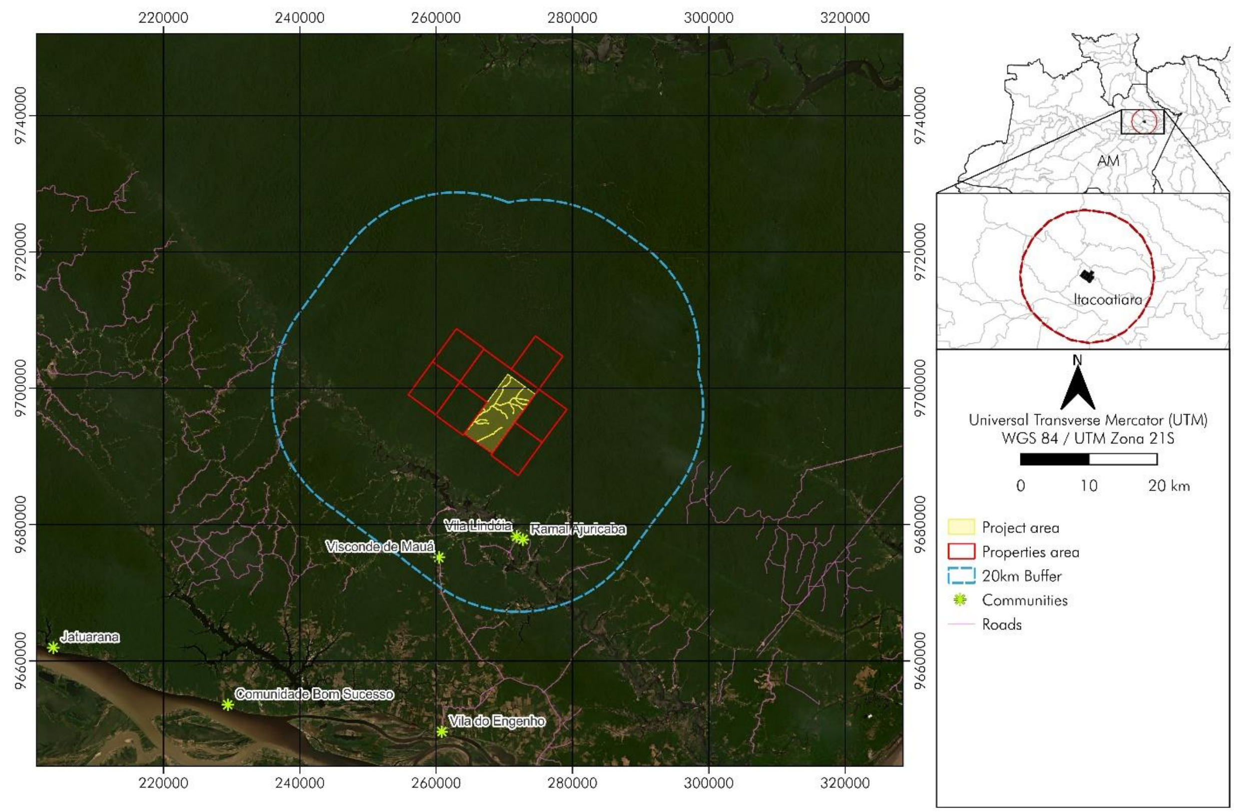

Figure 2.1. ABC-I1 Communities of interest for social diagnosis.

Regarding deforestation and fires in the Amazon biome, according to the Sustainable Amazon Foundation, the situation in Itacoatiara is no different from most of the municipalities in the biome where the forest degradation process (FAS, 2021):

> They are the product of an economic mechanism, which generates large profits for a small segment of Amazonian society, represented by loggers, land grabbers, and miners - all of them acting illegally and criminally. Illegal loggers generally operate on public lands, including conservation units and indigenous lands. They do not pay taxes, employ workers irregularly, without the proper labor rights, and operate without the necessary environmental permits, causing enormous environmental damage. The illegal loggers open illegal roads for the land grabbers, who steal public lands. The main function of cattle breeding by the "*grileiros*" is to create a façade for rural producers to obtain land documents in an illegal and fraudulent way. The illegal gold miners, who are the overwhelming majority, apply a significant part of their earnings to the purchase of land from squatters and to cattle breeding, to justify and apply illegally earned money. This practice leaves a trail of destruction in the rivers and social degradation in the local communities.

Given this scenario of advancement of the degradation process of the Amazon biome, initiatives that focus on environmental preservation, such as the adoption of carbon credits, and reduction of vegetal suppression, among others of sustainable nature, need to be implemented in order to ensure the maintenance of the standing forest, the protection of biodiversity, concomitantly with the adoption of measures that ensure the improvement of the quality of life of communities in interface with forest areas.

Therefore, according to the excerpt above, the pressure of deforestation in Amazonas can be understood as a result, mainly, of the illegal occupation of private lands, using for this purpose logging, illegal mining, and burning, mainly to make pasture for cattle. Thus, we can summarize this pressure that has worsened in recent years, and which is related to the destruction of significant portions of the forest in the region from the following aspects: (a) conversion of forest areas into agriculture and cattle-raising areas for the purposes of land ownership or not; (b) logging; and (c) land clearing by fire. There are also indirect causes such as: (d) government subsidies and incentives for agriculture and cattle ranching; (e) investment policies in infrastructure projects; (f) illegality of land tenure and ownership; (g) lack of state governance and law enforcement; and (h) market drivers such as rising commodity prices. All of these patterns can be identified in the state of Amazonas.

It is important to emphasize that in the meantime, the owner of the area that makes up the ABC project has been attentive to the situation of local environmental degradation, especially deforestation in the region, and has made efforts to set up fire brigades, as well as training locals to deal with situations of an uncontrolled fire, ensuring the preservation of large areas of standing forest within the property. Despite being in areas under pressure from deforestation, fires, and squatting, no irregular occupations were observed in the areas of the farms of the project, nor were there any ongoing lawsuits or lawsuits related to land ownership around the property. Thus, it was not necessary to proceed with any mitigation measures related to repossession suits, relocation of populations, or any other litigation process. In any case, to avoid the incidence of these types of conflicts on the project properties, it is necessary to implement a monitoring system surrounding the protected forest areas, to avoid damage to its biodiversity.

2.1.1 Potential negative impacts mapped for stakeholders

The socio-environmental diagnosis with the local community aimed to assess the impacts of the farms and their perception of them. On the occasion, the communication channels were reinforced and information about the activities carried out in the project was made available. The cell phone numbers of the local stakeholders were also collected to create an invitation list for the WhatsApp group, to establish a more direct communication channel with the farm management. The list of stakeholders, as well as the telephone contacts, can be found in the attached spreadsheet, which also presents data from the survey of institutional agents in the region, such as environmental agencies, municipal secretariats, universities, unions, non-governmental organizations, and other institutions of interest and potential partners of the project.

The territory surrounding the instances that are part of the ABC-I1 encompasses an area of demographic voids, in all its northern portion, not indicating, both in the satellite image studies and in the primary data surveys carried out throughout the fieldwork, the presence of communities at the interface with the forest areas, or that may use these resources either for economic activities or for subsistence. In Section 2.5 Table 2.4 contains the indication of the distances of certified Indigenous Lands, *Quilombola* Communities, Settlement Projects, and Traditional Communities, in relation to the ABC project property from official government data.

During the fieldwork, the field team identified the presence of riverside dwellers spread along the margins of the Urubu River and along the *Igarapés*. These small properties, in general, have a seasonal occupation profile, since the period of intense flooding or severe drought in the Amazon watershed influences the presence of human groupings in the locality. During some months of drought, such as August, September, and October, or during major floods, such as in March and April, these habitations usually remain empty, in some cases with the presence of only housekeepers, hired from among the riverside dwellers from the region itself. Many of these properties belong to residents of Lindóia Village, or of cities in the metropolitan region of Manaus, who frequent the river mainly in the months of the *Tucunaré* fishery, or during the dry season, when it is possible to enjoy the several river beaches that appear along the Urubu riverbed and the crystal-clear waters of the shallow *Igarapés* that are used for tourism, leisure, and swimming.

Regarding the implementation of the project and the interface of the property and its activities with local stakeholders, potential negative impacts were detected, of an indirect order due to the stages of project implementation and the increased movement of unknown people in the region with a family group that was direct in a family group that inhabits an area near the project property. This family was interviewed by Systemica's research team in Lindóia Village, where they also own land. As a mitigation measure, they have been informed about the realization of the project and will also be informed about the dynamics of people movement that will occur on site, as well as participating in informational lectures related to REDD+ projects. The group is composed of 19 people, 8 adults, and 11 children, who spend part of the year without access to school, especially during the dry season, when the boat crossing is harder because the streams are shallow and the engine stops working, making it necessary to pull the boat on some sections of the river.

The other properties of riverside dwellers identified along the river, in the section between Lindóia Village and the project area, are not understood as a community per se, but rather as seasonal housing properties. As for the fishermen, the research team identified the presence of a small community that fishes mainly *matrinxã* (a type of fish), to supply the local fish market and the restaurants and inns in the region. The fishing community is not a village and is composed of five houses, inhabited by three different family units. Two leaders of these families were interviewed by the research team, who did not identify, during the application of the questionnaires, possible impacts of the implementation of the project, or of the development of actions related to it.

Finally, it is emphasized that most of the interviewees from Lindóia Village do not even know the property or the owner and are mostly indifferent to the existence of the project and its implementation. No negative impacts, direct or indirect, were detected in these populations, nor in the surrounding area that makes up the 20 km buffer, which guided the social diagnosis study.

2.2 Local Stakeholder Consultation

Stakeholder consultation was conducted through direct communication with the community surrounding the project areas and competent institutions during the month of November 2022. The leaders of Lindóia

Village, communities and interest groups identified within the 20 km buffer area[12] were visited by the team of expert researchers[13,14], who provided explanatory material[15] containing the permanent communication channels for the project. This material was placed in strategic locations in the areas adjacent to the project, informing about the most relevant information, and later posters will be placed for communication about the auditing dates for validation and verification.

During this visit, a semi-structured questionnaire[16] was applied to provide the necessary information for the realization of a socio-environmental diagnosis. It was applied to the main representatives of the various groups, associations, and segments that make up the intercommunity system of Lindóia Village and its surroundings. The objective of the field incursion was to collect information about the possible impacts that the project could cause in the community, to inform several stakeholders, public or private, about the beginning of the project's activities, and to assess the potential of future partnerships that could be useful in the process of implementation and development of the project's actions and activities in the region[17]. The communication channel publicized after the mobilization with local leaders will also serve as support for sending the project summary and information about the audit visits.

According to information collected throughout the fieldwork, the communities that were identified around the project area, and that therefore become actors of interest are associated with the commercial and organizational core of the Lindóia Village. The communities of Ramal Ajuricaba and Visconde de Mauá, focused on food production via family farming are under the influence of the Lindóia Village, either by the proximity given by direct access of the junctions that converge to the AM-010 highway, the main link road with the capital, either by the presence of public services such as the Basic Health Unit (BHU), the school and the bus station, where passengers disembark from various destinations connecting the cities in the region, to Manaus.

At Lindóia Village, the research team identified the presence of local organizations, such as the Formigueiro Group, which is a collective organized by members of the community itself, which performs actions of a social nature and supports local income generation. The Residents Association of Lindóia Village was also mapped, whose board of directors was elected during the field team's visit, demonstrating that forms of social organization are locally in force, active, and have relevance in shaping the community's social fabric. The election was contested by three slates, which used mobilization strategies to convince the community, such as messages on social networks, collective meetings to explain the proposals, and that triggered different ways of understanding the reality, and therefore the proposition of solutions to local problems and demands. It was possible to observe that the election was

[12] Annex: Socioeconomia_Localização.pdf

[13] Annex: CV - Caroline Césari de Oliveira - Out2022.pdf

[14] Annex: CV - Marco Aurélio - Ago2022.pdf

[15] Annex: Panphlet.pdf

[16] Annex: Questionários_lideranças_Vila_Lindóia.pdf

[17] Annex: Stakeholders_List.xlsx

articulating the residents around ideas, wills, and opinions, and therefore, the presence of these organized groups and the whole movement around the association's electoral process demonstrated a capacity for community organization and democratic discussion about what is relevant for the future and wellbeing of the village's population. In this interim, and through a pre-existing profile of action, it is necessary that this social configuration be incorporated into the project, so that actions can be developed, through the creation of partnerships and the guarantee of the incorporation of these groups in the process of discussion and definition of actions regarding the development of the project and the implementation of its subsequent stages.

Regarding the Formigueiro Group, it should be noted that it is an organization that has been in existence for three years but has been working informally for over five years with the community of the Lindóia Village and surrounding areas. Currently, it is associated with more than 40 associations and local community groups, which the Formigueiro Group assists in the process of documentation legalization, maintenance of the associations pretending to monitor, and advisory to presidents and communities. As members of the group, we highlight the local groups and associations of family farmers, among other groups such as fishermen, merchants, and the support group for mothers and families of special children (children with some disability). It has projects being developed together with EMBRAPA and IDAM for fruit production such as papaya, citrus, and the distribution and technical assistance to small coffee producers, and aquaculture projects. It has also participated in initiatives for the training and qualification of rural producers with the Itacoatiara City Hall. Recently closed an agreement with SENAI for training in handling and reusing food, which was taught at the Municipal Ivo Amazonino Mendes School, which, in turn, receives support from the group for the maintenance of the "life guardians", who are monitors who help children with disabilities in the classroom, enabling access to education and interaction with peers for this special public. Therefore, due to the relevance of the performance and organization of these several groups in Lindóia Village, and due to the amount of more than 3 thousand inhabitants, whose sampling would be difficult to establish in an equitable way, because of the absence of data on the profile of the local inhabitants, we adopted the strategy of applying the questionnaire and mobilizing for collective meetings for consultation and information about the project was carried out with the community leaders. This included the current direction of the Residents' Association and members of the slates competing for the election of the entity's board, the leaders of the Formigueiro Group and other associations and communities that integrate the project, as well as representatives of fishermen, mothers' groups and riverbank dwellers who inhabit areas of interest to the project, and who may come to interact with its actions in future stages of project implementation.

The community of Lindóia Village is 6 km away from the project property, and there is no access between the property and the village, either by road or by the Urubu River. This lack of connection between the property territory and the village is reflected in the fact that few people interviewed showed knowledge of the enterprise, mainly because it is not a productive unit, which employs people and generates a flow of employees, goods, or services. The property is mostly composed of native forests, and its location is unknown to most of the people interviewed. Thus, during the application of questionnaires and the consultation meetings with local stakeholders, no direct or indirect impacts of project activities on the social, economic, or community dynamics of this community were identified.

Still with regards to the negative impacts, the existence of a family group that was approached during the application of the questionnaire, whose residence is close to the southern limit of the property at the level of the Igarapé do Boto, a place that gives access by the river to the portion of the forest that is being protected under this project. This family does not live on the property, so there is no connection to the question of land ownership. Regarding the transit of people, machinery, vehicles, and services, it is possible that the areas that this family unit uses for hunting and gathering items to supplement their diet correspond to the areas that will be accessed during the process of implementation and development of the project. Thus, a specific dialogue process with this family group must be carried out throughout the project, since these people are in a situation of food insecurity, depending therefore on forest resources for their subsistence, and where the children are in a complex situation of not being able to access school throughout the year. In the dry season, the boats lose navigability through the streams, having to be pushed in some stretches where the waters are shallower. This lack of transportation makes it difficult for the eleven children, aged between one and sixteen, to attend school, which increases the vulnerability situation to which this family is subjected. In this sense, the increased movement of people and machinery in the region can negatively impact the sense of security for this family since it is a region with few inhabitants and a closed forest. To mitigate this impact, it is necessary that the project promotes an increase in the quality of life for this group, helping these people in training for income generation, access to health care, and school transportation for the children and youth of the family, to reduce poverty and hunger.

Regarding the positive impacts generated by the project, the maintenance of forests is related to supporting and regulating ecosystem services, such as air quality, climate, water, protection against erosion and degradation processes, soil formation and regeneration, pollination, biological regulation, nutrients, life-maintenance cycles, and protection of the gene pool (Loft, 2011). Among other positive impacts resulting from the project, we can mention the strengthening of the relationship with institutional and non-institutional stakeholders, which contributes to the generation of a stronger community that is more attentive to its local socio-economic and environmental aspects.

Strengthening the relationship with the community is an approach with a close impact on the sustainable development goals for 2030, defined by the United Nations, in the fight against hunger and poverty eradication, improving the quality of education, access to health care, employability of the population, and economic growth, reinforcing gender and equality issues, in addition to combating climate change and protecting biodiversity.

The fieldwork was a relevant part of the diagnostic process of the social, environmental, and economic conditions of the communities and actors of interest in the project. It was carried out by a research team, composed of professionals specialized in community approaches and engagement, during the period from 16-11-2022 to 25-11-2022, for a total of 10 days of field research. The main objectives achieved through the fieldwork are listed below:

- Start the process of community engagement and local stakeholders, according to methodologies adhering to VCS standards;

- Preparation of an informative pamphlet for distribution to stakeholders with relevant information about the project;
- Identify local stakeholders inserted in the project area or that are directly or indirectly related to the study region (associations, cooperatives, cultural groups, etc);
- Meet/visit landowners, public-private agents and institutions of interest, and members of the surrounding communities, to disseminate project information;
- Hold a presentation meeting, if mobilization is feasible, for stakeholders and members of the surrounding communities to be engaged in the project;
- Identify priority issues of great relevance to the communities, including scenario assessment regarding gender and intergenerational issues, land conflicts, working conditions, violence rates, and access to public services;
- Identify priority territories for actions and engagement of potentially relevant communities for the project, by applying and proving the use of participatory methodologies;
- Ensure the production of evidence that includes the prior consent of the communities and actors of interest in the project.

2.2.1 Methodology

The work methodology was defined after successive meetings and alignments between the consulting team that would go to the field and Systemica's technical team. During these meetings, it was promoted a joint construction of strategies and the choice of the best tools to be used with the communities.

The bullet points below show the methodology defined to engage and mobilize the local population, aiming to be effective in the consultation process with surrounding communities and stakeholders. As defined by the VCS Standard, the following was done:

- Application of a simplified questionnaire with actors and members of interest for recognition/identification of the scenarios constituted in the territories under study;
- Signing of an authorization term for the use of information and images;
- Conducting a presentation/opening meeting of the project for the target public to be mobilized during fieldwork;
- Survey of primary information, through visits that will be documented, which will subsidize the production of a social diagnosis of the communities of interest to the project;
- Active search for the project's stakeholders, including the institutional ones and potential partnerships, aiming at the consultation and presentation of the project and its premises;
- Promotion of specific approaches with the delivery of an informative pamphlet containing the permanent communication channels for the project - e-mail: projetoABC@systemica.digital and WhatsApp number: +55 (11) 5039-1386.

2.2.2 Results of the mobilization

The project design and its implementation, including the information on the project monitoring, risks, costs, and benefits to local stakeholders, relevant laws and regulations, and auditing processes, were presented to the local community during the interviews and the "Start Date" event. In addition, the local community was informed about the upcoming visit of the validation body of the VCS Program[18, 19, 20, 21].

The meetings held on the project's "start date" had the objective to explain the main points and implications of implementing a carbon credit project, as well as disseminating and mobilizing the community to participate in the application of the questionnaire for socio-environmental diagnosis, assessing the priorities and most urgent demands. A total of 28 leaders and representatives of the various social groups present in the village were interviewed, prioritizing those who interact with both the Formigueiro Group and the Residents Association of the Lindóia Village, both in the project area, within the 20 km buffer and adjacent to it.

All the information necessary for the engagement of the communities in the project was provided during the collective meetings held, including the training activity for REDD+ activities, which was held with the representatives of the Formigueiro Group on November 19, 2022. With three other groups it was also possible to hold collective activities to explain the project and assess the priorities to be considered for the elaboration of the actions, namely:

- Visconde de Mauá Community on November 21, 2022;
- Community Leaders of Lindóia Village on November 22, 2022; and
- Mothers Group on November 23, 2022.

It is noteworthy that during these activities the participation of the communities was prioritized, as well as the clarification of doubts about the project, in addition to being an opportunity to discuss, along with the populations of interest, some of the REDD+ capabilities, with the facilitator focusing mainly on the following topics: (i) reducing emissions from deforestation; (ii) reducing emissions from forest degradation; (iii) how to contribute to the increase of forest carbon stocks; (iv) actions and attitudes that can contribute to the control of climate change and global warming.

Individual approaches were also promoted, where everyone engaged by the research team received the project's pamphlet, containing information about the ongoing work, as well as the communication channels to address potential doubts or questions that arise from the beginning of the development and implementation of the planned activities. This approach methodology was defined to initiate and ensure effective participation, as well as the understanding of the most relevant prerogatives for the continuation of the project.

[18] Annex: Start Date Grupo Formigueiro_19-11-22.pdf

[19] Annex: Start Date Comunidade Visconde de Mauá_21-11-22.pdf

[20] Annex: Start Date_Associação de Moradores da Vila de Lindóia_22-11-2022.pdf

[21] Annex: Start Date Grupo de Mães_23-11-22.pdf

The application of the planned methodologies and tools during the fieldwork prioritized the participation and inclusion of the community's viewpoints. To guarantee the transparency of the consultation process, each interviewed stakeholder was asked to sign the "Authorization for Use of Information Term", aiming at guaranteeing the informed consultation process, which certifies both their awareness of the project's objectives and the receipt of the informative pamphlet. It is noteworthy that special attention was given to making the language of the material more accessible, with the choice of an enlarged font, which aimed to facilitate the visualization of people with low vision or reading difficulties. The text of the pamphlet was designed to simplify the understanding and to facilitate reading, ensuring that the information was direct, and objective. There was also a concern on the part of the field team to pass on the information in a clear way, avoiding technical terms and words that could hinder the understanding of the content, in addition to the care taken to clarify each of the questions and doubts presented by the members of the mobilized communities[22].

The application of the questionnaires implied a work of identification and active search carried out by the field team, which mobilized a significant part of the local leaders, who make up the most diverse social strata and groups and organized entities of the village and surrounding area. These people were approached, as they have the multiplying role of making the project information reach their wider group, as well as being responsible for the most sensitive demands and issues of their respective communities, as they are engaged members in the process of formalizing and strengthening for the collective resolution of local demands. It is noteworthy that there is no mapping of the communities and localities that make up the territory of Lindóia Village and its surroundings, nor the limits of the communities and groups that are recognized as being part of the village. Further work will be needed to geo-reference these groups, in order to map others that may be in the project's area of interest, so that partnerships and engagement processes, and social participation are guaranteed for everyone who is in the project's area of influence and reach.

Thirty entities, community groups, and associations were mapped out, with the support of the Formigueiro Group, in the person of secretary Romário Elton da Cruz, and director Moisés Azevedo. It was possible to apply the questionnaire and provide relevant information to 28 representatives, who also participated in the dynamics of assessing priorities. This amount corresponds to almost all the leaders that were identified, and we believe that it is a significant sample among the groups mapped. It is not possible to establish an exact percentage because there is no official survey regarding the number of members and groups that effectively interact in the territory. Some community and group leaders were not found, and others were identified as being more than 150 km from the project area, that is, outside the buffer of interest of the actions. In some cases, there was even a logistical difficulty in locating or having access to some communities and their relevant actors, but in any case, we tried, with the support of the main leaders from Lindóia Village, to mobilize the main local actors, and it is important to highlight the help provided by the president of the Residents' Association, Mr. Raimundo Nonato Tamborini. All the help was very important for the participation of other leaders and representative groups of the locality, in providing space for the collective activities, inviting and mobilizing people through WhatsApp

[22] Annex: Autorização de Uso de Informações e Dinâmica das Prioridades.pdf

messages, and supporting the presence of the team and the proposed group dynamics and activities. The Table 2.1 below of mapped entities and groups was provided by the Formigueiro Group and complemented with information verified by the team in the field:

Table 2.1. List of communities, associations, and collectives in Lindóia Village and the project's surroundings.

Entity/group	Person in Charge / President	Location
Formigueiro Group	Moisés / Romário	Centro Comercial de Vila Lindóia (Lindóia Village Commercial Center)
Association of the Residents of Lindóia Village (Nossa Senhora de Nazaré)	Raimundo Nonato	Centro Comercial de Vila Lindóia (Lindóia Village Commercial Center)
Bom Jesus Community	Eliana	Km 152, roadway AM010
Ramas das Pedras	Professor Francisco	Access through AM010
Agrovila Community	Aroldo	Km 048, roadway AM010
Jaçanã Village Community	Ana Mura	Indigenous Land Urubu River
Nova Canaã Community	Jota Jota	Access through AM010
São Francisco de Assis Community	Campos	Access through AM010
Igarapé do Fortunato Community	Maria	Access through Urubu River
Copaíba Community	Edna Reis	Ramal Santa Luzia (Santa Luzia branch/ alley)
Nova Jerusalem Community	Jacira	Ramal Santa Luzia (Santa Luzia branch/ alley)
São Luiz Community	Nelson e Pedro	Ramal do Minério (Minério branch/ Alley)
Nova Vida Community	Andreia	Access via AM010
Lindóia Village Merchants Group	Rogerio	Centro Comercial de Vila Lindóia (Lindóia Village Commercial Center)
Ramal Anjuricaba	Luiz	Access through AM010

Entity/group	Person in Charge / President	Location
Viscone de Mauá Community	Barbosa	Access through AM010
Ramal da Paz	Erison	Access through AM010
Mount Sinai Community	Moreira	Access through AM010
Jericho Community	Silvana	Access through AM010
Barcelona Community II	Ivete	Access through AM010
Betel Community	Edilson	*Centro Urbano de Itacoatiara* (Urban Center of Itacoatiara)
São Geraldo Community	Nazira	Km 44, roadway AM010
Boca do Padre	Edenilson	Igarapé Costa da Conceição
Costa do Quelé	Eraldo	Amazonas River
Matrinxã Fishing Community	Alcione/ Rosilene	Urubu River
Group of Pilots and Tourist Guides of Lindóia Village	Marcio	Centro Comercial de Vila Lindóia (Lindóia Village Commercial Center)
Mothers of Children with Special Needs Group	Gertrudes	Centro Comercial de Vila Lindóia (Lindóia Village Commercial Center)
School Community of EM Ivo Amazonense de Moura	Silvana	Centro Comercial de Vila Lindóia (Lindóia Village Commercial Center)
River dwellers of the Urubu River	João	Igarapé do Boto
Family Farming Forum	Andrea	Itacoatiara/Lindóia Village

This produced material will be used for the development of the social diagnosis, which will define the demands and opportunities observed in this population and will be able to enhance the development of the planned actions, as well as the achievement of the expected results. Results of all activities developed, including information on location, date, and the number of participants involved are summarized in Table 2.2.

Table 2.2. Results of the activities with the community of Lindóia Village and surrounding.

Activity	Location	Date	Participants
Questionnaire for social diagnosis	Leaderships from Lindóia Village and surroundings	18 a 24/11	28
Start Date and Capacity Building Meeting for REDD+ Activities	Formigueiro Group	19/11/2022	13
Explanation of the Project, delivery of pamphlet and inauguration of communication channel	Lindóia Village	17 a 24/11	80
Capacity building for REDD+ activities	Formigueiro Group	19/11/2022	13
Process of filling out priorities with survey respondents	Leaderships from Lindóia Village	18 a 24/11	28 (individuals) and 2 (collectives)
Start Date for consultation with local stakeholders, explanation of the project, and dissemination of the communication channel	Viosconde de Mauá Association	21/11/2022	17
Start Date for consultation with local stakeholders, explanation of the project, and dissemination of the communication channel	Leaderships from Lindóia Village	22/11/2022	12
Start Date for consultation with local stakeholders, explanation of the project, and dissemination of the communication channel	Mothers of Children with Special Needs Group	23/11/2022	13

It is important to stress that all comments regarding the project implementation received through our communication channels previously mentioned in this section will be addressed individually and therefore documented. In addition, any arising complaints or suggestions for improvement will also be taken into consideration and judged internally by the project proponent. If the complaint or suggestion is pertinent and related to the scope of the project's obligations, it will be implemented.

Finally, the owners do not have any labor liabilities, in other words, no debts due to non-compliance with labor obligations, incorrect payment of social charges, or payment of mandatory benefits.

2.3 Environmental Impact

No individuals or communities were identified via satellite images, official data or field diagnosis as being installed within the limits of the project area. There is, however, as mentioned previously, a family composed of 19 people who settle within a radius of 1 km from the project property borders and perform hunting, fruit gathering and fishing activities for their own consumption that eventually undertake these activities within the project area. This should be understood as a subsistence activity, characterized by the collection for own consumption and to complement the nutritional variety and therefore this activity has never been a threat to the existence of the project forest. In the flood period of the Urubu River, the occurrence of sport fishing and fishing practiced by some riverside dwellers in the rivers that cross the project area were also reported in interviews with the community.

The family group, river dwellers, and sport fishing practitioners do not present a threat to the integrity of the property or the forest area and for this reason, there has been no need to prevent their passage by barriers or limited access so far. However, with the implementation of the ABC REDD+ project, one of the commitments adopted by the landowner is to fence the area, carry out surveillance, and prevent access to unauthorized people in the project area. These adopted measures will not impact the food supply of these families or negatively impact the economy generated by the sport fishing activity since this region presents a remarkable extension of biodiversity and is naturally rich in the diversity and quantity of these natural resources (Table 2.3).

No direct or indirect impacts were observed in the communities of Lindóia Village, Visconde de Mauá and Ramal Ajuricaba, however, indirect impacts of the ABC REDD+ project were identified in the above-mentioned family group, which were identified as being caused by the increase in the movement of unknown people in the region, due to the implementation stages of the project. However, these impacts can be overcome through a previous mobilization process to assure the participation of this group in the implementation processes of the project steps.

In conclusion, it is expected that the project will bring long-term positive socioeconomic and environmental impacts in the region, by providing improvement in the quality of life of the population and environmental education to end deforestation and fires in the Amazon.

Table 2.3. Distance in km between ABC REDD+ project and protected areas.

Classification of Protected Area National, Municipal and State Parks	ABC REDD+ project distance (km)
Parque Nacional de Anavilhanas	145.76
Parque Estadual Rio Negro Setor Sul	138.20
Parque Estadual Sumauma	104.89
Area of environmental protection	**ABC REDD+ project distance (km)**
Nhamunda	227.41
Taruma/Ponta Negra	107.36
Presidente Figueiredo - Caverna do Moroaga	63.37
Margem Esquerda do Rio Negro-Setor Aturia - Apuauzinho	108.08
Margem Esquerda do Rio Negro - Setor Tarumã Açu-Tarumã Mirima	110.82

Parque Linear do Binda	109.54
Margem Direita do Rio Negro - Setor Paduari - Solimões	113.20
Area of relevant ecological interest (ARIE)	**ABC REDD+ project distance (km)**
Projeto Dinamica Biologica de Fragmentos Florestais	78.94
National and State Forest	**ABC REDD+ project distance (km)**
Floresta Nacional de Pau-Rosa	143.19
Floresta Estadual De Faro	196.66
Floresta Estadual Maués	138.46
Floresta Estadual Rio Urubu	80.82
Biological Reserve	**ABC REDD+ project distance (km)**
Uatuma	98.44
Sustainable Development Reserve	**ABC REDD+ project distance (km)**
Tupe	125.97
Matupiri	242.75
Rio Negro	158.21
Canuma	126.82
Puranga Conquista	128.36
Uatuama	32.68
Rio Madeira	243.86

2.4 Public Comments

This ABC REDD+ project description is version created to submit the project to the under validation status. The public comment period has not yet been initiated. Any comments and answers arising will be attached to the project.

2.5 AFOLU-Specific Safeguards

2.5.1 Identification of stakeholders potentially impacted by the project

The ABC-I1 properties are in the north region of the Itacoatiara municipality (part of the metropolitan region of Manaus) in Amazonas State. Itacoatiara has 104,048 inhabitants, the third-largest population, and the third-highest Gross domestic product (GDP) among the 62 municipalities in the state. However, it still presents unequal access to public services for the local population. In addition, the city has an area of 8,891.9 km², entirely inserted within the Amazon biome (IBGE, 2022).

As mentioned in Section 2.2, through satellite images, secondary data from desk research, and primary data surveys carried out through fieldwork, a radius of 20 km from the property's limits was defined, and the communities in Section 2.1 were identified.

The communities and actors of interest identified in the project region are located in Lindóia Village, a rural area of Itacoatiara, close to the AM-010 highway. This central axis connects the municipality to the capital Manaus. A significant part of the members of these communities, practices family farming, mainly fruit and horticulture, in addition to the cultivation of Amazonian products such as cassava (flour and tapioca by-products), guarana, *cupuaçu*, *açaí*, and Brazil nuts. In this context, employment opportunities are very scarce, focusing on commercial activity, public service, and the timber industry, and illegal activities such as charcoal production and the illegal timber industry, as well as predatory sport fishing.

The community of Lindóia Village, in its historical process of development, had its settlement and urbanization associated with two factors. The first factor is related to the development of the river port of Itacoatiara in 1919, the second largest river port in the country, where cargo arrives daily from cities such as Belém, Cuiabá, Manaus, and Santarém. In addition, the construction of the Lindóia bridge that crossed the Urubu River (a river that passes through the region) facilitated access and travel to the region by land for many people (families and some small traders). Therefore, Lindóia Village served as a stopping point for those heading towards the port and, simultaneously, needed to travel by ferry across the river.

The second factor that boosted the development of Lindóia Village was based on a project by Emater-Am, in the mid-1970s, with the planting of rubber trees to extract latex. However, the infertile soil for growing rubber and the lack of technical assistance from responsible government agencies doomed the initiative to failure. Today, there are few rubber trees remaining that are part of the community's history, according to testimonials from local residents.

From the point of view of its social and political organization, the community founded the Association of Residents of Lindóia Village in 1982. The entity arises from the mobilization of the Catholic community associated with the Church of Nossa Senhora de Nazaré, the village's patron saint, and responsible for holding the "Festa da Fogueira" in June, considered one of the largest in the state. Therefore, the process of strengthening and organizing collective autonomy has been built for forty years in the village. This offers a certain maturity of local institutions, which proved to be effective, active, and consolidated in the context of fighting for the interests of the village and its population. In this same sense, the performance of another local entity, Formigueiro Group, which since 2020 has provided institutional support for the maintenance of local associations and cooperatives, focusing on the promotion of family farming and technical assistance to small producers.

The pre-existence of strengthened, organized, and legalized community entities, added to the framework of communities and groups interconnected to these collectivities, implied the strategic choice of approaches by the leaders in the process of social diagnosis. This situation is critical because presidents and local leaders often have a more comprehensive view of their community's social and economic situation. Another interesting point to highlight is the capacity for dialogue, which facilitates the process of applying the form, and the qualitative understanding of the most relevant issues to be incorporated into the diagnosis and worked on throughout developing the project's actions. In the meantime, 28 leaders were interviewed, appointed by the management of Formigueiro Group and by the Residents' Association, seeking to respect hierarchies and internal forces.

According to the exposed in Section 2.2, the field team interviewed and distributed informative pamphlets, highlighting the communication channels open to the community to access questions and complaints about the project in each household visited. Applying all participatory tools, including the questionnaire, the assessment of priorities, and the joint meetings, was critical in determining an in-depth diagnosis, even with a sample based only on leaders. A broader mobilization could have been done, but strategically, the leaders' approach was chosen since the call for wider groups could generate future expectations that the project might not be able to meet. As subsequent steps for the discussion of the actions will still be produced, it is believed that from a more certain scenario of the implementation of the activities, and the definition of a schedule, it will be possible to expand the mobilization. On the other hand, it is noteworthy that even though the research team had located and approached a relevant part of the leaders, the richness of groups and communities organized in the territory, through the absence of georeferencing of these collectives, justifies possible gaps in the approach.

An important fact is the population underestimation mentioned due to the outdated Brazilian Census; the last was carried out in 2010. The Census in Brazil is carried out every decade, but the Brazilian government has delayed it, and until the present moment, November of 2022, it has not been concluded. The situation creates great difficulty in obtaining real and updated data about the Brazilian regions, and rural areas, especially in the Legal Amazon, where there is a gap in the government's actions, an absence of environmental enforcement policies, and a lack of essential services to the population.

As a result, local communities were identified, and institutional stakeholders possibly involved in the project were mapped to understand the public impacts of the project. The process of consultation and explanation about the project's prerogatives was done by telephone calls and e-mail[23] containing a digital version of the pamphlet, contact number, and information about the project. Municipalities, environmental and agricultural agencies, universities, rural workers' unions, and non-governmental organizations can potentially become partners in the project to ensure efficiency and increase the scope of the planned actions. A spreadsheet containing the main agents identified that could be impacted by the project's activities (local agents identified and mobilized and institutional actors of interest to the

[23] Annex: E-mail Stakeholders Institucionais_Dez2022.pdf

project) and their contact telephone numbers and e-mails can be found in the attached spreadsheet, already mentioned in Section 2.2.

2.5.2 Identification of any legal or customary tenure/access rights to territories and resources, including collective and/or conflicting rights, by local stakeholders

In Itacoatiara, part of the job opportunities is related to the logging industry, both legal and illegal. The suppression of vegetation cover is a historical fact in the process of development of the small urban fabric of the village, with most of the houses being made of wood. The region of Lindóia Village has the presence of legalized loggers who work according to a forest management policy. Still, there is also an illegal activity aimed mainly at the internal public. The illegal production of charcoal persists, aimed at the domestic market in Manaus and the metropolitan region. This type of activity requires the illegal felling of native wood for subsequent burning, with charcoal being one of the main vectors of environmental degradation in the streams and areas of native vegetation that surround the Lindóia Village.

Sport fishing creates immense tourist potential for the region, associated with jungle tourism. It is possible to observe the presence of inns and hotels dedicated to this practice on the banks of the Urubu River. *Tucunaré* is the species most sought after by sport fishermen. However, the unregulated development of this practice has been causing a reduction in fish volume and changes in fishing spots, according to reports from riverside people and local fishermen. Local fishermen also report the harmful effects of unbridled sports practice, which often return injured fish to the river, compromising the animal's survival time in its natural habitat. No area of illegal mining was identified in the territory. However, the practice of setting fire to clean up cultivable areas and land grabbing are historically consolidated practices in the region (Carrero et al., 2022).

The project proponent (Systemica) recognizes, respects, and supports local stakeholders' property rights. Also, the project does not infringe on private, stakeholder, or government property or relocate people off their lands. The landowner does not face land tenure or resource access and use disputes. All legal documentation and proof of title are available in Sections 1.7 and 1.14 of this PD.

During the socio-environmental survey carried out by the field team, the presence of a family group that uses forest resources within the property was mapped. The use of resources is restricted solely to hunting, gathering, and fishing for items and food for the family's livelihood. The group comprises 19 people, 8 adults and 11 children, whose type of food varies according to the season. For example, part of the plantation, such as fruit trees and some vegetables, is located in the area where the family resides. During the flood season (from November to March), fishing, gathering, and hunting are more abundant. However, this family group also owns a house in Lindóia Village, which means that their resources and means of subsistence are not limited to the territory surrounding the project. This family nucleus inhabits a region where forest areas predominate, and the team has not located any other grouping so close to the areas surrounding the property. For the other communities, including the commercial center of Lindóia Village, the Visconde de Mauá community, and the Ramal Ajuricaba, there was no report of the use of natural resources in the area around the project. There is a physical division and access restriction, as these communities are separated from the property by an extensive area of forest and a strip of streams. Also, so for there is no road that facilitates vehicle access to the property. Most interviewees reported not knowing the property and the owner since there are no productive activities in the locality, with no reports of measured impacts.

Native species of the Amazon biome compose the forest where the project is inserted. Since the landowner is a logger and intends to cut legally native trees on his other properties (outside the project area), and as this is not a reforestation project, the project does not introduce invasive species or use species that may cause adverse effects. Also, it is not used fertilizers, pesticides, or biological control agents.

2.5.3 Legal and moral responsibility of the project with stakeholders (institutional and community) and workers of the properties involved in the project

All legal and some technical aspects of the project were presented to the communities, workers, and local stakeholders during interviews, training, and through pamphlets and e-mails. In these meetings, the entire VCS validation and verification process was addressed, as well as the monitoring results and the intentions, risks, costs, and benefits of the project. A continuous communication channel was also established to enable exchanges and answer any questions that may arise from the stakeholders (e-mail and WhatsApp).

It is essential to be explicit that all comments regarding the project's implementation received through our communication channels previously mentioned in this chapter will be addressed individually and therefore documented. In addition, any arising complaints or suggestions for improvement will also be considered and judged by an internal committee and, if pertinent and related to the scope of the project's obligations, will be implemented.

The contract[24] signed with the owners proves that they have 100% legal control of the areas and that there are currently no land conflicts. If conflicts of this nature occur in the area, the legal authorities will be immediately notified, and Systemica's juridical department will act to solve these conflicts. Moreover, the entities involved in the project are not engaged in any form of discrimination or sexual harassment. Finally, the owners do not have any labor liabilities, i.e., no debts due to non-compliance with labor obligations, incorrect social charges' payment, or payment of mandatory benefits.

2.5.4 Description of the social, economic, and cultural diversity within the local stakeholder groups

The project's stakeholders are government agencies, municipalities, universities, environmental and agricultural agencies, and the Lindóia Village. Thus, by identifying and applying different forms of consultation with the various stakeholders, the project is considered to encompass the stakeholders' social, economic, and cultural diversity.

2.5.5 Significant changes in the composition of local stakeholders over time

[24] Annex: Systemica – João Rogério Contract.pdf

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

Communication with the project team was promoted with all stakeholder profiles through fieldwork, calls, and meetings. An online communication channel is established by e-mail and form for government agencies, private companies, and NGOs. However, direct consultation was also carried out with municipal departments and unions.

Among the positive impacts expected by the community are the projects that will be carried out with the group of mothers of disabled children, riverside communities, fishermen and family farming. For these groups, actions related to improving the quality of life, access to education, comprehensive health, psychological support, job and income generation opportunities, training and promotion of family farming will be promoted. Another expected impact refers to the integration of already structured and active local communities in the territory, namely the Formigueiro Group and the Association of Residents of Lindóia Village, which will receive institutional and human support. Partnerships aim to complement and strengthen the list of actions and projects already developed by these community entities, prioritizing those aimed at improving the well-being and income generation opportunities for women, young people and children. Special attention will be given to mothers of disabled children, who must have support to access medical treatments and specialties, including psychological and psycho-pedagogical support, so that children have the right to access and remain in formal school. Such actions will be essential to improve the living conditions of these children and their families, especially those mothers who lack job opportunities due to their special needs of time and dedication to their children, making it difficult to access the formal job market.

2.5.6 Expected changes in well-being compared to the baseline scenario, including changes in ecosystem services identified as important to local stakeholders

Considering that the surrounding community does not exploit resources (non-timber forest products or others) within the project area, it is commonly understood that the operation of the business or the project activities themselves will not negatively impact the ecosystem services associated with extractive activities.

From the information collected, it is understood that there are no direct or indirect risks to local stakeholders associated with project activities since there are no communities occupying areas internal to the project properties, nor do they depend on the forest resources present there. Well-known benefits of maintenance of forests are related to supporting and regulating ecosystem services, such as air quality regulation, climate regulation, water regulation, protection against erosion, degradation process, soil formation and regeneration, pollination, biological regulation, nutrients, and life-maintenance cycle, protection of the gene pool (Loft, 2011). These projects have an immediate impact on the sustainable development goals for 2030, defined by the United Nations, in the fight against hunger and poverty eradication, improving the quality of education, access to health care, employability of the population, and economic growth, reinforcing gender and equality issues, in addition to combating climate change and protecting biodiversity.

No risks affecting the environment, biodiversity, and community are identified. However, regarding the implementation of the project and the interface of the property and its activities with local stakeholders, potential negative impacts were detected, of an indirect order due to the stages of project implementation and the increased movement of unknown people in the region with a family group that inhabits an area near the project property. As a mitigation measures, they have been informed about the realization of the project and will also be informed about the dynamics of people movement that will occur on-site, as well as participating in informational lectures related to REDD+ projects. Systemica's research team will keep constantly consulting with them to avoid harmful risks and impacts, mainly associated with trade-offs with food security, land loss, loss of yields, and climate change adaptation. Suppose any risk is reported by the community or the other families via our previously mentioned ongoing communication channels or observed by our local consultants during the project's life, including the design and consultation phase. In that case, an investigative inquiry will be opened in Systemica's internal committee so that measures can be taken.

Furthermore, no natural risk was observed in the project areas, such as fire, hurricanes, or other types, according to the satellite image analysis and literature research. If any of these risks occur, mitigation actions will be adopted to reduce their impacts. More details about these risks will be described in the Non-Permanence Risk Report.

2.5.7 Location of communities, local stakeholders, and areas outside the project area that are expected to be impacted by the project

Aware that there could also be other local actors for whom the development and execution of the project may cause direct or indirect impact, other communities, such as indigenous and *quilombola*, recognized traditional communities and settlements projects were identified through satellite images. The list of these communities and their distance to the centroid polygon of the ABC-I1 project areas are identified below in Table 2.4.

Table 2.4. Distance in straight line from the centroid of the ABC-I1 polygon from the indigenous communities, *quilombolas* and settlements.

Classification of Communities	Distance (km)
Indigenous Lands	
Apipica	74.34
Murutinga/Tracaja	63.52
Nhamundá/Mapuera	171.18
Paraná do Arauató	66.55
Patauá	81.36
Rio Urubu	31.30

Fortaleza do Patauá	188.44
Jatuarana	203.27
Jauary	67.30
Boa Vista – AM	62.49
Kaxuyana-Tunayana	164.47
Gavião	83.72
Waimiri-Atroari	188.61
Ponciano	90.42
Sissaíma	79.62
Trombetas/Mapuera	164.46
***Quilombolas* (Afro-Brazilian settlements)**	**Distance (km)**
Abui, Parana do Abui, Tapagem, Sagrado Coração	253.10
Alto Trombetas Ii - Área Ii	278.14
Alto Trombetas Ii - Área I	299.38
Alto Trombetas - Área I	253.58
Boa Vista	325.35
Alto Trombetas - Área Ii	287.45
Rio Andirá (Parte 02)	212.42
Rio Andirá (Parte 01)	217.94
Tambor	346.15
Settlements	**Distance (km)**
PDS Novo Remanso	32.66
PAE Curupira	101.41
PDS Costa Da Conceição	54.84
PA Água Branca	89.13
PA Aliança	148.04

PDS Costa Do Iranduba	114.74
FLOE Floresta Estadual De Maués	138.46
PA Paquequer	109.82
PA Ipora	34.37
PAE Novo Jardim	119.75
PDS Lago do Tucunaré	123.81
PA Rainha	45.25
PA Engenho	32.91
RDS do Uatumã	32.63
PA Santo Antônio	90.94
PDS Amatarí	48.67
PDS Lago do Mira	130.21
PA Espigão do Arara	122.42
RDS Urariá	123.21
PDS Axinim	118.92
PDS Morena	60.39
PA Sampaio	101.70
PA Nazaré	58.75
PA Puraquequara	87.01
PA Uatumã	102.93
Communities (Rural Clusters)	**Distance (km)**
Comunidade Bom Sucesso	59.41
Puraquequara	92.56
Comunidade São Miguel	95.67
Vila de Urucurituba	92.57
Vila Vera Cruz	166.41

Vila Lindoia	20.72
Jatuarana	74.04
Vila Amanari	156.36
Vila do Engenho	49.55
Santo Antonio dos Moraes	174.07
Vila São Joso	158.43

2.5.8 Location of territories and resources that local stakeholders possess or to which they have regular access

No local stakeholders profit from the resources produced by the project property, nor is there any economic activity associated with the extraction of forest or biodiversity products within the project area.

Process of consultation and continuous communication channel

Communication and stakeholder engagement occurred through direct community contact around the project area in November 2022. The people of Lindóia Village were visited by Systemica's research team, who explained the project and provided the contact phone number, a WhatsApp number, and an e-mail address to ensure multiple and continuous communication between the project's responsible and stakeholders. During this visit, a questionnaire was applied to carry out a socio-environmental diagnosis with the external community to assess the project's impacts on their lives and their opinion about the activities developed by the farm, working conditions, forms of organization, etc. In addition, it is worth mentioning that concerning the institutional actors, an e-mail was sent informing the contact information for discussing any arising questions about the project as well as the preliminary information about the project itself, including an informative pamphlet, as mentioned before.

2.5.9 Experience of the team involved in the project

The team responsible for planning the activities, diagnosing, and analyzing the data comprises a multi-skilled and multidisciplinary team. Attached is a complete description and experience of the Systemica team[25] and the contracted field employees (same as attached in Section 2.2) who executed the meeting with local communities and the field surveys.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

[25] Annex: Systemica_experience.pdf

This project is based on VCS Methodology VM0007, Version 1.6, approved 8 September 2020, entitled "REDD Methodology Framework (REDD-MF)" (VERRA, 2020a).

This REDD+ Methodology Framework document is the basic structure of a modular REDD+ methodology. It provides the generic functionality of the method, which frames pre-defined modules and tools that perform a specific function. It constitutes, together with the modules and tools it calls upon, a complete REDD+ baseline and monitoring methodology.

The modules and tools called upon in the VM0007 methodology are applicable to project activities that reduce emissions from planned deforestation.

Furthermore, the specific modules and tools applied to the ABC project are listed below:

<u>Carbon Pool Modules:</u>

CP-AB, "VMD0001 Estimation of carbon stocks in the above- and belowground biomass in live tree and non-tree pools", Version 1.1, 11 October 2013 (VERRA, 2013).

CP-W, "VMD0005 Estimation of carbon stocks in the long-term wood products pool", Version 1.1, 20 November 2012 (VERRA, 2012a).

<u>Baseline Module:</u>

BL-PL, "VMD0006 Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation/forest degradation and planned wetland degradation", Version 1.3, 8 September 2020 (VERRA, 2020b).

<u>Leakage Modules:</u>

LK-ASP, "VMD0009 Estimation of emissions from activity shifting for avoiding planned deforestation/forest degradation and avoiding planned wetland degradation", Version 1.3, 8 September 2020 (VERRA, 2020c).

LK-ME, "VMD0011 Estimation of emissions from market-effects", Version 1.1, 9 March 2015 (VERRA, 2015).

<u>Emissions Module:</u>

E-BPB, "VMD0013 Estimation of greenhouse gas emissions from biomass and peat burning", Version 1.2, 8 September 2020 (VERRA, 2020d).

<u>Monitoring Module:</u>

M-REDD, "VMD0015 Methods for monitoring of GHG emissions and removals in REDD and CIW projects", Version 2.2, 8 September 2020 (VERRA, 2020e).

<u>Miscellaneous Modules:</u>

X-STR, "VMD0016 Methods for stratification of the project area", Version 1.2, 8 September 2020 (VERRA, 2020f).

X-UNC, "VMD0017 Estimation of uncertainty for REDD project activities", Version 2.2, 8 September 2020 (VERRA, 2020g).

Tools:

T-ADD, "VT0001 Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities", Version 3.0, 1 February 2012 (VERRA, 2012b).

T-BAR, "VCS AFOLU Non-Permanence Risk Tool", Version 4.0, 19 September 2019 (VERRA, 2019).

T-SIG, "CDM Tool for testing significance of GHG emissions in A/R CDM project activities", Version 1.0 (CDM, 2007).

3.2 Applicability of Methodology

The project activity is responsible to reduce emissions from planned deforestation and is defined as a REDD activity type, according to the VCS AFOLU Guidance document. By choosing the appropriate modules based on the applicability conditions mentioned in each of the modules, a project-specific methodology was constructed.

All Project Activities:

No land areas are registered under the CDM or under any other GHG program (both voluntary and compliance-oriented). Therefore, no area must be excluded from the project area.

All REDD Activity Types:

This REDD activity for the ABC project is applicable due to the following conditions:

- Land in the project area has qualified as forest for at least the 10 years prior to the project start date.
- Baseline deforestation in the project area fall within the categories of Planned deforestation/degradation (VCS category APDD).
- Leakage avoidance activities do not include: i) Agricultural lands that are flooded to increase production (e.g., rice paddy); ii) Intensifying livestock production through use of feed-lots and/or manure lagoons.

Avoiding Planned Deforestation/Degradation:

Avoiding planned deforestation/degradation activities are applicable under the following condition: Where conversion of forest lands to a deforested condition must be legally permitted.

All the conversion of forest lands to deforested conditions in the ABC project in the baseline scenario is legally permitted (see Section 3.4). It is in accordance with the Brazilian Forest Law that allows the landowner to legally suppress the forest areas. Hence, the project is classified as planned deforestation, VCS APDD category.

The leakage of an APDD project where the baseline deforestation agent is identified is defined by the VMD0009 v1.3, estimating the total area of deforestation across all the lands managed by the baseline deforestation agent.

The selected modules, along with their VCS site descriptions and applicability conditions, are detailed below, showing their correspondence to the project-specific conditions:

<u>Carbon Pool Modules:</u>

VMD0001 Estimation of carbon stocks in the above- and belowground biomass in live tree and non-tree pools (CP-AB), v1.1.

The ABC project meets the applicability condition of this tool because the project area is covered by forest (see Section 3.4). This module allows for ex ante estimation of carbon stocks in above- and belowground tree and non-tree woody biomass in the baseline case (for both pre- and post-deforestation stocks) and project case and for ex post estimation of change in carbon stocks in above- and belowground tree biomass in the project case. Uncertainty of estimates is treated in module X-UNC. Identification of baseline (post-deforestation) land-uses and stocks is treated in module BL-PL. This module is applicable to all forest types and age classes. Inclusion of the aboveground tree biomass pool as part of the project boundary is mandatory as per the framework module REDD-MF. Non-tree aboveground biomass must be included as part of the project boundary if the following applicability criteria are met (per framework module REDD-MF):

• Stocks of non-tree aboveground biomass are greater in the baseline than in the project scenario, and

• Non-tree aboveground biomass is determined to be significant (using the T-SIG module). Belowground (tree and non-tree) biomass is not required for inclusion in the project boundary because omission is conservative.

VMD0005 Estimation of carbon stocks in the long-term wood products pool (CP-W), v1.1.

The ABC project meets the applicability condition of this tool because logging operations are expected to happen in the baseline scenario before forest conversion to non-forest. This module allows for ex-ante estimation of carbon stocks in the long-term wood products pool in the baseline case. Carbon stocks treated here are those stocks entering the wood products pool at the time of deforestation. This module is applicable to all cases where wood is harvested for conversion to wood products for commercial markets, for all forest types and age classes. This module is applicable in the baseline if the wood products pool is included as part of the project boundary as per applicability criteria in the framework module REDD-MF, specifically:

• Timber harvest occurs prior to or in the process of deforestation, and where timber is destined for commercial markets.

• The wood products pool is determined to be significant (using T-SIG).

<u>Baseline Module:</u>

VMD0006 Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation/forest degradation and planned wetland degradation (BL-PL), v1.3.

The ABC project area is defined as forest land that would be legally converted to non-forest land, characterizing the project activity as Avoid Planned Deforestation. This tool was used to estimate the GHG baseline emissions in the project. This module allows for estimating GHG emissions related to planned deforestation, planned degradation and planned wetland degradation in the baseline case. The module assesses GHG emissions within the project area for the baseline period. The module is applicable for estimating the baseline emissions on forest lands (usually privately or government owned) that are legally authorized and documented to be converted to non-forest land.

Leakage Modules:

VMD0009 Estimation of emissions from activity shifting for avoiding planned deforestation/forest degradation and avoiding planned wetland degradation (LK-ASP), v1.3.

The ABC project met the applicability condition of this tool because the baseline scenario is the conversion of legally authorized and documented forest lands to non-forest land. This module allows for estimating GHG emissions caused by the activity shifting leakage of avoiding planned deforestation and avoiding planned wetland degradation project activities. Also, as it was used the BL-PL module, the use of the VMD0009 module is mandatory. Under these situations, displacement of baseline activities can be controlled and measured directly by monitoring the baseline deforestation agents or class of agents.

VMD0011 Estimation of emissions from market-effects (LK-ME), v1.1.

In the ABC project, the wood extracted by deforestation would be sold to the market if the project did not take place. Therefore, this module allows estimating GHG emissions caused by the market-effects leakage related to the wood extraction for timber, fuelwood or charcoal in the baseline for carbon projects. As per the VCS AFOLU Requirements consideration of international market leakage is not required. This module is applicable for calculating market-effects leakage from REDD projects that are anticipated to reduce levels of wood harvest substantially and permanently. When REDD project activities result in reductions in wood harvest, it is likely that production could shift to other areas of the country to compensate for the reduction, including activity shifting to forested peatland that is drained because of project implementation. This tool shall be used in countries where wood harvest happens on forested peatland regardless of the absence of peatland within the project boundary. As referenced in REDD-MF, this module is mandatory (within the context of such methodology) where:

- The process of deforestation involves timber harvesting for commercial markets.

- The baseline is calculated using module BL-DFW and fuel wood or charcoal is harvested for commercial markets.

This module should not otherwise be used in the context of REDD-MF.

Emissions Module:

VMD0013 Estimation of greenhouse gas emissions from biomass and peat burning (E–BPB), v1.2.

This module is applied because the ABC project aims to estimate the GHG emissions generated in the deforestation process in the baseline scenario. In addition, the other procedure is to monitor possible GHG emissions from biomass burning during the project scenario caused by forest fires. The GHG emissions from fires in the baseline and project scenario will be calculated using this module. This module provides a step-wise approach for estimating GHG emissions from biomass burning ($E_{biomassburn,i,t}$) and peat burning ($GHG_{peatburn,i,t}$). This module is applicable to REDD project activities with emissions from biomass burning and REDD-WRC project activities with emissions from biomass and/or peat burning.

Monitoring Module:

VMD0015 Methods for monitoring of greenhouse gas emissions and removals (M-REDD), v2.2.

The use of this module is mandatory for REDD project activities. This module provides methods for monitoring ex-post emissions and removals of GHGs due to avoiding deforestation and forest degradation, and carbon stock enhancement that has been induced because of REDD project implementation within the project area and leakage belt and as a result of natural disturbances. This module was originally developed for REDD project activities. It is also mandatory for use in CIW project activities and for this purpose the following translation table must be used. Socio-economic processes causing the degradation of wetlands are like those causing deforestation or forest degradation. Therefore, for stand-alone CIW project activities (e.g., conservation of salt marshes without a tree biomass component), similar methods for baseline determination can be used as for REDD project activities (see Modules BL-UP and BL-PL). Strata as defined in the relevant baseline modules are fixed and may not be changed without baseline revision. The module is mandatory for REDD, CIW-REDD, RWE-REDD and stand-alone CIW project activities. Where selective logging is taking place in the project case:

- Emissions from logging may be omitted if it can be demonstrated the emissions are de minimis using Tool T-SIG.

- If emissions from logging are not omitted as de minimis, logging may only take place within forest management areas that possess and maintain a Forest Stewardship Council (FSC) certificate for the years when the selective logging occurs.

- Logging operations may only conduct selective logging that maintains a land cover that meets the definition of forest within the project boundary.

- All trees cut for timber extraction during logging operations must have a DBH greater than 30 cm.

- During logging operations, only the bole/log of the felled tree may be removed. The top/crown of the tree must remain within the forested area.

- The logging practices cannot include the piling and/or burning of logging slash.

- Volume of timber harvested must be measured and monitored.

Miscellaneous Modules:

VMD0016 Methods for stratification of the project area (X-STR), v1.2.

This module is mandatory because any module referencing strata *i* must be combined with this module. The ABC project used the aboveground biomass stratification only for pre-deforestation forest classes, and all the strata are the same in the baseline and the project scenario. The post-deforestation land uses were not stratified, following this module requirements. This module provides guidance on stratifying the project area into discrete, relatively homogeneous units to improve accuracy and precision of carbon stock, carbon stock change and GHG emission estimates. Different stratifications may be required for the baseline and project scenarios to achieve optimal accuracy of the estimates of net GHG emissions or removals. In the equations used in the accompanying modules, the suffix *i* is used to represent a stratum and the suffix *M* for the total number of strata (M_{WPS} for the project scenario and M_{BSL} for the baseline scenario). In case of REDD, aboveground biomass stratification is only used for pre-deforestation forest classes, and strata are the same in the baseline and the project scenario. Post-deforestation land uses are not stratified. Instead, average post-deforestation stock values (e.g., simple or historical area-weighted approaches are used, as per Module BL-UP).

VMD0017 Estimation of Uncertainty for REDD project activities (X-UNC), v2.2.

This module is mandatory for REDD+ project activities. This module allows for estimating uncertainty in the estimation of emissions and removals in REDD and WRC project activities. Uncertainty in the estimation of emissions and removals from ARR project activities is treated in the CDM tool Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities. The module may also be used for project planning purposes. Use of the module while planning the project can assure the monitoring is of sufficient intensity to minimize uncertainty deductions. The purpose of the methodology is for calculating ex ante and ex post a precision level and any deduction in credits for lack of precision following project implementation and monitoring. The module assesses uncertainty in baseline estimations and in estimations of project sequestration, emissions, and leakage. This module is mandatory when using methodology REDD+ MF. It is applicable for estimating the uncertainty of estimates of emissions and removals of $CO_{2\text{-}e}$ generated from REDD and WRC project activities. The module focuses on the following sources of uncertainty:

- Determination of rates of deforestation and degradation.
- Uncertainty associated with estimation of stocks in carbon pools and changes in carbon stocks.
- Uncertainty associated with estimation of peat emissions.
- Uncertainty in assessment of project emissions.

Where an uncertainty value is not known or cannot be simply calculated, a project must justify that it is using an indisputably conservative number and an uncertainty of 0% may be used for this component.

Guidance on uncertainty – a precision target of a 95% confidence interval half-width equal to or less than 15% of the recorded value must be targeted. This is especially important in terms of project planning for measurement of carbon stocks; sufficient measurement plots should be included to achieve this precision level across the measured stocks.

Tools:

VT0001 Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities (T-ADD), v3.0.

According to the VM0007, this tool was used to identify credible alternative land use scenarios, evaluate both alternatives, and demonstrate the project's additionality. For additional information see Section 3.5. The ABC project meets the applicability conditions of this tool because the conservation and protection activities of the project do not lead to violation of any applicable law. This tool provides for a step-wise approach to demonstrate additionality in VCS AFOLU projects. Project proponents proposing new baseline methodologies may incorporate this tool in their proposal. Project proponents may also propose other approaches for the demonstration of additionality as set out in the most recent version of the VCS for consideration under the VCS methodology approval process. In validating the application of this tool to a proposed project activity, validation/verification bodies should assess credibility of all data, rationales, assumptions, justifications, and documentation provided by project proponent(s) to support the selection of the baseline and demonstration of additionality. The tool is applicable under the following conditions:

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

b) The 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.

VCS AFOLU Non-Permanence Risk Tool (T-BAR), v4.0.

This tool is fully mandatory for the given project activity and must be used to determine the number of buffer credits that shall be deposited into the AFOLU pooled buffer account.

CDM Tool for testing significance of GHG emissions in A/R CDM project activities (T-SIG), v1.0.

This tool is not mandatory and may be used to justify the omission of carbon pools and emission sources. This tool facilitates the determination of which GHG emissions by sources, possible decreases in carbon pools, and leakage emissions are insignificant for a particular CDM A/R project activity. The tool shall be used in the application of an A/R CDM approved methodology to an A/R CDM project activity:

a) To determine which decreases in carbon pools, and increases in emissions of the greenhouse gases measured in CO_2 equivalents that result from the implementation of the A/R project activity, are insignificant and can be neglected.

b) To ensure that it is valid to neglect decreases in carbon pools and increases in GHG emissions by sources stated as being insignificant in the applicability conditions of an A/R CDM methodology.

3.3 Project Boundary

3.3.1 Geographical boundaries

In its first instance, the Amazon Biome Conservancy Grouped REDD+ Project is composed of seven properties as described in Section 1.12, summing to a total of 26,920.60 ha. The coordinates represented by these properties composing the ABC-I1 are presented in Table 3.1. Vectorized data of the project location is in the annex[26] as a KML file. João Rogério de Souza owns the seven properties, and the map with the properties' area boundary and the project area is in Figure 3.1. It is also provided in a kml annex the geographical boundaries within any future instance added to the ABC project must be[27].

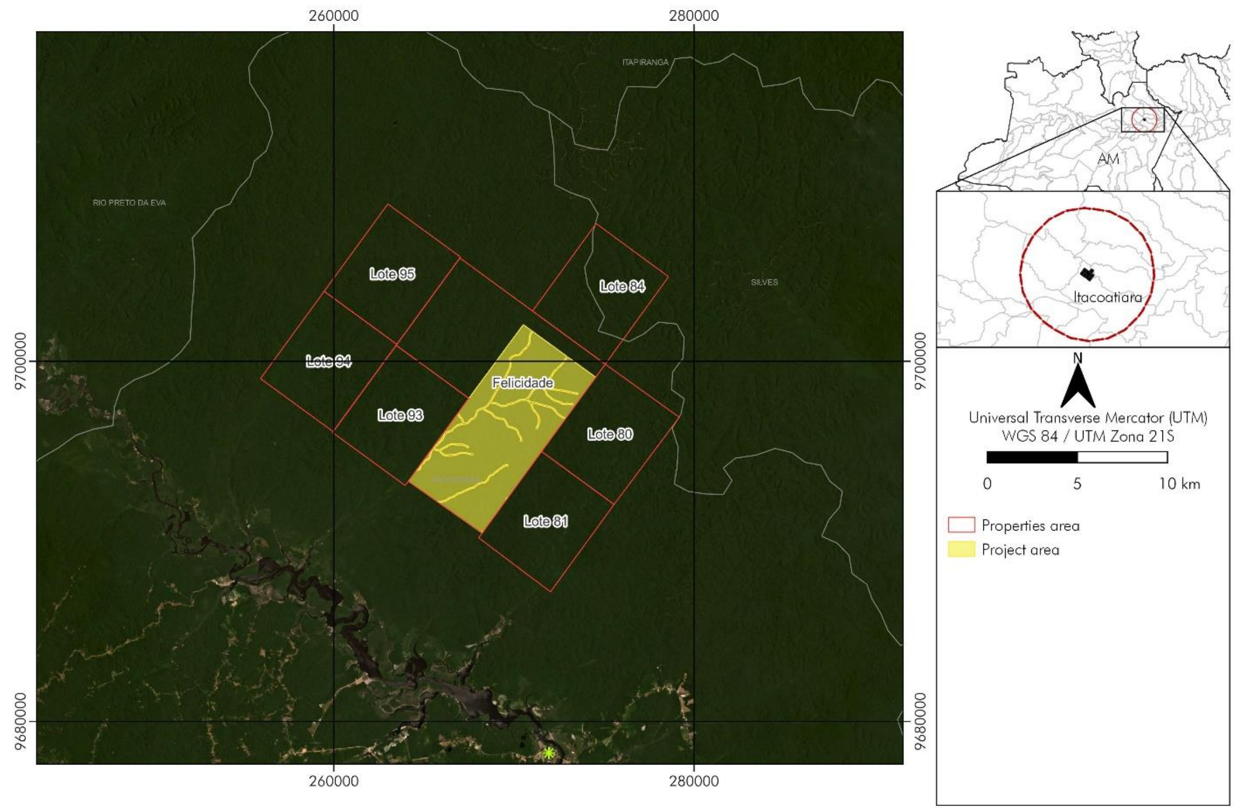

Figure 3.1. ABC properties and project area.

The project area of ABC-I1 is located only inside the *Lote Felicidade* one of the seven project properties. This property has 8,857.70 ha, being 5,140.20 ha designated to compose the project area, almost exactly to 20% of the total 26,920.6 ha. Details about the properties and project area (instance, properties, total area, project area, and geodetic coordinates) are in Table 3.1.

---

26 Annex: project_area_ABC.kml

27 Annex: Geographical_boundaries_ABC_Grouped_Project.kml

Table 3.1. ABC Properties and project area.

Project Activity Instance	Properties	Total Area (ha)	Project Area (ha)	Geodetic coordinates	
				Longitude	Latitude
ABC-I1	Lote 80	3 035.80	-	59° 1’ 15.13’’ W	2° 44’ 56.78’’ S
	Lote 81	2 985.70	-	59° 3’ 10.23’’ W	2° 47’ 34.12’’ S
	Lote 84	3 009.80	-	59° 1’ 31.89’’ W	2° 40’ 43.07’’ S
	Lote 93	3 008.60	-	59° 7’ 31.66’’ W	2° 44’ 22.01’’ S
	Lote 94	3 011.50	-	59° 9’ 40.76’’ W	2° 42’ 44.42’’ S
	Lote 95	3 011.50	-	59° 7’ 46.06’’ W	2° 40’ 6.856’’ S
	Lote Felicidade	8 857.70	5,140.20	59° 4’ 46.47’’ W	2° 43’ 36.96’’ S
	Total	**26 920.60**	**5,140.20**	-	-

Regarding leakage boundaries, and according to VMD0009 v1.3 (LK-ASP), leakage emissions due to activity shifting from forestlands that are legally authorized and documented to be converted to non-forest land, the identified areas of the landowners are in the annex[28], which will be subject to monitoring possible activity shifting by this agent to other areas under its management.

3.3.2 Temporal Boundaries

Start Date and End Date of the Historical Reference Period

The project has a historical reference period of 10 years, from 2011 until 2021. For the proxy areas, the historical reference period is also 10 years, from 2011 until 2021.

Start Date and End Date of the Project Crediting Period

The ABC grouped REDD+ project started on 19/11/2022. This date represents the effective date on which the project began generating GHG emissions reduction in the project area. The project has a crediting period of 30 years, starting on 19/11/2022 to 18/11/2052. The period of 30 years is equivalent to the commitment made by the ABC-I1 landowners for the minimum conservation time of

[28] Annex: Landowner_areas_leakage.pdf

their project areas, the same period for the longevity of ABC-I1. The first baseline has a period of 10 years, starting on 19/11/2022 to 18/11/2032.

Duration of the Monitoring Periods

The ABC REDD+ project has a monitoring period with a minimum duration of 1 year and the maximum duration of 5 years.

3.3.3 Carbon Pools

Table 3.2 shows the relevant carbon pools considered by the ABC project, according to the VM0007 and the modules VMD0001, VMD0002, VMD0003, VMD0004, and VMD0005.

Table 3.2. ABC Carbon pools.

Carbon Pools	Included?	Justification/Explanation
Aboveground tree biomass	Included	Mandatory for REDD projects according to VM0007. Carbon stock change is always significant.
Aboveground non-tree biomass	Excluded	Conservatively omitted.
Belowground tree biomass	Included	Optional according to VMD0001. Carbon stock change is significant to the project.
Deadwood	Excluded	Conservatively omitted.
Litter	Excluded	Optional according to VM0007. Conservatively omitted.
Soil organic carbon	Excluded	Optional according to VM0007. Conservatively omitted.
Wood products	Included	Mandatory for the given project activity where the process of deforestation involves timber harvesting for commercial markets.

3.3.4 Sources of Greenhouse Gas Emissions

Table 3.3 shows the relevant sources of GHG emissions considered by the ABC project, according to VM0007.

Table 3.3. ABC Sources of Greenhouse Gas Emissions.

Source		Gas	Included?	Justification/Explanation
Baseline	Burning of woody biomass	CO_2	Included	Carbon emitted through the planned area for deforestation.
		CH_4	Included	Methane emissions during burning of the biomass for land clearance

Source		Gas	Included?	Justification/Explanation
		N_2O	Included	Nitrous oxide emissions during burning of the biomass for land clearance
	Combustion of fossil fuels	CO_2	Excluded	-
		CH_4	Excluded	-
		N_2O	Excluded	-
	Use of fertilizers	CO_2	Excluded	-
		CH_4	Excluded	-
		N_2O	Excluded	-
Project	Burning of woody biomass	CO_2	Included	Carbon emitted through the planned area for deforestation.
		CH_4	Included	Methane emissions during burning of the biomass for land clearance
		N_2O	Included	Nitrous oxide emissions during burning of the biomass for land clearance
	Combustion of fossil fuels	CO_2	Excluded	-
		CH_4	Excluded	-
		N_2O	Excluded	-
	Use of fertilizers	CO_2	Excluded	-
		CH_4	Excluded	-
		N_2O	Excluded	-

3.4 Baseline Scenario

This section was developed according to the VMD0006 v.1.3 (BL-PL module) and the VT0001 v.3.0 tool criteria. That module and this tool provide a stepwise approach for determining the most plausible baseline scenario and the annual area of planned deforestation.

3.4.1 Agent of Planned Deforestation

According to the VMD0006 Section 1.1, the agent of deforestation is an already defined individual, organization, or corporation in the simplest scenario. For this first project activity instance in the ABC grouped Project, the organization R M INDUSTRIA E COMERCIO DE MADEIRAS LTDA[29] is the defined company with the business license for timber extraction[30].

For the inclusion of new instances in the ABC project, the agent must be a defined individual, organization, or corporation.

3.4.2 Area of Deforestation

The ABC-I1 has an immediate site-specific threat of deforestation, which is concrete and would lead to deforestation within a defined period of time. To demonstrate the threat of deforestation and the area of deforestation ($A_{planned,i}$), the BL-PL module requires documentary proof of the (i) legal permissibility for deforestation; (ii) suitability of project area for conversion to alternative non-forest land use; (iii) government approval for deforestation; and (iv) intent to deforest.

Legal permissibility for deforestation

According to the Forest Code (Law 12.651, Brasil (2012b)) the landowner must maintain at least 80% of the native vegetation coverage as a Legal Reserve.

CHAPTER IV

FROM THE LEGAL RESERVE AREA

Section I

From the Delimitation of the Legal Reserve Area

Art. 12. Every rural property must maintain an area with native vegetation cover, as a Legal Reserve, without prejudice to the application of the rules on permanent preservation areas, observed the following minimum percentages in relation to the area of the property, except for the cases provided for in art. 68 of this Law:

I - located in the Legal Amazon:

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

b) 35% (thirty-five percent) in the property located in a *Cerrado* area;

c) 20% (twenty percent), in the property located in an area of *campos gerais*;

The properties of the ABC-I1 are in a forested area in the Legal Amazon, which requires the conservation of at least 80% native vegetation.

CHAPTER V

FROM VEGETATION SUPPRESSION FOR ALTERNATIVE LAND USE

[29] Annex: Wood_Company_ABC-I1.pdf

[30] Annex: Business_licence_ABC-I1.pdf

Art. 26. The suppression of native vegetation for alternative land use, both in the public and private domains, will depend on the registration of the property in the CAR, what art. 29 deals with, and prior authorization from the competent government department of SISNAMA. (Law 12.651, Brasil (2012b))

All the properties in this project are in legal compliance with the requirements described above and stated in Section 1.14 Compliance with Laws, Statutes, and Other Regulatory Frameworks.

Suitability of project area for conversion to alternative non-forest land use

To determine de suitability of the ABC-I1 area for conversion to alternative non-forest land use, there were evaluated the accessibility of the lands to relevant markets (Figure 3.2), the suitability of soil for cattle ranching (Figure 3.3), the topography of the region (Figure 3.4), the slope (Figure 3.5) and the climate (Figure 3.6).

The ABC-I1 area is relatively close to relevant roads, warehouses, and slaughterhouses. This proximity to such markets facilitates agricultural, livestock, and timber operations.

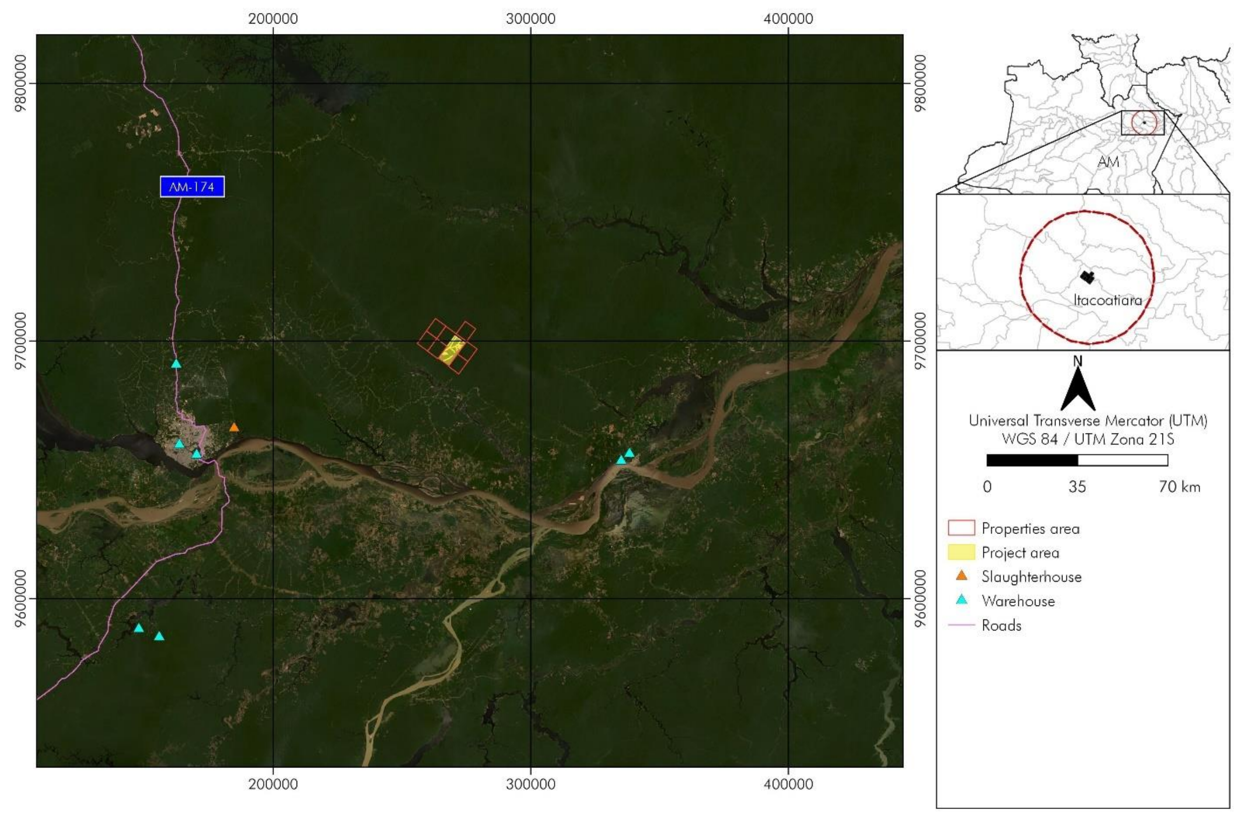

Figure 3.2. ABC-I1 Accessibility to relevant markets.

According to Section 1.13, Itacoatiara and Silves municipalities, project region, are in the structural provinces (i) *Amazonas-Solimões* and (ii) Cenozoic Coverages, and in the sub-provinces (i) *Alter do Chão* and (ii) Indiscriminate Cenozoic Coverages. More than 80% of both municipalities' territories are covered by these sub-provinces (BDiA, 2022a). According to IPEAN (1969), the geological formation of these regions is given by sedimentary formations of the Tertiary and Quaternary periods, more specifically by the morphostructural domains (i) Phanerozoic Basins and Sedimentary Covers and (ii) Quaternary Sedimentary Deposits (BDiA, 2022b). Regarding the geomorphological units, more than 65% of both municipalities' territories are inserted in the *Rio Negro-Rio Uatumã* Dissected Plateau, and Amazon Plain (BDiA, 2022b).

The project region is formed by Argisoil, Gleisoil, Latosoil, Neosoil, and Plintosoil. However, the seven properties' areas and the project area are only formed by Latosoil (Figure 3.3). This soil type is typical of tropical regions and occupies around 39% of the total area of the country – Brazil. It is highly weathered soil with no clay increment in-depth, and Its colors vary from reddish, brownish, or yellowish (Embrapa, 2022).

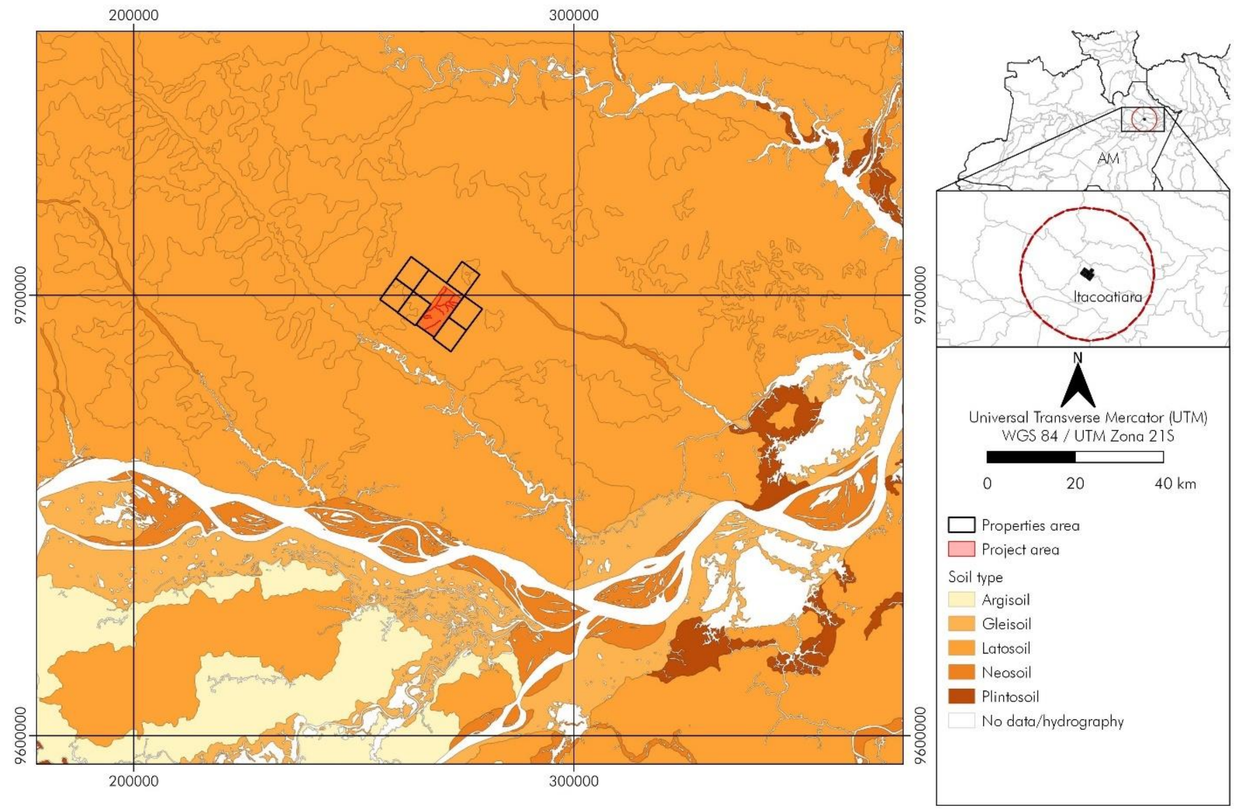

Figure 3.3. ABC-I1 Soil types.

According to Section 1.13, the properties areas' slope predominantly ranges from 5 to 15%, although slopes between 15 to 20% are found, mainly in the *Lote 84* (Figure 3.5). The elevation in the same area ranges from 0 to 210 meters (Figure 3.4). Topography is often related to physical and chemical soil variations that are often reflected by vegetation.

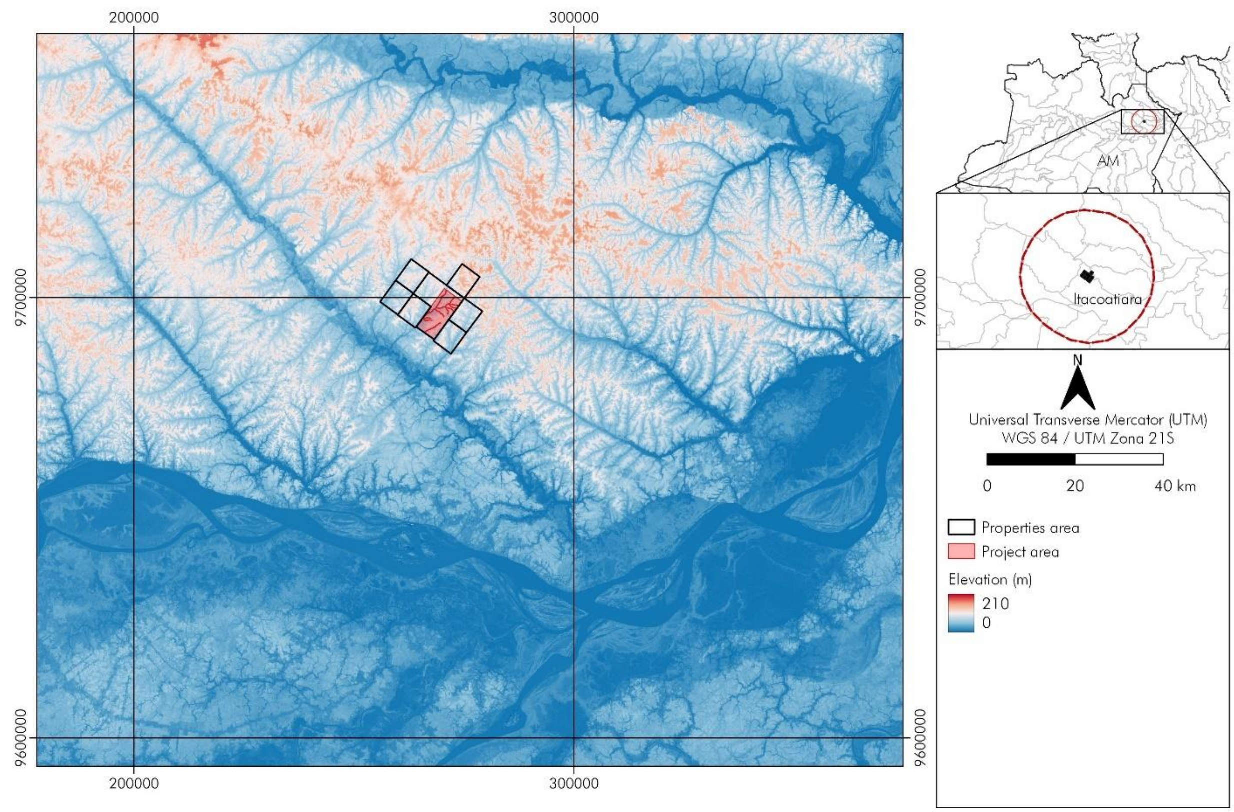

Figure 3.4. ABC-I1 Topography.

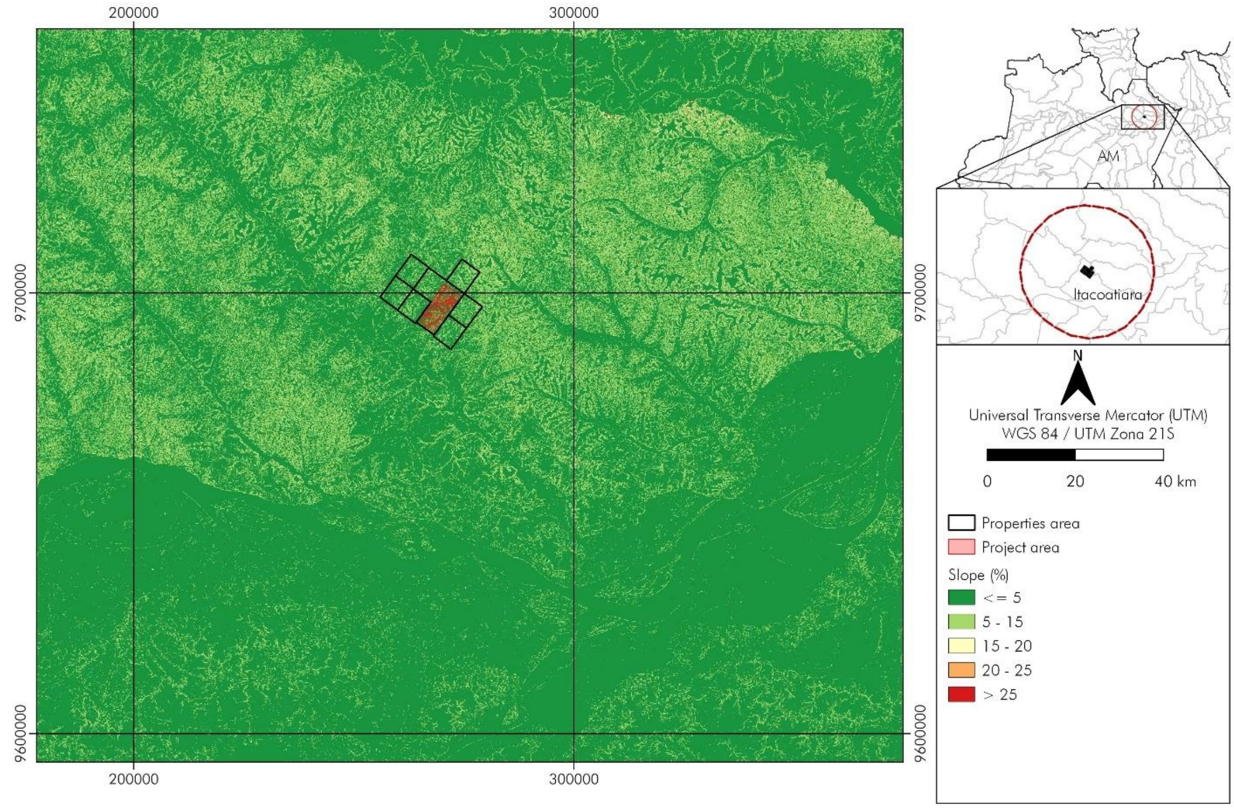

Figure 3.5. ABC-I1 Slope.

As described in Section 1.13, the project region's climate is classified as Equatorial rainforest (Af) and Equatorial monsoon (Am) according to the Köppen-Geiger classification (Kottek et al., 2006). However, all property areas' territory is covered only by Af climate (Figure 3.6). The total annual precipitation of this climate category exceeds 2,000 mm (McKnight & Hess, 2000), with monthly minimum rainfall over 60 mm, and temperatures above 18 °C (Brune, 2021). According to INMET (2022), the total precipitation between 1991 to 2020 was 2,543.80 mm, with the rainiest months being from December to May. The average temperature for the same period was 27.34 °C.

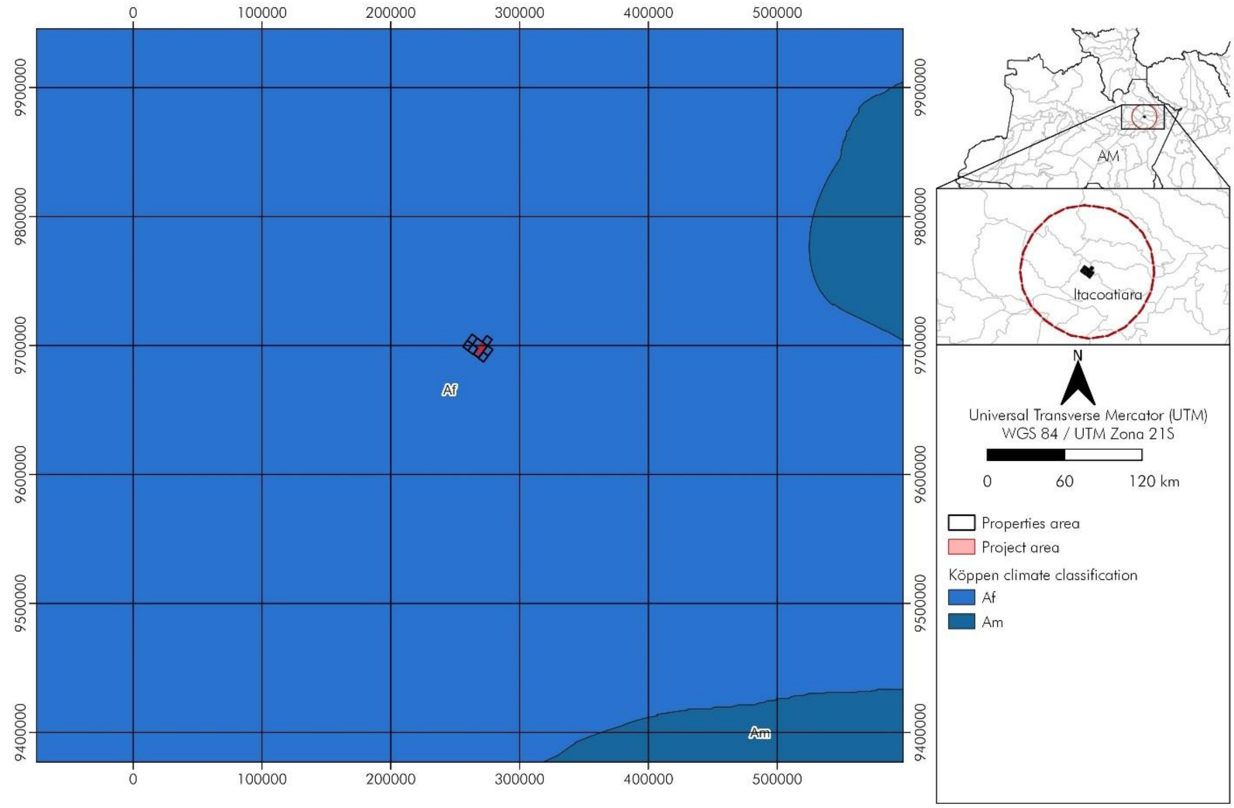

Figure 3.6. ABC-I1 Climate.

Both for agricultural production and logging, as well as for pastures and livestock, the characteristics of the project instances region are suitable for the conversion the forest to non-forest land use. In addition, given the high annual rainfall, as well as temperatures in the range of 27ºC, and low slope, such characteristics are ideas for good livestock productivity.

Government approval for deforestation

Recent approval from the relevant government department for the conversion of forest to alternative land use, or at least, the documentation that a request for approval has been filed with the relevant government department for permission to deforest and convert to alternative land use, is required as an eligibility criterion for the inclusion of new project activity instances and will be presented in the annex of this project. (Law 12.651, 2012; Brasil (2012b))

By law, for the suppression of vegetation to occur, government approval is required. The protocols and approval process may vary between States and environmental agencies in the Legal Amazon, therefore, the documents required for each property in this grouped project may vary as well. All the relevant protocols and approvals will be available for the auditor, in the annex of this project.

Intent to deforest

A legal plan for the suppression of vegetation[31] must be submitted to the relevant environmental agency and then approved by the agency, allowing the organization to deforest the area, to explore the land for non-forest economic uses. Each property of the ABC project has its specific related documents. The existence of these documents represents the intent to deforest.

3.4.3 Rate of Deforestation

The rate of deforestation ($D\%_{planned,i,t}$) is given by the plan for the suppression of vegetation and is equal to 10% per year of the total area of ABC-I1.

3.4.4 Likelihood of Deforestation

Considering that the forest areas are not under government control, the likelihood ($L\text{-}D_i$) of deforestation is equal to 100%.

3.4.5 Risk of Abandonment

There were identified 6 proxy areas (Figure 3.7) – with approximate sizes to the areas of the ABC-I1 – all located within a radius fewer than 180 kilometers from the ABC-I1 areas and distributed in the municipalities of Manaus, Itacoatiara, Anamã, Barreirinha, and Manicore, according to VMD0006 v.1.3 criteria, of which these areas should be in the immediate area of the project.

[31] Annex: Supression_Plan_ABC-I1.pdf

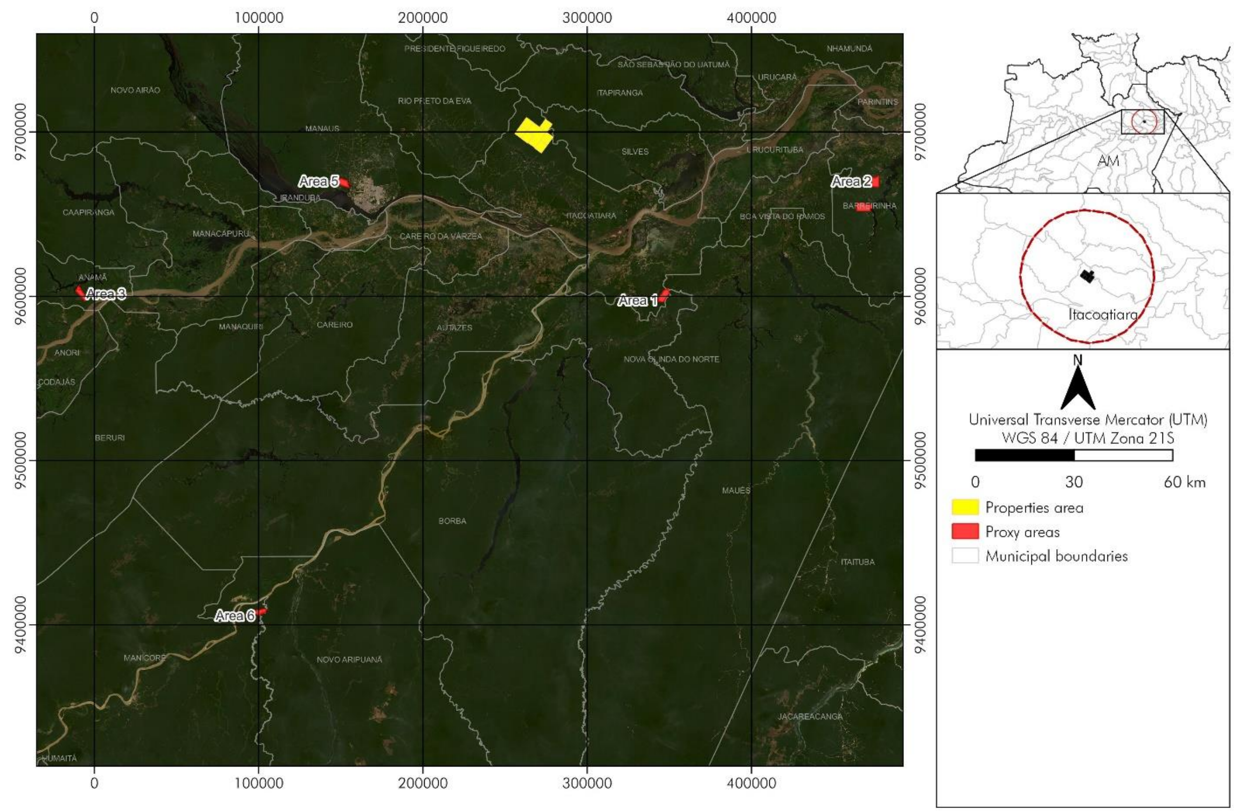

Figure 3.7. Identification of the proxy areas.

All areas were deforested for livestock activity at least ten years earlier, for this analysis, data from PRODES were used (TerraBrasilis, 2021). Deforestation identified in Table 3.4 refers to the period from 2007 to 2011. According to the BL-PL module, deforestation in the proxy area must have occurred in the 10 years prior to the baseline period, under the same criteria as the ABC-I1 lands, and the proxy areas selected meet this criterion, where the deforested percentage is less than 20% of the total property area.

Table 3.4. Deforestation information of proxy areas.

Property name	Number area	Longitude	Latitude	Area [ha]	Deforestation [ha]	Ratio deforestation [%]
Fazenda União	Area 1	347092.34	9599774.46	2 707.41	435.23	16
Fazenda Queimadas	Area 2	475112.19	9669216.59	2 372.40	354.63	15
Fazenda Lago Formoso I	Area 3	659140.79	9603080.51	1 977.71	154.20	8
Fazenda Marinheiro	Area 4	468073.18	9654116.23	3 674.82	258.20	7
Fazenda Tarumã I	Area 5	819447.39	9668066.06	1 939.37	99.69	5

Property name	Number area	Longitude	Latitude	Area [ha]	Deforestation [ha]	Ratio deforestation [%]
Fazenda São Sebastião	Area 6	764858.41	9408289.37	1 481.54	118.14	8

According to data from MapBiomas Collection 7 (MapBiomas, 2021), these areas maintained land use for the period 2011 to 2021 over 10 years (Figure 3.8), as shown in the images below. The land conversion practices identified were the same as those used by the baseline agent, and the post-deforestation land use identified was livestock.

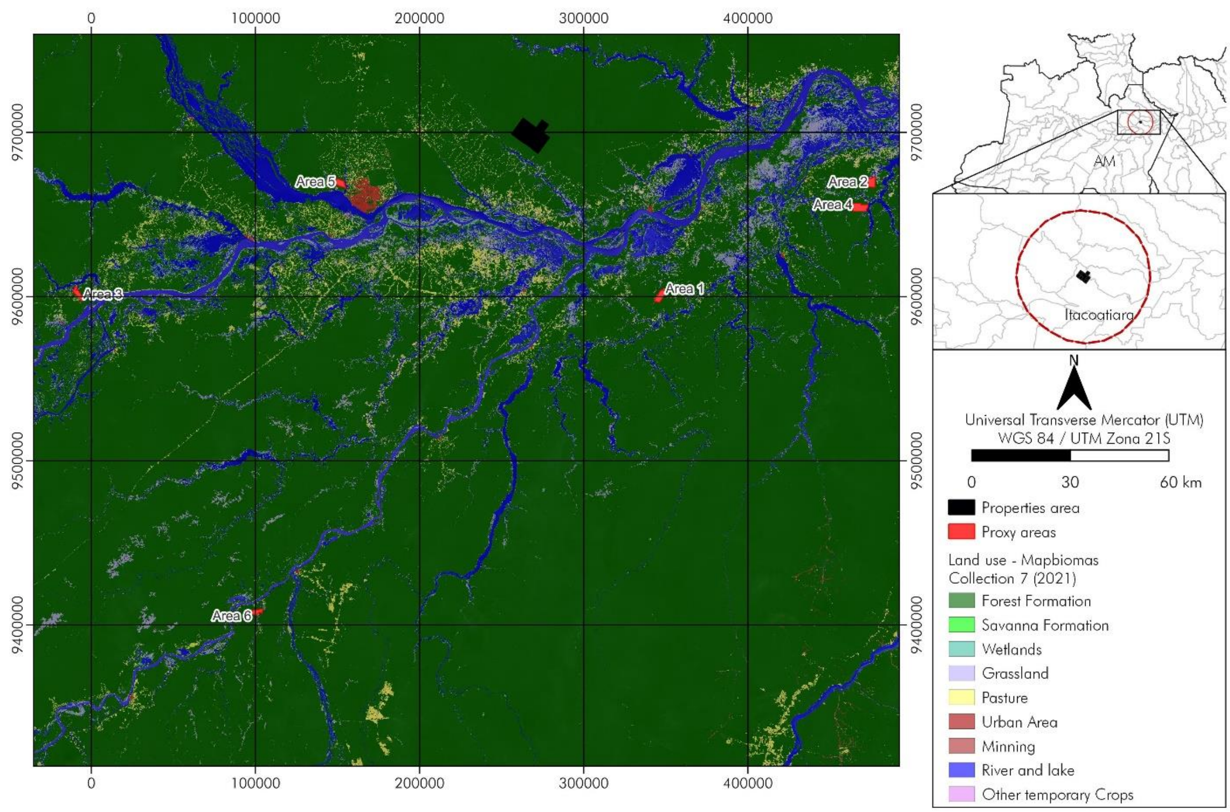

Figure 3.8. Land use of proxy areas.

Of these 6 properties, we selected the 5 proxy areas with the highest rate of permissibility (lower rate of deforestation) to study, from 2011 to 2021, the dynamics of land use classes and changes in land use in these areas. Below, the histogram of each of the areas shows that livestock has had consolidated and constant use in the last 10 years (Figure 3.9).

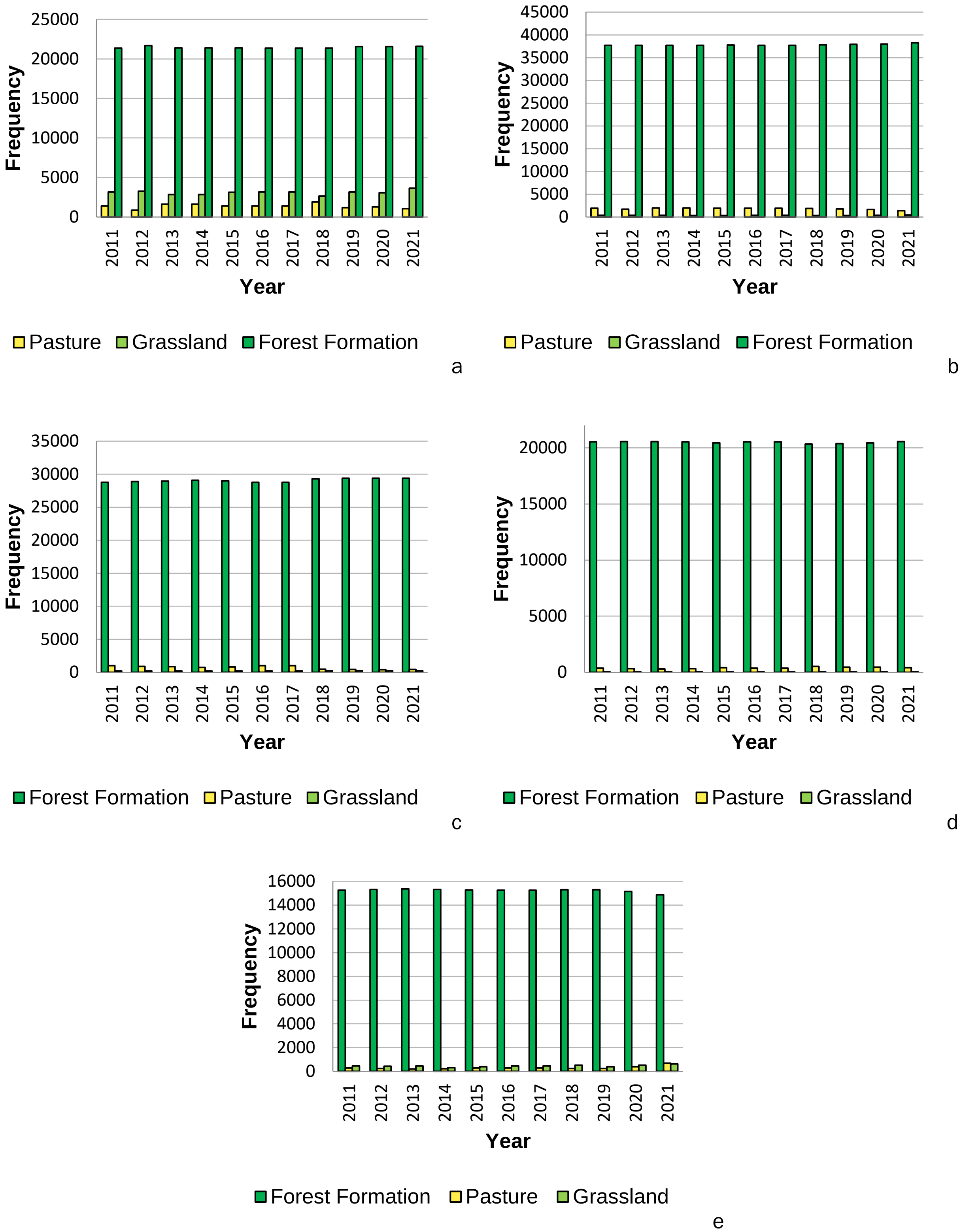

Figure 3.9. Histogram of Fazenda Queimadas's land use (a); Histogram of Fazenda Lago Formoso I's land use (b); Histogram of Fazenda Marinheiro's land use (c); Histogram of Fazenda Tarumã I's land use (d); Histogram of Fazenda São Sebastião (e).

Deforestation agents around proxy areas have the same characteristics found in the proximity of the project area: nearby highways, refrigerators, warehouses, and nearby communities. This proximity to such markets facilitates agricultural, livestock, and timber operations (Figure 3.10).

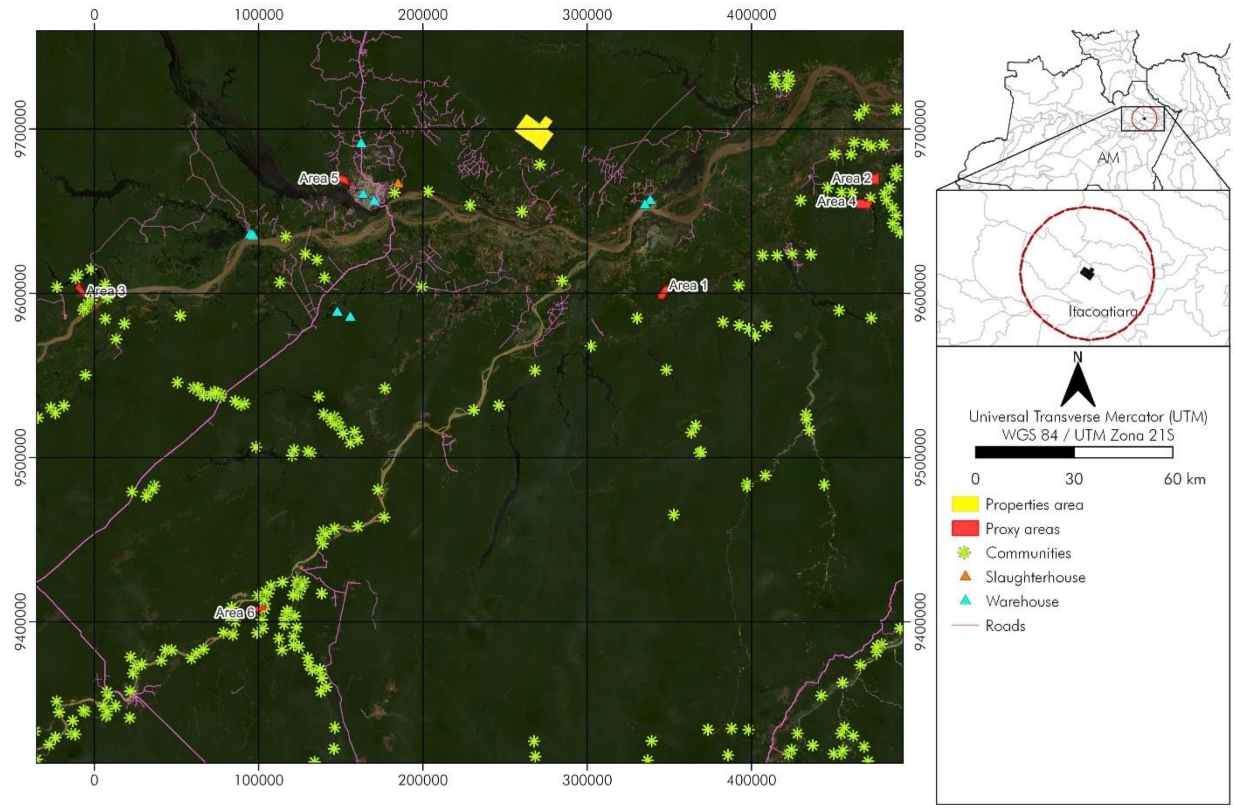

Figure 3.10. Accessibility to relevant markets.

It was verified the conditions of regrowth of native vegetation in the proxy areas, between 0% to 1% in relation to the area of the property in the last 10 years, thus it can be concluded that it is related to noises of classification and management, and not abandonment of the area.

Proxy areas have the same type of land management and land use since they are not located in Conservation Units of Integral Protection and Indigenous Lands, as demonstrated in Figure 3.11.

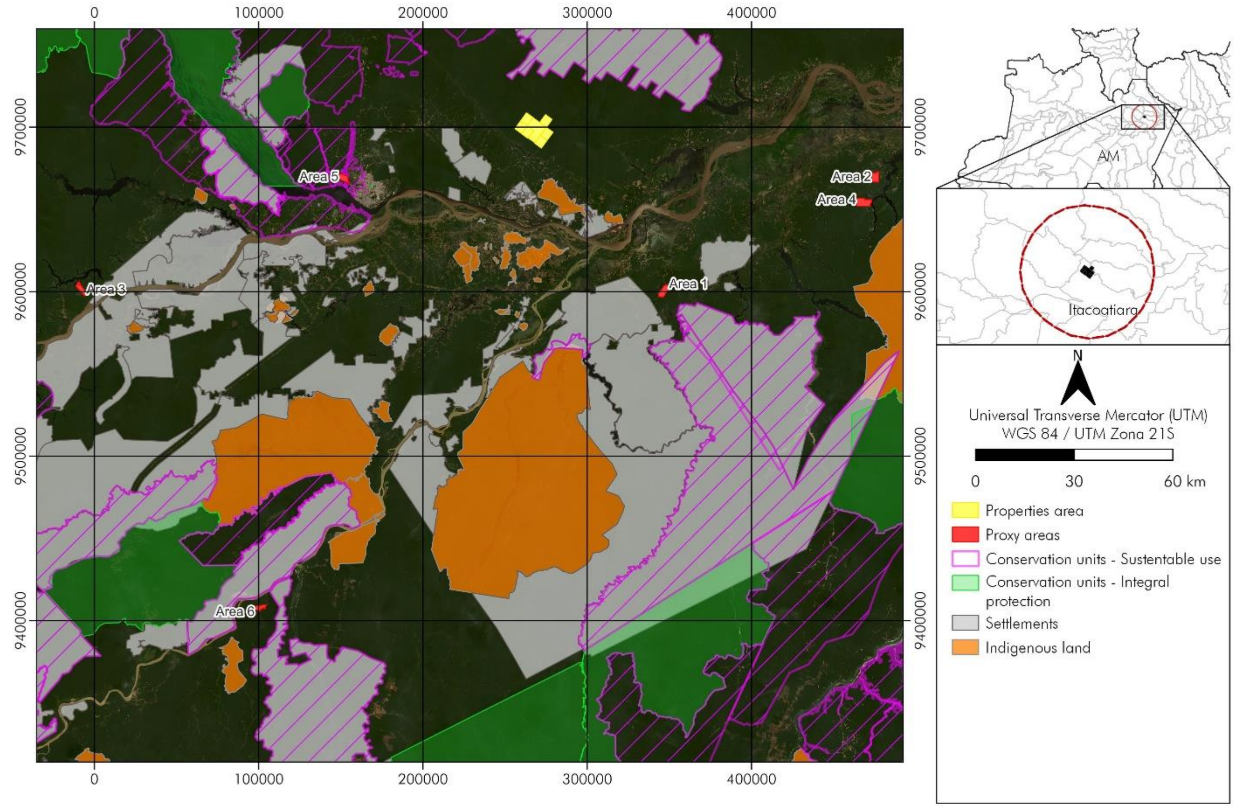

Figure 3.11. Proxy area location in relation to public lands.

The three conditions of similarity proposed by VMD0006 are met. The forest type around the proxy area and in the proxy area before deforestation is Ombrophilous Forest of dense canopy in 100% of the area, as shown in Figure 3.12.

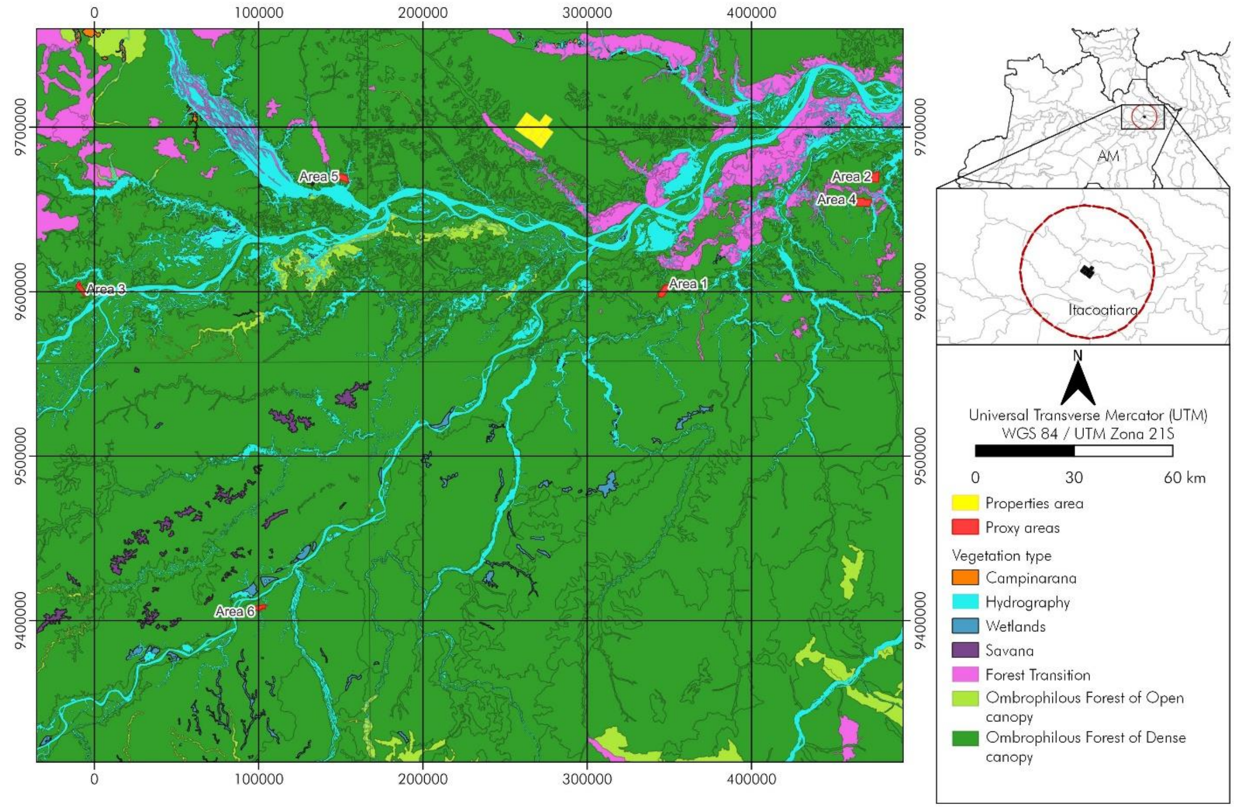

Figure 3.12. Proxy areas type of vegetation.

The type of soil found in the proxy areas is suitable for livestock in the region, the project area is covered 100% of Latosoil, the same soil is present in 100% of proxy areas, and in the same proportion as ABC-I1 area (Figure 3.13).

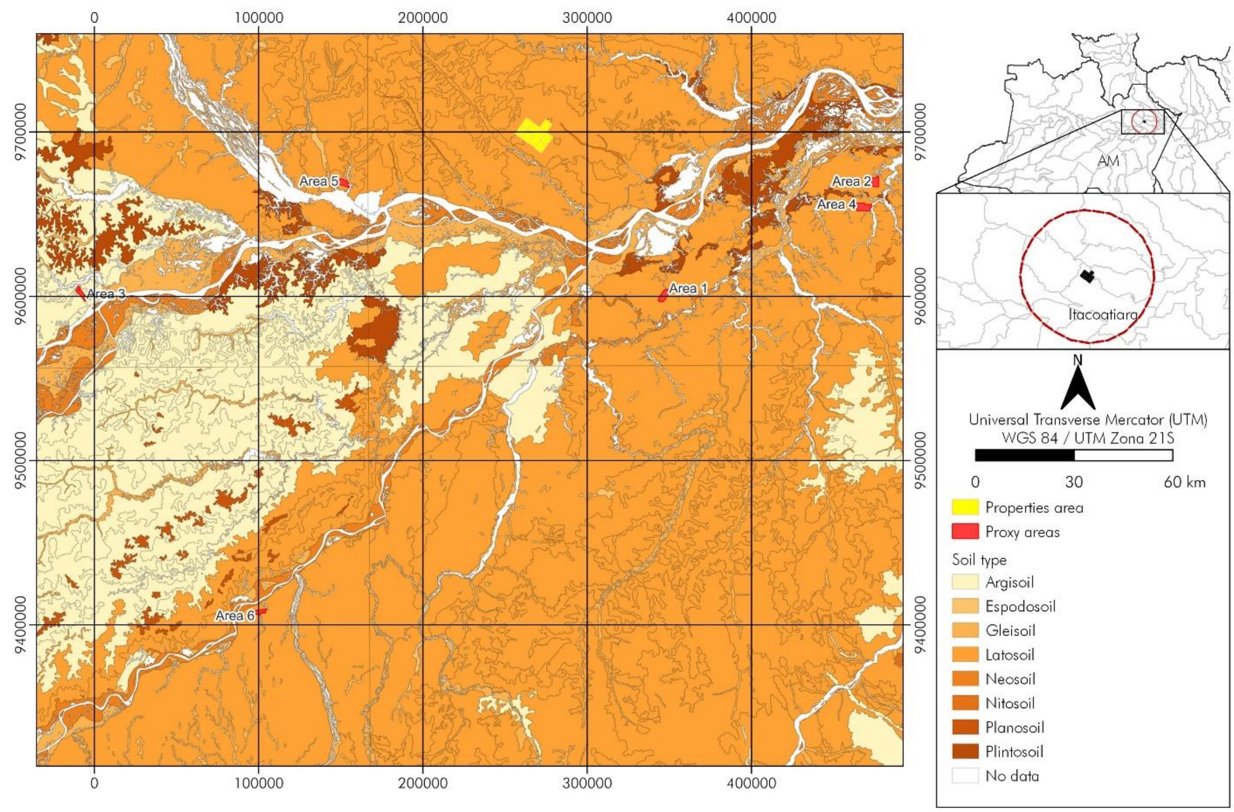

Figure 3.13. Proxy areas type of soil.

The proportion of "soft" slope classes (slope <15%) to "steep" (slope ≥15%) in proxy areas is equal to the ratio in the project area, likewise the elevation classes (500m classes) in these proxy areas are in the same proportion found in the project area. Therefore, 100% of the areas are situated in topographic conditions 100% similar, in slope less than or equal to 15% and at altitudes of 500 meters, as illustrated in the Figure 3.14 and Figure 3.15. It is worth mentioning that these conditions are also favorable for the development and management of livestock.

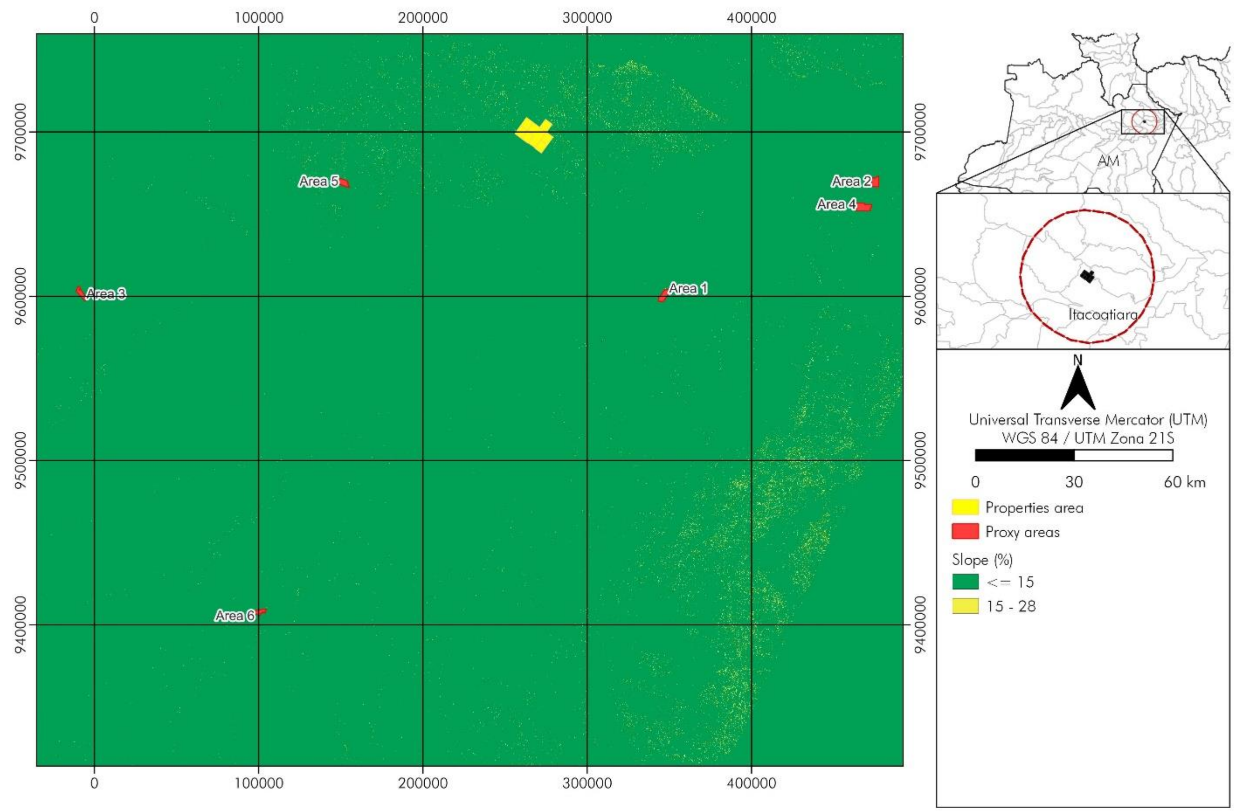

Figure 3.14. Slope ranges identified, in percentage, in proxy areas.

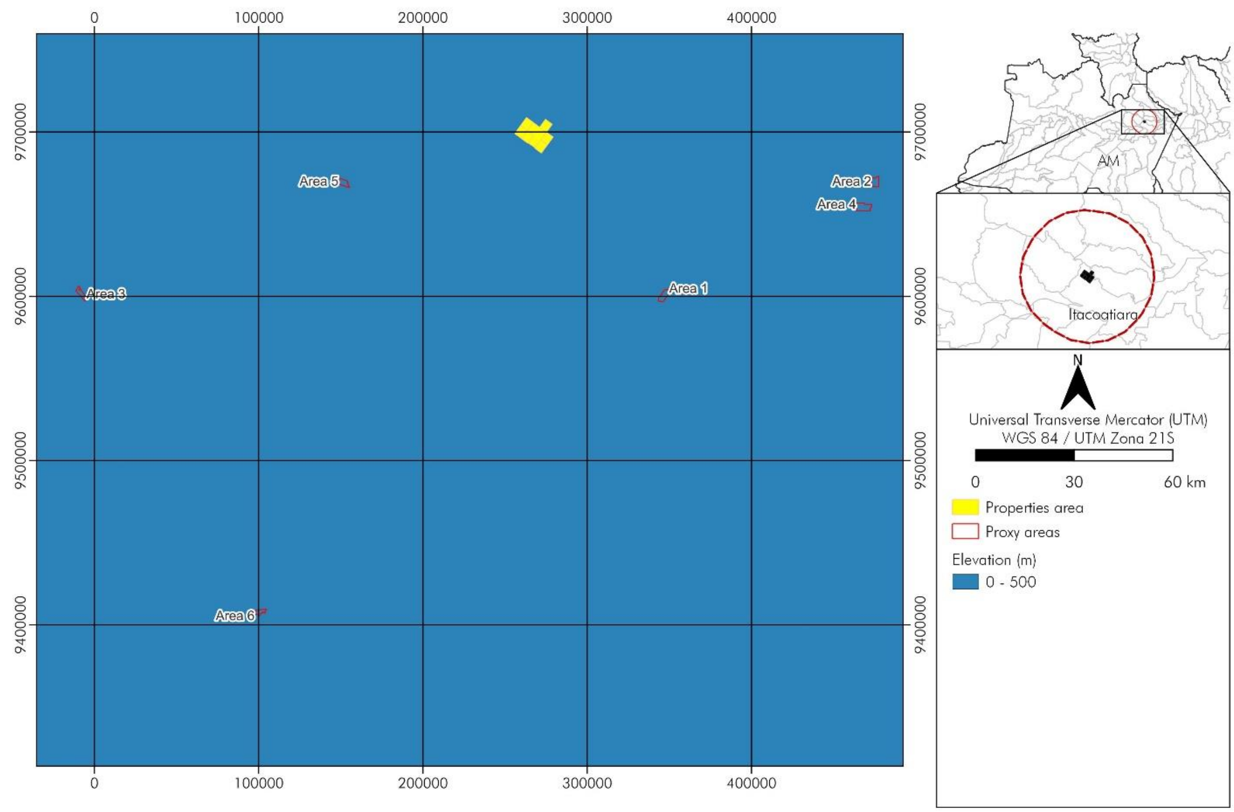

Figure 3.15. Altitude ranges identified, in meters, in proxy areas.

3.4.6 Annual Area of Deforestation

The total area that will be deforested is equal to 5,140.20 ha, and according to the rate of deforestation of 10% per year, the annual area of deforestation ($AA_{planned,i,t}$) would be equivalent to 514.02 ha/year.

3.5 Additionality

The project additionally assessment was carried out according to the most recent version of the VCS tool "VT0001 – Tool for the Demonstration and Assessment of Additionally in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities, version 3.0, 1 February 2012, Sectorial Scope 14.

Both applicability conditions from the tool are met because the project AFOLU activity 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 does not lead to violation of any applicable law even if the law is not enforced.

3.5.1 Step 1. Identification of alternative land use scenarios to the proposed VCS AFOLU project activity

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

All realistic and credible land use scenarios were identified considering relevant national and/or sectoral policies and circumstances, such as historical land uses practices and economic trends. The list of credible alternative land use scenarios that would have occurred on the land within the project boundary of the VCS AFOLU project is described below:

i. Continuation of the pre-project land use (Business as Usual Scenario).

This scenario involves the landowner's planned deforestation to explore the commercial uses of timber products and other non-forest economic activities. The planned deforestation is, according to the national forest code, allowed to occur in 20% of the area located in the Amazon rainforest. For deforestation to occur it is necessary to submit a request for the suppression of vegetation to the competent environmental department, together with the plan for the suppression of vegetation, and with subsequent authorization from the environmental department, represented by the Single Environmental License (LAU).

The main activities that cause deforestation in the Legal Amazon region are livestock and logging when carried out intensively, and without proper management practices (Ferreira et al., 2015; Morales et al., 2021). In these deforestation processes, the first step is normally clear-cutting and logging. It is estimated that only 35% (yield) of this timber is converted into long-term wood products (IBAMA, 2016), and the non-merchantable timber that stays in the field is usually accumulated and burnt before the installation of pasture or agricultural activities. Most carbon emissions from baseline activities occur during this operation.

In the Itacoatiara and Silves municipalities, livestock and logging are important economic activities. According to the IBGE (2021), these regions are in the 7th and 22nd positions of the state ranking, with 39,622 ha and 5,974 ha (equivalent to 4.5% and 1.6% of the total municipalities' areas) occupied with pasture, respectively (MapBiomas, 2021). Furthermore, these two municipalities occupy the 4th and 6th positions of the state ranking, due to their extraction of wood in the log being 85,000 m^3 and 72,000 m^3, respectively IBGE (2021). Notwithstanding, these activities are also the major agents that increase deforestation in regions.

According to IPAAM[32], since 2018 there were already 645 LAUs emitted in other to approve the request for the suppression of vegetation in the Amazonas State (region of ABC-I1 areas), in which, in 2021, the largest approved area for deforestation was identified, equivalent to 36,052 ha. As the main project activity involve avoiding the planned deforestation, all project activity instance has presented their protocol for deforestation and the subsequent LAU, which authorizes legal deforestation on land, which demonstrates the credibility of the presented scenario.

Also, according to Freitas Junior and Barros (2021), the regions in the Legal Amazon presented higher livestock growth rates (from 1990 until 2015) than other regions in Brazil, a fact that evidence the process of expansion of bovine production in the region. Several elements contribute to this growth, which the author mentions with emphasis on the opening of roads, the establishment of tax incentives,

[32] Annex: LAU_Supressão_IPAAM_2018-2022

and subsidized rural credit. As well as adequate weather conditions, with more uniform temperatures and less severe periods of drought than the other country's regions. Cattle ranching has grown in the region also because it tends to be more profitable than other regions due to low land prices and higher pasture productivity (IMAZON, 2015).

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

This scenario involves the maintenance of the preserved forest area by the landowners, with sustainable activities occurring in the project area, without any source of supplementary income. Monitoring and surveillance measures, taken by the landowners, will be made to privilege primarily their legal reserve (80% of the property), then to avoid any eventual external agent's land invasion. Such measures were presented in Section 1.11. Description of the Project Activity of this PD, which involve:

- Patrolling and surveillance activities are taken by employees with this specific task. Monitoring bases and the necessary equipment (food, water, motorcycles, mobile phones) will be provided to support with the task.
- Satellite monitoring will be done to identify fire alarms disclosed by the MapBiomas Alert data. Geospatial analysis can help to anticipate fires by tracking their advances. A deforestation pattern or regions with higher risk near the properties can be identified and provide information to create a mitigation plan.
- Leakage control is done by the project proponent together with the landowner to prevent potential carbon loss in the leakage area, which will be based on a cooperative effort with local stakeholders to promote a new approach to forest use and land use in the region.

Although being an interesting scenario, it also has the important characteristic of being completely financed by the landowners, which wouldn't receive any kind of additional revenue executing those actions.

iii. **Logging being conducted through Sustainable Forest management.**

Logging in the State of Amazonas is a practice that occurs both legally and illegally. This is because the related environmental legislation is systematically not enforced, and for that logging would take place through or not the approval of the sustainable forest management plan. In a study conducted by *Sistema de Monitoramento da Exploração de Madeira* - Simex (IMAZON, 2022), it was detected in the State of Amazonas the timber farm for an area of 14,976 ha in the period (Aug/2020 – Jul/2021), being 14% of the total area legally exploited. While of the unauthorized activity, most of it was identified within registered rural properties (40,9% of total illegal logging) (IMAZON, 2022).

The landowners of ABC-I1 will already explore their legal reserve, conducting logging activities through their timber companies. According to the legislation on the subject, there is the possibility to execute forest management activities in the forest areas from a Legal Reserve (80% of the property) and the other 20% (equivalent to the project area). In this scenario, the landowner would have to develop and approve a sustainable forest management plan under the competent environmental agency to explore the area.

Executing forest management to benefit from timber resources is an expensive activity but that would generate some revenue for the landowners and increase their land value. Those resources could be used to maintain the integrity of the rest of the forest area once it would start to have economic value. Although this is not the most viable economic scenario for the project area, it would still be a plausible scenario, given the possibility and the infrastructure for the treatment and sale of timber products in the region, combined with a growing demand for sustainable products.

According to the legislation on the subject, there is the possibility to execute forest management activities in the forest areas from a Legal Reserve (LR) inside an APA. In this scenario, the landowner would have to develop and approve a sustainable forest management plan under the competent environmental agency to explore his legal reserve area. Executing forest management to benefit from timber resources is an expensive activity but that would generate some revenue for the landowners. Those resources could be used to maintain the integrity of the forest area once it would start to have economic value. Actions to prevent illegal deforestation would be easier to take than such as patrolling and satellite monitoring, maybe not as strong and effective as in scenario (ii), but much better than doing nothing as in scenario (i).

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

Considering the three credible alternative land use scenarios from sub-step 1a, a demonstration of compliance with all mandatory applicable legal and regulatory requirements was made in the next paragraphs.

i. **Continuation of the pre-project land use (Business as Usual Scenario).**

Maintaining the planned activities for the project area before the ABC project, the landowners would continue to be in accordance with the pertinent legislation, already detailed in Section 1.14. Both landowners have the rights to explore 20% of their lands in the most appropriate way they decide to, according to the Brazilian Forest Code, that's what they plan to do and would continue to execute in this scenario. The planned activities for the project area involves the suppression of the vegetation followed by non-forest economic uses (e.g., cattle ranching and soybeans production).

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

In terms of compliance, in the same way as scenario (i) both landowners from the ABC-I1 comply with the legality already described in Section 1.14. Besides the economic activities done in 80% of their lands, the additional activities executed to avoid invaders do not imply compliance with any legislation that has not already been complied with.

iii. **Logging being conducted through Sustainable Forest management**

The Brazilian Forest Code (Law Nº 12,651, 2012, Brasil (2012b)) allows forest management practices inside the LR area of rural property, and there is no legal boundary to implement sustainable forest management practices in 20% of the property, after a Sustainable Forest Management Plan has been approved, meaning that additional revenues could be generated by the landowner.

Some important articles state that:

"Art. 17. The Legal Reserve must be conserved with native vegetation cover by the rural property owner, owner or occupant in any capacity, individual or legal entity, public or private law.

> § 1 The economic exploitation of the Legal Reserve is admitted through management sustainability, previously approved by the competent body of SISNAMA, in accordance with the modalities provided for in art. 20.

(...)

Art. 20. In the sustainable management of the forest vegetation of the Legal Reserve, practices of selective exploitation adopted in the modalities of sustainable management without purpose commercial for consumption on the property and sustainable management for forest exploitation with commercial purpose.

(...)

Art. 22. Sustainable forest management of the Legal Reserve vegetation with purpose commercial activity depends on authorization from the competent body and must comply with the following guidelines:

> I – do not de-characterize the vegetation cover and do not harm the conservation of the native vegetation of the area;
>
> II - ensure the maintenance of species diversity;
>
> III - conduct the management of exotic species with the adoption of measures that favor the regeneration of native species."

Sub-step 1c. Selection of baseline scenario

Based on the baseline scenario described in Section 3.4 and all the common practices and the BAU scenario, the most credible scenario for ABC-I1 to happen without the revenue of the carbon credits would be **scenario (i),** the continuation of the pre-project land use scenario.

Scenario (ii) is easily rejected considering that it would add only costs to the landowners, and no additional revenue to them.

Scenario (iii) was discarded mainly because scenario (i) presents more possibilities of non-forest economic uses for land, with higher potential for economic gains in the short, medium, and long term.

3.5.2 Step 2. Investment analysis

The proposed project activity, without the revenue from the sales of VCUs, is financially less attractive than scenario 1 (defined as the BAU scenario), to demonstrate that, according to VT0001 (VERRA, 2012b), an investment analysis will be performed.

Sub-step 2a. Determine appropriate analysis method

According to VT0001 (VERRA, 2012b), to determine whether to apply simple cost analysis, investment comparison analysis or benchmark analysis, it's required to identify if the VCS AFOLU project generates no financial or economic benefits other than VCS related income.

As the VCS AFOLU project generates financial or economic benefits other than VCS related income, it was applied the simple cost analysis (Option I).

Sub-step 2b. – Option I. Apply simple cost analysis

The costs to implement REDD+ activities involve community engagement, monitoring and surveillance of the property's areas against illegal squatters, a decent infrastructure for the local workers, etc. All the most relevant costs for implementing structured monitoring, surveillance, and fire protection system were identified in partnership with the landowners and are described in Table 3.5 and Table 3.6 below.

Table 3.5 General CAPEX for infrastructure and equipment.

CAPEX	Unit cost [R$]	Units required	Total cost [R$]
Vehicles	300 000.00	1	300 000.00
Main surveillance building and ancillary surveillance point	20 000.00	2	40 000.00
Energy generator	4 500.00	2	9 000.00
Motorcycle	25 000.00	2	50 000.00
Signaling plate	300.00	20	6 000.00
Fire brigade equipment kit	3 000.00	12	36 000.00

Table 3.6 General OPEX for maintaining the surveillance and monitoring system.

OPEX	Annual cost/unit [R$]	Units required	Total annual cost [R$]
Field team	21 600.00	8	172 800.00
Motorcycle fuel	1 200.00	2	2 400.00
Generator fuel	14 600.00	2	29 200.00
Vehicles fuel	1 680.00	1	1 680.00
Surveillance and patrolling	21 600.00	2	43 200.00
Courses and Training - Fire brigade	20 000.00	4	80 000.00
Remote monitoring (Satellite imagery)	65 000.00	1	65 500.00
Social survey and community engagement	35 000.00	1	35 000.00

Considering that the AFOLU Project activity does not generate any financial or economic benefits other than VCS related income, without the revenues of carbon credits, a systematic conservation activity for the areas would not be possible to occur.

3.5.3 Step 3. Barrier Analysis

The VT0001 (VERRA, 2012b) requires investment analysis (Step 2) or Barrier Analysis (Step 3). In this case, we opted for the Investment Analysis, already described in Step 2.

3.5.4 Step 4. Common practices analysis

The practice of implementing a structured monitoring system by private landowners in the Amazon without the benefit of carbon credits is a rare practice, being commonly observed on public lands, by measures adopted by the State Governments for biodiversity conservation.

The SNUC law allows the creation of conservative units in private lands (e.g. Private Reserve of Natural Heritage - *Reserva Particular do Patrimônio Natural* - RPPN), other mechanisms such as environmental servitude (Law Nº 6,938, 1981 (Brasil, 1981b)) and payment for environmental services (Law Nº 14,119, 2021 (Brasil, 2021)) can be seen as mechanisms for preserving and encouraging owners to take similar measures, however less effectively compared to a REDD+ project.

In the case of **Environmental servitude**, there are some possible benefits limited to the 20% of the land that the landowner has the right to explore, if implemented the conversion of the area to conservation matters, as an extension of its legal reserve. However, the financial and legal benefits do not exceed the opportunity cost of the local market (e.g., timber, livestock, and agriculture). Therefore, there are severe differences between the conservation mechanisms presented by the environmental servitude versus the proposed VCS AFOLU Project.

The implementation of **payment for environmental services** in the region is not yet effective to implement the proposed VCS AFOLU project activities, as the financial barrier exists while this is a recent mechanism in the Amazonas State.

According to the Brazilian government, the **RPPN** are important because contribute to the expansion of protected areas in the country; have highly positive indices for conservation, especially if considered the cost and benefit ratio; are easily created in relation to the other categories of UC; enable the participation of private initiative in the national conservation effort; contribute to the protection of the biodiversity of Brazilian biomes. The general benefits of adhering to the program are preserved property rights; exemption from the ITR related to the area created as RPPN; priority in the analysis of projects by the National Environment Fund (FNMA); preference in the analysis of agricultural credit applications, with official credit institutions, for projects to be implemented in properties that contain RPPN in its perimeter; possibilities of cooperation with private and public entities in the protection, and management of the Unit (ICMBio, 2020). Despite being apparently beneficial to landowners, the creation of an RPPN on the property is ineffective to stop local deforestation, considering both the high cost of opportunity in the face of cattle ranching, as well as the dismantling of environmental agencies seen in recent years in Brazil. It is also a mechanism that presents essential distinctions between the proposed AFOLU project activity, as the resources from the RPPN are insignificant given the REDD+ project costs, and there is no MRV-A system that would give the landowner any capability in implementing a structured monitoring and surveillance system around the properties. Furthermore, no RPPN records were found in Itacoatira nor in Silves (ICMBio, 2022).

The main alternative mechanism for carbon credit in the Amazon comes from the **Amazon Fund**, which "is a REDD+ mechanism created to raise donations for non-reimbursable investments in efforts to prevent, monitor and combat deforestation, as well as to promote the preservation and sustainable use in the Brazilian Amazon" (FundoAmazonia, 2022). However, there are some fundamental differences between the accounting and financing mechanism of projects available in Amazon fund versus the VCS REDD+ projects. In the first one, the project would only be possible if it was provided within the available budget of the fund, furthermore, the mechanism of accounting for the GHG emissions reductions adopts different MRV-A mechanisms, besides that the program has had no more projects approval since 2019 (CNN, 2022).

As it's possible to observe there are some forest conservation mechanisms available in the market with a limited applicability range, and with essential distinctions between the proposed VCS AFOLU project activity and with low effectiveness in avoiding the planned deforestation for the 20% of the property in the Amazon biome, the proposed VCS AFOLU project activity is not the baseline scenario and, hence, the ABC REDD+ Grouped Project is additional.

3.6 Methodology Deviations

No methodology deviations were made in the design and development of the project until the completion of this document.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Baseline emissions are estimated according to VM0007 v1.6 - REDD+ Methodology Framework (REDD+ MF) and VMD0006 v1.3 - Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation/forest degradation and planned wetland degradation (BL-PL). This module allows estimating GHG emissions related to planned deforestation on forest lands that are legally authorized and documented to be converted to non-forest land. As presented in Section 3.5, these areas would be deforested in the absence of the REDD project activity and converted to pasture for cattle rising.

4.1.1 Deforestation in the Baseline Scenario

The annual area of baseline planned deforestation ($AA_{planned,i,t}$) is calculated according to VMD0006 BL-PL v1.3 (Equation 1):

$$AA_{planned,i,t} = \left(A_{planned,i} * D\%_{planned,i,t}\right) * L - D_i \qquad \text{Equation 1}$$

Where:

$AA_{planned,i,t}$	Annual area of baseline planned deforestation for stratum *i* at time t; ha.
$A_{planned,i}$	Projected annual proportion of land that will be deforested in stratum *i* during year *t*; ha
$D\%_{planned,i,t}$	Total area of planned deforestation over the baseline period for stratum *i*; ha.
$L-D_i$	Likelihood of deforestation for stratum *i*; %.

The total area of planned deforestation over the baseline period ($A_{planned,i}$) is determined according to what is recognized as an immediate site-specific threat of deforestation, which, in its turn, is a function of the legal permissibility for deforestation. For a complete discussion of the $A_{planned,i}$ determination, see Section 3.4. the $A_{planned,i}$ was considered to be 5,140.20 ha. The projected annual proportion of land that will be deforested in stratum i during year t ($D\%_{planned,i,t}$) is determined according to vegetation suppression authorizations issued by the competent environmental agencies in each state[33]. The $D\%_{planned,i,t}$ was considered to be 10% per year. These authorizations should be viewed as verified plans with known and recorded actual annual deforestation proportions. According to the specifications of VMD0006 v1.3, $L-D_i$ is set to 100% because only private areas are included by the project (Table 4.1).

Table 4.1. Total and annual area of planned deforestation over the baseline scenario.

$L-D_i$	10%
Year	$AA_{planned,i,t}$
2022-2023	514.02
2023-2024	514.02
2024-2025	514.02
2025-2026	514.02
2026-2027	514.02
2027-2028	514.02
2028-2029	514.02
2029-2030	514.02
2030-2031	514.02
2031-2032	514.02
Total ($A_{planned,i}$)	5,140.20

4.1.2 Carbon Stock Change per pool in the Baseline Scenario

[33] Annex: Forest suppression plan.pdf

This section presents a reservoir's expected changes in carbon stocks in the baseline scenario. Initial stocks and stocks in post-deforestation are obtained by peer-reviewed literature. This parameter will be updated when the ABC project biomass inventory is made in the project area.

The project is located in the Amazon Biome, Amazonas, Brazil. Based on the correlation between geospatial data (BDiA, 2022c) and biomass data from the Amazon biome published in the literature (Nogueira et al., 2015), biomass was estimated in the project region. In the project area, only one stratum was identified, namely the Dense-canopy rainforest (submontane). According to Nogueira et al. (2015), the average biomass values of this stratum of the Amazon Forest are shown in Table 4.2. As already seen, after deforestation, the area would possibly become pasture, so post-deforestation values were considered pasture biomass according to Silva Neto et al. (2012) also present in Table 4.2.

Table 4.2. The total value of biomass, carbon, and carbon dioxide equivalent for dense-canopy rainforest, submontane (Ds) and Pastures of *Brachiaria brizantha* cv. Marandu (Br).

Forest Class	Nº of plots (n)	Aboveground biomass			Aboveground Carbon		Aboveground $CO_{2\text{-eq}}$		Belowground biomass		Belowground carbon		Belowground $CO_{2\text{-eq}}$		Total biomass		Total Carbon		Total carbon $CO_{2\text{-eq}}$	
		Mean	SD	$\sigma_{\bar{x}}^{c}$	Mean	$\sigma_{\bar{x}}^{c}$	Mean	$\sigma_{\bar{x}}^{c}$	Mean	$\sigma_{\bar{x}}^{c}$	Mean	$\sigma_{\bar{x}}^{c}$	Mean	$\sigma_{\bar{x}}^{c}$	Mean	$\sigma_{\bar{x}}^{c}$	Mean	$\sigma_{\bar{x}}^{c}$	Mean	$\sigma_{\bar{x}}^{c}$
		$Mg\ ha^{-1}$			$tC\ ha^{-1}$		$tCO_{2\text{-e}}\ ha^{-1}$		$Mg\ ha^{-1}$		$tC\ ha^{-1}$		$tCO_{2\text{-e}}\ ha^{-1}$		$Mg\ ha^{-1}$		$tC\ ha^{-1}$		$tCO_{2\text{-e}}\ ha^{-1}$	
Dense-canopy rainforest, submontane (Ds)[a]	533	319.59	76.72	6.51	150.21	7.09	550.76	25.99	70.63	11.59	33.20	5.63	121.72	20.64	390.22	13.30	183.40	9.05	672.48	33.19
Pastures of *Brachiaria brizantha* cv. Marandu (Br)[b]	36	7.87	3.48	1.14	3.70	0.56	13.56	2.04	1.74	0.38	0.82	0.18	3.00	0.66	9.61	1.20	4.52	0.59	16.56	2.15

[a]Nogueira et al. (2015)
[b]Silva Neto et al. (2012)
[c]Considering the conversion factor for a 95% confidence interval of 1.96.
Note: SD – standard deviation; $\sigma_{\bar{x}}$ – standard error

Aboveground Tree Biomass

The baseline carbon stock change in aboveground tree biomass ($\Delta C_{AB_{tree},i}$) is calculated according to the difference between the forest carbon stock in aboveground tree biomass ($C_{AB_{tree_{bsl}},i}$) and the post-deforestation carbon stock in aboveground tree biomass ($C_{AB_{tree_{post}},i}$), according to VMD0006 v1.3 (Equation 2) (Table 4.3):

$$\Delta C_{AB_{tree},i} = C_{AB_{tree_{bsl}},i} - C_{AB_{tree_{post}},i} \qquad \text{Equation 2}$$

Where:

$\Delta C_{AB_{tree},i}$	Baseline carbon stock change in aboveground tree biomass in stratum *i*; t CO_2-e ha^{-1}
$C_{AB_{tree_{bsl}},i}$	Forest carbon stock in aboveground tree biomass in stratum *i*; t CO_2-e ha^{-1}
$C_{AB_{tree_{post}},i}$	Post-deforestation carbon stock in aboveground tree biomass in stratum *i*; t CO_2-e ha^{-1}
i	1, 2, 3, … M strata

Forest carbon stock in aboveground tree biomass ($C_{AB_{tree_{bsl}},i}$) was estimated based on peer-reviewed literature (Nogueira et al., 2015). The carbon component of dry matter of 0.47 t C t $d.m^{-1}$ is used when converting biomass measured in Mg ha^{-1} to t C ha^{-1} (IPCC, 2006b). The value of t CO_{2-e} ha^{-1} was obtained considering the molar weight of CO_2 (44 g mol^{-1}) divided by C (12 g mol^{-1}) Equation 3.

$$C_{AB_{tree_{bsl}},i} = \mathrm{ab} * \mathrm{CF} * \frac{44}{12} \qquad \text{Equation 3}$$

Where:

$\mathrm{C_{AB\_tree,bsl,i}}$	Forest carbon stock in aboveground tree biomass in stratum *i*; t CO_{2-e} ha^{-1}
ab	Average biomass stock per hectare in the aboveground biomass pool of initial forest class *i*; Mg ha^{-1}
CF	Default value of carbon fraction in biomass CF = 0.47 t C $d.m^{-1}$ (IPCC, 2006b)
44/12	Ratio converting C to CO_{2-e}

Post-deforestation carbon stock in aboveground tree biomass ($C_{AB_{tree_{post}},i}$) is taken from peer reviewed literature (Silva Neto et al., 2012) considering an average degradation and the total dry mass. The total values for the carbon stock in the belowground biomass are indicated in the Table 4.3.

Table 4.3. Baseline carbon stock change in aboveground tree biomass (t CO_{2-e} ha^{-1}).

Stratum (i)	$C_{AB_{tree_{bsl},i}}$	$C_{AB_{tree_{post},i}}$	$\Delta C_{AB_{tree},i}$
	t CO_{2-e} ha^{-1}		
Dense-canopy rainforest, submontane (Ds)	550.76	13.56	537.20

Belowground Tree Biomass

Quantifying belowground tree biomass is also recommended, as it generally represents between 15% and 30% of aboveground biomass. The baseline carbon stock change in belowground tree biomass ($\Delta C_{BB\_tree,i}$) is calculated according to the difference between the forest carbon stock in the belowground tree ($C_{BB_{tree_{bsl},i}}$) and the post-deforestation carbon stock in belowground tree biomass ($C_{BB_{tree_{post},i}}$), according to VMD0006 v1.3, Equation 4:

$$\Delta C_{BB\_tree,i} = C_{BB_{tree_{bsl},i}} - C_{BB_{tree_{post},i}}$$ Equation 4

Where:

$\Delta C_{BB\_tree,i}$	Baseline carbon stock change in belowground tree biomass in stratum *i*; t CO_2-e ha^{-1}
$C_{BB_{tree_{bsl},i}}$	Forest carbon stock in belowground tree biomass in stratum *i*; t CO_2-e ha^{-1}
$C_{BB_{tree_{post},i}}$	Post-deforestation carbon stock in belowground tree biomass in stratum *i*; t CO_2-e ha^{-1}
i	1, 2, 3, … M strata

The aboveground is converted into belowground biomass through a root-shoot ratio. The value used for the ratio of belowground biomass to aboveground biomass was 0.221 for the tropical forest of natural origin, according to the updated IPCC report (IPCC, 2019). The average carbon stock per hectare in belowground tree biomass in stratum *i* is determined by Equation 5.

$$\mathrm{C_{BB\_tree,bsl,i}} = \mathrm{bb} * \mathrm{CF} * \frac{44}{12}$$ Equation 5

Where:

$\mathrm{C_{BB\_tree,bsl,i}}$	Forest carbon stock in belowground tree biomass in stratum i; t CO_{2-e} ha^{-1}
bb	Average biomass stock per hectare in the belowground biomass pool of initial forest class *i*; Mg ha^{-1}
CF	Default value of carbon fraction in biomass CF = 0.47 t C d.m^{-1} (IPCC, 2006b)
$44/12$	Ratio converting C to CO_{2-e}

Post-deforestation carbon stock in belowground tree biomass ($C_{BB_{tree_{post},i}}$) is taken from peer-reviewed literature (Silva Neto et al., 2012). The total values for the carbon stock in the belowground biomass are indicated in the Table 4.4.

Table 4.4. Baseline carbon stock change in belowground tree biomass (t CO_{2-e} ha^{-1}).

Stratum (i)	$C_{BB_{tree_{bsl},i}}$	$C_{BB_{tree_{post},i}}$	$\Delta C_{BB\_tree,i}$
	t CO_{2-e} ha^{-1}		
Dense-canopy rainforest, submontane (Ds)	121.72	3.00	118.72

Wood Products

The harvested trees would have been made into sawnwood, typical for the tropical hardwood species in Amazonas State. Baseline carbon stock change in wood products ($C_{WP,i}$, Equation 6) is calculated through commercial inventory estimation, according to VMD0005 v1.1.

$$C_{WP,i} = \sum_{ty=s,w,oir,p,o} C_{XB,ty,i} * (1 - WW_{ty}) \qquad \text{Equation 6}$$

Where:

$C_{WP,i}$	Carbon stock entering the wood products pool from stratum *i*; t CO_{2-e} ha^{-1}
$C_{XB,ty,i}$	Mean stock of extracted biomass carbon by class of wood product ty from stratum *i*; t CO_{2-e} ha^{-1}
WW_{ty}	Wood waste. The fraction immediately emitted through mill inefficiency by class of wood product *ty*; dimensionless WW_{ty} = 0.24 (Pearson et al. (2012), page 8)
ty	Wood product class – defined here as sawnwood (s), wood-based panels (w), other industrial roundwood (oir), paper and paper board (p), and other (o)
i	1, 2, 3, … M strata

The wood waste (WW_{ty}) is taken from peer-reviewed literature (Pearson et al., 2012). The mean stock of extracted biomass carbon by class of wood product ($C_{XB,ty,i}$, Equation 7) is calculated according to VMD0005 v1.1:

$$C_{XB,i,ty,i} = \frac{1}{A_i} * \sum_{j=1}^{S} \left(V_{ex,ty,j,i} * D_j * CF_j * \frac{44}{12} \right) \qquad \text{Equation 7}$$

Where:

$C_{XB,i,ty,i}$	Mean stock of extracted biomass carbon by class of wood product *ty* from stratum *i*; t CO_{2-e} ha^{-1}

A_i	Total area of stratum i; ha
$V_{ex,ty,j,i}$	Volume of timber extracted from within stratum *i* (does not include slash left onsite) by species j and wood product class *ty*; m^3 $V_{ex,ty,j,i}$ =38.3 m^3 ha^{-1} ((da SILVA et al., 2001; Veríssimo et al., 1992), Table 1)
D_j	Mean wood density of species *j*; t d.m.m^{-3}
CF_j	Carbon fraction of biomass for tree species *j*; t C t^{-1} d.m.
j	1, 2, 3, … S tree species
ty	Wood product class – defined here as sawnwood (s), wood-based panels (w), other industrial roundwood (oir), paper and paper board (p), and other (o)
$\frac{44}{12}$	Ratio of molecular weight of CO_2 to carbon; t $CO_{2\text{-}e}$ t C^{-1}

The carbon entering the wood products pool at the time of deforestation that is expected to be emitted over 100 years ($C_{WP100,i}$, Equation 8) is calculated according to VMD0005 v1.1. The fraction of wood products that will be emitted into the atmosphere within 5 years (SLF_{ty}) and between 5 and 100 years (Of_{ty}) of timber harvest is taken from peer-reviewed literature (Pearson et al., 2012; Winjum et al., 1998).

$$C_{WP100,i} = C_{WP,i} - C_{WP,i} * \left(1 - SLF_p\right) * (1 - Of_p)$$

Equation 8

Where:

$C_{WP100,i}$	Carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 100 years from stratum *i*; t $CO_{2\text{-}e}$ ha^{-1}
$C_{WP,i}$	Carbon stock entering wood products pool at time of deforestation from stratum *i*; t $CO_{2\text{-}e}$ ha^{-1}
SLF_{ty}	Fraction of wood products that will be emitted to the atmosphere within 5 years of timber harvest by class of wood product *ty*; dimensionless SLF_{ty} = 0.2 (page 276, Winjum et al. (1998) and Pearson et al. (2012))
Of_{ty}	Fraction of wood products that will be emitted to the atmosphere between 5 and 100 years of timber harvest by class of wood product *ty*; dimensionless OF_{ty}= 0.8 (page 276, Winjum et al. (1998) and Pearson et al. (2012))
ty	Wood product class – defined here as sawnwood (s), wood-based panels (w), other industrial roundwood (oir), paper and paper board (p), and other (o)
i	1, 2, 3, … M strata

The Table 4.5 shows the results found for the mean stock of extracted biomass carbon by class of wood product ty from stratum Ds, the carbon stock entering the wood products pool from stratum Ds and the carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 100 years from stratum Ds.

Table 4.5. Summary of calculations of wood products carbon pool in the baseline scenario (t CO_{2-e} ha^{-1}).

Stratum (i)	$C_{XB,i}$	$C_{WP,i}$	$C_{WP100,i}$
	t CO_{2-e} ha^{-1}		
Dense-canopy rainforest, submontane (Ds)	39.64	30.12	25.30

Carbon Stock Change in All Pools in the Baseline Scenario

The net carbon stock changes in all pools in the baseline ($\Delta C_{BSL,i,t}$) is calculated according to the following Equation 9 from VMD0006 v1.3. Conservatively, the parameters $\Delta C_{ABnon-tree,i}$, $\Delta C_{LI,i}$, $\Delta C_{BBnon-tree,i}$, $\Delta C_{DW,i}$, $\Delta C_{SOC,i}$ have been left out of calculations as they are not included in the project boundary.

$$\begin{aligned}\Delta C_{BSL,i,t} = {} & AA_{planned,i,t} * \left(\Delta C_{ABtree,i} - \Delta C_{WP,i} + \Delta C_{ABnon-tree,i} + \Delta C_{LI,i}\right) \\ & + \left(\sum_{t-10}^{t} AA_{planned,i,t}\right) * \left(\Delta C_{BBtree,i} + \Delta C_{BBnon-tree,i} + \Delta C_{DW,i}\right) * \left(\frac{1}{10}\right) \\ & + \left(\sum_{t-20}^{t} AA_{planned,i,t}\right) * \left(C_{WP100,i} + \Delta C_{SOC,i}\right) * \left(\frac{1}{20}\right)\end{aligned}$$

Equation 9

Where:

$\Delta C_{BSL,i,t}$	Sum of the baseline carbon stock change in all terrestrial pools in stratum *i* in year *t*, t CO_{2-e}
$AA_{planned,i,t}$	Annual area of baseline planned deforestation for stratum *i* in year *t*; ha
$C_{WP100,i}$	Carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 100 years from stratum *i*; t CO_{2-e} ha^{-1}
$\Delta C_{ABtree,i}$	Baseline carbon stock change in aboveground tree biomass in stratum *i*; t CO_{2-e} ha^{-1}
$\Delta C_{BBtree,i}$	Baseline carbon stock change in belowground tree biomass in stratum *i*; t CO_{2-e} ha^{-1}
$\Delta C_{ABnon-tree,i}$	Baseline carbon stock change in aboveground non-tree biomass in stratum *i*; t CO_{2-e} ha^{-1}
$\Delta C_{BBnon-tree,i}$	Baseline carbon stock change in belowground non-tree biomass in stratum *i*; t CO_{2-e} ha^{-1}
$\Delta C_{WP,i}$	Baseline carbon stock change in wood products in stratum *i*; t CO_{2-e} ha^{-1}
$\Delta C_{DW,i}$	Baseline carbon stock change in dead wood in stratum *i*; t CO_{2-e} ha^{-1}
$\Delta C_{LI,i}$	Baseline carbon stock change in litter in stratum *i*; t CO_{2-e} ha^{-1}
$\Delta C_{SOC,i}$	Baseline carbon stock change in soil organic carbon in stratum *i*; t CO_{2-e} ha^{-1}

i	1, 2, 3, … M strata
t	1, 2, 3, … t* years elapsed since the projected start of the project activity

Stock changes in aboveground biomass and litter are emitted at the time of deforestation. Following deforestation, emissions from belowground biomass, dead wood, soil and wood products take place gradually over time. Stock changes in belowground biomass and dead wood are emitted at an annual rate of 1/10 of the stock change for 10 years, and at an annual rate of 1/20 of the stock change for 20 years for soil organic carbon (for non-wetland soils). Carbon stocks entering the wood products pool at the time of deforestation and that are expected to be emitted over 100-years are emitted at an annual rate of 1/20 of the stock for 20 years. Thus, for a given year t, emissions are summed across areas deforested from time t-10 up to time t (for belowground biomass and dead wood) and from time t-20 up to time t (for soil organic carbon and wood products), in the Equation 9.

Therefore, Table 4.6 and Table 4.7 show the net emissions for belowground biomass distributed over 10 years and the the wood products pool and that are expected to be emitted over 100-years distributed over 20 years, respectively.

The Table 4.8 summarizes all the values needed to calculate the Equation 9, as well as the final results for $\Delta C_{BSL,i,t}$.

Table 4.6. Stock changes in belowground biomass gradually over 10 years (t CO_{2-e}).

Year*	$\Delta C_{BBtree,i} * AA_{planned,i,t}$	2022	2023	2024	2025	2026	2027	2028	2029	2030
	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}
2022-2023	61,024.78	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48
2023-2024	61,024.78	-	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48
2024-2025	61,024.78	-	-	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48
2025-2026	61,024.78	-	-	-	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48
2026-2027	61,024.78	-	-	-	-	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48
2027-2028	61,024.78	-	-	-	-	-	6,102.48	6,102.48	6,102.48	6,102.48
2028-2029	61,024.78	-	-	-	-	-	-	6,102.48	6,102.48	6,102.48
2029-2030	61,024.78	-	-	-	-	-	-	-	6,102.48	6,102.48
2030-2031	61,024.78	-	-	-	-	-	-	-	-	6,102.48
2031-2032	61,024.78	-	-	-	-	-	-	-	-	-
Total	610,247.83	6,102.48	12,204.96	18,307.44	24,409.91	30,512.39	36,614.87	42,717.35	48,819.83	54,922.31

*Years not shown in the table are values in 0.

Table 4.6. Stock changes in belowground biomass gradually over 10 years (t CO_{2-e}) (continued).

Year	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}
2022-2023	6,102.48	-	-	-	-	-	-	-	-	-
2023-2024	6,102.48	6,102.48	-	-	-	-	-	-	-	-
2024-2025	6,102.48	6,102.48	6,102.48	-	-	-	-	-	-	-
2025-2026	6,102.48	6,102.48	6,102.48	6,102.48	-	-	-	-	-	-
2026-2027	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	-	-	-	-	-
2027-2028	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	-	-	-	-
2028-2029	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	-	-	-
2029-2030	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	-	-
2030-2031	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	-
2031-2032	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48	6,102.48
Total	61,024.78	54,922.31	48,819.83	42,717.35	36,614.87	30,512.39	24,409.91	18,307.44	12,204.96	6,102.48

*Years not shown in the table are values in 0.

Table 4.7. Stock changes in $C_{WP100,i}$ gradually over 20 years (t CO_{2-e}).

Year*	$C_{WP100,i} * AA_{planned,i,t}$	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}
2022-2023	13,006.79	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34
2023-2024	13,006.79	-	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34
2024-2025	13,006.79	-	-	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34
2025-2026	13,006.79	-	-	-	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34
2026-2027	13,006.79	-	-	-	-	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34
2027-2028	13,006.79	-	-	-	-	-	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34
2028-2029	13,006.79	-	-	-	-	-	-	650.34	650.34	650.34	650.34	650.34	650.34	650.34
2029-2030	13,006.79	-	-	-	-	-	-	-	650.34	650.34	650.34	650.34	650.34	650.34
2030-2031	13,006.79	-	-	-	-	-	-	-	-	650.34	650.34	650.34	650.34	650.34
2031-2032	13,006.79	-	-	-	-	-	-	-	-	-	650.34	650.34	650.34	650.34
Total	130,067.87	650.34	1,300.68	1,951.02	2,601.36	3,251.70	3,902.04	4,552.38	5,202.71	5,853.05	6,503.39	6,503.39	6,503.39	6,503.39

*Years not shown in the table are values in 0.

Table 4.7. Stock changes in $C_{WP100,i}$ gradually over 20 years (t CO_{2-e}) (continued).

Year*	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}
2022-2023	650.34	650.34	650.34	650.34	650.34	650.34	650.34	-	-	-	-	-	-	-	-	-	-
2023-2024	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	-	-	-	-	-	-	-	-	-
2024-2025	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	-	-	-	-	-	-	-	-
2025-2026	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	-	-	-	-	-	-	-
2026-2027	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	-	-	-	-	-	-
2027-2028	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	-	-	-	-	-
2028-2029	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	-	-	-	-
2029-2030	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	-	-	-
2030-2031	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	-	-
2031-2032	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	650.34	-
Total	6,503.39	6,503.39	6,503.39	6,503.39	6,503.39	6,503.39	6,503.39	5,853.05	5,202.71	4,552.38	3,902.04	3,251.70	2,601.36	1,951.02	1,300.68	650.34	-

*Years not shown in the table are values in 0.

Table 4.8. Calculation of the sum of baseline carbon stocks changes in all pools (t CO_{2-e}).

Year	$A_{planned,i} * D\%_{planned,i,t}$	$AA_{planned,i,t}$	$AA_{planned,i,t} * \Delta C_{AB_{tree},i}$	$AA_{planned,i,t} * \Delta C_{WP,i}$	$AA_{planned,i,t} * \Delta C_{BBtree,i}$	$AA_{planned,i,t} * C_{WP100,i}$	$\Delta C_{BSL,i,t}$	$\Delta C_{BSL,i,t}$ Accumulated
	ha	ha	t CO_{2-e}	t CO_{2-e}	t CO_{2-e}	t CO_{2-e}	t CO_{2-e}	t CO_{2-e}
2022-2023	514.02	514.02	276,130.24	15,484.27	6,102.48	650.34	267,398.79	267,398.79
2023-2024	514.02	514.02	276,130.24	15,484.27	12,204.96	1,300.68	274,151.61	541,550.40
2024-2025	514.02	514.02	276,130.24	15,484.27	18,307.44	1,951.02	280,904.42	822,454.82
2025-2026	514.02	514.02	276,130.24	15,484.27	24,409.91	2,601.36	287,657.24	1,110,112.06
2026-2027	514.02	514.02	276,130.24	15,484.27	30,512.39	3,251.70	294,410.06	1,404,522.12
2027-2028	514.02	514.02	276,130.24	15,484.27	36,614.87	3,902.04	301,162.88	1,705,685.00
2028-2029	514.02	514.02	276,130.24	15,484.27	42,717.35	4,552.38	307,915.70	2,013,600.70
2029-2030	514.02	514.02	276,130.24	15,484.27	48,819.83	5,202.71	314,668.51	2,328,269.21
2030-2031	514.02	514.02	276,130.24	15,484.27	54,922.31	5,853.05	321,421.33	2,649,690.54
2031-2032	514.02	514.02	276,130.24	15,484.27	61,024.78	6,503.39	328,174.15	2,977,864.69
2032-2033	-	-	-	-	54,922.31	6,503.39	61,425.70	3,039,290.39
2033-2034	-	-	-	-	48,819.83	6,503.39	55,323.22	3,094,613.61
2034-2035	-	-	-	-	42,717.35	6,503.39	49,220.74	3,143,834.35
2035-2036	-	-	-	-	36,614.87	6,503.39	43,118.26	3,186,952.62
2036-2037	-	-	-	-	30,512.39	6,503.39	37,015.79	3,223,968.40
2037-2038	-	-	-	-	24,409.91	6,503.39	30,913.31	3,254,881.71
2038-2039	-	-	-	-	18,307.44	6,503.39	24,810.83	3,279,692.54
2039-2040	-	-	-	-	12,204.96	6,503.39	18,708.35	3,298,400.89
2040-2041	-	-	-	-	6,102.48	6,503.39	12,605.87	3,311,006.76
2041-2042	-	-	-	-	-	6,503.39	6,503.39	3,317,510.15
2042-2043	-	-	-	-	-	5,853.05	5,853.05	3,323,363.20
2043-2044	-	-	-	-	-	5,202.71	5,202.71	3,328,565.92
2044-2045	-	-	-	-	-	4,552.38	4,552.38	3,333,118.29
2045-2046	-	-	-	-	-	3,902.04	3,902.04	3,337,020.33
2046-2047	-	-	-	-	-	3,251.70	3,251.70	3,340,272.03
2047-2048	-	-	-	-	-	2,601.36	2,601.36	3,342,873.38
2048-2049	-	-	-	-	-	1,951.02	1,951.02	3,344,824.40
2049-2050	-	-	-	-	-	1,300.68	1,300.68	3,346,125.08
2050-2051	-	-	-	-	-	650.34	650.34	3,346,775.42
2051-2052	-	-	-	-	-	-	-	3,346,775.42
TOTAL	5,140.20	5,140.20					3,346,775.42	

Non-CO_2 Emissions in the Baseline Scenario

Greenhouse gas emissions in the baseline resulting from deforestation activities within the project area ($GHG_{BSL,i,t}$) are calculated using Equation 10, according to VMD0006 v1.3.

$$GHG_{BSL,i,t} = E_{FC,i,t} + E_{BiomassaBurn,i,t} + N_2O_{direct-N,i,t} \qquad \text{Equation 10}$$

Where:

$GHG_{BSL,i,t}$	Greenhouse gas emissions as a result deforestation activities within the project boundary in the stratum *i* in year *t*; t $CO_{2\text{-}e}$
$E_{FC,i,t}$	Net $CO_{2\text{-}e}$ emission from fossil fuel combustion in stratum *i* in year *t*; t $CO_{2\text{-}e}$
$E_{BiomassaBurn,i,t}$	Non-CO_2 emissions due to biomass burning in stratum *i* in year *t*; t $CO_{2\text{-}e}$
$N_2O_{direct-N,i,t}$	Direct N_2O emission as a result of nitrogen application on the alternative land use within the project boundary in stratum *i* in year *t*; t $CO_{2\text{-}e}$
i	1, 2, 3, … M strata
t	1, 2, 3, …t* years elapsed since the start of the REDD VCS project activity

The baseline scenario conservatively excludes nitrogen application ($N_2O_{direct-N,i,t}$) and net $CO_{2\text{-}e}$ emissions from burning fossil fuels ($E_{FC,i,t}$) (see Section 3.3). Hence, non-CO_2 emissions due to biomass burning ($E_{BiomassaBurn,i,t}$) are calculated according to VMD0013 v1.2 (Equation 11). For that, The area burnt ($A_{burn,i,t}$) equal to annual area of baseline planned deforestation in the baseline case ($AA_{planned,i,t}$). Combustion and emission factors and global warming potential are default values adopted and taken from IPCC reports (IPCC, 2006a, 2014).

$$E_{biomassbur\,n,i,t} = \sum_{g\,=\,1}^{G} \left(\left(\left(A_{burn,i,t} * B_{i,t} * COMF_i * G_{g,i} \right) * 10^{-3} \right) * GWP_g \right) \qquad \text{Equation 11}$$

Where:

$E_{biomassbur\,n,i,t}$	Greenhouse gas emissions due to biomass burning in stratum *i* in year *t* of each GHG (CO_2, CH_4, N_2O); t $CO_{2\text{-}e}$
$A_{burn,i,t}$	Area burnt for stratum *i* in year *t*; ha
$B_{i,t}$	Average aboveground biomass stock before burning stratum *I* in year *t*; t d.m. ha^{-1}
$COMF_i$	Combustion factor for stratum *i*; unitless $COMF_i$ = 0.59 (Table 2.6, page 2.55, IPCC (2006a))
$G_{g,i}$	Emission factor for stratum *i* for gas g; kg t^{-1} d.m. burnt G_{g,CH_4} = 6.8 kg t^{-1}, G_{g,NO_2} = 0.2 kg t^{-1} (Table 2.5, page 2.54, IPCC (2006a))

GWP_g	Global warming potential for gas *g*; t CO_2/t gas g $GWP_{CH_4} = 28$ t CO_2 t_{gas}^{-1}, $GWP_{NO_2} = 265$ t CO_2 t_{gas}^{-1} (Box 3.2, Table 1, page 87, IPCC (2014) and Grennhouse (2014))
g	1, 2, 3 … g greenhouse gases including carbon dioxide, methane and nitrous oxide; unitless
i	1, 2, 3, … M strata
t	1, 2, 3, … t* time elapsed since the start of the project activity; years

The average aboveground biomass stock before burning ($B_{i,t}$) is calculated according to VMD0013 v1.2 adjusted to reflect methodological deviation (Equation 12).

$$B_{i,t} = \left(C_{AB_{tree},i,t} + C_{DWi,t} + C_{LI,i,t}\right) * \frac{12}{44} * \frac{1}{CF} \qquad \text{Equation 12}$$

Where:

$B_{i,t}$	Average aboveground biomass stock before burning for stratum *i*, year *t*; tonnes d.m. ha^{-1}
$C_{AB_{tree},i,t}$	Carbon stock in aboveground biomass in trees in stratum *i* in year *t*; t CO_{2-e} ha^{-1})
$C_{DWi,t}$	Carbon stock in dead wood for stratum *i* in year *t*; t CO_{2-e} ha^{-1}
$C_{LI,i,t}$	Carbon stock in litter for stratum *i* in year *t*; t CO_{2-e} ha^{-1}
$\frac{12}{44}$	Inverse ratio of molecular weight of CO_2 to carbon; t CO_{2-e} t C^{-1}
$\frac{1}{CF}$	Carbon fraction of biomass; t C t^{-1} d.m. CF = 0.47 t C t^{-1} d.m. (pg. 4.48, Table 4.3, IPCC (2006b))
i	1, 2, 3, … M strata
t	1, 2, 3, … t* time elapsed since the start of the project activity; years

Table 4.9 shows the parameters used in calculating biomass burning for the baseline scenario, as well as results accounted for CH_4 and N_2O emissions generated and the average aboveground biomass stock before burning for stratum Ds.

Table 4.9. Non-CO_2 emissions in the baseline case (t CO_{2-e}).

$B_{i,t}$		319.59 t d.m. ha^{-1}		
Year	$AA_{planned,i,t} = A_{burn,i,t}$	$E_{biomassbur,CH_4,i,t}$	$E_{biomassbur,N_2O,i,t}$	$GHG_{BSL,i,t}$
	ha	t CO_{2-e}	t CO_{2-e}	t CO_{2-e}
2022-2023	514.02	18,454.07	5,136.90	23,590.97
2023-2024	514.02	18,454.07	5,136.90	23,590.97
2024-2025	514.02	18,454.07	5,136.90	23,590.97
2025-2026	514.02	18,454.07	5,136.90	23,590.97
2026-2027	514.02	18,454.07	5,136.90	23,590.97
2027-2028	514.02	18,454.07	5,136.90	23,590.97
2028-2029	514.02	18,454.07	5,136.90	23,590.97
2029-2030	514.02	18,454.07	5,136.90	23,590.97
2030-2031	514.02	18,454.07	5,136.90	23,590.97
2031-2032	514.02	18,454.07	5,136.90	23,590.97
2032-2033	-	-	-	-
2033-2034	-	-	-	-
2034-2035	-	-	-	-
2035-2036	-	-	-	-
2036-2037	-	-	-	-
2037-2038	-	-	-	-
2038-2039	-	-	-	-
2039-2040	-	-	-	-
2040-2041	-	-	-	-
2041-2042	-	-	-	-
2042-2043	-	-	-	-
2043-2044	-	-	-	-
2044-2045	-	-	-	-
2045-2046	-	-	-	-
2046-2047	-	-	-	-
2047-2048	-	-	-	-
2048-2049	-	-	-	-
2049-2050	-	-	-	-
2050-2051	-	-	-	-
2051-2052	-	-	-	-
Total	**5,140.20**	**184,540.70**	**51,369.00**	**235,909.69**

Net GHG emissions in the Baseline Scenario

The baseline net GHG emissions for planned deforestation (Equation 13) is determined according to VMD0006 BL-PL v1.3.

$$\Delta C_{BSL,planned} = \sum_{t=1}^{t^*}\sum_{i=1}^{M}(\Delta C_{BSL,i,t} + GHG_{BSL-E,i,t}) \qquad \text{Equation 13}$$

Where:

$\Delta C_{BSL,planned}$	Net greenhouse gas emissions in the baseline from planned deforestation up to year $t*$; t CO_{2-e}
$\Delta C_{BSL,i,t}$	Net carbon stock changes in all pools in the baseline stratum *i* in year *t*; t CO_{2-e}
$GHG_{BSL-E,i,t}$	Greenhouse gas emissions as a result of deforestation activities within the project boundary in the baseline stratum *i* in year *t*; t CO_{2-e} yr^{-1}.
i	1, 2, 3, … M strata
t	1, 2, 3, … t* time elapsed since the start of the project activity; years

Table 4.10 presents all values for net carbon stock changes in all pools in the baseline stratum Ds in year t, greenhouse gas emissions as a result of deforestation activities within the project boundary in the baseline stratum Ds in year t and, finally, the net greenhouse gas emissions in the baseline from planned deforestation up to year t.

Table 4.10. Net GHG emissions in the baseline from planned deforestation in the baseline period (t CO_{2-e}).

Year	$\Delta C_{BSL,i,t}$	$GHG_{BSL-E,i,t}$	$\Delta C_{BSL,planned}$	$\Delta C_{BSL,planned,\text{accumulated}}$
	t CO_{2-e}	t CO_{2-e}	t CO_{2-e}	t CO_{2-e}
2022-2023	267,398.79	23,590.97	290,989.76	290,989.76
2023-2024	274,151.61	23,590.97	297,742.58	588,732.34
2024-2025	280,904.42	23,590.97	304,495.39	893,227.73
2025-2026	287,657.24	23,590.97	311,248.21	1,204,475.94
2026-2027	294,410.06	23,590.97	318,001.03	1,522,476.97
2027-2028	301,162.88	23,590.97	324,753.85	1,847,230.82
2028-2029	307,915.70	23,590.97	331,506.66	2,178,737.48
2029-2030	314,668.51	23,590.97	338,259.48	2,516,996.97
2030-2031	321,421.33	23,590.97	345,012.30	2,862,009.27
2031-2032	328,174.15	23,590.97	351,765.12	3,213,774.38
2032-2033	61,425.70	-	61,425.70	3,275,200.08
2033-2034	55,323.22	-	55,323.22	3,330,523.30
2034-2035	49,220.74	-	49,220.74	3,379,744.04
2035-2036	43,118.26	-	43,118.26	3,422,862.31
2036-2037	37,015.79	-	37,015.79	3,459,878.09
2037-2038	30,913.31	-	30,913.31	3,490,791.40
2038-2039	24,810.83	-	24,810.83	3,515,602.23
2039-2040	18,708.35	-	18,708.35	3,534,310.58

Year	$\Delta C_{BSL,i,t}$	$GHG_{BSL-E,i,t}$	$\Delta C_{BSL,planned}$	$\Delta C_{BSL,planned,\text{accumulated}}$
	t $CO_{2\text{-}e}$	t $CO_{2\text{-}e}$	t $CO_{2\text{-}e}$	t $CO_{2\text{-}e}$
2040-2041	12,605.87	-	12,605.87	3,546,916.45
2041-2042	6,503.39	-	6,503.39	3,553,419.84
2042-2043	5,853.05	-	5,853.05	3,559,272.90
2043-2044	5,202.71	-	5,202.71	3,564,475.61
2044-2045	4,552.38	-	4,552.38	3,569,027.99
2045-2046	3,902.04	-	3,902.04	3,572,930.02
2046-2047	3,251.70	-	3,251.70	3,576,181.72
2047-2048	2,601.36	-	2,601.36	3,578,783.08
2048-2049	1,951.02	-	1,951.02	3,580,734.10
2049-2050	1,300.68	-	1,300.68	3,582,034.77
2050-2051	650.34	-	650.34	3,582,685.11
2051-2052	-	-	-	3,582,685.11
Total	**3,346,775.42**	**235,909.69**	**3,582,685.11**	

4.2 Project Emissions

Expected project emissions are estimated ex-ante and apply Equation 14 of module M-MON (VMD0015) of Methodology VM0007. Ex-ante projections of deforestation in the project case assume no deforestation have taken place as one of the project proponents is the baseline agent of deforestation and has committed to not undertake land clearing on the property.

$$\Delta C_{WPS-REDD} = \sum_{t=1}^{t*}\sum_{i=1}^{M}(\Delta C_{P,DefPA,i,t} + \Delta C_{P,Deg,i,t} + \Delta C_{P,DistPA,i,t} + GHG_{P-E,i,t} - \Delta C_{P,Enh,i,t}) \quad \text{Equation 14}$$

Where:

$\Delta C_{WPS-REDD}$	Net GHG emissions in the REDD project scenario up to year $t*$; t $CO_{2\text{-}e}$
$\Delta C_{P,DefPA,i,t}$	Net carbon stock change as a result of deforestation in the project area in the project case in stratum *i* in year *t*; t $CO_{2\text{-}e}$
$\Delta C_{P,Deg,i,t}$	Net carbon stock change as a result of degradation in the project area in the project case in stratum *i* in year *t*; t $CO_{2\text{-}e}$
$\Delta C_{P,DistPA,i,t}$	Net carbon stock change as a result of natural disturbance in the project area in the project case in stratum *i* in year *t*; t $CO_{2\text{-}e}$
$GHG_{P-E,i,t}$	Greenhouse gas emissions as a result of deforestation and degradation activities within the project area in the project case in stratum *i* in year *t*; t $CO_{2\text{-}e}$
$\Delta C_{P,Enh,i,t}$	Net carbon stock change as a result of forest growth and sequestration during the project in areas projected to be deforested in the baseline* in stratum *i* in year *t*; t $CO_{2\text{-}e}$ *For areas with a degradation baseline (i.e. using Module BL-DFW) this parameter shall be set to zero, for areas with baseline set by Module BL-UP and Module BL-PL this parameter may be conservatively set to zero.
i	1, 2, 3, … M strata

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

In the case of an identified deforestation agent, the agent has committed not to deforest, collect firewood, or remove wood from the forests in the project area. Thus, these actions are expected to prevent degradation by illegal actors, and ex-ante degradation is estimated as zero ($\Delta C_{P,Deg,i,t} = 0$).

Amazon forests have a low incidence of natural disturbance (Espírito-Santo et al., 2014), which does not generally result in tree death and C emissions ($\Delta C_{P,DistPA,i,t} = 0$). Furthermore, according to module VMD00015 for areas with baseline set by Module BL-PL the $\Delta C_{P,Enh,i,t}$ parameter may be conservatively set to zero ($\Delta C_{P,Enh,i,t} = 0$). Therefore, Equation 14 can be rewritten as (Equation 15):

$$\Delta C_{WPS-REDD} = \sum_{t=1}^{t*} \sum_{i=1}^{M} (\Delta C_{P,DefPA,i,t} + GHG_{P-E,i,t}) \qquad \text{Equation 15}$$

Where:

$\Delta C_{WPS-REDD}$	Net GHG emissions in the REDD project scenario up to year $t*$; t CO_{2-e}
$\Delta C_{P,DefPA,i,t}$	Net carbon stock change as a result of deforestation in the project area in the project case in stratum *i* in year *t*; t CO_{2-e}
$GHG_{P-E,i,t}$	Greenhouse gas emissions as a result of deforestation and degradation activities within the project area in the project case in stratum *i* in year *t*; t CO_{2-e}
i	1, 2, 3, … M strata
t	1, 2, 3, … t* years elapsed since the start of the project activity

The net carbon stock change as a result of deforestation ($\Delta C_{P,DefPA,i,t}$) is equal to the area deforested multiplied by the emission per unit area, according to VMD0015 v2.2 (Equation 16).

$$\Delta C_{P,DefPA,i,t} = \sum_{u=1}^{U} (A_{DefPA,u,i,t} * \Delta C_{pools,P,Def,u,i,t}) \qquad \text{Equation 16}$$

Where:

$\Delta C_{P,DefPA,i,t}$	Net carbon stock change as a result of deforestation in the project case in the project area in stratum *i* at time *t*; t CO_{2-e}
$A_{DefPA,u,i,t}$	Area of recorded deforestation in the project area stratum *i* converted to land use *u* at time *t*; ha
$\Delta C_{pools,P,Def,u,i,t}$	Net carbon stock changes in all pools in the project case in land use *u* in stratum *i* at time *t*; t CO_{2-e} ha^{-1}
u	1, 2, 3, … U post-deforestation land uses.
i	1, 2, 3, … M strata

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

According to VMD0015 v2.2, an *ex-ante* estimate of deforestation in the project area must be made. As the deforestation agent has committed to providing infrastructure and policies to prevent deforestation, the $A_{DefPA,u,i,t}$ parameter can be set to zero. Hence, the project area currently does not carry out any activities, so there are no project emissions to report at the audit time.

4.3 Leakage

Leakage emissions from displacement of planned deforestation are estimated in conformance with the Verified Carbon Standard (VCS) modular REDD methodology VM0007, specifically the VMD0009 LK-ASP and VMD0011 LK-ME modules. These modules provide for accounting for activity shifting leakage resulting from displacement of deforestation activities by the agent of deforestation and estimating GHG emissions caused by the market-effects leakage related to extraction of wood for timber (Equation 17).

$$\Delta C_{LK-REED} = \Delta C_{LK-AS,planned} + \Delta C_{LK-ME}$$ Equation 17

Where:

$\Delta C_{LK-REED}$ Net GHG emissions due to leakage from the REDD project activity up to year $t*$; t $CO_{2\text{-}e}$

$\Delta C_{LK-AS,planned}$ Net GHG emissions due to activity shifting leakage for projects preventing planned deforestation up to year $t*$ – from Module LK-ASP; t $CO_{2\text{-}e}$

ΔC_{LK-ME} Net GHG emissions due to market-effects leakage up to year $t*$ – from Module LK-ME; t $CO_{2\text{-}e}$

4.3.1 Estimation of emissions from activity shifting

Activity shifting leakage due to displacement of planned deforestation was assessed using a series of equations outline in VMD0009 LK-ASP. Thus, Equation 18 is used when the specific deforestation agent is identified as is the case of the ABC project.

$$\Delta C_{LK-AS,planned} = \sum_{t=1}^{t*}\sum_{i=1}^{M}\left(LKA_{planned,i,t} * \Delta C_{BSL,i}\right) + GHG_{LK,E,i,t}$$ Equation 18

Where:

$\Delta C_{LK-AS,planned}$ Net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation up to year $t*$; t $CO_{2\text{-}e}$

$LKA_{planned,i,t}$ The area of activity shifting leakage in stratum *i* in year *t*; ha

$\Delta C_{BSL,i}$ Net carbon stock changes in all pre-deforestation pools in baseline stratum *i*; t $CO_{2\text{-}e}$ ha^{-1}

$GHG_{LK,E,i,t}$	Greenhouse gas emissions as a result of leakage of avoiding deforestation activities in stratum i in year t; t CO_{2-e}
i	1, 2, 3, … M strata; unitless
t	1, 2, 3, … t* time elapsed since the start of the project activity; years

The procedure for calculating leakage when the deforestation agent is identified must follow three steps: (i) determination of the baseline rate of forest clearance by the deforestation agent; (ii) estimate new projection of forest clearance by the baseline agent of deforestation with project implementation if no leakage is occurring; and (iii) monitor all areas deforested by baseline agent of deforestation through the years in which planned deforestation was forecast to occur. In step (iii), all areas deforested by the baseline agent of deforestation must be monitored. Areas of deforestation may be anywhere in the host country. There is no requirement to track international leakage. For this, the following equation must be followed (Equation 19).

$$LKA_{planned,i,t} = A_{defLK,i,t} - NewR_{i,t}$$

Equation 19

Where:

$LKA_{planned,i,t}$	The area of activity shifting leakage in stratum *i* in year *t*; ha
$A_{defLK,i,t}$	The total area of monitored deforestation by the baseline agent of the planned deforestation in stratum *i* in year *t*; ha
$NewR_{i,t}$	New calculated forest clearance by the baseline agent of the planned deforestation in stratum *i* in year *t* where no leakage is occurring; ha
i	1, 2, 3, … M strata; unitless
t	1, 2, 3, … t* time elapsed since the start of the project activity; years

Non-CO_2 emissions due to biomass burning in the area of activity shifting leakage is calculated according to same procedures used to estimate baseline GHG emissions due to biomass burning. Non-CO_2 emissions due to nitrogen application are not part of the project scope.

According to VMD0009 LK-ASP v1.3, the parameter $A_{defLK,i,t}$ is monitored. *Ex-ante*, it is assumed this value is zero and the deforestation agent is the same as the project proponent. Still according to the methodology, if $NewR_{i,t}$ exceeds $A_{defLK,i,t}$ then $LKA_{planned,i,t}$ must be set as zero as negative leakage is not considered under the VCS. Therefore, for the time being, in the ABC project the $\Delta C_{LK-AS,planned}$ will be assumed to be zero. In this sense, GHG emissions due to activity shifting for avoiding planned deforestation are set to zero in *ex-ante*.

4.3.2 Estimation of emissions from market-effects

According to VMD0011 LK-ME v1.1, the total leakage due to market effects is equal to the sum of market-effects leakage through decreased timber harvest and decreased harvest for fuelwood / charcoal production (Equation 20).

$$\Delta C_{LK-ME} = LK_{MarketEffects,timber} + LK_{MarketEffects,FW/C} + LK_{MarketEffects,peat}$$ Equation 20

Where:

ΔC_{LK-ME}	Net greenhouse gas emissions due to market-effects leakage; t CO_{2-e}
$LK_{MarketEffects,timber}$	Total GHG emissions due to market-effects leakage through decreased timber harvest; t CO_{2-e}
$LK_{MarketEffects,FW/C}$	Total GHG emissions due to market-effects leakage through decreased harvest of fuelwood and charcoal sold into regional and/or national markets; t CO_{2-e}
$LK_{MarketEffects,peat}$	Total GHG emissions due to market-effects leakage through decreased timber, fuelwood and charcoal harvest resulting in increased peatland drainage; t CO_{2-e}

As there is no fuelwood or charcoal collection by the baseline agent of deforestation market leakage is limited to leakage through decreased timber harvest as calculated in Equation 21. Leakage due to market effects is equal to the baseline emissions from logging multiplied by a leakage factor and, where applicable, by a leakage management factor:

$$LK_{MarketEffects,timber} = \sum_{i=1}^{M} \left(LF_{ME} * LK_{MAF} * AL_{T,i} \right)$$ Equation 21

Where:

$LK_{MarketEffects,timber}$	Total GHG emissions due to market-effects leakage through decreased timber harvest; t CO_{2-e}
LF_{ME}	Leakage factor for market-effects calculations; dimensionless
LK_{MAF}	Leakage management adjustment factor; dimensionless
$AL_{T,i}$	Summed emissions from timber harvest in stratum *i* in the baseline case potentially displaced through implementation of the project; t CO_{2-e}
i	1,2,3,...M strata; dimensionless

The deduction of the leakage factor for market-effects calculations (LF_{ME}) was adopted based on the relation between mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type (PML_{FT}) and merchantable biomass as a proportion of total aboveground tree biomass for stratum i within the project boundary (PMP_i). The PML_{FT} is estimated considering the literature data. According to Homma (2011), from 45 billion m^3 of Amazon wood stocks, almost 14 billion m^3 was marketable. Thus, the PML_{FT} adopted is 31% for legal Amazon. The LF_{ME} used for timber is 0.4, where mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type is equal to merchantable biomass as a proportion of total aboveground tree biomass within the project boundary ($PML_{FT} = \pm 15\% \ to \ PMP_i$). The species that would be harvested in the project area is an Amazonian species and could only originate from other native forest sites in the Brazilian Amazon.

Additionally, they would need to come from woods that are in a state of relative maturity and where it is simple to locate trees of millable size (> 40 cm DBH). According to Higuchi et al. (1998), the proportion of stem (merchantable portion) biomass to total aboveground biomass is largely constant in mature Amazonian forests. It is also not anticipated to vary between the mature native forests in the project area and those in other regions of the Brazilian Amazon.

Deduction factors for LF_{ME}:

$$PML_{FT} = \pm 15\% \; to PMP_i \qquad LF_{ME} = 0.4$$

$$PML_{FT} > 15\% \; less \; than \; PMP_i \qquad LF_{ME} = 0.7$$

$$PML_{FT} > 15\% \; greater \; than \; PMP_i \qquad LF_{ME} = 0.2$$

Where:

PML_{FT}	Mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type (%)
PMP_i	Merchantable biomass as a proportion of total aboveground tree biomass for stratum *i* within the project boundary (%)
LF_{ME}	Leakage factor for market-effects calculations; dimensionless

Moreover, if leakage management activities are established within areas under the control of the project proponent in order to minimize the displacement of land use activities to areas outside the project area by maintaining the production of total biomass in commercial species that is merchantable, a leakage management adjustment factor (LK_{MAF}) may be applied (Equation 22). As leakage management activities have not been established within areas under the control of the proponent and according to Higuchi et al. (1998), that the proportion of stem biomass (marketable portion) to total aboveground biomass is constant in mature Amazonian forests, the LK_{MAF} was kept at 1.

$$LK_{MAF} = 1 - \left(\frac{PRODMB_{LMA,t}}{PRODMB_{BL,t}}\right) \qquad \text{Equation 22}$$

Where:

LK_{MAF}	Leakage management adjustment factor; dimensionless
$PRODMB_{LMA,t}$	Production biomass in commercial species that is merchantable in year t in leakage management areas; t per year
$PRODMB_{BL,t}$	Production of biomass in commercial species that is merchantable in year t in the baseline case; t per year
t	1, 2, 3, … t* time elapsed since the projected start of the REDD project activity; years

The next step is to estimate the emissions associated with the displaced logging activity. This is based on the total volume that would have been logged in the baseline in the project area across strata and time periods (Equation 23):

$$AL_{T,i} = \sum_{t=1}^{t} (C_{BSL,XBT,i,t}) \qquad \text{Equation 23}$$

Where:

$AL_{T,i}$	Summed emissions from timber harvest in stratum i in the baseline case laced through implementation of carbon project; t CO_{2-e}
$C_{BSL,XBT,i,t}$	Carbon emission due to displaced timber harvests in the baseline scenario in stratum i in year t; t CO_{2-e}
i	1, 2, 3, …M strata
t	1, 2, 3, … t* time elapsed since the projected start of the REDD project activity; years

The carbon emission due to the displaced logging has two components: the biomass carbon of the extracted timber and the biomass carbon in the forest damaged in the process of timber extraction (Equation 24):

$$C_{BSL,XBT,i,t} = \left(\left(V_{BSL,EX,i,t} * D_{mn} * CF \right) + \left(V_{BSL,EX,i,t} * LDF \right) + \left(V_{BSL,EX,i,t} * LIF \right) \right) * \frac{44}{12} \qquad \text{Equation 24}$$

Where:

$C_{BSL,XBT,i,t}$	Carbon emission due to timber harvests in the baseline scenario in stratum i in year t; t CO_{2-e}
$V_{BSL,EX,i,t}$	Volume of timber projected to be extracted from within the project boundary during the baseline in stratum i in year t; m^3 $V_{BSL,EX,i,t}$ = 38.3 m^3 ha^{-1} (da SILVA et al., 2001; Veríssimo et al., 1992)
D_{mn}	Mean wood density of commercially harvested species; t d.m.m^{-3} D_{mn} = 0.60 t d.m. m^{-3} (VMD0011-LK-ME-v1.1).
CF	Carbon fraction of biomass for commercially harvested species j; t C t d.m.$^{-1}$ CF = 0.47 t C t d.m.$^{-1}$ ((IPCC, 2006b) page 4.48, Table 4.3).
LDF	Logging damage factor; t C m^{-3} LDF = 0.53 t C m^{-3} (VMD0011-LK-ME-v1.1).
LIF	Logging infrastructure factor; t C m^{-3} LIF = 0.29 t C m^{-3} (VMD0011-LK-ME-v1.1)
i	1, 2, 3, … M strata
t	1, 2, 3, … t* time elapsed since the projected start of the project activity; years

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 tree (the branches and stump) and trees incidentally killed during tree felling. The default values given here comes from the slope of the regression equation between carbon damaged and volume extracted based on 774 logging gaps measured by Winrock International in Bolivia, Belize, the Republic of Congo, Brazil and Indonesia, and 134 logging gaps in Mexico.

The logging infrastructure factor (LIF) is a representation of the quantity of emissions that will ultimately arise per unit of timber (m^3) from roads, skid trails and logging decks. The conservative default value is the upper confidence interval of the average emission from analyses conducted across 1 473 hectares in the Republic of Congo and 366 hectares in Brazil.

Therefore, the total values for calculating leakage due to market effect, as well as the results for ΔC_{LK-ME} are shown in Table 4.11.

Table 4.11. Net greenhouse gas emissions due to market-effects leakage (t CO_{2-e}).

Year	$A_{planned,i} * D\%_{planned,i,t}$	$C_{BSL,XBT,i,t}$	$AL_{T,i}$	$LK_{MarketEffects,timber}$	ΔC_{LK-ME}
	ha	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}	tCO_{2-e}
2022-2023	514.02	79,617.70	79,617.70	31,847.08	31,847.08
2023-2024	514.02	79,617.70	79,617.70	31,847.08	31,847.08
2024-2025	514.02	79,617.70	79,617.70	31,847.08	31,847.08
2025-2026	514.02	79,617.70	79,617.70	31,847.08	31,847.08
2026-2027	514.02	79,617.70	79,617.70	31,847.08	31,847.08
2027-2028	514.02	79,617.70	79,617.70	31,847.08	31,847.08
2028-2029	514.02	79,617.70	79,617.70	31,847.08	31,847.08
2029-2030	514.02	79,617.70	79,617.70	31,847.08	31,847.08
2030-2031	514.02	79,617.70	79,617.70	31,847.08	31,847.08
2031-2032	514.02	79,617.70	79,617.70	31,847.08	31,847.08
2032-2033	-	-	-	-	-
2033-2034	-	-	-	-	-
2034-2035	-	-	-	-	-
2035-2036	-	-	-	-	-
2036-2037	-	-	-	-	-
2037-2038	-	-	-	-	-
2038-2039	-	-	-	-	-
2039-2040	-	-	-	-	-
2040-2041	-	-	-	-	-
2041-2042	-	-	-	-	-
2042-2043	-	-	-	-	-
2043-2044	-	-	-	-	-
2044-2045	-	-	-	-	-
2045-2046	-	-	-	-	-
2046-2047	-	-	-	-	-
2047-2048	-	-	-	-	-
2048-2049	-	-	-	-	-
2049-2050	-	-	-	-	-
2050-2051	-	-	-	-	-
2051-2052	-	-	-	-	-
Total	5,140.20				318,470.80

4.4 Net GHG Emission Reductions and Removals

Net GHG emission reduction estimates are based in VM0007 v1.6. The total net greenhouse gas emissions reductions of the REDD project activity are calculated as follows (Equation 25, Equation 26 and Equation 27):

$$NER_{REDD} = \Delta C_{BSL-REDD} - \Delta C_{WPS-REDD} - \Delta C_{LK-REDD}$$ Equation 25

Where:

NER_{REDD}	Total net GHG emission reductions of the REDD project activity up to year $t*$; t $CO_{2\text{-}e}$
$\Delta C_{BSL-REDD}$	Net GHG emissions in the REDD baseline scenario up to year $t*$; t $CO_{2\text{-}e}$
$\Delta C_{WPS-REDD}$	Net GHG emissions in the REDD project scenario up to year $t*$– from Module MREDD; t $CO_{2\text{-}e}$
$\Delta C_{LK-REDD}$	Net GHG emissions due to leakage from the REDD project activity up to year $t*$; t $CO_{2\text{-}e}$

$$\Delta C_{BSL-REDD} = \Delta C_{BSL,planned} + \Delta C_{BSL,unplanned} + \Delta C_{BSL,\deg rad-FW/C}$$ Equation 26

Where:

$\Delta C_{BSL-REDD}$	Net GHG emissions in the REDD baseline scenario up to year $t*$; t $CO_{2\text{-}e}$
$\Delta C_{BSL,planned}$	Net GHG emissions in the baseline scenario from planned deforestation up to year $t*$; t $CO_{2\text{-}e}$
$\Delta C_{BSL,unplanned}$	Net GHG emissions in the baseline scenario from unplanned deforestation up to year $t*$; t $CO_{2\text{-}e}$
$\Delta C_{BSL,\deg rad-FW/C}$	Net GHG emissions in the baseline scenario from degradation caused by fuelwood collection and charcoal making up to year $t*$; t $CO_{2\text{-}e}$

$$\Delta C_{LK-REDD} = \Delta C_{LK-AS,planned} + \Delta C_{LK-AS,unplanned} + \Delta C_{LK-AS,\deg rad-FW/C} + \Delta C_{LK-ME}$$ Equation 27

Where:

$\Delta C_{LK-REDD}$	Net GHG emissions due to leakage from the REDD project activity up to year $t*$; t $CO_{2\text{-}e}$
$\Delta C_{LK-AS,planned}$	Net GHG emissions due to activity shifting leakage for projects preventing planned deforestation up to year $t*$; t $CO_{2\text{-}e}$
$\Delta C_{LK-AS,unplanned}$	Net GHG emissions due to activity shifting leakage for projects preventing unplanned deforestation up to year $t*$; t $CO_{2\text{-}e}$

$\Delta C_{LK-AS,\mathrm{deg}rad-FW/C}$ Net GHG emissions due to activity shifting leakage for degradation caused by extraction of wood for fuel up to year $t*$; t $CO_{2\text{-}e}$

ΔC_{LK-ME} Net GHG emissions due to market-effects leakage up to year $t*$; t $CO_{2\text{-}e}$

Specific procedures for the quantification of the net GHG emissions in the REDD baseline scenario, the net GHG emissions in the REDD project scenario and GHG emissions due to leakage can be found in Sections 4.1, 4.2 and 4.3, respectively. Total net GHG emission reductions of the REDD project activity are reported in Table 4.12.

Table 4.12. Total net GHG emission reductions of the REDD project activity (t $CO_{2\text{-}e}$) (*ex-ante*).

Year	Estimated baseline emissions or removals ($tCO_{2\text{-}e}$)	Estimated project emissions or removals ($tCO_{2\text{-}e}$)	Estimated leakage emissions ($tCO_{2\text{-}e}$)	Estimated net GHG emission reductions or removals ($tCO_{2\text{-}e}$)
2022-2023	290,989.76	-	31,847.08	259,142.68
2023-2024	297,742.58	-	31,847.08	265,895.50
2024-2025	304,495.39	-	31,847.08	272,648.31
2025-2026	311,248.21	-	31,847.08	279,401.13
2026-2027	318,001.03	-	31,847.08	286,153.95
2027-2028	324,753.85	-	31,847.08	292,906.77
2028-2029	331,506.66	-	31,847.08	299,659.58
2029-2030	338,259.48	-	31,847.08	306,412.40
2030-2031	345,012.30	-	31,847.08	313,165.22
2031-2032	351,765.12	-	31,847.08	319,918.04
2032-2033	61,425.70	-	-	61,425.70
2033-2034	55,323.22	-	-	55,323.22
2034-2035	49,220.74	-	-	49,220.74
2035-2036	43,118.26	-	-	43,118.26
2036-2037	37,015.79	-	-	37,015.79
2037-2038	30,913.31	-	-	30,913.31
2038-2039	24,810.83	-	-	24,810.83
2039-2040	18,708.35	-	-	18,708.35
2040-2041	12,605.87	-	-	12,605.87
2041-2042	6,503.39	-	-	6,503.39
2042-2043	5,853.05	-	-	5,853.05
2043-2044	5,202.71	-	-	5,202.71
2044-2045	4,552.38	-	-	4,552.38
2045-2046	3,902.04	-	-	3,902.04
2046-2047	3,251.70	-	-	3,251.70
2047-2048	2,601.36	-	-	2,601.36
2048-2049	1,951.02	-	-	1,951.02
2049-2050	1,300.68	-	-	1,300.68
2050-2051	650.34	-	-	650.34
2051-2052	-	-	-	-
Total	**3,582,685.11**	**-**	**318,470.80**	**3,264,214.31**

4.4.1 Uncertainty Analysis

VMD0017 v2.2 is used to perform an uncertainty analysis under the ABC project. In order to create an overall uncertainty estimate of the total net GHG emission reductions, this module combines uncertainty information with conservative estimations. Uncertainty in baseline estimations were estimated through an assessment of deforestation rates, stocks in carbon pools and carbon stock changes.

Guidance on uncertainty – a precision target of a 95% confidence interval half-width equal to or less than 15% of the recorded value must be targeted. This is especially important in terms of project planning for measurement of carbon stocks; sufficient measurement plots should be included to achieve this precision level across the measured stocks.

Assess Uncertainty in Projection of Baseline Rate of Deforestation or Degradation

Uncertainty in baseline rate of deforestation is set as zero ($Uncertainty_{BSL,RATE} = 0$), as the deforestation rates are based on actual deforestation plans (BL-PL), following VMD0017 v2.2, Section 5.1.1 criteria.

Assess Uncertainty of Emissions and Removals in Project Area in Baseline Scenario

Uncertainty in the combined carbon stocks and greenhouse gas sources in the REDD baseline scenario is estimated according to VMD0017 v2.2 (Equation 28):

$$Uncertainty_{REDD-BSL,SS} = \frac{\sqrt{\sum_{i=1}^{M}\left(U_{REDD-BSL,SS,i} * E_{REDD-BSL,SS,i}\right)^2}}{\sum_{i=1}^{M} E_{REDD-BSL,SS,i}} \quad \text{Equation 28}$$

Where:

$Uncertainty_{REDD-BSL,SS}$	Total uncertainty in the combined carbon stocks and greenhouse gas sources in the REDD baseline scenario; %
$U_{REDD-BSL,SS,i}$	Percentage uncertainty in the combined carbon stocks and greenhouse gas sources in stratum i in the REDD baseline scenario; %
$E_{REDD-BSL,SS,i}$	Sum of combined carbon stocks and GHG sources in the REDD baseline scenario; t CO_{2-e}
i	1, 2, 3 …M strata; unitless

Uncertainty should be expressed as the 95% confidence interval half width as a percentage of the mean. Uncertainty is first propagated across pools within strata. The percentage uncertainty in the combined carbon stocks and greenhouse gas sources is calculated as follows (Equation 29):

$$U_{REDD-BSL,SS,i} = \frac{\sqrt{\sum_{1}^{n}\left(U_{REDD-BSL,SS,i,pool\#} * E_{REDD-BSL,SS,i,pool\#}\right)^2}}{\sum_{1}^{n} E_{REDD-BSL,SS,i,pool\#}} \quad \text{Equation 29}$$

Where:

$U_{REDD-BSL,SS,i}$	Percentage uncertainty in the combined carbon stocks and greenhouse gas sources in the REDD baseline scenario in stratum *i*; %

$U_{REDD-BSL,SS,i,pool\#}$	Percentage uncertainty for carbon stocks and greenhouse gas sources in the REDD baseline scenario in stratum *i*; %
$E_{REDD-BSL,SS,i,pool\#}$	Carbon stock or GHG sources in the REDD baseline scenario; t CO_{2-e}
i	1, 2, 3 …M strata; unitless

Uncertainty in pools derived from field measurement with 95% confidence interval calculated as the standard error of the averaged plot measurements in each stratum multiplied by the *t value* for the 95% confidence level (1.96).

Estimate Total Uncertainty in REDD Baseline Scenario

Total Uncertainty in REDD baseline scenario is estimated according to VMD0017 v2.2 (Equation 30):

$$Uncertainty_{REDD-BSL,t*} = \sqrt{Uncertainty_{BSL,RATE,t*}{}^{2} + Uncertainty_{REDD-BSL,SS}{}^{2}} \qquad \text{Equation 30}$$

Where:

$Uncertainty_{REDD-BSL,t*}$	Cumulative uncertainty in REDD baseline scenario up to year $t*$; %
$Uncertainty_{BSL,RATE,t*}$	Cumulative uncertainty in the baseline rate of deforestation up to year *t*; %
$Uncertainty_{REDD-BSL,SS}$	Total uncertainty in the combined carbon stocks and greenhouse gas sources in the REDD baseline scenario; %
t	1, 2, 3, …t* time elapsed since the start of the project activity; years

$Uncertainty_{REDD-BSL,t*}$ is equal to $Uncertainty_{REDD-BSL,SS}$ since $Uncertainty_{BSL,RATE,t*}$ is set to zero.

In the ABC project, as the biomass considered for now was from a bibliographic reference, the uncertainty values were obtained by the same reference (Nogueira et al., 2015). Therefore, the uncertainty of Table 4.2 was propagated (standard error−$\sigma_{\bar{x}}$ propagation equations) to the final calculation of the baseline carbon stock and then the percentage uncertainty of the estimate was calculated (Equation 30).

Uncertainty Ex Post in the REDD Project Scenario

As no ex post (re)measurements of carbon pools or GHG sources were made, the uncertainty of these sources is already included in $Uncertainty_{REDD-BSL,t*}$ and $Uncertainty_{REDD-WPS}$ is set to zero.

Total Error in the REDD+ Project Activity

Calculation of leakage is conservative in all instances and therefore uncertainty in leakage is not considered here. Total project uncertainty is therefore equal to the combined uncertainty in baseline and project estimates for the REDD activities (Equation 31). The total error in the REDD+ project activity is therefore calculated according to the scope of the project.

$$NER_{REDD+ERROR} = \sqrt{\left(Uncertainty_{REDD_{BSL},t*} * \Delta C_{BSL-REDD,t*}\right)^2} * \left(\frac{1}{\Delta C_{BSL-REDD,t*}}\right) \qquad \text{Equation 31}$$

Where:

$NER_{REDD+ERROR}$	Cumulative uncertainty for the REDD+ (REDD and WRC) project activities up to year $t*$; %
$Uncertainty_{REDD_{BSL},t*}$	Cumulative uncertainty in REDD baseline scenario up to year t; %
$\Delta C_{BSL-REDD,t*}$	Net GHG emissions in the REDD baseline scenario up to year t*; t CO_{2-e}
t	1, 2, 3, ...t* time elapsed since the project start; year

Therefore, we can consider that the Equation 31 can be simplified to $NER_{REDD+ERROR} = Uncertainty_{REDD_{BSL},t*}$.

Implications for Project Accounting

The allowable uncertainty in this methodology REDD-MF is +/- 15% of NER_{REDD+} at the 95% confidence level. Where uncertainty exceeds 15% of NERREDD+ at the 95% confidence level then the deduction shall be equal to the amount that the uncertainty exceeds the allowable level. The adjusted value for NER_{REDD} to account for uncertainty shall be calculated as described in Equation 32.

$$Adjusted\_NER_{REDD+} = NER_{REDD} * (100\% - NER_{REDD+ERROR} + 15\%) \qquad \text{Equation 32}$$

Where:

$Adjusted\_NER_{REDD+}$	Total net GHG emission reductions of the REDD+ project activities up to year $t*$ adjusted to account for uncertainty; t CO_{2-e}
$NER_{REDD+ERROR}$	Cumulative uncertainty for the REDD+ (REDD and WRC) project activities up to year $t*$; %

Factors related to the activities of the ARR or WRC project were not accounted for because they were not included in the scope of this project. As the uncertainty level was set at +/- 15%, no deductions should result for the uncertainty (Table 4.13).

Table 4.13. Cumulative uncertainty for the REDD+ project activities and Total net GHG emission reductions of the REDD+ project activities up to year *t adjusted to account for uncertainty (t $CO_{2\text{-}e}$) (ex-ante).**

Year	NER_{REDD}	$NER_{REDD+ERROR}$	Adjusted_NER_{REDD+}
	($tCO_{2\text{-}e}$)	%	($tCO_{2\text{-}e}$)
2022-2023	259,142.68	4.66%	259,142.68
2023-2024	265,895.50	4.56%	265,895.50
2024-2025	272,648.31	4.48%	272,648.31
2025-2026	279,401.13	4.39%	279,401.13
2026-2027	286,153.95	4.31%	286,153.95
2027-2028	292,906.77	4.24%	292,906.77
2028-2029	299,659.58	4.16%	299,659.58
2029-2030	306,412.40	4.09%	306,412.40
2030-2031	313,165.22	4.02%	313,165.22
2031-2032	319,918.04	3.96%	319,918.04
2032-2033	61,425.70	5.19%	61,425.70
2033-2034	55,323.22	5.44%	55,323.22
2034-2035	49,220.74	5.72%	49,220.74
2035-2036	43,118.26	6.04%	43,118.26
2036-2037	37,015.79	6.43%	37,015.79
2037-2038	30,913.31	6.89%	30,913.31
2038-2039	24,810.83	7.44%	24,810.83
2039-2040	18,708.35	8.07%	18,708.35
2040-2041	12,605.87	8.52%	12,605.87
2041-2042	6,503.39	2.47%	6,503.39
2042-2043	5,853.05	2.60%	5,853.05
2043-2044	5,202.71	2.76%	5,202.71
2044-2045	4,552.38	2.95%	4,552.38
2045-2046	3,902.04	3.19%	3,902.04
2046-2047	3,251.70	3.49%	3,251.70
2047-2048	2,601.36	3.91%	2,601.36
2048-2049	1,951.02	4.51%	1,951.02
2049-2050	1,300.68	5.53%	1,300.68
2050-2051	650.34	7.81%	650.34
2051-2052	-	-	-
Total	**3,264,214.31**		**3,264,214.31**

4.4.2 Calculation of AFOLU Pooled Buffer Account Contribution

The number of credits to be held in the AFOLU pooled buffer account is determined as a percentage of the total carbon stock benefits. For this project, this is equal to the net GHG emissions in the baseline minus the net emissions in the project case. Leakage emissions do not factor into the buffer calculations. Non_CO_2 emissions from fossil fuels and fertilizer usage were conservatively excluded from the project scope. Buffer is calculated through VM0007 v1.6 (Equation 33).

$$Buffer_{planeed} = \left(\left(\Delta C_{BSL,planeed} - \sum_{\substack{t=1 \\ BSL\ planned}}^{t*} \sum_{i=1}^{M} \left(E_{FC,i,t} + N_2O_{direct,i,t} \right) \right) - \left(\Delta C_{P,planned} - \sum_{\substack{t=1 \\ P\ planeed}}^{t*} \sum_{i=1}^{M} \left(E_{FC,i,t} + N_2O_{direct,i,t} \right) \right) \right) * Buffer\%$$

Equation 33

Where:

$Buffer_{planeed}$	Buffer withholding for avoiding planned deforestation project activities; t CO_{2-e}
$\Delta C_{BSL,planeed}$	Net greenhouse gas emissions in the baseline from planned deforestation up to year t*; t CO_{2-e}
$E_{FC,i,t}$	Net CO_{2-e} emission from fossil fuel combustion in stratum i in year t; t CO_{2-e}
$N_2O_{direct,i,t}$	Direct N2O emission as a result of nitrogen application on the alternative land use within the project boundary in stratum i in year t; t CO_{2-e}
$\Delta C_{P,planned}$	Net GHG emissions within the project area in the project scenario; t CO_{2-e}
$Buffer\%$	Buffer withholding percentage; %

The buffer pool allocation was estimated using the AFOLU Non-Permanence Risk Tool v.4.0 and the resulting value for the second baseline period was 10%.

4.4.3 Calculation of Verified Carbon Units

Total number of Verified Carbon Units (VCUs) generated by the project activity implementation is estimated (*ex-ante*) according to VM0007 v1.6 (Equation 34). It is important to remember that only ex-ante estimates were considered.

$$VCU_t = Adjusted_{NER_{REDD+}} - Buffer_{Planned}$$

Equation 34

Where:

VCU_t	Number of Verified Carbon Units at year t = t2 - t1; VCU

$Adjusted_{NER_{REDD+}}$	Total net GHG emission reductions of the REDD+ project activity up adjusted to account for uncertainty; t CO_{2-e}
$Buffer_{Planned}$	Total permanence risk buffer withholding; t CO_{2-e}

Hence, the estimated net GHG emission reductions or removals result from the difference between (i) the net GHG emission reductions or removals and (ii) buffer pool allocation (Table 4.14).

Table 4.14. Total net GHG emission reductions of the REDD project activity (t CO_{2-e}) (ex-ante) and Buffer pool allocation (t CO_{2-e}).

Year	Estimated net GHG emission reductions or removals or $Adjusted\_NER_{REDD+}$ (t CO_{2-e})	Buffer pool allocation (t CO_{2-e})	VCU_t (t CO_{2-e})
2022-2023	259,142.68	25,914.27	233,228
2023-2024	265,895.50	26,589.55	239,305
2024-2025	272,648.31	27,264.83	245,383
2025-2026	279,401.13	27,940.11	251,461
2026-2027	286,153.95	28,615.39	257,538
2027-2028	292,906.77	29,290.68	263,616
2028-2029	299,659.58	29,965.96	269,693
2029-2030	306,412.40	30,641.24	275,771
2030-2031	313,165.22	31,316.52	281,848
2031-2032	319,918.04	31,991.80	287,926
2032-2033	61,425.70	6,142.57	55,283
2033-2034	55,323.22	5,532.32	49,790
2034-2035	49,220.74	4,922.07	44,298
2035-2036	43,118.26	4,311.83	38,806
2036-2037	37,015.79	3,701.58	33,314
2037-2038	30,913.31	3,091.33	27,821
2038-2039	24,810.83	2,481.08	22,329
2039-2040	18,708.35	1,870.84	16,837
2040-2041	12,605.87	1,260.59	11,345
2041-2042	6,503.39	650.34	5,853
2042-2043	5,853.05	585.31	5,267
2043-2044	5,202.71	520.27	4,682
2044-2045	4,552.38	455.24	4,097
2045-2046	3,902.04	390.20	3,511
2046-2047	3,251.70	325.17	2,926
2047-2048	2,601.36	260.14	2,341
2048-2049	1,951.02	195.10	1,755
2049-2050	1,300.68	130.07	1,170
2050-2051	650.34	65.03	585
2051-2052	-	-	-
Total	3,264,214.31	326,421.43	2,937,792

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	$AA_{planned,i,t}$
Data unit	ha
Description	Annual area of baseline planned deforestation for stratum *i* at time *t*
Source of data	Calculated based on VMD0006 v1.3 equation 4
Value applied	See the values applied in the Table 4.1
Justification of choice of data or description of measurement methods and procedures applied	Estimated based on projected annual proportion of land that will be deforested in stratum i during year t, the total area of planned deforestation over the baseline period for stratum I and the likelihood of deforestation for stratum i according to VMD0006 v1.3.
Purpose of Data	Calculation of baseline emissions.
Comments	-

Data / Parameter	$A_{planned,i}$
Data unit	ha
Description	Projected annual proportion of land that will be deforested in stratum *i* during year *t*.
Source of data	Vegetation Management Plan
Value applied	5,140.20
Justification of choice of data or description of measurement methods and procedures applied	Determined according to what is recognized as an immediate site-specific threat of deforestation, which, in its turn, is a function of the legal permissibility for deforestation, the suitability of the project area for conversion to alternative non-forest land use, the government approval for deforestation and a management plan for deforesting the project area. See Section 3.4 for a complete description of measurement methods and procedures applied.
Purpose of Data	Calculation of baseline emissions.
Comments	-

Data / Parameter	$D\%_{planned,i,t}$

Data unit	%
Description	Total area of planned deforestation over the baseline period for stratum *i*
Source of data	Vegetation Management Plan
Value applied	10%
Justification of choice of data or description of measurement methods and procedures applied	Where a valid verifiable plan exists for rate at which deforestation is projected to occur, this rate must be used, according to VMD0006 v1.3, Section 1.3 criteria.
Purpose of Data	Determination of baseline scenario.
Comments	-

Data / Parameter	$L - D_i$
Data unit	%
Description	Likelihood of deforestation for stratum *i*
Source of data	VMD0006 v1.3
Value applied	100
Justification of choice of data or description of measurement methods and procedures applied	For all areas not both under Government control and zoned for deforestation, L-Di must be equal to 1. Must be revisited at the time of baseline revision
Purpose of Data	Determination of baseline scenario
Comments	-

Data / Parameter	CF
Data unit	t C t d.m^{-1}
Description	Default value of carbon fraction in biomass
Source of data	(IPCC, 2006b) page 4.48, Table 4.3
Value applied	0.47

Justification of choice of data or description of measurement methods and procedures applied	The default value was used to be more conservative
Purpose of Data	• Calculation of baseline emissions • Calculation of leakage
Comments	-

Data / Parameter	ab
Data unit	Mg ha^{-1}
Description	Average biomass stock per hectare in the aboveground biomass pool of initial forest class *i*
Source of data	Nogueira et al., 2015
Value applied	See the values applied in the Table 4.2
Justification of choice of data or description of measurement methods and procedures applied	Average biomass stock per hectare in the aboveground biomass pool was estimated based on peer-reviewed literature
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$C_{AB_{tree_{bsl}},i}$
Data unit	t $CO_{2\text{-}e}$ ha^{-1}
Description	Forest carbon stock in aboveground tree biomass in stratum *i*
Source of data	Estimated based on peer-reviewed literature (Nogueira et al., 2015).
Value applied	550.76
Justification of choice of data or description of measurement methods and procedures applied	Forest carbon stock in aboveground tree biomass was estimated based on peer-reviewed literature $C_{AB_{tree_{bsl}},i} = \mathrm{ab} * \mathrm{CF} * \frac{44}{12}$

Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$C_{AB_{tree_{post}},i}$
Data unit	t $CO_{2\text{-}e}$ ha^{-1}
Description	Post-deforestation carbon stock in aboveground tree biomass in stratum *i*
Source of data	Secondary data from peer-reviewed literature (Silva Neto et al., 2012)
Value applied	13.56
Justification of choice of data or description of measurement methods and procedures applied	Post-deforestation carbon stock in aboveground tree biomass is taken from peer reviewed literature (Silva Neto et al., 2012) considering an average degradation and the total dry mass
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$\Delta C_{AB_{tree},i}$
Data unit	t $CO_{2\text{-}e}$ ha^{-1}
Description	Baseline carbon stock change in aboveground tree biomass in stratum *i*
Source of data	Calculated based on VMD0006 v1.3 Equation 6
Value applied	537.20
Justification of choice of data or description of measurement methods and procedures applied	Estimated based on the forest carbon stock in aboveground tree biomass in stratum *i* and the post-deforestation carbon stock in aboveground tree biomass in stratum *i* $\Delta C_{AB_{tree},i} = C_{AB_{tree_{bsl}},i} - C_{AB_{tree_{post}},i}$
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	44/12
Data unit	Dimensionless
Description	Ratio converting C to CO_{2-e}
Source of data	-
Value applied	44/12 = 3.67
Justification of choice of data or description of measurement methods and procedures applied	Conversion of carbon to carbon dioxide
Purpose of Data	• Calculation of baseline emissions • Calculation of leakage
Comments	-

Data / Parameter	bb
Data unit	Mg ha^{-1}
Description	Average biomass stock per hectare in the belowground biomass pool of initial forest class *i*
Source of data	The aboveground is converted into belowground biomass through a root-shoot ratio
Value applied	See the values applied in the Table 4.2
Justification of choice of data or description of measurement methods and procedures applied	Average biomass stock per hectare in the belowground biomass pool was estimated based on peer-reviewed literature and through a root-shoot ratio
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	Root-shoot ratio
Data unit	t root d.m.t^{-1} shoot d.m.
Description	Root to shoot ratio appropriate to species or forest type / biome; note that as defined here, root to shoot ratio is applied as

	belowground biomass per unit area: aboveground biomass per unit area (not on a per stem basis)
Source of data	IPCC, 2019 – Table 4.4
Value applied	0.221
Justification of choice of data or description of measurement methods and procedures applied	The ecological zone was selected as a Tropical Rain Forest on the South American continent
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$C_{BB_{tree_{bsl}},i}$
Data unit	t $CO_{2\text{-}e}$ ha^{-1}
Description	Forest carbon stock in belowground tree biomass in stratum *i*
Source of data	Estimated based on peer-reviewed literature (Silva Neto et al., 2012)
Value applied	121.72
Justification of choice of data or description of measurement methods and procedures applied	Calculated from carbon stock in aboveground biomass in trees in the baseline in stratum *i* and root to shoot ratios $C_{BB\_tree,bsl,i} = bb * CF * \frac{44}{12}$
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$C_{BB_{tree_{post}},i}$
Data unit	t $CO_{2\text{-}e}$ ha^{-1}
Description	Post-deforestation carbon stock in belowground tree biomass in stratum *i*
Source of data	Estimated based on peer-reviewed literature (Silva Neto et al., 2012)
Value applied	3.00

Justification of choice of data or description of measurement methods and procedures applied	Post-deforestation carbon stock in belowground tree is taken from peer reviewed literature (Silva Neto et al., 2012) considering an average degradation and the total dry mass
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$\Delta C_{BB\_tree,i}$
Data unit	t $CO_{2\text{-}e}$ ha^{-1}
Description	Baseline carbon stock change in belowground tree biomass in stratum *i*
Source of data	Calculated based on VMD0006 v1.3 Equation 8
Value applied	118.72
Justification of choice of data or description of measurement methods and procedures applied	Estimated based on the forest carbon stock in aboveground tree biomass in stratum *i* and the post-deforestation carbon stock in aboveground tree biomass in stratum *i* $\Delta C_{BB\_tree,i} = C_{BB_{tree_{bsl}},i} - C_{BB_{tree_{post}},i}$
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$C_{WP,i}$
Data unit	t $CO_{2\text{-}e}$ ha^{-1}
Description	Carbon stock entering the wood products pool from stratum *i*
Source of data	Calculated based on VMD0005 v1.1 equation 2
Value applied	30.12
Justification of choice of data or description of measurement methods and procedures applied	Estimated based on mean stock of extracted biomass carbon by class of wood product ty from stratum *i* and the wood waste (the fraction immediately emitted through mill inefficiency by class of wood product)
Purpose of Data	Calculation of baseline emissions

Comments	-

Data / Parameter	$C_{XB,ty,i}$
Data unit	t CO_{2-e} ha^{-1}
Description	Mean stock of extracted biomass carbon by class of wood product ty from stratum *i*
Source of data	Calculated based on VMD0005 v1.1 equation 1
Value applied	39.64
Justification of choice of data or description of measurement methods and procedures applied	Estimated based on volume of timber extracted from stratum *i* (does not include slash left onsite) by species *j* and wood product class *ty* measurement methods and procedures applied, mean wood density of species *j*, carbon fraction and the total area of stratum
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	WW_{ty}
Data unit	Dimensionless
Description	Wood waste. The fraction immediately emitted through mill inefficiency by class of wood product *ty*
Source of data	Pearson et al. (2012), page 8
Value applied	0.24
Justification of choice of data or description of measurement methods and procedures applied	Waste wood gives the proportion emitted immediately due to factory inefficiency which is 0.19 in developed countries, 0.24 in developing countries.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$V_{ex,ty,j,i}$

Data unit	$m^3\ ha^{-1}$
Description	Volume of timber extracted from within stratum *i* (does not include slash left onsite) by species *j* and wood product class *ty*
Source of data	da SILVA et al., 2001; Veríssimo et al., 1992, Table 1
Value applied	38.3
Justification of choice of data or description of measurement methods and procedures applied	Estimated value based on the average of the values presented in Table 1 by Veríssimo et al., 1992 for a forest stratum similar to the ABC project
Purpose of Data	• Calculation of baseline emissions • Calculation of leakage
Comments	-

Data / Parameter	D_j
Data unit	$t\ d.m.m^{-3}$
Description	Mean wood density of species *j*
Source of data	Default value of VMD0011 LK-ME v1.1
Value applied	0.60
Justification of choice of data or description of measurement methods and procedures applied	Regional average (0.58 $t\ d.m.m^{-3}$ - tropical Africa; 0.60 $t\ d.m.m^{-3}$ - tropical America; 0.57 $t\ d.m.m^{-3}$ - tropical Asia) from Brown, S. 1997. Estimating Biomass and Biomass Change of Tropical Forests: a Primer. For the Food and Agriculture Organization of the United Nations. Rome, 1997. FAO Forestry Paper - 134. ISBN 92-5-103955-0.
Purpose of Data	• Calculation of baseline emissions • Calculation of leakage
Comments	-

Data / Parameter	$C_{WP100,i}$
Data unit	$t\ CO_{2-e}\ ha^{-1}$

Description	Carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 100 years from stratum *i*
Source of data	Calculated based on VMD0005 v1.1 equation 3
Value applied	25.30
Justification of choice of data or description of measurement methods and procedures applied	Estimated base on carbon stock entering wood products pool at time of deforestation from stratum *i*, fraction of wood products that will be emitted to the atmosphere within 5 years of timber harvest by class of wood product *ty*, and Fraction of wood products that will be emitted to the atmosphere between 5 and 100 years of timber harvest by class of wood product *ty*
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	SLF_{ty}
Data unit	Dimensionless
Description	Fraction of wood products that will be emitted to the atmosphere within 5 years of timber harvest by class of wood product *ty*
Source of data	page 276, (Winjum et al., 1998) and page 8, (Pearson et al., 2012)
Value applied	0.2
Justification of choice of data or description of measurement methods and procedures applied	Winjum et al. 1998 give the following proportions for wood products with short-term (<5 yr) uses after which they are retired and oxidized (applicable internationally): Sawnwood: 0.2 The methodology makes the assumption that all other classes of wood products, and where wood product class ty is unknown, are 100% oxidized within 5 years
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	Of_{ty}
Data unit	Dimensionless

Description	Fraction of wood products that will be emitted to the atmosphere between 5 and 100 years of timber harvest by class of wood product *ty*
Source of data	page 276, (Winjum et al., 1998) and page 8, (Pearson et al., 2012)
Value applied	0.8
Justification of choice of data or description of measurement methods and procedures applied	Default value suggested by Winjun et al., 1998
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$GHG_{BSL,i,t}$
Data unit	t $CO_{2\text{-}e}$
Description	Greenhouse gas emissions as a result deforestation activities within the project boundary in the stratum *i* in year *t*
Source of data	Calculated based on VMD0006 v1.3 equation 15
Value applied	See the values applied in the Table 4.10
Justification of choice of data or description of measurement methods and procedures applied	Calculated based on the non-CO_2 emissions due to biomass burning in stratum *i* in year *t*
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$E_{BiomassaBurn,i,t}$
Data unit	t $CO_{2\text{-}e}$
Description	Non-CO_2 emissions due to biomass burning in stratum *i* in year *t*
Source of data	Calculated based on VMD0013 v1.2 equation 1
Value applied	See the values applied in the Table 4.9

Justification of choice of data or description of measurement methods and procedures applied	Calculated based on area burnt for stratum *i* in year *t*, average aboveground biomass stock before burning stratum *i*, in year *t*, combustion factor for stratum *i*, emission factor for stratum *i* for gas *g* and the Global warming potential for gas *g*
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$A_{burn,i,t}$
Data unit	ha
Description	Area burnt for stratum *i* in year *t*
Source of data	Equal to $AA_{planned,i,t}$ in the baseline case
Value applied	See the values applied in the Table 4.9
Justification of choice of data or description of measurement methods and procedures applied	For the calculation of baseline emissions, the burned area is considered equivalent to the annual deforested area, assuming that all deforestation is preceded by a fire to clear the land in the baseline case
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$B_{i,t}$
Data unit	t d.m. ha^{-1}
Description	Average aboveground biomass stock before burning stratum *i* in year *t*
Source of data	Calculated based on VMD0013 v1.3 Equation 2
Value applied	319.59
Justification of choice of data or description of measurement methods and procedures applied	Calculated based on carbon stock in aboveground biomass in trees in stratum *i* in year *t*, Carbon stock in dead wood for stratum *i* in year *t*, Carbon stock in litter for stratum *i* in year *t* and Carbon fraction of biomass
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$COMF_i$
Data unit	Dimensionless
Description	Combustion factor for stratum *i*
Source of data	Table 2.6, page 2.55, IPCC (2006a)
Value applied	0.59
Justification of choice of data or description of measurement methods and procedures applied	Default values in Table 2.6 of IPCC, 2006a
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$G_{g,i}$
Data unit	kg t^{-1} d.m. burnt
Description	Emission factor for stratum *i* for gas *g*
Source of data	Table 2.5, page 2.54, IPCC (2006a)
Value applied	G_{g,CH_4} = 6.8 kg t^{-1}, G_{g,NO_2} = 0.2 kg t^{-1}
Justification of choice of data or description of measurement methods and procedures applied	Default values in Table 2.6 of IPCC, 2006a
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	GWP_g
Data unit	t CO_2/t gas g
Description	Global warming potential for gas *g*
Source of data	Box 3.2, Table 1, page 87, IPCC (2014)

Value applied	GWP_{CH_4} = 28 t CO_2 t_{gas}^{-1}, GWP_{NO_2} = 265 t CO_2 t_{gas}^{-1}
Justification of choice of data or description of measurement methods and procedures applied	Default factor from the latest IPCC Assessment Report
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$C_{AB_{tree},i,t}$
Data unit	t CO_{2-e} ha^{-1}
Description	Carbon stock in aboveground biomass in trees in stratum *i* in year *t*
Source of data	Estimated based on peer-reviewed literature (Nogueira et al., 2015)
Value applied	550.76
Justification of choice of data or description of measurement methods and procedures applied	Forest carbon stock in aboveground tree biomass was estimated based on peer-reviewed literature $C_{AB_{tree_{bsl},i}} = \text{ab} * \text{CF} * \frac{44}{12}$
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	12/44
Data unit	Dimensionless
Description	Ratio converting CO_{2-e} to C
Source of data	-
Value applied	12/44 = 0.27
Justification of choice of data or description of measurement methods and procedures applied	Conversion of carbon dioxide to carbon

Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$\Delta C_{BSL,i,t}$
Data unit	t CO_{2-e}
Description	Net carbon stock changes in all pools in the baseline stratum *i* in year *t*
Source of data	Calculated based on VMD0006 v1.3 Equation 13
Value applied	See the values applied in the Table 4.10
Justification of choice of data or description of measurement methods and procedures applied	Estimated based on the annual area of baseline planned deforestation for stratum *i* in year *t*, the baseline carbon stock change in aboveground tree biomass in stratum *i*, the baseline carbon stock change in belowground tree biomass in stratum *i*, the baseline carbon stock change in wood products in stratum *i*, and the carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 100-years from stratum *i*.
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	$\Delta C_{BSL,planned}$
Data unit	t CO_{2-e}
Description	Net greenhouse gas emissions in the baseline from planned deforestation up to year $t*$
Source of data	Calculated based on VMD0006 v1.3 Equation 1
Value applied	See the values applied in the Table 4.10
Justification of choice of data or description of measurement methods and procedures applied	Estimated based on the net carbon stock changes in all pools in the baseline and GHG emissions as a result of deforestation activities within the project boundary in the baseline stratum *i* in year *t*
Purpose of Data	Calculation of baseline emissions
Comments	-

Data / Parameter	ΔC_{LK-ME}
Data unit	t CO_{2-e}
Description	Net greenhouse gas emissions due to market-effects leakage
Source of data	Calculated based on VMD0011 v1.1 Equation 1
Value applied	See the values applied in the Table 4.11
Justification of choice of data or description of measurement methods and procedures applied	Total leakage due to market effects is equal to the sum of market-effects leakage through decreased timber harvest and decreased harvest for fuelwood / charcoal production
Purpose of Data	Calculation of leakage
Comments	-

Data / Parameter	$LK_{MarketEffects,timber}$
Data unit	t CO_{2-e}
Description	Total GHG emissions due to market-effects leakage through decreased timber harvest
Source of data	Calculated based on VMD0011 v1.1 Equation 2
Value applied	See the values applied in the Table 4.11
Justification of choice of data or description of measurement methods and procedures applied	Leakage due to market effects is equal to the baseline emissions from logging multiplied by a leakage factor and, where applicable, by a leakage management factor
Purpose of Data	Calculation of leakage
Comments	-

Data / Parameter	LF_{ME}
Data unit	Dimensionless
Description	Leakage factor for market-effects calculations

Source of data	VMD0011 LK-ME v1.1
Value applied	0.4
Justification of choice of data or description of measurement methods and procedures applied	When the mean biomass is equal 15% to the biomass within the project boundaries, the LF_{ME} shall be considered 0.4. In the ABC project, the biomass of the total trees aboveground is considered equal in the Amazon Biome and in the Project Area
Purpose of Data	Calculation of leakage
Comments	-

Data / Parameter	LK_{MAF}
Data unit	Dimensionless
Description	Leakage management adjustment factor
Source of data	Calculated based on VMD0011 v1.1 Equation 3
Value applied	1
Justification of choice of data or description of measurement methods and procedures applied	As leakage management activities have not been established within areas under the control of the proponent and according to Higuchi et al. (1998), that the proportion of stem biomass (marketable portion) to total aboveground biomass is constant in mature Amazonian forests, the LK_{MAF} was kept at 1.
Purpose of Data	Calculation of leakage
Comments	-

Data / Parameter	$C_{BSL,XBT,i,t}$
Data unit	t CO_{2-e}
Description	Carbon emission due to displaced timber harvests in the baseline scenario in stratum *i* in year *t*
Source of data	Calculated based on VMD0011 v1.1 Equation 5
Value applied	See the values applied in the Table 4.11
Justification of choice of data or description of	The carbon emission due to the displaced logging has two components: the biomass carbon of the extracted timber and the

measurement methods and procedures applied	biomass carbon in the forest damaged in the process of timber extraction
Purpose of Data	Calculation of leakage
Comments	-

Data / Parameter	LDF
Data unit	t C m^{-3}
Description	Logging damage factor
Source of data	VMD0011 LK-ME v1.1
Value applied	0.53
Justification of choice of data or description of measurement methods and procedures applied	Default value for broadleaf and mixed forests of 0.53 t C m^{-3}. Default value for broadleaf and mixed forests of 0.53 t C m^{-3} from 774 logging gaps measured by Winrock International in Bolivia, Belize, the Republic of Congo, Brazil and Indonesia may be used for tropical broadleaf forests
Purpose of Data	Calculation of leakage
Comments	-

Data / Parameter	LIF
Data unit	t C m^{-3}
Description	Logging infrastructure factor
Source of data	VMD0011 LK-ME v1.1
Value applied	0.29
Justification of choice of data or description of measurement methods and procedures applied	Conservative default value of 0.29 t C m^{-3} calculated from 1,839 hectares of logging concessions analysed by Winrock International in the Republic of Congo and Brazil, may be used for tropical broadleaf forests
Purpose of Data	Calculation of leakage
Comments	-

5.2 Data and Parameters Monitored

Data / Parameter	Project Forest Cover Monitoring Map
Data unit	N/A
Description	Map showing the location of forest land within the project area at the beginning of each monitoring period. If within the Project Area some forest land is cleared, the benchmark map must show the deforested areas at each monitoring event.
Source of data	Remote sensing in combination with GPS data collected during ground truthing
Description of measurement methods and procedures to be applied	The measurement methods and procedures applied are described in Approved VCS Module VMD0015-M-REDD-v2.2 - methods for monitoring of GHG emissions and removals in REDD and CIW projects.
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	N/A
Monitoring equipment	Remote sensing and GPS.
QA/QC procedures to be applied	The minimum map accuracy must be 90% for the classification of forest/non-forest in the remote sensing imagery. If the classification accuracy is less than 90% then the map is not acceptable for further analysis. More remote sensing data and ground truthing data will be needed to produce a product that reaches the 90% minimum mapping accuracy.
Purpose of data	• Calculation of baseline emissions • Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	$A_{burn,i,t}$
Data unit	ha
Description	Area burnt for stratum *i* in year *t*
Source of data	Remote sensing data

Description of measurement methods and procedures to be applied	It is considered that burning is a common practice in the region, and that all deforested area undergoes burning in a given moment
Frequency of monitoring/recording	Areas burnt will be monitored every 5 years or if verification occurs on a frequency of less than every 5 years, examination will occur prior to any verification event
Value applied	N/A
Monitoring equipment	Remote sensing and GPS
QA/QC procedures to be applied	Best practices in remote sensing and GIS: 1) Land use and land cover mapping is assessed using Landsat satellites images with resolution 30 meters (MapBiomas, 2022a) validating through a pixel-by-pixel based machine learning algorithms classification using Google Earth Engine. 2) The Mapbiomas methodology uses image with minimal cloud cover product of Landsat scenes mosaicked from various months of the year (MapBiomas, 2022a). 3) An independent verifiable accuracy assessment was performed using high-resolution image with 5 m resolution from Planet Image to confirm the minimum map accuracy of 90% for each land use class used. 4) Conservatively the secondary forest is eliminated of the forest class according to Silva Junior et al. (2020). Also, with the objective of reducing the classification error between forest cover maps, a PRODES hydrography mask was downloaded by TerraBrasilis plataform is added in each forest cover maps map, in this way, this land use class remained unchanged in all years (Assis et al., 2019)
Purpose of data	• Calculation of baseline emissions • Calculation of project emissions
Calculation method	N/A
Comments	As burning of biomass is common practice in the region, it was considered that all the deforested areas were burnt – deforestation cycle includes burning

Data / Parameter	$AA_{planned,i,t}$

Data unit	ha
Description	Annual area of baseline planned deforestation for stratum *i* at time *t*
Source of data	Calculated according to VMD0006 v1.3, Equation 5
Description of measurement methods and procedures to be applied	Calculated based on the Projected annual proportion of land that will be deforested in stratum *i* during year *t*, Total area of planned deforestation over the baseline period for stratum *i* and Likelihood of deforestation for stratum *i*
Frequency of monitoring/recording	Must be monitored every 5 years or if verification occurs on a frequency of less than every 5 years, examination will occur prior to any verification event
Value applied	See the values applied in the Table 4.1
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of baseline emissions
Calculation method	VMD0006 v1.3, Equation 5
Comments	-

Data / Parameter	$A_{planned,i}$
Data unit	ha
Description	Projected annual proportion of land that will be deforested in stratum *i* during year *t*
Source of data	Forest suppression plan
Description of measurement methods and procedures to be applied	According to the Forest Suppression Plan
Frequency of monitoring/recording	Must be examined at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	See the values applied in the Table 4.1

Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of baseline emissions
Calculation method	N/A
Comments	-

Data / Parameter	$A_{DefPA,u,i,t}$
Data unit	ha
Description	Area of recorded deforestation in the project area stratum *i* converted to land use *u* in year *t*
Source of data	Remote sensing data
Description of measurement methods and procedures to be applied	Remote sensing tools
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	N/A
Monitoring equipment	Remote sensing and GPS
QA/QC procedures to be applied	Best practices in remote sensing and GIS: 1) Land use and land cover mapping is assessed using Landsat satellites images with resolution 30 meters (MapBiomas, 2022a) validating through a pixel-by-pixel based machine learning algorithms classification using Google Earth Engine. 2) The Mapbiomas methodology uses image with minimal cloud cover product of Landsat scenes mosaicked from various months of the year (MapBiomas, 2022a). 3) An independent verifiable accuracy assessment was performed using high-resolution image with 5 m resolution from Planet Image to confirm the minimum map accuracy of 90% for each land use class used.

	4) Conservatively the secondary forest is eliminated of the forest class according to Silva Junior et al. (2020). Also, with the objective of reducing the classification error between forest cover maps, a PRODES hydrography mask was downloaded by TerraBrasilis plataform is added in each forest cover maps map, in this way, this land use class remained unchanged in all years (Assis et al., 2019)
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	-

Data / Parameter	$\Delta C_{P,DefPA,i,t}$
Data unit	t CO_{2-e}
Description	Net carbon stock change as a result of deforestation in the project area in the project case in stratum *i* in year *t*
Source of data	Calculated according to VMD0015 v2.2, Equation 3
Description of measurement methods and procedures to be applied	Calculated based on the area of recorded deforestation in the project area stratum *i* converted to land use *u* at time *t* and the net carbon stock changes in all pools in the project case in land use *u* in stratum *i* at time *t*
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emissions
Calculation method	VMD0015 v2.2, Equation 3
Comments	-

Data / Parameter	$\Delta C_{pools,Def,u,i,t}$

Data unit	t $CO_{2\text{-}e}$ ha^{-1}
Description	Net carbon stock changes in all pools as a result of deforestation in the project case in land use u in stratum *i* in year *t*
Source of data	Calculated according to VMD0015 v2.2, Equation 5
Description of measurement methods and procedures to be applied	Calculated based on carbon stock in all pools in the baseline case in stratum *i*, carbon stock in all pools in post-deforestation land use *u* in stratum *i* and carbon stock sequestered in wood products from harvests in stratum *i*
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emissions
Calculation method	VMD0015 v2.2, Equation 5
Comments	-

Data / Parameter	$GHG_{P,E,i,t}$
Data unit	t $CO_{2\text{-}e}$
Description	Greenhouse gas emissions as a result of deforestation activities within the project area in the project case in stratum *i* in year *t*
Source of data	Calculated based on VMD0015 v2.2 Equation 30
Description of measurement methods and procedures to be applied	Calculated based on the non-CO_2 emissions due to biomass burning in stratum *i* in year *t*
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	N/A
Monitoring equipment	N/A

QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emissions
Calculation method	VMD0015 v2.2 Equation 30
Comments	-

Data / Parameter	$E_{BiomassBurn,i,t}$
Data unit	t $CO_{2\text{-}e}$
Description	Greenhouse gas emissions due to biomass burning in stratum *i* in year t of each GHG (CO_2, CH_4, N_2O)
Source of data	Calculated based on VMD0013 v1.2 Equation 1
Description of measurement methods and procedures to be applied	Calculated based on area burnt for stratum *i* in year *t*, average aboveground biomass stock before burning stratum *i*, in year *t* combustion factor for stratum *i*, emission factor for stratum *i* for gas *g* and the Global warming potential for gas *g*
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	See the values applied in the Table 4.9
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emissions
Calculation method	VMD0013 v1.2 Equation 1
Comments	-

Data / Parameter	A_{sp}
Data unit	ha
Description	Area of sample plots in biomass inventory
Source of data	Recording and archiving of number and size of sample plots
Description of measurement methods and procedures to be applied	Cluster plot in Maltese cross setup with four rectangular sub-plots with 0.1 ha (10 m x 100 m) each
Frequency of monitoring/recording	Must be re-evaluated whenever the baseline is revised
Value applied	N/A
Monitoring equipment	GPS and measuring tape
QA/QC procedures to be applied	GPS coordinates are double checked in the field
Purpose of data	Calculation of baseline emissions
Calculation method	N/A
Comments	The biomass inventory will be estimated according to the Standard Operating Procedure (SOP)[34]

Data / Parameter	n
Data unit	Dimensionless
Description	Number of sample plots
Source of data	Recording and archiving of number of sample points
Description of measurement methods and procedures to be applied	Calculated with statistic equation

[34] Annex: SOP - Standard Operating Procedure.pdf

Frequency of monitoring/recording	Must be re-evaluated whenever the baseline is revised
Value applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	Standard statistic equation
Purpose of data	Calculation of baseline emissions
Calculation method	Calculated using the following formula: $$n = \frac{(t^2 \times CV^2)}{\left(E\%^2 + \left(\frac{t^2 \times CV^2}{N}\right)\right)}$$ Where: n Number of parcels sampled in each stratum (variable for each stratum) t Student t value at 90% of confidence level for (n-1) degree of freedom. CV Coefficient of variation (%) (variable for each stratum) $E\%$ Permissible sampling error (10%) N Number of parcels in total stratum area (variable for each stratum)
Comments	The biomass inventory will be estimated according to the Standard Operating Procedure (SOP)[35]

Data / Parameter	DBH
Data unit	cm
Description	Diameter at breast height of a tree in cm
Source of data	Field measurements in sample plots

[35] Annex: SOP - Standard Operating Procedure.pdf

Description of measurement methods and procedures to be applied	Measured 1.3m above ground. Measure all trees above some minimum DBH (≥ 10 cm) in the sample plots
Frequency of monitoring/recording	Must be re-evaluated whenever the baseline is revised. Where carbon stock enhancement is included, monitoring shall occur at least every five years
Value applied	N/A
Monitoring equipment	Measuring tape
QA/QC procedures to be applied	Standard quality control procedures for forest inventory including field data collection and data management were applied. The procedure of DBH measurement is already applied in national forest monitoring and is available from published handbooks, and from Penman et al. (2003) (an example of a handbook is MacDicken (1997)).
Purpose of data	Calculation of baseline emissions
Calculation method	Diameter (DBH) is calculated based on circumference at breast height (CBH) measurement, by means of the basic perimeter equation: $$DBH = \frac{CBH}{\pi}$$
Comments	The biomass inventory will be estimated according to the Standard Operating Procedure (SOP)[36]

Data / Parameter	$B_{i,t}$
Data unit	t d.m. ha^{-1}
Description	Average aboveground biomass stock before burning stratum *i* in year *t*
Source of data	Calculated based on VMD0013 v1.2 Equation 2
Description of measurement methods	Calculated based on the Carbon stock in aboveground biomass in trees in stratum *i* in year *t* and Carbon fraction of biomass

[36] Annex: SOP - Standard Operating Procedure.pdf

and procedures to be applied	
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	See the values applied in the Table 4.9
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	• Calculation of baseline emissions • Calculation of leakage
Calculation method	VMD0013 v1.2 Equation 2
Comments	-

Data / Parameter	$\Delta C_{WPS-REDD}$
Data unit	t CO_{2-e}
Description	Net GHG emissions in the REDD project scenario up to year $t*$
Source of data	Calculated according to VMD0015 v2.2, Equation 1
Description of measurement methods and procedures to be applied	Calculated based on net carbon stock change as a result of deforestation in the project area in the project case in stratum *i* in year *t*, Net carbon stock change as a result of degradation in the project area in the project case in stratum *i* in year *t*, Net carbon stock change as a result of natural disturbance in the project area in the project case in stratum *i* in year *t* and Greenhouse gas emissions as a result of deforestation and degradation activities within the project area in the project case in stratum *i* in year *t*
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	N/A
Monitoring equipment	N/A

QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emissions
Calculation method	VMD0015 v2.2, Equation 1
Comments	-

Data / Parameter	$\Delta C_{LK-REDD}$
Data unit	t CO_{2-e}
Description	Net GHG emissions due to leakage from the REDD project activity up to year $t*$
Source of data	Calculated according to VM0007 v1.6 Equation 4
Description of measurement methods and procedures to be applied	Calculated based on net GHG emissions due to activity shifting leakage for projects preventing planned deforestation up to year $t*$, and the Net GHG emissions due to market-effects leakage up to year $t*$
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	See the values applied in the Table 4.11
Monitoring equipment	
QA/QC procedures to be applied	
Purpose of data	Calculation of leakage
Calculation method	VM0007 v1.6 Equation 4
Comments	-

Data / Parameter	$\Delta C_{LK-AS,planned}$
Data unit	t CO_{2-e}
Description	Net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation up to year $t*$
Source of data	Calculated according to VMD0009 v1.3, Equation 1
Description of measurement methods and procedures to be applied	Calculated based on the area of activity shifting leakage in stratum *i* in year *t*, the net carbon stock changes in all pre-deforestation pools in baseline stratum *i*, and the Greenhouse gas emissions as a result of leakage of avoiding deforestation activities in stratum *i* in year *t*
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of leakage
Calculation method	VMD0009 v1.3, Equation 1
Comments	-

Data / Parameter	$LKA_{planned,i,t}$
Data unit	ha
Description	The area of activity shifting leakage in stratum *i* in year *t*
Source of data	Calculated according to VMD0009 v1.3, Equation 6
Description of measurement methods and procedures to be applied	Calculated according to the total area of monitored deforestation by the baseline agent of the planned deforestation in stratum *i* in year *t*, and the New calculated forest clearance by the baseline agent of the planned deforestation in stratum *i* in year *t* where no leakage is occurring

Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of leakage
Calculation method	VMD0009 v1.3, Equation 6
Comments	-

Data / Parameter	$A_{DefLK,i,t}$
Data unit	ha
Description	The total area of monitored deforestation by the baseline agent of the planned deforestation in stratum *i* in year *t*
Source of data	Remote sensing data
Description of measurement methods and procedures to be applied	Analysis of remote sensing data and/or legal records and/or survey information for lands owned or controlled or previously owned or controlled by the baseline agent of deforestation. Legal records will include government permits to deforest including concession licenses. Ex ante, project proponents must determine and justify the likelihood of leakage based on characteristics of the baseline agent or class of agent.
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	N/A
Monitoring equipment	Remote sensing and GIS tools
QA/QC procedures to be applied	Best practices in remote sensing and GIS: 1) Land use and land cover mapping is assessed using Landsat satellites images with resolution 30 meters

	(MapBiomas, 2022a) validating through a pixel-by-pixel based machine learning algorithms classification using Google Earth Engine. 2) The Mapbiomas methodology uses image with minimal cloud cover product of Landsat scenes mosaicked from various months of the year (MapBiomas, 2022a). 3) An independent verifiable accuracy assessment was performed using high-resolution image with 5 m resolution from Planet Image to confirm the minimum map accuracy of 90% for each land use class used. 4) Conservatively the secondary forest is eliminated of the forest class according to Silva Junior et al. (2020). Also, with the objective of reducing the classification error between forest cover maps, a PRODES hydrography mask was downloaded by TerraBrasilis plataform is added in each forest cover maps map, in this way, this land use class remained unchanged in all years (Assis et al., 2019)
Purpose of data	Calculation of leakage emissions
Calculation method	N/A
Comments	-

Data / Parameter	$NewR_{i,t}$
Data unit	ha
Description	New calculated forest clearance in stratum *i* in year *t* by the baseline agent of the planned deforestation where no leakage is occurring
Source of data	Calculated according to VMD0009 v1.3, Equation 4 or 5
Description of measurement methods and procedures to be applied	Calculated based on projected annual proportion of land that will be deforested outside the project boundary in stratum *i* in year *t*, and Total area of planned deforestation outside the project boundary over the baseline period for stratum *i*, according to equation 04 or based on Deforestation by the baseline agent of the planned deforestation in stratum *i* in year *t* in the absence of the project, projected annual proportion of land that will be deforested in project stratum *i* in year *t*, and Total area of planned deforestation over the baseline period for project stratum *i*

Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of leakage
Calculation method	VMD0009 v1.3, Equation 4 or 5
Comments	Equation 4 is used when the identified deforestation agent has made public a business plan or similar documentation containing data suited for estimating a conversion rate over the baseline period. Equation 5 is used when the conversion rate must be estimated. In this case, the projected annual proportion of land that will be deforested is the same used to set the baseline, while the deforestation provoked by the identified deforestation agent is calculated by VMD0009 v1.3, Equation 1 or 2

Data / Parameter	$D\%_{planned,i,t}$
Data unit	%
Description	Projected annual proportion of land that will be deforested in project stratum *i* in year *t*
Source of data	Deforestation permits for areas outside the project boundary
Description of measurement methods and procedures to be applied	Defined in deforestation permits. Use a verifiable plan or proxy areas
Frequency of monitoring/recording	Must be revisited at the time of baseline revision
Value applied	N/A
Monitoring equipment	N/A

QA/QC procedures to be applied	N/A
Purpose of data	Calculation of leakage
Calculation method	N/A
Comments	-

Data / Parameter	$A_{planned,i,OP}$
Data unit	ha
Description	Total area of planned deforestation outside the project boundaries over the entire project lifetime for stratum *i*
Source of data	Deforestation permits for areas outside the project boundary
Description of measurement methods and procedures to be applied	Defined in deforestation permits
Frequency of monitoring/recording	Must be re-evaluated whenever the baseline is revised
Value applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of leakage
Calculation method	N/A
Comments	This parameter is used when an identified deforestation agent has made public a business plan or similar documentation containing data suited for estimating a conversion rate over the baseline period in areas outside the project boundary

Data / Parameter	$WoPR_{i,t}$
Data unit	ha
Description	Deforestation by the baseline agent of the planned deforestation in stratum *i* in year *t* in the absence of the project
Source of data	Calculated according to VMD0009 v1.3, equation 2 or 3
Description of measurement methods and procedures to be applied	Projected based on linear regression according to VMD0009 v1.3 Equation 2 or based on the average number of hectares of forest cleared by the baseline agent of the planned deforestation in the five years prior to project implementation in stratum *i* by agent *ag* within the country (VMD0009 v1.3 Equation 3)
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of leakage
Calculation method	VMD0009 v1.3 Equation 2 is used when the results of the analysis must produce a statistically significant regression with a p≤0.05 and an adjusted r2 of ≥0.75. The regression is calculated based on the deforested by the deforestation agent each year over the previous five years within the country. Where no statistically significant regression can be found, VMD0009 v1.3 Equation 3 is used
Comments	-

Data / Parameter	$HistHa_{i,ag}$
Data unit	ha

Description	Number of hectares of forest cleared by the baseline agent of the planned deforestation in the five years prior to project implementation in stratum *i* by agent *ag* within the country
Source of data	Remote sensing data
Description of measurement methods and procedures to be applied	Analysis of remote sensing data and/or legal records and/or survey information for lands owned or controlled or previously owned or controlled by the baseline agent of deforestation
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	N/A
Monitoring equipment	Remote sensing tools
QA/QC procedures to be applied	Best practices in remote sensing and GIS: 1) Land use and land cover mapping is assessed using Landsat satellites images with resolution 30 meters (MapBiomas, 2022a) validating through a pixel-by-pixel based machine learning algorithms classification using Google Earth Engine. 2) The Mapbiomas methodology uses image with minimal cloud cover product of Landsat scenes mosaicked from various months of the year (MapBiomas, 2022a). 3) An independent verifiable accuracy assessment was performed using high-resolution image with 5 m resolution from Planet Image to confirm the minimum map accuracy of 90% for each land use class used. 4) Conservatively the secondary forest is eliminated of the forest class according to Silva Junior et al. (2020). Also, with the objective of reducing the classification error between forest cover maps, a PRODES hydrography mask was downloaded by TerraBrasilis plataform is added in each forest cover maps map, in this way, this land use class remained unchanged in all years (Assis et al., 2019)
Purpose of data	Calculation of leakage
Calculation method	N/A

Comments	-

Data / Parameter	$GHG_{LK,E,i,t}$
Data unit	t $CO_{2\text{-}e}$
Description	Greenhouse gas emissions as a result of leakage of avoiding deforestation activities in stratum *i* in year *t*
Source of data	Calculated according to VMD0009 v1.3, Equation 7
Description of measurement methods and procedures to be applied	Calculated based on Non-CO_2 emissions due to biomass burning in stratum *i* in year *t*
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of leakage
Calculation method	VMD0009 v1.3, Equation 7
Comments	-

Data / Parameter	ΔC_{LK-ME}
Data unit	t $CO_{2\text{-}e}$
Description	Net greenhouse gas emissions due to market-effects leakage
Source of data	Calculated according to VMD0011 v1.1 Equation 1
Description of measurement methods	Calculated based on total GHG emissions due to market- effects leakage through decreased timber harvest

and procedures to be applied	
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	See the values applied in the Table 4.11
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of leakage
Calculation method	VMD0011 v1.1 Equation 1
Comments	-

Data / Parameter	$LK_{MarketEffects,timber}$
Data unit	t CO_{2-e}
Description	Total GHG emissions due to market-effects leakage through decreased timber harvest
Source of data	Calculated according to VMD0011 v1.1, Equation 2
Description of measurement methods and procedures to be applied	Calculated according to leakage factor for market-effects calculations, summed emissions from timber harvest in stratum *i* in the baseline case potentially displaced through implementation of carbon project and leakage management adjustment factor
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	See the values applied in the Table 4.11
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A

Purpose of data	Calculation of leakage
Calculation method	VMD0011 v1.1, Equation 2
Comments	-

Data / Parameter	LF_{ME}
Data unit	Dimensionless
Description	Leakage factor for market-effects calculations
Source of data	Default data from VMD0011 v1.1
Description of measurement methods and procedures to be applied	Each project thus must calculate within each stratum the proportion of total biomass in commercial species that is merchantable (PMP_i). This must then be compared to mean proportion of total biomass that is merchantable for each forest type (PML_{FT}).
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	0.4
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of leakage
Calculation method	N/A
Comments	-

Data / Parameter	$AL_{T,i}$
Data unit	t CO_{2-e}

Description	Summed emissions from timber harvest in stratum *i* in the baseline case laced through implementation of carbon project
Source of data	Calculated based on VMD0011 v1.1, Equation 4
Description of measurement methods and procedures to be applied	Calculated based on Carbon emission due to displaced timber harvests in the baseline scenario in stratum *i* in time *t*
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	See the values applied in the Table 4.11
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of leakage
Calculation method	VMD0011 v1.1, Equation 4
Comments	-

Data / Parameter	$C_{BSL,XBT,i,t}$
Data unit	t $CO_{2\text{-}e}$
Description	Carbon emission due to timber harvests in the baseline scenario in stratum *i* in year *t*
Source of data	Calculated according to VMD0011 v1.1, Equation 5
Description of measurement methods and procedures to be applied	Calculated based on the volume of timber projected to be extracted from within the project boundary during the baseline in stratum *i* at time *t*, the mean wood density of commercially harvested species, the carbon fraction of biomass for commercially harvested species *j*, the logging damage factor (LDF), and the logging infrastructure factor (LIF)
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event

Value applied	See the values applied in the Table 4.11
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of leakage
Calculation method	VMD0011 v1.1, Equation 5
Comments	-

Data / Parameter	$V_{BSL,EX,i,t}$
Data unit	m^3
Description	Volume of timber projected to be extracted from within the project boundary during the baseline in stratum *i* in year *t*
Source of data	da SILVA et al., 2001; Veríssimo et al., 1992
Description of measurement methods and procedures to be applied	The volume of commercial wood found in previous inventories carried out to request the deforestation of the project area and the deforestation in the baseline scenario are considered to estimate market leakage effects.
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	38.3 m^3 ha^{-1}
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of leakage emissions
Calculation method	N/A

Comments	-

Data / Parameter	LDF
Data unit	t C m^{-3}
Description	Logging damage factor
Source of data	Default value provided by VMD0011 v1.1
Description of measurement methods and procedures to be applied	Default value for broadleaf and mixed forests of 0.53 t C m^{-3} from 774 logging gaps measured by Winrock International in Bolivia, Belize, the Republic of Congo, Brazil and Indonesia may be used for tropical broadleaf forests
Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	Default value for broadleaf and mixed forests of 0.53 t C m^{-3}
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of leakage emissions
Calculation method	N/A
Comments	-

Data / Parameter	LIF
Data unit	t C m^{-3}
Description	Logging infrastructure factor
Source of data	Default value provided by VMD0011 v1.1
Description of measurement methods and procedures to be applied	Factor for calculating the emissions arising from the creation of logging infrastructure (roads, skid trails and decks) during logging operations per cubic meter extracted

Frequency of monitoring/recording	Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value applied	Conservative default value of 0.29 t C m^{-3}
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of leakage
Calculation method	N/A
Comments	-

5.3 Monitoring Plan

The ABC Monitoring Plan was developed according to the approved VCS methodology VM0007 REDD+ Methodology Framework (APDD) v1.6, and its specific module for GHG emissions, the VMD0015 Methods for monitoring of GHG emissions and removals in REDD and CIW projects (M-REDD), version 2.2. The methodology requires the fulfillment of four main monitoring tasks:

- Monitoring of project implementation.
- Monitoring of actual carbon stock changes and greenhouse gas emissions.
- Monitoring of leakage carbon stock changes and greenhouse gas emissions.
- Estimation of ex post net carbon stock changes and greenhouse gas emissions.

To prepare the Monitoring Plan, it is required by the methodology to describe how these tasks will be implemented, and for each task it must include the following sections:

- Technical description of the monitoring tasks.
- Data to be collected.
- Overview of data collection procedures.
- Quality control and quality assurance procedures.
- Data archiving.
- Organization and responsibilities of the parties involved in all the above.

The parties involved in monitoring activities are represented in Figure 5.1. The work between the project proponent and landowners' entities is very often interlinked and their smooth cooperation resulting in effective monitoring practices.

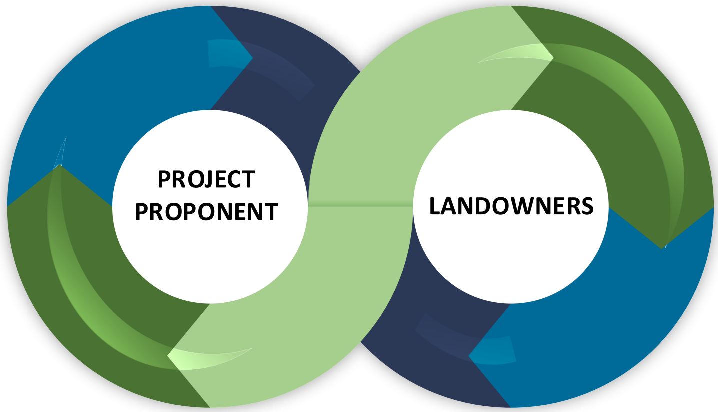

Figure 5.1. The parties involved in monitoring activities.

To clarify the general roles and responsibilities of the parties involved in the project seeks to describe each general role (Figure 5.2). The project proponent is responsible to the REDD+ activities advisor through strategic planning, verification, instructions, accounting and development of PD and monitoring report documents. General Systemica's quality control and quality assurance procedures are described in a document in annex[37]. The landowners are responsible for the execution and reporting of information through tactical planning, patrolling, surveillance, local infrastructure, and on-site project management. Therefore, this structure involves the work collaboratively for monitoring activities.

[37] Annex: QA_QC_v00.pdf

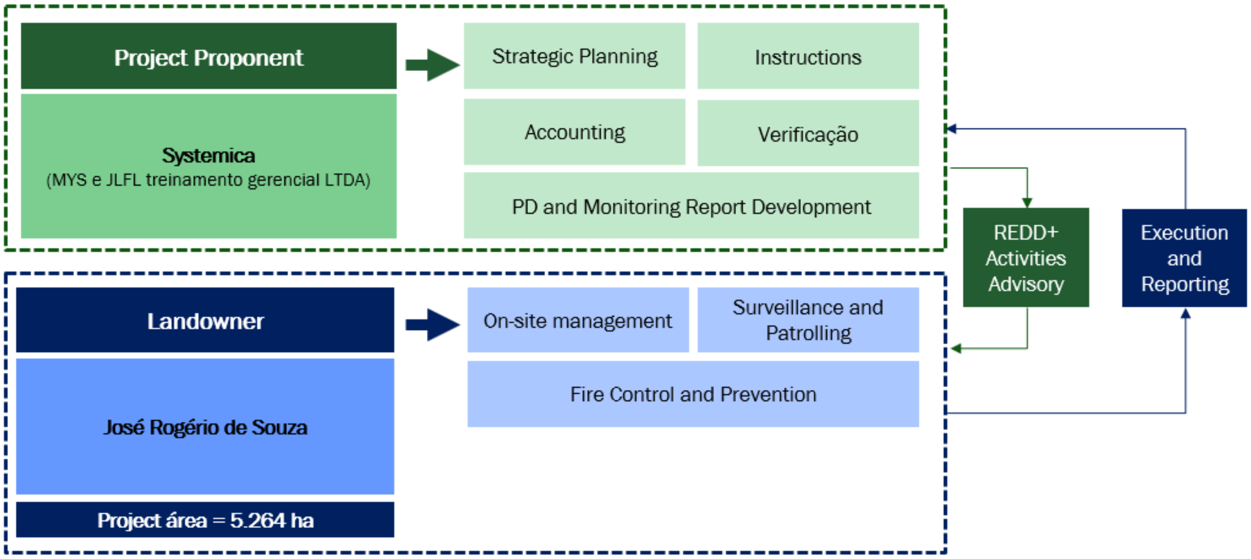

Figure 5.2. General overview of parties involved in monitoring activities

5.3.1 Monitoring of Project Implementation

Technical description of the monitoring task.

Here in the Section 5.3.1. will be covered actions assumed to be more qualitative than quantitative. The next sections of the monitoring plan involve the actions related with geospatial analysis and the parameters detailed in Section 5.2. The activities implementation that are going to be addressed by the ABC project are described below:

- **Establishment of frequent surveillance rounds** made by employees or contractors in the project area to ensure that there are no unwanted invaders. In addition, the rounds will help to be alert in case people from adjacent properties could represent some risk of deforestation for the project area.

  This activity can have a synergy with other activities that the landowner can have in their Legal Reserve Area. The ABC-I1 will have the installation of sustainable forest management activities over the next years in the other parts of the properties close to the project areas. This will create a need for forest surveillance and protection not only for the REDD+ project, but also for the forest management areas.

  Not only farm workers will need to be trained, but also a minimum infrastructure and equipment acquire to provide good working conditions so the surveillance can be done as it needs (i.e. walkie talkies, motorcycles or motorized quads to move around the properties, installation of tends or watchtowers with food and water supplies).

- **Creation of a fire prevention and combat plan.** Those activities are not in practice today, but it is important for the project implementation success the development of this fire prevent and combat plan (i.e. Acquisition of water trucks and other equipment to combat undesirable burnings, fire brigade training can be done with employees working on the properties that encompass the project area, firebreaks can be created to guarantee one more factor of protection to the project area in case the source of a fire is a neighboring property.

Establish and consolidate a close contact to local householding. During the first social diagnosis executed as an early project activity, local communities were consulted. Although Systemica team were able to understand more about the local conditions and got a first view of local community needs, some meetings will be done in order to reach an agreement about kind of social project activities.

Data to be collected, overview of data collection procedures and data archiving

The project activities described above are all going to be implemented and evidence are going to be generated in order to provide transparency. Future verifications will have details about those activities. Descriptive documents, attendance lists with signatures, georeferenced photos. Social activities will follow the same approach described with details through 2.

Quality control and quality assurance procedures.

All processes that subsidize the preparation of inputs that will compose the final products that will be delivered to customers and/or validators will be completely traceable: from the source of obtaining and processing data (primary or secondary) to the adoption of assumptions that were considered according to the specific case under evaluation. It is important that at any time, any interested party is able to consistently reconstruct the processes that were carried out by the team that developed the project. The complete guide for Ssytemica quality control and quality assurance is available in annex[38].

Organization and responsibilities of the parties involved in all the above

The Systemica LTDA. is responsible for generating the maps, GIS analysis, remote monitoring of the project area, data archiving, and for providing assistance and clarification during verification audits.

The landowners will be responsible for implementing the patrolling and surveillance system and providing the necessary vehicles and infrastructure if relevant to develop the project activities, as well as being co-responsible for data archiving.

All images, maps and records generated during project implementation should be conserved and made available to VCS verifiers at verification for inspection to demonstrate that the APDD project activity has been implemented.

5.3.2 Monitoring of actual carbon stock changes, GHG emissions within the project area and leakage

Technical description of the monitoring task.

As provided in module VMD0015 v2.2, monitoring actual changes in carbon stock and GHG emissions within the Project Area involves three main steps, which are: (i) selection and analysis of sources of land use and land cover (LU/LC) change data, (ii) interpretation and analyses, (iii) documentation. This section

[38] Annex: QA_QC_v1.0.pdf

5.3 of the monitoring report has its structure considering the requirements from the VM0007, procedures from the VMD0015 will be adapted to fit it.

The project area is not located in a region subjected to MRV by a jurisdictional program. Monitoring of LU/LC change within the project area will be performed annually by analyzing using images of the medium resolution, generated by MapBiomas. Some specific interpretation and analysis will be done on the possible events that could change the LU/LC of the ABC project area and in the leakage area.

The large-scale monitoring will be done through satellite images made available by INPE (PRODES) and MapBiomas Alert data, which is a system that validates and refines deforestation alerts with high-resolution images. Eventual carbon stock losses will be estimated as soon as possible. Non-CO_2 emissions will be monitored and accounted if they are significant, according to VM0015 (VERRA, 2012a).

Data to be collected.

It is important to emphasize here the best practices in remote sensing and GIS to obtain consistent data using the conservative approach: (i) land use and land cover mapping is assessed using Landsat satellite images with resolution of 30 meters (MapBiomas, 2022) validating through a pixel-by-pixel based machine learning algorithms classification using Google Earth Engine; (ii) the Mapbiomas methodology uses image with minimal cloud cover product of Landsat scenes mosaicked from various months of the year (MapBiomas, 2022); (iii) an independent verifiable accuracy assessment was performed using high-resolution image with 5 m resolution from Planet Image to confirm the minimum map accuracy of 90% for each land use class used; (iv) conservatively the secondary forest is eliminated of the forest class according to Silva Junior et al. (2020); (v) also, with the objective of reducing the classification error between forest cover maps, a PRODES hydrography mask was downloaded by TerraBrasilis plataform is added in each forest cover maps map, in this way, this land use class remained unchanged in all years (FG Assis et al., 2019). The data collection will be subject to MRV-A (monitoring, reporting, verification and accounting), especially to analyze the “Area of forest land converted to non-forest land”.

Non-CO_2 emissions from forest fires will be subject to monitoring and accounting, when significant. Also, an estimation of carbon stocks using Forest Inventory data within the project area will be performed to generate more accurate carbon stock values, which will be made available to VCS verifiers at verification for inspection. The field inventory methodology and data to be collected are described in a Standard Operating Procedure (SOP) annex[39], which is also available for consultation by the auditors.

The complete set of parameters that are going to be analyzed is available in the previous Section 5.2 of this PD.

Overview of data collection procedures.

General remote monitoring will be done with remote sensing methods, using images of medium resolution. The large-scale monitoring will be done through satellite images made available by INPE (PRODES) and MapBiomas Alert data, which is a system that validates and refines deforestation alerts

[39] Annex: SOP - Standard Operating Procedure.pdf

with high-resolution images by integrating and analyzing multiple alert systems, such as DETER, PRODES and so on. This platform data is widely used because it integrates and validates the alerts of several products increasing the reliability of the data and can be acquired on a daily frequency.

The forest condition within the Project Area and forest cover change due to planned deforestation are monitored through periodic assessment of classified satellite imagery covering the project area and is subject to monitoring the conversion of forest land to non-forest land. While increase or decrease in carbon stocks due to planned activities in the project area will also be monitored through documents and the data to be collected consists of annual satellite imagery processed by PRODES, for the entire land coverage of the Project Area.

Monitoring of carbon stock changes and GHG emissions within the project area from forest fires of areas subject to significant carbon stock decrease in the project scenario according to the ex-ante assessment, the carbon stock changes will be estimated, in case of planned deforestation, at least once after each harvest event if they occur.

The forest inventory methodology described in the SOP was specifically designed for ABC carbon inventories, to be applied in the baseline assessment, as well as in the monitoring period. The field carbon inventory involved the installation of permanent cluster plots. These permanent plots will be periodically assessed throughout the project duration.

The field inventory SOP (available for consultation by the auditors) describes the guidelines for the following aspects:

- Sampling method and sampling process;
- Procedures for allocation of plots in the field;
- Variables to be collect in forest inventory
- Standards for measurement of tree diameters under several conditions;
- Rules to process the borderline trees
- Documentation of coordinates of plots;
- Standards for identification and signalization of plots;
- Description of forest inventory team;
- Standards for measurement dynamics of the field inventory team;
- QA/QC procedures to guarantee the application of correct field procedures(annual training, evaluation, and performance reporting);
- Items for annual evaluation of field inventory team;
- QA/QC procedures to guarantee that field data are within the range of treedimensions required in the field inventory;
- QA/QC procedures to guarantee that there was no misunderstanding in datanotation in the field;
- QA/QC procedures to guarantee the reliability of data transfer;

- Model of data transfer error quantification and report;
- List of equipment and materials to be used in the field inventory.

Quality control and quality assurance procedures

The validation of land-use data used for modeling of land use will be performed by using the confusion matrix, in order to calculate the overall index of success by period and by class. Three specific classes will be used: forest, deforestation and non-forest (hydrography, not forest, clouds, roads, residues, unclassified objects, and others). The validation will be performed by using the land use mapping PRODES Digital, and the satellite images used will be scenes of satellite Landsat 8 TM to the total geographic scope of the Project Area. With the help of the "Create Random Points" tool in ArcGIS 10.0, 100 random points will be generated for each class / year as samples for evaluation, using satellite images as reference, making it possible to generate a confusion matrix for calculation of the accuracy indexes, and the Kappa index (indicators for validation of mapping accuracy). Land use classes must have higher values than 90% accuracy for the accuracy and Kappa index, as required in VM0007 v1.6.

Data archiving

All images, maps and records generated during project implementation should be conserved and made available to VCS verifiers at verification for inspection to demonstrate that the APDD project activity has actually been implemented.

Organization and responsibilities of the parties involved in all the above

The Systemica LTDA. is responsible for generating the maps, GIS analysis, remote monitoring of the project area, data archiving, and for providing assistance and clarification during verification audits.

The landowners will be responsible for implementing the patrolling and surveillance system and providing the necessary vehicles and infrastructure if relevant to develop the project activities, as well as being co-responsible for data archiving.

Field team inventory is responsible for providing all the required information for Systemica during the forest inventory, as well as being co-responsible for data archiving.

5.3.3 Monitoring of leakage

The ABC project area is not located within a jurisdiction that is monitoring, reporting, verifying and accounting for GHG emissions from deforestation under a VCS or UNFCCC registered program. The leakage area boundary was provided in Section 3.3. of Project Boundaries and it will be monitored whenever a verification of validation process needs to be done.

Technical description of the monitoring tasks.

According to the VM0007 v1.6 the main source of leakage is the deforestation agent, which in the case of the ABC grouped project is the landowners. Systemica will monitor all eventual areas deforested by the landowners in Brazil of all instances (baseline agent of deforestation) through the years in which the planned deforestation was forecasted to occur. There will be no track to international leakage. Other properties of them (that are already owned or that will be purchased by them) will be monitored through satellite images as well.

Data to be collected

Since all areas deforested by the baseline agent of deforestation must be monitored, to estimate the increased GHG emissions leakage areas the assumption is made that forest clearing is done by first logging activities (exploration of high-value wood) followed by burning the area. The parameter values used to estimate emissions shall be the same used for estimating forest fires in the baseline (Sections 5.1 and 5.2).

Overview of data collection procedures

Deforestation in the leakage areas area may be considered activity displacement leakage. Activity data for the leakage areas will be determined using the same methods applied to monitoring deforestation activity data in the project area. Furthermore, GHG emissions from displaced forest fires within the leakage areas will also be accounted for, if significant.

Leakage will be calculated by comparing ex-ante and ex-post evaluation. However, it is worth noting that where there is strong evidence can be collected that deforestation in the leakage areas is attributable to agents of deforestation that are not linked to the agent of deforestation, the detected deforestation will not be attributed to the project activity, thus not considered leakage.

Quality control and quality assurance procedures

The validation of land-use data used for modeling land use will be performed by using the confusion matrix, to calculate the overall index of success by period and by class. Three specific classes will be used: forest, deforestation, and non-forest (hydrography, not forest, clouds, roads, residues, unclassified objects, and others). The validation will be performed by using the land use mapping PRODES Digital, and the satellite images used will be scenes of satellite Landsat 8 TM to the total geographic scope of the Project Are. With the help of the "Create Random Points" tool in ArcGIS 10.0, 100 random points will be generated for each class/year as samples for evaluation, using satellite images as reference, making it possible to generate a confusion matrix for calculation of the accuracy indexes, and the Kappa index (indicators for validation of mapping accuracy). Land use classes must have higher values than 90% accuracy for the accuracy and Kappa index, as required in VM0007 v1.6 methodology.

Data archiving

All images, maps and records generated during project implementation should be conserved and made available to VCS verifiers at verification for inspection to demonstrate that the APDD project activity has been implemented.

Organization and responsibilities of the parties involved in all the above

The Systemica LTDA. is responsible for generating the maps, GIS analysis and remote monitoring of the project area, data archiving, and for providing assistance and clarification during verification audits. The landowners are responsible for providing evidence of any eventual deforestation through their properties.

5.3.4 Ex post calculation of net anthropogenic GHG emission reduction

Technical description of the monitoring tasks.

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 with the requirements established by the applied methodology VM0007 v1.6. The calculation of ex-post net anthropogenic GHG emission reductions is similar to the ex-ante calculation.

Data to be collected

The report of ex-post estimated net anthropogenic GHG emissions and calculation of Verified Carbon Units will apply the same table format used for the ex-ante assessment, according to VM0007 v1.6.

Overview of data collection procedures

The data collection procedures involve the compilation of data from previous procedures to calculate ex-post net anthropogenic GHG emission reduction.

Quality control and quality assurance procedures

All the previous relevant QC/QA procedures are applicable for the ex-post calculation of net anthropogenic GHG emission reduction. The cumulative areas credited map 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.

Data archiving

All maps and records generated during the project implementation will be conserved and made available to VCS verifiers at verification for inspection to demonstrate that the APDD project activity has been implemented. The procedures meet the highest levels of control, and the main purpose is to minimize the risk of error, obtaining reliable data on which to base the monitoring results, and thus, minimizing non-conformities. If non-conformities exist during the internal or external auditing processes, the data should be reviewed, and the non-conformities addressed.

Organization and responsibilities of the parties involved in all the above

Systemica is responsible for calculating and reporting the ex-post estimated net anthropogenic GHG emissions, data archiving, and for providing assistance and clarification during verification audits.

5.3.5 Revisiting the baseline projections for future fixed baseline period

The Systemica LTDA. is responsible for revisiting the baseline projections for a fixed baseline period. The current baseline is valid for 10 years, i.e., through November of 2032. The baseline will be reassessed every 10 years, and it will be validated at the same time as the subsequent verification.

Updating information on agents of deforestation in the project 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, the projected annual areas of baseline deforestation will be revisited and recalibrated in the model for projection of future deforestation.

Adjusting the land-use and land-cover change component of the baseline involves reassessing components of the baseline projections, such as the adjustment of annual areas and the location of baseline deforestation. Updating of the Carbon component of the baseline will only be carried out if more accurate methods for carbon stock estimates are available on the occasion of baseline revision.

REFERENCES

Alho, M. C. (2009). *Uma análise político-econômica de desenvolvimento no município de Itacoatiara-AM.* (Dissertação Mestrado em Desenvolvimento Regional). Universidade Federal do Amazonas, Manaus.

Assis, L. F. F. G., Ferreira, K. R., Vinhas, L., Maurano, L., Almeida, C., Carvalho, A., Rodrigues, J., Maciel, A., & Camargo, C. (2019). TerraBrasilis: a spatial data analytics infrastructure for large-scale thematic mapping. *ISPRS International Journal of Geo-Information, 8*(11), 513.

BDiA. (2022a). Banco de dados de informações ambientais (geologia). Retrieved from https://bdiaweb.ibge.gov.br/#/consulta/geologia. Accessed in December 13th, 2022.

BDiA. (2022b). Banco de dados de informações ambientais (geomorfologia). Retrieved from https://bdiaweb.ibge.gov.br/#/consulta/geomorfologia. Accessed in December 13th, 2022.

BDiA. (2022c). Banco de dados de informações ambientais (vegetação). Retrieved from https://bdiaweb.ibge.gov.br/#/consulta/vegetacao. Accessed in December 13th, 2022.

Brasil. (1850). *Provides for the vacant lands in the Empire to about those that are owned by titles of allotment without fulfilling the legal conditions, as well as by simple title deed meek and peaceful. Determines that measures and the former demarcations, whether they are ceded to onerous title, so for private companies individuals, as well as for colonies of nationals and foreigners, authorized the Government to promote colonization foreign in the way it is declared*. Federal Law Nº 601 of 18-September-1850. Retrieved from http://www.planalto.gov.br/ccivil_03/leis/l0601-1850.htm

Brasil. (1964). *Federal Law Nº 4,504. Provide on the Land Statute, among other provisions*. Federal Law Nº 4,504 of 30-November-1964. Retrieved from https://www.planalto.gov.br/ccivil_03/leis/l4504.htm

Brasil. (1973). *Federal Law Nº 6,015. Provide on public registries, among other provisions*. Federal Law Nº 6,015 of 31-December-1973. Retrieved from https://www.planalto.gov.br/ccivil_03/leis/l6015original.htm

Brasil. (1981a). *Federal Law N° 6,938. Provides for the National Environmental Policy, its purposes and mechanisms for its formulation and application, and makes other provisions*. Federal Law N° 6,938 of 31-August-1981. Retrieved from http://www.planalto.gov.br/ccivil_03/leis/l6938.htm#:~:text=LEI%20N%C2%BA%206.938%2C%20DE%2031%20DE%20AGOSTO%20DE%201981&text=Disp%C3%B5e%20sobre%20a%20Pol%C3%ADtica%20Nacional,aplica%C3%A7%C3%A3o%2C%20e%20d%C3%A1%20outras%20provid%C3%AAncias

Brasil. (1981b). *Federal Law Nº 6,938. Provides for the National Environmental Policy Environment, its purposes and formulation mechanisms and application, and makes other provisions.*: Federal Law Nº 6,938 of 31-August-1981.

Brasil. (1985). *Federal Law Nº 7,347. Disciplines the public civil action of liability for damage caused to the environment, to the consumer, to goods and rights of artistic, aesthetic, historical and tourist, among other provisions*. Federal Law Nº 7,347 of 24-July-1985. Retrieved from http://www.planalto.gov.br/ccivil_03/leis/l7347orig.htm

Brasil. (1988). *Constitution of the Federative Republic of Brazil: Constitutional Text of October 5, 1988, with the Alterations Introduced by Constitutional Amendments N° 1/92 through 72/2013 and by Revision Constitutional Amendments N° 1/94 through 6/94 Federal Senate*. Special Secretariat for Printing and Publishing. Retrieved from https://www.planalto.gov.br/ccivil_03/constituicao/constituicao.htm

Brasil. (1996). *Federal Law Nº 9,393. Provides on the Rural Territorial Property Tax – ITR, on debt payment represented by Agrarian Debt Bonds and gives other measures*. Federal Law Nº 9,393 of 19-December-1996. Retrieved from https://www.planalto.gov.br/ccivil_03/leis/l9393.htm

Brasil. (1998). *Federal Law Nº 9,605. Provides for criminal sanctions and administrative deriving from conduct and activities harmful to the environment, and other measures*. Federal Law Nº 9,605 of 12-February-1998. Retrieved from https://www.planalto.gov.br/ccivil_03/leis/l9605.htm

Brasil. (2002). *Federal Law Nº 10,406. Creates the Brazilian Civil Code. Brazilian civil code and related legislation. 2nd edition*. Federal Law Nº 10,406 of 10-January-2002. Retrieved from https://www.planalto.gov.br/ccivil_03/leis/2002/l10406compilada.htm

Brasil. (2007a). *State Law N° 3,135. Institutes the State Policy on Climate Change, Environmental Conservation and Sustainable Development of Amazonas, and establishes other measures*. State Law N°3,135 of 5-June-2007. Retrieved from https://legisla.imprensaoficial.am.gov.br/diario_am/12/2007/6/4939?q=carbono

Brasil. (2007b). *State Law N° 100. Provides for the Land Institute of the Amazonas, defining its organizational structure, setting its framework of commissioned positions, and establishing other measures*. State Law N° 100 of 18-May-2007. Retrieved from https://legisla.imprensaoficial.am.gov.br/diario_am/11/2007/5/2038?q=regulariza%C3%A7%C3%A3o+fundi%C3%A1ria+propriedades+privadas

Brasil. (2012a). *Federal Law N° 12,727. Amends Law N° 12,651, of May 25, 2012, which provides for the protection of native vegetation; amends Laws Nº 6,938, of August 31, 1981, 9393, of December 19, 1996, and 11,428, of December 22, 2006; and revokes Laws Nº 4,771, of September 15, 1965, and 7,754, of April 14, 1989, Provisional Measure Nº 2,166-67, of August 24, 2001, item 22 of item II of art. 167 of Law Nº 6,015, of December 31, 1973, and § 2 of art. 4 of Law N° 12,651, of May 25, 2012*. Federal Law N° 12,727 of 17-Octuber-2012. Retrieved from https://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/L12727.htm

Brasil. (2012b). *Federal Law Nº 12,651. Provides for the protection of native vegetation; amends Laws N° 6,938, of August 31, 1981, 9,393, of December 19, 1996, and 11,428, of December 22, 2006; repeals Laws N° 4,771, of September 15, 1965, and 7,754, of 14 of April 1989, and Provisional Measure N° 2,166-67, of August 24, 2001; and give others measures*. Federal Law Nº 12,651 of 25-May-2012. Retrieved from https://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12651.htm

Brasil. (2021). *Federal Law Nº 14,119. Establishes the National Policy for Payment for Services environmental; and amends Laws No. 8,212, of July 24, 1991, 8,629, of February 25, 1993, and 6,015, of December 31, 1993 1973, to adapt them to the new policy*: Federal Law Nº 14,119 of 13-January-2021.

Brune, A. (2021). Eucalypts for Tropical Rainforest (Af) climate. *Silvae Genetica, 70*(1), 170-183. doi:10.2478/sg-2021-0014

Carrero, G. C., Walker, R. T., Simmons, C. S., & Fearnside, P. M. (2022). Land grabbing in the Brazilian Amazon: Stealing public land with government approval. *Land Use Policy, 120*, 106133. doi:https://doi.org/10.1016/j.landusepol.2022.106133

CDM. (2007). CDM Tool for testing significance of GHG emissions in A/R CDM project activities (T-SIG). Version 1.0. Retrieved from https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-04-v1.pdf. Accessed in December 9th, 2022.

Chaves, F. (2022). História de Itacoatiara. *Blog Frank Chaves.* Retrieved from https://frankchaves-ita.blogspot.com/. Accessed in December 13th, 2022.

CNN. (2022). Governo federal estuda reativar Fundo Amazônia. *CNN Brasil.* Retrieved from https://www.cnnbrasil.com.br/politica/governo-federal-estuda-reativar-fundo-amazonia/. Accessed in December 16th, 2022.

da SILVA, S., Silva, J., Baima, A., Lobato, N., Thompson, I., & Costa Filho, P. (2001). Impacto da exploração madeireira em floresta de terra firme no município de Moju, Estado do Pará.

Embrapa. (2022). Solos Brasileiros. *Empresa Brasileira de Pesquisa Agropecuária.* Retrieved from https://www.embrapa.br/tema-solos-brasileiros/solos-do-brasil. Accessed in December 13th, 2022.

Espírito-Santo, F. D. B., Gloor, M., Keller, M., Malhi, Y., Saatchi, S., Nelson, B., Junior, R. C. O., Pereira, C., Lloyd, J., Frolking, S., Palace, M., Shimabukuro, Y. E., Duarte, V., Mendoza, A. M., López-González, G., Baker, T. R., Feldpausch, T. R., Brienen, R. J. W., Asner, G. P., Boyd, D. S., & Phillips, O. L. (2014). Size and frequency of natural forest disturbances and the Amazon forest carbon balance. *Nature Communications, 5*(1), 3434. doi:10.1038/ncomms4434

FAO. (2020). *Global Forest Resources Assessment: terms and definitions FRA 2020*. Rome: FAO.

FAO, & UNEP. (2020). The State of the World's Forests 2020. *Forests, biodiversity and people. Rome.* doi:10.4060/ca8642en

FAS. (2021). Amazonenses são contra o desmatamento e as queimadas. *Fundação Amazônia Sustentável.* Retrieved from https://fas-amazonia.org/blogpost/amazonenses-sao-contra-o-desmatamento-e-as-queimadas/. Accessed in December 13th, 2022.

Ferreira, B., Ribeiro, E. G., Pereira, B., Pinheiro, P. F., & Maciel, M. d. N. (2015). Imagens Orbitais na Análise da Degradação Florestal e Qualidade do Manejo em Áreas de Exploração no Município de Paragominas-PA. *ENCICLOPEDIA BIOSFERA, 11*(21). Retrieved from https://conhecer.org.br/ojs/index.php/biosfera/article/view/2033

Freitas Junior, A. M. d., & Barros, P. H. B. d. (2021). A expansão da pecuária para a Amazônia legal: externalidades espaciais, acesso ao mercado de crédito e intensificação do sistema produtivo. *Nova Economia, 31*, 303-333.

FundoAmazonia. (2022). Fundo Amazônia: O Brasil cuida. O mundo apoia. Todos ganham. *Fundo Amazônia.* Retrieved from https://www.fundoamazonia.gov.br/pt/fundo-amazonia/. Accessed in December 16th, 2022.

Grennhouse, G. P. (2014). Global Warming Potential Values. Retrieved from https://www.ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf. Accessed in December 16th, 2022.

Higuchi, N., dos SANTOS, J., Ribeiro, R. J., Minette, L., & Biot, Y. (1998). Biomassa da parte aérea da vegetação da floresta tropical úmida de terra-firme da Amazônia brasileira. *Acta Amazonica, 28*, 153-153.

Homma, A. K. O. (2011). Madeira na Amazônia: extração, manejo ou reflorestamento? *Embrapa Amazônia Oriental-Artigo em periódico indexado. Acesso Livre à Informação Científica da Embrapa (ALICE)*.

IBAMA. (2016). Resolução 474, de 06 de abril de 2016. Retrieved from http://www.ibama.gov.br/component/legislacao/?view=legislacao&legislacao=138205. Accessed in December 13th, 2022.

IBGE. (2022). Cidades e Estados. Retrieved from https://cidades.ibge.gov.br/. Accessed in December 12th, 2022.

ICMBio. (2020). Perguntas e Respostas sobre RPPN. *Instituto Chico Mendes de Conservação da Biodiversidade.* Retrieved from https://www.gov.br/icmbio/pt-br/servicos/crie-sua-reserva/perguntas-e-respostas-sobre-rppn. Accessed in December 16th, 2022.

ICMBio. (2022). RESERVAS PARTICULARES DO PATRIMÔNIO NATURAL - RPPN – PARÁ. *Instituto Chico Mendes de Conservação da Biodiversidade.* Retrieved from https://sistemas.icmbio.gov.br/simrppn/publico/detalhe/298/. Accessed in December 16th, 2022.

IMAZON. (2015). Pecuária na Amazônia: Tendências e Implicações para a Conservação Ambiental Retrieved from https://imazon.org.br/pecuaria-na-amazonia-tendencias-e-implicacoes-para-a-conservacao-ambiental/. Accessed in December 16th, 2022.

IMAZON. (2022). Sistema de Monitoramento da Exploração Madeireira (Simex): Mapeamento da exploração madeireira no Pará *Imazon.* Retrieved from https://imazon.org.br/publicacoes/sistema-de-monitoramento-da-exploracao-madeireira-simex-mapeamento-da-exploracao-madeireira-no-para-agosto-2020-a-julho-2021/. Accessed in December 16th, 2022.

INMET. (2022). Clima: gráficos climatológicos. *Instituto Nacional de Meteorologia.* Retrieved from https://clima.inmet.gov.br/GraficosClimatologicos. Accessed in December 13th, 2022.

IPAAM. (2018). Termelétrica Itacoatiara S/A. *Relatório de Impacto Ambiental – RIMA.* Retrieved from http://www.ipaam.am.gov.br/eia-rima-tisa/. Accessed in December 13th, 2022.

IPCC. (2006a). Chapter 2: Generic methodologies applicable to multiple land use categories. *IPCC Guidelines for National Greenhouse Gas Inventories*. Retrieved from https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch02_Generic%20Methods.pdf

IPCC. (2006b). Chapter 4: Forest land. *IPCC Guidelines for National Greenhouse Gas Inventories*. Retrieved from https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_04_Ch4_Forest_Land.pdf

IPCC. (2014). Climate Change 2014: Synthesis Report. *Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, 151.

IPCC. (2019). 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. *IPCC Guidelines for National Greenhouse Gas Inventories*. Retrieved from https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_04_Ch4_Forest_Land.pdf

IPEA. (2018). Agenda 2030: ODS-Metas Nacionais dos Objetivos de Desenvolvimento Sustentável, Proposta de Adequação. *Ministério de Planejamento e Gestão*. Retrieved from https://repositorio.ipea.gov.br/handle/11058/8636

IPEAN. (1969). Os solos da área Manaus – Itacoatiara. *Instituto de Pesquisas e Experimentação Agropecuárias do Norte.* Retrieved from https://edepot.wur.nl/482699#:~:text=A%20superficie%20do%20solo%2C%20muito,altas%20e%20de%20pequeno%20diametro. Accessed in December 13th, 2022.

Kottek, M., Grieser, J., Beck, C., Rudolf, B., & Rubel, F. (2006). World map of the Köppen-Geiger climate classification updated. *15*(3), 259-263.

Law 12.651. (2012). *Federal Law Nº 12,651 of 25-May-2012. Provides for the protection of native vegetation*. Brasília, Brazil

Loft, L. (2011). Market mechanisms for financing the reduction of emissions from deforestation and degradation in developing countries (REDD)–learning from payments for ecosystem services schemes. *International Journal of Biodiversity Science, Ecosystem Services & Management, 7*(3), 204-216. doi:10.1080/21513732.2011.645072

MacDicken, K. G. (1997). A guide to monitoring carbon storage in forestry and agroforestry projects.

MapBiomas. (2021). Plataforma Brasil. *Mapbiomas Brasil.* Retrieved from https://plataforma.brasil.mapbiomas.org. Accessed in December 13th, 2022.

MapBiomas. (2022a). Projeto de Mapeamento Anual do Uso e Cobertura da Terra no Brasil. Retrieved from https://mapbiomas.org/website. Accessed in 20th June, 2022.

MapBiomas. (2022b). Relatório anual do desmatamento no Brasil. *Mapbiomas Brasil.* Retrieved from https://s3.amazonaws.com/alerta.mapbiomas.org/rad2021/RAD2021_Completo_FINAL_Rev1.pdf. Accessed in December 13th, 2022.

McKnight, T., & Hess, D. (2000). *Physical geography: a landscape appreciation* (6th ed.). Prentice Hall.

Morales, B. F., da Costa, A. L., Nogueira, R. B., & Arraes, C. L. (2021). Estimativa das taxas de desmatamento do município de Itacoatiara, Amazonas, utilizando séries Temporais Landsat-5/TM. *Environmental Scientiae, 3*(1), 13-22.

Nelson, B. W. (1992). Diversidade florística de ecossistemas amazônicos. *Revista do Instituto Florestal, 4*, 111-118.

Nogueira, E. M., Yanai, A. M., Fonseca, F. O. R., & Fearnside, P. M. (2015). Carbon stock loss from deforestation through 2013 in Brazilian Amazonia. *Global Change Biology, 21*(3), 1271-1292. doi:10.1111/gcb.12798

Pearson, T., Swails, E., & Brown, S. (2012). Wood product accounting and climate change mitigation projects involving tropical timber. *Report TMT-PA, 7*(11).

Penman, J., Gytarsky, M., Hiraishi, T., Krug, T., Kruger, D., Pipatti, R., Buendia, L., Miwa, K., Ngara, T., & Tanabe, K. (2003). Good practice guidance for land use, land-use change and forestry. *Good practice guidance for land use, land-use change and forestry.*

Pires, J., & Prance, G. (1985). The vegetation types of the Brazilian Amazon. In G. T. Prance & T. E. Lovejoy (Eds.), *Key Environments: Amazonia* (pp. 109-145). California: Pergamon Press.

Silva Junior, C. H., Heinrich, V. H., Freire, A. T., Broggio, I. S., Rosan, T. M., Doblas, J., Anderson, L. O., Rousseau, G. X., Shimabukuro, Y. E., & Silva, C. A. (2020). Benchmark maps of 33 years of secondary forest age for Brazil. *Scientific data, 7*(1), 1-9. doi:10.6084/m9.figshare.12622025

Silva Neto, S. P. d., Santos, A. C. d., Leite, R. L. d. L., Dim, V. P., Neves Neto, D. N. d., & Cruz, R. S. d. (2012). Dependência espacial em levantamentos do estoque de carbono em áreas de pastagens de *Brachiaria brizantha* cv. Marandu. *Acta Amazonica, 42*, 547-556.

Simonetti, S. R., Vasconcelos, A. S., & Gadelha, E. M. (2010). *Potencialidade Turística das Áreas Rurais na Amazônia: os desafios do inventário turístico de Vila Lindóia, Município de Itacoatiara – AM*. Paper presented at the VI Seminário de Pesquisa em Turismo do MERCOSUL - Semintur, Caxias do Sul - RS.

SNIF. (2020). Tipologias Florestais. *Sistema Nacional de Informações Florestais.* Retrieved from https://snif.florestal.gov.br/pt-br/conhecendo-sobre-florestas/168-tipologias-florestais. Accessed in December 13th, 2022.

TerraBrasilis. (2021). PRODES (Desmatamento). *Instituto Nacional de Pesquisas Espaciais.* Retrieved from http://terrabrasilis.dpi.inpe.br/app/dashboard/deforestation/biomes/amazon/increments. Accessed in December 13th, 2022.

Tyukavina, A., Hansen, M. C., Potapov, P. V., Stehman, S. V., Smith-Rodriguez, K., Okpa, C., & Aguilar, R. (2017). Types and rates of forest disturbance in Brazilian Legal Amazon, 2000-2013. *Science Advances, 3*(4), e1601047. doi:10.1126/sciadv.1601047

Veríssimo, A., Barreto, P., Mattos, M., Tarifa, R., & Uhl, C. (1992). Logging impacts and prospects for sustainable forest management in an old Amazonian frontier: the case of Paragominas. *Forest ecology and management, 55*(1-4), 169-199.

VERRA. (2012a). VMD0005 Estimation of carbon stocks in the long-term wood products pool (CP-W). *Verified Carbon Standard.* Version 1.1. Retrieved from https://verra.org/wp-content/uploads/imported/methodologies/VMD0005-CP-W-v1.1.pdf. Accessed in December 9th, 2022.

VERRA. (2012b). VT0001 Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities (T-ADD). *Verified Carbon Standard.* Version 3.0. Retrieved from https://verra.org/wp-content/uploads/2017/11/VT0001v3.0.pdf. Accessed in December 9th, 2022.

VERRA. (2013). VMD0001 Estimation of carbon stocks in the above- and belowground biomass in live tree and non-tree pools (CP-AB). *Verified Carbon Standard.* Version 1.1. Retrieved from https://verra.org/wp-content/uploads/imported/methodologies/VMD0001v1.1.pdf. Accessed in December 9th, 2022.

VERRA. (2015). VMD0011 Estimation of emissions from market-effects (LK-ME). *Verified Carbon Standard.* Version 1.1. Retrieved from https://verra.org/wp-content/uploads/VMD0011-LK-ME-v1.1-1.pdf. Accessed in December 9th, 2022.

VERRA. (2019). VCS AFOLU Non-Permanence Risk Tool (T-BAR). *Verified Carbon Standard.* Version 4.0. Retrieved from https://verra.org/wp-content/uploads/2019/09/AFOLU_Non-Permanence_Risk-Tool_v4.0.pdf. Accessed in December 9th, 2022.

VERRA. (2020a). VM0007 REDD+ Methodology Framework (REDD+ MF). *Verified Carbon Standard.* Version 1.6. Retrieved from https://verra.org/wp-content/uploads/imported/methodologies/VM0007-REDDMF_v1.6.pdf. Accessed in December 9th, 2022.

VERRA. (2020b). VMD0006 Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation/forest degradation and planned wetland degradation (BL-PL). *Verified Carbon Standard.* Version 1.3. Retrieved from https://verra.org/wp-content/uploads/imported/methodologies/VMD0006-BL-PL_v1.3.pdf. Accessed in December 9th, 2022.

VERRA. (2020c). VMD0009 Estimation of emissions from activity shifting for avoiding planned deforestation/forest degradation and avoiding planned wetland degradation (LK-ASP). *Verified Carbon Standard.* Version 1.3. Retrieved from https://verra.org/wp-content/uploads/imported/methodologies/VMD0009-LK-ASP-v1.3.pdf. Accessed in December 9th, 2022.

VERRA. (2020d). VMD0013 Estimation of greenhouse gas emissions from biomass and peat burning (E-BPB). *Verified Carbon Standard.* Version 1.2. Retrieved from https://verra.org/wp-content/uploads/imported/methodologies/VMD0013-E-BPB-v1.2.pdf. Accessed in December 9th, 2022.

VERRA. (2020e). VMD0015 Methods for monitoring of GHG emissions and removals in REDD and CIW projects (M-REDD). *Verified Carbon Standard.* Version 2.2. Retrieved from https://verra.org/wp-content/uploads/imported/methodologies/VMD0015-M-REDD-v2.2.pdf. Accessed in December 9th, 2022.

VERRA. (2020f). VMD0016 Methods for stratification of the project area (X-STR). *Verified Carbon Standard.* Version 1.2. Retrieved from https://verra.org/wp-content/uploads/imported/methodologies/VMD0016-X-STR_v1.2.pdf. Accessed in December 9th, 2022.

VERRA. (2020g). VMD0017 Estimation of uncertainty for REDD project activities (X-UNC). *Verified Carbon Standard.* Version 2.2. Retrieved from https://verra.org/wp-content/uploads/imported/methodologies/VMD0017-X-UNC_v2.2.pdf. Accessed in December 9th, 2022.

Winjum, J. K., Brown, S., & Schlamadinger, B. (1998). Forest harvests and wood products: sources and sinks of atmospheric carbon dioxide. *Forest Science, 44*(2), 272-284.

Zappi, D. C., Sasaki, D., Milliken, W., Iva, J., Henicka, G. S., Biggs, N., & Frisby, S. (2011). Plantas vasculares da região do Parque Estadual Cristalino, norte de Mato Grosso, Brasil. *Acta Amazonica, 41*, 29-38.