



**Verified Carbon
Standard**

UNITOR REDD+ PROJECT



Document Prepared by CARBONEXT

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Project Title	UNITOR REDD+ Project
Version	1.7
Date of Issue	04-May-2022
Prepared By	CARBONEXT
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1 PROJECT DETAILS

1.1 Summary Description of the Project

The UNITOR REDD+ PROJECT is located in Lábrea, Amazonas State, Brazil, which is the municipality with the fourth highest aggregate deforestation rate in Brazil between 2008 – 2020, according to PRODES data¹. Municipal deforestation rates have risen year on year, from 3.8% in 2017 to 5.3% in 2020, making this a priority area for forest conservation worldwide. A new consortium of 15 neighbouring rural properties comprises the Unitor REDD+ Project area, together covering 99,035.20 ha of forest area, in order to develop forest carbon activities under the guidance and inspiration of the nearby Fortaleza Ituxi REDD Project.

The primary objective of the Unitor REDD+ Project is to avoid net emissions of 12,514,470 tCO₂e (average of 417,149 tCO₂e/year), corresponding to 24,769 hectares of avoided deforestation over the 30-year project lifetime.

Not only have natural ecosystems been extensively damaged in the Lábrea region, but land-use changes have caused severe social conflicts through land-grabbing and expansion of agriculture and cattle ranching activities, contributing to expulsion of communities of wild-harvesting families (“*extrativistas*”) from the region. Deforestation in Lábrea is strongly correlated to the proximity of roads (Vitel, 2009), correspondingly the recent increase in deforestation rates in the project Reference Region is mainly attributable to the “Jequitibá” and “Ramal do Boi” Roads. The latter is about 100 km long, passes at a distance of 4 km to the Project Area, and has connected roads which intersect the Project Area.

Given project approval, the landowners will implement mechanisms to ensure effective surveillance inside the Project Area. Specifically, there are 6 deforestation surveillance posts placed around the properties and there is an expectation to install 9 more stations after the sale of carbon credits (one in each of the properties, but to be revised), summing with the deforestation control efforts already underway in the neighbouring Ituxi REDD project. Also, fire brigades training and technical community training on sustainable cattle raising and forest management will be carried out. Furthermore, the project will continue sustainable forest management activities in the Project Area as a further tool to guarantee forest surveillance. The presence of workers in timber management areas is a significant factor to reduce the pressures of illegal wood harvesters trespassing inside the Project Area.

Thus, the project also aims to improve the social and environmental conditions in the project region, specifically contributing to improving deforestation control and developing social activities.

¹ http://terrabrasilis.dpi.inpe.br/app/dashboard/deforestation/biomes/legal_amazon/rates

1.2 Sectoral Scope and Project Type

Sectoral Scope: 14 - Agriculture, Forestry, Land Use

Project Category: Avoided Unplanned Deforestation (AUD project activity)

This is a grouped project.

1.3 Project Eligibility

According to the VCS Methodology Requirements v4.0², for Reduced Emissions from Deforestation and Degradation (REDD) projects, eligible activities are those that reduce net GHG emissions by reducing deforestation, which is the case of this project activity. Deforestation is the direct, human-induced conversion of forest land to non-forest land. The Project Area meets the internationally accepted definition of forest, and was qualified as forest for a minimum of 10 years before the project start date. The definition of forest may include mature forests, secondary forests, and degraded forests.

More specifically, according to the Decision 11/CP.7 of the Marrakesh Accord, the following definition of forests is adopted (UNFCCC, 2002)³: (a) “Forest” is a minimum area of land of 0.05-1.0 hectares with tree crown cover (or equivalent stocking level) of more than 10-30 per cent with trees with the potential to reach a minimum height of 2-5 meters at maturity in situ. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground or open forest. Young natural stands and all plantations which have yet to reach a crown density of 10-30 per cent or tree height of 2-5 meters are included under forest, as are areas normally forming part of the forest area which are temporarily un-stocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest.

Under the VCS, secondary forests are considered to be forests that have been cleared and have recovered naturally and that are at least 10 years old and meet the lower bound of the forest threshold parameters at the start of the project. The main effect of this project activity is on carbon emissions that are reduced by preventing the conversion of forest lands with high carbon stocks to non-forest lands with lower carbon stocks. In addition, avoiding conversion of forests to cropland or pasture can reduce emissions of CH₄ that are associated with biomass burning used to clear the land. This project activity stops unsanctioned deforestation on lands that are legally sanctioned for timber production, and thus is eligible as a REDD activity. This project activity reduces GHG emissions by stopping deforestation of mature forests, that would have occurred as a result of i) socio-economic forces that promote alternative uses of forest land and the inability of institutions to control these activities, ii) poor law enforcement and lack of property rights; iii) subsistence farming and illegal logging.

² https://verra.org/wp-content/uploads/2019/09/VCS_Methodology_Requirements_v4.0.pdf

³ https://unfccc.int/files/meetings/workshops/other_meetings/application/pdf/11cp7.pdf (page 5 of PDF)

The methodology was used for frontier configuration of deforestation, which is described as result from the expansion of roads and other infrastructure into forest lands. Roads and other infrastructure can improve forest access and lead to increased encroachment by human populations, such as subsistence farming on previously inaccessible forest lands.

This project activity is also eligible, as it respects all country's forest legislation and is in accordance with local and national environmental interests. As described in "1.17 Additional Information Relevant to the Project", subsection "Sustainable Development".

Therefore, in addition to the measures described in other sections of this document, mitigation of Leakage is further strengthened by government initiatives and/or legislation at Federal, municipal, State and ecosystem levels, once the LCA involves neighbouring States within the Amazonia biome.

1.4 Project Design

This project has been designed as an Avoided Unplanned Deforestation applying VM0015 methodology, Version 1.1.3 December 2012.

Eligibility Criteria

This is a grouped project. Unitor REDD+ is an AFOLU project activity designed to include REDD Avoided Unplanned Deforestation (AUD) components. In this sense, this project activity is designed to include more than one "project activity instance", such as the accession of new communities or landowners to the project across its lifetime. Thus, this grouped project is designed to allow the expansion of the project activity, subsequent to project validation.

This grouped project has one clearly defined geographic area within which project activity instances may be developed, which is defined using geodesic polygons, corresponding to the current Reference Region. The determination of baseline scenario and demonstration of additionality were based upon the initial project activity instances (15 farms), that are presented in this VCS-PD for validation. For inclusion of new geographic areas, it will be demonstrated that such areas are subject to the same baseline scenario and rationale for the demonstration of additionality as the geographic area that does include initial project activity instances.

A single baseline scenario is determined for the entire designated geographic area (Reference Region), in accordance with VM0015 methodology. The additionality of the initial project activity instances was demonstrated for each designated geographic area, in accordance with the methodology applied to the project. All factors relevant to the determination of the baseline scenario or demonstration of additionality (i.e., common practice; laws, statutes, regulatory frameworks or policies relevant to demonstration of regulatory surplus; historical deforestation rates) were assessed across the grouped project geographic area and respective Reference Region.

The project proponent has defined the capacity limit for this project activity in terms of the Reference Region. If exceptionally a new instance is located outside the Reference Region, it will be guaranteed that all limit premises will respect the same conditions of similarity of historical deforestation rates as applied in the Reference Region to the initial project instances.

For this grouped project, the following set of eligibility criteria for the inclusion of new project activity instances has been defined, which is applicable for VM0015 REDD AUD activities and the geographic area demarcated by the Reference Region:

- 1) Meet the applicability conditions set out in the methodology applied to the project: all the applicability criteria mentioned in VM0015 shall be met for any new instance: a) baseline activities shall include unplanned deforestation; b) project activities shall include one or a combination of the eligible categories defined in the description of the scope of the methodology (table 1 and figure 2 of VM0015); c) new instances may include different types of forest systems meeting the definition of “forest”; d) at the date of inclusion in this project, the new instance shall include only land qualifying as “forest” for a minimum of 10 years prior to the project start date; e) The project area can include forested wetlands (such as bottomland forests, floodplain forests, mangrove forests) as long as they do not grow on peat.
- 2) Use and apply the technologies or measures specified in the project description: all new instances to be included in this project activity will necessarily be assessed using the same satellite imagery and field techniques as applied for the first 15 instances, as described in the VCS-PD.
- 3) All new instances shall be subject to the baseline scenario determined in the project description for the specified project activity and geographic area.
- 4) All new instances shall 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 must have financial, technical and/or other parameters (such as the size/scale of the instances) consistent with the initial instances, or face the same investment, technological and/or other barriers as the initial instances.

In addition, new project activity instances shall:

- 1) Preferentially occur within the Reference Region (as mentioned above any instance to be included outside the Reference Region will undergo all the required similarity assessments).
- 2) Comply with all the set of eligibility criteria for the inclusion of new project activity instances (cited above).
- 3) Be included in the monitoring report with sufficient technical, financial, geographic and other relevant information to demonstrate compliance with the applicable set of eligibility criteria and enable sampling by the validation/verification body.

- 4) Be validated at the time of verification against the applicable set of eligibility criteria mentioned above.
- 5) Have evidence of project ownership, in respect of each project activity instance, held by the project proponent from the respective start date of each project activity instance (i.e., the date upon which the project activity instance began reducing or removing GHG emissions).
- 6) Have a start date that is the same as or later than the grouped project start date.
- 7) Be eligible for crediting from the start date of the instance through to the end of the project crediting period (only).

Where a new project activity instance starts in a previous verification period, no credit may be claimed for GHG emission reductions or removals generated during a previous verification period and new instances are eligible for crediting from the start of the next verification period. Where inclusion of a new project activity instance necessitates the addition of a new project proponent to the project, such instances shall be included in the grouped project within five years of the project activity instance start date. The procedure for adding new project proponents will respect the rules of the VCS Program document Registration and Issuance Process.

AFOLU non-permanence risk analyses will be assessed for each new geographic area. Activity-shifting, market leakage and ecological leakage assessments will be reassessed where new instances of the project activity are included in the project.

- 1) The geographic area within which all project activity instances shall occur is delineated with the Reference Region set in this VCS-PD.
- 2) The determination of the baseline for the project activity is in accordance with the requirements of the methodology applied to the project.
- 3) The demonstrations of additionality for the project activity are in accordance with the requirements of the methodology applied to the project.
- 4) A set of eligibility criteria for the inclusion of new project activity instances at subsequent verification events is defined in this VCS-PD (above in this topic).
- 5) A description of the central GHG information system and controls associated with the project and its monitoring is provided in the Monitoring Plan.

It is important to notice that the Leakage Management areas originally inserted in the project design will be priority to recruit new project instances. If the new instances involve the original Leakage Management areas, new areas shall be identified and adopted to manage leakage.

1.5 Project Proponent

Organization name	Ituxi Administração e Participação Ltda.
Contact person	Ricardo Stoppe Junior
Title	Project Proponent (Landowner)
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Organization name	Carbonext Consultoria Ltda.
Role in the project	Managing partner
Contact person	Janaína Dallan, Luiz Fernando de Moura & David Swallow
Title	Project developer
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Organization name	Green Forest Carbon Consultoria Empresarial Ltda
Contact person	Élcio Aparecido Moço
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1.6 Other Entities Involved in the Project

Organization name	Avix Engenharia e Estudos Técnicos
Role in the project	Satellite imagery analysis for baseline assessment
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1.7 Ownership

Organization name	I. Fazenda Santa Catarina: Ituxi Administração e Participação Ltda. (CNPJ (Brazilian corporate registration n°.: 23.831.247/0001-55) II. Fazenda Santa Maria: Rio Grande Produção Florestal Ltda (CNPJ: 04.670.469/0001-99) III. Fazenda Bahia: Castanhal Agro Indústria de Produtos Não Madeireiros Ltda – Me (CNPJ: 04.161.170/0001-09) IV. Fazenda Paraná: Odair Augustinho Dall'Agnol Junior (CPF (Brazilian private individual registry number): 718.832.589-87) V. Fazenda Santa Fé: Rio Grande Produção Florestal Ltda (CNPJ: 04.670.469/0001-99) VI. Fazenda Presidente Prudente: Veridiana Taina dos Santos Moço de Oliveira (CPF: 023.663.521-23) VII. Fazenda Jardim Alegre: Rio Grande Produção Florestal Ltda (CNPJ: 04.670.469/0001-99) VIII. Fazenda Santa Luzia: Élcio Aparecido Moço (CPF: 017.692.598-80) IX. Fazenda São José: Marilda Aparecida Lot Stoppe (CPF: 063.704.288-33) X. Fazenda Recanto: Rio Negro Gestão e Comércio de Produtos Agroflorestais LTDA (CNPJ: 34.542.720/0001-09) XI. Fazenda São Manoel: Henrique Manoel dos Santos Moço (CPF: 043.838.741-42) XII. Fazenda São Sebastião: Henrique Manoel dos Santos Moço (CPF: 043.838.741-42) XIII. Fazenda União: Rio Negro Gestão e Comércio de Produtos Agroflorestais LTDA (CNPJ: 34.542.720/0001-09) XIV. Fazenda Panorama: Élcio Aparecido Moço (CPF: 017.692.598-80) XV. Fazenda Três Barras: Castanhal Agro Indústria de Produtos Não Madeireiros Ltda – Me (CNPJ: 04.161.170/0001-09) The CNPJ (Brazilian corporate registration) and the CPF (Brazilian private individual registry number) are the official registration numbers that allow to evidence que titularity of rural properties: all the property registration documents are available for the audit team.
Contact person	Ricardo Stoppe Junior

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In compliance with VCS Standard 4.2 (Section "3.6 Ownership", "Requirements"), the evidence establishing project ownership accorded to the project proponent(s) has been presented to the audit team as the Project Area land titles, which correspond to enforceable and irrevocable agreements with the holder of the property with right in the land, vegetation, conservational and management process that generates GHG emission reductions and removals, which vests project ownership in the project proponent. All the Project Area land titles were provided to the audit team at validation.

1.8 Project Start Date

The Unitor Project's Start Date is defined as the date of implementation of the first Sustainable Forest Management (SFMP) activities on the ground. The first property to implement its SFMP was the Santa Maria on 26/04/2018. Following that, various instances of the project became active on different dates, as described below.

REDD activities implemented on the ground are constituted by implemented SFMPs and installed surveillance bases (see Table 1 below). Regarding the SFMPs, the documents taken into account to prove their start were: the SFMP documents themselves; Operating Licenses, Forest Inventories, or financial evidence relating to the implementation of activities on the ground. The earliest date of these four types of evidence was preferred in each instance, in line with Verra's suggestions during the auditing process. Where properties have no activities on them or no active SFMPs as yet, the earliest date of the group (Santa Maria) was taken into account.

As summarized below in Table 1, the first property to implement its SFMP was the Santa Maria property 26/04/2018, corresponding to the overall Project Start Date. The next is 27/07/2018, corresponding to Santa Catarina's SFMP, followed by 17/09/2018, when the Três Barras property's forest inventory was carried out, and 10/11/2018, for the Presidente Prudente property, being the date of the first payment made to the Field Manager to begin the Sustainable Forest Management Plan (SFMP), specifically to begin to execute the schedule of the Operational Exploration Plan (OEP)⁴.

⁴ The "Operational Exploration Plan" is the document that defines the planning of sustainable forest management operations, marking the initiation of the following activities: forest inventory; harvest planning; surveillance activities; and the property's governance and sustainable management.

Regarding surveillance, the completion of the São José and Santa Luzia properties' surveillance bases are relevant for the Start Date, both being finalized on 23/08/2018.

Properties with no activity on them have shared surveillance with the closest surveillance bases, which determines their Project Start Date (PSD), as summarized in the table below (see the yellow squares). Specifically, the following is noteworthy: Santa Fé, Bahia, Paraná, Jardim Alegre and São Sebastião use Santa Luzia's surveillance base as PSD. This is justified as they either border with it (in the former case), or are close by, within the same project group (see Figure 5). Importantly, the project monitors are employed to conduct patrols covering the whole project area on a weekly basis, by ground and river, as discussed in Section 1.11.

Table 1. Project Start Date summary

Project Group	Field activities comprising REDD start						
	Property	Type of action	Surveillance Base	SFMP/POE	Operating License	Forest Inventory	Financial Evidence
1. NE	São José	São José I Surveillance base	23/08/2018				
	Panorama	Shared	23/08/2018 (São José)				
	União	Shared	23/08/2018 (São José)				
	Recanto	Shared	23/08/2018 (São José)	In development	Inactive/ no L.O.		
2. Central	Santa Catarina	SFMP		27/07/2018	11/09/2018		
	Santa Maria	SFMP		26/04/2018	10/08/2018		
	Presidente Prudente	SFMP		01/02/2019	01/06/2020		10/11/2018
	São Manoel	SFMP	23/07/2019	13/01/2020	11/08/2020		
	Bahia	Shared	23/08/2018 (Sta Luzia)	In development	Inactive/ no L.O.		
	Santa Luzia	Santa Luzia Surveillance base	23/08/2018				
	Santa Fé	Shared	23/08/2018 (Sta Luzia)				
	Jardim Alegre	Shared	23/08/2018 (Sta Luzia)				
	Paraná	Shared	26/04/2018 (Santa Maria)				
	São Sebastião	Shared	23/08/2018 (Sta Luzia)				
3. SW	Três Barras	SFMP		out/18	18/12/2018	17/09/2018	

*Legend:

Green cells: actions implemented within the property

yellow cells: are shared with nearby properties

SFMPs are applicable as REDD actions as they have the explicit intention of contributing to conservation and to atmospheric carbon sequestration, and are key to forest surveillance by providing personnel on the ground. Indeed, SFMPs are an explicit component of the Brazilian National REDD+ Strategy⁵. Therefore, the initiation of the respective SFMP activities are defined as the Project Start Dates.

1.9 Project Crediting Period

Start date: 26/04/2018

End date: 25/04/2048

30 years.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	
Large project	X

Table 2. Estimated net GHG emission reductions or removals over the project lifetime

Year	Estimated GHG emission reductions or removals (tCO ₂ e)
2018	495,602
2019	448,585
2020	482,950
2021	655,055
2022	529,750
2023	180,304
2024	199,884
2025	614,065

⁵ http://redd.mma.gov.br/images/publicacoes/enredd_documento_web.pdf, page 8

2026	256,171
2027	668,416
2028	350,907
2029	448,798
2030	717,632
2031	707,846
2032	698,227
2033	696,827
2034	456,496
2035	443,348
2036	438,535
2037	425,343
2038	419,368
2039	406,460
2040	401,118
2041	395,776
2042	390,434
2043	385,092
2044	388,483
2045	43,319
2046	-51,807
2047	59,026
2048	-237,538
Total estimated ERs	12,514,470
Total number of crediting years	30
Average annual ERs	417,149

1.11 Description of the Project Activity

The UNITOR REDD+ PROJECT consists of a 99,035.20 hectares total Project Area of protected native forests, located in a region with the fourth highest deforestation rate in the Amazon Biome⁶ at the time of writing: the municipality of Lábrea. Being one of the southernmost municipalities in the Brazilian state of Amazonas, Lábrea is geographically located close to the “Arc of Deforestation” (Figure 1) and borders with other highly deforested municipalities to the South (Rio Branco, State of Acre; and Porto Velho, State of Rondônia). This project is not located within a jurisdiction covered by a jurisdictional REDD+ program.

Over the historical reference period of the present project (2009 – 2018) in the State of Amazonas, we see a consistent year-on-year increase in deforestation – with the exception of 2017 (10% decrease) – according to PRODES data: 405 km² in 2009 grew to 1,000 km² in 2018, representing an overall increase of 147%. The years 2019 and 2020 taken together saw 2,955 km² of deforestation: rates not seen since 1995-1996. An IPAM/ISA/IMAZON (2014) study presents several factors that have traditionally been linked to the felling of forests:

- i) the increase in prices for agricultural products, for example, have historically spurred deforestation for both productive and speculative purposes;
- ii) major infrastructure works, such as hydroelectric projects, paving of highways (which in the present case is represented by the BR-364 federal highway) and construction of ports, change the regional dynamics and may have contributed in part to the recent increase in felling of forests;
- iii) and the government’s continued weakening of environmental regulations: the Forest Code approved in 2012 allowed the legalization of a significant proportion of areas illegally deforested in the past, which created expectations that new deforestation would be amnestied in the future. Indeed, since the time of this study, this tendency has been confirmed by the progressive weakening of the enforcement of environmental legislation, which has been linked to the almost unprecedented levels of deforestation of recent years^{7,8}.

Furthermore, successive governments (Dilma in 2012, Temer in 2016, and Bolsonaro 2019⁹) have put forward measures such as the to reduce the areas Conservation Units (“UCs”)¹⁰, which were responsible for only 3% of deforestation up to 2014, although they cover 25 % of Brazilian Amazon territory. Such changes would particularly affect Lábrea, as 3,689,300 hectares of the

⁶ Source PRODES (accessed 22/03/21):

http://terrabrasilis.dpi.inpe.br/app/dashboard/deforestation/biomes/legal_amazon/rates

⁷ Source Folha de São Paulo (accessed 22/03/21): <https://www1.folha.uol.com.br/ambiente/2020/09/amazonia-tem-2o-pior-agosto-de-desmate-so-perdendo-para-o-do-1o-ano-sob-bolsonaro.shtml>

⁸ Source A Pública (accessed 22/03/21): <https://apublica.org/2020/08/governo-bolsonaro-reduz-multas-em-municipios-onde-desmatamento-cresce/>

⁹ Source O Eco.org (accessed 25/06/21): <https://www.oeco.org.br/noticias/bolsonaro-conversa-com-governadores-sobre-revisar-unidades-de-conservacao>

¹⁰ Source Terra de Direitos (accessed 22/03/21): <https://terradedireitos.org.br/acervo/artigos/ameacas-concretas-do-governo-bolsonaro-sobre-unidades-de-conservacao/23231>

municipality are represented by Federal UCs, the highest of any municipality within the BR-319's influence (Idesam, 2018). The patterns observed suggest that deforestation is increasing in public lands that: i) are not designated for specific purposes ("Non-designated public land") and ii) those for which land title information is lacking ("Land lacking land title information"). Around 37% of deforestation was reported by IPAM/ISA/IMAZON (2014) to have occurred in areas included in these two categories (see Table 3).

The South of the municipality of Lábrea has already been reached by the "Arc of Deforestation" causing it to be ranked among the Amazon Biome's most deforested municipalities for the last 10 years. This is primarily caused by the presence of the BR-364 highway, which connects Porto Velho to Rio Branco, and the BR-317, which forms the border with Boca do Acre municipality, in the West, in this portion of Lábrea (Idesam, 2018). As well as the damage caused to natural ecosystems, the land-use changes have ignited severe social conflicts through processes such as land-grabbing and installation of agriculture and cattle ranching activities, contributing to expulsion of small family farmers from the region. In addition, the Ministry of Transportation plans to pave the BR-319 Highway (Porto Velho-Manaus) in 2021, and to begin work on the Port of Lábrea¹¹, while promises to pave the BR-230, which connects the BR-319 to Lábrea, continue¹². To mitigate the environmental consequences of the BR-319 highway, in 2008 the government created four Conservation Units (UCs): the Wild-harvesting ("Extractive") Reserves (RESEX) of "Ituxi" and "Médio Purus", the National Forest (FLONA) of "Iquiri", and the National Park (PARNA) of "Mapinguari" were created (VITEL, 2009). The total area covered by Federal UCs in Lábrea is unusually high, at 54% (Idesam, 2018).

¹¹ Source: A Crítica (accessed 22/03/21): <https://www.acritica.com/channels/manaus/news/ministro-garante-recuperacao-da-br-319-e-construcao-do-porto-de-labrea>

¹²Source: Correio da Amazônia (accessed 22/03/21): <https://correiodaamazonia.com/caravana-da-aleam-chega-na-br-320-entre-humaita-e-labrea/>

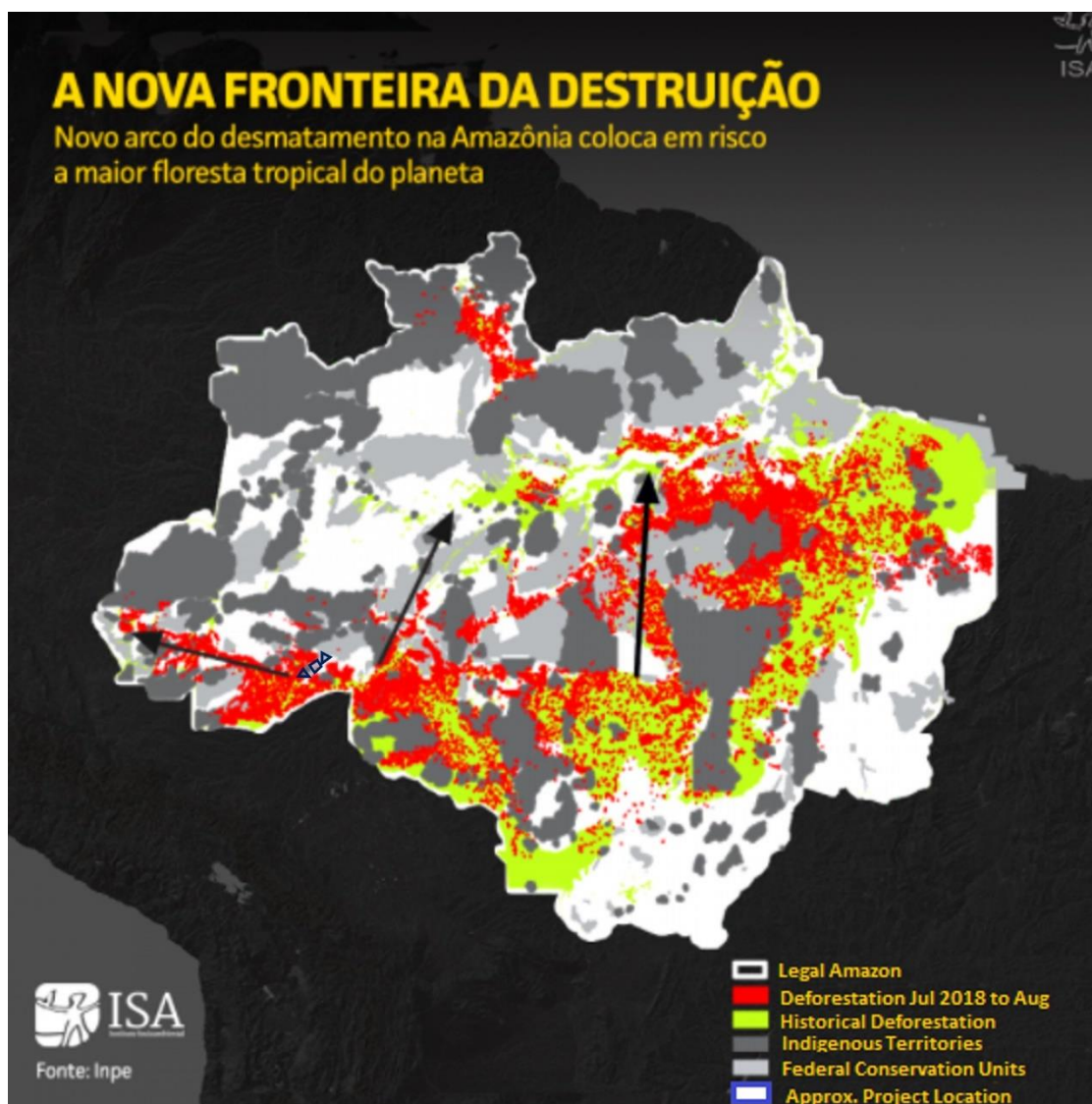
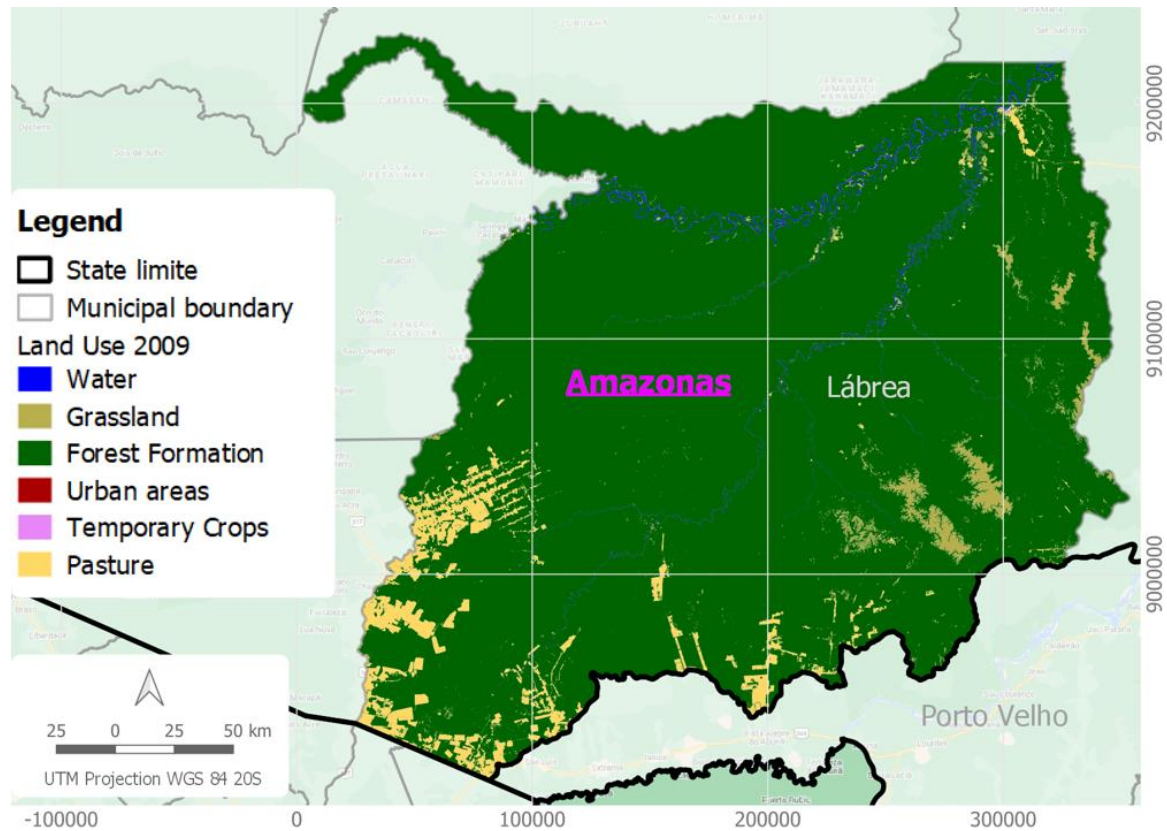


Figure 1. Location of the Arc of Deforestation in 2019 (Source: ISA, 2019)

Table 3. Deforestation in 2013 by land title category in the Brazilian Amazon. Source: IPAM/ISA/IMAZON (2014)

Land title category	Area deforested in 2013 (km ²)	% of the total deforested
Indigenous Territory	148.04	3%
Conservation Unit	312.18	6%
Environmental Protection Area (APA)	234.01	5%
Settlement	1,399.86	29%
Private Property	994.02	20%
Non-designated public land	665.20	14%
Land lacking land title information	1,121.45	23%
Total	4,874.76	

However, despite the large number and total size of the Conservation Units in Lábrea, the conservation efforts in the region, are not proving to be effective. Idesam (2018) carried out a study of the municipalities within the BR-319's influence: it reports that over the 2005 – 2016 period analysed, the deforestation rate was second only to that of Porto Velho municipality (the capital of Rondônia State, therefore highly urbanized), representing a 55% increase in deforestation, similarly its growth of herd size, reaching 315,000 in 2016, was second only to Porto Velho. A map of land-use in the municipality follows below at the beginning (2009) and end (2018) of the historical reference period follows below.



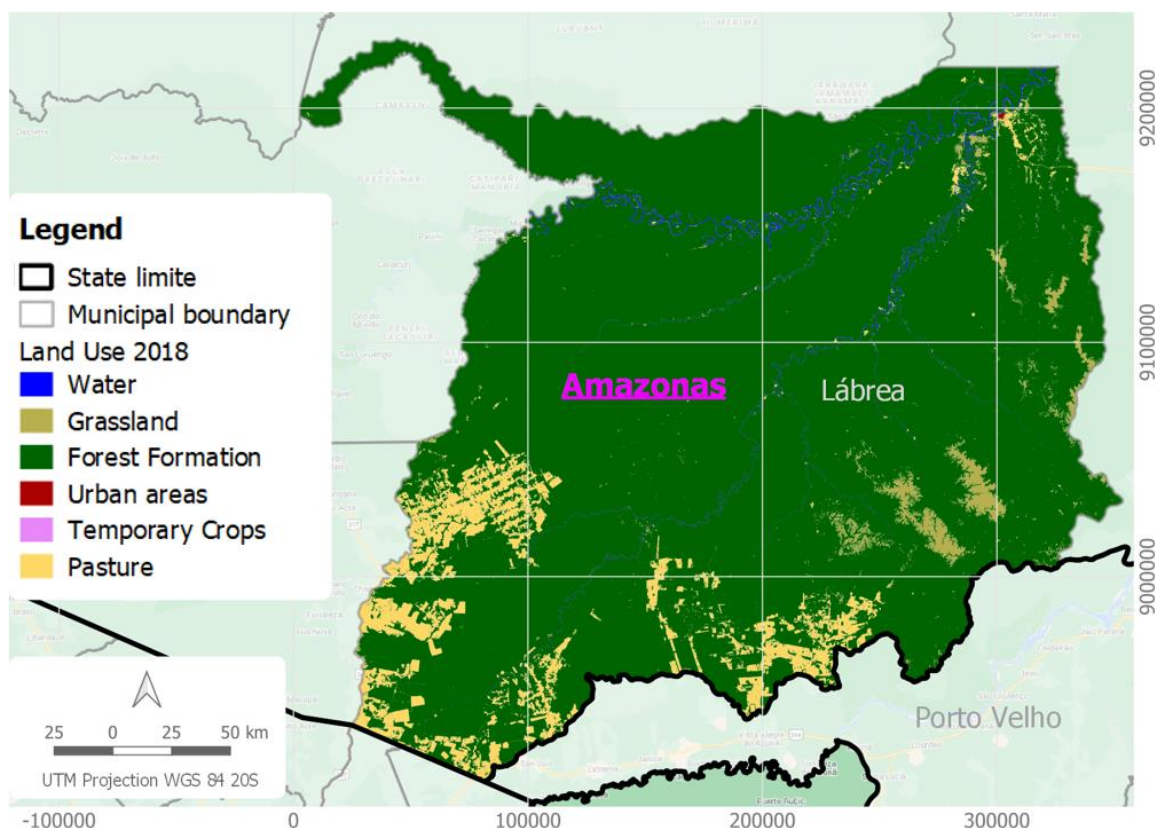


Figure 2. Land-use in Lábrea municipality at the beginning (2009) and end (2018) of the historical reference period. Source: Mapbiomas¹³.

The Idesam (2018) and Vitel (2009) studies support the hypothesis that deforestation in Lábrea is strongly correlated to the proximity of roads, and the increase in deforestation rates recent years can be mainly attributable to the “Jequitibá” and “Ramal do Boi” Roads. The “Ramal do Boi” Road is about 100 km long and passes at a distance of 4 km to the Project Area, and has connected roads which intersect the Project Area. Vitel (2009) field study indicated that deforestation in private properties is predominantly attributed to cattle ranching, and current images from the project area (see Figure 3) confirm this pattern.

Located on this road, the author mentions an 8,000-hectares property having 4,000 hectares of pasture and 7,000 cattle heads. The landowner (Mauro Barros or “Baiano”) was murdered in 2007, which testifies the social tensions for land grabbing in the region. Over the last decade, there has been major governmental concern regarding social issues related to land tenure in Lábrea: in 2007, former Minister Márcio Thomaz Bastos coordinated an urgent operation of federal police agents in the municipality, to guarantee security of rural workers during negotiations. During that period, the Brazilian Federal Police Intelligence performed a deep investigation in the region, to provide information to the Brazilian Ministry of Justice for implementation of an emergency plan. Despite IBAMA’s (Brazilian Institute for Environment and

¹³ Source: Mapbiomas, municipality Lábrea: <https://plataforma.brasil.mapbiomas.org>

Renewable Natural Resources) intensified monitoring of the area intensified since 2006, because of the extreme levels of deforestation, some illegal wood producers continue to log intensely during the rainy season, when clouds hinder identification of deforestation by satellite imaging (VITEL, 2009).



Figure 3. Deforestation in a private land attributed to cattle ranching, near “Ramal do Boi” road.

There is furthermore a marked history of illegal land occupation in the project region. The project owners have reported numerous occurrences of illegal land occupation in the project area, during the historical reference period (2009 – 2018). In addition to the police reports registered by the proponents about the attempts of invasion and land grabbing, there are numerous cases that had repercussions in the media. For example, in 2016 two men were arrested on suspicion of invading farms and forcing the owners to vacate their properties to sell them¹⁴. There are also operations carried out by the Federal Police to investigate criminal organizations that invade lands in the federal public domain to deforest and commercialize illegally harvested wood^{15 16}.

Furthermore, there is a famous case of historical land invasion relating to the nearby Fortaleza Ituxi REDD Project, which had State-wide repercussions as it involved an attempt to build an illegal hydropower plant on the waterfalls located on the property, instigated by former Rondônia

¹⁴ G1 (2016): <http://g1.globo.com/am/amazonas/noticia/2016/09/suspeitos-de-invadir-fazendas-no-interior-do-am-sao-presos-com-armas.html>

¹⁵ G1 (2020): <https://g1.globo.com/am/amazonas/noticia/2020/05/22/treze-pessoas-sao-presas-durante-operacao-contra-crimes-de-invasao-de-terras-publicas-e-desmatamento-ilegal-no-am.ghml>

¹⁶ Policia Federal (2021) <https://www.gov.br/pf/pt-br/assuntos/noticias/2021/03/pf-deflagra-operacao-constantino-para-investigar-invasoes-e-queimadas-em-terras-da-uniao-no-amazonas>

State Governor, Ivo Cassol and his company. This resulted in the initiation of a mission by the Amazonas State Government: the so-called Uiraçu Mission, which was coordinated by the Military Police of the municipality of Manaus-AM. This led to the discovery of a large-scale wood trafficking scheme, transported in trucks by Ivo Cassol's workers, to be sold in Rondônia State using faked invoices. Although the propriety of the area was rightfully restored to the Ituxi project owner, 3,000 hectares of cleared and burned land was left by the invaders, constituting environmental crimes.

Adding to this scenario of expanding roadways and history of land grabbing, the high levels of forests – which currently cover 92% of the municipality (6.26 million hectares) – create an exceptionally high potential for deforestation over the coming years in Lábrea, with a probable future resembling that of the neighbouring States of Acre and Rondônia, to the South, which have undergone intense deforestation historically, mainly due to the expansion of agriculture and cattle ranching.

Within this scenario of intense deforestation pressure, the Unitor REDD+ project's 15 properties represent 110,944.05 ha total property area which is 89.27% preserved, totalling 99,035.20 ha of forested lands. The 15 properties conduct different activities as Sustainable Forest Management, cattle farming, and no economic activity, as detailed in the below.

Table 4. Economic activities of each project property

Nº	Propriety	No Activity	Cattle Farming	SFMP
1	Santa Catarina			x
2	Santa Maria			x
3	Bahia		x	x*
4	Paraná	x		
5	Santa Fé	x		
6	Presidente Prudente			x
7	Jardim Alegre	x		
8	Santa Luzia	x		
9	São José		x	
10	Recanto			x*
11	São Manoel			x
12	São Sebastião	x		
13	União	x		
14	Panorama	x		
15	Três Barras		x	x
TOTAL		7	3	7

*The Recanto and Bahia properties are in the process of obtaining their Operating Licenses

Surveillance bases have been installed, and more are planned, to combat deforestation in the Project Area. The properties to have surveillance bases installed on them were the Santa Maria, São José, and Santa Luzia properties had, with the latter two completed on 23/08/2018, marking the start of their REDD activities. Further surveillance bases are planned on Três Barras, São Manoel, and a second base on São José.

These bases are designed to accommodate two monitors each, with all the necessary facilities and amenities for forest monitoring, including: kitchen, solar energy, internet, artesian well. The bases are used in an itinerant fashion, currently by the 6 active forest monitors in the area, to monitor illegal land occupation, illegal logging, and illegal deforestation. Ground patrols are carried out periodically with vehicles (motorcycles and pickup trucks) or on foot. River monitoring is usually done twice a week, and air monitoring is planned for MR1. With this infrastructure, a single guard can conduct ground surveillance of one project group (north-east, central or south-west, see figure 5) on a weekly basis, and the project already has at least two monitors per group. Monitoring frequencies may change, especially in the rainy season when access is limited.

Given the context described above, the baseline may involve the following non-exclusive baseline scenarios (discussed fully in section 3.5 Additionality):

i) SCENARIO 1: Continuation of the pre-project land uses:

The properties' activities were grouped together for financial analysis of the REDD+ project, however they can be described under the following categories of pre-project activities:

Sustainable Forest Management Plans (SFMPs): Five of the project properties have actively operational SFMPs and two are in the process of obtaining the operating license. Of the active five, four make a profit, while one makes a loss. Two further properties with pending operating licenses currently make no profit. The average profit across the five properties with active SFMPs is estimated at R\$501/ha of managed area.

No activity: under Scenario 1, the seven properties with no economic activities had no costs associated with them, because prior to the REDD project implementation, these properties had no forest monitors.

Cattle farming: Although three of the project properties also conduct cattle farming (Fazenda Três Barras; Fazenda Bahia; and Fazenda São José), it is important to point out that the cattle ranching areas are excluded from the REDD Projected Area in accordance with applicable VCS Standard and VM0015 methodology requirements, as the former consist of pastureland, while the latter are 100% forested land.

The business model is traditional, extensive cattle farming, which tends not to be financially attractive under most conditions, which is discussed fully in Scenario 7, below.

Project landowners will not be able to afford large long-term costs and efforts to avoid past deforestation pressures continuing in the Project Area. The majority (10 out of 15) of the

individual businesses currently administrated in the Project Area properties, as well as the sum total of all the activities together, are not financially attractive without carbon funding.

ii) SCENARIO 2: Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project:

The same categories of activity as mentioned in Scenario 1 were taken into account, however, costs for REDD+ monitoring, and implementation were added in, to create scenario 2. Therefore, the elements of Scenario 2 were as follows:

Sustainable Forest Management Plans (SFMPs): five of the project properties with active SFMPs, with average estimated profit of R\$501/ha of managed area..

No activity: Regarding the seven project properties with no economic activity, each was assigned two guards under Scenario 2, generating losses of R\$48,000 per property/ year.

REDD implementation, and monitoring costs: Costs for 20 forest monitors, six surveillance bases, various vehicles, and personnel training were added in to the 30 year cashflow.

Scenario 2 as a whole was found to have an IRR of -3.21% (see section 3.5 Additionality)¹⁷ and it includes uncommon practices of forest conservation with no financial returns.

The Project Proponents would not be able to afford costs to implement and maintain the proposed Project Activity. For this reason, the Project Proponents are seeking to monetize their project activities with carbon finance, in order to obtain the required financial resources. Thus, the proposed Project Activity is not financially feasible without carbon credits.

iii) SCENARIO 3: Planned deforestation and logging of the area permitted by Law:

This option is shown by project calculations to generate supplementary income to financially support long-term monitoring of the system; furthermore, this would correspond to active deforestation of the property by landowner in the future.

iv) SCENARIO 4: Wood harvesting to illegal levels followed by cattle farming (Business as usual – BAU):

Illegal harvesting of wood is shown by studies to extract up to 69 m³/ha⁽¹⁸⁾ where the legal SFMPs analysed extract up to 24,4 m³/ha. In the illegal case, this would lead to estimated revenues across our project SFMPs of R\$ 51,496,126 while the legal scenario generates R\$ 18,210,224, costs in both cases are estimated at R\$ 13,645,093.

The consequent per hectare estimated profits are of 501R\$/ha for the legal and 4,157 R\$/ha for the illegal timber operations (taking into account only those with with active licenses).

¹⁷ Calculations available in spreadsheet: "FINANCEIRO SENSITIVITY_Unitor_SFMP_v.14"

¹⁸ Source Imazon (accessed 25/03/21): <https://imazon.org.br/degradacao-de-florestas-pela-exploracao-madeireira-e-fogo-na-amazonia-oriental-brasileira-no-20/>

Following illegal deforestation, cattle farming is foreseen to be implanted, as described further under Scenario 7.

Given these economic dynamics, this is considered the regional business-as-usual (BAU) scenario.

v) SCENARIO 5: Unplanned deforestation caused by uncontrolled illegal trespassing:

This scenario is the result of the inability to control borders given the current negative cashflow scenarios that are prevalent in the property areas, indicating the need for additional sources of income for the successful sustainable operation of the farms.

vi) SCENARIO 6: Farm sale to private investors followed by the regional BAU:

Project Area landowners of the present project have received multiple verbal offers to sell their farms, as is the custom in the region. However, registered evidence of the interest of land purchase (e.g., purchase proposals) are not currently available.

vii) SCENARIO 7: Cattle Farming

To calculate the financial viability of livestock activities, financial data from Carrero et al (2015)¹⁹ and characteristics of operations which match the local reality from IIS 2015²⁰ were taken into account.

These characteristics are:

- A traditional extensive cattle farming model described as “business as usual” (IIS 2015);
- No access to technical assistance (IIS 2015);
- No access to rural credit (IIS 2015);
- Pasture size ranging from 1,000 – 4,000 ha (with an average size of pasture area of 2,915 ha in the project area);

By inputting the financial data from Carrero et al. 2015 to the pasture areas of the project properties, it was possible to calculate and average IRR of -0.03% and NPV of - R\$550,835 (or - 189R\$/ha) over 30 years.

This projection falls within the range of NPVs reported in literature sources for cattle ranching, which fall between -232R\$/ha and 569R\$/ha (IIS 2015) for the type of cattle farming described above, corresponding to 1,000 – 4,000 ha areas, respectively.

As shown above, cattle farming may be a lucrative activity under certain circumstances, and there is a strong cultural tendency in the region in favour of it, regardless of profit margins, partly because it is linked to other, more lucrative activities such as illegal wood harvesting and land speculation, as well as being deeply culturally ingrained in itself (Carrero et al. 2015; Schneider et al. 2000; Vitel, 2009).

¹⁹ Carrero et al (2015): A Cadeia Produtiva de Carne Bovina no Amazonas

²⁰ IIS (2015) [relatorio-BC-JUNHO-2015-GRAF.indd \(iis-rio.org\)](#)

Furthermore, pastureland is the most prolific post-deforestation land use in the reference region, accounting for over 99% of the post-deforestation land-use in Labrea Municipality, in accordance with analyses using MMA and Mapbiomas sources^{21,22}, as presented in section 4.1.5.2.

The deforestation projections presented in the PD corroborate the intensity of the deforestation pressure – suggested by past observation in the Reference Region and the municipality as a whole – on the Project Area into the future. Through the deforestation modelling presented in Section 4.1, the author clearly demonstrates that the Project Area would be strongly impacted by growing deforestation pressure over time: by 2048, 24,769 hectares (25%) of the project area is predicted to be lost.

Cattle farming is the core baseline activity, which by far predominates in the region, and thus it is considered to be the most plausible scenario.

Project's major climate, community and biodiversity objectives

Regarding the major climate objectives, through protecting forests in Lábrea municipality as described above, the Unitor REDD+ Project aims to avoid the emissions of 12,514,470 tCO₂e, corresponding to the avoidance of 24,769 hectares of deforestation over 30 years.

The project will also include the implementation of certain activities with a view to obtaining the necessary instruments and institutional support to ensure that sustainable forest management continues in the property and that leakage will be mitigated. Some activities are already quantified in the Project budget available to auditors. Other activities will depend on agreements with governmental and educational entities, and/or NGOs. For the latter activities, the project proponent will apply best efforts to convince these entities to collaborate with the project but cannot participate in direct funding. The project proposes the implementation of the following activities in favour of community and biodiversity:

- **Technical Training on Sustainable Cattle Raising:** the objective of this initiative will be qualifying labour that finds little opportunity to work in the region and ends up taking part in illegal settlements and land occupation. It is expected that this initiative will benefit at least 30 students in each training offered. Students and technicians of both sexes will be eligible for registrations, with the previous requirement of having finished the basic studies (middle school).
- **Forest Management Courses:** Courses on forest management methods will be offered to the local community. This may lead to the qualification of people who can work in the proposed project.

²¹ Source MMA (accessed 23/03/21): http://conama.mma.gov.br/index.php?option=com_sisconama&task=documento.download&id=20101 (pg. 73).

²² Source, Mapbiomas, municipality Lábrea: <https://plataforma.brasil.mapbiomas.org>

- Fire Brigade Training: training will be given to prepare fire brigade members, and in addition to the employees, the project's neighbours will be able to participate in the training event as well.
- Advice on nutritional aspects: lectures will be offered by professionals on health-related issues, such as transmissible diseases, healthy eating, hygiene habits, etc. The purpose is to improve the quality of life and access to basic health information, especially for communities that are further away from health posts.
- Biomass, fauna and flora inventory will be carry out to monitor the carbon stock and local biodiversity.
- Support for SEMA – AM's activities (Secretaria de Estado do Meio Ambiente do Amazonas; Amazonas State Secretariat of Environment): SEMA will benefit from having, under its jurisdiction, a second example of an innovative REDD model – the first being the nearby Fortaleza Ituxi REDD Project, also developed by Carbonext – that can be further replicated on other properties. It will continue to raise the public profile of the current administration, providing visibility and methodological advances in environmental preservation.
- Surveillance activities designed to mitigate illegal logging and land occupation in the area will be achieved through the Unitor REDD+ Project, summing with the efforts of the Fortaleza Ituxi REDD Project, thus covering a significant area of Lábrea municipality. By continuing to promote an increase in the number of REDD Projects in the region, whenever feasible, as well as sustainable forest management plans, the project aims to impact deforestation and degradation significantly. This process will be further consolidated through combined efforts with private and governmental entities, and NGOs. In this context, the project proponent will spearhead political mobilization of the regional forest sector and, continue to reinforce the engagement of all sectors involved in deforestation issues, in the long term. The main condition for execution of this activity is the approval and validation of the Unitor REDD+ Project, which will be a further important benchmark for engagement of all potential private landowners in the Lábrea region.
- Potential Roll-out to Other Areas: Unitor already being the project proponent's second REDD activity in the region, further areas with potential for REDD projects have already been identified around the project site, which will favour and encourage forest conservation by means of financial incentives obtained from credit sales and provide social and environmental benefits to local communities.
- Combatting illegal land occupation: The local community will be strategic in monitoring illegal land occupation and potential illegal logging. Those who are interested in being trained and carrying out local monitoring will be included in the project, an activity which may also become a new source of income for local communities.

The Unitor REDD+ Project aims at assuring the continuation of ongoing activities for forest protection plus the implementation of the following actions:

- I. Qualification of the local community to engage in the activities related to forest management within the farm;
- II. Long-term protection of the area of the property and opposition to invasion by land grabbers;
- III. Improvement of local security through project monitoring and public sharing of documentation;
- IV. Organization and training of forest fire brigades;
- V. Continued efforts together with SEMA - AM (Secretaria de Estado do Meio Ambiente do Amazonas; Amazonas State Secretariat of Environment) in order to continue to consolidate a model for environmental management, which is both attractive and replicable to future REDD projects.

Furthermore, the monitoring strategy is a fundamental point to ensuring the success of this project. The project's monitoring will combine satellite images (GIS) with field patrolling. Regarding GIS, the PRODES and the DETER systems provided by INPE will continue to be essential tools in the monitoring of deforestation by the project proponents. The project proponent will organize a regional effort in order to train and share information with local stakeholders. In addition to a regular revision by satellite images of the area covered by the project, there will be a team stationed within the property, which will conduct on-site surveillance of deforestation within and on the borders of the property, to ensure the maintenance and preservation of the forest. In this manner, a new development model may be created in the region of Lábrea and its surroundings, based on a new model for harnessing the forests' full potential, associated with the preservation of natural resources and sustainable economic activities, including sustainable forest management and non-timber products.

Monitoring carbon inventories within the limits of the project

The average carbon stock of the relevant Submontane open Ombrophylous forest was conservatively estimated as 753 tCO₂/ha (577 tCO₂/ha aboveground; 176 tCO₂/ha belowground), according to the local assessment explained in item 1.13 of this VCS-PD.

Leakage management

Leakage is expected to mainly manifest itself as land-use changes (cattle ranching, timber harvesting etc.) in the project surroundings. These land-uses have become more economically attractive than sustainable management of forest resources, owing primarily to the following factors: market pressure; occupation of frontier and other areas where law enforcement and command-and-control approaches are not effective; among other secondary factors.

The Project proponents will adopt proactive initiatives to fight these leakage sources, based on a cooperative effort with local stakeholders to promote a new approach to forest and land-use in the region, which are fully explained in section 1.17 of the present VCS-PD.

1.12 Project Location

a) Property name, ownership, total area and REDD area are presented below:

Table 5: Breakdown of properties in the Project Area

	Property Name	Ownership	Total property Area (ha)	REDD PA Area (all forest) (ha)	PA area composition (%)
i	Fazenda Santa Catarina	Ituxi Administração e Participação LTDA	10,031.37	10,009.53	10.1%
ii	Fazenda Santa Maria	Rio Grande Produção Florestal Ltda	6,046.67	6,016.63	6.1%
iii	Fazenda Bahia	Castanhal Agro Industria de Produtos Não Madeireiros Ltda	9,906.94	6,000.23	6.1%
iv	Fazenda Paraná	Odair Augustinho Dall' Agnol Junior	5,855.24	5,842.97	5.9%
v	Fazenda Santa Fé	Rio Grande Produção Florestal Ltda	11,310.39	11,237.47	11.3%
vi	Fazenda Presidente Prudente	Veridiana Taina dos Santos Moço de Oliveira	1,045.59	1,009.15	1.0%
vii	Fazenda Jardim Alegre	Rio Grande Produção Florestal Ltda	7,000.23	6,546.37	6.6%
viii	Fazenda Santa Luzia	Elcio Aparecido Moço	9,792.14	9,786.09	9.9%
ix	Fazenda São José	Marilda Aparecida Lot Stoppe	8,764.00	7,780.87	7.9%
x	Fazenda Recanto	Rio Negro Gestão e Comercio de Produtos Agroflorestais	2,025.01	2,024.38	2.0%
xi	Fazenda São Manoel	Henrique Manoel dos Santos Moço	1,472.33	1,468.86	1.5%
xii	Fazenda São Sebastião	Henrique Manoel dos Santos Moço	2,450.02	2,441.62	2.5%

xiii	Fazenda União	Rio Negro Gestão e Comercio de Produtos Agroflorestais	1,642.41	1,631.63	1.6%
xiv	Fazenda Panorama	Rio Negro Gestão e Comercio de Produtos Agroflorestais	1,110.74	1,108.45	1.1%
xv	Fazenda Três Barras	Castanhal Agro Indústria de Produtos Não Madeireiros Ltda	33,504.60	26,130.96	26.4%
TOTAL			111,957.69	99,035.20	100.0%

b) Map of the project area:

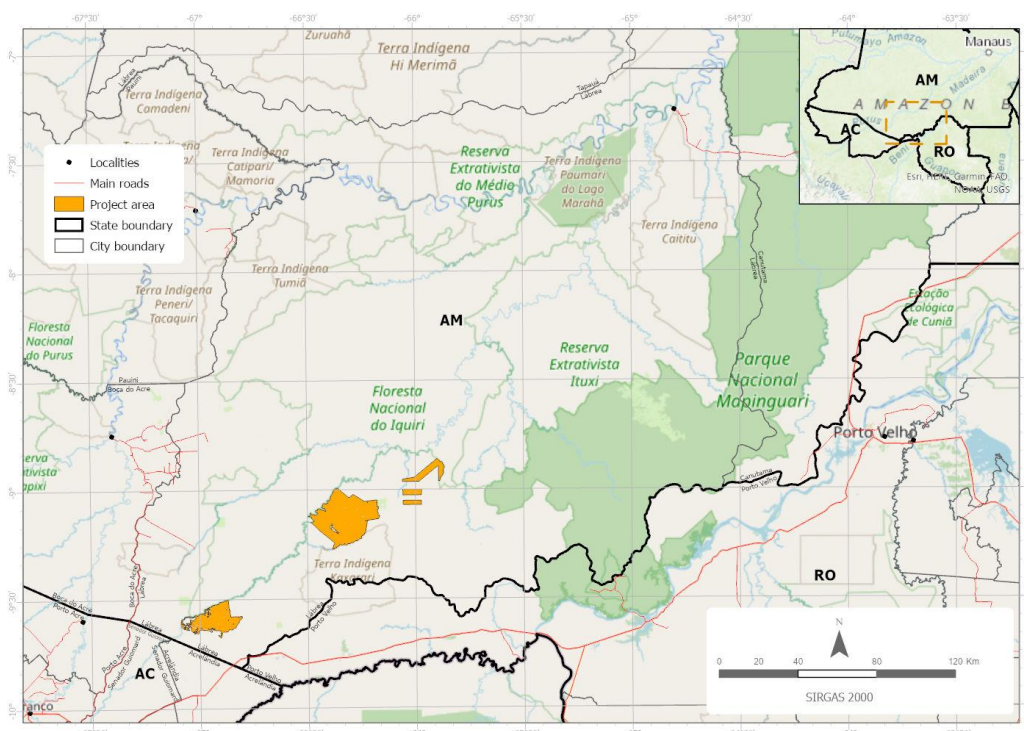


Figure 4: Map of the project area. Source: IBGE (2019)²³

The property boundaries were created using the land limit assigned by the owners and registered with INCRA²⁴.

c) Map of the location of each of the properties within the project area

²³ Source: IBGE: <https://portaldemapas.ibge.gov.br/portaal.php#homepage>

²⁴ Source: SIGEF: <https://sigef.incra.gov.br/consultar/parcelas/>

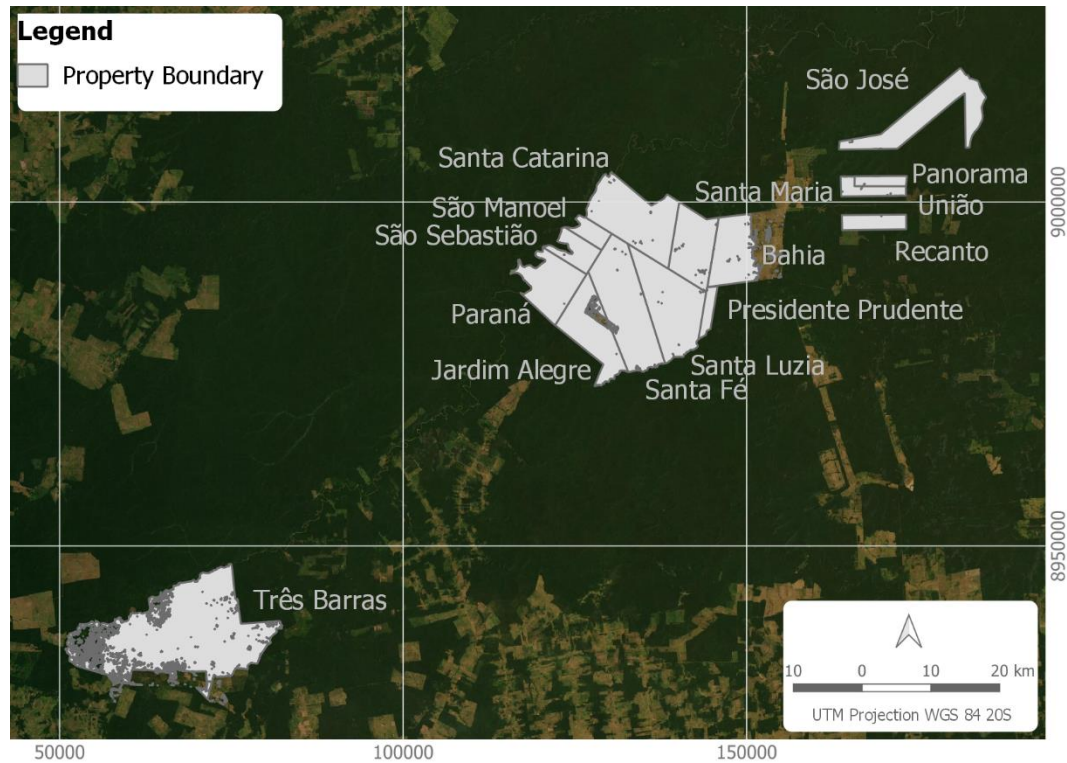


Figure 5. Location of each of the properties within the project area

- d) The main geodetic coordinates of the Project Area, separated into three main zones, are as follows, applying the Lat; Long coordinate system. The complete set of 1,671 coordinates, is available upon request.

The Project Area was created using the delimitation of the properties minus the areas that were deforested between 2009 and 2018 in the properties. The geographic coordinates of the main vertices of each zone were calculated and can be seen in the tables bellow.

Project Zone 1:

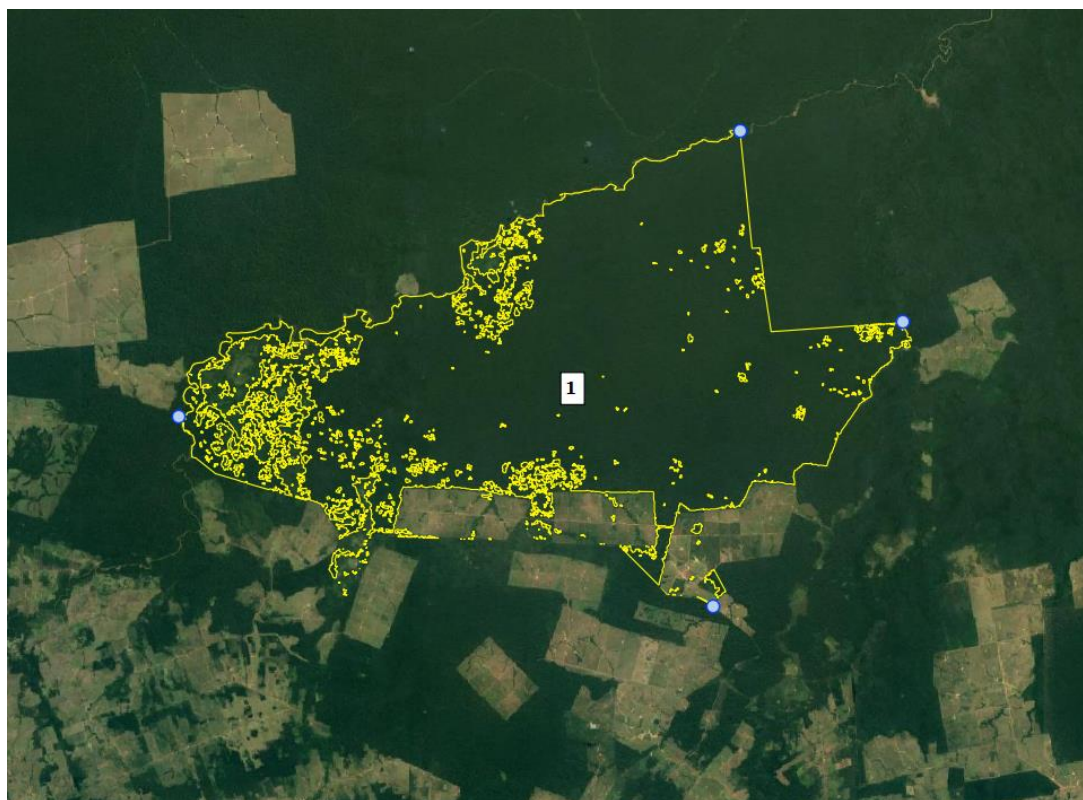


Figure 6: Area of the project Zone 1

Table 6: Latitude and Longitude of Project Zone 1

Latitude	Longitude
-9,57635	-66,8059
-9,68594	-66,8814
-9,60964	-67,0903
-9,50126	-66,8689

Project Zone 2:

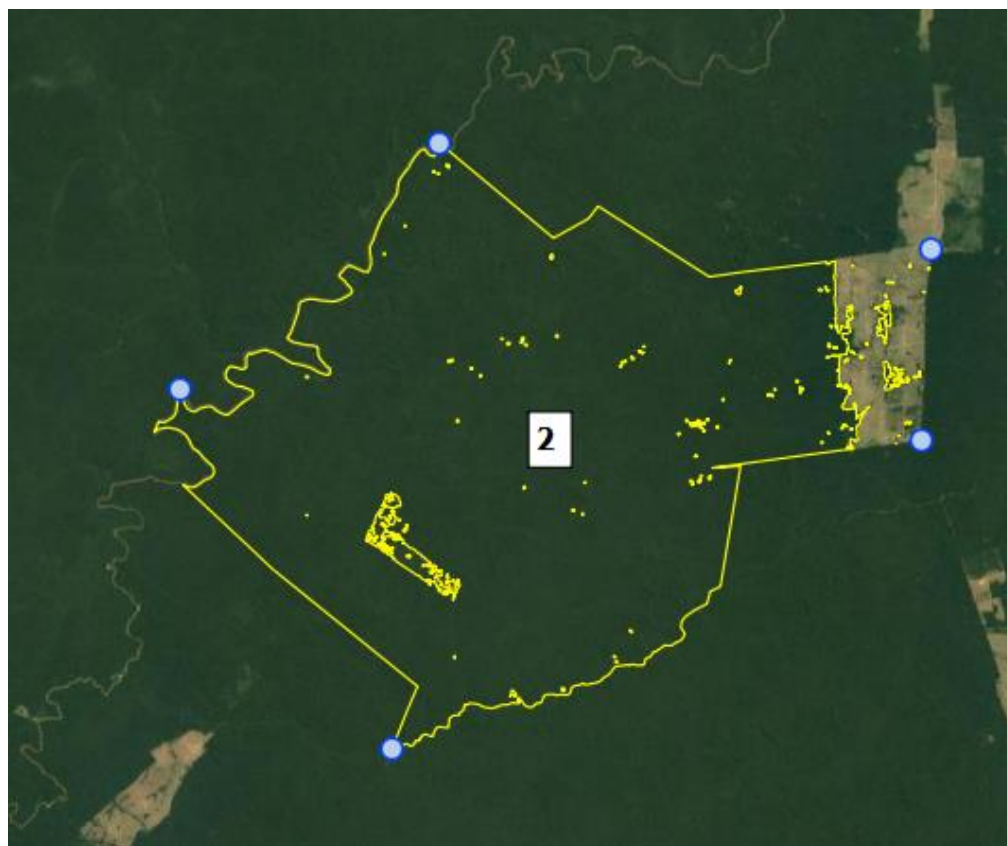


Figure 7: Area of the project Zone 2

Table 7: Latitude and Longitude of Project Zone 2

Latitude	Longitude
-9,1317	-66,138
-9,2724	-66,387
-9,1051	-66,484
-8,9915	-66,362

Project Zone 3:

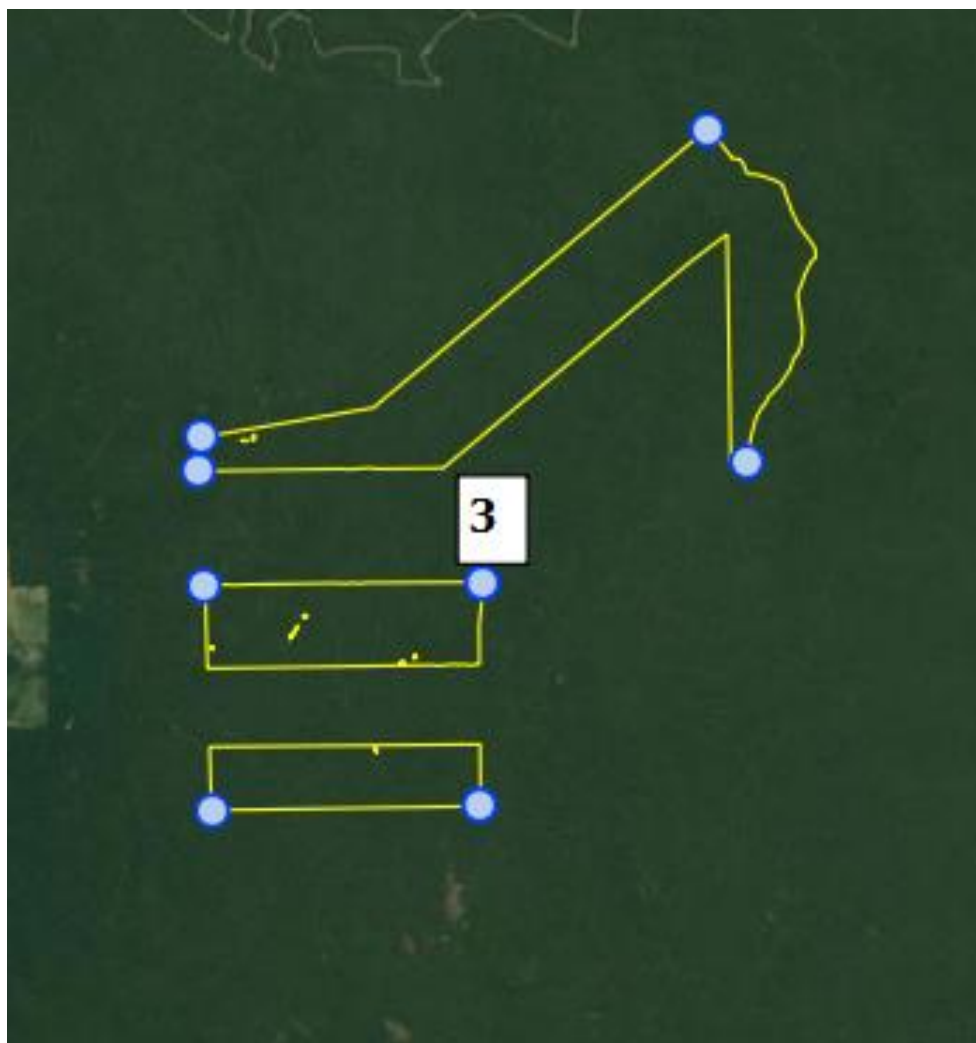


Figure 8: Area of the project Zone 3

Table 8: Latitude and Longitude of Project Zone 3

Latitude	Longitude
-9,00007	-65,9707
-9,00006	-66,0583
-9,00007	-65,9707
-8,96355	-65,8877
-8,96468	-66,0603
-8,95416	-66,0595
-8,85916	-65,8994
-9,0701	-65,9722
-9,07068	-66,0569
-9,0701	-65,9722

- e) Total size of the project area: 99,035.20 hectares.

1.13 Conditions Prior to Project Initiation

The present project activity has not been implemented to generate GHG emissions for the purpose of their subsequent reduction, removal or destruction. Instead, this project only foresees the reduction of emissions that would occur in the Project Area, as demonstrated from historical deforestation records taken from a Reference Region that meets all requirements of similarity defined in the VM0015 methodology. In this context, it is important to point out that historical deforestation in the Reference Region over the historical reference period could not be controlled by the project proponent in any way. Thus, there was no activity implemented to forge emissions for subsequent reduction prior to its start date.

Pastureland accounts virtually all (over 99%) the deforested land occupation in the reference region, as attested to by MMA²⁵ and Mapbiomas²⁶ (see section 4.1.5.2), and thus is considered to be the Business-as-Usual scenario. The implementation of this BAU activity is usually financed by means of initial capital obtained in wood logging. It can reasonably be assumed that the same pattern of deforestation and land uses observed in the Reference Area would be replicated in the Project Area in the absence of the present REDD Project.

An overview of cattle ranching dynamics in Labrea Municipality follows:

- The majority are traditional, extensive, extensive operations without access to rural credit or technical assistance (IIS 2015);
- The majority are medium (1000 ha) to large (≥ 4000 ha) pasture areas (property owner information²⁷; IIS 2015²⁸);
- The vast majority produce beef cattle (Carrero et al (2015)²⁹ (IBGE, 2017);
- Low access to technical assistance (IIS 2015);
- Average costs for the producer per animal of R\$906; average revenues per animal of R\$1.118 (Carrero et al (2015);
- Such operations are expected to yield an NPV per hectare between – 232 and 569 R\$/ha (IIS 2015³⁰), as reflected in cashflows used in the additionality analysis (see section 3.5).

The Project Area's forest cover is primarily (64%) Open ombrophylous forest ("As", according to Brazilian Vegetation Map, IBGE); and 36% is Dense ombrophilous forest ("Ds"). The above- and below-ground carbon stocks used in calculations for this Project Activity are presented in part "4.1.6.1 Estimation of baseline carbon stock changes" of this VCS-PD.

²⁵ Source MMA (accessed 23/03/21):

http://conama.mma.gov.br/index.php?option=com_sisconama&task=documento.download&id=20101 (pg. 73).

²⁶ Source, Mapbiomas, municipality Lábrea: <https://plataforma.brasil.mapbiomas.org>

²⁷ Spreadsheet: FINANCEIRO SENSITIVITY_Unitor - BAU_V8, presented at audit

²⁸ IIS (2015): ANÁLISE ECONÔMICA DE UMA PECUÁRIA MAIS SUSTENTÁVEL

²⁹ Carrero et al (2015): A Cadeia Produtiva de Carne Bovina no Amazonas

³⁰ IIS (2015): ANÁLISE ECONÔMICA DE UMA PECUÁRIA MAIS SUSTENTÁVEL, "Figure 2 Valor Presente Líquido (R\$/ha) da pecuária nos cenários BAU, com assistência técnica e intensificação (...)"

The Project Area is divided into three main groups, which are comprised between The Iquiri National Forest (FLONA do Iquiri), bordering all the areas to the North, and the Kaxarari Indigenous Land to the South of the central group:

I. A North-eastern group of four properties (Fazendas): São José; Panorama; União and Recanto;

II. A central group of ten properties (Fazendas): Santa Catarina; Santa Maria; Bahia; Presidente Prudente; Santa Luzia; Santa Fé; Jardim Alegre; Paraná; São Sebastião; and São Manoel;

III. A Southwestern group being a single property, the largest one: Fazenda Três Barras.

All of which represent a total area of 99,035.20 hectares. The areas with SFMPs are shown on the map below (Figure 9). The Project has seven properties with SFMPs, however two are pending operating license approval: Fazenda Recanto and Bahia. So far, the authorized management area with an operational license totals 9,838.99 hectares. The permitted harvest rate is on average 25 m³/hectare.

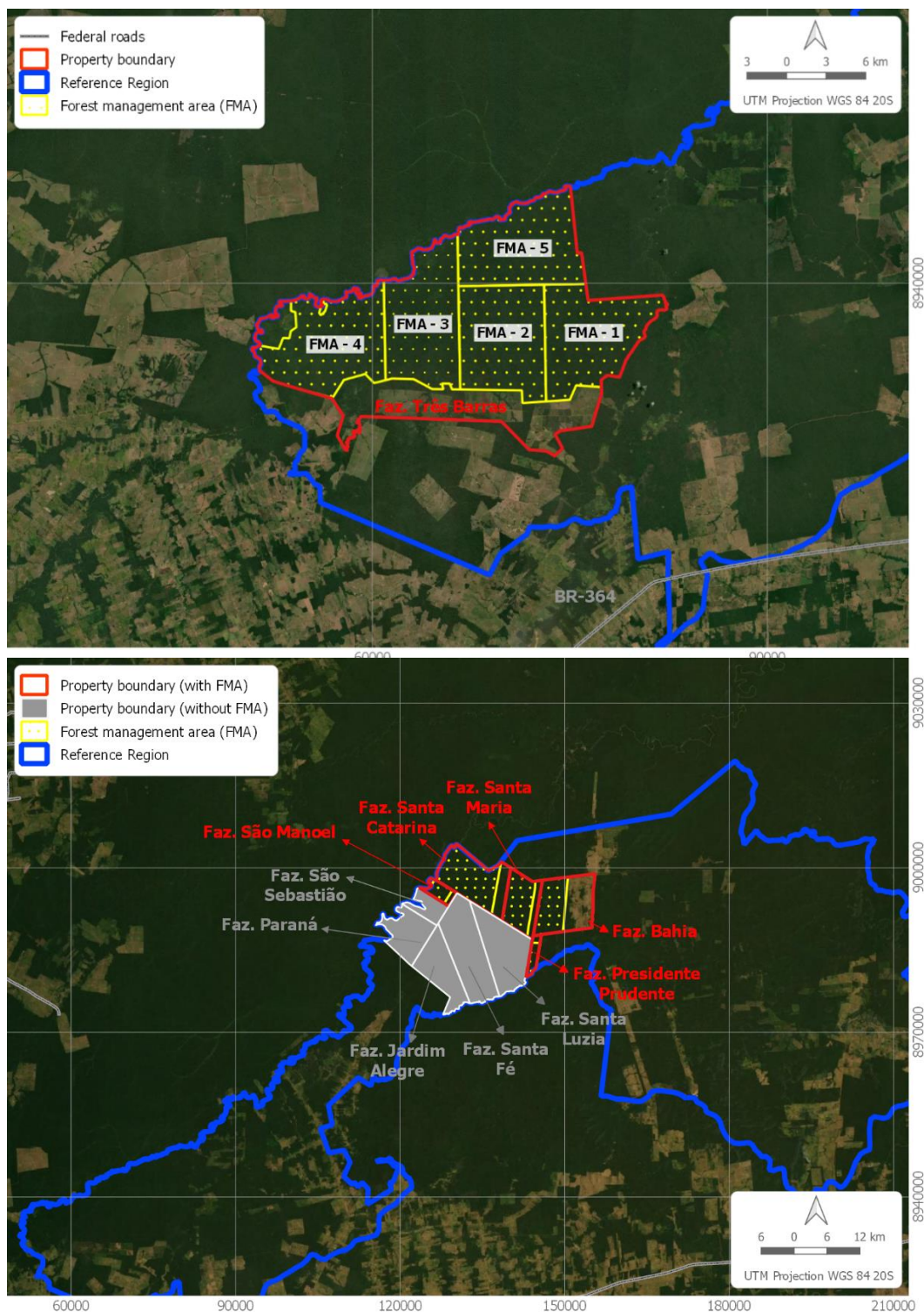


Figure 9. Project Area and Sustainable Forest Management areas

A summary of the key geographic variables pertaining to the project area follow below.

Land Tenure

Figure 23 in section 2.2. shows the main legally recognised protected areas in the Project Area and surrounding region. The following categories were included: Federal, State and Municipal Protected Areas (“Unidades de Conservação (UC)”), Indigenous Territories recognized by FUNAI, legally approved settlement projects, and private land certified by INCRA. In this respect, 100% of the Project Area is composed of legally documented private land, proof of which was made available at audit.

Forest classes

The project area is 100% covered by native Amazonian vegetation. The dominant forest class in the Project Area is submontane open ombrophylous forest, type “As” according to IBGE (Brazil, IBGE, 2012), which covers 64% of the Project Area, followed by submontane dense ombrophylous forest (“Ds”), covering 36% of the project area.

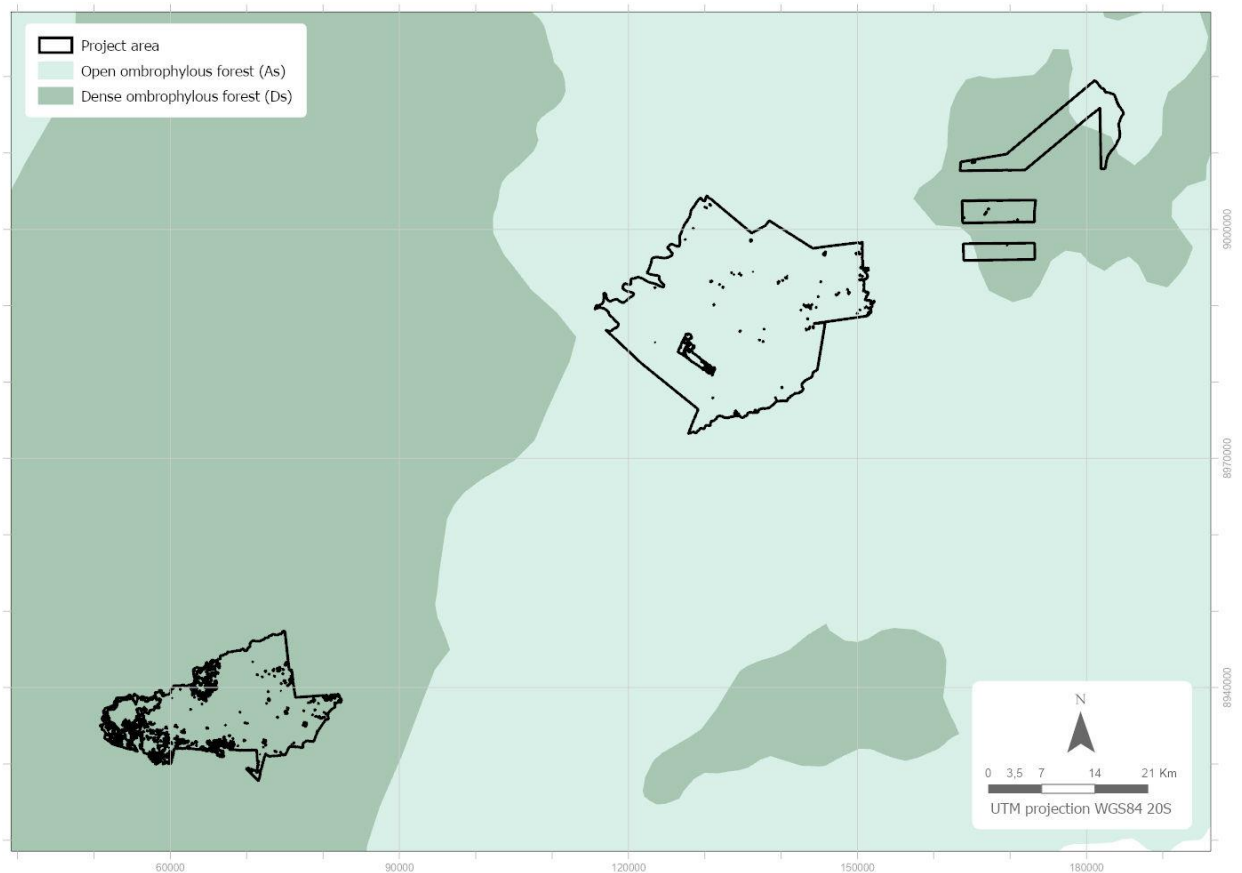


Figure 10. Forest classes within Project area

Elevation

According to Topodata³¹ – INPE sources, the range of elevation around Reference Region and Project Area is between 0 m and 434 m and the range of elevation within Project Area is between 94 and 216 meters.

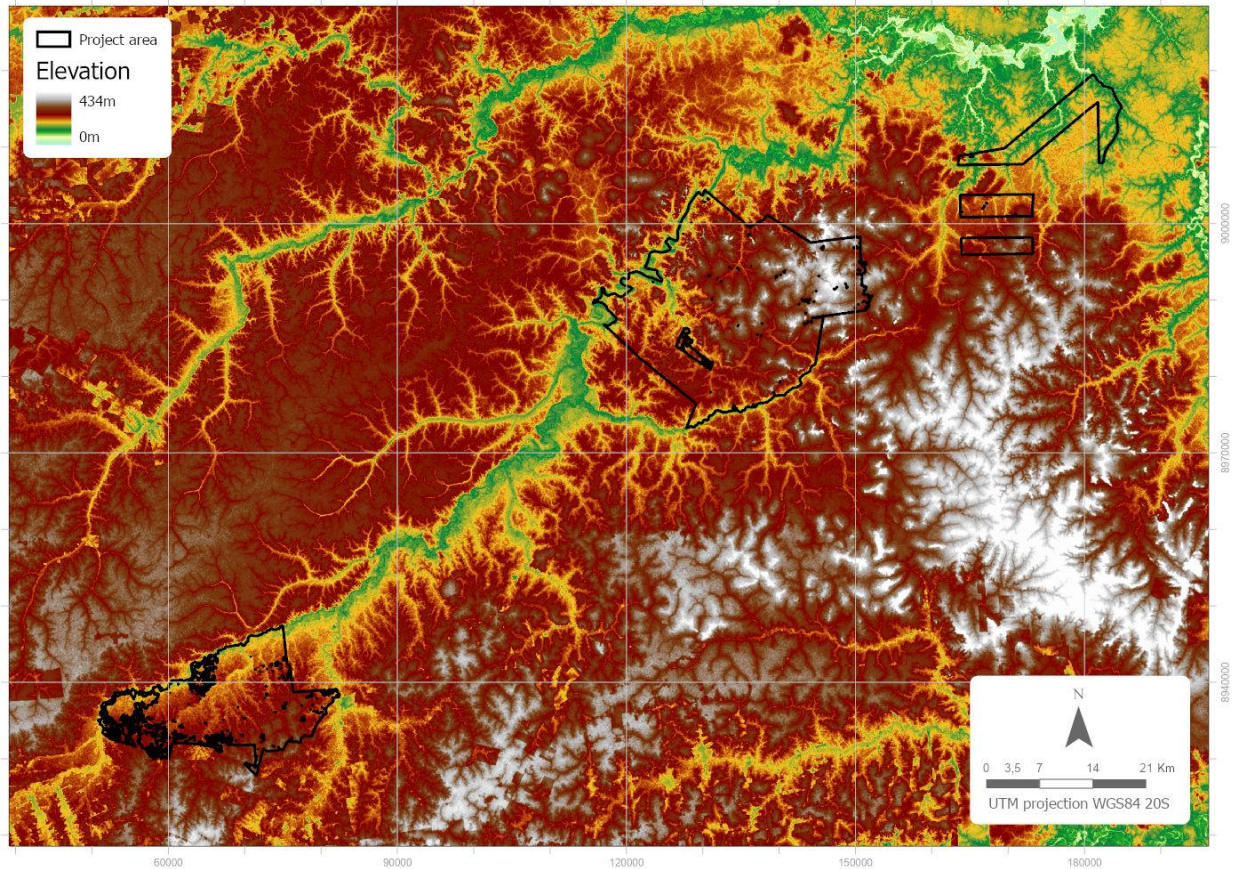


Figure 11. Elevation within Project area

Slope

According to Topodata – INPE sources 100% of the Project Area is represented by the following classes: Flat, Slightly undulating, and Undulating; the most prevalent class was "Flat", which covers 76% of it, as shown in the figure below.

³¹ Source: <http://www.dsr.inpe.br/topodata/acesso.php>; subsets: 08S_675; 09S_675; 08S_66; 09S_66

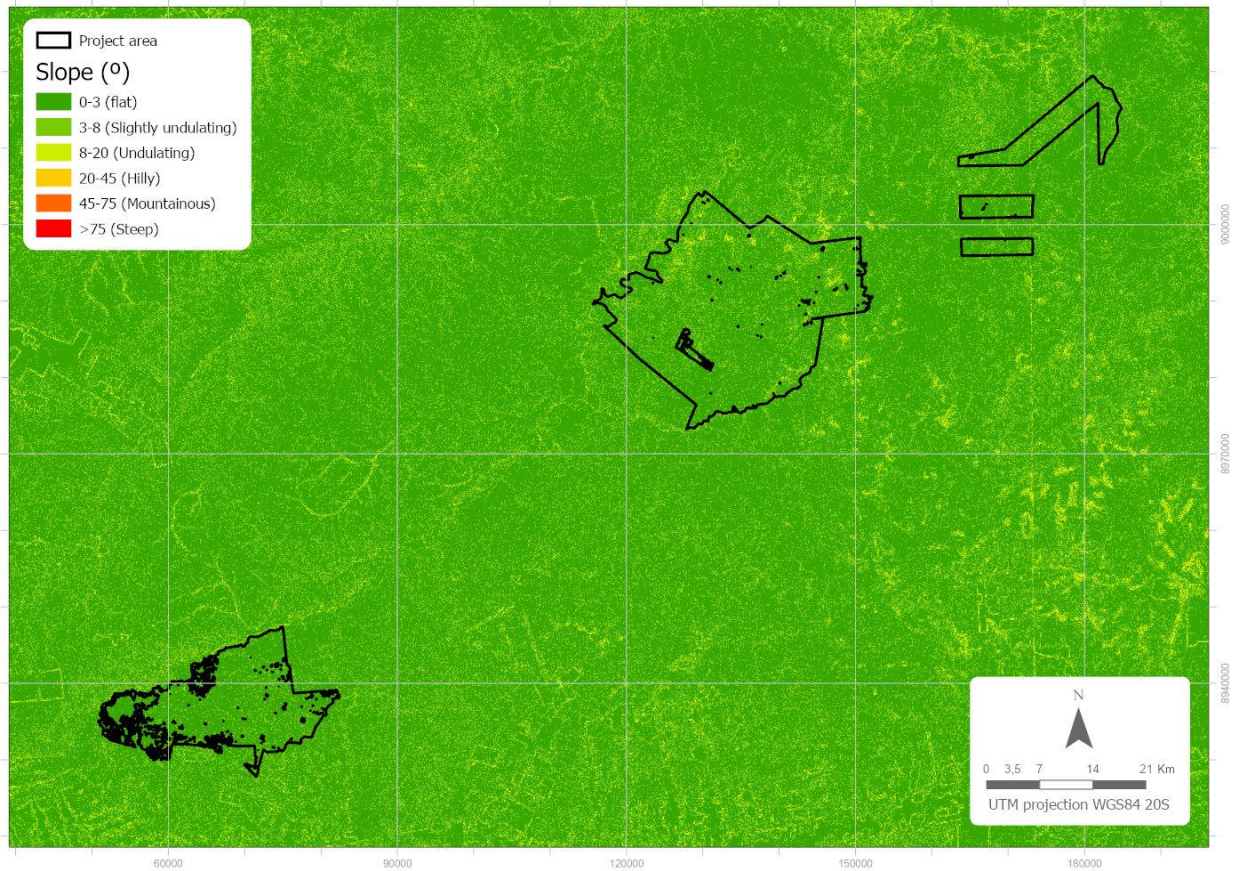


Figure 12. Slope classes within Project area

Climate

The Project Area is located within a Tropical monsoon climate (Am) zone of the Koppen classification of Brazil (Alvarez et al., 2013). The characteristics of such regions include:

- no winter season;
- high average annual rainfall, averaging > 2,100 mm/year;
- a monsoon season associated with heavy rains during the summer, with monthly rainfall possibly >400 mm;
- relative humidity usually above 80%;
- The driest months have average rainfall <60mm;
- little monthly or annual variation in temperature, ranging between 23°C and 25°C as a monthly average, and minimum temperatures always >18°C.

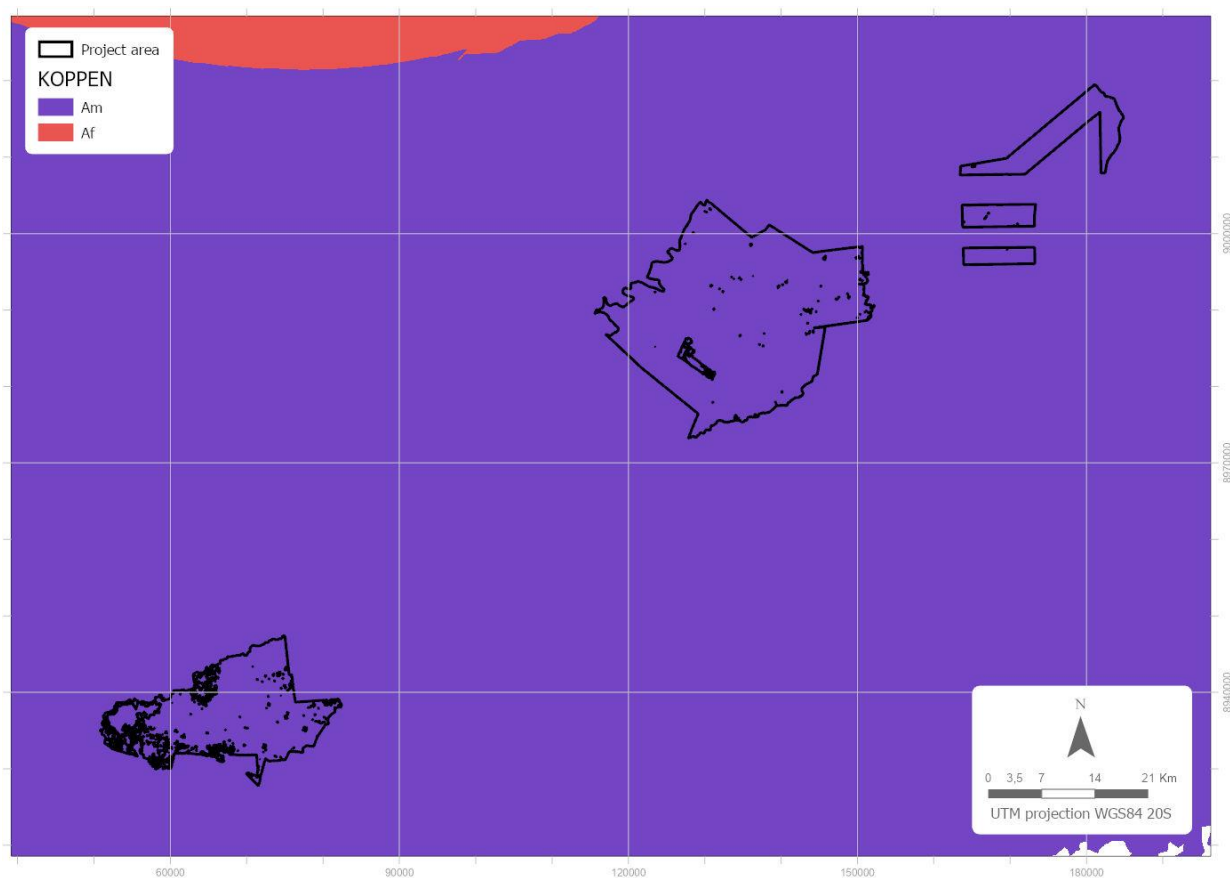


Figure 13. Koppen climate zone within Project area

Hydrography

According to the National Water Resources Plan, the Project Area is located within the Rio Purus Watershed sub-basin level 1 (PNRH, 2006³²).

³² Source: Secretaria de Recursos Hídricos do Ministério do Meio Ambiente - SRHU/MMA , PNRH (2006) available at: [Catálogo de Metadados da ANA \(snirh.gov.br\)](http://catálogo.de.metadados.da.ana.gov.br)

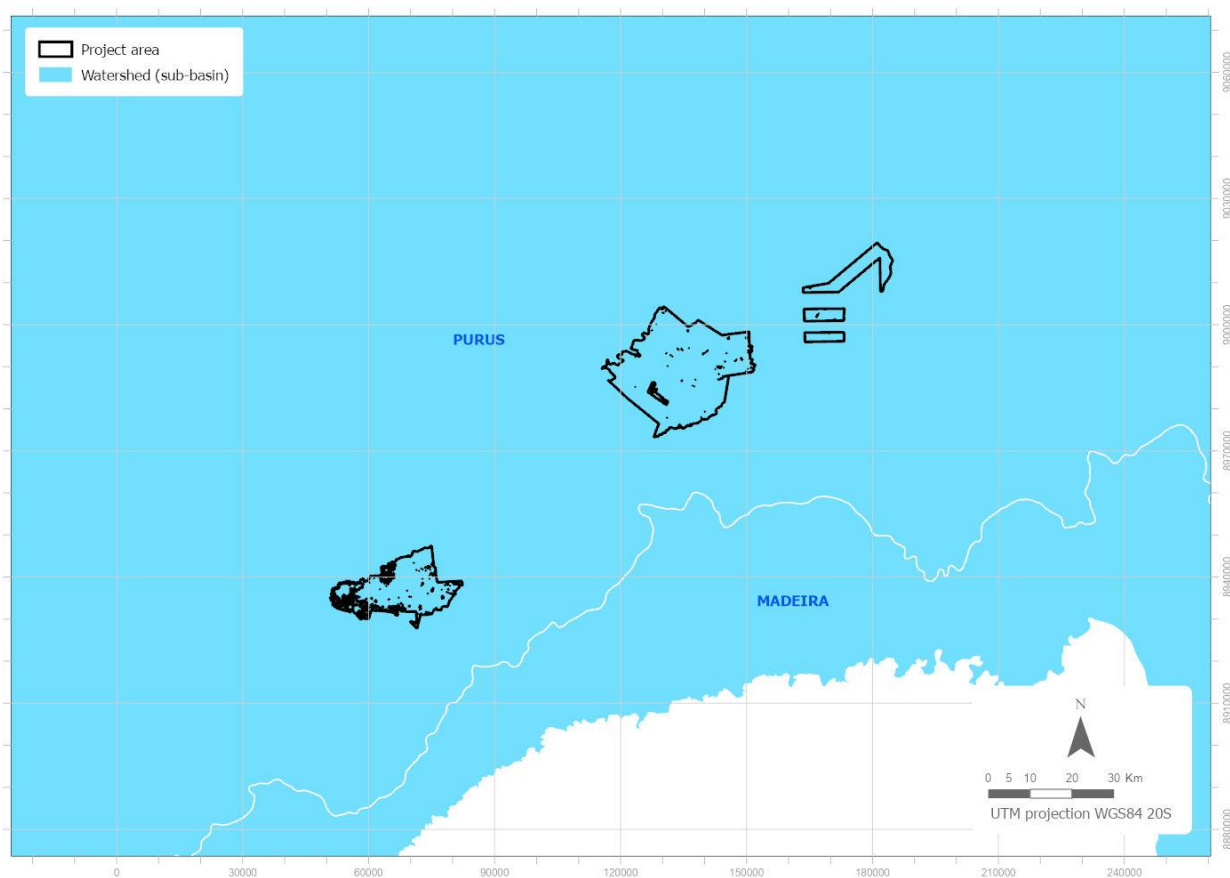


Figure 14. Watershed within the Project Area

Soil Types

According to the Brazilian Soil Classification System (SiBCS, 2006)³³ the Project Area contains three different soil types, as show in table and figure below:

Table 9. Breakdown of soil types in the Project Area

PA			
Soil Type	Soil Association	Area (ha)	Area (%)
LVA _d 3	Red-yellow dystrophic latosols + Red dystrophic latosols	48,527.25	49%
PVAd ₉	Red-yellow dystrophic argisols + Haplic cambisols	38,623.73	39%
PVAd ₄	Association of Red-yellow dystrophic agrisols + Red-yellow dystrophic latosols	11,884.20	12%
Total		99,035.20	100%

³³ Source: http://geoinfo.cnps.embrapa.br/layers/geonode%3Abrasil_solos_5m_20201104

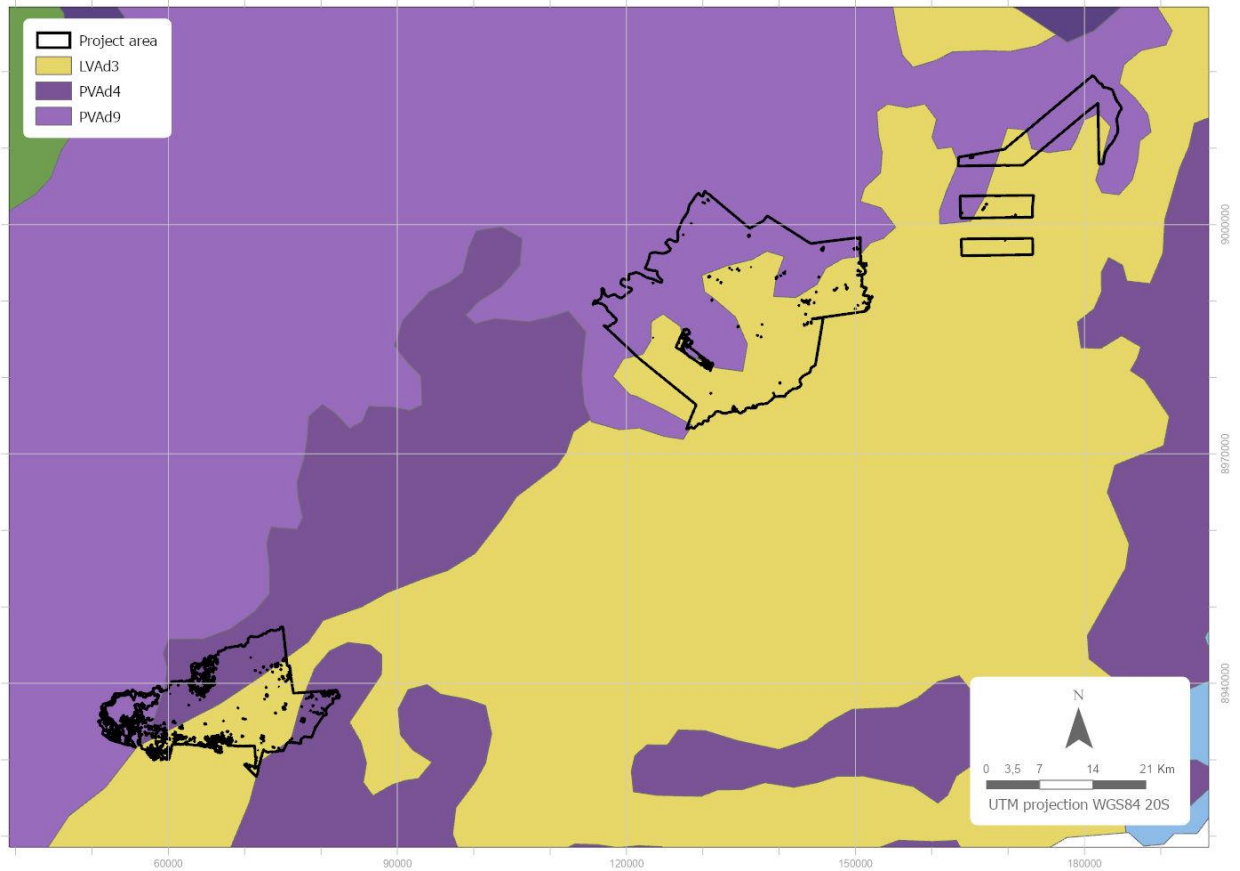


Figure 15. Soil types within Project area

The general characteristics of these types of soil are:

- LVAd3 - Widely used for farming. Under natural conditions, phosphorus contents are low, and phosphate fertilization is indicated. Another limitation to the use of this soil class is the low amount of water available to plants. The flat elevation or smooth undulating allows agricultural mechanization³⁴.
- PVAAd9 - All components of this association can be used in agriculture provided that the direct planting system in straw is used, which system allows for better erosion control, especially in soils like this association that have medium texture. In order to be successful in exploration agricultural, correctives and fertilizers must be used intensively³⁵.
- PVAAd4 - The first component is only viable for pasture or reforestation, while the second, as long as corrected and fertilized, is viable to use with annual crops³⁵.

³⁴ Source:

https://www.agencia.cnptia.embrapa.br/gestor/solos_tropicais/arvore/CONT000g05ip3qr02wx5ok0q43a0r3t5vjo4.html

³⁵ Source: <https://ainfo.cnptia.embrapa.br/digital/bitstream/item/159404/1/BPD-11-2002-Parana-Centro-Leste-Area-10.pdf>

Ecosystem Type

The Project Area is located in the Amazon biome³⁶, which has characteristics in accordance with the specific variables described above.

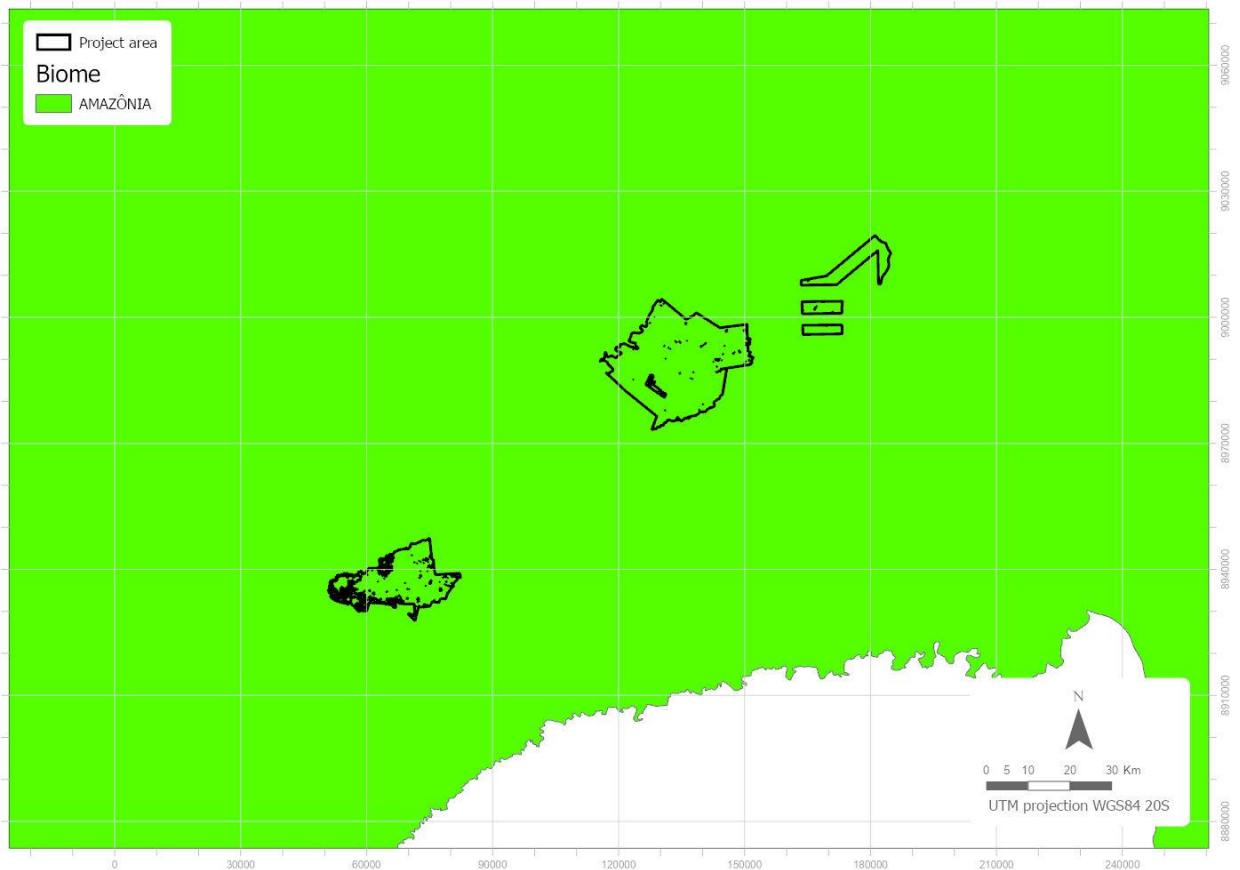


Figure 16. Biome within Project area

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The following documents demonstrate compliance of the project with all and any relevant local, regional and national laws, statutes and regulatory frameworks.

Regulatory Frameworks: Operation License (Licença de Operação)

Granted by the State of Amazonas, The Operational License is the document attesting that wood extraction performed inside the Project Area is in compliance with State Laws. All the documents in their entirety are available for consultation by the audit team.

The following definitions of the Brazilian Forest Code stand out as being relevant:

³⁶ Source: <http://terrabrasilis.dpi.inpe.br/en/download-2/>

“III – Legal Reserve (LR): area located inside a rural estate, excluding the Area of Permanent Preservation, necessary for sustainable use of natural resources, conservation and recovering of ecological processes to conservation of biodiversity and to shelter and protection of native fauna and flora.

VI – Legal Amazon: the States of Acre, Pará, Amazonas, Roraima, Rondônia, Amapá and Mato Grosso, and the regions located to the North of parallel 13°S, in States of Tocantins and Goiás, and to the West of meridian 44°W, of the State of Maranhão.”

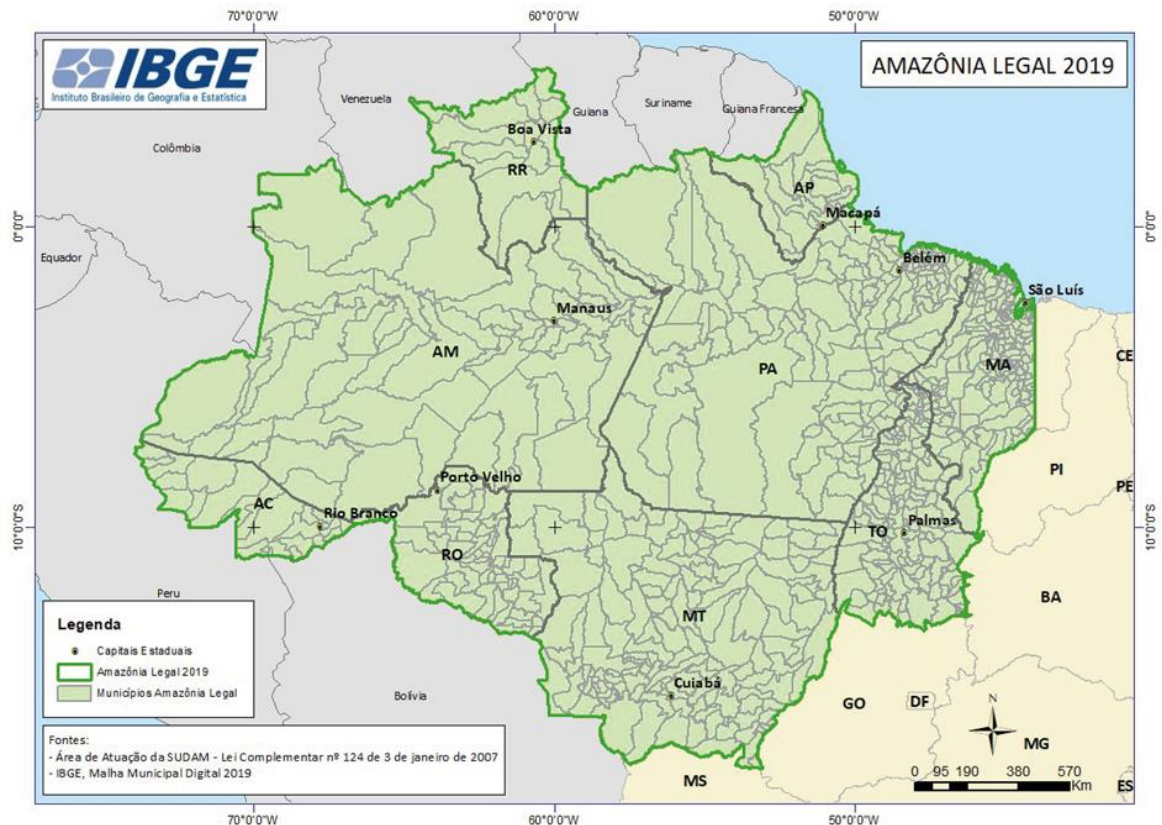


Figure 17. The Brazilian Legal Amazon States Acre (AC), Amapá (AP), Amazonas (AM), Maranhão (MA), Mato Grosso (MT), Pará (PA), Rondônia (RO), Roraima (RR), Tocantins (TO) (ancient North of Goiás). Source: IBGE (2019).

The Legal Reserve (LR) must be registered in property deed in the Real Estate Registry Office: its location must be publicly known, and future landowners must know where it is located, its boundaries and frontiers. The LR can be located anywhere inside a rural estate. Brazilian Forest Code determines that, once allocated, LR may not be changed even in cases of real estate transfer, land dismembering or area rectification.

The LR allocation is a prerequisite to obtaining permission to exploit the native vegetation existing inside the rural estate. In order to obtain this Permit for Forestry Stewardship, the landowner must previously register the location of the LR in land property documents through the Real Estate Registry Office, before suppressing any kind of native vegetation.

According to Provisory Measure No. 2166-67 (Medida Provisória nº 2.166-67) of August 24, 2001:

“Article 16. The forests and other types of native vegetation, excepting those located in Areas of Permanent Preservation, as well as those not subject to the politics of restricted use or subject to specific legislation, are susceptible to suppression, as long as a portion of vegetation is preserved, as Legal Reserve, at a minimum:

I – eighty percent (80%), in rural estates located in forest zones located in the Legal Amazon.”

In compliance with Brazilian Forest Code, the farms have officially allocated 80% of their total area as LR, in accordance with the following clauses of the relevant law.

According to Law No. 12,651 of May 25, 2012³⁷:

“Art. 17 The Legal Reserve must be preserved with native vegetation cover by the rural property owner, possessor or occupant for any reason, individual or legal entity, public or private.”

“§ 1. Economic exploitation of the Legal Reserve is allowed by means of sustainable management, previously approved by the competent body of Sisnama, according to the modalities foreseen in art. 20.”

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

“Art. 22 - The sustainable forest management of the Legal Reserve vegetation with commercial purposes depends on the authorization of the competent body and must meet the following guidelines and orientations

I - not to decharacterize the vegetation cover and not to harm the conservation of the native vegetation of the area;

II - ensure the maintenance of species diversity;

³⁷ <https://www.jusbrasil.com.br/topicos/26439289/artigo-17-da-lei-n-12651-de-25-de-maio-de-2012>

III - conduct the exotic species management with the adoption of measures that favor the regeneration of native species.”

The map of the location of the 80% of preserved forests in the Project Area is provided below.

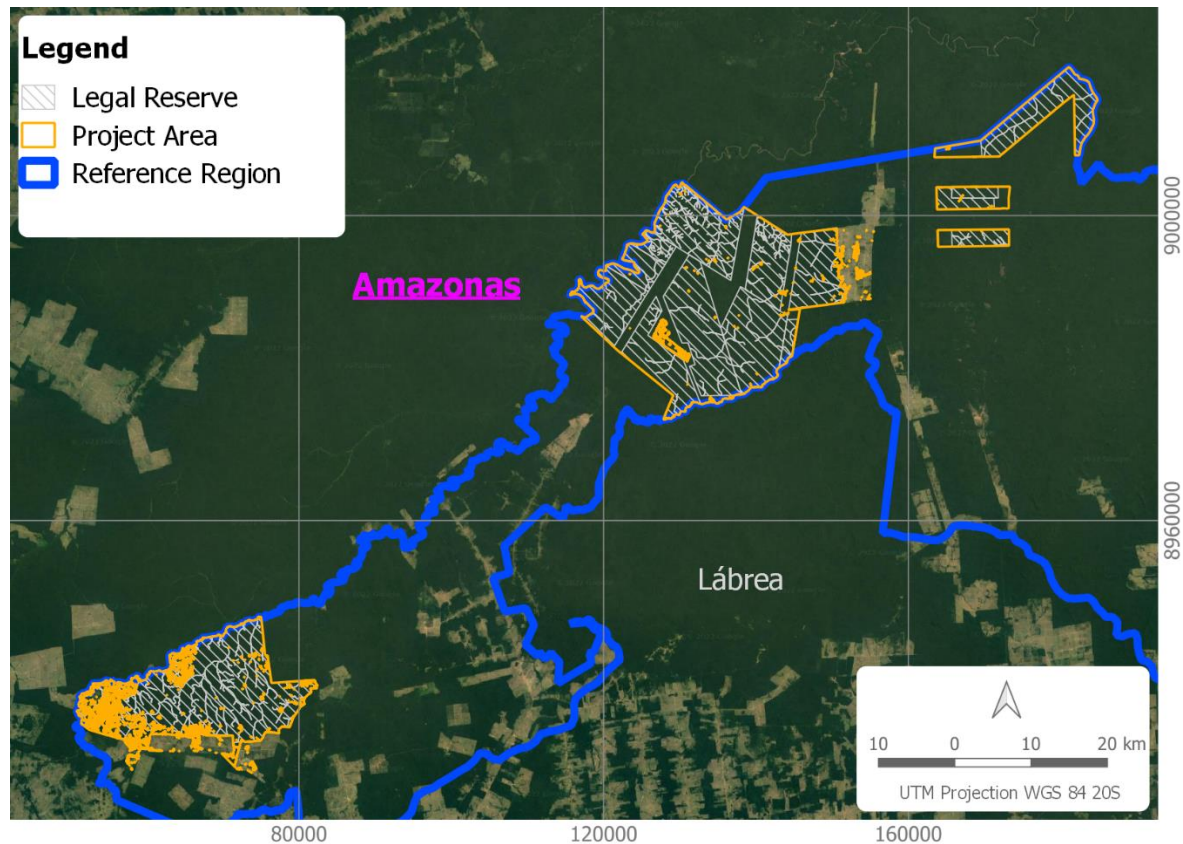


Figure 18 - Map of Legal Property, Reference Region, and Property Boundary

In spite of the legal provisions intended to preserve at least 80% of the Amazon Forest coverage, lack of law enforcement by local authorities along with public policies seeking to increase commodities production and encourage land use for agricultural, bio energy and cattle breeding purposes created a scenario of almost complete disregard of the mandatory provisions of the Forest Code. High rates of criminality associated with land disputes usually jeopardize efforts concerning law enforcement improvement. In addition to that, to cover vast distances of areas with low demographic density makes tracking of illegal activities and land surveillance very difficult for the authorities. Accordingly, policies implemented to address illegal deforestation only by means of command-and-control approaches have proven to be ineffective so far (IPAM, 2011).

Other major laws and regulations, at the state and federal levels, relevant to the project in question, and with which the project is in compliance, are listed below:

Federal:

- LAW NO. 12,187, OF 12/29/2009 - Establishes the National Policy on Climate Change – PNMC and other measures.
- LAW NO. 12,651, OF MAY 25, 2012 - Provides on the protection of native vegetation; Amends Laws n° 6,938, from August 31st, 1981, 9,393, of December 19, 1996, and 11,428, of December 22, 2006; revokes Laws No. 4,771, of September 15, 1965, and 7,754, of April 14, 1989, and Provisional Measure No. 2,166-67, of August 24, 2001. 67, of August 24, 2001; and makes other other measures. Law no. 12,187, of 12/29/2009: It establishes the National Policy on Climate Change – PNMC and other measures.
- PROVISIONAL MEASURE NO. 571, OF 05/25/2012 Amends Law No. 12,651, of May 25, 2012; which provides for the protection of native vegetation; amends Laws 6,938 of August 31, 1981; 9,393 of December 19, 1996; and 11,428 of December 22, 2006; revokes Laws Nos. 4,771, September 15, 1965; and 7,754, April 14, 1989; and Provisional Measure No. 2,166-67 of August 24, 2001.
- DECREE NO. 58,054, OF 03/23/1966 It promulgates the Convention for the protection of flora, fauna and the scenic beauties of the countries of America.
- DECREE NO. 2,959, OF 02/10/1999 - Provides for measures to be implemented in the Legal Amazon, for monitoring, prevention, environmental education and forest firefighting.

State:

- STATE LAW NO. 1,532/82 - Disciplines the State Policy for the Prevention and Control of Pollution, Improvement and Recovery of the Environment and Protection of Natural Resources.
- STATE LAW NO. 2,416/96 - Provides for the requirements for granting a license for the exploration, processing and industrialization of forest products and by-products for timber purposes.
- STATE LAW NO. 3,135/07 - Establishes the State Policy on Climate Change, Environmental Conservation and Sustainable Development of Amazonas.

- STATE LAW NO. 3,785/12 - Provides for environmental licensing in the State of Amazonas, revokes Law n. 3,219, of December 28, 2007.
- STATE LAW NO. 4,406/16 - Establishes the State Policy for Regularization, provides for the Rural Environmental Registry - CAR, the Rural Environmental Registry System - Sicar-AM, the Environmental Regularization Program - PRA, in the State of Amazonas.
- STATE DECREE NO. 10.028/87 - State System for Licensing Activities with Potential Impact on the Environment.
- STATE DECREE NO. 15,780/94 - Amends Art. 57 of State Decree No. 10,028, of February 4, 1987, which regulated Law No. 1,532, of July 6, 1982, which provides for the State Activity Licensing System with Potential Impact on the Environment
- STATE DECREE NO. 15,842/94 - Amends Art. 44 of State Decree No. 10,028, of February 4, 1987, which regulated Law No. 1,532 of July 6, 1982, which provides for the State Licensing System for Activities with Potential of Impact on the Environment.

Additionally, some federal labour laws that may apply to the project:

- CONSOLIDATION OF LABOR LAWS (CLT) - Regulates provisions relating to labor legislation and institutes the Permanent Program for Consolidation, Simplification and Debureaucratization of Infralegal Labor Standards and the National Labor Award, and amends Decree No. 9,580 of November 22, 2018.
- REGULATORY NORMS (NR) (such as: NR-5 - Internal Commission For Accident Prevention NR-12 - Safety At Work In Machinery And Equipment; NR-24 - Sanitary And Comfort Conditions In The Workplace; NR-26 - Safety Signs)

As such, the Project Area is in compliance with all identified applicable laws, and there no cases of non-compliance laws, statutes and other regulations were identified.

Given the permanent attempts against the Project Area, the project proponents' best efforts are required to prevent property invasion and to remain in compliance with Brazilian Forest Code. Some of the farms hold sustainable logging activities. These activities are carried out according to Sustainable Forest Management Plans previously approved by the Amazonas State Government. These management plans were conceived in accordance with Brazilian Forest Code and local regulation.

1.15 Participation under Other GHG Programs

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

Not applicable: the project is not engaged in any other emissions trading program and the host country has no binding limits on GHG emissions as yet. The project has not been registered, or is seeking registration under any other GHG programs.

1.15.2 Projects Rejected by Other GHG Programs

Not applicable: the project has not been rejected by any other GHG programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

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

1.16.2 Other Forms of Environmental Credit

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

1.17 Additional Information Relevant to the Project

Leakage Management

Although there is a risk of leakage, the proponents believe that the Project will have positive impacts on surrounding areas, through the following of its technical and economic aspects:

- I. Sustainable management of forest resources generating success and profit;
- II. Additional return to forest management, due to REDD incentives, which can compensate avoiding deforestation for other activities;
- III. Positive example of sustainable real estate maintenance, in addition to profits with sustainable management plus REDD revenues.

According to reasons above, the Project may well stimulate other landowners to adhere to this Project concept.

By means of Project monitoring activities, satellite imaging, and social and governmental cooperation for monitoring the Project and its surroundings, the project proponent believes that the success of this business plan will generate an increased number of sustainably managed areas with REDD+.

The main leakage management activities are outlined below:

- Technical training on sustainable cattle raising: the objective of this initiative will be qualifying labour that finds little opportunity to work in the region and ends up taking part in illegal settlements and land occupation. It is expected that this initiative will benefit 15 students every year. Students and technicians of both sexes will be eligible for registrations, with the previous requirement of having finished the basic studies (middle school).
- Forest management courses: Courses on forest management methods will be offered to the internal workers for updating on techniques and practices and to train new employees. The standardization procedure for these trainings is available for auditing.
- Training of fire brigades: training will be given to prepare fire brigade members, and in addition to the employees, the project's neighbours will be able to participate in the training event as well.
- Support of SEMA – AM's activities (Secretaria de Estado do Meio Ambiente do Amazonas; Amazonas State Secretariat of Environment): SEMA will benefit from having, under its jurisdiction, a second example of an innovative REDD model – the first being the nearby Fortaleza Ituxi REDD Project, also developed by Carbonext – that can be further replicated on other properties. It will continue to raise the public profile of the current administration, providing visibility and methodological advances in environmental preservation.
- Surveillance activities designed to mitigate illegal logging and land occupation in the area will be achieved through the Unitor REDD+ Project, summing with the efforts of the Fortaleza Ituxi REDD Project, thus covering a significant area of Lábrea municipality. By continuing to promote an increase in the number of REDD Projects in the region, whenever feasible, as well as sustainable forest management plans, the project aims to impact deforestation and degradation significantly. This process will be further consolidated through combined efforts with private and governmental entities, and NGOs. In this context, the project proponent will spearhead political mobilization of the regional forest sector and, continue to reinforce the engagement of all sectors involved in deforestation issues, in the long term. The main condition for execution of this activity is the approval and validation of the Unitor REDD+ Project, which will be a further

important benchmark for engagement of all potential private landowners in the Lábrea region.

- Potential Roll-out to Other Areas: Unitor already being the project proponent's second REDD activity in the region, further areas with potential for REDD projects have already been identified around the project site, which will favour and encourage forest conservation by means of financial incentives obtained from credit sales and provide social and environmental benefits to local communities.
- Combatting illegal land occupation: The local community will be strategic in monitoring illegal land occupation and potential illegal logging. Those who are interested in being trained and carrying out local monitoring will be included in the project, an activity which may also become a new source of income for local communities.

Commercially Sensitive Information

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

Sustainable Development

The map below shows the strategic zone for “Containment of the expansion fronts with protected areas and alternative uses”, which was established by the MacroZEE/AL (Macrozoneamento Ecológico-Econômico da Amazônia Legal; Ecological and Economic Macro-zoning of Amazon) developed by the Brazilian Ministry of Environment³⁸, which encompasses the Project Area. The MacroZEE/AL aims to establish strategic indications of occupation and use of land on a sustainable basis to guide, at the regional scale, the development and spatial distribution of public development policies, territorial and environmental planning, as well as the decisions of private agents. Due to its shield function for the heart forest protection, this territorial unit deserves strengthening policies. In this context, the Unitor REDD+ Project aligns with the strategies set up by the MacroZEE/AL of the Brazilian Ministry of Environment.

³⁸ Source MMA (accessed 23/03/21): <https://antigo.mma.gov.br/component/k2/item/8200-figuras>



Figure 19. Containment of the expansion fronts with protected areas and alternative uses (Source: Brazilian Ministry of the Environment – MMA)

Due to the increase in deforestation in the Legal Amazon, the Action Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm: Plano de Ação para a Prevenção e Controle do Desmatamento na Amazônia Legal) came into effect, starting mitigation and ongoing actions to reduce deforestation. The Unitor REDD+ Project is in line with main PPCDAm premises³⁹.

At the international level, the Unitor REDD+ Project complies with the logic of the environmental priorities defined by the Brazilian Federal Administration at COP 14 in December 2008, where a deforestation reduction goal of 70% by the year 2018 was declared, and following that, further goals of achieving zero illegal deforestation by 2030, and offsetting of greenhouse gas emissions originating from legal removal of vegetation. The latter are elements of the Brazilian NDC, which the country aims to adopt more firmly within the framework of the Paris Climate Accords (COP-21)⁴⁰. To attain these goals, an essential component will be to ally government initiatives with independent actions such as that proposed under the present project.

Going into more detail, the Unitor project is aligned with Brazil's commitments to the UN Sustainable Development Goals (SDGs). Firstly, on the environmental side, Brazil has made

³⁹ Source Brazilian Government (accessed 19/04/2021): https://www.gov.br/agricultura/pt-br/acesso-a-informacao/acoes-e-programas/ppa/plano-plurianual-ppa-2016-2019-1/relatorio_avaliacao_programa_2050-mudanca_do_clima.pdf

⁴⁰ Source MMA (accessed 19/04/21): <http://redd.mma.gov.br/pt/redd-e-a-indc-brasileira>

commitments to SDG 13 – “Take urgent action to combat climate change and its impacts” – aligning its national goals⁴¹ with the UN’s, for example UN goal 13.3⁴²:

- 13.3: Improve education, increase human and institutional awareness and capacity on climate change, its risks, mitigation, adaptation, impacts, and early warning systems.

The project activities involving technical qualification, training in forest management, and community development in the form of participative workshops, aim to increase the collective understanding of climate change and the importance of the forest. This intervention at the small-scale level has broader objectives, for a collective transformation of cultural relations lifestyles of the local community and the economy, in its relation to the environment.

Regarding goal 13, the Unitor REDD project involves the conservation of a predicted 25,329 hectares of forest over its lifespan and it is an essential activity for climate change mitigation.

Perhaps most importantly, the project is aligned with SDG 15 regarding Terrestrial Ecosystems, which was adopted into the Brazilian goals as follows: “15.1. By 2020, to conserve at least 30% of the Amazon, through systems of conservation units provided for in the Law on the National System of Conservation Units (SNUC), and other categories of officially protected areas such as Permanent Preservation Areas (APPs), Legal Reserves (RLs) and indigenous lands with native vegetation (...)”. The present project’s direct conservation of APPs and RLs, as well as synergistic actions with the surrounding Conservation Units are strongly aligned with this national goal.

Brazilian SDG goal 15.2, regarding sustainable forest management, tree plantation and restoration of forests, which stipulates to “eliminate illegal deforestation in all Brazilian biomes by 2030, expand the area of forests under sustainable environmental management and recover 12 million hectares of degraded forests and other forms of native vegetation, in all biomes and preferably in Permanent Preservation Areas (APPs) and Legal Reserves (RLs) and, in areas of alternative land use, expand the planted forest area by 1.4 million hectares”, is directly supported by the Unitor project’s following activities:

- Sustainable forest management in seven properties;
- Monitoring of illegal land occupation, illegal logging, and illegal deforestation;
- Ultimate goals of avoided deforestation of 25,329 hectares of Amazon rainforest over 30 years on private lands, preserving APPs and RLs.

On the socio-economic front, Brazil adopted “UN Goal 1: End poverty in all its forms everywhere”⁴³, “UN Goal 3: Ensure a healthy life and promote well-being for everyone, at all ages”, and “UN Goal 8: Promote inclusive and sustainable economic growth, employment and decent work for all”, and, with the most relevant Brazilian sub-goals to the project being:

⁴¹ Source IPEA (accessed 23/07/21): <https://www.ipea.gov.br/ods/ods13.html>

⁴² Source ODS Brasil (accessed 23/07/21): <https://odsbrasil.gov.br/>

⁴³ Source UN (accessed 23/07/21): <https://www.un.org/sustainabledevelopment/poverty/>

- SDG 1.1: “By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than PPC\$3.20 a day”;
- SDG 1.2: “By 2030, reduce proportion of men, women and children of all ages living in monetary and non-monetary poverty by at least half, in all its dimensions, according to national definitions”;
- SDG 3.4: “By 2030, reduce premature mortality from non-communicable diseases by one third through prevention and treatment, and promote mental health and well-being”
- SDG 8.3: “Promote development with the generation of decent work; formalization; the growth of micro, small and medium companies; entrepreneurship and innovation”; and
- SDG 8.4: “Increase the efficiency of the use of global resources in consumption and production, and strive to decouple economic growth from environmental degradation, in accordance with the Action Plan for Sustainable Production and Consumption (PPCS).”

The project will create approximately 52 job posts (permanent and temporary) per year, involving local people and community members:

- 6 forest monitors are already hired, plus a further 16 planned monitors, being two per each of the seven properties with no SFMP activities, plus two for the property with only cattle being permanent posts, totalling 22 jobs (SDG 1.1)⁴⁴;
- An average of five team members per each of the six sustainable forest management areas, which are temporary positions, with an unpredictable number of total job vacancies for separate individuals, estimated at 30 jobs (SDG 1.1);
- Furthermore, it is relevant to state that the creation of 50 predicted jobs, mentioned above, is also aligned with Brazilian SDG 8.3 in that, given the reality of the region, it will certainly involve the formalization of informal jobs and source of income for families.
- Monitoring of equal opportunities relating to gender in the project indicators (SDG1.2);
- The organization of training events focusing on sustainable cattle ranching and forest management (SDG 8.3 and 8.4).

In relation to the SDG 3.4, workshops on health, well-being and nutrition will be given to employees and the community, aiming to raise awareness about non-communicable diseases and the importance of having healthy habits.

This project therefore represents an enormous potential to continue the work started by the neighbouring Fortaleza Ituxi REDD Project: assisting the Federal Administration and state agencies to attain these national- and international-level goals and leverage further REDD projects, providing mitigation for these municipalities which are facing critical deforestation levels, as in the case for Lábrea, Nova Califórnia, and Extrema.

⁴⁴ Evidence for hiring made available at audit

Further Information

No further information to disclose.

2 SAFEGUARDS

2.1 No Net Harm

The project activities do not cause any potential negative offsite stakeholder impacts. The project does not result in net negative impacts on the wellbeing of other stakeholder groups. A communication channel will be established for stakeholders to express their concerns and to solve potential conflicts and grievances that arise during project planning and implementation.

Technical qualification, training in forest management, community development in the form of participative workshops may increase the collective understanding of climate change and the importance of the forest. This understanding is essential for each individual in the process of a collective transformation of cultural relations and of the lifestyle of the local community.

The project proponent proposes the organization of training events focusing on sustainable cattle ranching, which intend to train workers to apply the knowledge for a sustainable meat production chain. Furthermore, fire brigade teams will be trained, and a biomass inventory has already been conducted in a neighbouring REDD project by the project proponents.

Complementary monitoring of labour conditions will reduce several work safety risks, in addition to improving wellbeing of local workers: annually internal audits for health and security assessments, nutrition aspects, personal care and hygiene etc. All situations and occupations that might arise through the implementation of the project and pose a substantial risk to worker safety will be comprehensively assessed.

All relevant laws and regulations covering worker's rights will be periodically informed to workers, as part of community development sessions in the form of participative workshops. These workshops and training sessions will also cover subjects related to health and security, in a manner to reduce risks during the field activities.

2.2 Local Stakeholder Consultation

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

Institutional Public Consultation

The institutional public consultation began on February 25, 2021, and covered public agencies, institutions, associations, communities and NGOs, with a total of 14 stakeholders being mapped, as listed below. These stakeholders were contacted by email and received a project summary.

- Lábrea City Hall;
- Porto Velho City Hall (districts of Nova Califórnia and Extrema);
- Municipal Secretariat of Education of Lábrea;
- Municipal Secretariat of Education of Porto Velho (districts of Nova Califórnia and Extrema);
- SEMA - AM (Amazonas State Secretariat of Environment);
- SEDAM (Secretary of State for Environmental Development);
- Extractive Reserve (RESEX) of “Ituxi”;
- National Forest (FLONA) of “Iquiri”;
- National Park (PARNA) of “Mapinguari”;
- Community leaders of Kaxarari Indigenous Land;
- IFAM (Federal Institute of Science and Technology; Campus Lábrea);
- IDAM - Institute for Sustainable Agricultural and Forest Development of the State of Amazonas.

During the consultation process, IDAM (the Amazonas State Institute for Development in Cattle, Agriculture and Sustainable Forest Activities) was consulted via interview call with three separate employees, one of whom expressed enthusiasm about the environmental and social objectives of the project, and requested site visits in order to better understand the demographics and potential for collaboration on community technical assistance. This potential is being reviewed internally, among the project owner and developer, during the run-up to validation.

Meanwhile, SEMA (Environment Secretariat of Amazonas State) requested clarification regarding the public consultation process, on 11/03/2021, which was duly responded to with re-sending informative documents on the project via e-mail.

No further comments are available at the time of validation.

Community Public Consultation

As stated in the methodology, individuals, neighbours and communities living within:

- i. the project area were mapped; and

- ii. within a 20km radius of the project area, were mapped (Figure 20).



Figure 20. Project Area and the 20km radius where the neighbours were mapped

Between March 7 and April 4, 2021, project representatives visited neighbours and communities in person to explain the characteristics of the Unitor REDD+ project, as detailed below:

- i. March 7, 2021: “Presidente Prudente” and “Santa Maria” properties;
- ii. March 27, 2021: “Ramal do Boi” (community outside the project area);
- iii. April 01, 2021: “Três Barras” property;
- iv. April 02, 2021: “São José” property.

As required in VCS standard 4.1, item 3.16.17, for the “Local stakeholder consultation”, a comprehensive project summary was actively presented to the communities and other stakeholders in Portuguese in the field, by two project agents. For the “Institutional Consultation”, in turn, the government organs and other institutions were contacted by e-mail. In both consultation modalities, the project proponent communicated in a didactic way: i) the project design and implementation, including the results of monitoring; ii) the risks, costs and benefits the project may bring to local stakeholders; iii) all relevant laws and regulations covering workers’ rights in the host country; iv) the process of VCS Program validation and verification and the validation/verification body’s site visit.

During the visits, three documents were collected:

i. Declaration of Consent with the Project: those consulted declare that they received a visit from a project representative, that they are aware of the objectives and which properties belong to the project area. They also declare that they agree with the realization of the Unitor REDD+ Project.

ii. Customary Resource Use Survey: Questionnaire used for neighbour and community interviews to fully understand community natural resource use and management activities within the Project Area.

iii. Awareness of Communication Channels: respondents declare that they have received information about the communication channels to be used for complaints and questions regarding the Project.

All statements are duly stored and made available during the audit.

Stakeholder identification and analysis process utilized to identify Communities and Other Stakeholders

Traditional communities

With the objective of locating the traditional communities, social movements and conflicts occurring in the project region, the “New Social Mapping of the Amazon Project”, sub-series “Social Movements, Collective Identity and Conflicts” was consulted (De Almeida et al. 2009; De Almeida et al. 2013). The subject of these studies is the “Wild-Harvesting (“Extrativista”) Communities of the Resex Ituxi” and the “Indigenous peoples of the municipality of Lábrea”, as the main elements of the social landscape of the region. Based on this assessment, it was concluded that these social groups require consideration as stakeholders.

Quilombola communities

The survey on “quilombola” (African Heritage) communities was performed for the State of Amazonas. According to SEPPIR (Secretariat of Policies for Promotion of Racial Equality; Secretaria de Políticas de Promoção da Igualdade Racial) database⁴⁵, the State has six officially recognized “quilombola” communities. The studies show that no such community is located in a position which could be directly affected by the project activities.

Indigenous Territories

To locate the Indigenous Territories (“TIs”) that may be impacted by the project activities, the FUNAI⁴⁶ map database of TIs was consulted, and seven indigenous villages were mapped in the project region (IBGE data). As shown in Table 10 apart from the Kaxarari Indigenous Territory, the Apurinã km-124 BR-317 Indigenous Territory is the closest, located 23 km in a straight line from

⁴⁵ Source (accessed 23/03/21): <http://monitoramento.seppir.gov.br/>

⁴⁶ Source (accessed 23/03/21): <http://www.funai.gov.br/index.php/2013-11-06-16-22-33>

the nearest point of the Project Area. However, in an analysis of the location of indigenous villages themselves, they were found to be further away from the project area. The location of the villages (Figure 21) considered the clusters of infrastructure such as small houses and other community facilities within the indigenous territories. The identification of these features was performed by visual interpretation of high-resolution satellite images provided by Esri Imagery Basemap map service. Thus, it is inferred that the project activities have only mild effects on these indigenous communities, given that the Project Area is relatively distant from them.

However, the central area of the project borders directly with the Kaxarari Indigenous Territory, which has a legal area of 145,889.98 hectares and a population of 445 people⁴⁷, adjacent to the Project Area. According to the assessment carried out, it was concluded that this Indigenous Territory may be affected by the project activity. The latter has been subject to strong deforestation pressure, as recently reported by the media⁴⁸.

Table 10. Shortest distance in a straight line between the boundaries of the project area and indigenous territories

Indigenous Territory	Distance (km)
Kaxarari	0.0
Apurinã km-124 BR-317	23.0
Boca do Acre	44.0
Camicua	108.0
Igarapé Capana	127.0
Igarapé Ribeirão	150.0
Karipuna	178.0

⁴⁷ Source (accessed 22/07/21): Terra Indígena Kaxarari | Terras Indígenas no Brasil (terrasindigenas.org.br)

⁴⁸Source (accessed 25/06/21): <https://www.rondoniaoativo.com/geral/noticia/2015/05/08/exclusivo-madeireiros-retornam-para-t-i-kaxarari-apos-operacao-toruk.html>



Figure 21. Locations of indigenous villages within the Indigenous Territories

Other Stakeholders

The project activities will require direct interaction with certain public entities, as well as partnerships with research and teaching institutions. Thus, the process of stakeholder identification encompassed all entities that will be associated directly or indirectly to the activities foreseen in this project.

Additionally, a survey was carried out to map the Conservation Units and rural settlements located nearby the Project Area (Table 11). The shapefiles of the conservation units were obtained through INPE's free database⁴⁹. While the shapefiles of the settlements were obtained from the INCRA database⁵⁰. These data were analysed using ArcGIS software, which allowed us to verify the distance between the project and these other areas.

The closest Conservation Units to the Project Area are “the National Forest (FLONA) of “Iquiri”, “Extractive Reserve (RESEX) of “Ituxi”, and the National Park (PARNA) of “Mapinguari”, in order

⁴⁹ Source (accessed 22/07/21): <http://terrabrasilis.dpi.inpe.br/downloads/>

⁵⁰ Source (accessed 22/07/21): https://certificacao.incra.gov.br/csv_shp/export_shp.py

of increasing distance (Table 11). The management staff of these Conservation Units are being contacted to publicize this project, and to exchange data on local fauna, flora and communities.

Table 11. Distances in a straight line between Conservation Units and the Project Area

Conservation Unit	Distance (km)
National Forest Iquiri	0
RESEX Ituxi	0
National Park Mapinguari	23
RESEX Arapixi	101

Table 12. Distances in a straight line between Settlements and the Project Area

Project Zone*	Nearest Settlement	Distance (km)
Project zone #1	Pedro Peixoto	5.28
Project zone #2	Gedeão	18.48
Project zone #3	Curuquete	36.88

* Zoning as described in section 1.12

According to the “New Social Mapping of the Amazon Project”, sub-series “Social Movements, Collective Identity and Conflicts”, the most relevant social movements in the project region are “Extractive Communities of the Resex Ituxi” (number 33 in the figure below) and the “Indigenous peoples of the municipality of Lábrea” (number 43 in the figure below).

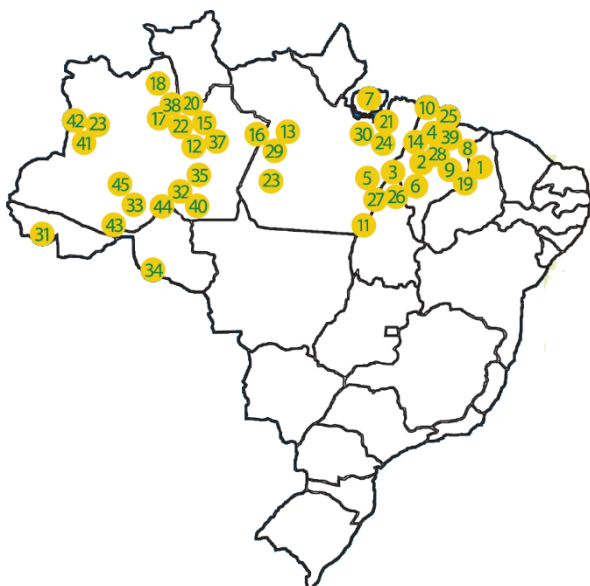


Figure 22. New Social Mapping of the Amazon”, “Social Movements, Collective Identity and Conflicts”: 33 - “Extractive Communities of the Resex Ituxi”; 43 - “Indigenous peoples of the municipality of Lábrea”

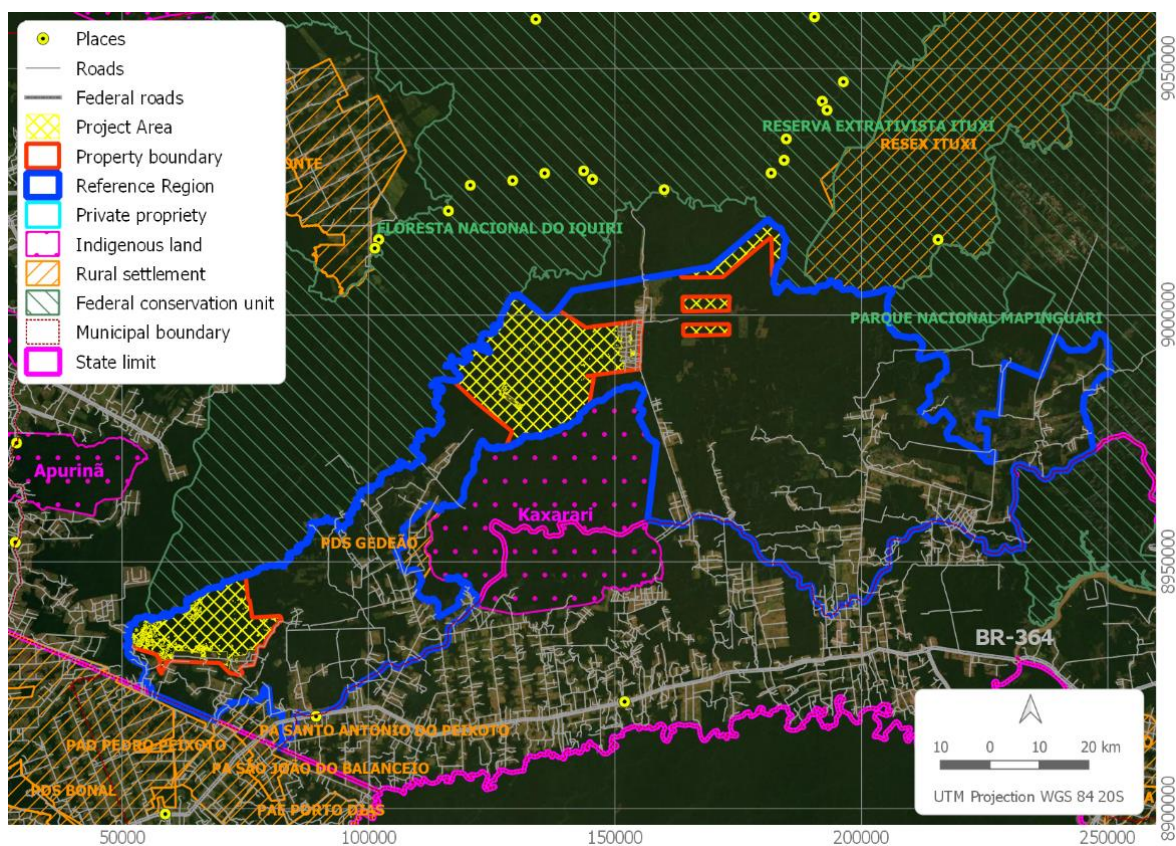


Figure 23: Land use map of the project region, showing the Project Area, Conservation Units, Settlements, Indigenous Territories, and private lands.

Communication Channel

The project proponent understands that stakeholders want and need to be involved in project design, implementation, monitoring and evaluation throughout the project lifetime. Therefore, communication channel was established for stakeholders to continually express their concerns and to solve eventual conflicts and grievances that arise during project planning, implementation, and monitoring. The main communication channel is the project's own email (redunitorcarbonext@carbonext.com.br), which is managed by the Carbonext team.

It is expected that this communication channel will be a mechanism to ensure that the project proponent and all other entities involved in project design and implementation are not involved in or complicit in any form of discrimination or harassment with respect to the project. All denouncements will be available to stakeholders and auditors. In case of conflicts, the project proponent and stakeholders will be free to propose and take any appropriate corrective action. This is the formalized grievance redress procedure that will be used throughout the project lifetime to address disputes with stakeholders, which may arise during project planning and implementation.

The process for receiving, hearing, responding to and attempting to resolve Grievances will be performed within a reasonable time period. It is expected that each grievance is responded in a delay of 7 days, proposing and/or taking corrective actions. This Feedback and Grievance Redress Procedure has three stages:

1. The Project Proponent shall attempt to amicably resolve all grievances and provide a written response to the grievances in a manner that is culturally appropriate. (Action must be taken in 7 days);
2. Any grievances that are not resolved by amicable negotiations shall be referred to mediation by a neutral third party. (Action must be taken in 30 days);
3. Any grievances that are not resolved through mediation shall be referred either to a) arbitration, to the extent allowed by the laws of the relevant jurisdiction or b) competent courts in the relevant jurisdiction, without prejudice to a party's ability to submit the grievance to a competent supranational adjudicatory body, if any. (The time to accomplish this stage is dependent on local jurisdiction delays.)

The results of the local stakeholder consultation are documented in the Plan of Action, where the project activities, schedules, goals, responsible personnel and indicators are defined, relating the benefits to the Sustainable Development Goals (SDGs). In order to provide benefits related to demands identified in the public consultation, the plan provides for actions such as Technical Training on Sustainable Cattle Raising, Forest Management Courses, Fire Brigade Training and Advice on nutritional aspects. All and any input received during the consultation has been taken to define the Plan of Action activities.

The implementation of activities and monitoring of indicators is carried out by the proponent through photographic records, attendance lists, invoices and an internal stock control system.

The project proponent will communicate the project implementation, including the monitoring results, risks, costs and benefits of the project to local stakeholders through lectures, meetings with associations and formal communications to interested institutions, during the development of activities and in periodic verifications.

The procedure to take due account of all and any input received during the consultation is established in the Feedback, Comment, and Conflict Resolution procedure⁵¹, which involves the following steps:

- I. Registering of stakeholder communication through appropriate communication channels (in-person with project agents and representatives, telephone, Whatsapp, and e-mail);
- II. Internal processing of the communication within Carbonext and project proponents,
- III. Decision of action required;
- IV. Follow-up communication with stakeholders if applicable;
- V. Implementation of appropriate action if applicable;
- VI. Monitoring and revision of effectiveness of actions, and conclusive communication with affected stakeholders.

The rights of workers in Brazil will be informed to the workers through lectures specifically on "Workers' Rights" by qualified professionals throughout the project activities.

The VCS Program validation and verification process and visit to the validation/verification body's website will be informed via email updates to VERRA accredited auditors as project updates and progress are made.

2.3 Environmental Impact

The project's environmental impacts can be summarized as follows:

- Avoided deforestation of 25,328.6 hectares of Amazon rainforest over 30 years.
- Forest conservation practices will be disseminated as a means for increase value of standing forests.

High conservation value species and biodiversity will not be negatively affected. This project activity does not foresee the implementation of planting activities using potentially invasive or exotic species. The Project team guarantees that no genetically modified organisms (GMOs) will be used to generate GHG emissions reductions or removals.

The project's broader climate, community and biodiversity objectives are comprehensively described in Section 1.11., under sub-heading "Project's major climate, community and biodiversity objectives", therefore this section will explore the biodiversity value and flora and fauna species of interest within the Project Area, which will be considerably benefitted by the preservation of 99,035.2 hectares of forest habitat, which the Unitor REDD+ Project represents.

Biodiversity in the Project Area: description of importance

⁵¹ Document presented at audit: Procedimento – Stakeholder - Feedback, Comentários e Resolução de Conflitos

According to the literature available, it can be concluded that fauna biodiversity inside the Project Area is of highly significant value. In 2007, the Brazilian Ministry of Environment published an official document that establishes priorities for sustainable land use and conservation (MMA, 2007). Within it, the regions of Nova California, RESEX Ituxi and several other areas in the municipality of Lábrea were classified as “extremely high importance” for conservation.

The National Forest (FLONA) of “Iquiri”, located in the municipality of Boca do Acre (AM), which borders directly to the North of all three of the project area groups, published the results of its first inventory of mammals in 2012⁵². The inventory documented 33 species of mammals, including four that stand out on the International Union for the Conservation of Nature (IUCN) Red List: Jaguar (*Panthera onca*), classified as “Near Threatened” (NT)⁵³; Giant Otter (*Pteronura brasiliensis*), “Endangered” (EN); Giant Anteater (*Myrmecophaga tridactyla*), “Vulnerable” (VU); and Giant Armadillo (*Priodontes maximus*), “Vulnerable” (VU).

A study of the biodiversity was recently commissioned by the project proponents in the neighbouring Fortaleza Ituxi REDD Project, carried out by Rio Negro Agroflorestal Ltda. (2020). This area is located within the same municipality and has similar vegetation type, ecosystem, and biodiversity characteristics, allowing us to use it as a primary data source relating to the biodiversity of the Unitor REDD+ Project.

It mentions the importance of the micro-region in which the project is located: the floodplain between the River Purus and the River Madeira. In the Amazon biome, it is important to note that certain taxonomic groups and their species have their territories marked out by rivers and their floodplains and it is hoped that some of the species documented may be considered endemic to the Purus-Madeira floodplain (Ayres e Clutton-Brock 1992, Ribas et al. 2011, as cited in Rio Negro Agroflorestal Ltda. 2020).

Between the 11th and 24th of July 2020, the survey of vertebrate fauna found 302 species of amphibians, reptiles, birds and mammals, taking into account only the direct records made using the sampling method of active search via transects and opportunistic sightings. Of these, two species are not terrestrial, the Amazon River Dolphin (*Inia geoffrensis*) and the Neotropical otter (*Lontra longicaudis*), classified as aquatic and semi-aquatic mammals, respectively. 152 species from the aforementioned taxonomic groups were recorded (see table below).

⁵² Source ICMBio (accessed 24/03/21): <https://www.icmbio.gov.br/portal/ultimas-noticias/20-geral/3209-flona-do-iquiri-faz-primeiro-inventario-de-mamiferos>

⁵³ Source IUCN Red List (accessed 24/03/21):

<https://www.iucnredlist.org/search?query=Panthera%20onca%20&searchType=species>

Table 13. Species richness and sightings

Taxonomic Group	Transects		General	
	S	N	S	N
Reptiles and Amphibians	10	11	21	42
Birds	129	520	253	2148
Mammals	13	67	28	230
TOTAL	152	598	302	2420

*S: Species richness

*N: Number of sightings

Reptiles and amphibians: The ten species of amphibians documented were all of the order *Anura* (frogs and toads). As for reptiles, 16 species of the order *Squamata* (snake lizards), one species of the order *Testudine* or *Chelonia* (tortoises and turtles) and two species of the *Crocodylia* class (alligators) were found.

The sighted turtle species is found predominantly in the waters of the Iquiri and Ituxi Rivers. Known locally as “tracajá”, the Yellow-spotted River Turtle (*Podocnemis unifilis*) is considered Vulnerable (VU) by the IUCN (IUCN, 2020)⁵⁴, and Near-threatened (NT) in the national classification (ICMBio, 2018).

⁵⁴ Source IUCN Red List (accessed 24/03/21): <https://www.iucnredlist.org/species/17825/97397562>



Figure 24. Yellow-spotted River Turtle (*Podocnemis unifilis*), classified as Vulnerable (VU) sighted in the neighbouring Fortaleza Ituxi REDD Project (image: Rio Negro Agroflorestal Ltda., 2020)

Birds: 250 species of birds were documented during the study, belonging to 23 orders and 59 families (Piacentini et al. 2015, as cited in Rio Negro Agroflorestal Ltda. 2020). The most common order was *Passeriformes* (at 128 species, representing more than 50% of the documented species), followed by *Piciformes* (16 species), and finally *Accipitriformes*, *Apodiformes*, and *Psittaciformes* (the latter three with ten registered species each). The families with the highest number of species recorded were *Thamnophilidae* (25 species), followed by *Tyrannidae* (20 species), and finally *Dendrocolaptidae* and *Thraupidae* (each with 13 species).

Among the documented bird species, four are classified within threatened categories according to the IUCN (2020): The Great Tinamou (*Tinamus major*), and the Orange-cheeked Parrot (*Pyrilia barrabandi*) are considered Near-threatened (NT); while the Channel-billed Toucan (*Ramphastos vitellinus*) is considered vulnerable (Vulnerable –VU); and the Green-thighed Parrot (*Pionites leucogaster*) is considered Endangered (EN).

Two migratory species were recorded, the Solitary Sandpiper (*Tringa solitaria*), from the northern hemisphere, and the Common Vermillion Flycatcher (*Pyrocephalus rubinus*), a migrator from the south to the Amazon.

In addition, specialist species which require environments with certain ecological characteristics were recorded, such as: the Manu Antbird (*Cercomacra manu*), which is probably the first record for the State of Amazonas; the Large-headed Flat bill (*Ramphotrigon megacephalum*), which exclusively inhabit bamboo groves (Kratter 1995, as cited in Rio Negro Agroflorestal Ltda. 2020); and the Humaita Antbird (*Myrmelastes humaythae*), which is associated wet, forested habitats and is present in the Amazon lowlands⁵⁵. These records and the presence of several types of habitats and microhabitats (tropical ombrophylous forests, floodplains, rapids, rocky outcrops, bamboo forests, among others), denotes the presence of a complex variety of environments and highlights the need for a more detailed sampling of birdlife in the region.



Figure 25. Red-billed Toucan (*Ramphastos tucanus*), classified as Vulnerable (VU), sighted in the neighbouring Fortaleza Ituxi REDD Project (image: Rio Negro Agroflorestal Ltda., 2020)

Mammals:

40 species of mammals were documented, belonging to 10 orders and 21 families. Of the 12 existing mammalian orders, individuals of the orders *Didelphimorphia*, *Cingulata*, *Pilosa*, *Primates*, *Chiroptera*, *Carnivora*, *Artiodactyla*, *Cetacea* and *Rodentia* were registered during the

⁵⁵ Source: <https://ebird.org/species/humant1/>

survey. The most common order found was *Primates* (12 species), followed by *Carnivora* (7 species), *Artiodactyla* (6 species), *Cingulata* and *Rodentia* (both with 4 species), and finally *Pilosa* (3 species). The families with the largest number of registered species were *Dasypodidae* (4 species) and *Cervidae* (4 species), followed by *Felidae*, *Callitrichidae*, *Cebidae*, and *Atelidae*, (3 species each). The last three belong to the order *Primates*, which encompasses all monkeys in the New World, with their diversity in Brazil being one of the largest globally: 139 taxa (species and subspecies), 5 families and 19 genera have been documented in Brazil⁵⁶.

Among the registered mammal species, the following are in threat categories according to the IUCN (2020): the Amazon River Dolphin (*Inia geoffrensis*) is considered Endangered –(EN); the Giant Armadillo (*Priodontes maximus*); Lowland Tapir (*Tapirus terrestris*); White-lipped Peccary (*Tayassu pecari*); and Peruvian Woolly Monkey (*Lagothrix cana cana*) are considered Vulnerable (VU). Meanwhile, Neotropical Otter (*Lontra longicaudis*), and Jaguar (*Panthera onca*) are considered Near Threatened (NT). From secondary literature sources, we can add four more species to this list: Giant Otter (*Pteronura brasiliensis*) (EN), Black-faced Spider Monkey (*Ateles chamek*) (EN); Giant anteater (*Myrmecophaga tridactyla*) (VU); and Pampas Deer (*Ozotoceros bezoarticus*) (NT).

According to the Brazilian national list of extinction threat (ICMBio 2018; table 4.2), 12 of the registered species (primary and secondary data) are in some threat category, with ten being Vulnerable (VU) and two Endangered (EN). A species of marsupial *Didelphis imperfecta*, the Guianan White-eared Opossum, known locally only as *mucura*, was sighted in the sampling area. It is little-known in the Amazon region, and there are no known sightings close to the study area, thus suggesting the possibility of this being a record of range expansion for this species.

⁵⁶ Source: <https://www.sbprimatologia.org.br/os-primatas/>



Figure 26. An Amazon River Dolphin (*Inia Geoffrensis*), classified as Endangered (VU), sighted in the neighbouring Fortaleza Ituxi REDD Project (image: Rio Negro Agroflorestal Ltda., 2020)

To look at the species accumulation curves presented by the study (Rio Negro Agroflorestal Ltda., 2020), both the data from active sampling through transects, and general data including opportunistic sightings, show a slight tendency towards stabilization and do not reach an asymptote. This further corroborates the urgent need for continued fauna population survey efforts in the project region, as they are likely to reveal further species of interest, a possibility reinforced by species richness indicators (i.e., bootstrap and jackknife) presented by the Rio Negro Agroflorestal Ltda (2020) study.

2.4 Public Comments

The project was submitted to the Verra website for public comment from 27 May 2021 to 26 June 2021. During this period no public comments were received and therefore, none are required to be reported here, in accordance with sections 3.16.5 - 3.16.8 of the VCS Standard.

2.5 AFOLU-Specific Safeguards

Local Stakeholder Identification and Background

As preconized in VCS standard 4.1 (item 3.16.11), the project proponent conducted an assessment of the local stakeholders that are potentially impacted by the project. Information on local stakeholders at the start of the project, are included in this section of the VCS-PD.

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

Local stakeholder consultation: Local communities and families; neighbouring communities and families; workers. For this survey, a sampling based on the Non-permanence analysis has been adopted, meeting the following criteria: i) minimum of 50% of stakeholders inside the Project Area have been consulted; ii) minimum of 20% of stakeholders relying on the Project Area have been consulted within a distance of 20 km of project boundaries.

A community public consultation presentation was delivered to the following communities, small settlements and families during the month of March 2021, and the number of people in attendance is shown in Table 14.

Table 14. Family and communities consulted by project agents, and participant numbers.

Family/ Community Name	N° Participants	Family/ Community Name	N° Participants
Brasileira	10	Edir Luciano	6
Aleluia	15	Serena	5
T. Rocha	5	Vanderlei	8
Seraria	120	André	5
Santa Rosa	12	Farms (Sítios) L - D	25
Viuva	8	Farms (Sítios) L - E	30
Caxarari	40	Adeson	8
Marcos Valência	10	Sandro	5
Fenrando	10	América	4
S. Terra	250	Rebeca	10
Grupo	25	Edvaldo	5
Adriano	7	Enio	6
Peleu	6	Pedra Bonita	6
Jorge Polaco	8	Claudemar	5
P. Estefanele	5	Castanha	6
TOTAL		665	

As demonstrated to audit team (and described in sub-item “Community Public Consultation” below), the survey allowed the project proponent to assess the following stakeholders’ characteristics (required in VCS standard 4.1, item 3.16.11):

Table 15: Characteristics and assessment of the Local Stakeholders.

Item	Characteristic	Characteristic Assessment
1)	The process(es) used to identify local stakeholders likely impacted by the project and a list of such stakeholders;	As mentioned above, the identification of the local stakeholders was made according to the stakeholders present in the project area and in a 20km distance from the project area boundaries. The list of consulted stakeholders is in Table 14 above.
2)	Identification of legal or customary tenure/access rights to territories and resources, including collective and/or	Local stakeholders have access to the project area to perform activities such as the harvesting of nuts, açai and copaiba oil, excluding illegal deforestation. It was

	conflicting rights, held by local stakeholders;	identified in the communities consultations the areas that each stakeholder have access and the activity performed in the area.
3)	Description of the social, economic and cultural diversity within local stakeholder groups and the differences and interactions between the stakeholder groups;	The surrounding communities have a great diversity of origins. Most families are descendants of immigrants from the northeast of Brazil who settled in the region during the rubber boom, which took place between 1870 and 1912. During this period, there was an upsurge in migration from northeastern states, this migration was motivated by the hunger and misery that plagued a large part of Brazilian society during the Second Reign in Brazil⁵⁷. In the 1870s, governments encouraged migration as a way to alleviate social conflicts resulting from land concentration that began in the Colonial Period. After the decay of the rubber cycle, these families started to work primarily with the harvest of other non-timber forest products, such as açaí, copaiba oil and nuts. But outside the harvest period, they perform various other services on the farms in the region, such as assistant in forest management and livestock.
4)	Potential changes in the makeup of local stakeholders over time;	The makeup of the local stakeholders is not expected to suffer any significant change over time.
5)	Expected changes in well-being and other stakeholder characteristics under the baseline scenario, including changes to ecosystem services identified as important to local stakeholders;	Changes that impact stakeholders' well-being are not expected, as access to the natural resources they use in the project area, such as nuts and açaí, will be maintained.
6)	Identification of the location of communities, local stakeholders and	It was identified, during the community consultation, the location of the communities

⁵⁷ INFOESCOLA (2015) <https://www.infoescola.com/historia-do-brasil/ciclo-da-borracha/>

	areas outside the project area that are predicted to be impacted by the project;	and local stakeholders, being in the project area or in a 20km distance.
7)	Identification of the location territories and resources which local stakeholders own or to which they have customary access;	It was identified, during the community consultation, the areas in the project area and project boundaries that local stakeholders have access and that they use some type of resources for activities such harvesting, cattle raising.

Risks to Local Stakeholders

As required in VCS standard 4.1, the following items were assessed to identify any risks to the local stakeholders:

Table 16. Risk assessment to the Local Stakeholders.

Item	Characteristic	Characteristic Assessment
3.16.12	Identification of likely natural and human-induced risks to local stakeholder well-being expected during the project lifetime and outline measures needed to mitigate these risks	No natural or human-induced risks are expected to occur to the local stakeholder's well-being during the project lifetime. In the event of any risk, measures will be taken to mitigate the risk. In addition, during the public consultation, none of the participants expressed conflicts or identified any risk to their interests that might be caused by the project implementation.
3.16.13	Identification of the risks for local stakeholders to participate in the project	No risks for local stakeholders to participate in the project, including the project design or implementation, were identified. The project will not cause any risk to food security, land loss, loss of yields and climate change adaptation.
3.16.14	Identification of any allegations or complaints on discrimination or sexual harassment	No allegation or complaints on discrimination or sexual harassment by the local stakeholders were identify or made. The project proponents nor other entity involved in project design and implementation are allowed to commit any form of discrimination or harassment.

3.16.15	The management teams involved in the project shall have expertise and prior experience implementing land management and carbon projects with community engagement at the project scale.	The management teams involved in the project have expertise and prior experience implementing land management and carbon projects with community engagement at the project scale. Information on project team is further detailed as part of the Non-permanence Risk Analysis.
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Respect for Local Stakeholder Resources

Through this VCS-PD, the project proponent declares that the project activity has no negative impacts in project implementation. If any negative impact is identified during the project lifetime, this impact will be mitigated. The project proponent shall recognize, respect and support local stakeholders' property rights and where feasible, take measures to help secure rights. The project shall not encroach on private, stakeholder or government property or relocate people off their lands without consent. The project may affect property rights if free, prior and informed consent is obtained from those concerned and a transparent agreement is reached that includes provisions for just and fair compensation. In the event there are any ongoing or unresolved conflicts over property rights, usage or resources, the project shall undertake no activity that could exacerbate the conflict or influence the outcome of an unresolved dispute.

Regarding topic 3.16.16 item 2, no activity is planned in the project area that will introduce invasive and non-native species, as well as no fertilizers, chemical pesticides or biological control agents will be used.

Communication and Consultation

As required in VCS standard 4.1, item 3.16.17, for the "Local stakeholder consultation", a comprehensive project summary was actively presented to the communities and other stakeholders in Portuguese in the field, by two project agents. For the "Institutional Consultation", in turn, the government organs and other institutions were contacted by e-mail. In both consultation modalities, the project proponent communicated in a didactic way: i) the project design and implementation, including the results of monitoring; ii) the risks, costs and benefits the project may bring to local stakeholders; iii) all relevant laws and regulations covering workers' rights in the host country; iv) the process of VCS Program validation and verification and the validation/verification body's site visit.

The project proponent understands that stakeholders want and need to be involved in project design, implementation, monitoring and evaluation throughout the project lifetime. Therefore, complying with VCS Standard 4.1 (item 3.16.18), a communication channel was established for

stakeholders to continually express their concerns and to solve eventual conflicts and grievances that arise during project planning, implementation, and monitoring. The main communication channel is the project's own email (reddunitorcarbonext@carbonext.com.br), which is managed by the Carbonext team.

It is expected that this communication channel will be a mechanism to ensure that the project proponent and all other entities involved in project design and implementation are not involved in or complicit in any form of discrimination or harassment with respect to the project. All denouncements will be available to stakeholders and auditors. In case of conflicts, the project proponent and stakeholders will be free to propose and take any appropriate corrective action. This is the formalized grievance redress procedure that will be used throughout the project lifetime to address disputes with stakeholders, which may arise during project planning and implementation.

The process for receiving, hearing, responding to and attempting to resolve Grievances will be performed within a reasonable time period. It is expected that each grievance is responded in a delay of 7 days, proposing and/or taking corrective actions. This Feedback and Grievance Redress Procedure has three stages (VCS Standard 4.1; item 3.16.18):

1. The Project Proponent shall attempt to amicably resolve all grievances and provide a written response to the grievances in a manner that is culturally appropriate. (Action must be taken in 7 days);
2. Any grievances that are not resolved by amicable negotiations shall be referred to mediation by a neutral third party. (Action must be taken in 30 days);
3. Any grievances that are not resolved through mediation shall be referred either to a) arbitration, to the extent allowed by the laws of the relevant jurisdiction or b) competent courts in the relevant jurisdiction, without prejudice to a party's ability to submit the grievance to a competent supranational adjudicatory body, if any. (The time to accomplish this stage is dependent on local jurisdiction delays.)

All communication and consultation are performed in an appropriate manner, respecting the culture and particularity of each stakeholder or its representatives, as required in the VCS Standard 4.1; item 3.16.19. Besides that, the results of implementation will be provided in a timely manner, as well as the consultation will be performed prior to design decisions or implementation to allow stakeholders adequate time to respond to the proposed design or action.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

Approved VCS Methodology VM0015 “Methodology for Avoided Unplanned Deforestation”, Version 1.1, 3 December 2012. At: <https://verra.org/methodology/vm0015-methodology-for-avoided-unplanned-deforestation-v1-1/> (last visited 03/03/2021).

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. At: <https://verra.org/methodology/vt0001-tool-for-the-demonstration-and-assessment-of-additionality-in-vcs-agriculture-forestry-and-other-land-use-afolu-project-activities-v3-0/> (last visited 03/03/2021).

AFOLU “Non-Permanence Risk Tool” VCS Version 4, Procedural Document, 19 September 2019, v4.0. At: https://verra.org/wp-content/uploads/2019/09/AFOLU_Non-Permanence_Risk-Tool_v4.0.pdf (last visited 03/03/2021).

3.2 Applicability of Methodology

The Approved VCS Methodology VM0015 “Methodology for Avoided Unplanned Deforestation”, Version 1.1, is for estimating and monitoring GHG emissions of project activities that avoid unplanned deforestation (AUD). The forest landscape configuration is frontier. Carbon stock enhancements in forests that would be deforested in the baseline case can also be accounted under this methodology. However, credits for reducing GHG emissions from avoided degradation are excluded.

Baseline activities involve unplanned deforestation for logging and grazing activities. Project activities may include some level of planned deforestation, but planned deforestation is excluded from the project area. In the case of this Project Activity, some landowners have Operation Licenses for sustainable forest management and are currently harvesting timber from the property.

The eligible categories of project activity covered by this methodology are represented with the letters A to H in Table 17. This Project Activity falls into categories A and B, as it predominantly involves protection of forest with and without controlled logging (sustainable forest management), and the baseline consists of deforestation in old-growth forests without logging (performing clear cut). For this type of project activity, the carbon balance is represented as shown in Figure 277 and Figure 278, depending on whether or not logging is practiced.

Table 17. Scope of the VM0015 methodology (Table 1 of the VM0015)

			PROJECT ACTIVITY	
			Protection without logging, fuel wood collection or charcoal production	Protection with controlled logging, fuel wood collection or charcoal production
BASELINE	Deforestation	Old-growth without logging	A	B
		Old-growth with logging	C ¹	D ¹
		Degraded and still degrading	E ¹	F ¹
		Secondary growing	G ¹	H ¹
	No-deforestation ²	Old-growth without logging	No change	Degradation
		Old-growth with logging	IFM	IFM-RIL
		Degraded and still degrading	IFM	IFM
		Secondary growing	No change	Degradation

1. Accounting for carbon stock increase in the project scenario is optional and can conservatively be omitted.
2. If the baseline is not deforestation, the change in carbon stocks is not covered in this methodology.

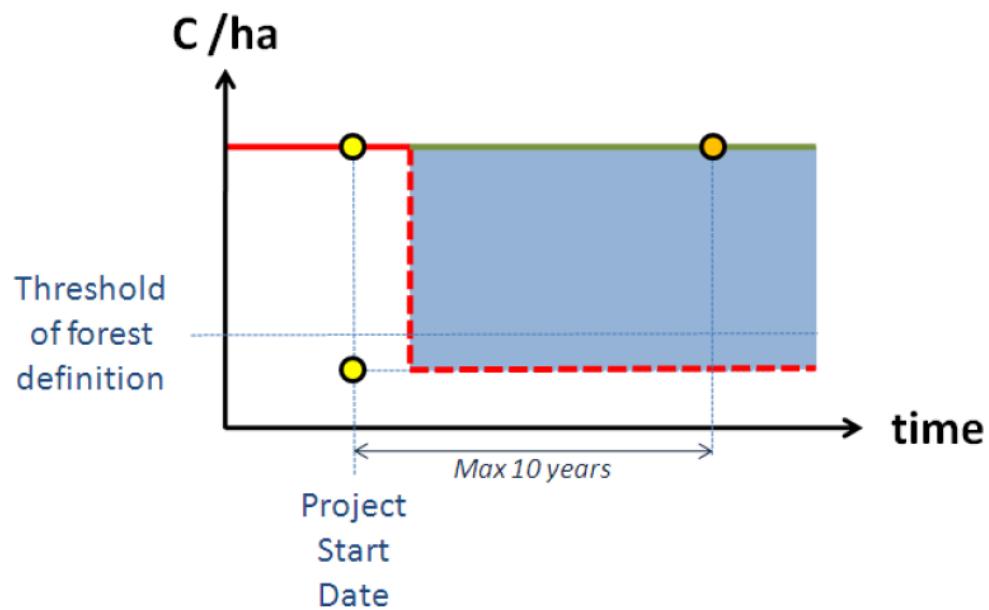


Figure 27. Carbon balance in project category A of VM0015 methodology

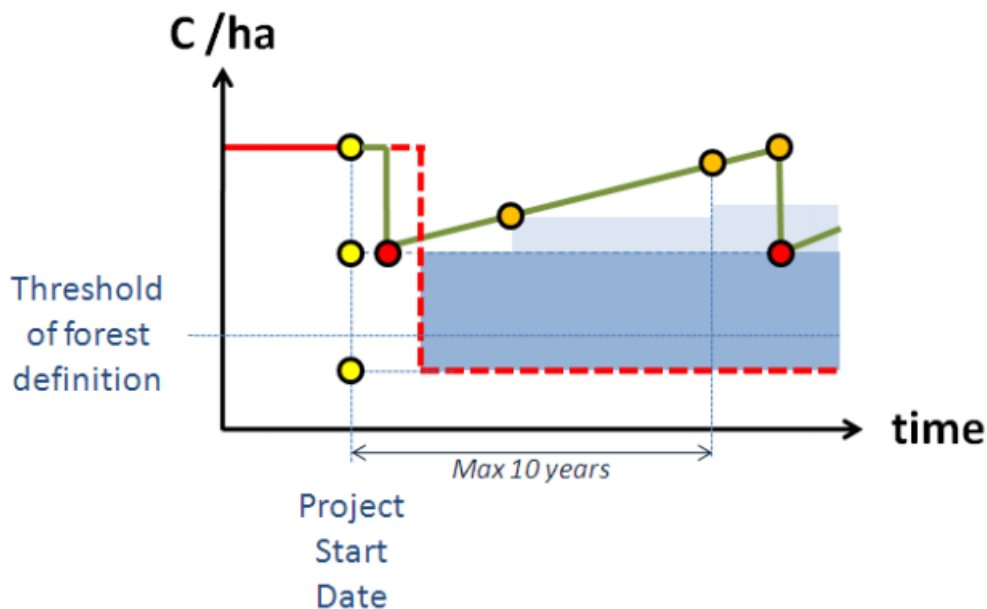


Figure 28. Carbon balance in project category B of VM0015 methodology

The VM0015 methodology has no geographic restrictions and is applicable to this Project Activity due to the following conditions:

- Baseline activities include unplanned deforestation for timber and grazing activities, where forest lands are converted to non-forest lands.
- The Project Activity includes eligible categories A and B, as defined in the description of the scope of the methodology.
- The Project Area includes old-growth forest, meeting the definition of “forest”.
- At project commencement, the Project Area includes only land qualifying as “forest” for a minimum of 10 years prior to the project start date.
- The Project Area does not include forested lands growing on peat, as stated in section 1.13 of the present PD, citing IBGE official Brazilian vegetation and soil maps: the Project Area is composed by the following soil types, none of which meet the criteria for turf, cited in the VM0015 methodology:
 - Red-yellow dystrophic latosols + Red dystrophic latosols (LVAd3): 49%
 - Red-yellow dystrophic argisols + Haplic cambisols (PVAd9): 39%
 - Association of Red-yellow dystrophic argisols + Red-yellow dystrophic latosols (PVAd4): 12%.

In this context, it is demonstrated that the VM0015 methodology is applicable to the proposed AUD project activity.

As mentioned in section 3.1 of this VCS-PD, “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, Sectoral Scope 14, was used in this project. The tool is applicable to this project, according to statements below:

- a) The project activity does not lead to violation of any applicable law, even if the law is not enforced;
- b) There is a baseline methodology to provide for a stepwise approach justifying the determination of the most plausible baseline scenario.

Section 3.1 of this VCS-PD also mentions the use of AFOLU “Non-Permanence Risk Tool” VCS Version 4, Procedural Document, 19 September 2019, v4.0. At: <http://www.v-c-s.org/program-documents> (last visited 03/03/2021), which is mandatory to be applied to GHG removals or avoided emissions through carbon sinks.

3.3 Project Boundary

Spatial Boundaries – PROJECT AREA

The geographic project boundaries are defined under “1.12 Project Location”.

The project area, according to VM00015, is an area covered only by forest for at least 10 years before (as proven via evidence at audit) the Project start date: the date when activities are initiated to protect against the risk of future deforestation. The procedure excluded the deforested areas within the potential Project Area and included only areas covered in forest at start date: 10/11/2018. As a result, we obtained an area of 99,035.2 hectares of forest as the Project Area. The planned deforestation areas within the activities of the sustainable forest management plans (roads and stations, yards, and other infrastructure) will be discounted during future monitoring events, as they become available to the project proponents.

Spatial Boundaries – REFERENCE REGION

For delimitation of the Reference Region boundary and future deforestation projection, the main drivers of deforestation were defined:

- Accessibility of forests: The Reference region has a vast and dense network of primary, secondary and tertiary roads, as well as navigable rivers. The nearest locations of these paths will have a greater potential of deforestation;
- Distance from Deforestation (Proximity to forest edges): Given the accessibility and physiographic conditions, regions near the ancient deforestation and communities,

districts, municipal centres also tend to have a higher probability and risk of future deforestation;

- Distance from sawmills.

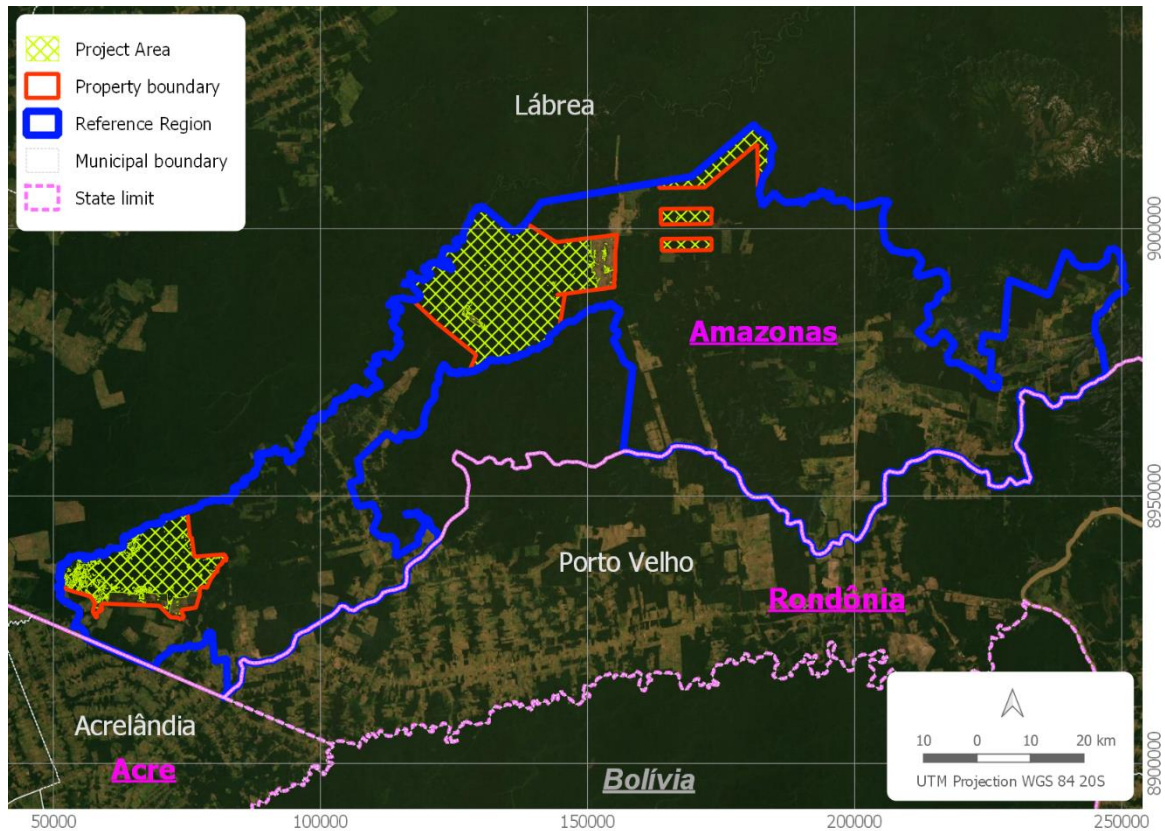


Figure 29. Location of the Reference Region and Project Area

The Reference Region is the spatial demarcation for gathering information on rates, agents and patterns related to deforestation, which is used for historical analysis of land use change and projection of future deforestation, and its monitoring.

The Reference Region was defined based on the dynamics of deforestation as well as physical and ecosystem aspects of the landscape and its similarity to the Project Area. To define its spatial boundaries, protected areas (indigenous lands and protected areas) and INCRA settlements were excluded from the Reference Region, as these are public areas with different agrarian and legal attributes compared to a private property.

The following are the main criteria used in defining the Reference Region:

- a. Absence of a national or sub-national baseline in the region of the Project Area;
- b. In view of the item a), the municipal boundaries with the greatest influence on the regional context were used to define the boundaries of the Reference Region;

- c. Information on the agents, patterns, land ownership and other drivers of deforestation in the region were used to delimit the Reference Region;
- d. The Reference Region encompasses an area larger than the Project Area;
- e. The existing baseline covers at least the length of the baseline period (10 years) and is not outdated;
- f. The existing baseline shows the location of deforestation annually;
- g. The spatial resolution of existing baseline is equal to the smallest mappable unit considered in the monitoring period (1 hectare);
- h. The methods used are transparent, free for consultation and follow the precepts of VM00015 methodology, version 1.1.

As a result, we obtained a Reference Region of 683,676.00 hectares, which includes the Project Area of 99,035.2 hectares. VM0015 *recommends* that when the Project Area is under 100,000 hectares, the Reference Region must be 20 to 40 times larger than the Project Area – according to the footnote on p.18 of VM0015. It is emphasized that this is a recommendation not a requirement of the methodology. In the case of the Unitor REDD Project, the Reference Region is 6.9 times larger the Project Area, and while the project area is below 100,000 hectares, it is within 1% of that figure, which was considered a negligible difference. A reference region 20 – 40 larger than the PA would have included areas (such as the cities of Rio Branco and Porto Velho) with excessively different dynamics to those of the project, resulting in various issues such as exaggerated baseline deforestation rates, which would be counter to the principle of conservativeness.

This divergence of the PD from the VM0015 recommendation does not negatively impact the conservativeness of the quantification of GHG emission reductions or removals, because the Reference Region, being 6.9 times larger than the Project Area, avoids areas with higher baseline deforestation rates, which would be included within a Reference Region 20 – 40 larger than the Project Area.

Moreover, the VM0015 conservativeness requirements between the PA and RR was guaranteed by means of the similarity analyses required by the methodology, as described fully in Section 3.3 of the VCS-PD.

This divergence refers to the spatial boundaries parameters established in VM0015 Methodology and only relates to the criteria and procedures for monitoring or measurement and do not relate to any other part of the methodology.

It is concluded that the deforestation in the Project Area is likely to occur in a manner similar to that observed in the Reference Region.

Similarity analysis between Reference Region and Project Area

Agents and drivers

In the absence of the present REDD project, it is assumed that the property would undergo deforestation at the same intensity, carried out by the same agents and motivated by the same drivers, as that which occurs in the Reference Area. There is historical evidence (described previously in this VCS-PD) to argue that the same deforestation pressures which apply to the Reference Region also act on the Project Area.

Land occupation

Figure 30 shows the land-use within the Reference Region, illustrating the main legally recognised protected areas. The following categories were included: Federal, State and Municipal Protected Areas (“Unidades de Conservação (UC)”), Indigenous Territories recognized by FUNAI, legally approved settlement projects, and private land certified by INCRA. The Figure also presents the location of the project properties, and it is noteworthy that the project borders directly with one Federal Protected Area: The Iquiri National Forest (FLONA).

Due to the large area and territorial complexity, the Reference Region was defined in such a way as to broadly encompass as much of the territory as possible, while reconciling that with the similarity of the landscape and of the drivers of deforestation with those of the Project Area.

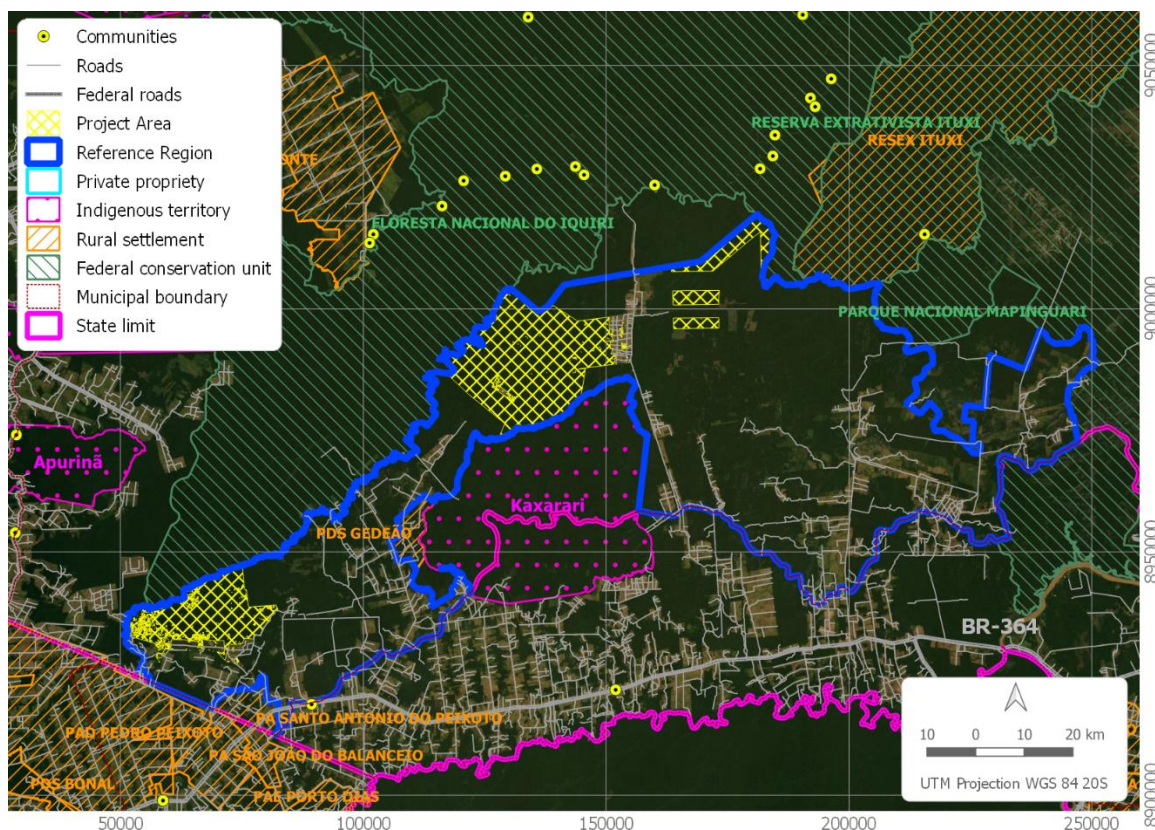


Figure 30. Land occupation in the Reference Region and Project Area

The conclusion on similarity in terms of land use, land tenure and legal status of the land: 100% of Project Area is similar to Reference Region in terms of land use, land tenure, and legal status, meeting methodology requirements. The project proponent has intentionally kept the maximum possible of private properties in the RR to guarantee similarity.

Forest classes

The dominant forest classes in the Reference Region are submontane open ombrophylous forest, type “As” according to IBGE, covering 75% of the RR, and submontane dense ombrophylous forest (“Ds”), 25% of the RR, according to the project’s analysis of MMA data⁵⁸. Regarding Project Area, 64% of its forests are classified as open ombrophylous forest (“As”), and 36% are submontane dense ombrophylous forest (“Ds”). The Figure below shows the spatial representation of these vegetation types in the Project Area and Reference Region.

⁵⁸ Source MMA (accessed 11/03/21): <http://mapas.mma.gov.br/geonetwork/srv/br/metadata.show?id=416>

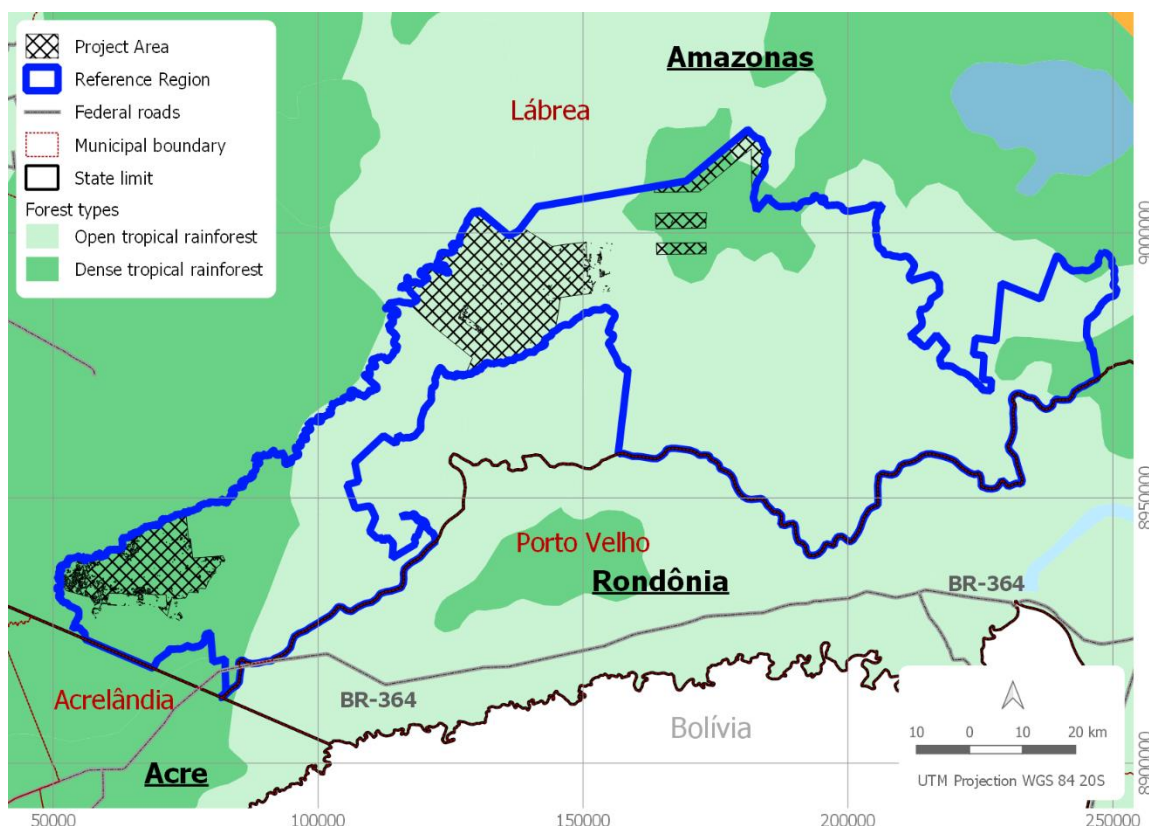


Figure 31. Identification of forest types in the Reference Region and Project Area

Conclusion on the similarity of forest types: 100% of the PA has forest classes that are in 100% of the RR, namely Submontane open ombrophylous forest (“As”) and Submontane dense ombrophylous forest (“Ds”), therefore meeting the methodology requirement for this specific similarity criterion, that states: *“At least 90% of the project area must have forest classes or vegetation types that exist in at least 90% of the rest of the reference region”*.

Elevation analysis

To classify the altitude of the Project Area and the Reference Region, in accordance with methodology criteria, which requires similarity of 90% between both areas, a mosaic of digital elevation models was prepared using scenes 09S66_ZN, 08S66_ZN, 09S675_ZN, and 08S675_ZN; in TIFF format, provided by Topdata - INPE. The map below shows the elevation levels of the Reference Region and Project Area. The following graphs show the elevation distributions (Nº. of pixels/ Altitude) in the Project Area and Reference Region, demonstrating the similarity between them.

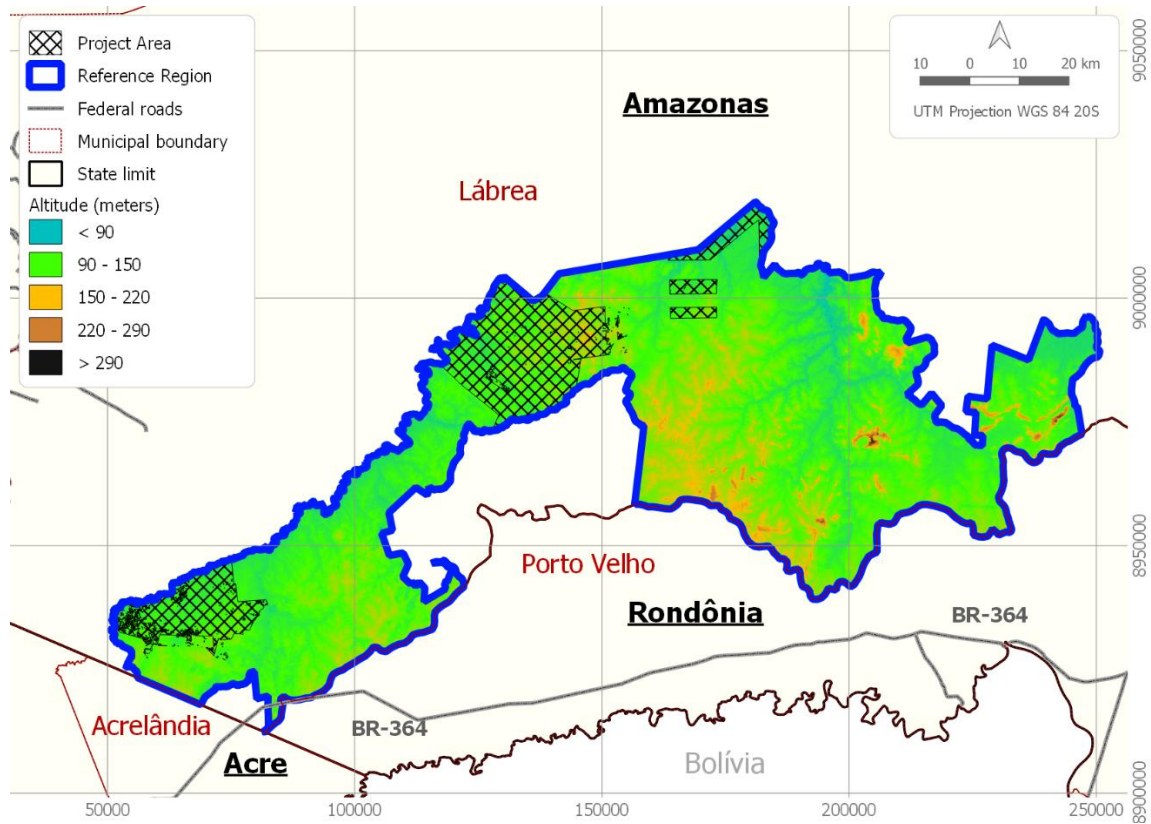


Figure 32. Elevation analysis of the Reference Region and Project Area

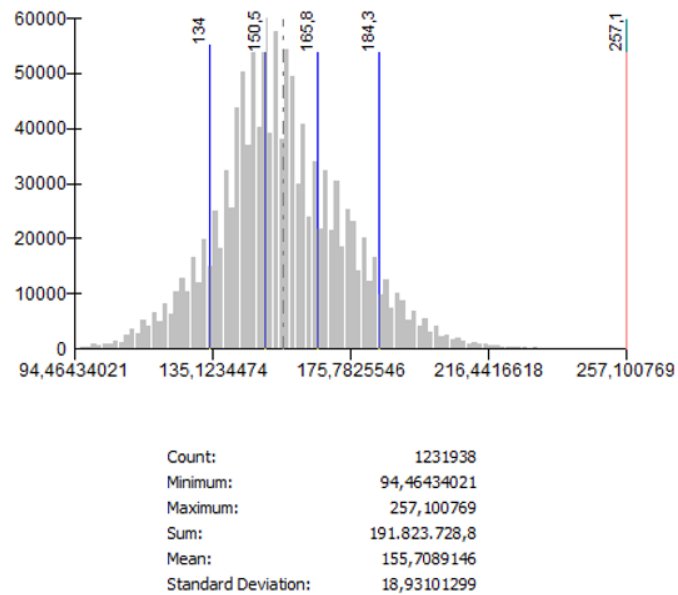


Figure 33. Distribution of elevation in the Project Area

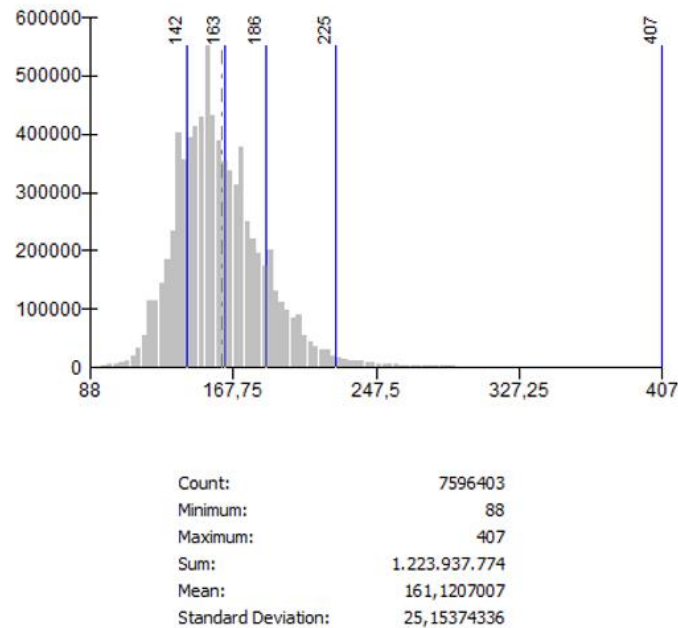


Figure 34. Distribution of elevation in the Reference Region

Conclusion regarding elevation similarity: 100% of the Project Area has elevation ranging between 94 and 216 meters, while more than 90% the Reference Region is located in altitudes between 94 and 216 meters. Thus, the assessment of elevation similarity is superior to 90% and meets methodology requirements. Moreover, the average altitude in the Project Area is 155 m, while it is 165 m in the Reference Region, which suggests that accessibility would be slightly easier inside the Project Area in comparison to the Reference Region.

In this analysis, our main goal was to prove that the elevation in the PA is within the range of elevation in RR, so justifying that elevation factor would not hinder deforestation inside the PA in a different way it could affect deforestation in the RR. The fact that the PA has lower elevation than RR indicates that it can be more susceptible to deforestation than RR itself and the estimates can be seen as conservative.

Slope analysis

To analyse slope within the Project Area and the Reference Region, in compliance with methodology criteria, which require 90% similarity between the areas, a mosaic of digital elevation models was created using scenes 09S66_SC, 08S66_SC, 09S675_SC, and 08S675_SC; in TIFF format, sourced from Topdata - INPE, in which each pixel represents the average slope of the land.

The map below shows the similarity of the slope classes in the Reference Region and Project Area; and in the following Tables, these classes were quantified for both areas. For both the Project Area and Reference Region, 100% of the areas are represented by the following classes: Flat, Slightly undulating, and Undulating; the most prevalent class was "Flat", which covers 74 – 76% of both areas.

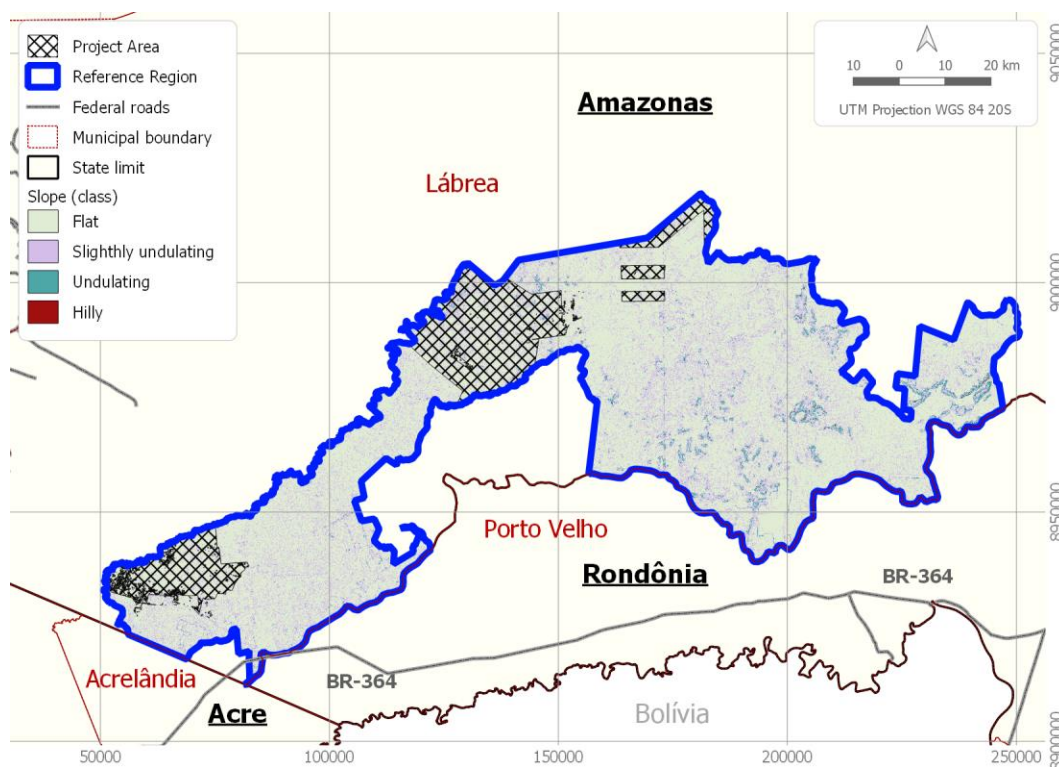


Figure 35. Landscape slope analysis in the Reference Region and Project Area

Table 18.

Project Area				Reference Region			
N	Slope class	Area (ha)	Area (%)	N	Slope class	Area (ha)	Area (%)
1	Flat	75.687,40	76,425%	1	Flat	509.270,00	74,490%
2	Slightly undulating	22.417,39	22,636%	2	Slightly undulating	159.877,80	23,385%
3	Undulating	927,84	0,937%	3	Undulating	14.141,43	2,068%
4	Hilly	2,61	0,003%	4	Hilly	386,73	0,057%
5	Mountainous	0,00	0,000%	5	Mountainous	0,00	0,000%
6	Steep	0,00	0,000%	6	Steep	0,00	0,000%
	Total	99.035,24	100,000%		Total	683.675,96	100,000%

Conclusion regarding slope class: the same three slope classes cover 100% of both the Project Area and the Reference Region, specifically: Flat, Slightly undulating, and Undulating. The

predominant class, "Flat", is within 2% of difference in the PA and RR, while the second most predominant class, Slightly undulating, is exactly the same at 23%. Thus, the assessment of slope similarity is superior to 90% and meets methodology requirements.

Rainfall

To assess the climate and its similarity between the Project Area and the Reference Region, we used a study by Alvarez et al. (2013), which suggests a new map of the Köppen classification of Brazil, using monthly and annual historical temperature and rainfall series.

The Figure below shows a map of the climate classification of the Project Area and Reference Region.

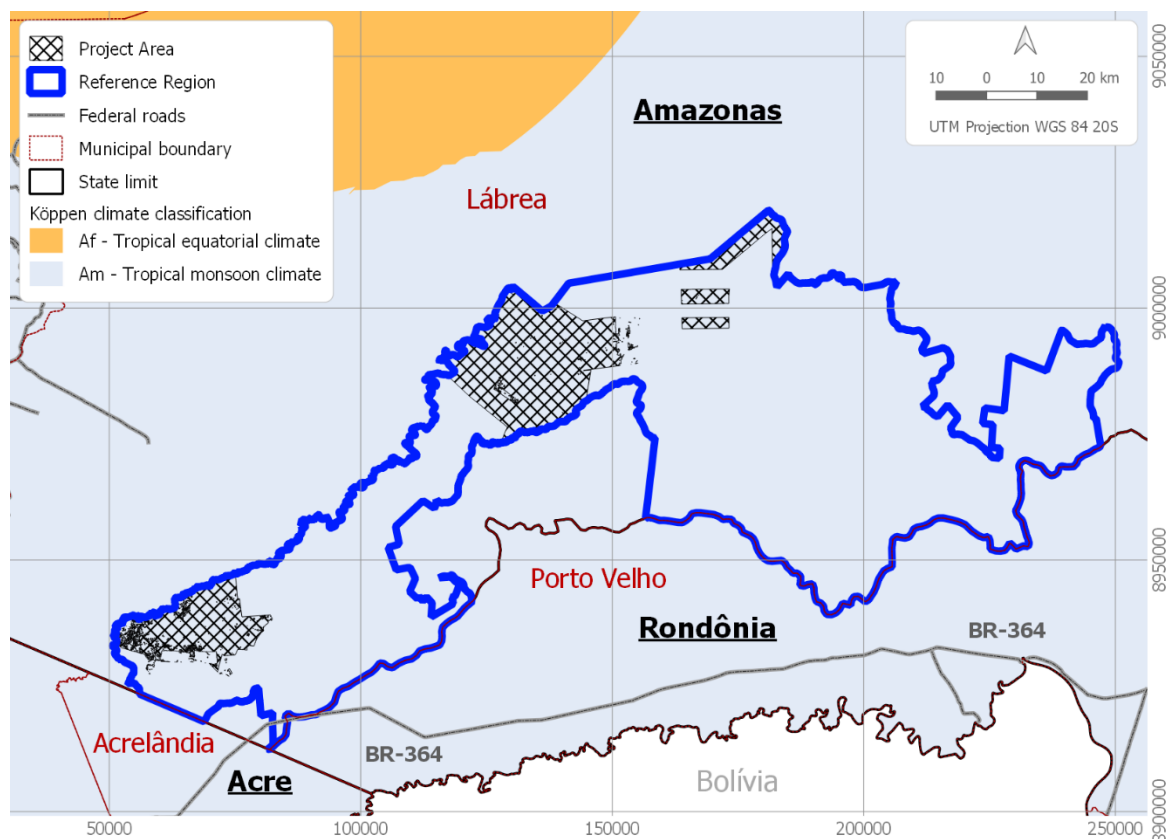


Figure 36. Climate and rainfall analysis in the Reference Region and Project Area

Conclusion on rainfall climate similarity: The two project areas show no distinctions as to climatic variables, being therefore 100% similar, in that they both fall entirely within a Tropical monsoon climate (Am) zone, having the same annual average temperatures above 18°C, and monthly rainfall above 60 mm.

General Conclusion on Similarity between PA and RR

The similarity between the Project Area and the Reference Region has been proven according to the requirements of VM0015. The similarity was found to be above 90% for more than three criteria: Land Occupation (100%); Forest classes (100%); Elevation (more than 90%); Slope (more than 90%); and Rainfall (100%).

Spatial Boundaries – LEAKAGE BELT

The leakage belt is the land area or land areas surrounding or adjacent to the project area in which baseline activities could be displaced due to the project activities implemented in the project area.

To define the boundary of the leakage belt, Opportunity cost analysis (Option I) was tested, in accordance with Approved VCS Methodology VM0015 “Methodology for Avoided Unplanned Deforestation”, Version 1.1, 3 December 2012, Sectoral Scope 14.

The boundary of the leakage belt will be revisited at the end of each fixed baseline period, as opportunity costs are likely to change over time. In addition, this boundary of the leakage belt may have to be revisited if other VCS-AFOLU projects are registered nearby the project area.

Opportunity cost analysis (Option I) is applicable where economic profit is an important driver of deforestation. To test the applicability of Option I, historical records have shown that at least 80% of the area deforested in the reference region (or some of its strata) during the historical reference period has occurred at locations where deforesting was profitable for cattle ranching activities. In this context, literature studies, surveys and other credible and verifiable sources of information were used to demonstrate profitability of the main products of deforestation in the region: wood and cattle.

Based on Opportunity cost analysis (Option I) rationale, leakage can only occur in areas outside the project area where the total cost of establishing and raising cattle and transporting the products to market is less than the price of the products (i.e., opportunity costs are > 0). To identify this zone, the following steps were applied:

- a) List the main land uses that deforestation agents are likely to implement within the project area in the baseline case: in the baseline case of this project, deforestation is carried out to obtain timber to finance cattle ranching.

- b) Find credible and verifiable sources of information on the following variables:

$S\$x$ = Average selling price per ton of the main product (living cattle) that would be established in the project area in the baseline case:

Considering that the volume of timber from illegal deforestation is not reliably registered in any country statistics, living cattle was considered as the main and final product of

deforestation in this assessment. Living cattle is usually sold and transported to slaughterhouses in the region.

The average selling price of living cattle was obtained from Institute for Conservation and Sustainable Development of the Amazon (*Instituto de Conservação e Desenvolvimento Sustentável da Amazônia*, IDESAM): R\$ 5,733 / ton⁵⁹. Nevertheless, there is a great variety of fees and taxes that must be discounted from the sale price, corresponding to up to 40% of the total sale price⁶⁰. Owing to a 30% “tax evasion index” (rate of cattle sold without any selling documentation and taxation), the discount on total selling price has been reduced, resulting in a total of R\$ 5,232 / ton return on selling price after taxes.

SPxi= Most important points of sale (spatial locations) for each main product Px in the reference region.

In this assessment, it was considered that the most important selling points for living cattle are slaughterhouses in the region, along the BR-364 highway.

PCxi= Average in situ production costs per ton of product

The average production costs of living cattle were obtained from Institute for Conservation and Sustainable Development of the Amazon (*Instituto de Conservação e Desenvolvimento Sustentável da Amazônia*, IDESAM): R\$ 4,646 / ton⁶¹. In this context, the margin remaining for transportation costs is the difference between the net selling price (R\$ 5,232 / ton) and the production cost (R\$ 4,646 / ton), multiplied by 40% (percent foreseen in “sharecropper’s agreement” for paying the landowner), which results in R\$ 234.2 / ton for transportation.

TCv = Average transport cost per kilometre for one ton of product using the most typical transport technology available to the producer.

The most typical means of transportation available for cattle producers in the region is road transport by truck. Transportation costs in the region are estimated at R\$ 3.41/t.km⁶². This cost indicates that cattle could be transported at a distance of approximately 69 km by road.

⁵⁹ <https://idesam.org/publicacoes/a-cadeia-produtiva-da-carne-bovina-no-amazonas/> (accessed in 02/09/2021)

⁶⁰ PIS: 0% (<https://www.campograndenews.com.br/artigos/produtor-rural-pessoa-juridica-x-pis/pasep-e-cofins>); COFINS: 0% (<https://www.campograndenews.com.br/artigos/produtor-rural-pessoa-juridica-x-pis/pasep-e-cofins>); ICMS: 4,0% (https://online.sefaz.am.gov.br/silt/Normas/Legisla%C3%A7%C3%A3o%20Estadual/Resolu%C3%A7%C3%A3o%20GS-EFAZ/Ano%202019/RG%20003_19.htm); IRPJ: 25% (http://www.planalto.gov.br/ccivil_03/leis/l8541.htm); INSS/FUNRURAL: 2,05% (<https://www.agrolink.com.br/colunistas/funrural--o-imposto-que-o-produtor-rural-nao-pode-esquecer-448507.html>); CSLL: 9% (Receita regulamenta alterações de alíquotas da CSLL — Português (Brasil) (www.gov.br)).

⁶¹ <https://idesam.org/publicacoes/a-cadeia-produtiva-da-carne-bovina-no-amazonas/> (accessed in 02/09/2021)

⁶² <http://dtri.sefaz.to.gov.br/legislacao/ntributaria/instr.normativas/2019/Inst.%20Normativa176.19.pdf> (accessed in 02/09/2021)

Option I is based on the assumption that deforestation agents in the project area will not displace their activities beyond the reference region. Additionally, Option I requires to demonstrate that at least 80% of the area deforested in the reference region during the historical reference period has occurred at locations where deforesting was profitable.

According to TERRACCLASS (2020) data, the total area of non-forest is 159,149 hectares in the Reference Region. A belt was mapped within the Reference Region, starting at the main consumption centres in the South, and extending over a 69-km belt along the BR-364 highway. 129,007 hectares of non-forest were mapped inside this belt. Thus, it can be assumed that at least 81% of deforestation in the Reference Region has been motivated by profitability in cattle ranching (considering only the consumers in the Southern region).

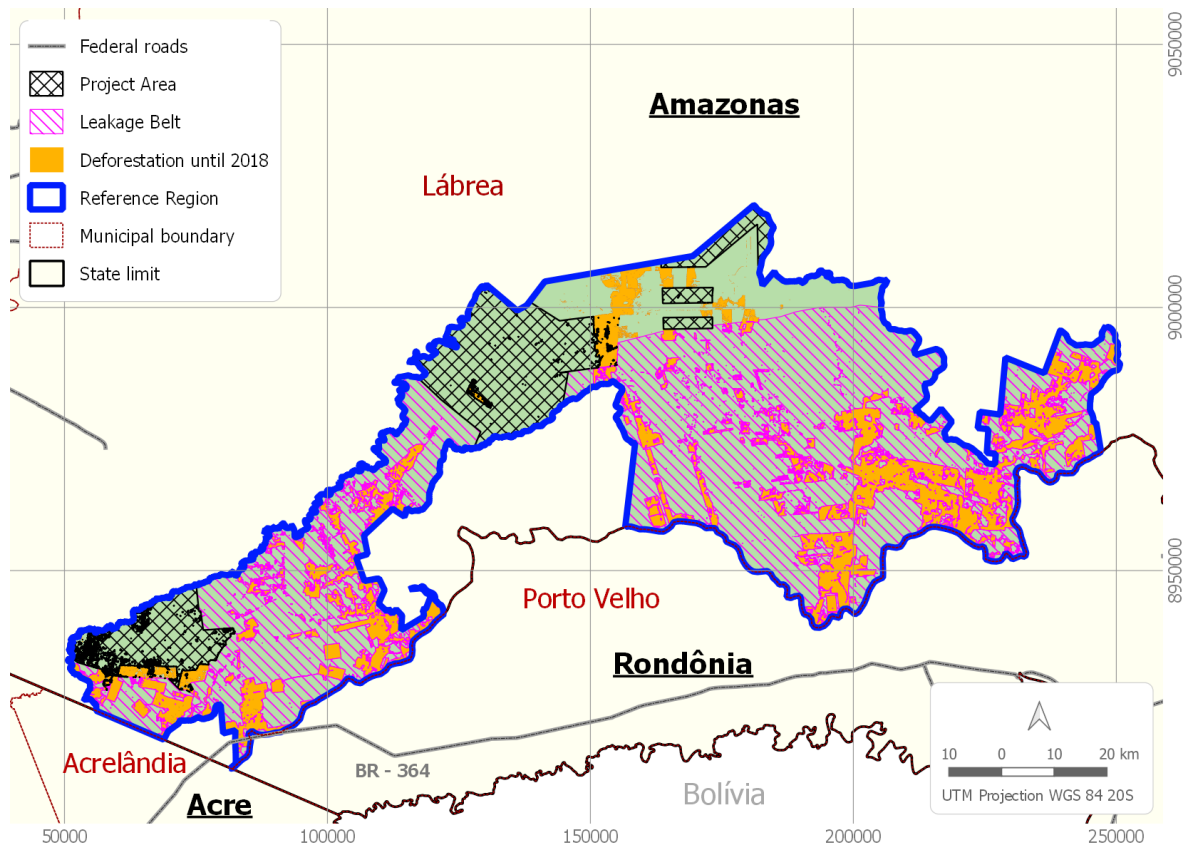


Figure 37. Location of the Leakage Belt

The Leakage Management Areas are non-forest areas located outside the project boundary, in which the project proponent intends to implement activities that will reduce the risk of activity displacement leakage. The boundary of leakage management areas is clearly defined using the common projection and GIS software formats used in the project.

The definition of the Leakage Management Areas took into account the deforested areas of private lands neighbouring the “Ramal do Boi” Road and the BR364 Motorway. The following spatial criteria were used for delimitation:

- I. Non-forest classes;
- II. Logistical proximity for the Project Proponents to conduct management near the REDD project, taking into account the main access point to the Project Area, with the objective of creating a barrier to stop deforestation entering the Project Area from the Reference Region;
- III. high potential for land-use changes in these areas, considering their proximity to roads and other deforested areas.

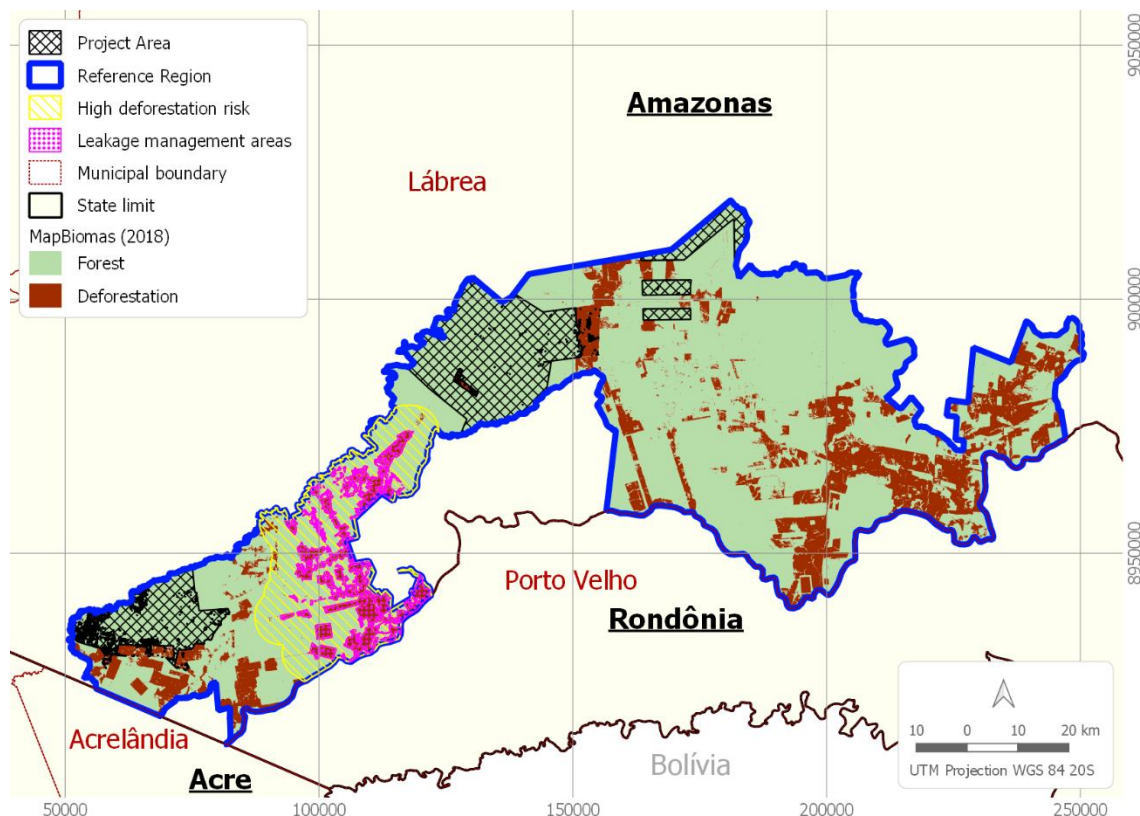


Figure 38. Location of the Leakage Management areas

AFOLU non-permanence risk analyses will be assessed for each new geographic area. Activity-shifting, market leakage and ecological leakage assessments will be reassessed where new instances of the project activity are included in the project.

- 1) The geographic area within which all project activity instances shall occur is delineated with the Reference Region set in this VCS-PD.
- 2) The determination of the baseline for the project activity is in accordance with the requirements of the methodology applied to the project.
- 3) The demonstrations of additionality for the project activity are in accordance with the requirements of the methodology applied to the project.

4) A set of eligibility criteria for the inclusion of new project activity instances at subsequent verification events is defined in this VCS-PD (above in this topic).

5) A description of the central GHG information system and controls associated with the project and its monitoring is provided in the Monitoring Plan.

It is important to notice that the Leakage Management areas originally inserted in the project design will be priority to recruit new project instances. If the new instances involve the original Leakage Management areas, new areas shall be identified and adopted to manage leakage.

Table 19. Sources and GHG included or excluded within the boundary of the proposed AUD project activity

Source		Gas	Included?	Justification/Explanation
Baseline	Biomass burning	CO ₂	No	Counted as carbon stock change
		CH ₄	Yes	Methane emissions during burning of biomass for land clearance.
		N ₂ O	Yes	Nitrous oxide emissions during burning of biomass for land clearance
		Other	-	Not applicable.
	Livestock emissions	CO ₂	No	Not a significant source
		CH ₄	No	Not a significant source
		N ₂ O	No	Not a significant source
		Other	-	Not applicable.
Project	Biomass burning	CO ₂	No	Counted as carbon stock change
		CH ₄	Yes	Methane emissions during burning of biomass for land clearance.
		N ₂ O	Yes	Nitrous oxide emissions during burning of biomass for land clearance
		Other	-	Not applicable.
	Livestock emissions	CO ₂	No	Not a significant source
		CH ₄	No	Not a significant source

Source		Gas	Included?	Justification/Explanation
		N ₂ O	No	Not a significant source
		Other	-	Not applicable.

Avoiding conversion of forests to pasture can reduce emissions of N₂O and CH₄ that are associated with biomass burning, which is used to clear the land. These emissions have been included in emission reduction calculations. However, emissions attributed to fertilizer use, and other agricultural practices that would have occurred if the forests had been converted, were conservatively omitted.

Included in quantifications

The following table indicates the recommendations of carbon pools to include, as described in the “VCS Methodology Requirements v4.0”:

Table 20. Carbon Pools to be Considered in Methodologies (Source: VCS Methodology Requirements v4.0)

		Above-ground tree* biomass	Above-ground non-tree* biomass	Below-ground biomass	Litter	Dead wood	Soil	Wood products
REDD	Planned or unplanned deforestation/degradation (APD or AUDD) with annual crop as the land cover in the baseline scenario	Y	O	O	N	O	O	S

Y: Carbon pool shall be included in the project boundary.

S: Carbon pool shall be included where project activities may significantly reduce the pool, and may be included where baseline activities may significantly reduce the pool.

N: Carbon pool does not have to be included, because it is not subject to significant changes or potential changes are transient in nature.

O: Carbon pool is optional and may be excluded from the project boundary.

* For ARR, ALM and ACoGS projects, in place of "Aboveground tree" and "Aboveground non-tree", these two carbon pool categories should be read as "Aboveground woody" and "Aboveground non-woody" respectively.

Carbon pools were selected in a conservative manner. Conservative numbers and approaches were adopted to obtain 0% uncertainty in this component. The following carbon pools were hence included and excluded in quantifications, in compliance with "VCS Methodology Requirements v4.0", as shown in the table below:

Table 21: Carbon pools included or excluded within the boundary of the proposed AUD project activity

Carbon pools	Included/Excluded	Justification / Explanation
Above-ground	Tree: Included	Is mandatory according to the VCS Methodology Requirements v4.0, as shown in the table above.
	Non-tree: Excluded	For conservativeness purposes.

Below-ground	Included	Included as recommended in the VM0015 Methodology.
Dead wood	Excluded	Justification detailed in the text below.
Harvested wood products	Included	Included as recommended in the VM0015 Methodology.
Litter	Excluded	It does not have to be included, according to the VCS Methodology Requirements v4.0 , as shown in the table above.
Soil organic carbon	Excluded	Not to be measured in conversions to pasture grasses, which is the case in this project, according to VCS Program Update of May 24th, 2010.

Deforestation emissions were estimated for all forest strata (conservatively excluding non-tree biomass), of which the above- and belowground carbon pools were previously determined by means of a literature survey of data from the Project Area region. It is considered that a certain portion of logged wood is converted into long-term wood products, which serve as carbon pools after deforestation. This was factored into the calculation of net deforestation emissions.

Justification for not including the dead wood carbon pool

The omission of the dead wood carbon pool was determined as a matter of conservativeness, given that in the baseline scenario this carbon pool is likely to have much lower values than in the project scenario. So, even though dead wood carbon pool is significantly lower in the baseline than in the project scenario, the project proponent opted not to include this carbon pool in accounting of VCU benefits.

3.4 Baseline Scenario

Forest land is expected to be converted to non-forest land in the baseline scenario. The landowners cannot afford efforts and costs to keep long-term vigilance of the project boundaries to avoid unplanned deforestation from uncontrolled invasions. In this context, the project falls within the category AFOLU – REDD - Avoiding unplanned deforestation (AUD).

Selection of the most probable baseline scenario for the project

The project properties are unable to afford large-scale long-term costs and efforts for surveillance of their lands. There have been events of trespassing within the historical reference period and communities unofficially living within the project boundaries.

Furthermore, the sustainable forest management conducted at seven of the properties is under considerable pressure from other economic activities conducted in areas surrounding the properties, related to land grabbing and to extensive cattle-raising, in addition to the difficulties inherent to the development of forestry stewardship, which is currently undergoing a crisis in Brazil.

As the landowners have received offers for land purchase over the historical reference period, and given the difficulties faced with sustainable forest management and land tenure at present, sale of land is an alternative means to alleviate expenses relating to surveillance and legal assistance. In the latter case, it is highly probable that new landowners will prioritize activities involving deforestation and installation of the most common land uses in the region (i.e., pasture for cattle ranching).

The “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, Sectoral Scope 14 was applied in order to select the most probable baseline scenario for the project. The approach is presented in section 3.5 “Additionality”.

Cattle Farming (Scenario 7), is the most probable baseline scenario for the present project, as fully described in section 3.5 below.

Description of baseline scenario adopted

According to the descriptions above, it is expected that unplanned deforestation is most likely to occur in the Project Area in case of absence of the REDD Project. The rate of deforestation adopted for calculation of REDD Project benefits was obtained from the Mapbiomas database.

In the absence of the REDD project, it is assumed that the property would certainly undergo the same deforestation intensity as other neighbouring lands.

Above- and belowground carbon pools were determined by means of a literature survey regarding the Project region. Considering that the baseline process of deforestation involves timber harvesting for commercial markets, the content of carbon fixed into long-term wood products was also considered in calculation of net deforestation emissions. It is assumed that the Project Activity preserves soil organic carbon and litter pools to a greater extent than BAU activities. However, for conservativeness purposes, the project proponents decided not to include the soil and litter carbon pools in the REDD Project benefits.

Fossil fuel emissions were not accounted for in the Reference Area (baseline case) or for the Project Activity. It is assumed that the Project Activity also reduces emissions from fossil fuel

burning, in comparison with BAU activities. However, this factor was also not accounted for conservativeness purposes and difficulties in monitoring during the project period.

3.5 Additionality

The Project's additionality is demonstrated below, according to "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, Sectoral Scope 14. The tool is applicable to this project, according to statements below:

- a) The project activity does not lead to violation of any applicable law, even if the law is not enforced;
- b) There is a baseline methodology to provide for a stepwise approach justifying the determination of the most plausible baseline scenario.

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

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

a) The identified credible non-excluding alternative land use scenarios to the proposed VCS AFOLU project activity include:

i) SCENARIO 1: Continuation of the pre-project land uses:

For the purposes of additionality analysis, the two categories of activity falling within the REDD+ project boundaries were grouped together into one scenario. The components of Scenario 1 can be described under the following categories:

Sustainable Forest Management Plans (SFMPs): Five of the project properties have SFMPs, with active operational licenses, while two have a pending license. They generate income but are less attractive than livestock.

No economic activity: Seven project properties have no economic activity, generating no income, with a -100% loss rate, and display negative profit ratios and IRRs.

SFMP plus cattle farming: Cattle farming is not considered to be a project activity of the present REDD+ project as the latter includes only forested areas, according to VCS rules, and the cattle farming activities are necessarily outside of it.

The majority (10 out of 15) of the businesses currently administrated in the Project Area properties are not financially attractive without carbon funding, as demonstrated in analyses made available to the auditors⁶³.

Scenario 1, continuation of pre-project land-uses was included in accordance with VT0001 tool requirements.

ii) SCENARIO 2: Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project:

The same categories of activity as mentioned under Scenario 1 were taken into account, however, the costs for REDD+ monitoring, and implementation were added to create scenario 2. Therefore, the elements of Scenario 2 were defined as follows:

Sustainable Forest Management Plans (SFMPs): for the five project properties with active SFMPs, the average estimated profit is R\$501/ha of managed area.

No activity: Seven of the project properties have no economic activity, generating no income, with a 100% loss rate, as mentioned above.

REDD implementation, and monitoring costs: Costs for 22 forest monitors, six bases, various vehicles, and personnel training were added in to the 30-year cashflow.

Scenario 2, Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project was included in accordance with VT0001 tool requirements.

iii) SCENARIO 3: Planned deforestation and logging of the area permitted by Law:

This option is shown by project calculations to generate supplementary income to financially support long-term monitoring of the system; furthermore, this would correspond to active deforestation of the property by landowner in the future. Thus, this is a credible scenario.

iv) SCENARIO 4: Wood harvesting to illegal levels followed by cattle farming (Business as usual – BAU):

Studies of the local area argue that rural properties most often conduct harvesting of wood to illegal levels followed by implementation of cattle farming (Vitel, 2009; SCHNEIDER et al., 2000). Thus, this is considered the regional business-as-usual (BAU) scenario and is a credible scenario.

v) SCENARIO 5: Unplanned deforestation caused by uncontrolled illegal trespassing:

This scenario is the result of the inability to control borders given the current negative cashflow scenarios that are prevalent in the property areas, indicating the need for additional sources of income for the successful sustainable operation of the farms. This is considered a credible scenario.

vi) SCENARIO 6: Farm sale to private investors followed by the regional BAU

⁶³ Calculations available in spreadsheet: "FINANCEIRO SENSITIVITY_Unitor_SFMP_v.14"

The Project Area landowners have received multiple verbal offers to sell their farms, as is the custom in the region, however registered evidence of the interest of land purchase (e.g., purchase proposals) are not currently available. The scenario is both profitable in itself and saves the landowners from further expenses on the Project Area.

The profitability of the BAU scenario – Wood harvesting to illegal levels followed by cattle farming – is the most attractive of all scenarios analysed, as argued above, and sale of the farm property will increase that profitability. Therefore Scenario 6 is considered a credible scenario.

vii) SCENARIO 7: Cattle Farming

The characteristics, types and dynamics of cattle farming in the region were ascertained from the proponents' knowledge, and literature studies (Carrero et al. 2015; IIS 2015; Vitel, 2009). The key characteristics are as follows:

- Traditional, extensive cattle farming operations (IIS 2015⁶⁴);
- Lacking access to technical assistance (IIS 2015);
- Lacking access to rural credit (IIS 2015);
- Medium to large producers (1000 ha – ≥4000 ha) are predominant in the immediate project region;
- the primary product is beef (IIS 2015; Carrero et al. 2015; IBGE 2017).

Although the financial returns for such traditional, extensive operations are negative in many cases, they are often associated with much more lucrative activities such as illegal timber harvestin and land-speculation (Carrero et al. 2015; Schneider et al. 2000; Vitel, 2009), so cattle farming continues to be the overwhelmingly predominant economic activity in the region.

This is attested to by the fact that pastureland is the most prolific post-deforestation land use in the reference region, accounting for over 99% of the post-deforestation land-use in Labrea Municipality (see section 4.1.5.2).

Scenario 7, cattle farming, is the core baseline activity linked to deforestation in the project region, and thus it is considered the most plausible scenario.

b) All identified land use scenarios above may be deemed realistic and credible, as they currently exist and are technically feasible in the project region. For all land use scenarios, credibility is justified by current BAU practices attested by the literature and local observations.

c) Outcome of Sub-step 1a: Credible land-use scenarios that could have occurred on the land within the project boundary were identified as Scenarios 1, 2, 3, 4, 5, 6 and 7, described above.

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

a) The following procedure was applied:

⁶⁴ IIS (2015): ANÁLISE ECONÔMICA DE UMA PECUÁRIA MAIS SUSTENTÁVEL

i) Demonstration that all land use scenarios identified in the sub-step 1a are in compliance with all mandatory applicable legal and regulatory requirements:

SCENARIO 1: Continuation of the pre-project land uses: Sustainable Forest Management Plans are in accordance with the law given that they are issued operating licenses by the Amazonas Institute of Environmental Protection (IPAAM), as are cattle farms, provided that they follow all relevant legal requirements of the Forest Code (described in Scenario 3, below).

Documentation of legal possession of all properties is the only additional relevant aspect of law, regarding both the SFMP and No Economic Activity components of the scenario. Thus, this scenario is in compliance with legal and regulatory requirements.

SCENARIO 2: Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project: In the same way as Scenario 1, the properties with SFMP and No Economic Activities are in accordance with the law.

Regarding the implementation of the project activity, all activities are fully compliant with the law. Thus, this scenario is in compliance with legal and regulatory requirements as specified in section 1.14 of the VCS-PD.

SCENARIO 3: Planned deforestation and logging of the area permitted by Law: In compliance with Brazilian Forest Code, the farm should officially allocate 80% of its total area as LR (Legal Reserve) for conservation. The remaining 20% of land may be deforested subject to a license. The project properties have officially allocated 80% of their total area as LR. Thus, this scenario is in compliance with legal and regulatory requirements.

SCENARIO 6: Farm sale to private investors followed by the regional BAU: The farm sale component of this scenario is in compliance with Brazilian property laws, as the landowner can sell and transfer land rights to any other person or private company.

The regional BAU is described as illegal but unenforced, below. Thus, this scenario is in compliance with legal and regulatory requirements.

SCENARIO 7: Cattle farming: Cattle farms can be implemented within the limits of the Forest Code, providing the legal limit of 20% deforestation is respected and the relevant license is obtained. Thus, this scenario is in compliance with legal and regulatory requirements.

ii) Demonstration that applicable mandatory legal requirements are systematically not enforced and that non-compliance with requirements is widespread:

SCENARIO 4: Wood harvesting to illegal levels followed by cattle farming (Business as usual – BAU): Although this scenario is in violation of the Law, it can be considered as the regional business-as usual scenario. It is illegal because landowners surpass the deforestation limit stipulated in the Forest Code as 20%. It has historically been common, and is increasingly so under the common administration, for properties to ignore government fines and embargos on outgoing timber, and to carry out massive deforestation following the embargo, with properties

carrying out such practices being described as “innumerable”⁶⁵. Following illegal deforestation, cattle farming is commonly installed on the deforested areas (Vitel, 2009).

Thus, it is demonstrated that SCENARIO 4 is widespread and, indeed, is the business-as-usual scenario, in the region of the project.

SCENARIO 5: Unplanned deforestation caused by illegal trespassing: This scenario does not comply with all mandatory legislation and regulations. In the project region, it has been historically proven that governmental resources for fighting land invasions by squatters are not effective. Nearby forest areas have been invaded by squatters and registered by the Brazilian media (newspapers, radio and internet) and the evidence is available to the auditors. As such, land-grabbing is a widespread practice.

Thus, it is demonstrated that SCENARIO 5 is possible in the context of this project activity.

b) Outcome of Sub-step 1b: It has been demonstrated that SCENARIOS 1, 2, 3, 4, 5, 6, and 7 are plausible alternative land use scenarios to this VCS AFOLU project activity.

Sub-step 1c. Selection of the baseline scenario

Outcome of Sub-step 1c:

SCENARIO 7 cattle farming is considered to be the baseline scenario as it is:

- the core baseline activity which underlies other activities such as planned deforestation, illegal or illegal timber harvesting, or farm sale;
- the most prevalent post-deforestation baseline use in the Reference Region (See PD Section 1.13 and 4.1.5.2);
- It is conservative to consider just cattle farming as the baseline activity as the scenarios that involve cattle farming plus another activity (Scenarios 1, 4 and 6).

STEP 2. Investment analysis

In accordance with the VT0001 tool, the aim of this step is to “determine whether the proposed project activity, without the revenue from the sale of GHG credits is economically or financially less attractive than at least one of the other land use scenarios”.

Sub-Step 2a. Determine appropriate analysis method:

Given that the project operations do generate economic benefits other than VCU-related income, Investment comparison analysis (Option II) was applied.

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

⁶⁵ Source (accessed 10.02.21): <https://apublica.org/2020/08/governo-bolsonaro-reduz-multas-em-municipios-onde-desmatamento-cresce/>

It is considered that the Investment Rate of Return (IRR) is the most suitable financial indicator for the project type and decision-making context. The Internal Rate of Return (IRR) is the discount rate that makes the net present value (NPV) of a project zero. In other words, it is the expected compound annual rate- of return that will be earned on a project or investment⁶⁶.

$$IRR = NPV = \sum_{t=1}^T \frac{C_t}{(1+r)^t} - C_0 = 0$$

Where: C_t = Net cash inflow during the period t ; C_0 = Total initial investment costs; r = the discount rate; t = the number of time periods.

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

For this analysis, the following scenarios were most important to be compared:

- SCENARIO 1: Continuation of the pre-project land uses;
- SCENARIO 2: Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project;
- SCENARIO 7: Cattle ranching.

Furthermore, the comparisons of the project with the other Scenarios 3 (Planned deforestation and logging of the area permitted by Law), Scenario 4 (Wood harvesting to illegal levels followed by cattle farming); and Scenario 6 (farm sale followed by BAU) are also included below, however they are superfluous as they tend to be more financially attractive than cattle ranching. IRR calculations are presented below.

The following methodological premises were followed:

- As required by “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, Sectoral Scope 14, the IRR of the proposed VCS AFOLU project, with forest management and without VCU revenues (Scenario 2) has been calculated at -3.21%.
- The costs and revenues relating to SFMPs used for the IRR calculation are presented in the table below, showing the value reported by the project proprietors at the time of audit.

SCENARIO 1: Continuation of the pre-project land uses:

As previously described, this scenario consists of two components: SFMPs and No Economic Activity, described below.

⁶⁶ Source (accessed 10/02/21): <https://corporatefinanceinstitute.com/resources/knowledge/finance/internal-rate-return-irr/>

Sustainable Forest Management Plans (SFMPs): Regarding the five project properties with operational SFMPs, in summary the average profit across properties with SFMPs is of 501 R\$/ha of managed area.

The costs and sale prices were originally informed by the property owners at the time of writing of the present PD (late 2020 – early 2021). In order to justify these estimates, they were cross-checked with recent quotes from regional suppliers. Lower reported expenses than the reference value are considered to be acceptable as they are conservative. This is because higher SFMP costs would make the project scenario even less attractive than the baseline scenario, and this was not exaggerated in project analyses. All evidence was presented at audit.

Table 22. SFMP financial input values for the IRR calculation and their proofs

Item	Sub-Item	Average Cost reported by proponents (R\$/ha)	Average Cost of Quotations (R\$/ha)	Difference (%)
APAT development		R\$ 49.22	R\$ 43.00	-13%
Forestry Inventory	Field service	R\$ 156.61	R\$ 187.50	20%
Office service	Preparation of the Project	R\$ 101.03	R\$ 86.00	-15%
	Logistical Map			
	ART			
	Follow-up			
	Execution			
Forest management	Opening of roads	R\$ 166.04	R\$ 243.50	47%
	Felling	R\$ 224.80	R\$ 550.00	145%
	Transport	R\$ 337.47	R\$ 247.50	-27%
	Labor	R\$ 166.11	R\$ 440.00	165%
	Technical monitoring	R\$ 56.21	R\$ 32.50	-42%
TOTAL COST (R\$)		R\$ 1,257.50	R\$ 1,830.00	46%

Regarding Deviations of Forest Management costs from quotations*:

- **Felling:** The average value reported by third-party companies to carry out the forest harvest is much higher than the value reported by the proponents, this is mainly due to the fact that third-party companies use their own machinery to carry out the harvest, so that the rent value of the machines are included in the final cost.
- **Labour:** The large variation in the cost of employees is due to the fact that the proponent uses a different team dimension than third-party companies.

Two employees per project area were included in the SFMP quotes. The relevant cashflow analysis for the calculations above was presented at audit⁶⁷.

Regarding the sale price of timber:

The State of Amazonas establishes, through resolutions published quarterly, the minimum sale price for wood of native species, that is, it is not allowed to issue a sales invoice with a price lower than that established by the resolution⁶⁸.

To obtain an average sale price of logs, it was considered the prices established by resolution in the years 2019, 2020 and 2021, thus, an average price of R\$81.97 was obtained, corresponding to the average sale price of logs determined by a resolution published by SEFAZ⁶⁸.

The prices vary by species, from the cheaper and more common, such as “breu-sucuruba” (*Trattinickia burserifolia*) with local price of R\$54⁶⁸, to the rarer and more expensive such as “ipê” (*Tabebuia* sp.), with a local price of R\$127⁶⁸.

No Economic Activity: under Scenario 1, the seven properties of this category had no costs and no income, because prior to the REDD project implementation, these properties had no forest monitors.

Regarding the area maintenance expenses line in the cashflow below, it takes into account only the initial investment costs of bases purchased prior to the Project Start Date, which the project would have had without being developed as a VCS AFOLU project.

The tables below present the cashflow and the financial indicators relevant to Scenario 1.

Table 23. Scenario 1 cashflow and IRR

	SCENARIO 1 CASHFLOW										
	Year										
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	
Actual costs	0	4,960,138	8,097,691	5,362,119	7,010,286	7,028,322	6,698,456	6,703,469	6,703,469	6,689,704	X
Actual revenue	0	4,859,845	8,689,226	5,680,612	5,456,102	5,470,981	2,669,419	2,679,206	2,916,822	2,902,899	X
Total Forest Management Expenses (R\$)	0	4,960,138	8,097,691	5,362,119	7,010,286	7,028,322	6,698,456	6,703,469	6,703,469	6,689,704	X
Area Maintenance Expenses (R\$)	0	-15,802	0	0	0	0	0	0	0	0	X
Annual profit (R\$)	0	-116,095	591,535	318,493	1,554,184	1,557,341	4,029,037	4,024,262	3,786,647	3,786,805	X
	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Actual costs	6,689,704	4,455,853	0	0	0	0	0	0	0	0	X

⁶⁷ Spreadsheet: FINANCEIRO_SENSITIVITY_Unitor_SFMP_v.14_Scenario 1

⁶⁸SEFAZ (2021)

https://online.sefaz.am.gov.br/silt/Normas/Legisla%C3%A7%C3%A3o%20Estadual/Resolu%C3%A7%C3%A3o%20GSEFAZ/Ano%202021/RG%20006_21.htm

Actual revenue	2,456,260	594,284	0	0	0	0	0	0	0	0	X
Total Forest Management Expenses (R\$)	6,689,704	4,455,853	0	0	0	0	0	0	0	0	X
Area Maintenance Expenses (R\$)	0	0	0	0	0	0	0	0	0	0	X
Annual profit (R\$)	4,233,445	3,861,569	0	0	0	0	0	0	0	0	X
	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048
Actual costs	0	0	0	0	0	0	0	4,960,138	8,097,691	5,362,119	6,925,508
Actual revenue	0	0	0	0	0	0	0	4,859,845	8,689,226	5,680,612	4,463,122
Total Forest Management Expenses (R\$)	0	0	0	0	0	0	0	4,960,138	8,097,691	5,362,119	6,925,508
Area Maintenance Expenses (R\$)	0	0	0	0	0	0	0	0	0	0	0
Annual profit (R\$)	0	0	0	0	0	0	0	100,293	591,535	318,493	2,462,387

SCENARIO 1 – CONTINUATION OF PRE-PROJECT LAND-USES	
Total costs (30 years) (R\$)	95,760,469
Total revenue (30 years) (R\$)	68,068,463
Total profit (30 years) (R\$)	-27,692,006
Net Present Value - NPV (R\$)	-17,041,221
IRR (%)	-2.19%

SCENARIO 2: Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project:

As previously stated, Scenario 2 consists of the same two categories of activity mentioned under Scenario 1, but with the costs for REDD+ monitoring, and implementation added. Therefore, the elements of Scenario 2 are as follows:

Sustainable Forest Management Plans (SFMPs): the relevant costs and revenues, as described under Scenario 1, were obtained from recent actual and projected SFMP data from the Project Area. In summary, the five project properties with active SFMPs display an average estimated profit of R\$501/ha of managed area.

The revenue from timber sales from the SFMP, correspond to the average sale price of logs determined by a resolution published by SEFAZ⁶⁸, with a value of R\$81.97 (see Scenario 1 above). This is presented in the “actual revenue” line of the cashflow below.

No Economic Activity: differently to Scenario 1, the seven project properties with no economic activity were assigned two guards per property, generating costs of R\$48,000 per property per year, and they have no financial returns associated with them.

REDD implementation, and monitoring costs: These costs correspond to 22 forest monitors (the 14 mentioned for the 7 fazendas above, plus 2 for fazenda São José), six bases, various vehicles, and personnel training activities, and their respective maintenance and continuity costs across the 30-year cashflow. The table below summarizes their initial investment and continued annual

costs for all subsequent years, and they are presented in the “Project proponent and implementation expenses (R\$)” line of the cashflow.

Table 24. Key cost data for the Project activity on the land without VCS AFOLU Scenario

	Initial Investments	Continued Annual Costs
Monitors	R\$ 402,700.00	R\$ 512,700.00
Bases	R\$ 63,207.60	N/A
Trainings	R\$ 8,000.00	R\$ 8,000.00
Vehicles	R\$ 1,984,903.81	R\$ 44,125.00
Others	R\$ 262,046.78	R\$ 65,511.70
Total	R\$ 2,720,858.19	R\$ 630,336.70

In this way, the costs and revenues of Scenario 2 were obtained, to create the cashflow below.

Table 25. Scenario 2 cashflow and IRR

	SCENARIO 2 CASHFLOW										
	Year										
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	
Actual costs	0	4,960,138	8,097,691	5,362,119	7,010,286	7,028,322	6,698,456	6,703,469	6,703,469	6,689,704	X
Actual revenue	0	4,859,845	8,689,226	5,680,612	5,456,102	5,470,981	2,669,419	2,679,206	2,916,822	2,902,899	X
Total forest management expenses (R\$)	0	4,960,138	8,097,691	5,362,119	7,010,286	7,028,322	6,698,456	6,703,469	-6,703,469	-6,689,704	X
Project proponent and implementation expenses (R\$)	-29,233	-214,214	-517,428	1,903,804	-630,337	-630,337	-630,337	-630,337	-630,337	-630,337	X
Annual profit (R\$)	-29,233	-314,506	74,107	1,585,312	2,184,521	2,187,678	4,659,374	4,654,599	-4,416,983	-4,417,142	X
	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Actual costs	6,689,704	4,455,853	0	0	0	0	0	0	0	0	X
Actual revenue	2,456,260	594,284	0	0	0	0	0	0	0	0	X
Total forest management expenses (R\$)	6,689,704	4,455,853	0	0	0	0	0	0	0	0	X
Project proponent and implementation expenses (R\$)	-630,337	-630,337	-630,337	-630,337	-630,337	-630,337	-630,337	-630,337	-630,337	-630,337	X
Annual profit (R\$)	4,863,781	4,491,905	-630,337	-630,337	-630,337	-630,337	-630,337	-630,337	-630,337	-630,337	X
	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048
Actual costs	0	0	0	0	0	0	0	4,960,138	8,097,691	5,362,119	6,925,508
Actual revenue	0	0	0	0	0	0	0	4,859,845	8,689,226	5,680,612	4,463,122
Total forest management expenses (R\$)	0	0	0	0	0	0	0	4,960,138	-8,097,691	-5,362,119	6,925,508

Project proponent and implementation expenses (R\$)	-630,337	-630,337	-630,337	-630,337	-630,337	-630,337	-630,337	-630,337	-630,337	-630,337	-542,262
Annual profit (R\$)	-630,337	-630,337	-630,337	-630,337	-630,337	-630,337	-630,337	-730,629	-38,801	-311,844	3,004,649

SCENARIO 2 – Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project	
Total costs (30 years) (R\$)	115,340,363
Total revenue (30 years) (R\$)	68,068,463
Total profit (30 years) (R\$)	-47,271,900
Net Present Value - NPV (R\$)	-26,836,437
IRR (%)	-3.21%

Scenario 2's financials over 30 years are presented above, and result in an NPV of -26,836,437 and IRR of -3.21% (spreadsheet is available to auditors)⁶⁹.

Scenario 3 (Planned deforestation and logging of the area permitted by Law) and Scenario 6 (Farm sale to private investors followed by the regional BAU): Land speculation takes place to meet the demand for land by current production systems, mostly extensive, such as livestock. The land market in the Amazon, according to Costa (2012), deals with three types of products: 'Lands with Forest', 'Land for Pasture' and 'Land for Crops', with Forest Lands being deforested and converted to the other two mentioned types. After conversion of land to pasture or for crops, the selling price of land increases 0.8 to 4.5 times above that of land with forest, respectively⁷⁰. Thus, Scenario 3 and Scenario 6 are more financially attractive than the project areas with SFMPs in a scenario without VCU revenue.

Scenario 4 Wood harvesting to illegal levels followed by cattle farming (Business as usual – BAU):

Illegal harvesting of wood is shown by studies to extract up to 69 m³/ha⁷¹ where the legal SFMPs analysed extract up to 25 m³/ha. Thus, this would lead to estimated profits level of 501 R\$/ha and 4,157 R\$/ha, for legal and illegal harvesting levels, respectively.

Following illegal deforestation, cattle farming is conducted with an IRR calculated at -0.03%, corroborated by literature sources (SCHNEIDER et al., 2000; Carrero et al. 2015, IIS 2015).

Therefore, both components of Scenario 4 are more financially attractive than Scenario 1 in the absence of VCU revenue.

Scenario 7. Cattle Ranching: Regarding the baseline land-use (pasture), the data on cattle farming provided by the project proprietors was cross-checked, and Carrero et al (2015)⁷² was

⁶⁹ Spreadsheet: FINANCEIRO_SENSITIVITY_Unitor_SFMP_v.14

⁷⁰ INPE (2019): <http://mtc-m21c.sid.inpe.br/col/sid.inpe.br/mtc-m21c/2019/08.16.19.10/doc/publicacao.pdf>

⁷¹ Source Imazon (accessed 25/03/21): <https://imazon.org.br/degradacao-de-florestas-pela-exploracao-madeireira-e-fogo-na-amazonia-oriental-brasileira-no-20/>

⁷² Carrero et al (2015): A Cadeia Produtiva de Carne Bovina no Amazonas

deemed to be the best source of data, for the extensive, traditional, type of beef cattle operation concerned (described above in Step 1).

Thus, costs per head were set at R\$1015.44 and revenues per head at R\$ 1253.05 (Carrero et al. 2015⁷³). By inputting these financials into the scenario supplied by the project owners, key figures for the BAU cattle ranching scenario were established as follows:

Table 26. Key data for the Cattle Ranching Scenario

	Fazenda Três Barras	Fazenda São José	Fazenda Bahia	TOTAL
Pasture area (ha)	3,993.21	462.84	4,288.59	8,744.64
Cattle heads	2,995	347	3,216	6,558
Estimated cost	R\$ 3,041,163.25	R\$ 352,491.35	R\$ 3,266,119.81	R\$ 6,659,774.41
Estimated revenue	R\$ 3,752,782.02	R\$ 434,972.77	R\$ 4,030,377.43	R\$ 8,218,132.22
Estimated profit	R\$ 711,618.77	R\$ 82,481.42	R\$ 764,257.62	R\$ 1,558,357.81
Estimated profit per hectare	R\$ 178.21	R\$ 178.21	R\$ 178.21	
Profit %	18.96%	18.96%	18.96%	

The average pasture area of 2,914.88 ha in the context of the project properties was utilized. The resulting cashflow and financial indicators for the cattle ranching scenario are presented below.

Table 27: Scenario 7 cashflow and IRR

	SCENARIO 7 CASHFLOW										
	Year										
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	
Actual costs	8,253,458	8,253,458	8,253,458	8,253,458	8,253,458	8,253,458	8,253,458	8,253,458	8,253,458	8,253,458	x
Actual revenue	8,218,132	8,218,132	8,218,132	8,218,132	8,218,132	8,218,132	8,218,132	8,218,132	8,218,132	8,218,132	x
Total Cattle Farming Expenses (R\$)	-8,253,458	-8,253,458	-8,253,458	-8,253,458	-8,253,458	-8,253,458	-8,253,458	-8,253,458	-8,253,458	-8,253,458	x
Annual profit (R\$)	-35,326.2	-35,326.2	-35,326.2	-35,326.2	-35,326.2	-35,326.2	-35,326.2	-35,326.2	-35,326.2	-35,326.2	x
	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Actual costs	8,253,458	8,253,458	8,253,458	8,253,458	8,253,458	8,253,458	8,253,458	8,253,458	8,253,458	8,253,458	x
Actual revenue	8,218,132	8,218,132	8,218,132	8,218,132	8,218,132	8,218,132	8,218,132	8,218,132	8,218,132	8,218,132	x
Total Cattle Farming Expenses (R\$)	-8,253,458	-8,253,458	-8,253,458	-8,253,458	-8,253,458	-8,253,458	-8,253,458	-8,253,458	-8,253,458	-8,253,458	x

⁷³ Carrero et al (2015): A Cadeia Produtiva de Carne Bovina no Amazonas

Annual profit (R\$)	-35,326.2	-35,326.2	-35,326.2	-35,326.2	-35,326.2	-35,326.2	-35,326.2	-35,326.2	-35,326.2	-35,326.2	X
	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048
Actual costs	8,253,458	8,253,458	8,253,458	8,253,458	8,253,458	8,253,458	8,253,458	8,253,458	8,253,458	8,253,458	8,253,458
Actual revenue	8,218,132	8,218,132	8,218,132	8,218,132	8,218,132	8,218,132	8,218,132	8,218,132	8,218,132	8,218,132	8,218,132
Total Cattle Farming Expenses (R\$)	-8,253,458	-8,253,458	-8,253,458	-8,253,458	-8,253,458	-8,253,458	-8,253,458	-8,253,458	-8,253,458	-8,253,458	-8,253,458
Annual profit (R\$)	-35,326.2	-35,326.2	-35,326.2	-35,326.2	-35,326.2	-35,326.2	-35,326.2	-35,326.2	-35,326.2	-35,326.2	-35,326.2

SCENARIO 7 – Cattle ranching	
Total costs (30 years) (R\$)	255,857,211.29
Total revenue (30 years) (R\$)	254,762,098.86
Total profit (30 years) (R\$)	- 1,095,112
Net Present Value - NPV (R\$)	- 550,835
IRR (%)	-0.03%

As presented above, the resulting financial indicators over 30 years were IRR of -0.03% and NPV of - R\$550,835 (or – 189R\$/ha). The relevant evidence was presented at audit⁷⁴.

The NPV/ ha value above is within the expected range reported in literature (IIS 2015) for operations of this type, ranging from -232 R\$/ha to 569 R\$/ha, for 1000 – 4000 ha properties, respectively.

Thus, the scenario presented above at the lower end of the profitability range presented in the aforementioned study (IIS 2015), and they could become more favourable if some characteristics were to change, such as application of technical assistance or rural credit. However, despite these slightly negative figures, cattle continues to be the vastly predominant economic activity, explained by the cultural predisposition to carry out cattle ranching (Vitel 2009), as previously described in section 1.11.

In conclusion, Scenario 7 Cattle Ranching (IRR -0.03%), is found to be more financially attractive than both Scenario 1, Continuation of Pre-Project Land-Uses (IRR -2.19), and Scenario 2, Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project (IRR -3.21).

In conformity with the VT0001 tool, it is concluded that the VCS AFOLU project without the financial benefits from the VCS (Scenario 2) is not the most financially attractive, because Scenario 7 (cattle farming), as well as linked Scenarios 3, 4 and 6 all have more favourable financial indicators. Accordingly, Step 2d (Sensitivity Analysis) is subsequently applied.

Sub-step 2d. Sensitivity analysis

⁷⁴ Spreadsheet: FINANCEIRO SENSITIVITY_Unitor - BAU_V8

This sensitivity analysis was performed on Scenario 2 (Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project), to show whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions. The investment analysis provides a valid argument in favor of additionality only if it consistently supports (for a realistic range of assumptions) the conclusion that the proposed project is unlikely to be financially attractive. Thus, this sub-step seeks to prove that the Project Activity without VCU revenues would not be more financially attractive than the baseline, even if the market becomes more favorable in different scenarios (sensitivity analysis).

For the sensitivity analysis, the IRR and NPV were estimated for the Project Activity under a composite optimistic scenario, comprising an optimistic wood price (138% the current price at R\$113.00/m³), and a 22% reduction in forest management expenses, would result in a financial return close to cattle farming (see table below “Optimistic Scenario”).

In terms of sensitivity to price fluctuations only, in order to reach the -0.03% IRR benchmark of cattle ranching, a 69% increase in wood price (R\$ 138.40 /m³) (see table below: “Price Sensitivity”), or a 49% cost reduction (table below “Cost Reduction”), are required as demonstrated below (spreadsheet made available at audit).

Table 28: Sensitivity analysis for forest management, including scenarios to reach an IRR equal to that observed in the baseline (cattle ranching)

	PROJECT WITH FOREST MANAGEMENT WITHOUT VCUs		
	Annual profit or loss (R\$)	IRR (%)	NPV (R\$)
CURRENT SCENARIO	-47,271,900	-3.2%	-26,836,437
OPTIMISTIC SCENARIO	-440,854	-0.03%	691,941
WOOD PRICE INCREASE	-412,412	-0.03%	516,818
COST REDUCTION	68,329,732	-0.03%	1,032,940.94

Given the variation needed to obtain the target IRR, and current prices in the market as informed by literature and the project proponents, both scenarios are improbable (sensitivity analysis worksheet is available to auditors and stakeholders).

In conformity with VT0001 tool, it is concluded that “the Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project” (Scenario 2) is unlikely to be financially most attractive.

Accordingly, Step 4 (Common practice analysis) follows below.

STEP 4: Common Practice Analysis

According to the VT0001 “Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities”, the previous steps are to be complemented with an analysis of the extent to which similar activities have already spread in the geographical area of the proposed VCS AFOLU project activity. This test is a credibility check to demonstrate additionality that complements the investment analysis (Step 2). Other registered VCS AFOLU project activities shall not be included in this analysis.

This analysis involved a survey of similar activities in the region of the proposed Project Activity, according to the following characteristics in a same project: large scale operations; operations with a valid and licensed Sustainable Management Plan (i.e. legal wood producers); operations providing logs to local sawmills (i.e. local generation of jobs and revenues); operations with investments in forest conservation and community enhancement.

In a survey performed by IEB (2014)⁷⁵, the supply of legal logs was the main restraint in Lábrea’s supply chain, as mentioned by 56% of stakeholders interviewed. In 2014, four Small Scale Sustainable Forest Management Plans (SFMPs) were licensed for processing organizations. However, the volume of logs supplied by these SFMPs was insufficient to fulfil demand in the municipality, representing only 8% of total volume consumed yearly.

Illegal operations producing significant volumes (2,000 m³) have been identified by police in southern Lábrea State⁷⁶. Forestry stewardship in Brazil has been undergoing a crisis across the 2010 to 2020 decade. A crash in legal wood supply could be approaching, linked to weakening governmental regulations and consequent increasing illegality in wood production. Studies indicate that the rate of illegality in the Brazilian timber sector ranges between 40% and 80% of total production⁷⁷. Furthermore, forest management itself poses several difficulties, which impact the economic viability of the operation. To take all the measures and steps required to achieve a sound business operation, the Project Proponents have encountered challenges that constitute risks. These risks can be considered barriers to the continuation of the forest management project itself, and resources from the sales of carbon credits would be a very important component of the operation today and years to come.

The review presented above indicates that large-scale operations with valid licensed SFMPs are not the common practice in the region of the present Project, mainly on the basis of supply of logs to local sawmills (i.e., local generation of jobs and revenues). The absence of such projects in the region is further reinforced when considering operations with investments in forest conservation and community enhancement, which is the case of this Project Activity.

⁷⁵ Diagnóstico da cadeia produtiva da madeira no município de Lábrea-AM - Brasília: IEB, 2014. 70p. Disponível em: [22.08 madeira.indd\(idesam.org.br\)](http://22.08.madeira.indd(idesam.org.br))

⁷⁶ Source (accessed 20/02/21): <http://g1.globo.com/am/amazonas/noticia/2012/08/ibama-deflagra-operacao-contra-extracao-ilegal-de-madeira-no-am.html>

⁷⁷ Source (accessed 23/07/21): <http://bibliotecadigital.fgv.br/ojs/index.php/cgpc/article/view/3568>

Furthermore, the only other REDD project nearby is the the Fortaleza Ituxi REDD Project, which is under the administration of the same project proponents as this project. Therefore, REDD projects are not a common practice in the area.

Given that no activities similar to the proposed VCS AFOLU project activity were identified, Step 4 is satisfied (i.e., similar activities are not likely to be carried out in the project region).

Thus, the proposed VCS AFOLU project activity is not the baseline scenario and, hence, it is additional

Additional community and biodiversity benefits

Peace and social development will only be possible by means of creation of formal employment and the legal benefits related to them. This is among the purposes of the Project Proponents' Sustainable Forest Management Plans. Creating consistency of the wood supply throughout its supply chain, from inventory/harvesting through to the final processing at the sawmill.

Whole families will be provided with opportunities to be employed within the timber supply chain, in non-timber forest products, and in professional education courses, which aim to meeting the Market requirements.

So, the project has the potential to provide its participants with new sources of income, as well as stimulating the generation of jobs linked to the forest management, generating a new demand for products originated within the boundaries of the project, and expanding the conditions for improved education and health services to the neighbouring community, with greater access to other development centres thanks to a more adequate transportation structure.

Furthermore, support for IDAM (the Amazonas State Institute for Development in Cattle, Agriculture and Sustainable Forest Activities) was raised during the public consultation and is in the process of development for possible implementation. Its aim would be to provide technical assistance to small family farmers for sustainable production of their crops and wild-harvesting products, while planting trees, and supporting monitoring of illegal deforestation.

The Unitor REDD+ Project is committed to conduct social-environmental activities linked to the preservation of the forest stewardship and maintaining the integrity of the project proponent's farm.

Among the proposed activities, the project proponent forecasts the organization of training courses focusing on sustainable cattle ranching, aiming to train workers produce meat sustainably.

The model proposed by this project intends to continue to replicate, as this is already the second example by the present proponent in the region – following the Fortaleza Ituxi REDD Project. The central idea is to multiply preserved areas in the surrounding region adopting sustainable practices, converting the region into a model for sustainable development and with the benefits of the income arising from the reduction in emissions.

The additional community and biodiversity benefits – which would not have occurred in the absence of the project activity – are summarized as follows:

Communities:

- Organization of trainings focusing on sustainable cattle ranching and sustainable forest management
- Provision of support for the local technical assistance Institute, promoting sustainable production and monitoring of illegal deforestation.

Biodiversity:

- A biomass and fauna inventory have been conducted in the neighbouring Fortaleza Ituxi REDD Project, providing valuable primary data for the present project. Further inventories will be carried out to assess the maintenance of local biodiversity and biomass.
- A survey of High Conservation Value species has been conducted in the neighbouring Fortaleza Ituxi REDD Project, which serves as primary data for the species in the project area.

3.6 Methodology Deviations

No methodology deviations were identified during the development of the present VCS PD.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

4.1.1 STEP 2: ANALYSIS OF HISTORICAL LAND-USE AND LAND-COVER CHANGE

4.1.1.1. Definition of classes of land-use and land-cover

The analysis of land use is based mainly on Mapbiomas⁷⁸, which utilizes Landsat images that are classified into multiple classes: forest, cropland, pastureland, waterways, and so on. However, for our classification the relevant classes were "Non-Forest Land" and "Forest Land".

The map below shows the dynamics of land-use and land occupation, with all the historical changes over the years 2009-2018 represented.

⁷⁸ Source MapBiomas (accessed 03/03/2021): <https://mapbiomas.org/atbd---entenda-cada-etapa>

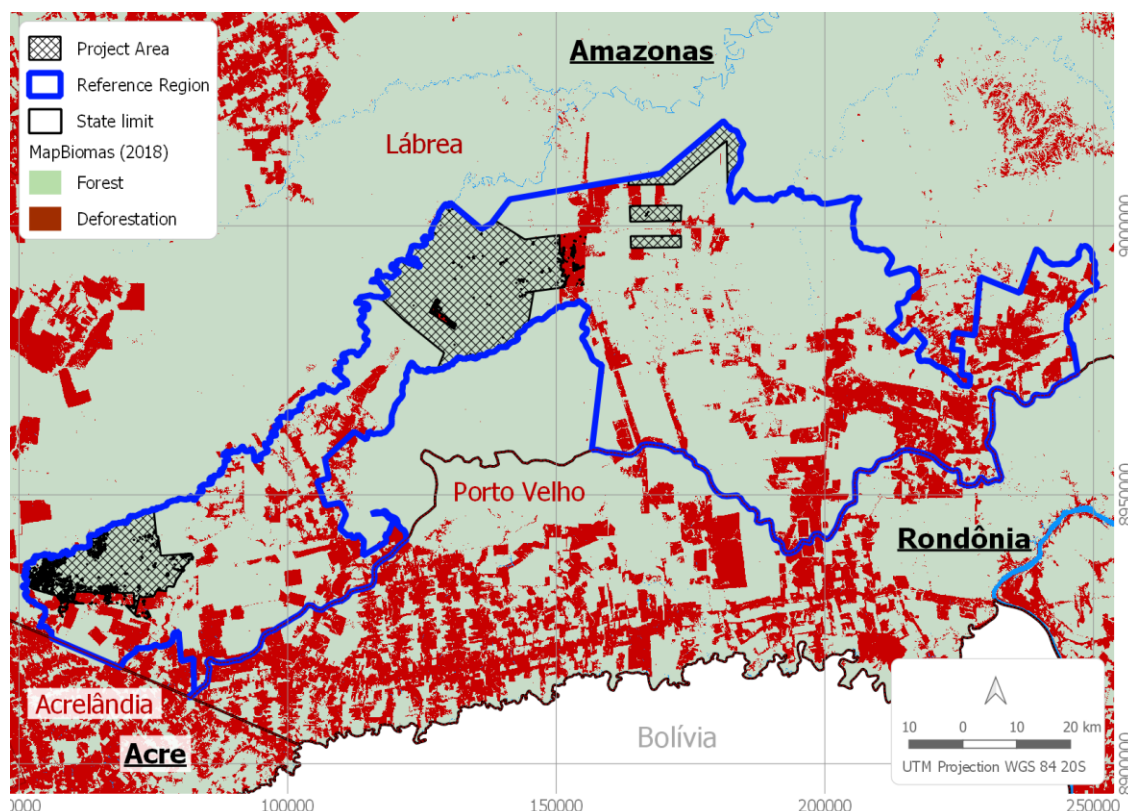


Figure 39. Mapping of land use in 2019, for the Reference Region and Project Area.
Source: Mapbiomas (2019)

The classification of the maps is conducted by MapBiomas technicians via the process defined in 4.1.1.3., below. Regarding the satellite images, for each year four scenes were used from the satellite Landsat 8 TM, orbits: 001/65, 001/66, 233/65, and 233/66.

Regarding accuracy, Mapbiomas assessed its overall and per-class accuracy for each land-use and land-cover class between the years 1985 and 2018⁷⁹. The accuracy estimates were based on a sample of pixels, known as the reference database, comprising ~75,000 samples. For each year, each pixel of the reference database was evaluated by technicians trained in visual interpretation of Landsat images, using metrics that compare the mapped class with the verified class by the technicians in the reference database.

For each year, the accuracy analysis is conducted, applying cross-tabulation of the samples of the mapped and real classes, in the format of Table 29, called the error matrix or confusion matrix. The frequencies $n_{i,j}$ represent the number of pixels in the sample classified as class i and evaluated as class j . The row totals represent the number of samples mapped as class i , while the column totals $n_{*,j}$ represent the number of samples that were assessed by technicians as class j .

⁷⁹ Source: MapBiomas (accessed 03/03/2021): <https://mapbiomas.org/analise-de-acuracia>

Table 29. Data evaluation confusion matrix⁸⁰

Map\ Real	Class 1	...	Class H	Total
Class 1	$n_{1,1}$	...	$n_{1,H}$	$n_{1,*}$
...	...	...	...	...
Class H	$n_{H,1}$	...	$n_{H,H}$	$n_{H,*}$
Total	$n_{*,1}$	...	$n_{*,H}$	$n_{*,*}$

Overall, for the whole reference period, Mapbiomas reports higher than 97.3% accuracy⁸¹, being therefore above the 90% accuracy required by the VM0015 methodology. In this way, the reliability of land use class maps was validated, and data was used input for the modelling and projection of future deforestation.

Table 30. Data used for historical LU/LC change analysis (Table 5 of VM0015).

Vector (Satellite or Airplane)	Sensor	Resolution		Coverage	Acquisition date	Scene or Point identifier	
		Spatial	Spectral	km	(YYYY)	Path / Latitude	Row / Longitude
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μ m	170 x 183	2013	1	66
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μ m	170 x 183	2013	1	67
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μ m	170 x 183	2013	233	66
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μ m	170 x 183	2013	233	67
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μ m	170 x 183	2016	1	66
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μ m	170 x 183	2016	1	67
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μ m	170 x 183	2016	233	66
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μ m	170 x 183	2016	233	67
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μ m	170 x 183	2018	1	66
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μ m	170 x 183	2018	1	67
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μ m	170 x 183	2018	233	66
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μ m	170 x 183	2018	233	67

For evaluation of land use changes, Mapbiomas integrates the maps of each class into a single map, which represents the coverage and land use of the entire Brazilian territory for each year. In this step, rules of prevalence are applied: if a given pixel is classified in two maps as different classes, it is possible to define which one belongs in the final map. Prevalence rules may vary according to the peculiarities of the biomes, themes or regions. The integration of the series is done for each year, generating an integrated map for each year, usually saved as a single ASSET

⁸⁰ Source: Mapbiomas (accessed 04/03/21): <https://mapbiomas.org/estatistica-de-acuracia>
⁸¹ Source: Mapbiomas (accessed 03/03/21): <https://mapbiomas.org/estatistica-de-acuracia>

with the number of annual layers of the period analysed. The integrated map goes through yet another spatial filter step to clean the edges and loose pixels as a result of the integration process.

In order to understand the changes in land-cover and land-use, maps with class transitions between different pairs of selected years are produced, making it possible to visualize the dynamics across the Brazilian territory. Transition maps are produced pixel by pixel and after completion, they pass through a further spatial filter to eliminate isolated or border transition pixels. From these maps, the transition matrices for each biome, state, municipality and the other territorial categories available on the MapBiomas platform are constructed.

Table 31. List of all land use and land cover classes existing at the project start date within the reference region (Table 6 of VM0015).

Class Identifier		Trend in Carbon stock ¹	Presence in ²	Baseline activity ³			Description (including criteria for unambiguous boundary definition)
ID _{cl}	Name			LG	FW	CP	
1	Forest Land	decreasing	RR; LK; LM; PA	yes	no	no	Determined by automated classification methods
2	Non-Forest Land	increasing	RR; LK; LM; PA	yes	no	no	Determined by automated classification methods

Source: Remote Sensing data from Mapbiomas: database indicates that virtually all deforestation is converted in pasture.

1. Note if “decreasing”, “constant”, “increasing”

2. RR = Reference region, LK = Leakage belt, LM = Leakage management Areas, PA = Project area

3. LG = Logging, FW = Fuel-wood collection; CP = Charcoal Production (yes/no)

4. Each class shall have a unique identifier (ID_{cl}). The methodology sometimes uses the notation icl (= 1, 2, 3, ... Icl) to indicate “initial” (pre-deforestation) classes, which are all forest classes; and fcl (= 1, 2, 3, ... Fcl) to indicate final” (post-deforestation) classes. In this table all classes (“initial” and “final”) shall be listed.

4.1.1.2. Definition of categories of land-use and land-cover change

The potential LU/LC-change categories that could occur within the Project Area and Leakage Belt during the project crediting period, in both the baseline and project case, are presented below.

Table 32. Potential land-use and land-cover change matrix (Table 7.a of VM0015)

<i>ID_{cl}</i>			Initial LU/LC class (2009)		Total (ha)
			<i>Forest</i>	<i>Pasture</i>	
			<i>I1</i>	<i>I2</i>	
Final LU/LC class (2018)	F1	<i>Forest</i>	537,642.37	0.00	537,642.37
	F2	<i>Pasture</i>	60,724.92	85,309.32	146,034.24
Total (ha)			598,367.29	85,309.32	683,676.61

Source: GIS processing by AVIX, based on Mapbiomas database.

Table 33. List of land-use and land-cover change categories (Table 7.b of VM0015).

ID _{ct}	Name	Trend in Carbon stock	Presence in	Activity in the baseline case		
				LG	FW	CP
I1/F1	Forest / Pasture	Decrease	RR; LK; LM; PA	yes	no	no

Source: Remote Sensing data from Mapbiomas: database indicates that virtually all deforestation is converted in pasture.

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

Regarding the acquisition, pre-processing, classification, post-classification, and evaluation of the accuracy of satellite images, for projection of changes in land-use and land-cover change (LULCC) over the Project lifetime, the following steps were carried out, primarily utilizing already processed data from Mapbiomas, where LU/LC or LU/LC-change classes and categories are well described:

- 1) Data Acquisition: In general terms, the Mapbiomas platform utilizes satellite data from Landsat 8 OLI with a spectral resolution of 0.43 - 2.26 μm , which are freely available from Google Earth Engine, and cover a timespan of over thirty years⁸². Their spatial resolution is of 30 x 30 meters. 380 images are required to cover Brazil completely, each one of them with tens of millions of pixels. In total, over nine billion pixels, measuring 30 x 30 m each, make up the entire country on Mapbiomas. For our analysis the Landsat scenes used were: 001/66, 001/67, 233/66, 233/67.
 - a) Pre-processing: In order to obtain a clean image, pixels without clouds are selected from the images available over the selected period, a similar process is conducted for other factors which may “dirty” them, such as smoke. Metrics are extracted for each of these pixels that explain the behaviour of the pixel in that year. This is done with each of the 7 spectral bands of the satellite as well as for the calculated fractions and spectral indices. For example, for Band 1, the following are collected:

⁸² Source: Mapbiomas (accessed 07/03/21): <https://mapbiomas.org/atbd---entenda-cada-etapa>

the median of the values of the band over the period, the maximum value, the minimum value and the amplitude of variation. At the end, each pixel carries up to 105 layers of information for one year.

- b) Classification: for each year, Mapbiomas creates a mosaic of images representing the behaviour of each pixel through 105 metrics or layers of information, which are loaded as data collections ("Assets") into the Google Earth engine. These mosaics are the source of parameters which allows the images to be classified: teams responsible for each biome and each transversal theme produce a map of each LU/LU class (forest, field, agriculture, pasture, urban area, water, etc.). The classification of the maps is conducted by MapBiomass technicians utilizing an automatic classifier called "random forest", based on machine learning and running Google's processing cloud: for each year and each of the land-use classes being classified, the machines are "trained" utilizing samples of the target class, which are obtained from reference maps and direct collection via visual interpretation of Landsat images⁸³.
- c) Post-classification: Mapbiomas then applies a spatial filter, aiming to increase the spatial consistency of the data, eliminating isolated or border pixels. Neighbourhood rules are defined that can lead to a change in the pixel classification. For example, a pixel that has less than two of the nine neighbouring pixels of the same class will be reclassified to the predominant class in the neighbourhood. Each pixel in each year and for each class of use goes through this process of spatial filtering.

To reduce temporal inconsistencies, especially changes in coverage and use that are impossible or not allowed (e.g., Natural Forest > Non-Forest > Natural Forest) and to correct failures due to excessive cloud or lack of data, temporal filter rules are applied, with specific rules for temporal filtering for each biome, theme or region. In total in Collection 3, more than a hundred rules were applied. The temporal filter is applied to each pixel analysing all years of the Collection (e.g., Collection 3 consisted of 33 years).

- d) Evaluation of classification accuracy: The minimum accuracy, taking into account levels 1 – 3, is guaranteed by Mapbiomas to be 97.3% for all classes treated: forest, and non-forest, including cropland, pastureland, waterways, etc.

LU/LC-change analysis was carried out in the project area, to exclude any areas with forests that are less than 10 years old at the project start date, the resulting size was: 99,035.20 ha.

A brief analysis of deforestation location reveals a "fishbone" pattern of deforestation in the Reference Region, which refers to the opening of connected (secondary and tertiary) roads, mainly from the BR-364 major federal highway.

Historical deforestation data show cumulative deforestation of 61,757.37 hectares, equivalent to more than 9% of the Reference Region. A non-compliance within the Reference Region with regard to "Law No. 12,651" can be inferred, which requires conservation of 80% of forest Legal Reserve on each rural property in the Amazon Biome. This is a strong argument regarding the

⁸³ Source MapBiomass (accessed 03/03/2021): <https://mapbiomas.org/atbd---entenda-cada-etapa>

additionality of this REDD project, because it indicates a strongly worsening trend in the dynamics of land use in the Reference Region, as further described below.

According to the analysis of the annual rate of deforestation in the Reference Region, obtained from historical deforestation data, it can be seen that 2009 and 2017 displayed, respectively, the lowest and highest annual rates of deforestation, denoting an increasing trend across the historical reference period, with an average of 1% deforestation, but the last three years showing 2.1%. Only in the years 2013 - 2015, which have an average of 0.5% deforestation, do we see a temporary break in this trend, however the tendency is redoubled in 2016, when the average deforestation jumps again to 1.5%.

4.1.2 STEP 3: ANALYSIS OF AGENTS, DRIVERS AND UNDERLYING CAUSES OF DEFORESTATION AND THEIR LIKELY FUTURE DEVELOPMENT

4.1.2.1 Identification of agents of deforestation

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

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

- a) Name of the main agent: Cattle Ranchers
- b) Description of the main features of the main agent of deforestation: Cattle ranching (pasture) is usually financed by means of initial capital obtained in wood logging. Deforestation is considered to occur through clear-cutting of forests for logging followed by pasture installation. A field survey performed by Vitel (2009) throughout the “Ramal do Boi”, which passes through several private properties in the Reference Region and in the Project Area, indicated that deforestation in private properties nearby is predominantly attributed to cattle ranching. This deforestation pattern may be caused by private landowners themselves and also by professional land-grabbers, through invasions of unguarded areas. As stated earlier in this PD, multiple illegal land occupation recordings within the properties have been reported by the owners. The final use of virtually all occupied lands would be cattle ranching (pasture). Thus, it can be affirmed that the deforestation agent group is composed by large and small-scale cattle ranchers supported by land-grabbers and loggers in the initial stage of deforestation. This group is composed by private owners and itinerant land-grabbers. It can also be affirmed that this group of deforestation agents is culturally and economically adapted to this “business cycle” of deforestation, whose results are clearly demonstrated in the Reference Region during the reference period.
- c) Assessment of the most likely development of the population size of the deforestation agent group in the Reference Region, Project Area and Leakage Belt: As the main deforestation agent in the region, cattle ranching (pasture) is expected

to increase in the project region. This increase is inferred from official IBGE data on cattle livestock in the municipality of Lábrea: from 2006 to 2007, the herd size increased dramatically from 7,027 to 285,519 heads (3963%), while from 2008 to 2019, the herd increased by only 12%.

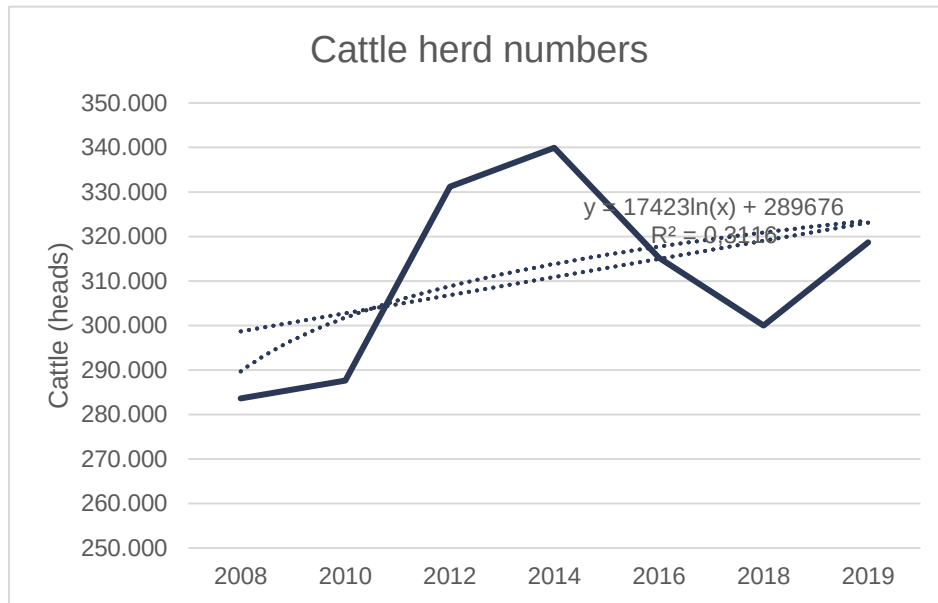


Figure 40. Historical growth of livestock numbers in the municipality of Lábrea, State of Amazonas (IBGE, 2019)

Given these dynamics, the herd size is expected to increase by up to 63% (519,274 heads) during the project lifetime (up to 2049, *Figure 41*), according to statistical projections conducted with official IBGE data from the 11 years prior to the project start date. This significant pace of growth in cattle-related land uses will certainly impose considerable deforestation pressures in the future.

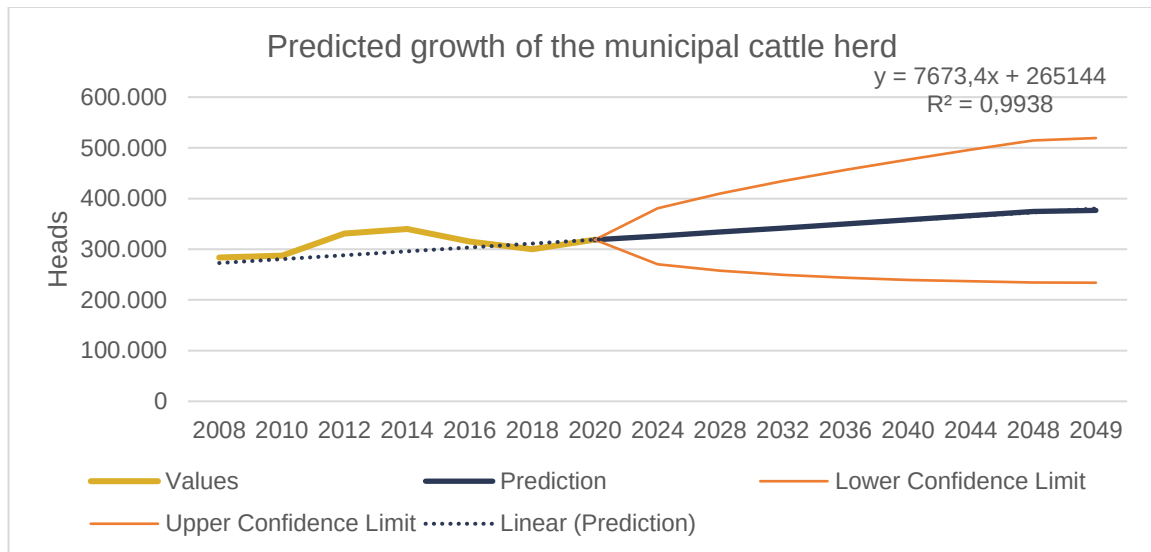


Figure 41. Projected growth of livestock numbers in the municipality of Lábrea, State of Amazonas within project lifetime (adapted from IBGE, 2019)

Timber harvesting can be regarded as the initial approach in a series of activities by deforestation agents, as it is the precursor of cattle ranching implementation. Official registration of officially documented logging for sale to sawmills has been volatile over the last 10 years, according to official IBGE data. As shown in Figure 42 below, production of official timber reached a low in 2012, rising to a peak in 2018, and since then it has been falling again. This could signal a rapidly approaching crash in legal wood supply linked to the current government's weakening of environmental laws and consequent disregard for regulations by producers⁸⁴, as studies point out that illegal wood supplies from the Amazon ranges from 40% to 80% (Vilella, Betiol, & Teixeira, 2011), and illegal operations producing significant volumes (2,000 m³) have been identified by police in southern Lábrea State. Data on timber supply also seems to be associated with the behaviour of the group of deforestation agents described in (b). There is a broadly inverse correlation between timber production and cattle head numbers, wherein the 2008 – 2012 and 2018 – 2020 periods show increases in cattle production, while the supply of legal wood is decreasing in the region, a correlation which is well supported by literature (Margulis 2001, Imazon 2008). Thus, the trend of reduction in legal wood supply may be related to the increase in illegal timber production activities, promoted by cattle ranchers as final users of land. All the collected data and cited literature allows us to infer that the activity of cattle ranchers, supported initially by illegal logging agents, is increasing in the region.

⁸⁴ Source (accessed 29/06/21): <https://imazon.org.br/imprensa/imazon-avalua-exploracao-madeireira-ilegal-paraense/>

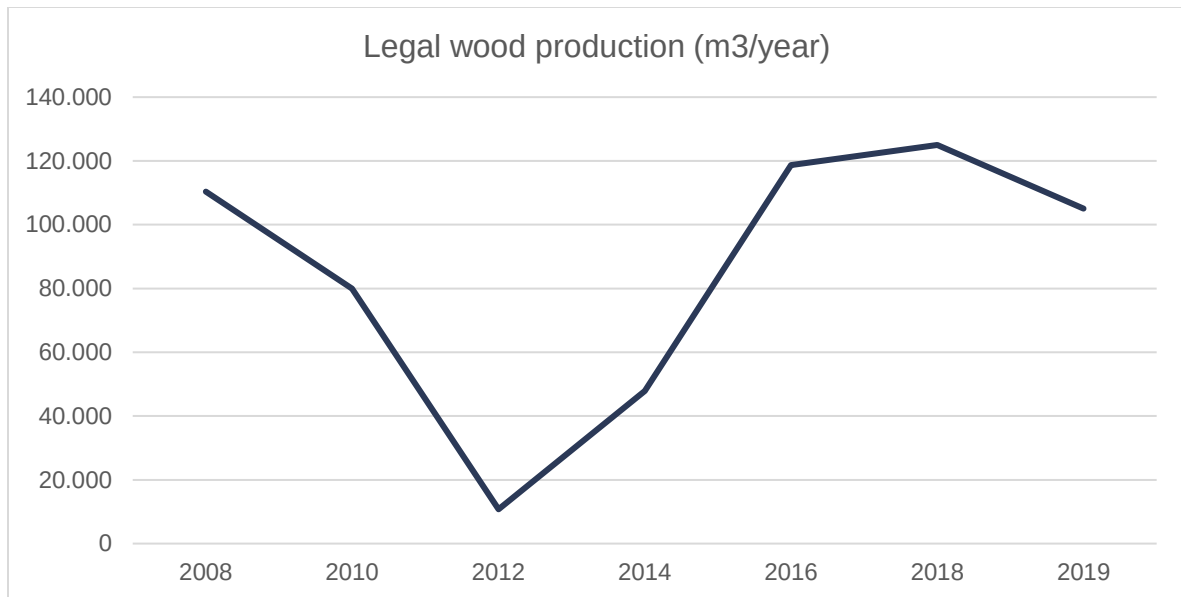


Figure 42. Historical production of legally registered logs in the municipality of Lábrea, State of Amazonas (IBGE, 2019)

d) Statistics on historical deforestation attributable to the agent group: the highest deforestation rate is 2018, in the reference region during the historical reference period (2009 – 2018), and the lowest is in 2010. We can therefore identify a constantly increasing trend in deforestation from 2010 (0.15% deforestation) to 2018 (2.80% deforestation) in the reference region, which is a dramatic increase.

Analysis of land use, via project analysis of Mapbiomas data, along with literature studies⁸⁵, indicate that of the 23% of the Reference Region which is deforested (159,148,7 hectares), 100% can be assumed to comprise of pasture lands. There are no other significant land uses within the deforested lands in the Reference Region. This corroborates the strong activity of cattle ranchers in the Reference Region. Thus, it is confirmed that virtually all deforestation in the Reference Region is attributed to the group of deforestation agents related to conversion of forest to pasture for cattle ranching, as indicated in items (a) and (b).

⁸⁵ IPAM/ISA/IMAZON (2014). The Increase in Deforestation in the Amazon in 2013: a point off the curve or out of control? (Available at <https://imazon.org.br/en/publicacoes/the-increase-in-deforestation-in-the-amazon-in-2013-a-point-off-the-curve-or-out-of-control/> ; last visited in 18/July/2017)

4.1.2.2 Identification of deforestation drivers

In this step, the factors that drive the land-use decisions of the agent group are analysed to identify the immediate causes of deforestation. For this analysis, two sets of driver variables are distinguished:⁴

For this analysis, two sets of driver variables are distinguished:

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

Cattle prices:

- 1) According to CEPEA (2021)⁸⁶, the price of cattle increased 72% over the 2009 to 2018 period. This economic phenomenon can be observed throughout the country. Young (1998) as cited in Rivero et al. (2009), evaluating the mechanisms that cause deforestation in the Legal Amazon, found a positive relation between the expansion of agricultural areas and the variation of prices of agricultural products. For Margulis (2001) as cited in Rivero et al. (2009), the higher the agricultural prices, the higher is the migration to rural lands, which results in deforestation;
- 2) This key driver variable is likely to have a major impact on cattle ranchers' decision to deforest. Considering that the higher is the cattle price, the higher are the profits obtained with pasture for cattle ranching, instead of maintaining standing forests;
- 3) The figure below (CEPEA, 2019) clearly shows the increasing trend of cattle prices over the years;
- 4) The dynamics of cattle prices are regulated by micro and macroeconomic scenario throughout the country, and there are no applicable project measures that can be implemented to address this driver.

⁸⁶ Source (accessed: 16/03/21): CEPEA, <https://www.cepea.esalq.usp.br/br/consultas-ao-banco-de-dados-do-site.aspx>

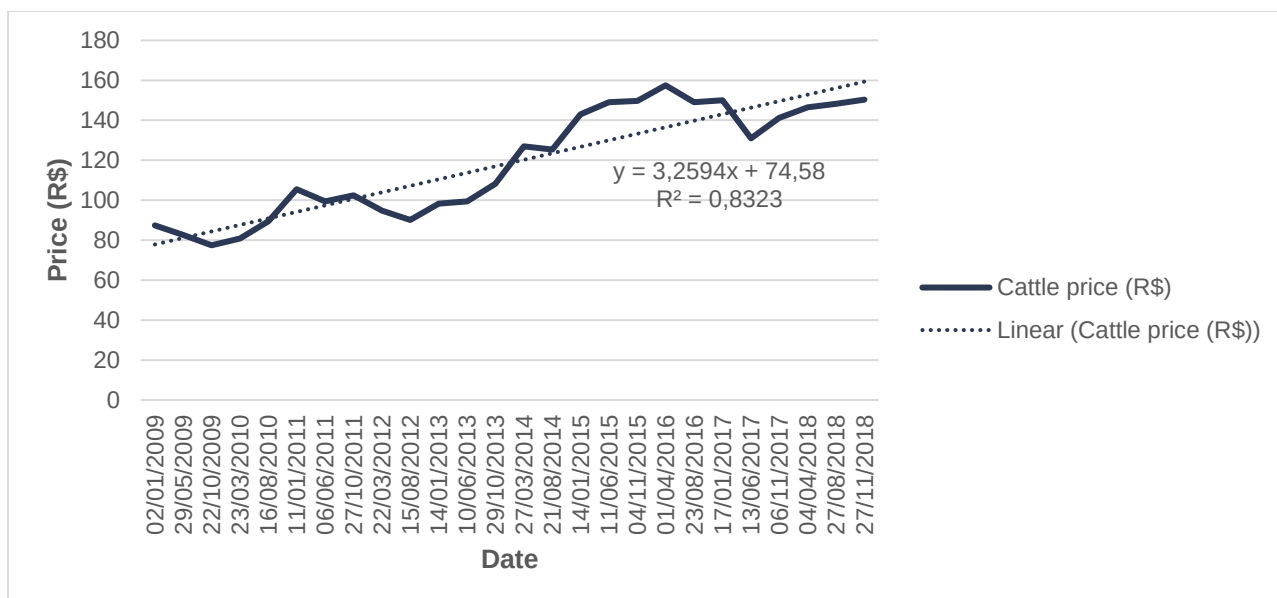


Figure 43. Cattle prices in Brazil (CEPEA, 2019)

Population density:

- 1) This deforestation driver is associated with the dynamics of the local cattle market, as well as with the increase of potential deforestation agents working in the region. Several authors include population density as a prediction variable in deforestation models, which demonstrates that this driver has important impact on deforestation trends (Reis and Margulis, 1991; Reis, 1996; Andersen and Reis, 1997 as cited in Rivero et al. 2009);
- 2) This key driver variable provides an increasing pressure of deforestation by cattle ranchers, avid for mitigating poverty by means of a profitable business;
- 3) The population of Lábrea (municipality where the Project Area is located) is expected to grow approximately 63% during the project period. This estimate was made by means of a linear regression based on the past 3 years of official data on population, according to official IBGE data. This population growth rate could represent a major driver to increase the deforestation in the region over upcoming decades;
- 4) Considering that the project activity cannot regulate the population density, there will be no project measures to address this driver.

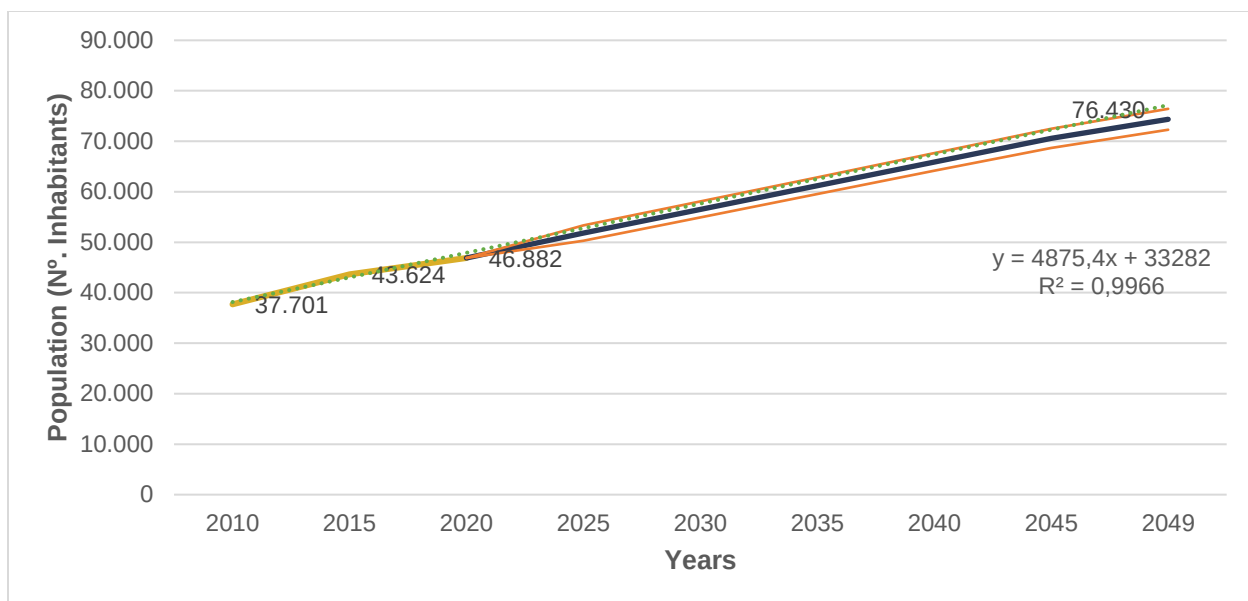


Figure 44. Projected population growth in the municipality of Lábrea, Amazonas, Brazil

b) Driver variables explaining the location of deforestation, also called “predisposing factors” (de Jong, 2007). These driver variables were used in deforestation projection modelling, the results of which show that such variables can predict the location of deforestation variables explaining the quantity (hectares) of deforestation:

Access to forests (existing roads and navigable rivers):

- 1) Studies on historical location of deforestation in the Reference Region can evidence that this factor has been a driver for deforestation during the historical reference period. It is broadly recognized that deforestation is accelerated in regions that have denser road networks (IMAZON, 2021⁸⁷);
- 2) The presence of roads and navigable rivers is a logical deforestation driver, since it facilitates the flow of wood and other products harvested from the forest. The capacity to transport wood logs, rapidly clear the land for pasture and place wood logs in sawmills, quickly obtaining revenues, certainly has a major impact on cattle ranchers’ decision to deforest the most accessible forest areas;
- 3) The Reference Region holds a dense network of primary, secondary, and tertiary roads. The lands located near these roads are more likely to undergo deforestation, generating a progressive fishbone effect. This deforestation pattern may even increase exponentially in some cases, given that a single road may originate several other offshoot roads in the future, and so on. In a brief analysis of deforestation location, the existence of the fishbone deforestation patterns can be noted, which indicates the creation of secondary and tertiary

⁸⁷ Source (accessed 16/03/21): Imazon, <https://imazongeo.org.br/>

roads, mainly from the major federal highway (BR-364) in the Reference Region. Barber et al. (2014), in their study on deforestation drivers in the Amazon, conclude that proximity to transportation networks, particularly the rapidly growing unofficial road network, is a major proximate driver of deforestation in the Amazon. Thus, it can be expected that the growth of the unofficial road network will increasingly affect the dynamics of deforestation over the project lifetime.

A similar line of reasoning is applicable to the navigable rivers surrounding the Project Area: the Ituxi River is a navigable river that has been used to access the northern portion of the Project Area, and is a valuable way for land-grabbers to easily invade the property and clear forests for logging and pasture. In the case of navigable rivers, the number of paths will be invariable across the project lifetime, as the creation of new navigable rivers is highly unlikely.

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

Proximity to forest edges:

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

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

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

4) The project measures that will be implemented to address this driver are the same measures that are being adopted to manage leakage in this project. These measures are

described in detail in “1.17 Leakage Management” of this PD, and involve Technical Training on Sustainable Cattle Raising, Forest Management Courses, and others.

4.1.2.3 Identification of underlying causes of deforestation

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

- Land-use policies and their enforcement;
- Poverty and wealth.

Land-use policies and their enforcement:

1) As previously mentioned in this PD, in spite of the legal provisions intended to preserve at least 80% of the Amazon’s forest cover, the lack of law enforcement by local authorities along with the increase in production and prices of cattle has created a scenario of almost complete disregard of the mandatory provisions of the Forest Code. High rates of criminality associated with land disputes usually jeopardize efforts concerning law enforcement improvement. In addition to that, to cover vast distances of areas with low demographic density makes tracking of illegal activities and land surveillance very difficult for the authorities. Accordingly, policies implemented to address illegal deforestation only by means of command-and-control approaches have proven to be ineffective so far (IPAM, 2011). Data on deforestation history show a cumulative deforestation of 146,034.24 hectares, equivalent to more than 21.4% of the Reference Region. This is interpreted as non-compliance within the Reference Region with Law No. 12,651, which requires a Legal Reserve of 80% in each rural property of the Amazon Biome.

2) This key underlying cause has a strong effect on the decisions of the main deforestation agents, as they are at liberty to continue their illegal business activities with very low probability of being detained by authorities.

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

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

Poverty and wealth:

- 1) According to statistics on the municipality of Lábrea-AM (IBGE, 2017), the average monthly wage of formal workers in 2015, to take a year from the historical reference period, was just 1.7 times the minimum salary. Formal workers represent only 4.6% of total Lábrea population, and 52.7% of the population lived with half a salary per month in 2010. These data show that the region faces poverty issues.
- 2) This key underlying cause has a major impact on deforestation decisions, as the main agents (cattle ranchers, operationally supported by loggers and land-grabbers) can easily recruit cheap manpower, consisting of workers seeking to sustain their families by means of this profitable activity, despite it being illegal, due to the inconsistency of law enforcement.
- 3) Over the coming years, it is not expected that the region will rapidly solve the poverty issue, as it is historically deeply rooted in the region. Given this context, poverty can be assumed to be a constant underlying cause during the project lifetime.
- 4) Although the project activity cannot solve the poverty issue, it aims to provide new jobs for local agents, who will be able to generate revenues for their families by means of a legal and sustainable initiative.

4.1.2.4 Identification of chain of events leading to deforestation.

Based on the historical evidence collected, it is concluded that the implementation of the BAU activity (pasture) is usually financed by means of initial capital obtained through timber logging. Official data from IBGE (2019) suggests a possible upcoming crisis in legal wood log production, reflecting a lack of supply of legal wood to the local market, mainly represented by local sawmills.

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

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

4.1.2.5 Conclusion

Available evidence about the most likely future deforestation trend within the Reference Region and Project Area is deemed to be “Conclusive”. Meaning that the hypothesized relationships

between agent groups, driver variables, underlying causes and historical levels of deforestation have been verified via literature studies and other verifiable local sources of information.

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

4.1.3. PROJECTION OF THE QUANTITY OF FUTURE DEFORESTATION

This section refers to the following steps of the VM0015 Methodology: 4.1.1: Selection of the baseline approach; and Step 4.1.2: Quantitative projection of future deforestation.

The Modelling approach “c” has been chosen to project future deforestation, which involves estimation of deforestation as a function of driver variables.

This baseline approach has been chosen given that the deforestation rates measured in the reference period in the Reference Region were found to display an increasing trend as a function of time. Importantly, in 2015 and 2016, the increase in rate displayed an exponential jump (71% - 151% change), as opposed to the rather linear tendency in previous years (average of 40% change 2011 – 2014), which therefore suggests, in the words of the methodology “that the future deforestation is likely to be higher than predicted with approach “b” (time function)”, thus meeting methodology criteria to use approach “c” (modelling).

4.1.4 PROJECTION OF THE LOCATION OF FUTURE DEFORESTATION

This section refers to Step 4.2 of the VM0015 Methodology.

The basic tasks to perform this analysis are as follows, which is also represented in the flowchart below:

- Preparation of factor maps;
- Preparation of risk maps for deforestation;
- Selection of the most accurate deforestation risk map; and
- Mapping of the locations of future deforestation.

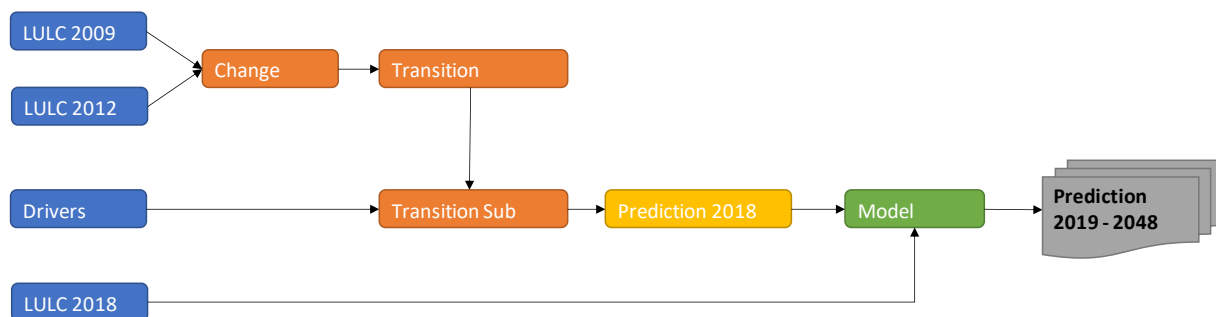


Figure 45. Flowchart illustrating the Risk Map creation process

Table 34: List of variables, maps and factor maps (Table 10 of VM0015)

Factor Map		Source	Variable represented		Meaning of the categories or pixel value		Other Maps and Variables used to create factor map		Algorithm or Equation used
ID	File Name		Unit	Description	Range	Meaning	ID	File name	
1	dist_desmat_1	Mapbiomas (2009 - 2018)	meters	Distance to existing deforestation	0 - 11.370	Values close to 0 are closer to the deforestation	1A	desmatamento_driver.shp	Euclidean Distance - ArcGis (Esri)
2	dist_estradas_1	Imazon (2014)	meters	Distance to main roads	0 - 11.591	Values close to 0 are closer to main roads	2A	estradas_driver.shp	Euclidean Distance - ArcGis (Esri)
3	dist_hidro_1	IBGE (2019)	meters	Distance to waterways	0 - 8.326	Values close to 0 are closer to waterways	3A	hidrografia_driver.shp	Euclidean Distance - ArcGis (Esri)
4	dist_serrarias_1	N/A	meters	Distance to sawmills	0 - 82.144	Values close to 0 are closer to sawmills	4A	serrarias_driver.shp	Euclidean Distance - ArcGis (Esri)

Definition of the Model

The chosen tool for the analysis of Unitor REDD+ Project's baseline is the Land Change Modeler, LCM (Eastman, 2009), available at TerrSet 2000 Edition software (formerly: "IDRISI Taiga").

The LCM evaluates the relationship between drivers of deforestation (human and biophysical), restrictions (Protected Areas) and changing areas of land use derived from two maps of use and occupation of land. The tool projects changes for the future at intervals set by the user based on past patterns of change (AMUCHÁSTEGUI and FORREST, 2013).

This study took the following drivers into account: distance from deforestation, distance from roads, distance from sawmills, and distance from waterways. These drivers, selected as explanatory variables of deforestation dynamics, have a history of use in similar analyses in other projects registered in the VCS, although they are from different regions.

During the analysis of deforestation dynamics in the Reference Region, the input data (explanatory variables) of neural network models were all analysed, despite the possibility of correlation and redundancy of information between them.

The variables "distance from deforestation (2016)" and "distance from sawmills", "distance from static roads" as well as the linear "distance from waterways" were included in the final model for the project baseline.

The model selected with the best potential to explain the future of deforestation dynamics in the Reference Region presented a value of AUC = 0.940. Location analysis of future deforestation within the Reference Region was performed to determine the annual areas of deforestation within the Project Area and Leakage Belt (VM0015 step 4.2). Once location analysis has been completed, the proportion of annual areas of baseline deforestation within the project area and leakage belt was determined using GIS analysis.

Table 35. Sensitivity analysis for selection of the model with the greatest explanatory potential for land-use changes over the period analysed.

Variable/ Model	Distance from sawmills	Distance from deforestation (2016)	Distance from static roads	Distance from waterways	AUC ROC value
Model 1	x	x	x	x	0.94

Quality Control of the Model

To evaluate the model and the variables that best explain the dynamics of deforestation, the ROC (Relative Operating Characteristic) analysis were used, as in SANGERMANO et al. (2012) and MATTA (2015).

To evaluate the accuracy of the models, it was necessary to compare the map obtained by the prediction model with actual data. For this analysis, two land maps are compared by MapBiomass professionals⁸⁸: i) Estimated / modelled map up to 2018, and ii) actual observed deforestation map of 2018.

Projected Results from the Model

The accumulated baseline deforestation projected to occur within the Reference Region over the 30-year project lifetime is of 176,101.7 ha, as shown in the table below, corresponding to an estimated average annual rate of deforestation is 5,870.1 hectares for the Reference Region.

Table 36. Annual areas of baseline deforestation in the reference region (Table 9.a of VM0015)

Year	Project year	Total - RR	
		annual ABSLRR _t ha	cummulative ABSLRR ha
2018	0	9,969.7	9,969.7
2019	1	15,387.3	25,357.1
2020	2	14,004.4	39,361.4
2021	3	14,016.7	53,378.1
2022	4	12,262.1	65,640.2
2023	5	11,988.5	77,628.7
2024	6	11,715.3	89,344.0
2025	7	11,726.4	101,070.4
2026	8	11,046.5	112,116.9
2027	9	10,800.2	122,917.1
2028	10	10,553.9	133,471.0
2029	11	4,252.1	137,723.1
2030	12	4,252.1	141,975.1
2031	13	4,252.1	146,227.2
2032	14	4,252.1	150,479.3
2033	15	4,252.1	154,731.3
2034	16	1,990.3	156,721.6
2035	17	1,990.3	158,711.9
2036	18	1,990.3	160,702.2
2037	19	1,990.3	162,692.5
2038	20	1,990.3	164,682.8
2039	21	1,945.9	166,628.7
2040	22	1,945.9	168,574.7
2041	23	1,945.9	170,520.6
2042	24	1,945.9	172,466.5
2043	25	1,945.9	174,412.4
2044	26	1,901.5	176,314.0

⁸⁸ Source Mapbiomas (accessed 24/03/2021): <https://mapbiomas.org/atbd---entenda-cada-etapa>

2045	27	1,901.5	178,215.5
2046	28	1,901.5	180,117.1
2047	29	1,901.5	182,018.6
2048	30	604.3	182,622.9
TOTAL		182,622.9	

The accumulated baseline deforestation projected to occur within the Project Area over the 30-year project lifetime was estimated at 24,768.7 hectares, corresponding to an estimated average annual rate of deforestation is 825.62 hectares for the Project Area.

Table 37. Annual areas of baseline deforestation in the Project Area (Table 9.b of VM0015)

Year	Project year	Total - PA	
		annual ABSLPA _t ha	cummulative ABSLPA ha
2018	0	1,041.18	1,041.2
2019	1	1,386.73	2,427.9
2020	2	1,700.25	4,128.2
2021	3	1,750.05	5,878.2
2022	4	1,736.86	7,615.1
2023	5	1,005.81	8,620.9
2024	6	838.90	9,459.8
2025	7	1,590.44	11,050.2
2026	8	848.95	11,899.2
2027	9	1,594.29	13,493.5
2028	10	952.36	14,445.8
2029	11	881.23	15,327.0
2030	12	881.23	16,208.3
2031	13	881.23	17,089.5
2032	14	881.23	17,970.7
2033	15	881.23	18,852.0
2034	16	420.81	19,272.8
2035	17	420.81	19,693.6
2036	18	420.81	20,114.4
2037	19	420.81	20,535.2
2038	20	420.81	20,956.0
2039	21	406.03	21,362.1
2040	22	406.03	21,768.1
2041	23	406.03	22,174.1
2042	24	406.03	22,580.1
2043	25	406.03	22,986.2
2044	26	412.83	23,399.0
2045	27	412.83	23,811.8

2046	28	412.83	24,224.7
2047	29	412.83	24,637.5
2048	30	131.20	24,768.7
TOTAL		24,768.7	

Table 38. Annual areas of baseline deforestation in the Leakage Belt (Table 9.c of VM0015)

Year	Project year	Total - LK	
		annual ABSLLK _t ha	cummulative ABSLLK ha
2018	0	4,149.6	4,149.6
2019	1	13,433.1	17,582.7
2020	2	12,253.8	29,836.6
2021	3	12,292.6	42,129.2
2022	4	10,778.3	52,907.5
2023	5	10,561.9	63,469.5
2024	6	10,344.6	73,814.1
2025	7	10,377.8	84,191.9
2026	8	9,798.3	93,990.2
2027	9	9,601.4	103,591.5
2028	10	9,403.6	112,995.1
2029	11	2,668.9	115,664.0
2030	12	2,668.9	118,332.9
2031	13	2,668.9	121,001.8
2032	14	2,668.9	123,670.7
2033	15	2,668.9	126,339.6
2034	16	2,021.9	128,361.5
2035	17	2,021.9	130,383.3
2036	18	2,021.9	132,405.2
2037	19	2,021.9	134,427.0
2038	20	2,021.9	136,448.9
2039	21	2,060.3	138,509.2
2040	22	2,060.3	140,569.6
2041	23	2,060.3	142,629.9
2042	24	2,060.3	144,690.2
2043	25	2,060.3	146,750.6
2044	26	2,104.0	148,854.5
2045	27	2,104.0	150,958.5
2046	28	2,104.0	153,062.5
2047	29	2,104.0	155,166.5
2048	30	668.7	155,835.1
TOTAL		155,835.1	

4.1.4.1 Location of future deforestation: Conclusion

The location of deforestation in the Reference Region was strongly influenced by the factor of accessibility of forests, contributing to the expansion and clearing of new areas in the region as a whole, mainly as extensions from the BR-364 along its length in the states of Acre and Rondônia into the Amazon. It is assumed that “Ramal do Boi” road will also be a driver to facilitate deforestation.

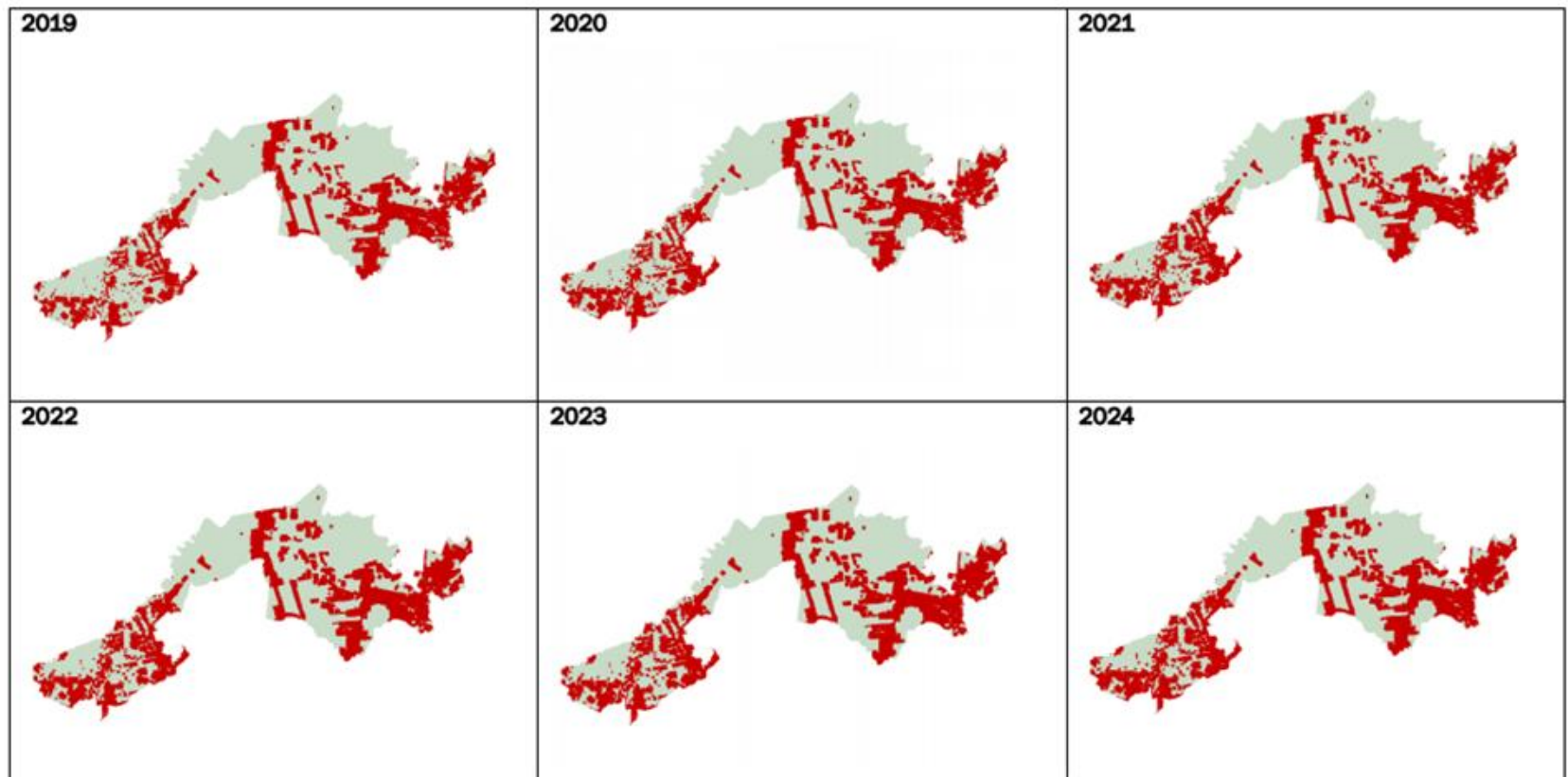
The Reference Region has a vast and dense network of primary, secondary and tertiary roads, as well as navigable rivers. Rivers have also been considered as paths to facilitate deforestation: the maps of projection of deforestation location indicate a consistent occurrence of future deforestation in the vicinity of waterways. Thus, the nearest locations to these paths will have a greater potential of deforestation.

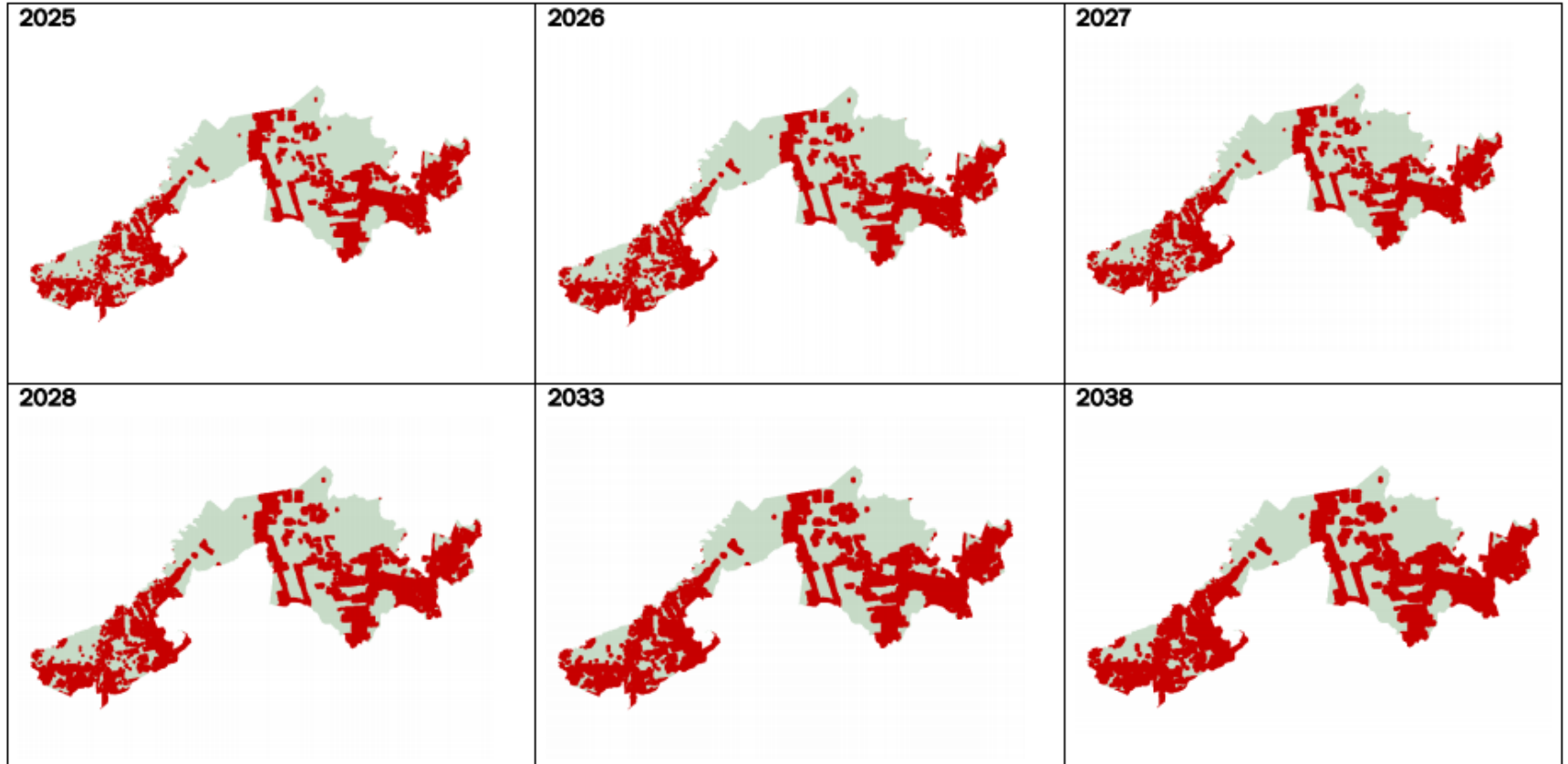
Distance from previously deforested areas (i.e., proximity to forest edges) has also been an important deforestation driver: regions near old deforestation and communities, municipal centres, etc. tend to have a higher probability and risk of future deforestation.

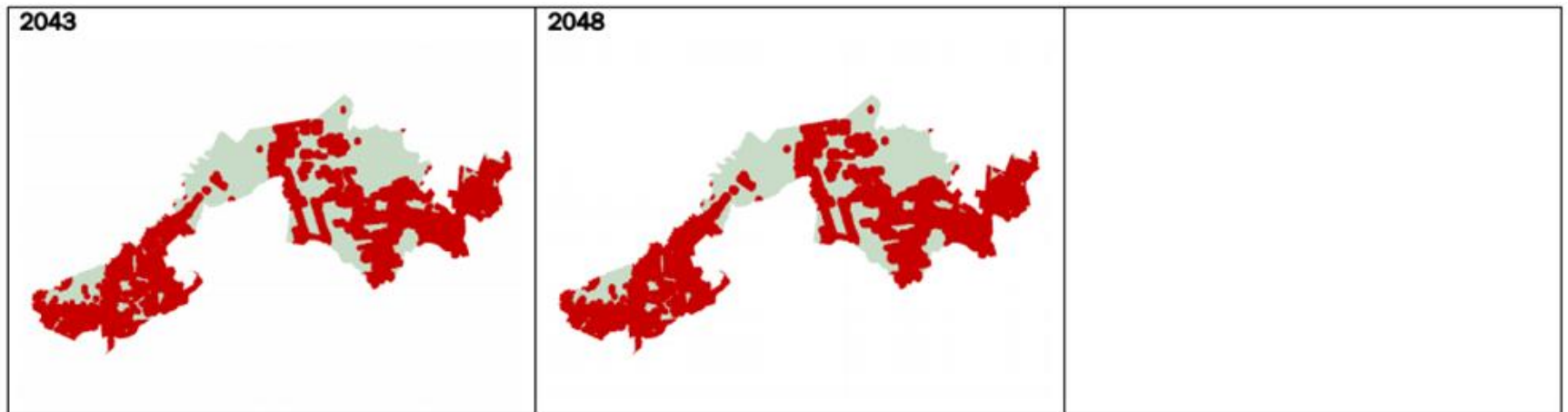
All drivers related to the dynamics of land-use change caused by cattle ranching may increase the potential of the aforementioned deforestation drivers. Thus, any fluctuations in the market of livestock-related products may affect the deforestation in the region as a whole, mainly in locations close to consumption clusters.

In parallel, demographic dynamics (i.e., changes in population density) are also important drivers, interacting with and amplifying all the other drivers mentioned above, as they cause an increase in food consumption and availability of labour, which directly affect deforestation. The following figure shows the yearly projection of deforestation location up to 2048.

Figure 46. Mapping of cumulative annual deforestation projected up to 2048, covering the Reference Region and Project Area







The Figure below shows the location of deforestation within the Project Area, highlighting the general tendency of the deforestation to push upwards from the greater concentration of roads, waterways, existing deforestation and sawmills in the South and to the East of the central group of project areas.

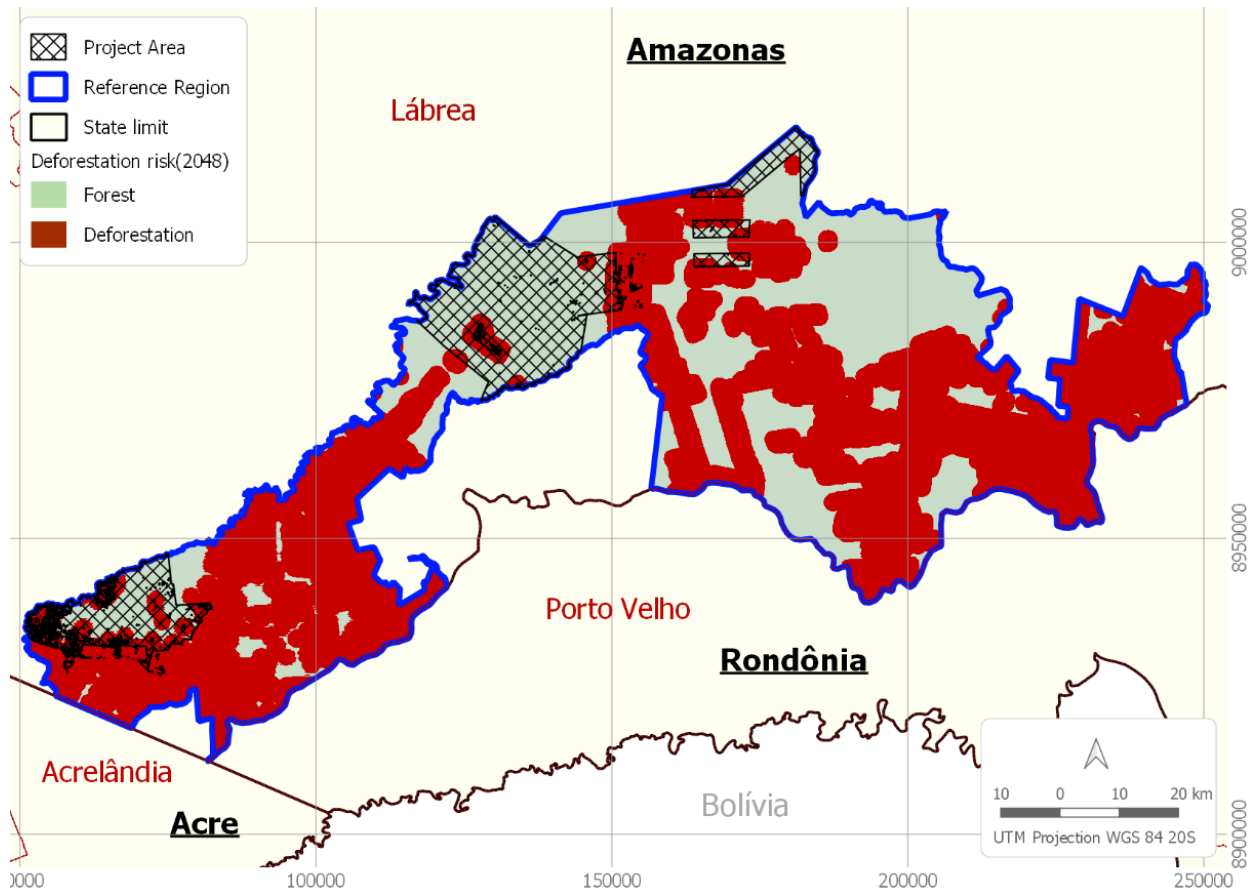


Figure 47. Mapping of cumulative deforestation projected to 2048, in the Project Area.

4.1.5 DEFINITION OF THE LAND-USE AND LAND-COVER CHANGE COMPONENT OF THE BASELINE

This section refers to Step 5 of the VM0015 Methodology, the goal of which step is to calculate activity data (hectares per year) of the initial forest classes (icl) that will be deforested and activity data of the post-deforestation classes (fcl) that would replace them in the baseline case.

After step 4, the area and location of future deforestation are both known and pre-deforestation carbon stocks were determined by matching the predicted location of deforestation with the location of forest classes with known carbon stocks.

4.1.5.1 Calculation of baseline activity data per forest class

(Step 5.1) According to MMA data, the Project Area displays 64% of its forests classified as open ombrophylous forest (“As”), and 36% is submontane dense ombrophylous forest (“Ds”), however

only open (“As”) is taken into account, for conservativeness reasons fully explained in section 4.1.6.1 below. The data processing procedure in this step was the same as performed and explained in previous steps.

The following table shows the annual estimates of deforestation within the Project Area, obtained by means of modelling.

Table 39. Annual areas deforested per forest class icl within the project area in the baseline case (baseline activity data per forest class) (Table 11.b of VM0015)

Year	ID _{icl} > Name >	1	Total baseline deforestation in the project area	
		Submontane open ombrophilous forest (As)		
	Project year <i>t</i>	ha	annual ABSLPA _{<i>t</i>} ha	cummulative ABSLPA ha
2018	0	1,041.2	1,041.2	1,041.2
2019	1	1,386.7	1,386.7	2,427.9
2020	2	1,700.3	1,700.3	4,128.2
2021	3	1,750.1	1,750.1	5,878.2
2022	4	1,736.9	1,736.9	7,615.1
2023	5	1,005.8	1,005.8	8,620.9
2024	6	838.9	838.9	9,459.8
2025	7	1,590.4	1,590.4	11,050.2
2026	8	849.0	849.0	11,899.2
2027	9	1,594.3	1,594.3	13,493.5
2028	10	952.4	952.4	14,445.8
2029	11	881.2	881.2	15,327.0
2030	12	881.2	881.2	16,208.3
2031	13	881.2	881.2	17,089.5
2032	14	881.2	881.2	17,970.7
2033	15	881.2	881.2	18,852.0
2034	16	420.8	420.8	19,272.8
2035	17	420.8	420.8	19,693.6
2036	18	420.8	420.8	20,114.4
2037	19	420.8	420.8	20,535.2
2038	20	420.8	420.8	20,956.0
2039	21	406.0	406.0	21,362.1
2040	22	406.0	406.0	21,768.1
2041	23	406.0	406.0	22,174.1
2042	24	406.0	406.0	22,580.1
2043	25	406.0	406.0	22,986.2
2044	26	412.8	412.8	23,399.0
2045	27	412.8	412.8	23,811.8
2046	28	412.8	412.8	24,224.7
2047	29	412.8	412.8	24,637.5

2048	30	131.2	131.2	24,768.7
TOTAL			24,768.7	

The following table shows the annual estimates of deforestation within the Leakage Belt, obtained by means of modelling.

Table 40. Annual areas deforested per forest class icl within the Leakage Belt area in the baseline case (baseline activity data per forest class) (Table 11.c of VM0015)

Year	ID _{icl} >	1	Total baseline deforestation in the leakage belt	
	Name >	Submontane open ombrophilous forest (As)		
	Project year <i>t</i>	ha	annual ABSLLK _t ha	cummulative ABSLLK ha
2018	0	4,149.6	4,149.6	4,149.6
2019	1	13,433.1	13,433.1	17,582.7
2020	2	12,253.8	12,253.8	29,836.6
2021	3	12,292.6	12,292.6	42,129.2
2022	4	10,778.3	10,778.3	52,907.5
2023	5	10,561.9	10,561.9	63,469.5
2024	6	10,344.6	10,344.6	73,814.1
2025	7	10,377.8	10,377.8	84,191.9
2026	8	9,798.3	9,798.3	93,990.2
2027	9	9,601.4	9,601.4	103,591.5
2028	10	9,403.6	9,403.6	112,995.1
2029	11	2,668.9	2,668.9	2,668.9
2030	12	2,668.9	2,668.9	118,332.9
2031	13	2,668.9	2,668.9	121,001.8
2032	14	2,668.9	2,668.9	123,670.7
2033	15	2,668.9	2,668.9	126,339.6
2034	16	2,021.9	2,021.9	128,361.5
2035	17	2,021.9	2,021.9	130,383.3
2036	18	2,021.9	2,021.9	132,405.2
2037	19	2,021.9	2,021.9	134,427.0
2038	20	2,021.9	2,021.9	136,448.9
2039	21	2,060.3	2,060.3	138,509.2
2040	22	2,060.3	2,060.3	140,569.6
2041	23	2,060.3	2,060.3	142,629.9
2042	24	2,060.3	2,060.3	144,690.2
2043	25	2,060.3	2,060.3	146,750.6
2044	26	2,104.0	2,104.0	148,854.5
2045	27	2,104.0	2,104.0	150,958.5
2046	28	2,104.0	2,104.0	153,062.5
2047	29	2,104.0	2,104.0	155,166.5

2048	30	668.7	668.7	155,835.1
TOTAL			155,835.1	

4.1.5.2 Calculation of baseline activity data per post-deforestation forest class (Step 5.2)

To project the LU/LC classes that will replace forests in the baseline case, Method 1 “Historical LU/LC-change” was chosen, because historical LU/LC-changes are assumed to be representative of future trends. Hence, post-deforestation land-uses are allocated to the projected areas of annual deforestation in same proportions as those observed on lands deforested during the historical reference period in the Reference Region.

As mentioned in “1.13 Conditions Prior to Project Initiation” of this VCS-PD, pasture accounts for virtually all the deforested land occupation in the project region. An analysis of land-use cover in Lábrea Municipality over the historical reference period years⁸⁹, show that, of the agricultural land uses, pastureland accounts for over 99% of the area in every year analysed. Corresponding evidence was duly presented at audit, under category “16 – Land use land cover maps”. Thus, the post deforestation class is considered exclusively as “pasture”.

The following table shows the annual estimates of deforestation within the Project Area, obtained by means of modelling.

Table 41. Annual areas deforested in each zone within the Project Area in the baseline case (baseline activity data zone) (Table 13.b of VM0015)

Year	ID _z >	1	Total baseline deforestation in the project area	
	Name >	Pasture		
	Project year <i>t</i>	ha	annual ABSLPA _{<i>t</i>} ha	cummulative ABSLPA ha
2018	0	1,041.2	1,041.2	1,041.2
2019	1	1,386.7	1,386.7	2,427.9
2020	2	1,700.3	1,700.3	4,128.2
2021	3	1,750.1	1,750.1	5,878.2
2022	4	1,736.9	1,736.9	7,615.1
2023	5	1,005.8	1,005.8	8,620.9
2024	6	838.9	838.9	9,459.8
2025	7	1,590.4	1,590.4	11,050.2
2026	8	849.0	849.0	11,899.2
2027	9	1,594.3	1,594.3	13,493.5
2028	10	952.4	952.4	14,445.8
2029	11	881.2	881.2	15,327.0

⁸⁹ Source, Mapbiomas, municipality Lábrea: <https://plataforma.brasil.mapbiomas.org>

2030	12	881.2	881.2	16,208.3
2031	13	881.2	881.2	17,089.5
2032	14	881.2	881.2	17,970.7
2033	15	881.2	881.2	18,852.0
2034	16	420.8	420.8	19,272.8
2035	17	420.8	420.8	19,693.6
2036	18	420.8	420.8	20,114.4
2037	19	420.8	420.8	20,535.2
2038	20	420.8	420.8	20,956.0
2039	21	406.0	406.0	21,362.1
2040	22	406.0	406.0	21,768.1
2041	23	406.0	406.0	22,174.1
2042	24	406.0	406.0	22,580.1
2043	25	406.0	406.0	22,986.2
2044	26	412.8	412.8	23,399.0
2045	27	412.8	412.8	23,811.8
2046	28	412.8	412.8	24,224.7
2047	29	412.8	412.8	24,637.5
2048	30	131.2	131.2	24,768.7
TOTAL			24,768.7	

The following table shows the annual estimates of deforestation within the Leakage Belt, obtained by means of modelling.

Table 42. Annual areas deforested in each zone within the Leakage Belt area in the baseline case (baseline activity data per zone) (Table 13.c of VM0015)

Year	ID _z >	1	Total baseline deforestation in the leakage belt	
	Name >	Pasture		
	Project year <i>t</i>	ha	annual ABSLLK _t ha	cummulative ABSLLK ha
2018	0	4,149.6	4,149.6	4,149.6
2019	1	13,433.1	13,433.1	17,582.7
2020	2	12,253.8	12,253.8	29,836.6
2021	3	12,292.6	12,292.6	42,129.2
2022	4	10,778.3	10,778.3	52,907.5
2023	5	10,561.9	10,561.9	63,469.5
2024	6	10,344.6	10,344.6	73,814.1
2025	7	10,377.8	10,377.8	84,191.9
2026	8	9,798.3	9,798.3	93,990.2
2027	9	9,601.4	9,601.4	103,591.5
2028	10	9,403.6	9,403.6	112,995.1
2029	11	2,668.9	2,668.9	2,668.9

2030	12	2,668.9	2,668.9	118,332.9
2031	13	2,668.9	2,668.9	121,001.8
2032	14	2,668.9	2,668.9	123,670.7
2033	15	2,668.9	2,668.9	126,339.6
2034	16	2,021.9	2,021.9	128,361.5
2035	17	2,021.9	2,021.9	130,383.3
2036	18	2,021.9	2,021.9	132,405.2
2037	19	2,021.9	2,021.9	134,427.0
2038	20	2,021.9	2,021.9	136,448.9
2039	21	2,060.3	2,060.3	138,509.2
2040	22	2,060.3	2,060.3	140,569.6
2041	23	2,060.3	2,060.3	142,629.9
2042	24	2,060.3	2,060.3	144,690.2
2043	25	2,060.3	2,060.3	146,750.6
2044	26	2,104.0	2,104.0	148,854.5
2045	27	2,104.0	2,104.0	150,958.5
2046	28	2,104.0	2,104.0	153,062.5
2047	29	2,104.0	2,104.0	155,166.5
2048	30	668.7	668.7	155,835.1
TOTAL			155,835.1	

4.1.6 ESTIMATION OF BASELINE CARBON STOCK CHANGES AND NON-CO2 EMISSIONS

This section refers to Step 6 of the VM0015 Methodology, the goal of which is to finalize the baseline assessment by calculating:

- Baseline carbon stock changes; and (optionally)
- Baseline non-CO2 emissions from forest fires used to clear forests.

4.1.6.1 Estimation of baseline carbon stock changes

The use of carbon stock estimates in similar ecosystems derived from local studies, literature and IPCC defaults is permitted, provided the accuracy and conservativeness of the estimates are demonstrated.

As mentioned in section “1.13 Conditions Prior to Project Initiation” of this VCS-PD, biomass data were taken from actual field measurements from the neighbouring Fortaleza Ituxi REDD Project⁹⁰. The data relating to the above- and below-ground carbon stocks in Submontane open ombrophilous forest (As), presented in Table 15.a of VM0015 (below), were calculated from this biomass inventory study. The statistics relating to the latter are presented below.

As noted under section 3.3., sub-section “similarity”, the project area contains contains 36% Dense Ombrophilous Forest (DOF), as well as 64% of Open Ombrophilous Forest (OOF), considered

⁹⁰ Source: Ituxi REDD biomass inventory

below. However, given that DOF is reported in scientific literature (Barni et al., 2016⁹¹, Ministry of Science, Technology and Innovation (2015)⁹² to have higher biomass and carbon stocks than OOF, considering above- and below-ground biomass, it was considered conservative to simplify, avoid stratification of the project area, and take only OOF into account.

Table 43. Statistics on above- and below-ground biomass inventory data

	ab (t/ha)	bb (t/ha)
Average	314.75	96.00
Standard deviation	117.61	35.87
n	224.00	224.00
t	1.29	1.29
Margin of error	10.10	3.08
Upper bound	324.85	99.08
Lower bound	304.65	92.92

⁹¹ Source (accessed 27/07/2021): http://philip.inpa.gov.br/publ_livres/mss%20and%20in%20press/Barni_et_al-biomassa_florestal_em_Roraima_PORTUGUES_2016.07.19.pdf

⁹² Source (accessed 27/07/2021): http://redd.mma.gov.br/images/FREL/RR_LULUCF_Mudanca-de-Uso-e-Floresta.pdf

Table 44. Carbon stocks per hectare of initial forest classes icl existing in the project area and leakage belt: Estimated values (Table 15.a of VM0015)

Year	Project year t	Initial forest class <i>icl</i> Name: Submontane open ombrophilous forest (As) ID <i>icl</i> 1 Average carbon stock per hectare ± 90% CI													
		Cab <i>icl</i>		Cbb <i>icl</i>		Cwp <i>icl</i>								Ctot <i>icl</i>	
						short lived		medium lived		long lived					
		C stock	± 90% CI	C stock	± 90% CI	C stock	± 90% CI	C stock	± 90% CI	C stock	± 90% CI			C stock	± 90% CI
		t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹		
		2018	0	577	559	176	170	0	0	0	0	30	25	723	704
2019	1														
2020	2														
...	...														
2048	30														

90% Confidence Intervals have been used to define whether the most suitable choice would be the average or the lower limit of the range, to mitigate uncertainties in estimates, as shown in the table below. In the present case, the averages of above and below-ground biomass were used for calculations; while the upper limit of the interval was used for the calculations related to the wood products carbon pool, for conservativeness purposes and mitigation of uncertainties.

Table 45. Carbon stocks per hectare of initial forest classes icl existing in the project area and leakage belt: Values to be used after discounts due to uncertainties (Table 15.b of VM0015)

Year	Project year t	Initial forest class <i>icl</i>											
		Name: Submontane open ombrophylous forest (As)											
		ID <i>icl</i> 1											
		Average carbon stock per hectare ± 90% CI											
		Cab <i>icl</i>		Cbb <i>icl</i>		Cwp <i>icl</i>						Ctot <i>icl</i>	
		C stock		C stock		short lived		medium lived		long lived			
		C stock change		C stock change		C stock change		C stock change		C stock change		C stock change	
		t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹
2018	0												
2019	1												
2020	2	577	0	176	0	0	0	0	0	35	5	718	-5
n	n												
2048	30												

The same reasoning is applicable to post-deforestation classes, for which the upper limit of the interval was taken in the case of above-ground biomass, while the average has been chosen for below-ground biomass, for conservativeness purposes and mitigation of uncertainties.

Table 46. Long-term (20-year) average carbon stocks per hectare of post-deforestation LU/LC classes present in the Reference Region (Table 16 of VM0015)

Year	Project year t	Post deforestation class <i>fcl</i>											
		Name: Pasture											
		ID <i>fcl</i> 1											
		Average carbon stock per hectare ± 90% CI											
		<i>Cab fcl</i>		<i>Cbb fcl</i>		<i>short lived</i>		<i>Cwp fcl</i>		<i>long lived</i>		<i>Ctot fcl</i>	
average stock	± 90% CI	average stock	± 90% CI	average stock	± 90% CI	average stock	± 90% CI	average stock	± 90% CI	average stock	± 90% CI		
t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	
2018	0	11.37	5.9	18.15	9.4	0	0	0	0	0	0	29.52	15.3
2019	1												
2020	2												
...	...												
2048	30												
Average		11.37		18.15		0		0		0		29.52	
Average to be used in calculations		16.8		26.9		0		0		0		43.7	

Table 47. Long-term (20-year) area weighted average carbon stock per zone (Table 17 of VM0015)

Zone		Post -deforestation LU/LC-class fcl			Area weighted long-term (20 years) average carbon stocks per zone z			
		Name:	Pasture					
		ID fcl	1					
		Cab fcl	Cbb fcl	Cwp fcl	Cab z	Cbb z	Cwp z	Ctot z
		C stock	C stock	C stock	C stock	C stock	C stock	C stock
		t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹	t CO ₂ e ha ⁻¹
1	RR	16.8	26.9	0	16.8	26.9	0	43.7

The carbon stock change factors shown below were calculated based on VM0015 premises, using Method 2, as activity data are available for categories.

Table 48. Carbon stock change factors for land-use change categories (ct or ctz) (Method 2) (Table 20.c of VM0015)

Year after deforestation		ΔCab _{ctz,t}	ΔCbb _{ctz,t}	ΔCwp _{ctz,t} long-lived
1	2018	-575.35	-14.91	0
2	2019	1.68	-14.91	0
3	2020	1.68	-14.91	0
4	2021	1.68	-14.91	0
5	2022	1.68	-14.91	0
6	2023	1.68	-14.91	0
7	2024	1.68	-14.91	0
8	2025	1.68	-14.91	0

9	2026	1.68	-14.91	0
10	2027	1.68	-14.91	0
11	2028	0	0.00	0
12	2029	0	0.00	0
13	2030	0	0.00	0
14	2031	0	0.00	0
15	2032	0	0.00	0
16	2033	0	0.00	0
17	2034	0	0.00	0
18	2035	0	0.00	0
19	2036	0	0.00	0
20	2037	0	0.00	0
21	2038	0	0.00	0
22	2039	0	0.00	0
23	2040	0	0.00	0
24	2041	0	0.00	0
25	2042	0	0.00	0
26	2043	0	0.00	0
27	2044	0	0.00	0
28	2045	0	0.00	0
29	2046	0	0.00	0
30	2047	0	0.00	0
31	2048	0	0.00	0

The following tables show the calculation of baseline carbon stock changes in above-ground biomass, below-ground biomass and wood products in the Project Area, using the carbon stock change factors presented in the Table 48 immediately above.

Table 49. Baseline carbon stock change in the above-ground biomass in the Project Area (Table 22.b.1 of VM0015)

Year	Project year t	Activity data per category x Carbon stock change factor for above-ground biomass in the project area		Total baseline carbon stock change in the project area	
		Forest / Pasture		annual	cumulative
		ABSLPA _{ct,t}	ΔCab _{ct,t}	ΔCabBSLPA _t	ΔCabBSLPA
		ha	tCO ₂ -e ha ⁻¹	tCO ₂ -e	tCO ₂ -e
2018	0	1,041.2	-575	-599,048	-599,048
2019	1	1,386.7	-328	-796,107	-1,395,155
2020	2	1,700.3	-236	-974,157	-2,369,311
2021	3	1,750.1	-170	-999,945	-3,369,256
2022	4	1,736.9	-130	-989,430	-4,358,687
2023	5	1,005.8	-66	-565,892	-4,924,578
2024	6	838.9	-49	-468,165	-5,392,743
2025	7	1,590.4	-81	-899,154	-6,291,897

2026	8	849.0	-39	-469,855	-6,761,752
2027	9	1,594.3	-66	-897,259	-7,659,011
2028	10	952.4	-39	-526,990	-8,186,001
2029	11	881.2	-38	-486,797	-8,672,798
2030	12	881.2	-40	-488,176	-9,160,974
2031	13	881.2	-44	-489,618	-9,650,592
2032	14	881.2	-47	-491,059	-10,141,650
2033	15	881.2	-48	-491,269	-10,632,919
2034	16	420.8	-23	-226,295	-10,859,214
2035	17	420.8	-26	-228,265	-11,087,478
2036	18	420.8	-28	-228,986	-11,316,465
2037	19	420.8	-33	-230,963	-11,547,427
2038	20	420.8	-36	-231,858	-11,779,286
2039	21	406.0	-37	-224,128	-12,003,413
2040	22	406.0	-40	-224,928	-12,228,342
2041	23	406.0	-44	-225,729	-12,454,070
2042	24	406.0	-49	-226,529	-12,680,600
2043	25	406.0	-55	-227,330	-12,907,929
2044	26	412.8	-56	-231,268	-13,139,198
2045	27	412.8	-56	-231,282	-13,370,479
2046	28	412.8	-56	-231,295	-13,601,774
2047	29	412.8	-56	-231,309	-13,833,083
2048	30	131.2	-18	-69,285	-13,902,368

Table 50. Baseline carbon stock change in the below-ground biomass in the Project Area (Table 22.b.2 of VM0015)

Year	Project year t	Activity data per category x Carbon stock change factor for below-ground biomass in the project area		Total baseline carbon stock change in the project area	
		Forest / Pasture		annual	cumulative
		BBSLPA _{ct,t}	ΔCbb _{ct,t}	ΔCbbBSLPA _t	ΔCbbBSLPA
		ha	tCO ₂ -e ha ⁻¹	tCO ₂ -e	tCO ₂ -e
2018	0	1,041.2	-14.91	-15,524	-15,524
2019	1	1,386.7	-14.91	-36,200	-51,724
2020	2	1,700.3	-14.91	-61,550	-113,274
2021	3	1,750.1	-14.91	-87,643	-200,917
2022	4	1,736.9	-14.91	-113,540	-314,457
2023	5	1,005.8	-14.91	-128,536	-442,993
2024	6	838.9	-14.91	-141,044	-584,037
2025	7	1,590.4	-14.91	-164,757	-748,794
2026	8	849.0	-14.91	-177,415	-926,209
2027	9	1,594.3	-14.91	-201,186	-1,127,394
2028	10	952.4	-14.91	-199,861	-1,327,255
2029	11	881.2	-14.91	-192,324	-1,519,580

2030	12	881.2	-14.91	-180,113	-1,699,693
2031	13	881.2	-14.91	-167,159	-1,866,851
2032	14	881.2	-14.91	-154,401	-2,021,253
2033	15	881.2	-14.91	-152,544	-2,173,797
2034	16	420.8	-14.91	-146,310	-2,320,107
2035	17	420.8	-14.91	-128,871	-2,448,978
2036	18	420.8	-14.91	-122,488	-2,571,466
2037	19	420.8	-14.91	-104,991	-2,676,458
2038	20	420.8	-14.91	-97,066	-2,773,524
2039	21	406.0	-14.91	-89,981	-2,863,505
2040	22	406.0	-14.91	-82,896	-2,946,401
2041	23	406.0	-14.91	-75,811	-3,022,212
2042	24	406.0	-14.91	-68,725	-3,090,937
2043	25	406.0	-14.91	-61,640	-3,152,577
2044	26	412.8	-14.91	-61,521	-3,214,099
2045	27	412.8	-14.91	-61,402	-3,275,501
2046	28	412.8	-14.91	-61,283	-3,336,784
2047	29	412.8	-14.91	-61,164	-3,397,949
2048	30	131.2	-14.91	-56,846	-3,454,795

Table 51. Baseline carbon stock change in the wood products in the Project Area (Table 22.b.6 of VM0015)

Year	Project year t	Activity data per category x Carbon stock change factor for wood products biomass in the project area		Total baseline carbon stock change in the project area	
		Forest / Pasture		annual	cumulative
		WPSLPA _{ct,t}	ΔCwp _{ct,t}	ΔCwpBSLPA _t	ΔCwpBSLPA
		ha	tCO ₂ -e ha ⁻¹	tCO ₂ -e	tCO ₂ -e
2018	0	1,041.2	0.00	0	0
2019	1	1,386.7	0.00	0	0
2020	2	1,700.3	0.00	0	0
2021	3	1,750.1	0.00	0	0
2022	4	1,736.9	0.00	0	0
2023	5	1,005.8	0.00	0	0
2024	6	838.9	0.00	0	0
2025	7	1,590.4	0.00	0	0
2026	8	849.0	0.00	0	0
2027	9	1,594.3	0.00	0	0
2028	10	952.4	0.00	0	0
2029	11	881.2	0.00	0	0
2030	12	881.2	0.00	0	0
2031	13	881.2	0.00	0	0
2032	14	881.2	0.00	0	0
2033	15	881.2	0.00	0	0

2034	16	420.8	0.00	0	0
2035	17	420.8	0.00	0	0
2036	18	420.8	0.00	0	0
2037	19	420.8	0.00	0	0
2038	20	420.8	0.00	0	0
2039	21	406.0	0.00	0	0
2040	22	406.0	0.00	0	0
2041	23	406.0	0.00	0	0
2042	24	406.0	0.00	0	0
2043	25	406.0	0.00	0	0
2044	26	412.8	0.00	0	0
2045	27	412.8	0.00	0	0
2046	28	412.8	0.00	0	0
2047	29	412.8	0.00	0	0
2048	30	131.2	0.00	0	0

The following tables show the calculation of baseline carbon stock changes in above-ground biomass, below-ground biomass and wood products in the Leakage Belt, using the carbon stock change factors presented in Table 48.

Table 52. Baseline carbon stock change in the above-ground biomass in the leakage belt area (Table 22.c.1 of VM0015)

Year	Project year t	Activity data per category x Carbon stock change factor for above-ground biomass in the leakage belt		Total baseline carbon stock change in the leakage belt	
		Forest / Pasture		annual	cumulative
		ABSLK _{ct,t}	ΔCab _{ct,t}	ΔCabBSLLK _t	ΔCabBSLLK
		ha	tCO ₂ -e ha ⁻¹	tCO ₂ -e	tCO ₂ -e
2018	0	4,150	-575	-2,387,485	-2,387,485
2019	1	13,433	-439	-7,721,831	-10,109,316
2020	2	12,254	-235	-7,020,673	-17,129,989
2021	3	12,293	-167	-7,022,368	-24,152,357
2022	4	10,778	-116	-6,130,399	-30,282,756
2023	5	10,562	-94	-5,987,713	-36,270,469
2024	6	10,345	-79	-5,844,900	-42,115,370
2025	7	10,378	-69	-5,846,592	-47,961,962
2026	8	9,798	-58	-5,495,644	-53,457,606
2027	9	9,601	-52	-5,365,855	-58,823,461
2028	10	9,404	-48	-5,242,866	-64,066,328
2029	11	2,669	-14	-1,374,840	-65,441,168
2030	12	2,669	-16	-1,390,987	-66,832,155
2031	13	2,669	-18	-1,407,198	-68,239,353
2032	14	2,669	-20	-1,420,859	-69,660,212

2033	15	2,669	-23	-1,434,155	-71,094,367
2034	16	2,022	-20	-1,074,803	-72,169,170
2035	17	2,022	-24	-1,088,879	-73,258,048
2036	18	2,022	-29	-1,101,979	-74,360,027
2037	19	2,022	-36	-1,114,747	-75,474,774
2038	20	2,022	-48	-1,127,181	-76,601,955
2039	21	2,060	-50	-1,150,411	-77,752,366
2040	22	2,060	-52	-1,151,436	-78,903,802
2041	23	2,060	-53	-1,152,461	-80,056,263
2042	24	2,060	-55	-1,153,486	-81,209,749
2043	25	2,060	-57	-1,154,511	-82,364,261
2044	26	2,104	-58	-1,179,553	-83,543,814
2045	27	2,104	-57	-1,179,414	-84,723,228
2046	28	2,104	-57	-1,179,276	-85,902,504
2047	29	2,104	-57	-1,179,138	-87,081,641
2048	30	669	-18	-353,186	-87,434,827

Table 53. Baseline carbon stock change in the below-ground biomass in the Leakage Belt area (Table 22.c.2 of VM0015)

Year	Project year t	Activity data per category x Carbon stock change factor for below-ground biomass in the leakage belt		Total baseline carbon stock change in the leakage belt	
		Forest / Pasture		annual	cumulative
		BBSLLK _{ct,t}	$\Delta C_{bb,ct,t}$	$\Delta C_{bb}BSLLK_t$	$\Delta C_{bb}BSLLK$
		ha	tCO ₂ -e ha ⁻¹	tCO ₂ -e	tCO ₂ -e
2018	0	4,150	-14.91	-61,870	-61,870
2019	1	13,433	-14.91	-262,156	-324,026
2020	2	12,254	-14.91	-444,859	-768,885
2021	3	12,293	-14.91	-628,140	-1,397,025
2022	4	10,778	-14.91	-788,844	-2,185,869
2023	5	10,562	-14.91	-946,320	-3,132,189
2024	6	10,345	-14.91	-1,100,557	-4,232,746
2025	7	10,378	-14.91	-1,255,289	-5,488,035
2026	8	9,798	-14.91	-1,401,379	-6,889,414
2027	9	9,601	-14.91	-1,544,534	-8,433,948
2028	10	9,404	-14.91	-1,622,870	-10,056,819
2029	11	2,669	-14.91	-1,462,377	-11,519,196
2030	12	2,669	-14.91	-1,319,467	-12,838,663
2031	13	2,669	-14.91	-1,175,979	-14,014,642
2032	14	2,669	-14.91	-1,055,068	-15,069,710
2033	15	2,669	-14.91	-937,385	-16,007,095
2034	16	2,022	-14.91	-813,294	-16,820,388
2035	17	2,022	-14.91	-688,707	-17,509,096
2036	18	2,022	-14.91	-572,762	-18,081,858

2037	19	2,022	-14.91	-459,753	-18,541,611
2038	20	2,022	-14.91	-349,693	-18,891,304
2039	21	2,060	-14.91	-340,619	-19,231,923
2040	22	2,060	-14.91	-331,546	-19,563,469
2041	23	2,060	-14.91	-322,472	-19,885,940
2042	24	2,060	-14.91	-313,398	-20,199,339
2043	25	2,060	-14.91	-304,325	-20,503,663
2044	26	2,104	-14.91	-305,549	-20,809,212
2045	27	2,104	-14.91	-306,773	-21,115,985
2046	28	2,104	-14.91	-307,998	-21,423,983
2047	29	2,104	-14.91	-309,222	-21,733,205
2048	30	669	-14.91	-289,046	-22,022,251

Table 54. Baseline carbon stock change in the wood products in the Leakage Belt area (Table 22.c.6 of VM0015)

Year	Project year t	Activity data per category x Carbon stock change factor for wood products biomass in the leakage belt area		Total baseline carbon stock change in the leakage belt area	
		Forest / Pasture		annual	cumulative
		WPSLLK _{ct,t}	ΔCwp _{ct,t}	ΔCwpBSLLK _t	ΔCwpBSLLK
		ha	tCO ₂ -e ha ⁻¹	tCO ₂ -e	tCO ₂ -e
2018	0	4,149.6	0.00	0	0
2019	1	13,433.1	0.00	0	0
2020	2	12,253.8	0.00	0	0
2021	3	12,292.6	0.00	0	0
2022	4	10,778.3	0.00	0	0
2023	5	10,561.9	0.00	0	0
2024	6	10,344.6	0.00	0	0
2025	7	10,377.8	0.00	0	0
2026	8	9,798.3	0.00	0	0
2027	9	9,601.4	0.00	0	0
2028	10	9,403.6	0.00	0	0
2029	11	2,668.9	0.00	0	0
2030	12	2,668.9	0.00	0	0
2031	13	2,668.9	0.00	0	0
2032	14	2,668.9	0.00	0	0
2033	15	2,668.9	0.00	0	0
2034	16	2,021.9	0.00	0	0
2035	17	2,021.9	0.00	0	0
2036	18	2,021.9	0.00	0	0
2037	19	2,021.9	0.00	0	0
2038	20	2,021.9	0.00	0	0
2039	21	2,060.3	0.00	0	0
2040	22	2,060.3	0.00	0	0

2041	23	2,060.3	0.00	0	0
2042	24	2,060.3	0.00	0	0
2043	25	2,060.3	0.00	0	0
2044	26	2,104.0	0.00	0	0
2045	27	2,104.0	0.00	0	0
2046	28	2,104.0	0.00	0	0
2047	29	2,104.0	0.00	0	0
2048	30	668.7	0.00	0	0

4.1.6.2 Baseline non-CO2 emissions from forest fires

Conversion of forest to non-forest involving fires is a source of emissions of non-CO₂ gases (CH₄ and N₂O). Sources report a steady increase in the number of fire alerts in Lábrea over the historical reference period. Furthermore, GIS analysis was conducted utilizing data on fire occurrence from the CPTEC/INPE database⁹³ and Mapbiomas⁹⁴, which was duly presented at audit under the category “Forest Fire Assessment in the RR”. Frequency of forest fires within the Reference Region over the historical reference period, for years 2011 – 2018 was assessed, these being the years of the historical reference period for which fire data were available. To this extent, as specified in the methodology, data on such forest fires are available from the historical reference period

It was observed that fires occurred in all the years analysed, totalling 3477 fires in the period. The frequency fires constantly grew, year on year, from 2013 to 2018, with only one decrease, from 2012 to 2013, as shown in Figure 48 below. Corresponding evidence was presented at audit, under category “21 - Remote sensing data and GIS, supervisor reports to justify the area affected by forest fire”. This leads the project proponent to conclude that these emissions are an important component of the baseline, therefore CH₄ and N₂O emissions from biomass burning were included. The effect of fire on carbon emissions is counted in the estimation of carbon stock changes; therefore, CO₂ emissions from forest fires were ignored to avoid double counting.

⁹³ Source (last visited on 04/07/2021): <http://queimadas.dgi.inpe.br/queimadas/bdqueimadas#exportar-dados>

⁹⁴ Source . Projeto MapBiomas – Coleção 5.0 da Série Anual de Mapas de Uso e Cobertura da Terra do Brasil (last visited on 04/07/2021): https://mapbiomas.org/colecoes-mapbiomas-1?cama_set_language=pt-BR.

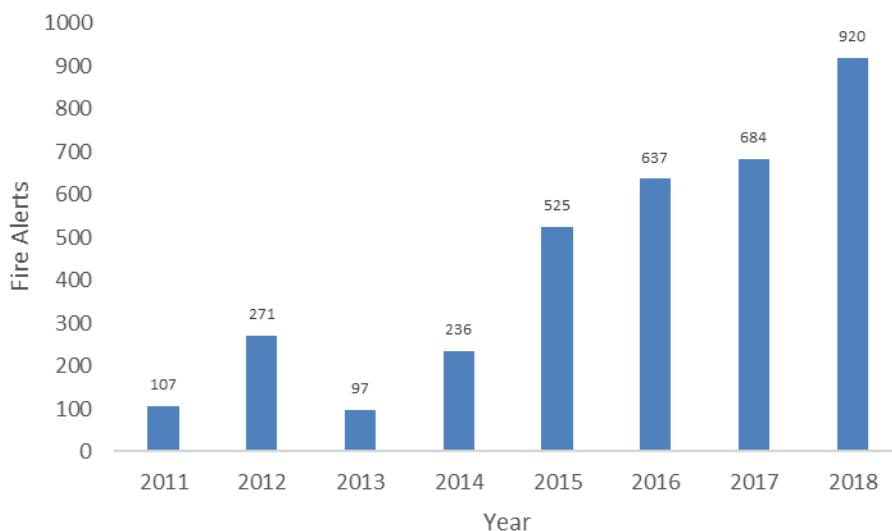


Figure 48: Fire alerts within the RR over the historical reference period.

To estimate non-CO₂ emissions from forest fires, the average percentage of the deforested area in which fire was used, the average proportion of mass burnt in each carbon pool ($P_{burnt,p}$), and the average combustion efficiency of each pool (CE_p) were estimated. These average percentage values were estimated for each forest class (icl) and are assumed to remain the same in the future.

In accordance with the VM0015 methodology, GHG emissions from biomass burning were estimated based on revised IPCC 1996 GL LULUCF guidance, as follows.

$$EBB_{tot_{icl,t}} = EBB_{N20_{icl,t}} + EBB_{CH4_{icl,t}} \quad (11)$$

Where:

$EBB_{tot_{icl,t}}$ Total GHG emission from biomass burning in forest class icl at year t ; tCO₂-e ha⁻¹

$EBB_{N20_{icl,t}}$ Total GHG emission from biomass burning in forest class icl at year t ; tCO₂-e ha⁻¹

$EBB_{CH4_{icl,t}}$ CH₄ emission from biomass burning in forest class icl at year t ; tCO₂-e ha⁻¹

$$EBB_{N20_{icl,t}} = EBB_{CO2_{icl,t}} * 12/44 * NCR * ER_{N20} * 44/28 * GWP_{N20}$$

$$EBB_{CH4_{icl,t}} = EBB_{CO2_{icl,t}} * 12/44 * ER_{CH4} * 16/12 * GWP_{CH4}$$

Where:

$EBBCO2_{icl,t}$ Per hectare CO₂ emission from biomass burning in slash and burn in forest class *icl* at year *t*; tCO₂-e ha⁻¹

$EBBN2O_{icl,t}$ Per hectare N₂O emission from biomass burning in slash and burn in forest class *icl* at year *t*; tCO₂-e ha⁻¹

$EBBCH4_{icl,t}$ Per hectare CH₄ emission from biomass burning in slash and burn in forest class *icl* at year *t*; tCO₂-e ha⁻¹

NCR Nitrogen to carbon ratio (IPCC default value = 0.01); dimensionless

ER_{N2O} Emission ratio for N₂O (IPCC default value = 0.007)

ER_{CH4} Emission ratio for CH₄ (IPCC default value = 0.012)

GWP_{N2O} Global Warming Potential for N₂O (IPCC default value = 310 for the first commitment period)

GWP_{CH4} Global Warming Potential for CH₄ (IPCC default value = 21 for the first commitment period)

$$BBCO2_{icl,t} = Fburnt_{icl} * (x + a)^n = \sum_{p=1}^p (C_{p,icl,t} * Pburnt_{p,icl} * CE_{p,icl}) \quad (14)$$

period in the forest class *icl*; %

$C_{p,icl,t}$ Average carbon stock per hectare in the carbon pool *p* burnt in the forest class *icl* at year *t*; tCO₂-e ha⁻¹

$Pburnt_{p,icl}$ Proportion of forest area burned during the historical reference period in the forest class *icl*; %

$CE_{p,icl}$ Average combustion efficiency of the carbon pool *p* in the forest class *icl*; dimensionless

p Carbon pool that could burn (above-ground biomass, dead wood, litter)

icl 1, 2, 3 ... *lcl* (pre-deforestation) forest classes

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

The IPCC default combustion efficiency of 0.5 was used. The Nitrogen to Carbon Ratio (NCR) of 0.01 was used.

Table 55. Parameters used to calculate non-CO2 emissions from forest fires (Table 23 of VM0015)

Initial Forest Class		Parameters				$ECO2-ab$	$EBBCO2-tot$	$EBBN2O_{icl}$	$EBBCH4_{icl}$	$EBBtot_{icl}$
		$F_{burnt_{icl}}$	C_{ab}	$P_{burnt_{ab,icl}}$	$CE_{ab,icl}$					
ID_{icl}	Name	ND	$tCO_2e\ ha^{-1}$	ND	ND	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$
1	Submontane open ombrophylous forest (As)	1.0	577	0.86	0.5	248	248	2.31	22.7	25.1

Table 56. Baseline non-CO2 emissions from forest fires in the Project Area (Table 24 of VM0015)

Year	Project year t	Emissions of non-CO2 gasses from baseline forest fires		Total baseline non-CO2 emissions from forest fires in the project area	
		$ID_{icl} = 1$		annual	cumulative
		$ABSLPA_{icl,t}$	$EBBBSL_{tot_{icl}}$	$EBBBSLPA_t$	$EBBBSLPA$
		ha	$tCO_2-e\ ha^{-1}$	tCO_2-e	tCO_2-e
2018	0	1,041.2	25.05	26,083	26,083
2019	1	1,386.7	25.05	34,739	60,822
2020	2	1,700.3	25.05	42,593	103,415
2021	3	1,750.1	25.05	43,841	147,256
2022	4	1,736.9	25.05	43,510	190,767
2023	5	1,005.8	25.05	25,197	215,964
2024	6	838.9	25.05	21,015	236,979
2025	7	1,590.4	25.05	39,842	276,822
2026	8	849.0	25.05	21,267	298,089
2027	9	1,594.3	25.05	39,939	338,028
2028	10	952.4	25.05	23,858	361,886
2029	11	881.2	25.05	22,076	383,961
2030	12	881.2	25.05	22,076	406,037
2031	13	881.2	25.05	22,076	428,113
2032	14	881.2	25.05	22,076	450,189

2033	15	881.2	25.05	22,076	472,265
2034	16	420.8	25.05	10,542	482,807
2035	17	420.8	25.05	10,542	493,349
2036	18	420.8	25.05	10,542	503,891
2037	19	420.8	25.05	10,542	514,432
2038	20	420.8	25.05	10,542	524,974
2039	21	406.0	25.05	10,172	535,146
2040	22	406.0	25.05	10,172	545,317
2041	23	406.0	25.05	10,172	555,489
2042	24	406.0	25.05	10,172	565,660
2043	25	406.0	25.05	10,172	575,832
2044	26	412.8	25.05	10,342	586,174
2045	27	412.8	25.05	10,342	596,516
2046	28	412.8	25.05	10,342	606,857
2047	29	412.8	25.05	10,342	617,199
2048	30	131.2	25.05	3,287	620,486

4.2 Project Emissions

The goal of this step (STEP 7 of the VM0015 methodology) is to provide an ex-ante estimate of future carbon stock changes and non-CO2 emissions from forest fires under the project scenario (“actual”).

4.2.1 Ex ante estimation of actual carbon stock changes

These carbon stock changes are due to the following:

- Planned activities within the project area.
- Unplanned deforestation that cannot be avoided.

Carbon stock changes due to possible future catastrophic events cannot be predicted and are therefore excluded from the *ex-ante* assessment.

Certain discrete areas of forest within the project area will be subject to project activities that will change the carbon stocks of these areas compared to the baseline. In this Project Activity, such activities are related to planned timber logging.

According to the Sustainable Forest Management Plan, the annual area of sustainable logging is 3,931.62 hectares. Given that the total management area is of 43,247.79 hectares, it is assumed that logging activities will be carried out over 11 years, followed by a 15 year fallow period. The

table below shows the yearly estimates of carbon stock decrease due to planned logging activities in the Project Area.

The increase following planned logging activities in the Project Area was also estimated, using secondary data by West et al. (2014), which indicates an annual increase of 3.03 tCO₂ per hectare per year due to post-logging regeneration of vegetation.

Table 57. Ex ante estimated actual carbon stock decrease due to planned logging activities in the Project Area (Table 25.b of VM0015)

Year	Project year t	Areas of planned logging activities x Carbon stock change (decrease) in the project area		Total carbon stock decrease due to planned logging activities	
		$IDC_l = 1$		annual	cumulative
		$APLPA_{lcl,t}$	$\Delta C_{totlcl,t}$	$\Delta CPLdPA_t$	$\Delta CPLdPA$
		ha	tCO ₂ -e ha ⁻¹	tCO ₂ -e	tCO ₂ -e
2018	0	488.7	103.20	50,433	50,433
2019	1	2,893.9	103.20	298,637	349,069
2020	2	4,430.8	103.20	457,241	806,310
2021	3	3,297.3	103.20	340,270	1,146,580
2022	4	4,775.5	103.20	492,814	1,639,394
2023	5	4,786.1	103.20	493,910	2,133,304
2024	6	3,976.6	103.20	410,370	2,543,673
2025	7	3,980.1	103.20	410,728	2,954,401
2026	8	3,980.1	103.20	410,728	3,365,128
2027	9	3,971.7	103.20	409,867	3,774,995
2028	10	3,971.7	103.20	409,867	4,184,862
2029	11	2,694.3	103.20	278,041	4,462,903
2030	12	0.0	103.20	0	4,462,903
2031	13	0.0	103.20	0	4,462,903
2032	14	0.0	103.20	0	4,462,903
2033	15	0.0	103.20	0	4,462,903
2034	16	0.0	103.20	0	4,462,903
2035	17	0.0	103.20	0	4,462,903
2036	18	0.0	103.20	0	4,462,903
2037	19	0.0	103.20	0	4,462,903
2038	20	0.0	103.20	0	4,462,903
2039	21	0.0	103.20	0	4,462,903
2040	22	0.0	103.20	0	4,462,903
2041	23	0.0	103.20	0	4,462,903
2042	24	0.0	103.20	0	4,462,903
2043	25	0.0	103.20	0	4,462,903
2044	26	0.0	103.20	0	4,462,903

2045	27	3,430.1	103.20	353,972	4,816,875
2046	28	4,395.0	103.20	453,549	5,270,424
2047	29	3,286.6	103.20	339,165	5,609,590
2048	30	4,775.5	103.20	492,814	6,102,404

Table 58. Ex ante estimated carbon stock increase following planned logging activities in the project area (Table 26.b of VM0015)

Year	Project year t	Areas of planned logging activities x Carbon stock change (increase up to maximum long-term average)		Total carbon stock increase due to planned logging activities	
		IDcl = 1		annual	cumulative
		APLPA _{icl,t}	$\Delta C_{tot,icl,t}$	$\Delta CPLiPA_t$	$\Delta CPLiPA$
		ha	tCO ₂ -e ha ⁻¹	tCO ₂ -e	tCO ₂ -e
2018	0	488.7	3.03	1,478	1,478
2019	1	2,893.9	3.03	10,232	11,711
2020	2	4,430.8	3.03	23,635	35,346
2021	3	3,297.3	3.03	33,610	68,956
2022	4	4,775.5	3.03	48,056	117,012
2023	5	4,786.1	3.03	62,534	179,545
2024	6	3,976.6	3.03	74,563	254,108
2025	7	3,980.1	3.03	86,603	340,711
2026	8	3,980.1	3.03	98,642	439,353
2027	9	3,971.7	3.03	110,657	550,010
2028	10	3,971.7	3.03	122,671	672,681
2029	11	2,694.3	3.03	130,821	803,502
2030	12	0.0	3.03	130,821	934,324
2031	13	0.0	3.03	130,821	1,065,145
2032	14	0.0	3.03	130,821	1,195,967
2033	15	0.0	3.03	130,821	1,326,788
2034	16	0.0	3.03	130,821	1,457,609
2035	17	0.0	3.03	130,821	1,588,431
2036	18	0.0	3.03	130,821	1,719,252
2037	19	0.0	3.03	130,821	1,850,074
2038	20	0.0	3.03	130,821	1,980,895
2039	21	0.0	3.03	130,821	2,111,716
2040	22	0.0	3.03	130,821	2,242,538
2041	23	0.0	3.03	130,821	2,373,359
2042	24	0.0	3.03	130,821	2,504,181
2043	25	0.0	3.03	130,821	2,635,002
2044	26	0.0	3.03	130,821	2,765,824
2045	27	3,430.1	2.99	139,719	2,905,543
2046	28	4,395.0	2.82	144,260	3,049,803

2047	29	3,286.6	2.59	140,799	3,190,602
2048	30	4,775.5	2.46	145,270	3,335,872

Some unplanned deforestation may happen in the Project Area despite the AUD project activity. The level at which deforestation is actually reduced in the project case depends on the effectiveness of the proposed activities, which cannot be measured *ex ante*.

To allow *ex-ante* projections to be made, the project proponent shall make a conservative assumption about the effectiveness of the proposed project activities and estimate an Effectiveness Index (EI) between 0 (no effectiveness) and 1 (maximum effectiveness). The estimated value of EI is used to multiply the baseline projections by the factor (1 - EI) and the result shall be considered the ex-ante estimated emissions from unplanned deforestation in the project case. The project design team conservatively considers that surveillance activities are able to attain 90% of effectiveness in avoiding unplanned deforestation inside the Project Area. According to studies comparing the incidence of fires in the Reference Region and the Project Area (for 2019 and 2020), it is evidenced the initial fire occurrences in PA are 74% lower than in the RR. Moreover, none of these occurrences resulted in biomass loss, as demonstrated by satellite imagery. Evidences are available to auditors.

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

Where:

$\Delta CUDdPA_t$ Total *ex ante* actual carbon stock change due to unavoided unplanned deforestation at year t in the project area; tCO₂-e GHG emission from biomass burning in forest class *icl* at year t; tCO₂-e ha⁻¹

$\Delta CBSL_t$ Total baseline carbon stock change at year t in the project area; tCO₂-e

EI Ex ante estimated Effectiveness Index; %

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

Table 59. Ex ante estimated net carbon stock change in the project area under the project scenario (Table 27 of VM0015)

Year	Project year t	Total carbon stock decrease due to planned logging activities		Total carbon stock increase due to planned logging activities		Total carbon stock decrease due to unavoided unplanned deforestation		Total carbon stock change in the project case	
		annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
		ΔCPLdPA_t	ΔCPLdPA	ΔCPLiPA_t	ΔCPLiPA	ΔCUDdPA_t	ΔCUDdPA	ΔCPSPA_t	ΔCPSPA
		tCO ₂ -e	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e
2018	0	50,433	50,433	1,478	1,478	-61,457	-61,457	-110,412	-110,412
2019	1	298,637	349,069	10,232	11,711	-83,231	-144,688	-371,635	-482,047
2020	2	457,241	806,310	23,635	35,346	-103,571	-248,259	-537,176	-1,019,223
2021	3	340,270	1,146,580	33,610	68,956	-108,759	-357,017	-415,419	-1,434,641
2022	4	492,814	1,639,394	48,056	117,012	-110,297	-467,314	-555,055	-1,989,697
2023	5	493,910	2,133,304	62,534	179,545	-69,443	-536,757	-500,819	-2,490,516
2024	6	410,370	2,543,673	74,563	254,108	-60,921	-597,678	-396,728	-2,887,243
2025	7	410,728	2,954,401	86,603	340,711	-106,391	-704,069	-430,516	-3,317,759
2026	8	410,728	3,365,128	98,642	439,353	-64,727	-768,796	-376,812	-3,694,571
2027	9	409,867	3,774,995	110,657	550,010	-109,844	-878,641	-409,055	-4,103,626
2028	10	409,867	4,184,862	122,671	672,681	-72,685	-951,326	-359,881	-4,463,507
2029	11	278,041	4,462,903	130,821	803,502	-67,912	-1,019,238	-215,132	-4,678,639
2030	12	0	4,462,903	130,821	934,324	-66,829	-1,086,067	63,993	-4,614,646
2031	13	0	4,462,903	130,821	1,065,145	-65,678	-1,151,744	65,144	-4,549,502
2032	14	0	4,462,903	130,821	1,195,967	-64,546	-1,216,290	66,275	-4,483,227
2033	15	0	4,462,903	130,821	1,326,788	-64,381	-1,280,672	66,440	-4,416,787
2034	16	0	4,462,903	130,821	1,457,609	-37,260	-1,317,932	93,561	-4,323,226
2035	17	0	4,462,903	130,821	1,588,431	-35,714	-1,353,646	95,108	-4,228,118
2036	18	0	4,462,903	130,821	1,719,252	-35,147	-1,388,793	95,674	-4,132,444
2037	19	0	4,462,903	130,821	1,850,074	-33,595	-1,422,389	97,226	-4,035,218
2038	20	0	4,462,903	130,821	1,980,895	-32,892	-1,455,281	97,929	-3,937,289
2039	21	0	4,462,903	130,821	2,111,716	-31,411	-1,486,692	99,411	-3,837,879
2040	22	0	4,462,903	130,821	2,242,538	-30,782	-1,517,474	100,039	-3,737,840
2041	23	0	4,462,903	130,821	2,373,359	-30,154	-1,547,628	100,667	-3,637,172
2042	24	0	4,462,903	130,821	2,504,181	-29,525	-1,577,154	101,296	-3,535,876
2043	25	0	4,462,903	130,821	2,635,002	-28,897	-1,606,051	101,924	-3,433,952
2044	26	0	4,462,903	130,821	2,765,824	-29,279	-1,635,330	101,542	-3,332,409
2045	27	353,972	4,816,875	139,719	2,905,543	-29,268	-1,664,598	-243,521	-3,575,931
2046	28	453,549	5,270,424	144,260	3,049,803	-29,258	-1,693,856	-338,547	-3,914,477
2047	29	339,165	5,609,590	140,799	3,190,602	-29,247	-1,723,103	-227,614	-4,142,091
2048	30	492,814	6,102,404	145,270	3,335,872	-12,613	-1,735,716	-360,157	-4,502,248

4.2.2 Ex ante estimation of actual non-CO2 emissions from forest fires

Where forest fires have been included in the baseline scenario, non-CO₂ emissions from biomass burning must be included in the project scenario. This is done by multiplying the baseline emissions by the factor (1 – EI).

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

Where:

$EBBPSPA_t$ Total ex ante actual non-CO₂ emissions from forest fires due to unavoids unplanned deforestation at year t in the project area; tCO₂-e

$EBBBSPA_t$ Total non-CO₂ emissions from forest fires at year t in the project area; tCO₂-e

EI Ex ante estimated Effectiveness Index; %

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

Table 60. Total ex ante estimated actual emissions of non-CO2 gases due to forest fires in the project area (Table 28 of VM0015)

Year	Project year t	Total ex ante estimated actual non-CO2 emissions from forest fires in the Project area	
		annual	cumulative
		$EBBPSPA_t$	$EBBPSPA$
		tCO ₂ -e	tCO ₂ -e
2018	0	2,608	2,608
2019	1	3,474	6,082
2020	2	4,259	10,342
2021	3	4,384	14,726
2022	4	4,351	19,077
2023	5	2,520	21,596
2024	6	2,102	23,698
2025	7	3,984	27,682
2026	8	2,127	29,809
2027	9	3,994	33,803
2028	10	2,386	36,189
2029	11	2,208	38,396
2030	12	2,208	40,604
2031	13	2,208	42,811
2032	14	2,208	45,019
2033	15	2,208	47,226
2034	16	1,054	48,281
2035	17	1,054	49,335
2036	18	1,054	50,389

2037	19	1,054	51,443
2038	20	1,054	52,497
2039	21	1,017	53,515
2040	22	1,017	54,532
2041	23	1,017	55,549
2042	24	1,017	56,566
2043	25	1,017	57,583
2044	26	1,034	58,617
2045	27	1,034	59,652
2046	28	1,034	60,686
2047	29	1,034	61,720
2048	30	329	62,049

4.2.3 Ex ante estimation of actual carbon stock changes

Table 61. Total ex ante estimated actual net carbon stock changes and emissions of non-CO2 gases in the Project Area (Table 29 of VM0015)

Year	Project year t	Total ex ante carbon stock decrease due to planned activities		Total ex ante carbon stock increase due to planned activities		Total ex ante carbon stock decrease due to unavoided unplanned deforestation		Total ex ante net carbon stock change		Total ex ante estimated actual non-CO2 emissions from forest fires in the project area	
		annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
		ΔCPAdPA_t	ΔCPAdPA	ΔCPAiPA_t	ΔCPAiPA	ΔCUDdPA_t	ΔCUDdPA	ΔCPSPA_t	ΔCPSPA	EBBPSPA_t	EBBPSPA
		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
2018	0	50,433	50,433	1,478	1,478	-61,457	-61,457	-110,412	-110,412	2,608	2,608
2019	1	298,637	349,069	10,232	11,711	-83,231	-144,688	-371,635	-482,047	3,474	6,082
2020	2	457,241	806,310	23,635	35,346	-103,571	-248,259	-537,176	-1,019,223	4,259	10,342
2021	3	340,270	1,146,580	33,610	68,956	-108,759	-357,017	-415,419	-1,434,641	4,384	14,726
2022	4	492,814	1,639,394	48,056	117,012	-110,297	-467,314	-555,055	-1,989,697	4,351	19,077
2023	5	493,910	2,133,304	62,534	179,545	-69,443	-536,757	-500,819	-2,490,516	2,520	21,596
2024	6	410,370	2,543,673	74,563	254,108	-60,921	-597,678	-396,728	-2,887,243	2,102	23,698
2025	7	410,728	2,954,401	86,603	340,711	-106,391	-704,069	-430,516	-3,317,759	3,984	27,682
2026	8	410,728	3,365,128	98,642	439,353	-64,727	-768,796	-376,812	-3,694,571	2,127	29,809
2027	9	409,867	3,774,995	110,657	550,010	-109,844	-878,641	-409,055	-4,103,626	3,994	33,803
2028	10	409,867	4,184,862	122,671	672,681	-72,685	-951,326	-359,881	-4,463,507	2,386	36,189
2029	11	278,041	4,462,903	130,821	803,502	-67,912	-1,019,238	-215,132	-4,678,639	2,208	38,396
2030	12	0	4,462,903	130,821	934,324	-66,829	-1,086,067	63,993	-4,614,646	2,208	40,604
2031	13	0	4,462,903	130,821	1,065,145	-65,678	-1,151,744	65,144	-4,549,502	2,208	42,811
2032	14	0	4,462,903	130,821	1,195,967	-64,546	-1,216,290	66,275	-4,483,227	2,208	45,019
2033	15	0	4,462,903	130,821	1,326,788	-64,381	-1,280,672	66,440	-4,416,787	2,208	47,226
2034	16	0	4,462,903	130,821	1,457,609	-37,260	-1,317,932	93,561	-4,323,226	1,054	48,281
2035	17	0	4,462,903	130,821	1,588,431	-35,714	-1,353,646	95,108	-4,228,118	1,054	49,335
2036	18	0	4,462,903	130,821	1,719,252	-35,147	-1,388,793	95,674	-4,132,444	1,054	50,389
2037	19	0	4,462,903	130,821	1,850,074	-33,595	-1,422,389	97,226	-4,035,218	1,054	51,443
2038	20	0	4,462,903	130,821	1,980,895	-32,892	-1,455,281	97,929	-3,937,289	1,054	52,497

2039	21	0	4,462,903	130,821	2,111,716	-31,411	-1,486,692	99,411	-3,837,879	1,017	53,515
2040	22	0	4,462,903	130,821	2,242,538	-30,782	-1,517,474	100,039	-3,737,840	1,017	54,532
2041	23	0	4,462,903	130,821	2,373,359	-30,154	-1,547,628	100,667	-3,637,172	1,017	55,549
2042	24	0	4,462,903	130,821	2,504,181	-29,525	-1,577,154	101,296	-3,535,876	1,017	56,566
2043	25	0	4,462,903	130,821	2,635,002	-28,897	-1,606,051	101,924	-3,433,952	1,017	57,583
2044	26	0	4,462,903	130,821	2,765,824	-17,250	-1,623,300	113,572	-3,320,380	524	58,107
2045	27	353,972	4,816,875	139,719	2,905,543	-16,969	-1,640,270	-231,223	-3,551,602	524	58,630
2046	28	453,549	5,270,424	144,260	3,049,803	-16,689	-1,656,959	-325,978	-3,877,581	524	59,154
2047	29	339,165	5,609,590	140,799	3,190,602	-16,409	-1,673,368	-214,776	-4,092,356	524	59,678
2048	30	492,814	6,102,404	145,270	3,335,872	-7,712	-1,681,080	-355,256	-4,447,612	166	59,844

4.3 Leakage

The goal of this step (STEP 8) is to provide an ex-ante estimate of the possible decrease in carbon stock and increase in GHG emissions (other than carbon stock change) due to leakage.

Two sources of leakage are considered in this methodology and must be addressed:

- Decrease in carbon stocks and increase in GHG emissions associated with leakage prevention measures;
- Decrease in carbon stocks and increase in GHG emissions associated with activity displacement leakage.

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

If leakage prevention measures include tree planting, agricultural intensification, fertilization, fodder production and/or other measures to enhance cropland and grazing land areas, a reduction in carbon stocks and/or an increase in GHG emissions may occur compared to the baseline case. If this decrease in carbon stocks or increase in GHG emissions is significant, it must be accounted for and monitoring will be required. If it is not significant, it must not be accounted for and ex post monitoring will not be necessary.

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

- Carbon stock changes due to activities implemented in leakage management areas;
- Methane (CH₄) and nitrous oxide (N₂O) emissions from livestock intensification (involving a change in the animal diet and/or animal numbers).

In the case of this project activity, this component of the calculation is not applicable. The present project activity does not involve a decrease in carbon stocks or increase in GHG emissions associated with leakage prevention activities. In this project, leakage prevention activities do not involve any carbon stock reduction due to deforestation or additional emissions caused by increased grazing activities. The project proponent will offer training on sustainable cattle raising, to promote deforestation-free increases in livestock (that would occur in the baseline). It is intended that ranchers will be able to rationalize the land-use by means of techniques that allow a bigger production without increasing the area, so decreasing deforestation pressures. The activities do not intend to effect additional changes to “animal diet and/or animal numbers”, compared to that occurring in the baseline: the training goals will lead to a spatial rearrangement of production in a sustainable manner. Thus, the final balance of these training activities will be lower deforestation for a given number of cattle heads. This being the case, only the decrease in carbon stocks and increase in GHG emissions due to activity displacement leakage are calculated and monitored in the present project.

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

Activities that will cause deforestation within the project area in the baseline case could be displaced outside the project boundary due to the implementation of the AUD project activity. If carbon stocks in the leakage belt area will decrease more during project implementation than projected in the baseline case, this will be an indication that leakage due to displacement of baseline activities has occurred. Leakage due to activity displacement can thus be estimated by *ex post* monitoring of deforestation in the leakage belt and comparing *ex post* observed deforestation with *ex ante* projected baseline deforestation.

Ex ante activity displacement leakage can only be guessed based on the anticipated combined effectiveness of the proposed leakage prevention measures and project activities. This shall be done by multiplying the estimated baseline carbon stock changes for the project area by a “Displacement Leakage Factor” (DLF) representing the percent of deforestation expected to be displaced outside the project boundary.

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

It is expected that 100% of potential deforestation agents in the Reference Region will be given the opportunity to participate in leakage prevention activities. Thus, the “Displacement Leakage Factor” (DLF) is conservatively considered as 0.05.

If emissions from forest fires have been included in the baseline, the *ex-ante* emissions from forest fires due to activity displacement leakage will be calculated by multiplying baseline forest

fire emissions in the project area by the same DLF used to estimate the decrease in carbon stocks.

Table 62. Ex ante estimated leakage due to activity displacement (Table 34 of VM0015)

Year	Project year t	Total ex ante estimated decrease in carbon stocks due to displaced deforestation		Total ex ante estimated increase in GHG emissions due to displaced forest fires	
		annual ΔCADLK_t tCO ₂ -e	cumulative ΔCADLK tCO ₂ -e	annual EADLK _t tCO ₂ -e	cumulative EADLK tCO ₂ -e
2018	0	-30,729	-30,729	1,304	1,304
2019	1	-41,615	-72,344	1,737	3,041
2020	2	-51,785	-124,129	2,130	5,171
2021	3	-54,379	-178,509	2,192	7,363
2022	4	-55,148	-233,657	2,176	9,538
2023	5	-34,721	-268,379	1,260	10,798
2024	6	-30,460	-298,839	1,051	11,849
2025	7	-53,196	-352,035	1,992	13,841
2026	8	-32,363	-384,398	1,063	14,904
2027	9	-54,922	-439,320	1,997	16,901
2028	10	-36,343	-475,663	1,193	18,094
2029	11	-33,956	-509,619	1,104	19,198
2030	12	-33,414	-543,033	1,104	20,302
2031	13	-32,839	-575,872	1,104	21,406
2032	14	-32,273	-608,145	1,104	22,509
2033	15	-32,191	-640,336	1,104	23,613
2034	16	-18,630	-658,966	527	24,140
2035	17	-17,857	-676,823	527	24,667
2036	18	-17,574	-694,397	527	25,195
2037	19	-16,798	-711,194	527	25,722
2038	20	-16,446	-727,640	527	26,249
2039	21	-15,705	-743,346	509	26,757
2040	22	-15,391	-758,737	509	27,266
2041	23	-15,077	-773,814	509	27,774
2042	24	-14,763	-788,577	509	28,283
2043	25	-14,449	-803,025	509	28,792
2044	26	-14,639	-817,665	517	29,309
2045	27	-14,634	-832,299	517	29,826
2046	28	-14,629	-846,928	517	30,343
2047	29	-14,624	-861,552	517	30,860
2048	30	-6,307	-867,858	164	31,024

4.3.3 Ex ante estimation of total leakage

Table 63. Ex-ante estimated total leakage (Table 35 of VM0015)

Year	Project year t	Total ex ante increase in GHG emissions due to displaced forest fires		Total ex ante decrease in carbon stocks due to displaced deforestation		Total net carbon stock change due to leakage		Total net increase in emissions due to leakage	
		annual EADLK _t tCO ₂ -e	cumulative EADLK tCO ₂ -e	annual Δ CADLK _t tCO ₂ -e	cumulative Δ CADLK tCO ₂ -e	annual Δ CLK _t tCO ₂ -e	cumulative Δ CLK tCO ₂ -e	annual ELK _t tCO ₂ -e	cumulative ELK tCO ₂ -e
2018	0	1,304	1,304	-30,729	-30,729	-30,729	-30,729	1,304	1,304
2019	1	1,737	3,041	-41,615	-72,344	-41,615	-72,344	1,737	3,041
2020	2	2,130	5,171	-51,785	-124,129	-51,785	-124,129	2,130	5,171
2021	3	2,192	7,363	-54,379	-178,509	-54,379	-178,509	2,192	7,363
2022	4	2,176	9,538	-55,148	-233,657	-55,148	-233,657	2,176	9,538
2023	5	1,260	10,798	-34,721	-268,379	-34,721	-268,379	1,260	10,798
2024	6	1,051	11,849	-30,460	-298,839	-30,460	-298,839	1,051	11,849
2025	7	1,992	13,841	-53,196	-352,035	-53,196	-352,035	1,992	13,841
2026	8	1,063	14,904	-32,363	-384,398	-32,363	-384,398	1,063	14,904
2027	9	1,997	16,901	-54,922	-439,320	-54,922	-439,320	1,997	16,901
2028	10	1,193	18,094	-36,343	-475,663	-36,343	-475,663	1,193	18,094
2029	11	1,104	19,198	-33,956	-509,619	-33,956	-509,619	1,104	19,198
2030	12	1,104	20,302	-33,414	-543,033	-33,414	-543,033	1,104	20,302
2031	13	1,104	21,406	-32,839	-575,872	-32,839	-575,872	1,104	21,406
2032	14	1,104	22,509	-32,273	-608,145	-32,273	-608,145	1,104	22,509
2033	15	1,104	23,613	-32,191	-640,336	-32,191	-640,336	1,104	23,613
2034	16	527	24,140	-18,630	-658,966	-18,630	-658,966	527	24,140
2035	17	527	24,667	-17,857	-676,823	-17,857	-676,823	527	24,667
2036	18	527	25,195	-17,574	-694,397	-17,574	-694,397	527	25,195
2037	19	527	25,722	-16,798	-711,194	-16,798	-711,194	527	25,722
2038	20	527	26,249	-16,446	-727,640	-16,446	-727,640	527	26,249
2039	21	509	26,757	-15,705	-743,346	-15,705	-743,346	509	26,757
2040	22	509	27,266	-15,391	-758,737	-15,391	-758,737	509	27,266
2041	23	509	27,774	-15,077	-773,814	-15,077	-773,814	509	27,774
2042	24	509	28,283	-14,763	-788,577	-14,763	-788,577	509	28,283
2043	25	509	28,792	-14,449	-803,025	-14,449	-803,025	509	28,792
2044	26	517	29,309	-14,639	-817,665	-14,639	-817,665	517	29,309
2045	27	517	29,826	-14,634	-832,299	-14,634	-832,299	517	29,826
2046	28	517	30,343	-14,629	-846,928	-14,629	-846,928	517	30,343
2047	29	517	30,860	-14,624	-861,552	-14,624	-861,552	517	30,860
2048	30	164	31,024	-6,307	-867,858	-6,307	-867,858	164	31,024

4.4 Net GHG Emission Reductions and Removals

4.4.1 Calculation of ex-ante estimation of total net GHG emissions reductions

The net anthropogenic GHG emission reduction (STEP 9 of the VM0015 Methodology) of the proposed AUD project activity is calculated as follows:

$$\Delta REDD_t = (\Delta CBSLPA_t + EBBBSLPA_t) - (\Delta CPSPA_t + EBBPSPA_t) - (\Delta CLK_t + \Delta ELK_t)$$

Where:

$\Delta REDD_t$ Ex ante estimated net anthropogenic greenhouse gas emission reduction attributable to the AUD project activity at year t; tCO₂e

$\Delta CBSLPA_t$ Sum of baseline carbon stock changes in the project area at year t; tCO₂e

Note: The absolute values of $\Delta CBSLPA_t$ shall be used in the equation above

$EBBBSLPA_t$ Sum of baseline emissions from biomass burning in the project area at year t; tCO₂e

$\Delta CPSPA_t$ Sum of ex ante estimated actual carbon stock changes in the project area at year t; tCO₂e of baseline emissions from biomass burning in the project area at year t; tCO₂e

Note: If $\Delta CPSPA_t$ represents a net increase in carbon stocks, a negative sign before the absolute value of $\Delta CPSPA_t$ shall be used. If $\Delta CPSPA_t$ represents a net decrease, the positive sign shall be used.

$EBBPSPA_t$ Sum of (ex ante estimated) actual emissions from biomass burning in the project area at year t; tCO₂e

ΔCLK_t Sum of ex ante estimated leakage net carbon stock changes at year t; tCO₂e

Note: If the cumulative sum of ΔCLK_t within a fixed baseline period is > 0, ΔCLK_t shall be set to zero.

ΔELK_t Sum of ex ante estimated leakage emissions at year t; tCO₂e

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

4.4.2 Calculation of ex-ante estimation of total net GHG emissions reductions

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

$$VCU_t = REDD_t - VBC_t$$

$$VBC_t = (CBSLPA_t - CPSPA_t) * RF_t$$

Where:

VCU_t Number of Verified Carbon Units that can be traded at time t ; tCO₂-e

$REDD_t$ Ex-ante estimated net anthropogenic greenhouse gas emission reductions attributable to the AUD project activity at year t ; tCO₂-e ha⁻¹

VBC_t Number of Buffer Credits deposited in the VCS Buffer at time t ; tCO₂-e

$CBSLPA_t$ Sum of baseline carbon stock changes in the project area at year t ; tCO₂e

$CPSPA_t$ Sum of ex ante estimated actual carbon stock changes in the project area at year t ; tCO₂-e ha⁻¹

RF_t Risk factor used to calculate VCS buffer credits; %

Note: RF_t is a risk factor to be determined using the latest version of the VCS-approved AFOLU Non-Permanence Risk Tool.

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

It is specified that the risk rating according to the AFOLU Non-Permanence Risk Tool is 10, being sub-divided into Internal Risk (5.0), External Risk (0) and Natural Risk (2.50), which is rounded up to 10 points.

Table 64. Ex ante estimated net anthropogenic GHG emission reductions ($\Delta REDD_t$) and Voluntary Carbon Units (VCU_t) (Table 36 of VM0015)⁹⁵

Year	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
2018	640,654	113,020	32,033	495,602
2019	640,654	113,020	32,033	495,602
2020	867,046	375,109	43,352	448,585
2021	1,078,300	541,435	53,915	482,950
2022	1,131,429	419,803	56,571	655,055
2023	1,146,480	559,406	57,324	529,750
2024	719,624	503,339	35,981	180,304

⁹⁵ Note: for remaining columns of this table, see Appendix 1: Calculation of Total VCUs

2025	630,224	398,829	31,511	199,884
2026	1,103,753	434,500	55,188	614,065
2027	668,537	378,939	33,427	256,171
2028	1,138,384	413,049	56,919	668,416
2029	750,709	362,267	37,535	350,907
2030	701,197	217,339	35,060	448,798
2031	690,365	-61,785	34,518	717,632
2032	678,852	-62,936	33,943	707,846
2033	667,536	-64,068	33,377	698,227
2034	665,889	-64,233	33,294	696,827
2035	383,147	-92,507	19,157	456,496
2036	367,678	-94,054	18,384	443,348
2037	362,016	-94,620	18,101	438,535
2038	346,496	-96,172	17,325	425,343
2039	339,466	-96,875	16,973	419,368
2040	324,280	-98,393	16,214	406,460
2041	317,996	-99,022	15,900	401,118
2042	311,711	-99,650	15,586	395,776
2043	305,426	-100,279	15,271	390,434
2044	299,142	-100,907	14,957	385,092
2045	303,131	-100,508	15,157	388,483
2046	303,026	244,556	15,151	43,319
2047	302,920	339,581	15,146	-51,807
2048	302,815	228,648	15,141	59,026
Total	17,977,649	4,564,296	898,882	12,514,470

Ex ante VCUs tradable (tCO ₂ e)	Ex ante buffer credits (tCO ₂ e)
445,186	50,416
402,518	46,067
433,097	49,853
587,838	67,217
474,958	54,791
160,944	19,361
178,636	21,248

550,726	63,339
229,125	27,046
599,477	68,939
314,210	36,697
402,399	46,399
644,403	73,228
635,654	72,192
627,054	71,174
625,801	71,025
409,880	46,617
398,123	45,224
393,820	44,715
382,025	43,318
376,682	42,685
365,108	41,352
360,331	40,786
355,555	40,221
350,779	39,655
346,002	39,089
349,050	39,433
38,403	4,916
-47,210	-4,597
52,540	6,486
-214,136	-23,403
11,228,979	1,285,492

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	CF
Data unit	tC/tdm
Description	Default value of carbon fraction in biomass
Source of data	Values from the literature (e.g., IPCC 2003. Good practice guidance for land use, land-use change and forestry. Kanagawa: IGES, 2003. Available at: < http://www.ipccnggip.iges.or.jp/public/gpglulucf/gpglulucf.html >)
Value applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	The default value was used for conservativeness purposes.
Purpose of Data	• Calculation of baseline emissions • Calculation of project emissions • Calculation of leakage
Comments	If new and more accurate carbon fraction data become available, these can be used to estimate the net anthropogenic GHG emission reduction of the subsequent fixed baseline period.

Data / Parameter	44/12
Data unit	Dimensionless
Description	Carbon mass to CO ₂ e mass conversion factor
Source of data	From scientific literature: 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 AFOLU
Value applied	44/12
Justification of choice of data or description of	Conversion from C to CO ₂ based on molecular weights

measurement methods and procedures applied	
Purpose of Data	• Calculation of baseline emissions • Calculation of project emissions • Calculation of leakage
Comments	IPCC standard value

Data / Parameter	R
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	Average of following references: 0.37 root-shoot ratio (R), according to “2006 IPCC Guidelines for National Greenhouse Gas Inventories”, V. 4, Ch. 4, AFOLU, pg. 4.49, Table 4-4; and 0.24 root-shoot ratio, according to VM0015, Appendix 3, Table 2. Root to shoot ratios
Value applied	0.31
Justification of choice of data or description of measurement methods and procedures applied	Local values are not known, and the IPCC and VM0015 factors are conservative values.
Purpose of Data	• <i>Calculation of baseline emissions</i> • <i>Calculation of project emissions</i> • <i>Calculation of leakage</i>
Comments	Peer-reviewed work performed in the region of the Project Area, with a similar vegetation typology. The statistical quality of model is in accordance with methodology requirements

Data / Parameter	BEF
Data unit	Dimensionless

Description	Biomass Expansion Factor
Source of data	According to “Brown, S., A. J. R. Gillespie, and A. E. Lugo, 1989. Biomass estimation methods for tropical forests with applications to forest inventory data. Forest Science, 35:881-902”. (Table 4; pg. 890; minimum value deducted from lowest limit.: $1.743 - 0.083 = 1.66$)
Value applied	1.66
Justification of choice of data or description of measurement methods and procedures applied	BEF was applied for conversion of merchantable volume to total aboveground tree biomass
Purpose of Data	• Determination of baseline scenario (AFOLU projects only) • Calculation of baseline emissions • Calculation of project emissions • Calculation of leakage
Comments	N/A

Data / Parameter	Cab_{icl}
Data unit	tCO ₂ /ha
Description	Average carbon stock per hectare in the above-ground biomass carbon pool of initial forest class icl
Source of data	Forest biomass inventory carried out in Fortaleza Ituxi REDD Project in the municipality of Lábrea, nearby the Project area. Further details are provided in “1.13 Conditions Prior to Project Initiation” of this VCS-PD.
Value applied	577
Justification of choice of data or description of measurement methods and procedures applied	As a forest biomass inventory has been carried out in a neighbouring REDD project in the municipality of Lábrea, data have been used for this estimate. In this inventory, an average biomass of 189.6 t/ha has been obtained as result. 1.66 Biomass Expansion Factor (BEF) was applied for conversion of merchantable volume to total aboveground tree biomass, according to “Brown, S., A. J. R. Gillespie, and A. E. Lugo, 1989. Biomass estimation methods for tropical forests with applications to forest inventory data. Forest Science, 35:881-902”. (Table 4; pg. 890;

	minimum value deducted from lowest limit.: $1.743 - 0.083 = 1.66$). The result of this multiplication is 314.7 t/ha, whose conversion to CO₂ corresponds to 577 tCO₂/ha.
Purpose of Data	Calculation of baseline emissions
Comments	Field measurements and literature studies used for this assessment, as well as respective calculations, are available for consultation by the audit team.

Data / Parameter	Cbb_{icl}
Data unit	tCO ₂ /ha
Description	Average carbon stock per hectare in the below-ground biomass carbon pool of initial forest class icl
Source of data	Forest biomass inventory carried out in Fortaleza Ituxi REDD Project in the municipality of Lábrea, nearby the Project area. Further details are provided in “1.13 Conditions Prior to Project Initiation” of this VCS-PD.
Value applied	176
Justification of choice of data or description of measurement methods and procedures applied	As a forest biomass inventory has been carried out in a neighbouring REDD project in the municipality of Lábrea, data have been used for this estimate. In this inventory, an average biomass of 189.6 t/ha has been obtained as result. This value has been multiplied by BEF (1.66, see table above), which resulted in 314.7 t/ha (aboveground biomass). This later value has been multiplied by the root-shoot ratio (R). 0.31 root-shoot ratio (R) was applied (average of following references: 0.37 root-shoot ratio (R), according to “2006 IPCC Guidelines for National Greenhouse Gas Inventories”, V. 4, Ch. 4, AFOLU, pg. 4.49, Table 4-4; and 0.24 root-shoot ratio, according to VM0015, Appendix 3, Table 2. Root to shoot ratios). The multiplication of aboveground biomass (314,7 t/ha) by the R results in 96 t/ha of biomass, which converted to CO₂ corresponds to 176 tCO₂/ha.
Purpose of Data	Calculation of baseline emissions

Comments	Literature studies used for this assessment, as well as respective calculations, are available for consultation by the audit team.
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Data / Parameter	Cabfcl
Data unit	tCO ₂ /ha
Description	Average carbon stock per hectare in the above-ground biomass carbon pool of final post-deforestation class fcl
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, V. 4, Chapter 6: Grassland, pg. 6.27, Table 6.4 (for Pasture)
Value applied	16.8
Justification of choice of data or description of measurement methods and procedures applied	Conservative default value from IPCC, to estimate post-deforestation land use carbon stock.
Purpose of Data	Calculation of baseline emissions
Comments	Conservative average to be used in calculations, based on uncertainties in source values.

Data / Parameter	Cbbfcl
Data unit	tCO ₂ /ha
Description	Average carbon stock per hectare in the below-ground biomass pool of final post-deforestation class fcl
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, V. 4, Chapter 6: Grassland, pg. 6.27, Table 6.4 (for Pasture)
Value applied	26.9
Justification of choice of data or description of measurement methods and procedures applied	Conservative default value from IPCC, to estimate post-deforestation land use carbon stock.
Purpose of Data	Calculation of baseline emissions

Comments	Conservative average to be used in calculations, based on uncertainties in source values.
Data / Parameter	El
Data unit	N/A
Description	Ex ante estimated effectiveness index
Source of data	Local assessment
Value applied	0.9
Justification of choice of data or description of measurement methods and procedures applied	The project design team conservatively considers that surveillance activities are able to attain 90% of effectiveness in avoiding unplanned deforestation inside the Project Area. According to studies comparing the incidence of fires in the Reference Region and the Project Area (for 2019 and 2020), it is evidenced the initial fire occurrences in PA are 74% lower than in the RR. Moreover, none of these occurrences resulted in biomass loss, as demonstrated by satellite imagery. Evidence is available to auditors.
Purpose of Data	Calculation of project emissions
Comments	This value is an ex-ante estimate. Accurate and actual values will be monitored and reported in verification periods.

Data / Parameter	DLF
Data unit	N/A
Description	Displacement Leakage Factor
Source of data	Local assessment
Value applied	0.05
Justification of choice of data or description of measurement methods and procedures applied	If deforestation agents do not participate in leakage prevention activities and project activities, the Displacement Factor shall be 100%. Where leakage prevention activities are implemented the factor shall be equal to the proportion of the baseline agents estimated to be given the opportunity to participate in leakage prevention activities and project activities. The project

	design team estimates that 100% of potential deforestation agents in the Reference Region will be given the opportunity to participate in leakage prevention activities. Projections of deforestation within the Leakage Belt have duly been made as part of the present project, according to projections of deforestation presented in Section 4.1, Table 36. The project proponent has conservatively allowed 5% leeway on this estimate, which is unlikely to be surpassed. If this allowance is surpassed, an assessment of how much is due to the project will be conducted during monitoring. Thus, the “Displacement Leakage Factor” (DLF) was conservatively defined as 0.05. It is worthy to notice that the project proponent is continuously divulging and recruiting new landowners to participate in this grouped REDD initiative, which can be also considered as a measure to fight leakage. Other leakage fighting activities are also listed in this VCS-PD, as fire brigade trainings, sustainable cattle raising etc.
Purpose of Data	Calculation of leakage
Comments	This value is an ex-ante estimate. Accurate and actual values will be monitored and reported in verification periods

Data / Parameter	Deforestation
Data unit	ha
Description	Maps of forest cover areas converted into non-forest areas
Source of data	Measured through data from PRODES/INPE project (if available) or supervised classification.
Value applied	Yearly variable: deforestation values are presented for the Reference Region, Leakage Belt and Project Area (projections) in this VCS-PD
Justification of choice of data or description of measurement methods and procedures applied	The project area is located within a region that is subject to a monitoring program that is approved or sanctioned by the national government (PRODES). The data generated by this program is used in this project. PRODES data are applicable for use in this project, according to the criteria listed below (Methodology VM0015): i) PRODES monitoring occurs in the entire

	project area and leakage belt. ii) PRODES monitoring occurs in the entire reference region and covers the beginning, middle and end of the fixed baseline period. iii) PRODES monitors conversion of forest land to non-forest land. iv) Monitoring occurred during the entire fixed baseline period. v) data accuracies are acceptable according to the methodology criteria. An order of preference of data applies to the available sources of data: 1) Mapbiomas in first order of preference; 2) PRODES in second place; and 3) place self-classification of images.
Purpose of Data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	LDF
Data unit	Mg C m ⁻³
Description	Logging damage factor
Source of data	Pearson et al 2014 ⁹⁶
Value applied	0.71
Justification of choice of data or description of measurement methods and procedures applied	The Pearson et al 2014 study was identified as the most authoritative study on this topic relating to sustainable forest management for Brazil
Purpose of Data	Calculation of project emissions
Comments	N/A

Data / Parameter	LIF
Data unit	Mg C m ⁻³
Description	Logging infrastructure factor
Source of data	Feldpausch et al (2005) via Pearson et al 2014 ⁹⁶
Value applied	0.27

⁹⁶ <https://winrock.org/wp-content/uploads/2016/03/Pearson-et-al-2014-Logging.pdf>

Justification of choice of data or description of measurement methods and procedures applied	Feldpausch et al (2005) is identified within the Pearson et al 2014 study as the most authoritative study on this topic relating to sustainable forest management for Bolivia and Brazil.
Purpose of Data	Calculation of project emissions
Comments	N/A

5.2 Data and Parameters Monitored

Data / Parameter	ACPA _t
Data unit	Ha
Description	Annual area within the Project Area affected by catastrophic events at year t
Source of data	- Remote sensing data and GIS, - Supervisor reports
Description of measurement methods and procedures to be applied	The following sources will be monitored: - INMET (INMET. Instituto Nacional de Meteorologia). https://www.gov.br/agricultura/pt-br/assuntos/inmet?r=home/page&page=%20rede_estacoes_conv_graf - Periodic reports from area supervisor - INPE (INPE. Instituto Nacional de Pesquisas Espaciais). https://queimadas.dgi.inpe.br/queimadas/portal - itens 1 and 5)
Frequency of monitoring/recording	Each time a catastrophic event occurs
Value applied	The value will be calculated ex-post each time a catastrophic event occurs, when significant
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	1) Land use and land cover mapping is assessed using images with spatial resolution superior to 30 meters. Image acquisition

	is performed during the period of low incidence of clouds and rainfall in the region, within July and September. - Images undergo geometric correction by means of geo-referencing, using topographic maps as reference or USG-NASA orthorectified images. - For analysis of areas with cloud cover, visual interpretation of radar image is performed. - Evaluation of classification accuracy is performed by analyzing the overall accuracy and kappa index obtained from a confusion matrix. The minimum accuracy of the classification mapping should be 80%.
Purpose of data	Calculation of project emissions
Calculation method	Remote sensing and GIS
Comments	N/A

Data / Parameter	ABSLKt
Data unit	ha
Description	Annual area of baseline deforestation within the leakage belt at year t
Source of data	Remote sensing data and GIS
Description of measurement methods and procedures to be applied	Deforestation in the leakage belt area will be considered activity displacement leakage. Activity data for the leakage belt area will be determined using the same methods applied to monitoring deforestation activity data in the project area.
Frequency of monitoring/recording	Annually
Value applied	Table 38
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing and GIS: Land use and land cover mapping is assessed using images with spatial resolution superior to 30 meters. Image acquisition is performed during the period of low

	incidence of clouds and rainfall in the region, within July and September. 2) Images undergo geometric correction by means of geo-referencing, using topographic maps as reference or USG-NASA orthorectified images. 3) For analysis of areas with cloud cover, visual interpretation of radar image is performed. 4) Evaluation of classification accuracy is performed by analysing the overall accuracy and kappa index obtained from a confusion matrix. The minimum accuracy of the classification mapping should be 80%.
Purpose of data	• Calculation of leakage
Calculation method	Analysis of satellite images and maps
Comments	Where strong evidence can be collected that deforestation in the leakage belt is attributable to deforestation agents that are not linked to the project area, the detected deforestation will not be attributed to the project activity, thus not considered leakage.

Data / Parameter	ABSLPAt
Data unit	ha
Description	Annual area of baseline deforestation in the project area at year t
Source of data	Remote sensing data and GIS
Description of measurement methods and procedures to be applied	Forest cover change due to deforestation is monitored through periodic assessment of classified satellite imagery covering the project area.
Frequency of monitoring/recording	Annually
Value applied	Table 37
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing and GIS: 1) Land use and land cover mapping is assessed using images with spatial resolution superior to 30 meters.

	Image acquisition is performed during the period of low incidence of clouds and rainfall in the region, within July and September. - Images undergo geometric correction by means of geo-referencing, using topographic maps as reference or USG-NASA orthorectified images. - For analysis of areas with cloud cover, visual interpretation of radar image is performed. - Evaluation of classification accuracy is performed by analysing the overall accuracy and kappa index obtained from a confusion matrix. The minimum accuracy of the classification mapping should be 80%.
Purpose of data	- Calculation of project emissions - Calculation of baseline emissions
Calculation method	Analysis of satellite images and maps
Comments	N/A

Data / Parameter	$\Delta CADLkt$
Data unit	tCO ₂ e
Description	Total decrease in carbon stocks due to displaced deforestation at year t
Source of data	Remote sensing data and GIS
Description of measurement methods and procedures to be applied	Deforestation in the leakage belt area will be considered activity displacement leakage. Activity data for the leakage belt area will be determined using the same methods applied to monitoring deforestation activity data in the project area.
Frequency of monitoring/recording	Annually
Value applied	Table 62
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Land use and land cover mapping is assessed using images with spatial resolution superior to 30 meters. Image acquisition is performed during the period of low

	incidence of clouds and rainfall in the region, within July and September. 2) Images undergo geometric correction by means of geo-referencing, using topographic maps as reference or USG-NASA orthorectified images. 3) For analysis of areas with cloud cover, visual interpretation of radar image is performed. 4) Evaluation of classification accuracy is performed by analysing the overall accuracy and kappa index obtained from a confusion matrix. The minimum accuracy of the classification mapping should be 80%.
Purpose of data	• Calculation of leakage
Calculation method	Emissions from deforestation are estimated by multiplying the detected area of forest loss by the average forest carbon stock per unit area.
Comments	N/A

Data / Parameter	$APLPA_{icl,t}$												
Data unit	ha												
Description	Areas of planned logging activities in forest class icl at year t in the project area.												
Source of data	SFMP documents and receipts.												
Description of measurement methods and procedures to be applied	The planned logging area in the project area that result in carbon stock decrease will be subject to monitoring, when significant.												
Frequency of monitoring/recording	Annually.												
Value applied	<table border="1"> <thead> <tr> <th>Year</th><th>ha</th></tr> </thead> <tbody> <tr> <td>2018</td><td>488.7</td></tr> <tr> <td>2019</td><td>2,893.9</td></tr> <tr> <td>2020</td><td>4,430.8</td></tr> <tr> <td>2021</td><td>3,297.3</td></tr> <tr> <td>2022</td><td>4,775.5</td></tr> </tbody> </table>	Year	ha	2018	488.7	2019	2,893.9	2020	4,430.8	2021	3,297.3	2022	4,775.5
Year	ha												
2018	488.7												
2019	2,893.9												
2020	4,430.8												
2021	3,297.3												
2022	4,775.5												

	2023	4,786.1
	2024	3,976.6
	2025	3,980.1
	2026	3,980.1
	2027	3,971.7
	2028	3,971.7
	2029	2,694.3
	2030	0.0
	2031	0.0
	2032	0.0
	2033	0.0
	2034	0.0
	2035	0.0
	2036	0.0
	2037	0.0
	2038	0.0
	2039	0.0
	2040	0.0
	2041	0.0
	2042	0.0
	2043	0.0
	2044	0.0
	2045	3,430.1
	2046	4,395.0
	2047	3,286.6
	2048	4,775.5
Monitoring equipment	Project proponent records according to official SFMP documents and receipts.	
QA/QC procedures to be applied	These procedures are subject to requirements and procedures defined by the State organ IPAAM (<i>Instituto de Proteção Ambiental do Estado do Amazonas</i>) ⁹⁷ for SFMPs.	
Purpose of data	Calculation of project emissions	
Calculation method	N/A	
Comments	N/A	

⁹⁷ <http://www.ipaam.am.gov.br/>

Data / Parameter	$\Delta\text{CPAdPat}$
Data unit	tCO ₂ e
Description	Total decrease in carbon stock due to all planned activities at year t in the project area.
Source of data	Documents, remote sensing and GIS.
Description of measurement methods and procedures to be applied	The planned activities in the project area that result in carbon stock decrease will be subject to monitoring, when significant.
Frequency of monitoring/recording	Annually.
Value applied	0
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing and GIS: 1) Land use and land cover mapping is assessed using images with spatial resolution superior to 30 meters. Image acquisition is performed during the period of low incidence of clouds and rainfall in the region, within July and September. 2) Images undergo geometric correction by means of geo-referencing, using topographic maps as reference or USG-NASA orthorectified images. 3) For analysis of areas with cloud cover, visual interpretation of radar image is performed. 4) Evaluation of classification accuracy is performed by analysing the overall accuracy and kappa index obtained from a confusion matrix. The minimum accuracy of the classification mapping should be 80%.
Purpose of data	• Calculation of project emissions

Calculation method	Emissions from all planned activities are estimated by the sum of the emissions from planned deforestation + emissions from planned logging activities + emissions from planned fuel-wood and charcoal activities.
Comments	N/A

Data / Parameter	ΔCPSLKt
Data unit	tCO ₂ e
Description	Total annual carbon stock change in leakage management areas in the project case
Source of data	- Activity reports related to leakage prevention measures. - Field assessments. - Remote sensing and GIS.
Description of measurement methods and procedures to be applied	The planned activities in leakage management areas that result in carbon stock decrease will be subject to monitoring, when significant.
Frequency of monitoring/recording	Annually
Value applied	0
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing and GIS: 1) Land use and land cover mapping is assessed using images with spatial resolution superior to 30 meters. Image acquisition is performed during the period of low incidence of clouds and rainfall in the region, within July and September. 2) Images undergo geometric correction by means of geo-referencing, using topographic maps as reference or USG-NASA orthorectified images. 3) For analysis of areas with cloud cover, visual interpretation of radar image is performed. 4) Evaluation of classification accuracy is performed by analysing the overall accuracy and kappa index obtained from a confusion matrix. The minimum accuracy of the classification mapping should be 80%.

Purpose of data	Calculation of leakage
Calculation method	Emissions from planned activities in leakage management areas are estimated by multiplying the detected area of forest loss by the average forest carbon stock per unit area.
Comments	N/A

Data / Parameter	ΔCUDdPA_t
Data unit	tCO ₂ e
Description	Total actual carbon stock change due to unavoided unplanned deforestation at year t in the project area
Source of data	Remote sensing and GIS
Description of measurement methods and procedures to be applied	Forest cover change due to unplanned deforestation is monitored through periodic assessment of classified satellite imagery covering the project area.
Frequency of monitoring/recording	Annually
Value applied	Table 61
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	1) Land use and land cover mapping is assessed using images with spatial resolution superior to 30 meters. Image acquisition is performed during the period of low incidence of clouds and rainfall in the region, within July and September. 2) Images undergo geometric correction by means of geo-referencing, using topographic maps as reference or USG-NASA orthorectified images. 3) For analysis of areas with cloud cover, visual interpretation of radar image is performed. 4) Evaluation of classification accuracy is performed by analysing the overall accuracy and kappa index obtained from a confusion matrix. The minimum accuracy of the classification mapping should be 80%.
Purpose of data	Calculation of project emissions

Calculation method	Emissions from unavoided unplanned deforestation are estimated by multiplying the detected area of forest loss by the average forest carbon stock per unit area.
Comments	N/A

Data / Parameter	EBBPSPAt
Data unit	tCO2e
Description	Sum of (or total) actual non-CO2 emissions from forest fire at year t in the project area
Source of data	Remote sensing data and GIS, - Supervisor reports.
Description of measurement methods and procedures to be applied	If forest fires occur, these non-CO2 emissions will be subject to monitoring and accounting, when significant.
Frequency of monitoring/recording	Annually
Value applied	0
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing and GIS: 1) Land use and land cover mapping is assessed using images with spatial resolution superior to 30 meters. Image acquisition is performed during the period of low incidence of clouds and rainfall in the region, within July and September. 2) Images undergo geometric correction by means of geo-referencing, using topographic maps as reference or USG-NASA orthorectified images. 3) For analysis of areas with cloud cover, visual interpretation of radar image is performed. 4) Evaluation of classification accuracy is performed by analysing the overall accuracy and kappa index obtained from a confusion matrix. The minimum accuracy of the classification mapping should be 80%.
Purpose of data	• Calculation of project emissions

Calculation method	Analysis of satellite images and maps to determine the incidence of deforestation and multiplying it by the respective emission factors.
Comments	If forest fires occur, these non-CO2 emissions will be subject to monitoring and accounting, when significant.

Data / Parameter	EADLKt
Data unit	tCO2e
Description	Total ex ante increase in GHG emissions due to displaced forest fires at year t
Source of data	Remote sensing data and GIS
Description of measurement methods and procedures to be applied	When significant, GHG emissions due displaced forest fires will be monitored.
Frequency of monitoring/recording	Annually
Value applied	0
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing and GIS: 1) Land use and land cover mapping is assessed using images with spatial resolution superior to 30 meters. Image acquisition is performed during the period of low incidence of clouds and rainfall in the region, within July and September. 2) Images undergo geometric correction by means of geo-referencing, using topographic maps as reference or USG-NASA orthorectified images. 3) For analysis of areas with cloud cover, visual interpretation of radar image is performed. 4) Evaluation of classification accuracy is performed by analysing the overall accuracy and kappa index obtained from a confusion matrix. The minimum accuracy of the classification mapping should be 80%.
Purpose of data	• Calculation of leakage

Calculation method	Analysis of satellite images and maps to determine the incidence of deforestation and multiplying it by the respective emission factors.
Comments	Where strong evidence can be collected that forest fires in the leakage belt is attributable to deforestation agents that are not linked to the project area, the detected deforestation will not be attributed to the project activity, thus not considered leakage.

Data / Parameter	RFt
Data unit	%
Description	Risk factor used to calculate VCS buffer credits
Source of data	- VCS Non-Permanence Risk Report (v3.1), - Remote sensing data and GIS, - Supervisor report. - Literature data.
Description of measurement methods and procedures to be applied	All sources of data from the VCS Non-Permanence Risk Report will be used to measure the various risk factors.
Frequency of monitoring/recording	Annually
Value applied	10
Monitoring equipment	VCS-approved AFOLU Non-Permanence Risk Tool
QA/QC procedures to be applied	Literature data from reputed sources will be used and critically checked. When possible, the average of two or more sources will be used.
Purpose of data	• Calculation of VCS buffer credits
Calculation method	All the risk factors described in the VCS Risk Report were assessed.
Comments	N/A

Data / Parameter	Deforestation in the project area and leakage belt
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Data unit	ha
Description	Forest cover areas converted into non-forest areas inside the Project Area and Leakage Belt
Source of data	Calculated through remote sensing images
Description of measurement methods and procedures to be applied	The monitoring of the forest cover in the Project Area and Leakage Belt will be done through satellite image analysis. When data from the PRODES system are not available, the forest cover monitoring will be carried out by automatic classification and visual interpretation of images from other optical sensors or SAR data.
Frequency of monitoring/recording	Annually
Value applied	N/A
Monitoring equipment	Remote sensing images digital processing program, geographic information systems
QA/QC procedures to be applied	Best practices in remote sensing and GIS: 1) Land use and land cover mapping is assessed using images with spatial resolution superior to 30 meters. Image acquisition is performed during the period of low incidence of clouds and rainfall in the region, within July and September. 2) Images undergo geometric correction by means of geo-referencing, using topographic maps as reference or USG-NASA orthorectified images. 3) For analysis of areas with cloud cover, visual interpretation of radar image is performed. 4) Evaluation of classification accuracy is performed by analysing the overall accuracy and kappa index obtained from a confusion matrix. The minimum accuracy of the classification mapping should be 80%.
Purpose of data	• Calculation of project emissions • Calculation of leakage
Calculation method	Analysis of satellite images and maps

Comments	N/A
Data / Parameter	$\Delta C_{abBSLLKt}$
Data unit	tCO ₂ e
Description	Total baseline carbon stock changes for the above-ground biomass pool in the leakage belt
Source of data	Calculated
Description of measurement methods and procedures to be applied	- leakage prevention activities will be listed; - a map showing areas of intervention and type of intervention will be created; - areas where leakage prevention activities impact carbon stock will be identified; - non-forest classes existing within these areas in the baseline case will be identified; - carbon stocks will be measured on the identified classes or conservative literature estimates will be used; - carbon stock changes in the leakage management areas under the project scenario will be reported using table 30b of the VM0015; - net carbon stock changes that the leakage prevention measures cause during the fixed baseline period and, optionally, the project crediting period will be calculated; - results of the calculations will be reported in table 30.c of the VM0015.
Frequency of monitoring/recording	To be determined depending on the activity
Value applied	0
Monitoring equipment	Remote sensing images digital processing program, geographic information systems
QA/QC procedures to be applied	Best practices in remote sensing and GIS: 1) Land use and land cover mapping is assessed using images with spatial resolution superior to 30 meters. Image acquisition is performed during the period of low incidence of clouds and rainfall in the region, within July and September. 2) Images undergo geometric correction by means of geo-referencing, using topographic maps as reference or USG-NASA orthorectified images.

	3) For analysis of areas with cloud cover, visual interpretation of radar image is performed. 4) Evaluation of classification accuracy is performed by analysing the overall accuracy and kappa index obtained from a confusion matrix. The minimum accuracy of the classification mapping should be 80%.
Purpose of data	• Calculation of leakage
Calculation method	Analysis of satellite images and maps to determine deforestation in Leakage Belt and multiplying it by the carbon stocks previously set.
Comments	N/A

5.3 Monitoring Plan

This Monitoring Plan was developed according to Methodology VM0015 “Methodology for Avoided Unplanned Deforestation”, Version 1.1.3 The methodology encompasses three main monitoring tasks:

- i) Monitoring of actual carbon stock changes and GHG emissions within the project area;
- ii) Monitoring of leakage; and
- iii) Ex post calculation of net anthropogenic GHG emission reduction.

This Monitoring Plan describes how these tasks will be implemented. For each task, the monitoring plan includes the following aspects:

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

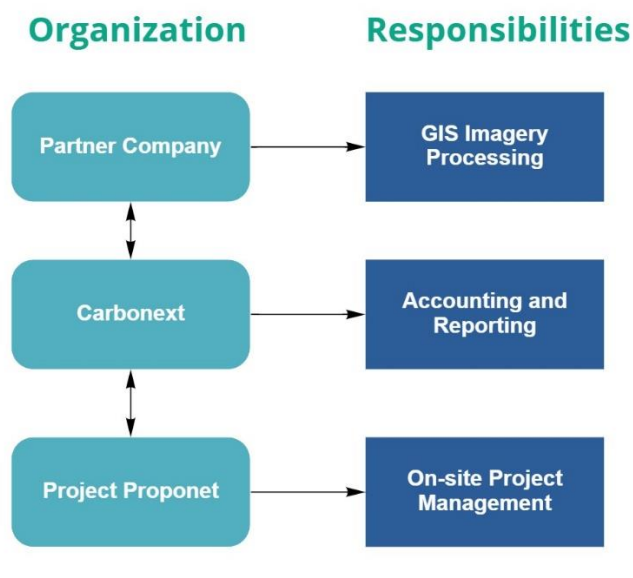


Figure 49. General overview of parties involved in monitoring activities.

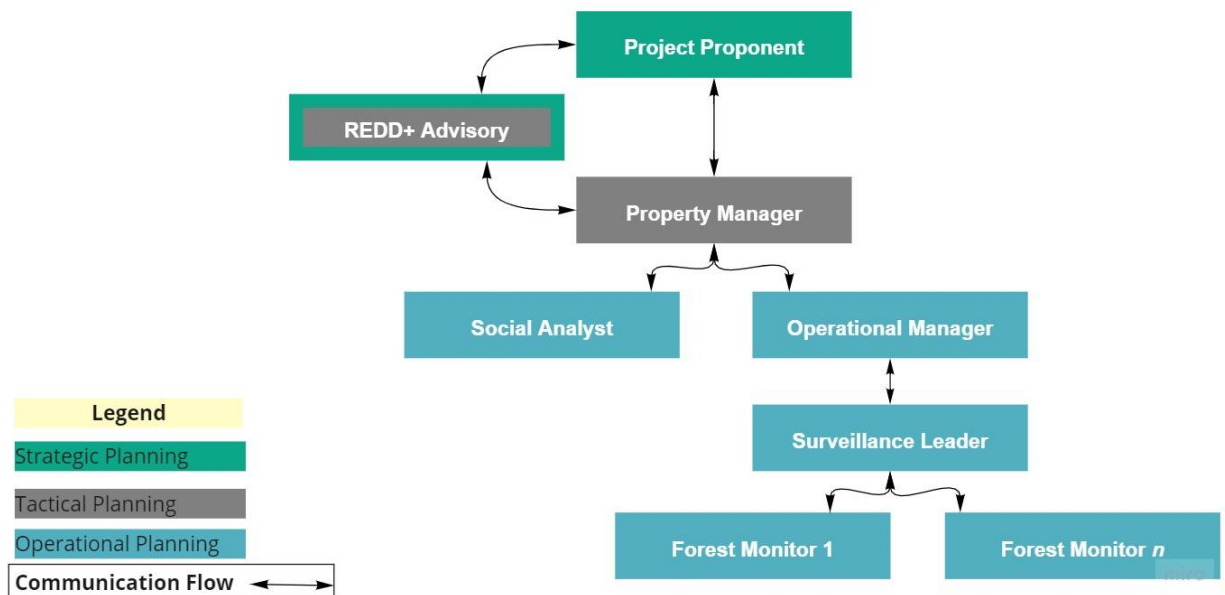


Figure 50. General overview of staff in the Project Area

5.3.1 Monitoring of actual carbon stock changes and GHG emissions within the project area

Monitoring of project implementation

a) Technical description of the monitoring tasks.

Project activities implemented within the project area will be monitored to be consistent with the management plans of the project area and the PD.

b) Data to be collected.

Monitoring of deforestation-avoidance activities will be performed by means of evaluations of the surveillance rounds, and using satellite imagery to continuously inspect the forest condition within the Project Area. 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 AUD project activity has actually been implemented.

Monitoring of social and biodiversity parameters of project implementation will be based on data required in Table 65 and Table 66, which attest that foreseen activities are being effectively implemented. A system will be implemented to record data on costs and investments, based on invoices, receipts and contracts related to activity implementation, as well as signed attendance lists.

c) Overview of data collection procedures.

All invoices, receipts and contracts related to activities implemented in this REDD project shall be conserved in printed version. Whenever possible, documentation should be kept in electronic format.

d) Quality control and quality assurance procedures.

The project proponent will train personnel to collect and keep all documentation in a sure place. All electronic documentation should also be sent to CARBONEXT to further security and checking.

e) Data archiving.

All maps and records generated during project implementation will be conserved and made available to VCS verifiers at verification. Backup copies of files should be available in the project proponent facilities, as well as in CARBONEXT facilities.

All documents and records will be kept in a secure retrievable manner for at least two years after the end of the project crediting period.

f) Organization and responsibilities of the parties involved in all the above.

The project proponent is responsible to implement this monitoring item. CARBONEXT is co-responsible in archiving, and quality control and quality assurance procedures.

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

a) Technical description of the monitoring tasks.

Monitoring of land-use and land-cover change within the Project Area will be performed annually by analyzing satellite imagery of the Project Area.

Imagery analysis of land use will be based on secondary information from PRODES Digital (INPE, 2014), referring mainly to the classes "Forest Land" and "Non-Forest Land".

b) Data to be collected.

The categories of change that will be subject to MRV-A (monitoring, reporting, verification and accounting) are "Area of forest land converted to non-forest land", "Area of forest land undergoing carbon stock decrease" and "Area of forest land undergoing carbon stock increase". These categories are mandatory in AUD project activities having the same characteristics as this project (i.e., planned logging above the baseline and claiming carbon credits for carbon stock increase).

In this context, data to be collected consists of annual satellite imagery processed by PRODES, for the entire land coverage of Project Area.

The satellite images used will be four scenes of satellite Landsat 8 TM (orbits 001/65, 001/66, 233/65, and 233/66) to the total geographic scope of the Project Area and Reference Region.

c) Overview of data collection procedures.

The project area is located within a region that is subject to a monitoring program that is approved or sanctioned by the national government (PRODES). The data generated by such program is used in this project. PRODES data are applicable for use in this project, according to the criteria listed below (Methodology VM0015):

- i) PRODES monitoring occurs in the entire project area and leakage belt.
- ii) PRODES monitoring occurs in the entire reference region and covers the beginning, middle and end of the fixed baseline period.
- iii) PRODES monitors conversion of forest land to non-forest land.
- iv) Monitoring occurred during the entire fixed baseline period.

d) 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, accumulated deforestation and other (hydrography, not forest, clouds, roads, residues, unclassified objects, and others).

The validation will be performed by using the land use mapping PRODES Digital. The satellite images used will be four scenes of satellite Landsat 8 TM (orbits 001/65, 001/66, 233/65, and 233/66) to the total geographic scope of the Project Area and Reference Region.

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 VM0015 1.1.3 methodology.

e) Data archiving.

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

All documents and records will be kept in a secure retrievable manner for at least two years after the end of the project crediting period.

f) Organization and responsibilities of the parties involved in all the above.

All satellite imagery assessments will be performed by AVIX. CARBONEXT is responsible for reporting and data archiving, according to VM0015, and for providing assistance during verification audits. The Project Proponent is co-responsible for data archiving.

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

a) Technical description of the monitoring tasks.

Monitoring of carbon stocks is mandatory in the following cases:

Within the project area:

a) Areas subject to significant carbon stock decrease in the project scenario according to the *ex-ante* assessment. These will be areas subject to controlled deforestation and planned harvest activities, such as logging, fuel wood collection and charcoal production. In these areas, carbon stock changes must be estimated at least once after each harvest event.

b) Areas subject to unplanned and significant carbon stock decrease, e.g., due to uncontrolled forest fires and other catastrophic events. In these areas, carbon stock losses must be estimated as soon as possible after the catastrophic event.

Within leakage management areas:

a) Areas subject to planned and significant carbon stock decrease in the project scenario according to the *ex-ante* assessment. In these areas, carbon stocks must be estimated at least once after the planned event that caused the carbon stock decrease.

b) Data to be collected.

The results of monitoring activity data and carbon stocks must be reported using the same formats and tables used for the *ex-ante* assessment, according to Methodology VM0015 (the applicability of each table must be evaluated *ex post*, in the Monitoring Report):

Table 15 Ex post carbon stock per hectare of initial forest classes icl existing in the project area and leakage belt.

Table 16 Ex post carbon stock per hectare of final classes fcl existing in the project area and leakage belt.

Table 25.a Ex post carbon stock decrease due to planned and unplanned deforestation in the project area.

Table 25.b Ex post carbon stock decrease due to planned logging activities.

Table 25.c Ex post carbon stock decrease due to planned fuel-wood and charcoal activities.

Table 25.d Total ex post carbon stock decrease due to planned activities in the project area.

Table 25.e Ex post carbon stock decrease due to forest fires.

Table 25.f Ex post carbon stock decrease due to catastrophic events.

Table 25.g Total ex post carbon stock decrease due to forest fires and catastrophic events.

Table 26.a Ex post carbon stock increase due to growth without harvest.

Table 26.b Ex post carbon stock increase following planned logging activities.

Table 26.c Ex post carbon stock increase following planned fuel-wood and charcoal activities.

Table 26.d Total ex post carbon stock increase due to planned activities in the project area.

Table 26.e Ex post carbon stock increase on areas affected by forest fires.

Table 26.f Ex post carbon stock increase on areas affected by catastrophic events.

Table 26.g Ex post carbon stock increase on areas recovering after forest fires and catastrophic events.

Table 27 Ex post total net carbon stock change in the project area.

Non-CO₂ emissions from forest fires are subject to monitoring and accounting, when significant. In this case, under the project scenario it will be necessary to monitor the variables of table 23 within the project area and to report the results in table 24, according to VM0015.

Decreases in carbon stocks and increases in GHG emissions (e.g., in case of forest fires) due to natural disturbances (such as hurricanes, earthquakes, volcanic eruptions, tsunamis, flooding, drought, fires, tornados or winter storms) or man-made events, including those over which the project proponent has no control (such as acts of terrorism or war), are subject to monitoring and must be accounted under the project scenario, when significant. Use tables 25.e, 25.f and 25.g to report carbon stock decreases and, optionally, tables 26.e, 26.f and 26.g to report carbon stock increases that may happen on the disturbed lands after the occurrence of an event. Use tables 23 and 24 to report emissions from forest fires.

If the area (or a sub-set of it) is affected by natural disturbances or man-made events generated VCUs in past verifications, the total net change in carbon stocks and GHG emissions in the area(s) that generated VCUs must be estimated, and an equivalent amount of VCUs must be cancelled from the VCS buffer.

Summarize the results of all ex-post estimations in the project area using the same table format used for the ex-ante assessment:

Table 29: Total ex post estimated actual net changes in carbon stocks and emissions of GHG gases in the project area.

c) Overview of data collection procedures.

The project area is located within a region that is subject to a monitoring program that is approved or sanctioned by the national government (PRODES). The data generated by such program is used in this project. PRODES data are applicable for use in this project, according to the criteria listed below (Methodology VM0015):

i) PRODES monitoring occurs in the entire project area and leakage belt.

ii) PRODES monitoring occurs in the entire reference region and covers the beginning, middle and end of the fixed baseline period.

iii) PRODES monitors conversion of forest land to non-forest land.

iv) Monitoring occurred during the entire fixed baseline period.

d) 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, accumulated deforestation and other (hydrography, not forest, clouds, roads, residues, unclassified objects, and others).

The validation will be performed by using the land use mapping PRODES Digital (2014). The satellite images used will be four scenes of satellite Landsat 8 TM (orbits 001/65, 001/66, 233/65, and 233/66) to the total geographic scope of the Project Area and Reference Region.

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 VM00015 1.1 methodology.

e) Data archiving.

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

All documents and records will be kept in a secure retrievable manner for at least two years after the end of the project crediting period

f) Organization and responsibilities of the parties involved in all the above.

All satellite imagery assessments will be performed by a third-party specialist GIS company, currently represented by Avix. CARBONEXT is responsible for reporting and data archiving, according to VM0015, and for providing assistance during verification audits. The Project Proponent is co-responsible for data archiving.

5.3.2 Monitoring of leakage

a) Technical description of the monitoring tasks.

The sources of leakage identified as significant in the *ex-ante* assessment are subject to monitoring. Two sources of leakage are potentially subject to monitoring:

- Decrease in carbon stocks and increase in GHG emissions associated with leakage prevention activities;
- Decrease in carbon stocks and increase in GHG emissions in due to activity displacement leakage.

This Project Activity does not involve decrease in carbon stocks and increase in GHG emissions associated with leakage prevention activities. In this project, leakage prevention activities do not involve any carbon stock reduction due to deforestation or additional emissions caused by increased grazing activities. In this case, only the decrease in carbon stocks and increase in GHG emissions in due to activity displacement leakage will be monitored.

b) Data to be collected.

Deforestation above the baseline in the leakage belt area will be considered activity displacement leakage.

The result of the ex-post estimations of carbon stock changes must be reported using the same table formats used in the ex-ante assessment of baseline carbon stock changes in the leakage belt.

Table 22.c.1. Ex post above-ground net carbon stock changes in the leakage belt.

Table 22.c.2. Ex post below-ground net carbon stock changes in the leakage belt.

Table 22.c.6. Ex post net carbon stock changes in the wood products in the leakage belt.

Where strong evidence can be collected that deforestation in the leakage belt is attributable to deforestation agents that are not linked to the Project Area, the detected deforestation will not be attributed to the Project Activity and considered leakage. The operational entity verifying the monitoring data shall determine whether the documentation provided by the project proponent represents sufficient evidence to consider the detected deforestation as not attributable to the Project Activity and therefore not leakage.

To estimate the increased GHG emissions due to forest fires in the leakage belt area the assumption is made that forest clearing is done by burning the forest. The parameter values used to estimate emissions shall be the same used for estimating forest fires in the baseline (table 23), except for the initial carbon stocks (Cab, Cdw) which shall be those of the initial forest classes burned in the leakage belt area.

Report the result of the estimations using the same table formats used in the ex-ante assessment of baseline GHG emissions from forest fires in the project area:

Table 23: Parameters used to calculate emissions from forest fires in the leakage belt area.

Table 24: Ex post estimated non-CO₂ emissions from forest fires in the leakage belt area.

The results of all ex-post estimations of leakage are summarized using the same table format used for the ex-ante assessment:

Table 35. Total ex post estimated leakage.

c) Overview of data collection procedures.

The project area is located within a region that is subject to a monitoring program that is approved or sanctioned by the national government (PRODES). The data generated by such program is used in this project. PRODES data are applicable for use in this project, according to the criteria listed below (Methodology VM0015):

- i) PRODES monitoring occurs in the entire project area and leakage belt.
- ii) PRODES monitoring occurs in the entire reference region and covers the beginning, middle and end of the fixed baseline period.
- iii) PRODES monitors conversion of forest land to non-forest land.
- iv) Monitoring occurred during the entire fixed baseline period.

d) 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, accumulated deforestation and other (hydrography, not forest, clouds, roads, residues, unclassified objects, and others).

The validation will be performed by using the land use mapping PRODES Digital (2014). The satellite images used will be four scenes of satellite Landsat 8 TM (orbits 001/65, 001/66, 233/65, and 233/66) to the total geographic scope of the Project Area and Reference Region.

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 VM00015 1.1 methodology.

e) Data archiving.

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

All documents and records will be kept in a secure retrievable manner for at least two years after the end of the project crediting period.

f) Organization and responsibilities of the parties involved in all the above.

All satellite imagery assessments will be performed by the third-party GIS company. CARBONEXT is responsible for reporting and data archiving, according to VM0015, and for providing assistance during verification audits. The Project Proponent is co-responsible for data archiving.

5.3.3 Ex post calculation of net anthropogenic GHG emission reduction

a) Technical description of the monitoring tasks.

The calculation of ex post net anthropogenic GHG emission reductions is similar to the ex-ante calculation with the only difference that ex post estimated carbon stock changes and GHG emissions must be used in the case of the project scenario and leakage.

b) Data to be collected.

Report the ex post estimated net anthropogenic GHG emissions and calculation of Verified Carbon Units (VCUt, and VBCT) using the same table format used for the ex-ante assessment:

Table 36: Ex post estimated net anthropogenic GHG emission reductions and VCU.

c) Overview of data collection procedures.

Data collection procedures are the same as described in previous steps. This step involves compilation of data from previous procedures to calculate ex post net anthropogenic GHG emission reduction.

d) Quality control and quality assurance procedures.

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

e) Data archiving.

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

All documents and records will be kept in a secure retrievable manner for at least two years after the end of the project crediting period.

f) Organization and responsibilities of the parties involved in all the above.

All satellite imagery assessments will be performed by AVIX. CARBONEXT is responsible for reporting and data archiving, according to VM0015, and for providing assistance during verification audits. The Project Proponent is co-responsible for data archiving.

5.3.4 community and biodiversity variables to be monitored

Communities

a) Technical description of the monitoring tasks.

Among the proposed activities, the project proponent forecasts the organization of trainings focusing on sustainable cattle ranching. Furthermore, fire brigade teams will be trained, and new income opportunities will be created in the Municipalities of Lábrea and Porto Velho in terms of sustainable forest management.

b) Data to be collected.

The indicators that will be monitored are described in the Table 65.

Table 65. Social parameters to be monitored

Activity	Scope	Indicator	Unit	Monitoring Frequency	Goal	Corrective Actions after Critical Analyses
Training of Fire Brigade	Project Area	Attendance	Nº of attendees	Annual	100% employees	Enhance partnership with teaching institutions; Improve dissemination and communication means; Revise condition of local and time of sessions
Health and Security internal audits	Project Area	Occurrences	Nº of non-conformities detected; Nº of corrective actions performed;	Semiannual	90% corrective actions completed	Improve supervision attendance in the field; Improve the number of supervisors in the field
Advice on nutritional aspects	Project Area	Attendance	Nº of attendees	Annual	At least 30 participants (employees + neighbors)	Enhance partnership with teaching institutions; Improve dissemination and communication means; Revise condition of local and time of sessions
Gender equity	Project Area	Presence of men and women in trainings	% by gender	Annual	At least 30% of the presence of women in training and workshops carried out by the project	Increase the participation of women in trainings
Activities dependent on carbon credit sales						
Training on sustainable cattle raising	Regional	Attendance	Nº of attendees	2 years	At least 15 participants (employees + neighbors)	Enhance partnership with teaching institutions; Improve dissemination and communication means; Revise condition of local and time of sessions
Training on sustainable forest management	Regional	Attendance	Nº of attendees	Annual	At least 15 participants (employees + neighbors)	Enhance partnership with teaching institutions; Improve dissemination and communication means; Revise condition of local and time of sessions
Creation of jobs positions	Project Area	Hired employees	Nº of workers	Annual	Have at least 30 workers total	Offer technical training; Improve working conditions

c) Overview of data collection procedures.

The following forms will be applied after any of the trainings or the advice on nutritional aspects are completed for data collection:

- I. **Attendance List:** It contains the name of the participant, type of affiliation with the project and signature.
- II. **Reaction Assessment:** participants will be able to register their perceptions regarding the content presented, making it possible to evaluate the content and make suggestions for future training. This assessment can be done anonymously and is not mandatory.

In relation to the Health and Security audits, there is a checklist (named “Vistoria de Saúde e Segurança”) that will be applied.

d) Quality control and quality assurance procedures.

All communication with workers and families will be registered in minutes of meeting, which might be signed by all parties involved. Reports should be produced according to the monitoring frequency adopted. These reports should clearly inform the results of variables involved in monitoring, by means of photos, interviews, and documents.

e) Data archiving.

All records generated during project implementation will be conserved and made available to VCS verifiers at verification for inspection to demonstrate that the AUD project activity has actually been implemented.

All documents and records will be kept in a secure retrievable manner for at least two years after the end of the project crediting period.

f) Organization and responsibilities of the parties involved in all the above.

The Project Proponent is responsible for financing, implementing, and monitoring social aspects within the Project Area. Carbonext is co-responsible for monitoring the realization of the trainings and keep the evidences in a data room.

Biodiversity

a) Technical description of the monitoring tasks.

The monitoring tasks aim to assess the level of awareness on conservation importance, as well as to keep mechanisms to avoid forest fires and illegal practices inside the Project Area.

b) Data to be collected.

This assessment will be monitored and reported according to the frequency adopted (Table 66).

Table 66. Biodiversity parameters to be monitored

Activities dependent on the completion of the Validation Process						
Activity	Scope	Indicator	Unit	Monitoring Frequency	Goal	Corrective Actions after Critical Analyses
Trainging of Fire Brigade	Project Area	Attendance	Nº of attendees	5 years	100% employees	Enhance partnership with teaching institutions; Improve dissemination and communication means; Revise condition of local and time of sessions
Activities dependent on carbon credit sales						
Biomass, fauna and flora inventory	Project Area	Carbon Stock	tCO ₂ per hectare	5 years	Maintenance of carbon stocks	Increase in surveillance mechanisms; Develop conservation practices; Consult specialists;
		Endangered fauna species	Nº of endangered species		Maintenance of number of fauna endangered species	
		Total fauna species	Nº of species		Maintenance of total number of species	
		Endangered flora species	Nº of endangered species		Maintenance of number of flora endangered species	
		Total flora species	Nº of species		Maintenance of total number of species	

c) Overview of data collection procedures.

Data collection and records will be carried out by the local administrator.

d) Quality control and quality assurance procedures.

The quality control and quality assurance procedures will be determined by the local administrator and survey with attendees.

e) Data archiving.

All records generated during project implementation will be conserved and made available to VCS verifiers at verification for inspection to demonstrate that the AUD project activity has actually been implemented.

All documents and records will be kept in a secure retrievable manner for at least two years after the end of the project crediting period.

f) Organization and responsibilities of the parties involved in all the above.

The Project Proponent is responsible for all assessments in this Project Activity.

5.3.5 Revisiting the baseline projections for future fixed baseline period

According to VM0015, the baseline will be revisited every 10 years. Thus, the first revision of the baseline is scheduled for 2028. For this purpose, the following tasks will be carried out:

- Updating information on agents, drivers and underlying causes of deforestation, which involves the following sub-tasks:
 - Collecting information that is relevant to understand deforestation agents, drivers and underlying causes;
 - Redoing step 3 of the ex-ante methodology, as specified in the methodology;
 - Recalibrating the model for projection of future deforestation, using new “Factor Maps” for the subsequent fixed baseline period.
- Adjusting the land-use and land-cover change component of the baseline, which involves reassessing the following components of the baseline projections:
 - The annual areas of baseline deforestation.
 - The location of baseline deforestation.
 - Adjustment of the annual areas of baseline deforestation.
 - Adjustment of the location of the projected baseline deforestation.
- Adjusting, as needed, the carbon component of the baseline (this task will only be carried out if more accurate methods for carbon stocks estimates are available in the occasion of baseline revision).

APPENDIX

APPENDIX 1: CALCULATION OF TOTAL VCUS

Year	Project year t	Ex ante net		Ex ante VCUs tradable		Ex ante	
		anthropogenic GHG emission reductions				buffer credits	
		annual	cumulative	annual	cumulative	annual	cumulative
		ΔREDD _t	ΔREDD	VCU _t	VCU	VBC _t	VBC
		tCO ₂ -e	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e	tCO ₂ -e
2018	0	788,448	788,448	708,287	708,287	80,161	80,161
2019	1	454,880	1,243,328	408,146	1,116,433	46,734	126,895
2020	2	489,244	1,732,572	438,725	1,555,158	50,520	177,414
2021	3	661,349	2,393,921	593,466	2,148,624	67,883	245,297
2022	4	536,044	2,929,965	480,586	2,629,210	55,458	300,755
2023	5	186,599	3,116,564	166,571	2,795,781	20,027	320,783
2024	6	206,178	3,322,742	184,264	2,980,045	21,915	342,697
2025	7	620,360	3,943,102	556,354	3,536,399	64,006	406,703
2026	8	262,465	4,205,567	234,753	3,771,152	27,712	434,415
2027	9	674,710	4,880,278	605,105	4,376,257	69,605	504,021
2028	10	350,907	5,231,185	314,210	4,690,467	36,697	540,718
2029	11	448,798	5,679,982	402,399	5,092,866	46,399	587,117
2030	12	717,632	6,397,614	644,403	5,737,269	73,228	660,345
2031	13	707,846	7,105,460	635,654	6,372,923	72,192	732,537
2032	14	698,227	7,803,687	627,054	6,999,976	71,174	803,711
2033	15	696,827	8,500,514	625,801	7,625,778	71,025	874,736
2034	16	456,496	8,957,010	409,880	8,035,657	46,617	921,352
2035	17	443,348	9,400,358	398,123	8,433,781	45,224	966,577
2036	18	438,535	9,838,892	393,820	8,827,601	44,715	1,011,292
2037	19	425,343	10,264,236	382,025	9,209,626	43,318	1,054,610
2038	20	419,368	10,683,603	376,682	9,586,308	42,685	1,097,295
2039	21	406,460	11,090,063	365,108	9,951,416	41,352	1,138,647
2040	22	401,118	11,491,181	360,331	10,311,747	40,786	1,179,433
2041	23	395,776	11,886,956	355,555	10,667,302	40,221	1,219,654
2042	24	390,434	12,277,390	350,779	11,018,081	39,655	1,259,309
2043	25	385,092	12,662,482	346,002	11,364,083	39,089	1,298,398
2044	26	388,483	13,050,965	349,050	11,713,133	39,433	1,337,832
2045	27	43,319	13,094,284	38,403	11,751,536	4,916	1,342,748
2046	28	-51,807	13,042,477	-47,210	11,704,326	-4,597	1,338,151
2047	29	59,026	13,101,503	52,540	11,756,866	6,486	1,344,637
2048	30	-237,538	12,863,965	-214,136	11,542,731	-23,403	1,321,235

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