UNITOR REDD+ PROJECT

Document 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 data[1]. Municipal deforestation rates have risen year on year, from 3.8% in 2017 to 5.3% in 2020, making it a priority area for forest conservation worldwide. A consortium of 15 neighbouring properties comprises the Unitor REDD+ Project, summing to 99,035.20 ha of forest area, who have come together to develop forest carbon activities under the guidance, example and inspiration of the nearby Fortaleza Ituxi REDD Project.

In the Lábrea region, not only have natural ecosystems been extensively damaged, but land-use changes have provoked severe social conflicts through land-grabs and expansion of agriculture and cattle ranching activities, contributing to expulsion of communities of wild-harvesting families ("*extrativistas*") from the region. The deforestation pressure in Lábrea originates from the neighbouring States of Acre and Rondônia, which suffered intense historical deforestation, mainly due to the expansion of agriculture and cattle ranching[2]. According to Vitel (2009), the 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.

Given the deforestation pressures and financial difficulties regarding sustainable economic activities in the Project Area, sale of the farm to private investors is considered the most plausible baseline scenario. In recent years, some of the project landowners have been approached to sell their properties. In this context, the regional business-as-usual scenario (BAU) is the most plausible future scenario, involving deforestation beyond Brazilian Forest Code limits and sale of illegal timber, followed by implementation of unsustainable cattle ranching operations. With project activity approval, the landowner intends to improve the mechanisms of surveillance inside the Project Area, as well as implement activities that will result in climate, community and biodiversity benefits. Five of the project properties have operational sustainable forest management activities (plus two with licenses pending approval), which also permit monitoring of the areas by staff. The harvest activities are predominantly carried out by clients, who possess all the equipment and personnel needed to perform low-impact logging/harvesting activities. Three of the properties have cattle ranching activities (2 of which also have SFMPs), with legal levels of forest on their ranches, these owners will continue to improve their practices thanks to

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

[2] http://www.mma.gov.br/port/conama/processos/A29EB9BD/Resumo_PropZEE_SubRegiaoPorus.pdf (pg. 73). Last visited 18th July, 2017.

the sustainable cattle raising courses that will be provided by the project. Five of the project properties have no economic activities on their farms at the time of writing of this VCS-PD, which are the following properties (or *Fazendas*): Paraná; Jardim Alegre; Santa Luzia; São Sebastião; and Panorama.

Project's expected climate, community and biodiversity benefits

Estimated net GHG emission reductions: 16,210,610 tCO_2e (average of 522,923 tCO_2e/year), corresponding to the avoided of deforestation of 24,031 hectares over the 30 years of the project lifetime.

Year	Project year t	Ex ante net anthropogenic GHG emission reductions annual $\Delta REDD_t$ tCO_2-e	 cumulative $\Delta REDD$ tCO_2-e
2018	0	0	0
2019	1	611,415	611,415
2020	2	769,039	1,380,453
2021	3	866,141	2,246,594
2022	4	837,143	3,083,737
2023	5	485,674	3,569,411
2024	6	451,633	4,021,044
2025	7	868,836	4,889,879
2026	8	508,184	5,398,063
2027	9	922,655	6,320,718
2028	10	614,463	6,935,182
2029	11	646,382	7,581,564
2030	12	742,394	8,323,958
2031	13	733,237	9,057,195
2032	14	723,520	9,780,715
2033	15	713,951	10,494,666
2034	16	467,744	10,962,410
2035	17	463,044	11,425,454
2036	18	449,896	11,875,349
2037	19	445,083	12,320,432
2038	20	431,891	12,752,323
2039	21	418,128	13,170,451
2040	22	412,736	13,583,188
2041	23	407,345	13,990,532
2042	24	401,953	14,392,485
2043	25	396,561	14,789,046
2044	26	394,752	15,183,798
2045	27	275,636	15,459,434

2046	28	242,062	15,701,496
2047	29	280,435	15,981,931
2048	30	228,680	16,210,610
Total (tCO_2e)		**16,210,610**	
Average (tCO_2e)		**522,923**	

- Sustainable forest management is the initial tool to guarantee the surveillance in the Project Area, as approved or pending Sustainable Forest Management Plans (SFMPs) are present in 6 of the 15 properties. The presence of workers in timber management areas is the frontrunning factor to reduce the pressures of trespassing illegal wood harvesters inside the Project Area.

- Secondly, the project activity has increased surveillance to avoid further trespassing into the Project Area. Additionally, 15 surveillance posts will also be placed around the farm and new motorcycles will be purchased, with a view to ensuring security at the project site and surrounding areas, summing with the deforestation control efforts already underway in the neighbouring Ituxi REDD project;

- Technical training on sustainable cattle raising and forest management, fire brigades, production of Brazil-nuts (already in place) etc.;

- Seedling Production Nursery and donation for neighbours wishing to plant;

- Complementary monitoring of labour conditions in the Project Area.

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 AFOLU Requirements[3], 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. 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

[3] https://verra.org/wp-content/uploads/2020/11/PREVIOUS-VERSION-AFOLU-Requirements-v3.6.pdf

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 CH_4 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.

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.

Commercially Sensitive Information

No commercially sensitive information has been excluded from this public version of the Project Description.

Further Information

Not applicable.

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. This AFOLU project activity is designed to include REDD Avoided Unplanned Deforestation (AUD) components. In addition, this project activity is designed to include more than one "project activity instance", such as different communities or landowners along the project 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. Such geographic area is defined using geodetic polygons. The determination of baseline scenario and demonstration of additionality were based upon the initial project activity instances (15 farms), that are included in this VCS-PD at 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, 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 not defined a capacity limit to this project activity in terms of geographic area. However, it has been established that such limit will respect the same conditions of similarity of historical deforestation rates as applied in 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 geographic area comprised within the Reference Region:

1) Meet the applicability conditions set out in the methodology applied to the project.

2) Use the technologies or measures specified in the project description.

3) Apply the technologies or measures in the same manner as specified in the project description.

4) Are subject to the baseline scenario determined in the project description for the specified project activity and geographic area.

5) Have characteristics with respect to additionality that are consistent with the initial instances for the specified project activity and geographic area. For example, the new project activity instances have financial, technical and/or other parameters (such as the size/scale of the instances) consistent with the initial instances, or face the same investment, technological and/or other barriers as the initial instances.

In addition, new project activity instances shall:

1) Occur within the Reference Region.

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.

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.

1.5 Project Proponent

Organization name	Ituxi Administração e Participação Ltda.
Contact person	Ricardo Stoppe Junior
Title	Project Proponent (Landowner)
Address	Av. Calama N. 5040 Sala 01, Porto Velho, Rondônia
Telephone	55 (92) 3634-7521
Email	aamericardo@ig.com.br

Organization name	Carbonext Consultoria Ltda.
Role in the project	Technical advisory on project development
Contact person	Janaína Dallan, Luiz Fernando de Moura & David Swallow
Title	Project developer
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Telephone	+55 (11) 2339-6931
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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
Contact person	Mateus Trez
Title	Technology, Remote Sensing and Geoprocessing Coordinator
Address	www.avix.com.br

Telephone	+55 (19) 3427-2438
Email	janaina@carbonext.com.br

1.7 Ownership

Organization name	I. Fazenda Santa Catarina: Ituxi Administração e Participação Ltda. (CNPJ (Brazilian corporate registration nº.: 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

Title	Main Project Proponent (Landowner)
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1.8 Project Start Date

28/11/2018 is defined as the project start date, being the date of the first official document attesting to the start of the Forest Management Plan within the most recent property to be included in the Unitor group: Presidente Prudente Farm. Equipment and personnel for forest management were present in properties of the project area which conduct SFMP, and the preliminary studies to begin operations had been conducted by this date. It is assumed that the presence of personnel served to increase surveillance and deter potential deforestation agents.

1.9 Project Crediting Period

Start date: 28/11/2018

End date: 27/11/2048

30 years.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	X
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
2018	0
2019	611,415
2020	769,039
2021	866,141

2022	837,143
2023	485,674
2024	451,633
2025	868,836
2026	508,184
2027	922,655
2028	614,463
2029	646,382
2030	742,394
2031	733,237
2032	723,520
2033	713,951
2034	467,744
2035	463,044
2036	449,896
2037	445,083
2038	431,891
2039	418,128
2040	412,736
2041	407,345
2042	401,953
2043	396,561
2044	394,752
2045	275,636
2046	242,062
2047	280,435
2048	228,680
Total estimated ERs	16,210,610

Total number of crediting years	30
Average annual ERs	522,923

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 Biome[4] 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 km^2 in 2009 grew to 1,000 km^2 in 2018, representing an overall increase of 147%. The years 2019 and 2020 taken together saw 2,955 km^2 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[5,6].

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[4] Source PRODES (accessed 22/03/21): http://terrabrasilis.dpi.inpe.br/

[5] 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

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

Furthermore, successive governments (Dilma in 2012, Temer in 2016, and Bolsonaro 2019[7]) have put forward measures such as the to reduce the areas Conservation Units ("UCs")[8], 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 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 1).

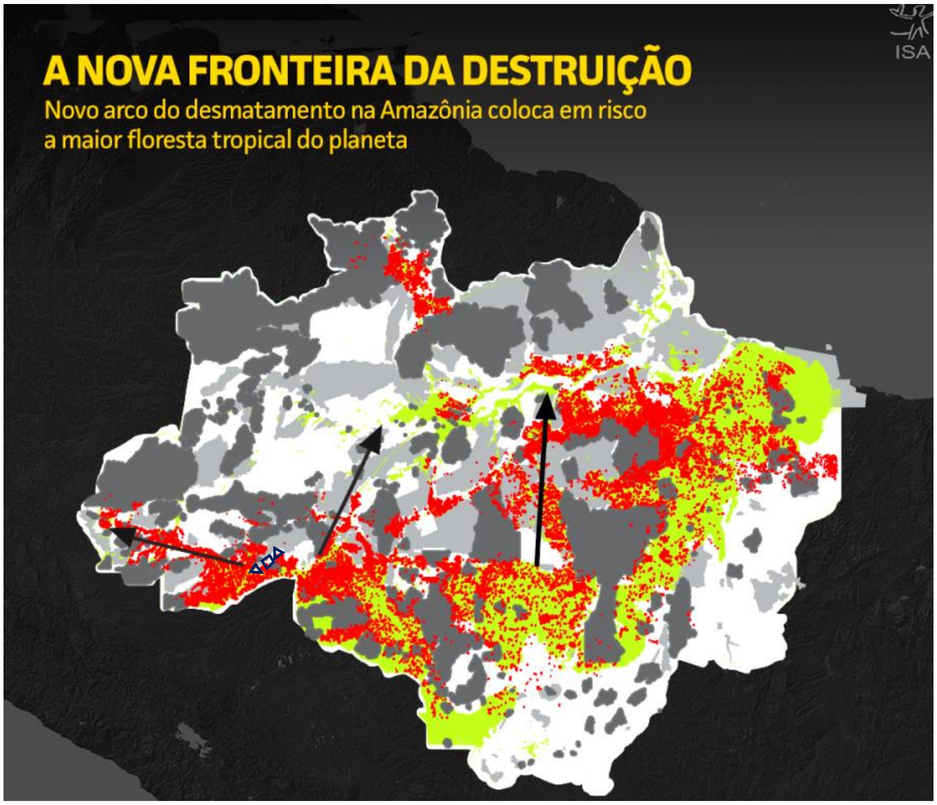
The South of the municipality of Lábrea has already been reached by the "Arc of Deforestation" causing it to be ranked among the Amazon Biome's most deforested municipalities for the last 10 years. This is primarily caused by the presence of the BR-364 highway, which connects Porto Velho to Rio Branco, 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 Lábrea[9], while promises to pave the BR-230, which connects the BR-319 to Lábrea, continue[10]. 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).

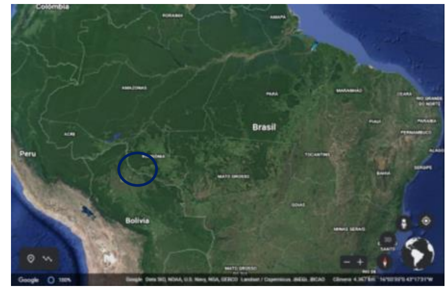
[7] Source Amazônia.org (accessed 22/03/21): https://amazonia.org.br/2019/07/bolsonaro-conversa-com-governadores-sobre-revisar-unidades-de-conservacao/

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

[9] 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

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





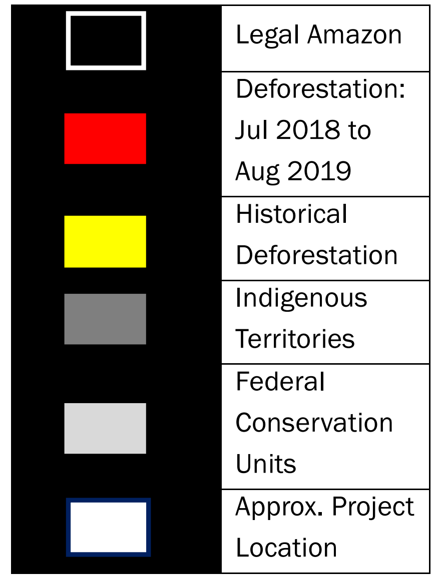


Figure 1. Location of the Arc of Deforestation in 2019 (Source: ISA, 2019)

Table 1. 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 Land	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 Lábrea region as a whole, 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.

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 2) confirm this pattern.

Along the 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 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).

	Project Area
	“Ramal do Boi” road

Figure 2. 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), the evidence for which is available to auditors. 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 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.

Given the context above, the baseline may involve the following non-exclusive baseline scenarios:

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

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 (12 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, as demonstrated in the present VCS-PD.

Three categories can be distinguished within the properties activities:

1a. Sustainable Forest Management Plans (SFMPs): Five of the properties project properties have actively operational SFMPs, while two have pending licenses. Of the active five, only two make a profit (5.7% and 9.84% percentage profit), while three make a loss. Those with pending operating licenses currently make no profit. The average profitability across all properties is a loss of -R$197.79/ha of managed area (-2.83%), and all the project owners have expressed the need for carbon credit income.

The IRR for SFMPs was calculated as -8% under a normal scenario. Thus, this is not the most plausible scenario.

1b. No activity:

Five of the project properties have no economic activity, generating no income, with a 100% loss rate, which is not financially sustainable.

Thus, this is not the most plausible scenario.

1c. SFMP plus cattle farming:

Three of the project properties conduct both SFMPs and cattle farming, however one has not yet reached the stage of sales, and so has no income as of yet. One of the properties has a small positive profit of R$ 0.37/ha and a profit ratio of 5.4%. Cattle farming has an IRR reported in literature as 4% (SCHNEIDER et al.,2000), while our analyses suggest it may be slightly higher in the local region, at 6%.

Thus, 1c is a possible scenario.

ii) SCENARIO 2: Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project: 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: 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 70 m^3 (11) while the legal SFMPs analysed extract up to 25 m^3/ha. Thus, this would lead to a 64% income increase and profit levels of R$ 76.58/ha or 29.3%. The calculated IRR for this scenario is 41%.

Following illegal deforestation, cattle farming is conducted with the IRR of at least 4%, with analyses of local data suggesting 6%. Given these economic analyses and literature studies (SCHNEIDER et al. 2000), this is considered the regional business-as-usual (BAU) scenario.

Thus, this is a plausible scenario.

iv) SCENARIO 4: 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 plausible scenario.

v) SCENARIO 5: Farm sale to private investors followed by the regional BAU:

[11] https://imazon.org.br/degradacao-de-florestas-pela-exploracao-madeireira-e-fogo-na-amazonia-oriental-brasileira-no-20/

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.

Given that SCENARIO 5 would be the most profitable and would save the landowner from current expenses on the Project Area, it can be regarded as the most plausible baseline scenario.

Corroborating the statements about the deforestation pressure on the Project Area, as mentioned above, Vitel (2009) presented projections of deforestation patterns for the municipality of Lábrea to year 2040. In these projections, the Project Area is strongly affected by deforestation. Through deforestation modelling, the author clearly demonstrates that the Project Area would not stand the growing deforestation pressure over time, which is supported by the project's own simulations, although in a more conservative fashion: by 2048, 24,031.3 hectares (24%) of the project area is predicted to be lost.

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 16,210,610 tCO_2e, corresponding to the avoidance of 24,031.3 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 these latter activities, the project proponent will make its best efforts to convince these entities to collaborate in 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 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 local community. This may lead to the qualification of people who can work in the proposed project.
- 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.

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. Creation of incentives to recover degraded areas surrounding the property (donation of native seedlings), and

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 tCO_2/ha (577 tCO_2/ha aboveground; 176 tCO_2/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) Names of the project properties:

I. Fazenda Santa Catarina
II. Fazenda Santa Maria
III. Fazenda Bahia
IV. Fazenda Paraná
V. Fazenda Santa Fé
VI. Fazenda Presidente Prudente

VII. Fazenda Jardim Alegre

VIII. Fazenda Santa Luzia

IX. Fazenda São José

X. Fazenda Recanto

XI. Fazenda São Manoel

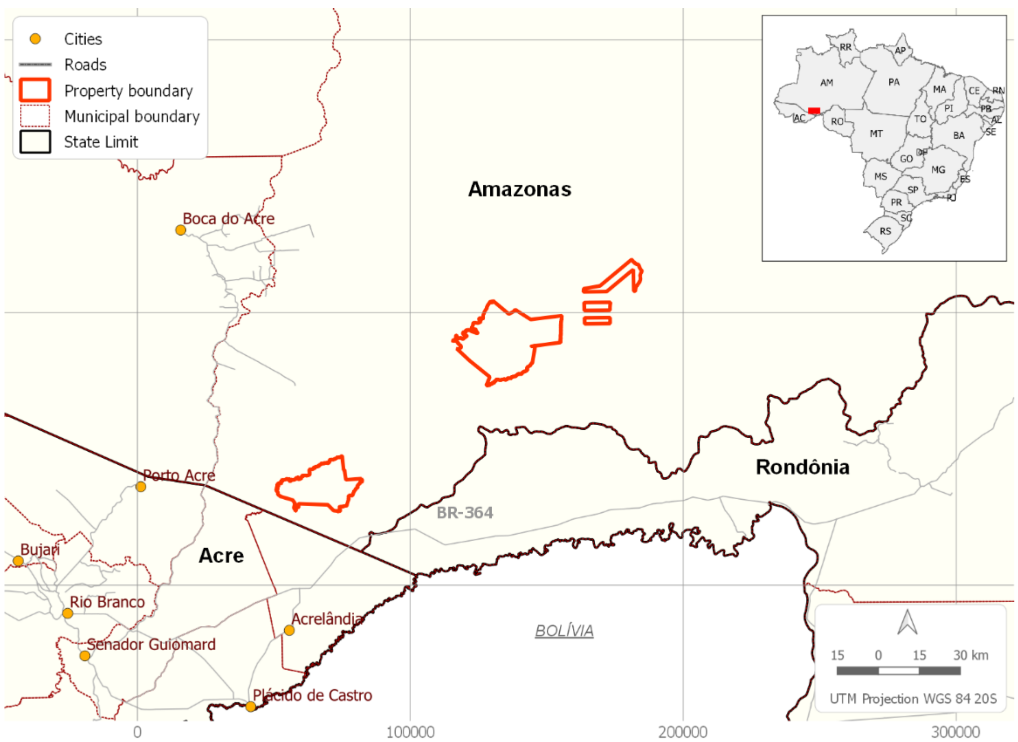
XII. Fazenda São Sebastião

XIII. Fazenda União

XIV. Fazenda Panorama

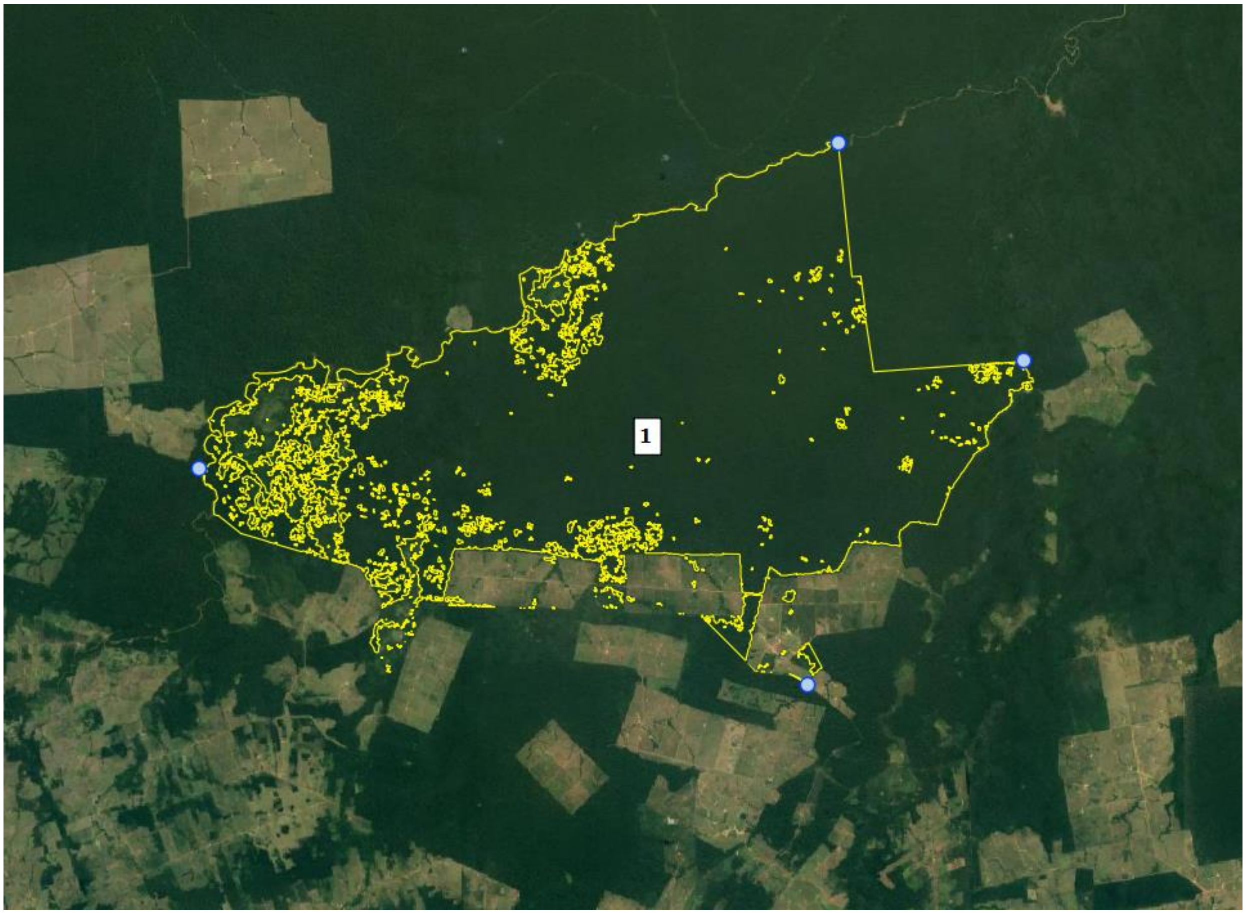
XV. Fazenda Três Barras

b) Map of the project area:



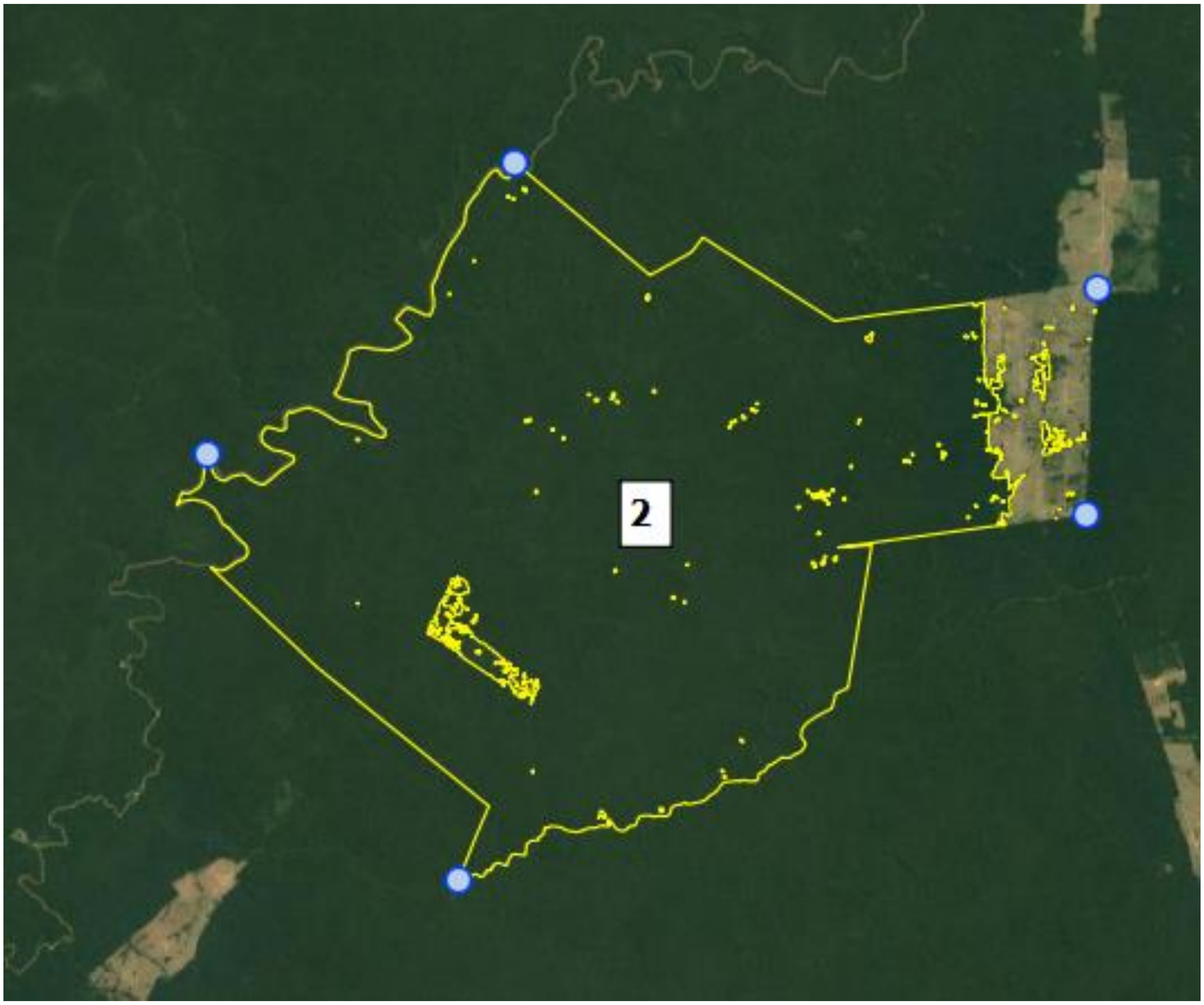
c) The main geodetic coordinates of the Project Area, separated into three main zones, are as follows, applying the Lat; Long coordinate system. The complete set of 1,671 coordinates, is available upon request:

Project Zone 1:



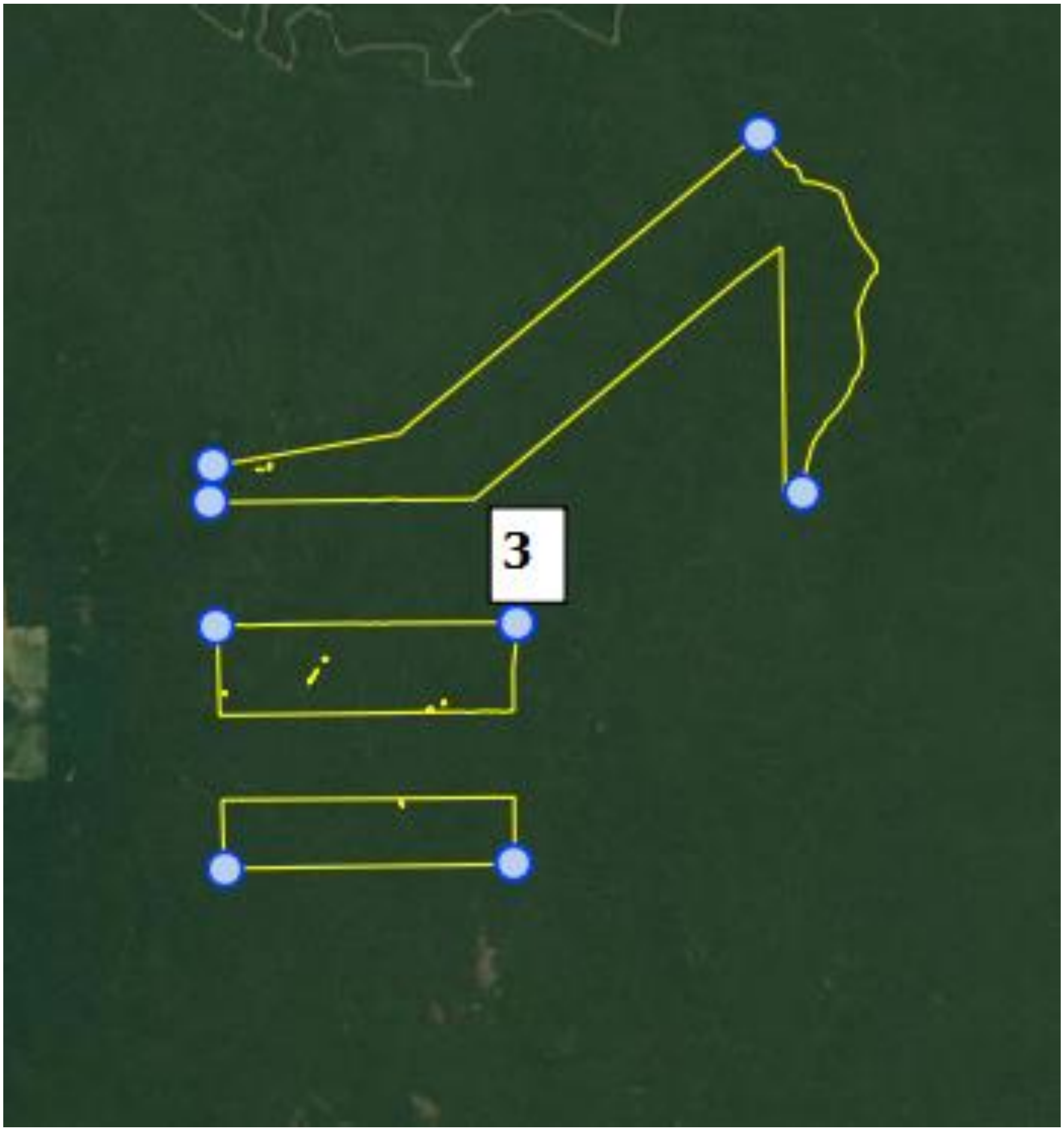
Latitude	Longitude
-9,57635	-66,8059
-9,68594	-66,8814
-9,60964	-67,0903
-9,50126	-66,8689

Project Zone 2:



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

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

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

1.13 Conditions Prior to Project Initiation

Pasture accounts for virtually all the deforested land occupation in the project region, as attested to by MMA[12]. The implementation of this BAU activity is usually financed by means of initial capital obtained in wood logging. It is believed that the same pattern of deforestation and land uses observed in the Reference Area might be fairly replicated into the Project Area in the absence of this REDD Project.

The Project Area forest cover is characterized as Open ombrophylous forest ("As", according to Brazilian Vegetation Map, IBGE). The above and belowground carbon stocks used in calculations for this Project Activity are compiled in item "4.1.6.1 Estimation of baseline carbon stock changes" of this VCS-PD.

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 99,035.2 hectares. The areas with SFMPs are shown on the map below. The Project has seven properties with Operating Licenses that are either active or pending approval, representing total Management Areas of 43,247.79, and annual, which are divided into Units of Forest Production ("UPFs") totalling 3,931.62 hectares to be harvested per year. The permitted harvest rate is on average 18.59 m^3/hectare.

[12] Source MMA (accessed 23/03/21)
http://www.mma.gov.br/port/conama/processos/A29EB9BD/Resumo_PropZEE_SubRegiaoPorus.pdf (pg. 73)

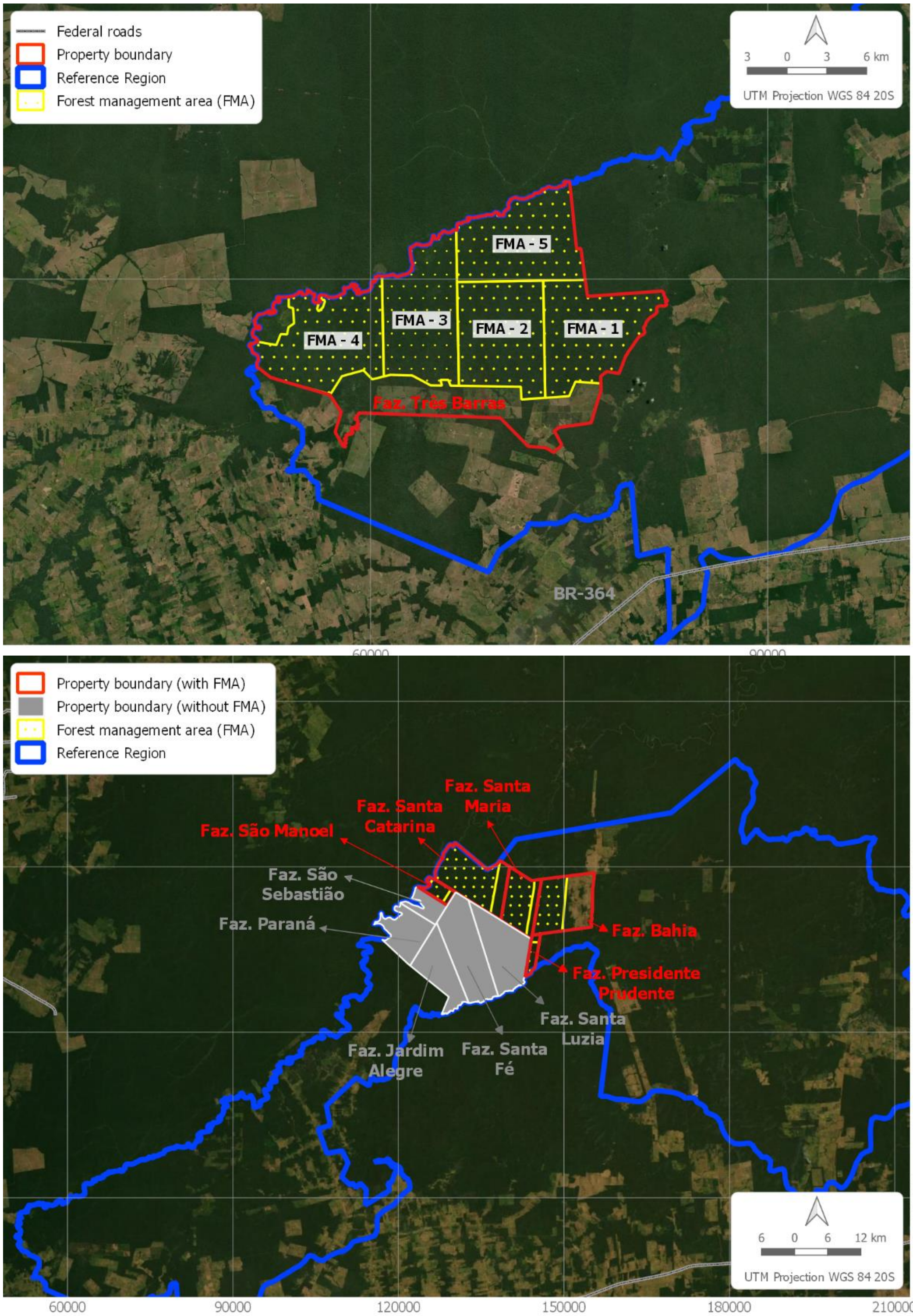


Figure 3. Project Area and Sustainable Forest Management areas

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:

"*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 13ºS, in States of Tocantins and Goiás, and to the West of meridian 44ºW, of the State of Maranhão."

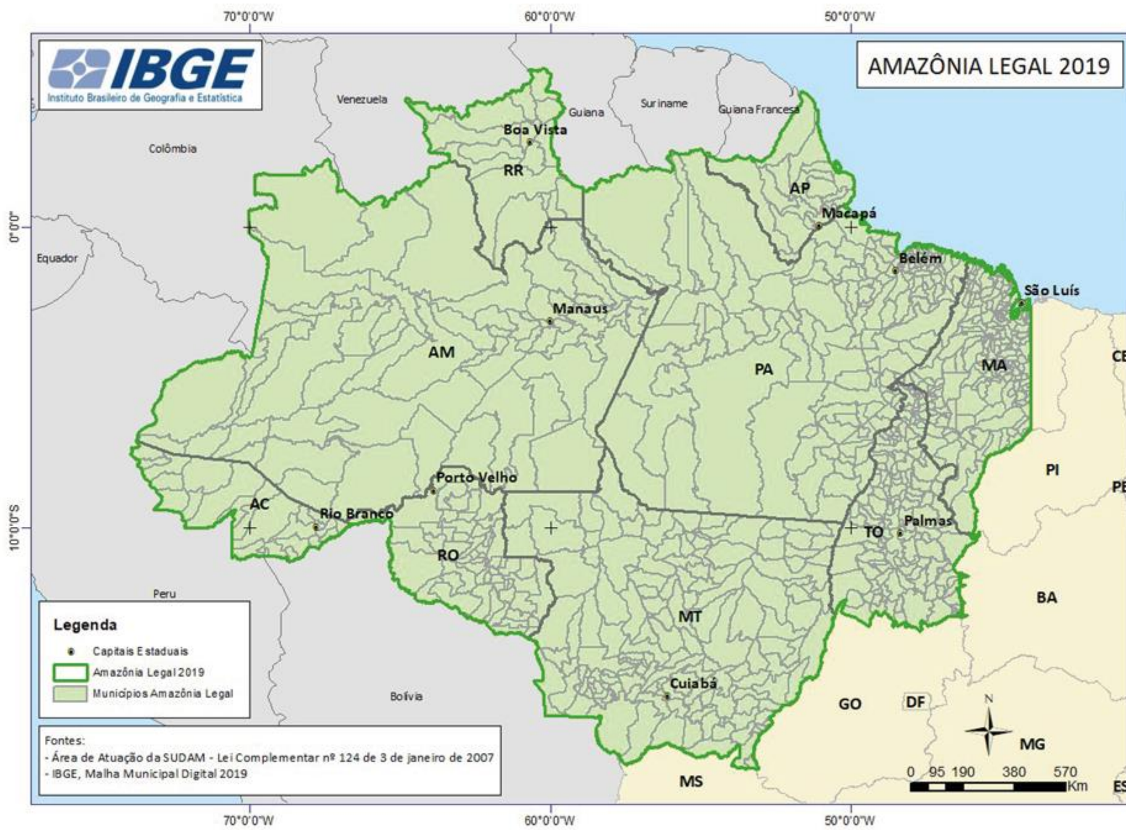


Figure 4. The Brazilian Legal Amazon States Acre (AC), Amapá (AP), Amazonas (AM), Maranhão (MA), Mato Grosso (MT), Pará (PA), Rondônia (RO), Roraima (RR), Tocantins (TO) (ancient North of Goiás). Source: IBGE (2019).

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."

Thus, in compliance with Brazilian Forest Code, the farms have officially allocated 80% of their total area as LR.

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).

Given the permanent attempts against the Project Area, the project proponents use their best efforts 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. This Project might be a successful example of the following 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 local community. This may lead to the qualification of people who can work in the proposed project.

- 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 Unitor REDD+ Project complies with the logic of the environmental priorities defined by the Brazilian Federal Administration, which, in the course of COP 14 Conference held in Poznan, Poland, in December 2008, declared a deforestation reduction goal of 70% by the year 2018. The Unitor REDD+ Project complies with the logic of the environmental priorities defined by the Brazilian Federal Administration, which, in the course of COP 14 Conference held in Poznan, Poland, in December 2008, declared a deforestation reduction goal of 70% by the year 2018, 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 within the framework of the Paris Climate Accords (COP-21)[13]. In order to attain this goal, it will be necessary to join government initiatives with independent actions (such as that proposed under the present project).

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) from the Brazilian Ministry of Environment[14], 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

[13] Source MMA (accessed 19/04/21): http://redd.mma.gov.br/pt/redd-e-a-indc-brasileira

[14] Source MMA (accessed 23/03/21): http://www.mma.gov.br/component/k2/item/8200-figuras

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.

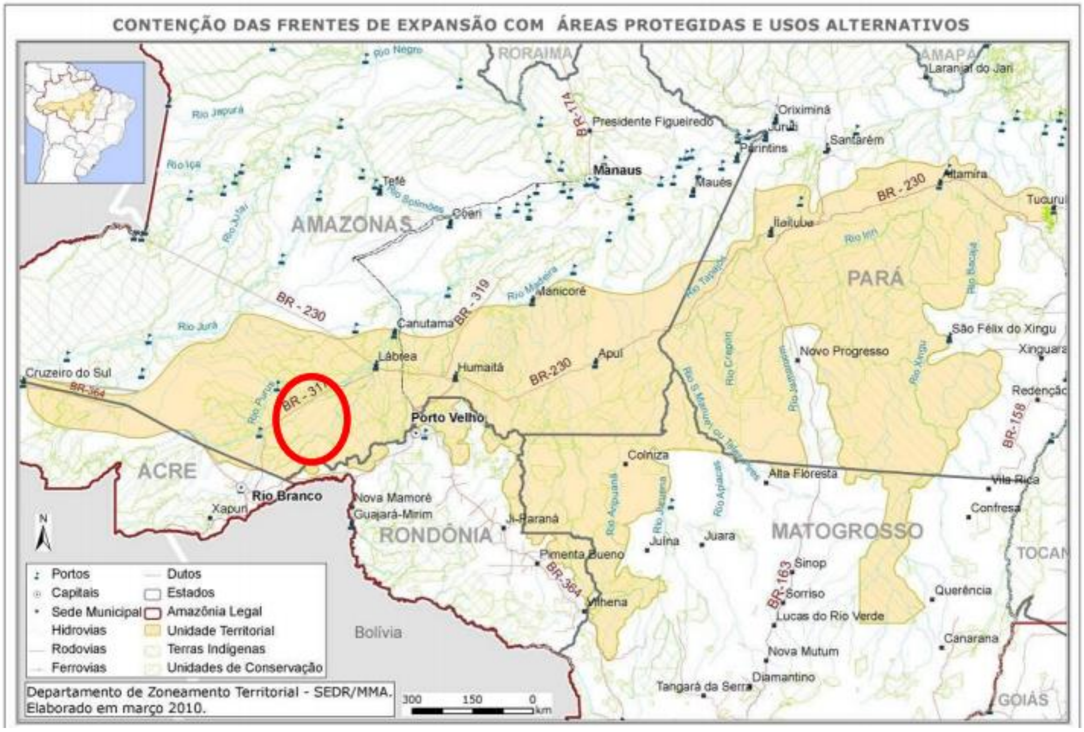


Figure 5. Containment of the expansion fronts with protected areas and alternative uses (Source: Brazilian Ministry of the Environment – MMA)

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 premises[15].

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 goals and leverage further pilot REDD projects at the municipal level, ensuring priority for the municipalities facing critical deforestation levels, as in the case of Lábrea and Porto Velho's districts of Nova Califórnia and Extrema.

[15] 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

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 the 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: monthly 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

Following database surveys and given the activities planned under the present project, the following list of stakeholders was drawn up:

- 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);
- 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).

A comprehensive project summary was actively presented to the communities and other stakeholder in Portuguese in the field, by two project agents in March 2021, and the government organs and other institutions were contacted by e-mail. Furthermore, a communication channel was made available for request of further information, including full project documentation, to answer questions, and to voice concerns.

The project proponent understands that stakeholders want and need to be involved in project design, implementation, monitoring and evaluation throughout the project lifetime. Therefore, a communication channel will be established for stakeholders to continually express their concerns and to solve eventual conflicts and grievances that arise during project planning, implementation and monitoring. It is expected that 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:

First: 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);

Second: 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);

Third: 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.)

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

Traditional communities

With the objective of locating the traditional communities and also the 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) database[16], the State has six officially recognized "quilombola" communities. The studies show that none of these communities is geographically located in a position that 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 map database of TIs provided by FUNAI[17] was consulted. As shown in the table below, 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 the nearest point of the Project Area. 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.

[16] Source (accessed 23/03/21): http://monitoramento.seppir.gov.br/

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

Table 2. Distances in a straight line between Indigenous Territories and the Project Area

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

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 people, adjacent to the Project Area. According to the assessment carried out, it is concluded that this indigenous land may be affected by the project activity. This Indigenous Territory been subject to strong deforestation pressure, as recently reported by the media[18].

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.

Map of Community Locations

The following maps indicate the social movements currently active, as well as the location of communities and Conservation Units in the project region. 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 on the Brazilian map below) and the "Indigenous peoples of the municipality of Lábrea" (number 43 in the Brazilian map below).

[18]Source (accessed 23/03/21): http://www.rondoniaovivo.com/interior/distrito-de-vista-alegre-do-abuna/noticia/exclusivo-madeireiros-retornam-para-t-i-kaxarari-apos-operacao-toruk/129839

Concerning the Indigenous Territories, eight indigenous villages were mapped in the project region (IBGE data), as indicated in the Google Earth map below. As previously stated, the direct impact of this project activity on regional indigenous lands is considered to be very feeble, given that the closest indigenous village is neighbour of the Project Area, and the second closest is located at 23 km.

A land-use survey was also carried out of the project region, mapping Conservation Units, Settlements, Indigenous Territories and private lands. 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 of increasing distance. The management staff of these Conservation Units are being contacted to publicize this project, and to exchange data on local fauna, flora and communities.

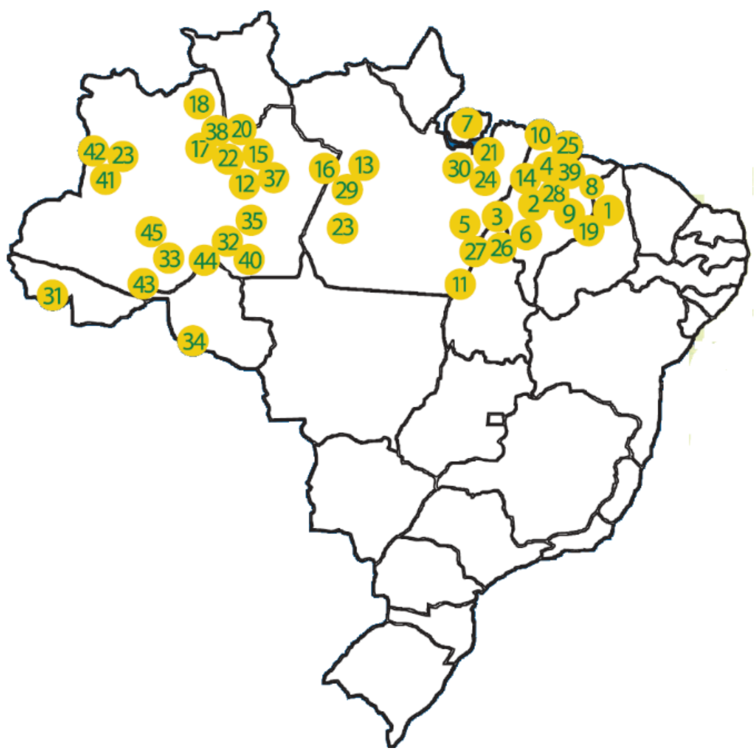


Figure 6. New Social Mapping of the Amazon", "Social Movements, Collective Identity and Conflicts": 33 - "Extractive Communities of the Resex Ituxi"; 43 - "Indigenous peoples of the municipality of Lábrea"

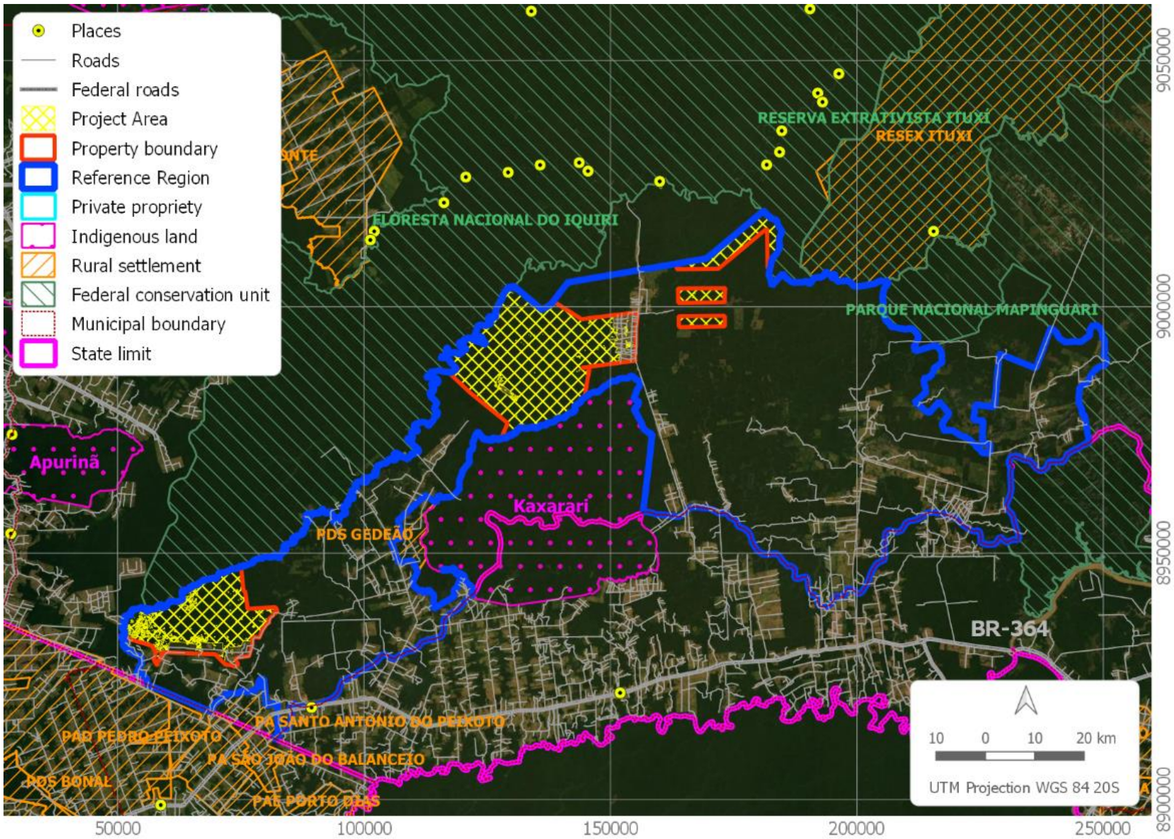


Figure 7. Land use map of the project region, showing the Project Area, Conservation Units, Settlements, Indigenous Territories, and private lands.

2.3 Environmental Impact

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

- Avoided deforestation of 24,031.3 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

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 2012[19]. 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 (*Pantera onca*), classified as "Near Threatened" (NT)[20]; Giant Otter (*Pteronura brasiliensis*), "Endangered" (EN); Giant Anteater (*Myrmecophaga tridactyla*), "Vulnerable" (VU); and Giant Armadillo (*Priodontes maximus*), "Vulnerable" (VU).

A study of the biodiversity has recently been carried out by the project proponents of the neighbouring Fortaleza Ituxi REDD Project, 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 be considered endemic to the Purus-Madeira floodplain (Ayres e Clutton-Brock 1992, Ribas et al. 2015, 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).

[19] 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

[20] Source IUCN Red List (accessed 24/03/21): https://www.iucnredlist.org/search?query=Panthera%20onca%20&searchType=species

Table 3. 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)[21], and Near-threatened (NT) in the national classification (ICMBio 2018).

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

Figure 8. 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 *Acciptriformes*, *Apodifiormes*, 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 1997, as cited in Rio Negro Agroflorestal Ltda. 2020); and the Humaita Antbird (*Myrmelastes humaythae*), which is associated with floodplains and white water streams and endemic to the Purus-Madeira Region (del Hoyo et al. 2020, , as cited in Rio Negro Agroflorestal Ltda. 2020). 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 9. 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 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: 116 species, 5 families and 19 genera have been documented in Brazil (Reis et al. 2015, as cited in Rio Negro Agroflorestal Ltda. 2020)

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.

Figure 10. 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 jacknife) presented by the Rio Negro Agroflorestal Ltda (2020) study.

2.4 Public Comments

During the public consultation process, which occurred over March and April 2021, 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 public comments are available at the time of validation.

2.5 AFOLU-Specific Safeguards

A local stakeholder consultation presentation was delivered to community-level stakeholders:

a. within the project area; and

b. within a 20 km radius, in the field, by two project agents over the month of March 2021.

The census aimed to cover over 50% of category a) and over 20% of category b), in view of increasing project security in line with non-permanence guidelines. 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 the table below:

Table 4. Family and communities consulted by project agents, and participant numbers.

Family/ Community Name	Nº Participants	Family/ Community Name	Nº 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**		

The community public consultation contained questions regarding:

- Which project areas are frequented by the residents;
- Whether there was any reliance on the project area for resources;
- Knowledge of conflicts or problems relating to these areas;
- Contact information (invitation to converse with regularly patrolling project agents, as well as e-mail) for questions, comments, grievances, and whistle-blowing purposes;
- And furthermore, proactive questions to discover the community's view on how the project can assist with educational, health, logistics/ infrastructure, livelihood, and business issues that the community may be facing.

At the time of writing of the present VCS-PD the community consultations were ongoing, however the project had not discovered any complaints or grievances reported by the communities. The Unitor REDD+ project is committed to maintaining open channels of communication, for all kinds of communication, from communities to project proponents and owners, across the project lifetime.

The same approach was applied to the institutional Stakeholders mentioned in section 2.2, however the channels of communication with them are primarily through e-mail and telephone, which the project proponent made due efforts to make open and clear during the public consultation process conducted over March 2021, in order for institutional stakeholders to voice any questions, comments, grievances, or whistle-blowing alert that they may have. Regarding the results from the institutional stakeholders, at the time leading up to validation, they are restricted to those described in Section 2.4, above.

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: http://www.v-c-s.org/methodologies/VM0015 (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: http://www.v-cs.org/methodologies/VT0001 (last visited 03/03/2021).

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).

CDM – Executive Board “Tool for testing significance of GHG emissions in A/R CDM project activities (Version 01)” EB 31. At: https://cdm.unfccc.int/methodologies/ARmethodologies/tools/aram-tool-04-v1.pdf (last visited in 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 5. This Project Activity falls into category B, as it predominantly involves protection of forest with 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 11.

Table 5. Scope of the VM0015 methodology

			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.

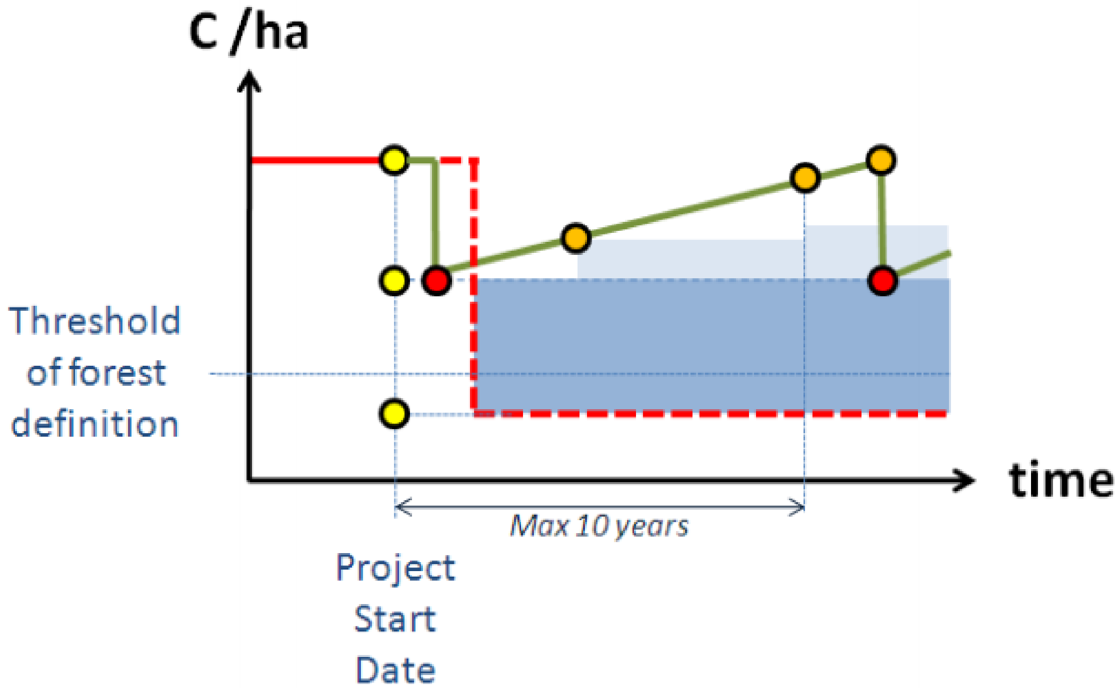


Figure 11. Carbon balance in project category B of VM0015 methodology

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

a) Baseline activities include unplanned deforestation for timber and grazing activities, where forest lands are converted to non-forest lands.

b) The Project Activity includes eligible category B, as defined in the description of the scope of the methodology.

c) The Project Area includes old-growth forest, meeting the definition of "forest".

d) At project commencement, the Project Area includes only land qualifying as "forest" for a minimum of 10 years prior to the project start date.

e) The Project Area does not include forested lands growing on peat.

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

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 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: 28/11/2018. 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.

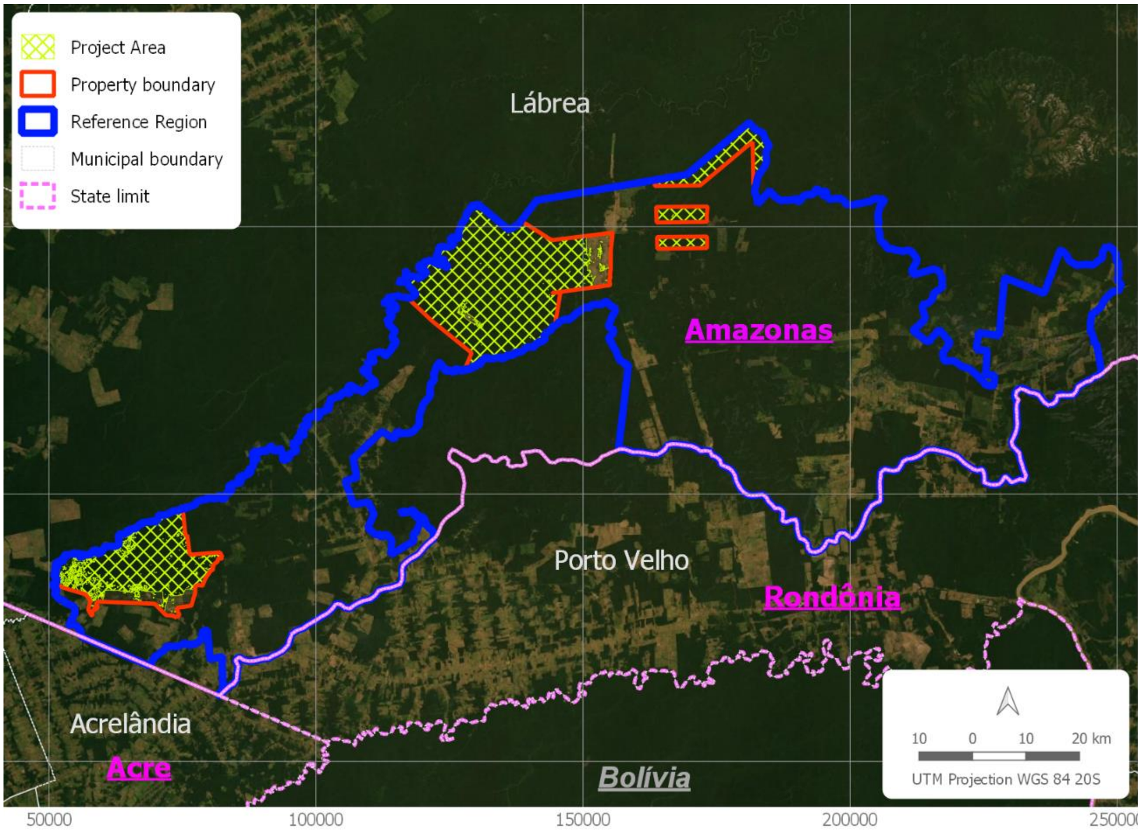


Figure 12. Location of the Reference Region and Project Area

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. In this case, 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 this would have included areas (such as the cities of Rio Branco and Porto Velho) with excessively different dynamics to those of the project, resulting for example in exaggerated baseline deforestation rates.

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

The Figure below 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 an attempt 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.

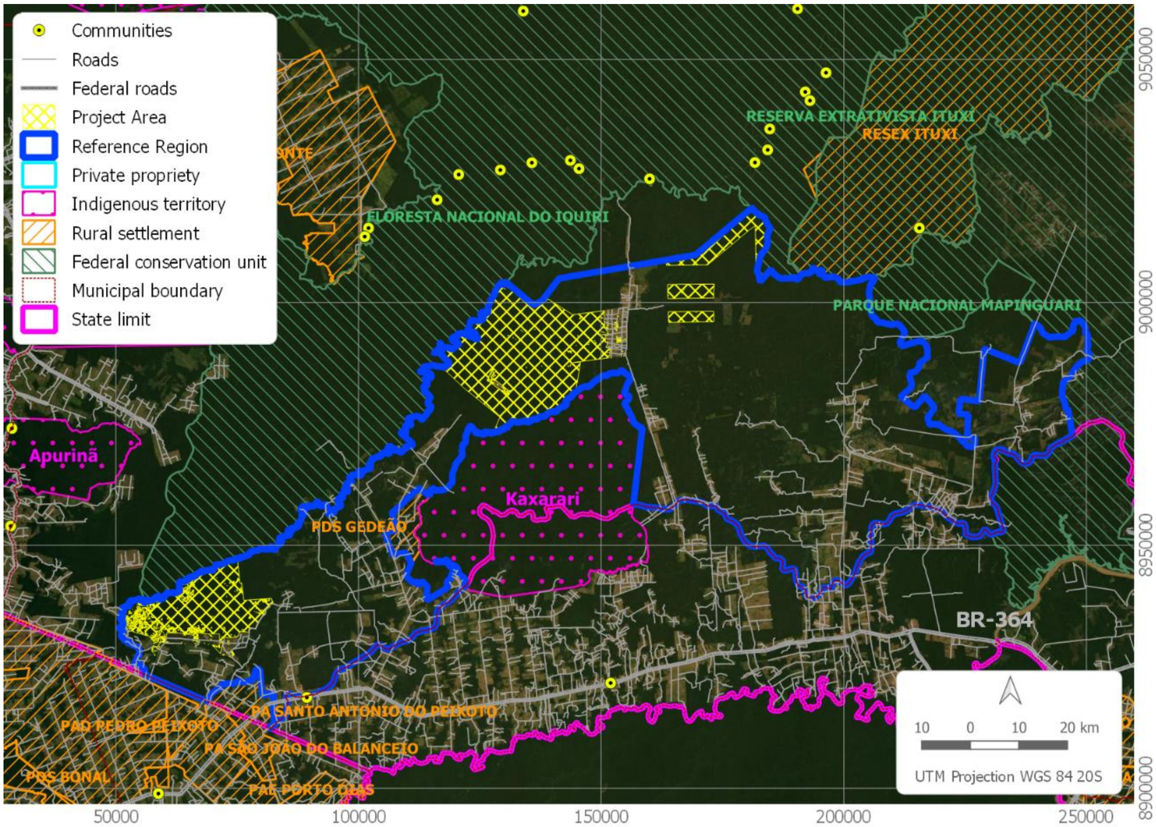


Figure 13. Land occupation in the Reference Region and Project Area

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 (Brazil, IBGE, 2012), covering 75% of the RR, and submontane dense ombrophylous forest (“Ds”), 25% of the RR, according to the project’s analysis of MMA data[22]. 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.

[22] Source MMA (accessed 11/03/21): http://mapas.mma.gov.br/i3geo/datadownload.htm

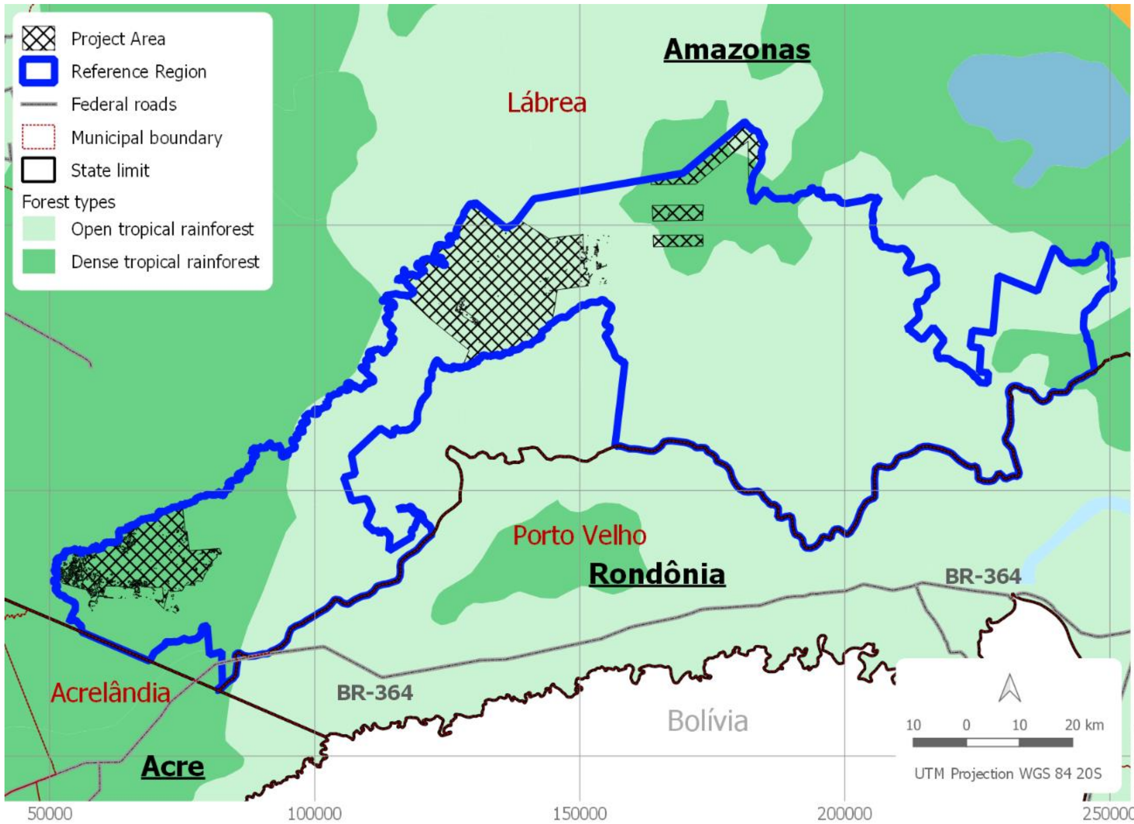


Figure 14. Identification of forest types in the Reference Region and Project Area

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.

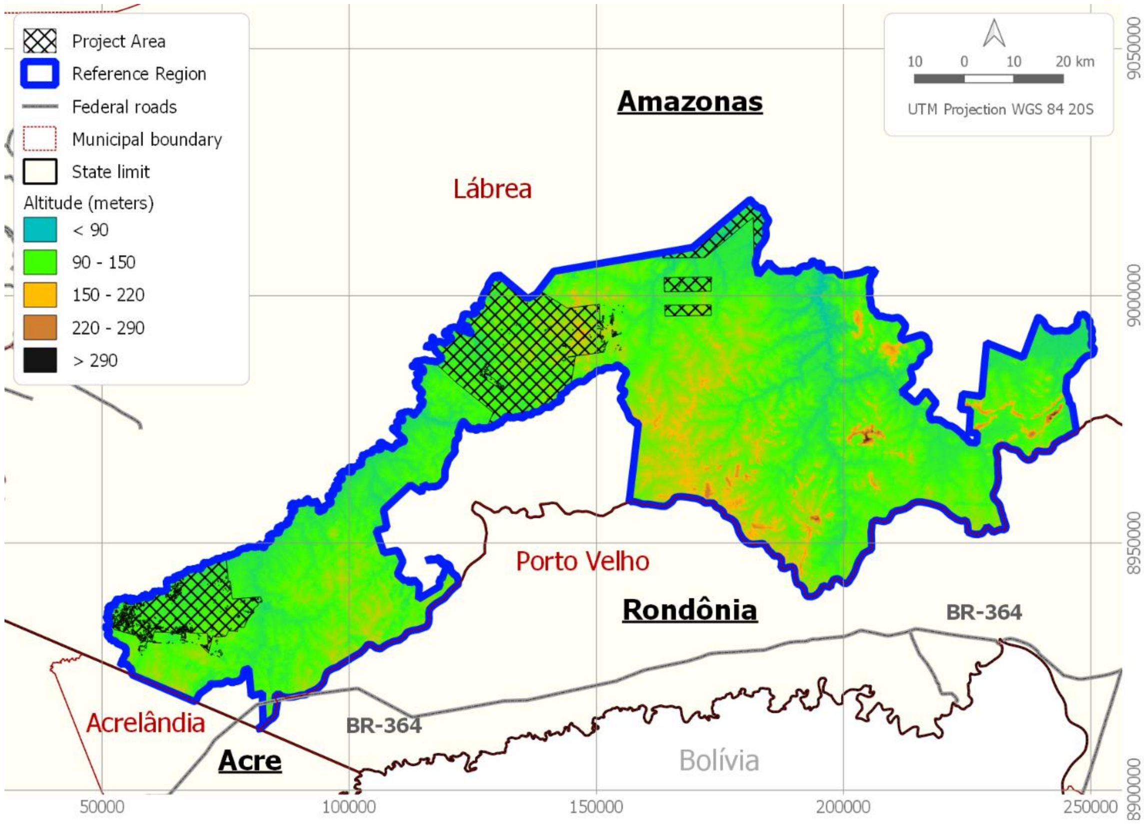


Figure 15. Elevation analysis of the Reference Region and Project Area

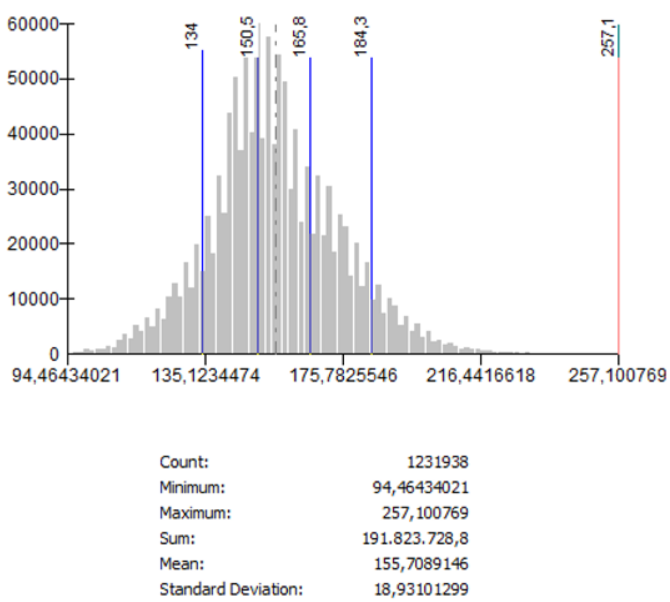


Figure 16. Distribution of elevation in the Project Area

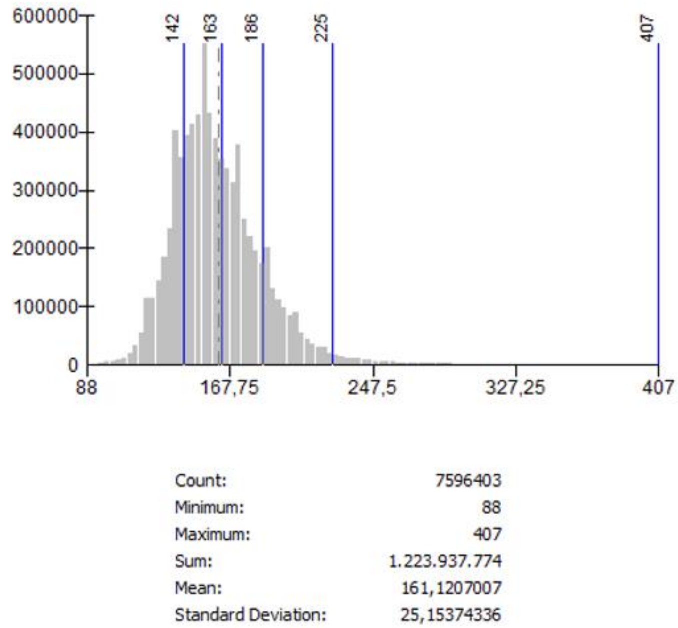


Figure 17. Distribution of elevation in the Reference Region

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.

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.

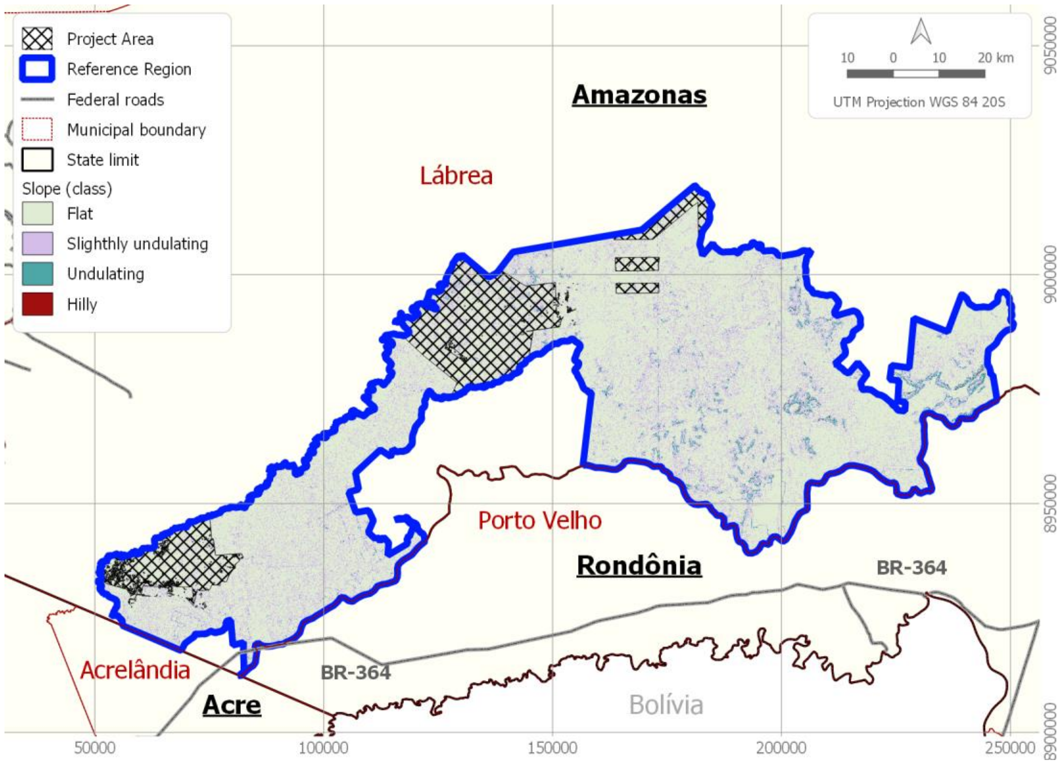


Figure 18. Landscape slope analysis in the Reference Region and Project Area

Table 6. Distribution of slope classes in the Reference Region and Project Area

Project Area				Reference Region			
Nº	**Slope class**	**Area (ha)**	**Area (%)**	**Nº**	**Slope class**	**Area (ha)**	**Area (%)**
1	Flat	75,687.40	76%	1	Flat	509,270.00	74%
2	Slightly undulating	22,417.39	23%	2	Slightly undulating	159,877.80	23%
3	Undulating	927.84	1%	3	Undulating	14,141.43	2%
4	Hilly	2.61	0%	4	Hilly	386.73	0%
5	Mountainous	0.00	0%	5	Mountainous	0.00	0%
6	Steep	0.00	0%	6	Steep	0.00	0%
	Total	99,035.24	100%		Total	683,675.96	100%

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 Koppen 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.

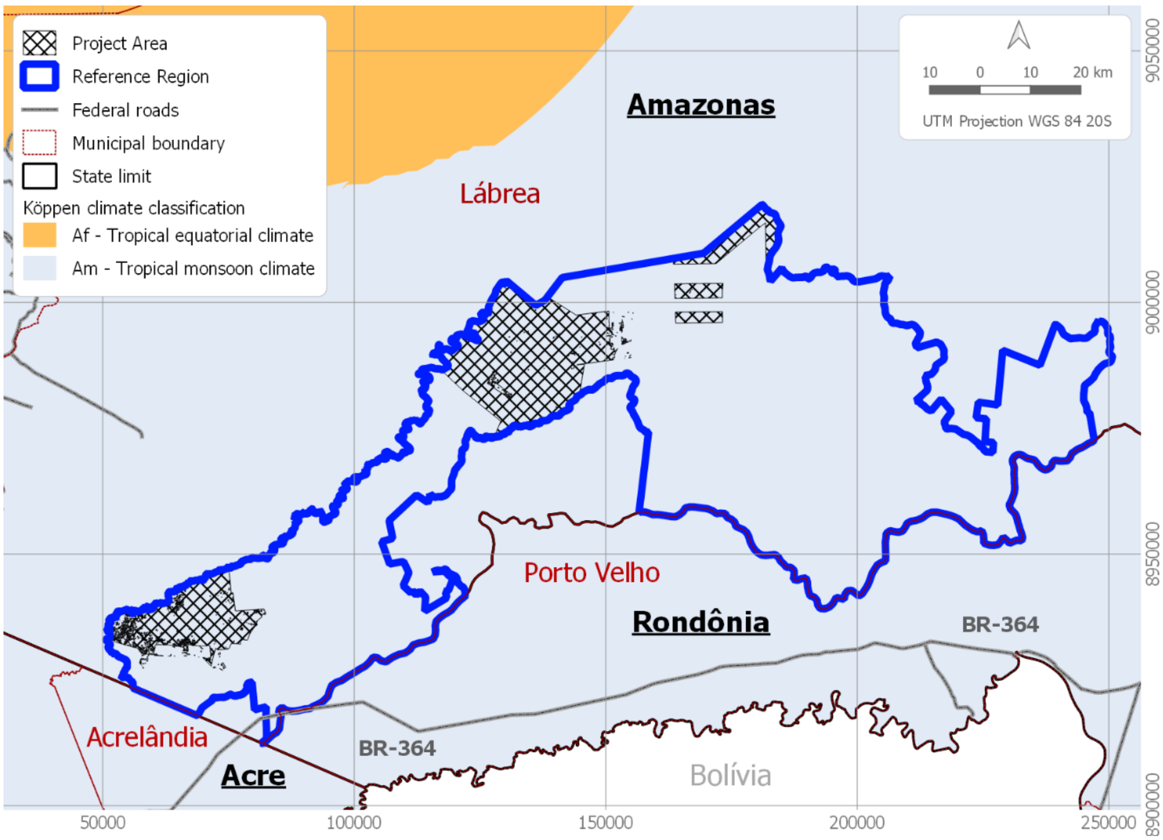


Figure 19. Climate and rainfall analysis in the Reference Region and Project Area

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 temperature 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 Instituto Matogrossense de Economia Agropecuária (IMEA): R$ 5,558 / ton. Nevertheless, there is a great variety of fees and taxes that must be discounted from the sale price, corresponding to up to 41.2% of the total sale price[23]. Owing to a 50% "clandestine index" (rate of cattle sold without any selling documentation and taxation), the discount on total selling price has been reduced to 20.6%, resulting in a total of R$ 3,271 / 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 are slaughterhouses in the region.

The spatial locations of the main companies are indicated on the map. The main slaughterhouses are located within neighbouring towns inside the reference region.

$PCxi$= Average in situ production costs per ton of product

The average production costs of living cattle were obtained from Instituto Matogrossense de Economia Agropecuária (IMEA): R$ 2,595 / ton. In this context, the margin remaining for transportation costs is the difference between the net selling price (R$ 3,271 / ton) and the production cost (R$ 2,595 / ton), which results in R$ 270.43 / 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$ 3.95/t.km**[24, 25]. This cost indicates that cattle could be transported a distance of approximately **68.5 km** by road.

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

[23] Sources (last visited 12/03/21): https://www.campograndenews.com.br/artigos/produtor-rural-pessoa-juridica-x-pis/pasep-e-cofins; http://g1.globo.com/ac/acre/noticia/2016/09/no-acre-decreto-reduz-icms-na-venda-de-gado-para-abate-ao-am-ero.html; http://ageconsearch.umn.edu/bitstream/147509/2/506.pdf

[24] Source (last visited 12/03/21): https://cloud.cnpgc.embrapa.br/sac/2012/10/16/prezados-senhores-busquei-no-site-a-embrapa-e-nao-obtive-exito1-onde-posso-obter-o-peso-medio-de-um-novilho-2-onde-posso-obter-o-peso-medio-de-um-boi-com-45-meses-3- um-novilho-e-considerado-no/

[25] Source (last visited 12/03/21: Instrução Normativa SAT Nº 299 DE 14/05/2012 - Estadual - Goiás - LegisWeb

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 TERRACLASS (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 68.5 -km radius. 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).

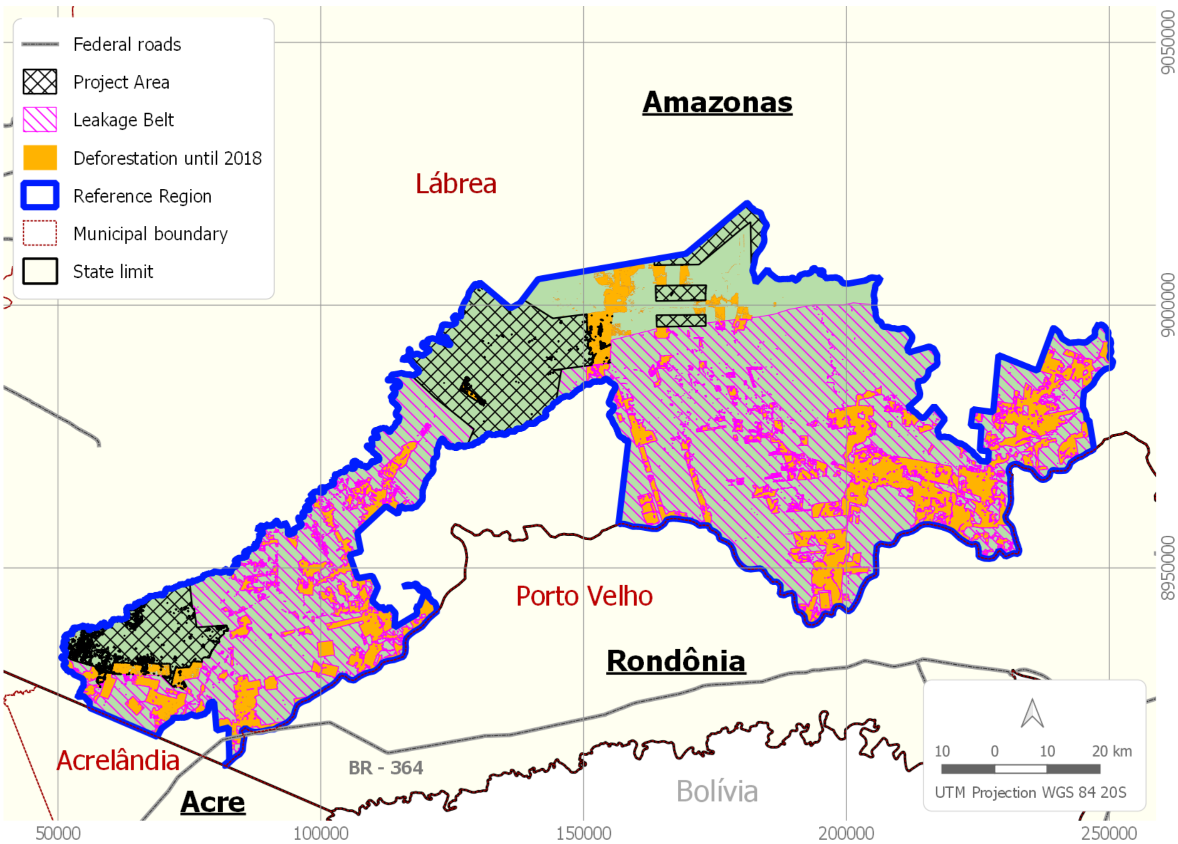


Figure 20. Location of the Leakage Belt

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.

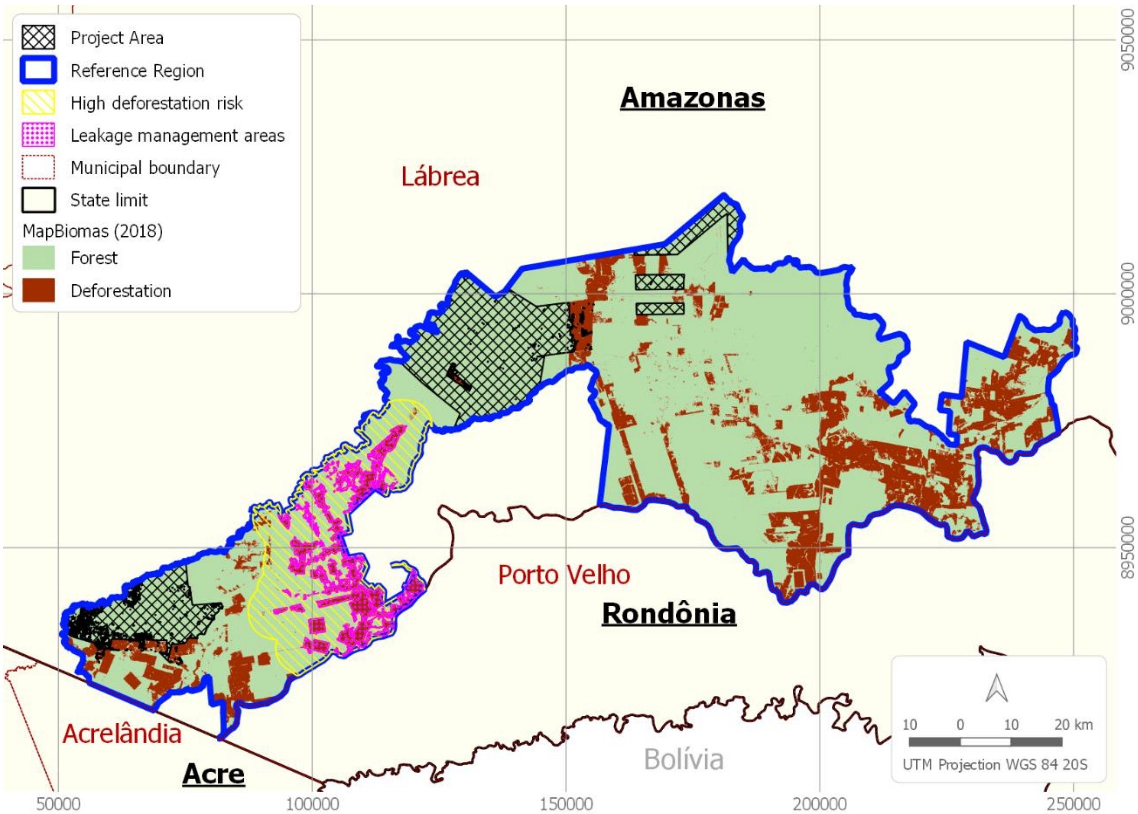


Figure 21. Location of the Leakage Management areas

Source		Gas	Included?	Justification/Explanation
Baseline and Leakage Belt	Unplanned deforestation	CO_2	Yes	Carbon emitted through unplanned deforestation
		CH_4	No	
		N_2O	No	
		Other	-	
	Biomass burning	CO_2	No	
		CH_4	Yes	Methane emissions during burning of biomass for land clearance

Source		Gas	Included?	Justification/Explanation
		N_2O	No	
		Other	-	
	Livestock emissions	CO_2	No	
		CH_4	Yes	Significant source of livestock emissions
		N_2O	Yes	Significant source of livestock emissions
		Other	-	
Project	Forest Management	CO_2	Yes	Carbon emitted in extraction of timber logs
		CH_4	No	
		N_2O	No	
		Other	-	

Avoiding conversion of forests to pasture can reduce emissions of N_2O and CH_4 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.

Carbon Pools included in quantifications

The following table indicates the recommendations of carbon pools to include, as described in the “AFOLU Requirements, v3.6”:

Table 7. Carbon Pools to be Considered in Methodologies (Source: AFOLU Requirements, v3.6)

		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	N	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 involved in quantifications, in compliance with “AFOLU Requirements, v3.6”:

- Aboveground biomass – trees (mandatory);
- Belowground biomass (optional); and
- Harvested wood products.

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).

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:

It is clear that the 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 (12 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 auditors. The properties' activities fall into the following categories:

1a. <u>Sustainable Forest Management Plans (SFMPs):</u> Five of the properties project properties have actively operational SFMPs, while two have pending licenses. Of the active five, only two make a profit (5.7% and 9.84% percentage profit), while three make a loss. Those with pending operating licenses currently make no profit. The average profitability across all properties is a loss of -R$197.79/ha of managed area, and all the project owners have expressed the need for carbon credit income.

The IRR for SFMPs was calculated as -8%. Thus, this is not the most plausible scenario.

1b. No activity:

Five project properties have no economic activity, generating no income, with a -100% loss rate, which is not financially sustainable at the time of writing of the present VCS-PD. These are the following properties (or Fazendas): Paraná; Jardim Alegre; Santa Luzia; São Sebastião; and Panorama.

Thus, this is not the most plausible scenario.

1c. SFMP plus cattle farming:

Three of the project properties conduct both SFMPs and cattle farming, however one has not yet reached the stage of sales, and so has no income as of yet. One of the properties has a small positive profit of R$0.37/ha and a profit ratio of 5.4%. Cattle farming has an IRR reported in literature as 4% (SCHNEIDER et al., 2000), while our analyses suggest it may be slightly higher in the local region, at 6%.

Thus, 1c is a possible scenario.

ii) SCENARIO 2: Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project: The Project Proponents would not be able to afford costs to implement 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 be unlikely 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 not the most plausible scenario.

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 70m^3 (26) where the legal SFMPs analysed extract up to 25m3/ha, thus this would lead to a 64% income increase and profit levels of R$ 76.58/ ha or 29.3%. Calculated IRR for this scenario is 41%.

Following illegal deforestation, cattle farming is conducted with the IRR of at least 4%, with analyses of local data suggesting 6%. Given these economic analyses and literature studies (SCHNEIDER et al., 2000), this is considered the regional business-as-usual (BAU) scenario.

Thus, this is a plausible scenario.

[26] https://imazon.org.br/degradacao-de-florestas-pela-exploracao-madeireira-e-fogo-na-amazonia-oriental-brasileira-no-20/

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 plausible scenario.

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.

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: The most probably alternative land use scenarios that could have occurred on the land within the project boundary are SCENARIOS 1c, 4, 5, and 6 described above.

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

a) The following procedure was applied:

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 1c. SFMP plus cattle farming

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 which follow the Forest Code legal requirements described in Scenario 3, below. Thus, this scenario is in compliance with legal and regulatory requirements.

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 could be deforested by license. Thus, this scenario is in compliance with legal and regulatory requirements.

v) 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.

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): Adoption of common land-use practices in the region (business-as-usual - BAU): This scenario is in violation of the Law given that landowners would 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 fines and embargos on outgoing timber, described in this article as “innumerable”[27]. Following illegal deforestation, cattle farming is commonly installed on the deforested areas (Vitel, 2009).

Thus, it is demonstrated that SCENARIO 4 is possible in the context of this project activity.

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: Is has been demonstrated that SCENARIOS 1c, 4, 5, and 6, are plausible alternative land use scenarios to this VCS AFOLU project activity.

Given that SCENARIO 6: Farm sale to private investors followed by the regional BAU would be the most profitable and would save the landowners from current expenses on the Project Area, it can be regarded as the most plausible baseline scenario.

Sub-step 1c. Selection of the baseline scenario

For the additionality analysis, Step 2 (Investment Analysis) has been selected.

STEP 2. Investment analysis

We have three broad profiles of operations within the Unitor properties, therefore different analyses are applied to each of them:

1a. Sustainable Forest Management Plans (SFMPs): seven of the project properties have SFMPs, five of them with active operational licenses and two pending. They generate income but mostly make a loss, with a profit percentage ranging from 9.84% to -45.60% (discounting those with no income).

For this category (Option II), investment comparison analysis, was applied.

[27] Source (accessed 10.02.21): https://apublica.org/2020/08/governo-bolsonaro-reduz-multas-em-municipios-onde-desmatamento-cresce/

1b. No economic activity:

Five project properties have no economic activity, generating no income, with a -100% loss rate, and highly negative display profit ratios, ROIs and IRRs.

For this category, Option I, simple cost analysis, was applied.

Sub-Step 2a. Determine appropriate analysis method:

Given that operations of type 1a. generate economic benefits other than VCU-related income, Investment comparison analysis (Option II) was applied, as well as Option I (simple cost analysis) for properties of category 1b.

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

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 investment[28].

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

Where: Ct = Net cash inflow during the period t; C0 = 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 project scenario was compared with the financially least attractive baseline scenario, which is low technology cattle ranching. In this context, the evaluation of scenario 6 (farm sale followed by BAU) are unnecessary, given that they are more financially attractive than cattle ranching.

- Thus, IRR calculations are presented below: 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 has been calculated: -8% (The spreadsheet used for this calculation is available for the audit team and any stakeholder wishing to reproduce the analysis. Tables below present the raw data used in calculation and the IRR formula shown above.)

[28] Source (accessed 10/02/21): https://corporatefinanceinstitute.com/resources/knowledge/finance/internal-rate-return-irr/

- IRR for cattle ranching reported in the literature is 4%[29]. However, our analyses of local data suggest this is slightly higher in the region, at 6% (Again, the spreadsheet relating to this calculation is available for the auditors and any other stakeholders).

	FOREST MANAGEMENT CASHFLOW - REPORTED											
	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Actual costs	865,474	865,474	865,474	865,474	865,474	865,474	865,474	865,474	865,474	865,474	865,474	865,474
Actual revenue	0	0	0	0	2,109,900	2,109,900	2,109,900	2,109,900	0	0	0	0
Total Forest Management Expenses (R$)	-865,474	-865,474	-865,474	-865,474	-865,474	-865,474	-865,474	-865,474	-865,474	-865,474	-865,474	-865,474
Project Proponent Expenses (R$)	-15,450	-15,450	-15,450	-15,450	-15,450	-15,450	-15,450	-15,450	-15,450	-15,450	-15,450	-15,450
Monthly profit (R$)	-880,924	-880,924	-880,924	-880,924	1,228,977	1,228,977	1,228,977	1,228,977	-880,924	-880,924	-880,924	-880,924

PROJECT WITH FOREST MANAGEMENT WITHOUT VCUs	
Annual profit (R$)	-2,131,483
IRR (%)	-8.4
Net Present Value - NPV (R$)	-1,652,716

a. The project IRR was obtained from data from the last harvest period in the Project Area, which is facing cash-flow issues, as the estimates are: total annual costs of R$ 10,571,085, annual revenue of R$ 8,439,601, leading to the negative NPV and IRR values shown above (spreadsheet is available to auditors). This is based on a realistic sale price of 85 R$/m3 corresponding to the highest prices informed by project proponents[30].

b. Regarding the alternative land use (pasture), recent data on cattle farming provided by the project proponents was used, showing annual investments of R$ 309,400 and annual revenue of R$ 328,544 leading to a positive annual profit of R$ 19,144, and IRR 6%. This simulation utilized realistic sale prices informed by the proponents of R$ 36 – R$ 40.5 per arroba (15kg) of fattened animals, however recent sale prices in the market

[29] SCHNEIDER et al. Amazônia Sustentável: limitantes e oportunidades para o desenvolvimento rural. Brasília: World Bank; Belém: Imazon, 2000. 58 pp. (last visited 09/02/2021): http://documents.worldbank.org/curated/en/964821468232758110/pdf/311960PAPER0Amazon01see0also0WTP51 51.pdf, visited in 01/07/2019

[30] Source: See for example "VIABILIDADE da santa maria.PDF"

achieve 750% - 850% this level[31]. For the project scenario with forest management, it has been estimated that the IRR only becomes positive in Year 1 when credit price reaches R$ 70.00 (USD 13.00) per VCU.

c. It can be assumed that the comparison between the current revenues inside the Project Area and the revenues of pasture lands is reliable, given that real data were used for estimates in both cases, and in the case of the pasture data, a peer-reviewed technical article corroborates the information (reporting IRR 4%, close to our estimates) (SCHNEIDER et al. (2000). Given that the prices of cattle have been increasing from the last decade (CEPEA, 2017), it can be considered that the use of data from year 2000 is conservative, given that IRR of pasture tends to be higher at present.

d. Regarding the seven properties with active or pending SFMPs, they are currently operating with a negative balance, which could be mitigated by VCU revenue, enabling a positive IRR to be reached, indicating that it is a riskier economic activity if compared with pasture for cattle ranching. Although pasture has a low IRR, it allows more stable revenues, and can be financed by previous revenues obtained with logging for land clearing. Thus, this Project Activity cannot be considered as the most financially attractive: it is less attractive than the most common baseline land-use scenario, which is pasture for cattle ranching.

It is concluded that the proposed project activity without VCUs of Sustainable Forest Management Plans (1a.), is not the most financially attractive, so Step 2d (Sensitivity Analysis) is subsequently applied, following which the simple cost analysis (Option I) of properties of category 1b is conducted.

Sub-step 2d. Sensitivity analysis

This sensitivity analysis was performed 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, IRR and NPV were estimated for the Project Activity in an optimistic scenario, a function of an optimistic wood price (120% the current price, R$ 102.00/m3), and a 10% reduction in forest management expenses, resulting in financial indicators less favorable than the BAU scenario of cattle farming (see table below “Optimistic Scenario”).

[31] Source (accessed 11/02/20212): https://www.abrafrigo.com.br/index.php/2021/02/05/clipping-da-abrafrigo-no-1418-de-05-de-fevereiro-de-2021/

In order to reach the 6% IRR benchmark, which is equal to the IRR of cattle-ranching, the baseline land use scenario, a wood price of (R$ 123.00 /m3) (see table below: “Price Sensitivity”), or a 32% cost reduction (table below “Cost Reduction”), are required as demonstrated below (calculation worksheet is available for auditors).

	PROJECT WITH FOREST MANAGEMENT WITHOUT VCUs		
	Annual profit or loss (R$)	IRR (%)	NPV (R$)
CURRENT SCENARIO	-2,131,483.28	-8.4%	-1,652,715.98
OPTIMISTIC SCENARIO	396,426.62	1.6%	200,575.04
PRICE SENSITIVITY	1,641,515	6	1,098,990
COST REDUCTION	1,191,936	6	801,976

Thus, according to the sensitivity analysis, the project activity with forest management would reach a 6% IRR, calculated for cattle ranching in the region, only if wood price increased by 145% or operational costs reduced by 32%. Given the variation needed to obtain the 6% IRR and current prices in the market as informed by the project proponents, both scenarios are improbable (sensitivity analysis worksheet is available to auditors and stakeholders).

In light of this sensitivity analysis, it is concluded that the properties classed as 1a. in the proposed project are unlikely to be financially most attractive, and regarding them, Step 4 (Common practice analysis) is applied, following the Simple cost analysis below.

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

For the operations classed as 1b. No economic activity, we apply the simple cost analysis (Option I), as they do not generate profits.

The five properties with no economic activities, have average total costs of R$ 48,000 per property for year, or R$ 9.17/hectare on average, which is spent on labor for maintenance of the area.

→ It is therefore concluded that properties classed as 1b. in the proposed VCS AFOLU project produces no financial benefits other than VCS related income, we therefore proceed to Step 4 (Common practice analysis)

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 complemented with an analysis of the extent to which similar activities have already diffused 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 (the Project Area has the second biggest Operation License (Licença de Operação) in the State of Amazonas); 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)[32], 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 m^3) have been identified by police in southern Lábrea State[33]. 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. Today, the majority of wood production in the Amazon is illegal (Cardoso & Souza Jr., 2020). 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.

[32] Diagnóstico da cadeia produtiva da madeira no município de Lábrea-AM - Brasília: IEB, 2014. 70p

[33] 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

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: fathers to be employed within the timber supply chain, mothers in non-timber forest products, and youths 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;

- Provision of support for the local technical assistance Institute, promoting sustainable production and monitoring of illegal deforestation.

Biodiversity:

- A biomass inventory has been conducted in the neighbouring Fortaleza Ituxi REDD Project, providing valuable primary data for the present project;

- 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;

- Forest conservation practices will be disseminated as a means for increase value of standing forests.

3.6 Methodology Deviations

The Reference Region must be 20 to 40 times larger than the Project Area, for Project Areas. In this case, the Reference Region is 6.9 times larger the Project Area, and while the project area is slightly below 100,000 hectares, it is within 1% of that figure, which was considered a negligible difference. A reference region 20 – 40 larger than this would have included areas (such as the cities of Rio Branco and Porto Velho) with excessively different dynamics to those of the project, resulting for example in exaggerated baseline deforestation rates

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 Mapbiomas[34], which utilizes Landsat images that are classified into multiple classes: forest, cropland, pastureland, waterways, etc., however for our classification the relevant classes were "Non-Forest Land" and "Forest Land".

[34] Source MapBiomas (accessed 03/03/2021): https://mapbiomas.org/atbd---entenda-cada-etapa

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

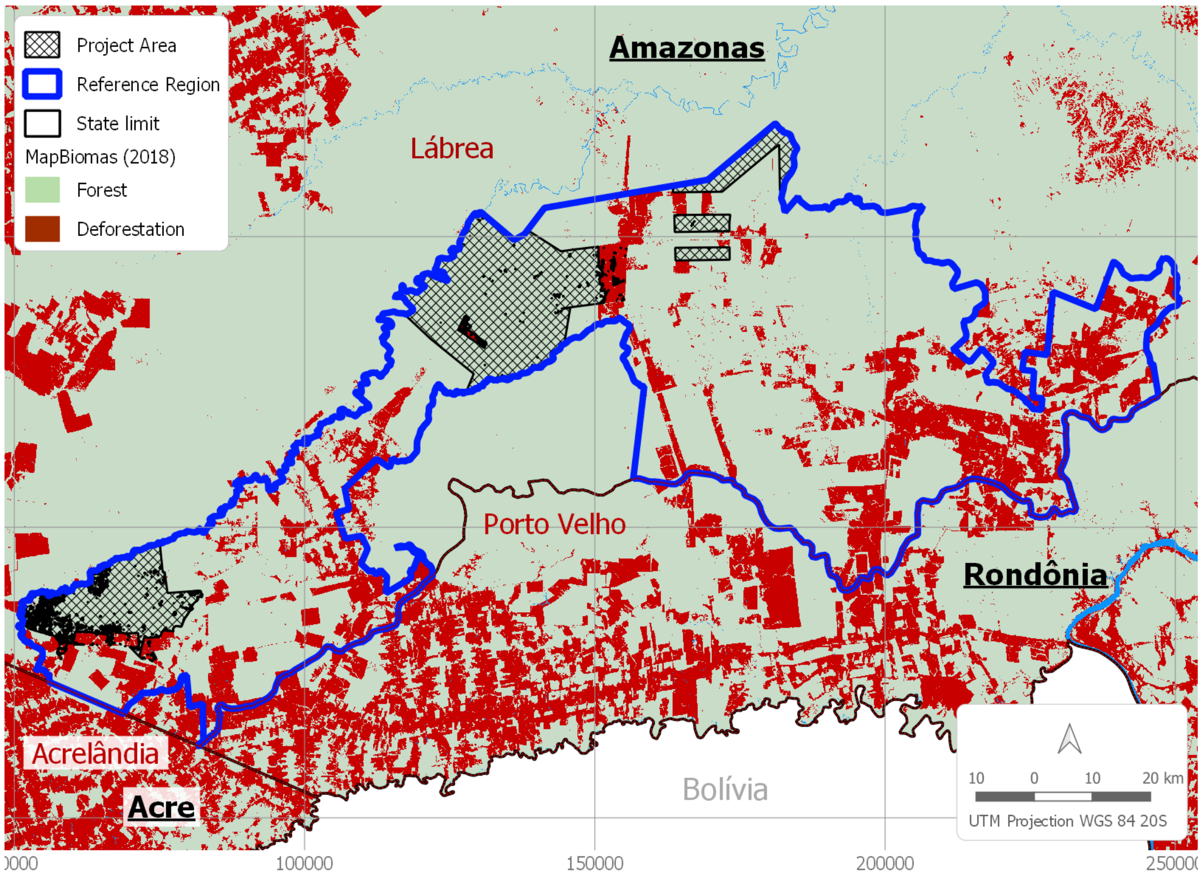


Figure 22. Mapping of land use in 2019, for the Reference Region and Project Area. Source: Mapbiomas (2019)

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 2018[35]. 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 08 (below), called the error matrix or

[35] Source MapBiomas (accessed 03/03/2021): https://mapbiomas.org/analise-de-acuracia

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.

Table 8. Data evaluation confusion matrix[36]

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

Overall, for the whole reference period, Mapbiomas reports higher than 97.3% accuracy[37], 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 9. Data used for historical LU/LC change analysis.

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 μm	170 x 183	2013	1	66
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μm	170 x 183	2013	1	67
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μm	170 x 183	2013	233	66
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μm	170 x 183	2013	233	67
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μm	170 x 183	2016	1	66
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μm	170 x 183	2016	1	67
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μm	170 x 183	2016	233	66
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μm	170 x 183	2016	233	67
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μm	170 x 183	2018	1	66
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μm	170 x 183	2018	1	67
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μm	170 x 183	2018	233	66
Satellite	Landsat 8 OLI	30 X 30 m	0.43 - 2.26 μm	170 x 183	2018	233	67

[36] Source: Mapbiomas (accessed 04/03/21): https://mapbiomas.org/estatistica-de-acuracia
[37] Source: Mapbiomas (accessed 03/03/21): https://mapbiomas.org/estatistica-de-acuracia

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 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 10. List of all land use and land cover classes existing at the project start date within the reference region.

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

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 (IDcl). 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 11. Potential land-use and land-cover change matrix

			Initial LU/LC class (2009)		Total (ha)
			Forest	*Pasture*	
		ID_{cl}	*I1*	*I2*	
	F1	*Forest*	484,849.8	0.00	**484,849.81**

Final LU/LC class (2018)	F2	*Pasture*	57,332.56	83,582.43	**140,914.99**
Total (ha)			**542,182.37**	**83,582.43**	**625,764.80**

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

IDct	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

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:

a) 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 years[38]. 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.

b) 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: 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.

c) 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

[38] Source: Mapbiomas (accessed 07/03/21): https://mapbiomas.org/atbd---entenda-cada-etapa

classification of the maps is conducted by MapBiomas 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 images[39].

d) 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).

e) 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 adherence to 80% of forest Legal Reserve on each rural property in the Amazon Biome. This is a strong argument regarding the 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

[39] Source MapBiomas (accessed 03/03/2021): https://mapbiomas.org/atbd---entenda-cada-etapa

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 property, 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, by means of invasions in 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%.

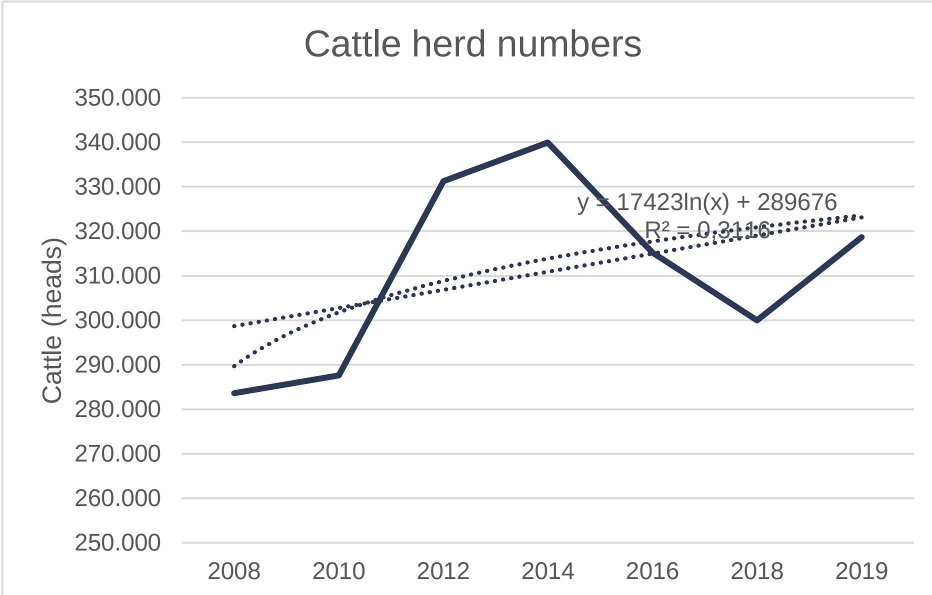


Figure 23. Historical growth of livestock numbers in the municipality of Lábrea, State of Amazonas (IBGE, 2019)

Given these dynamics, the herd size is expected to increase by up to 63% (519,274 heads) during the project lifetime (up to 2049, see figure below), 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.

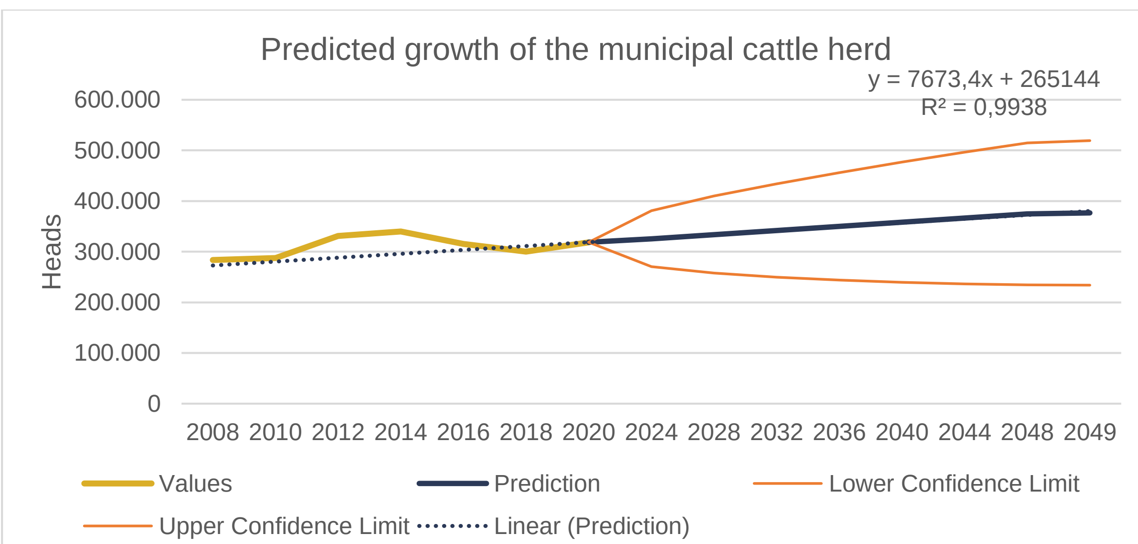


Figure 24. Projected growth of livestock numbers in the municipality of Lábrea, State of Amazonas within project lifetime (adapted from IBGE, 2019)

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 25 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 producers[40], as studies point out that illegal wood supplies from the Amazon reach 70% (Cardoso & Souza Jr., 2020)[41], and illegal operations producing significant volumes (2,000 m^3) 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.

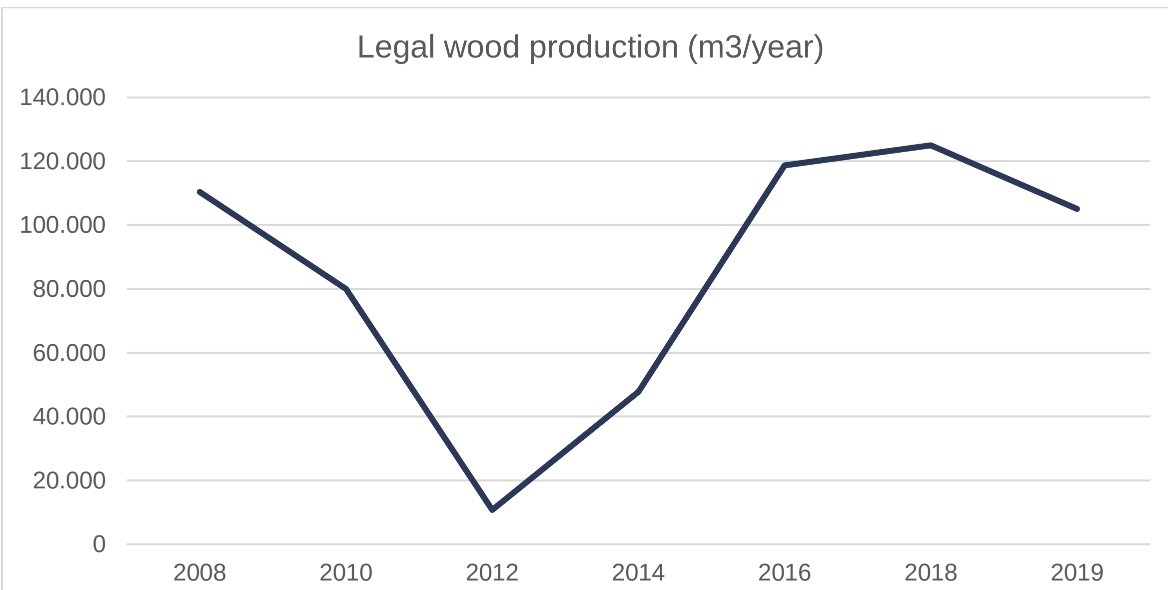


Figure 25. Historical production of legally registered logs in the municipality of Lábrea, State of Amazonas (IBGE, 2019)

[40] Source (accessed 19/02/21): https://amazonia.org.br/2020/05/70-da-madeira-explorada-no-para-e-ilegal-mostra-estudo/

[41] These data are from the bordering State of Pará, and Imazon have confirmed to the project proponents that such data are soon to be published for the State of Amazonas, and are not yet available.

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 studies[42], indicate that of the 23% of the Reference Region which is deforested (159,148.70 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).

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:

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)[43], 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;

[42] IPAM/ISA/IMAZON (2014). The Increase in Deforestation in the Amazon in 2013: a point off the curve or out of control? (Available at http://imazon.org.br/publicacoes/the-increase-in-deforestation-in-the-amazon-in-2013-a-pointoff-the-curve-or-out-of-control/?lang=en; last visited in 18/July/2017)

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

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.

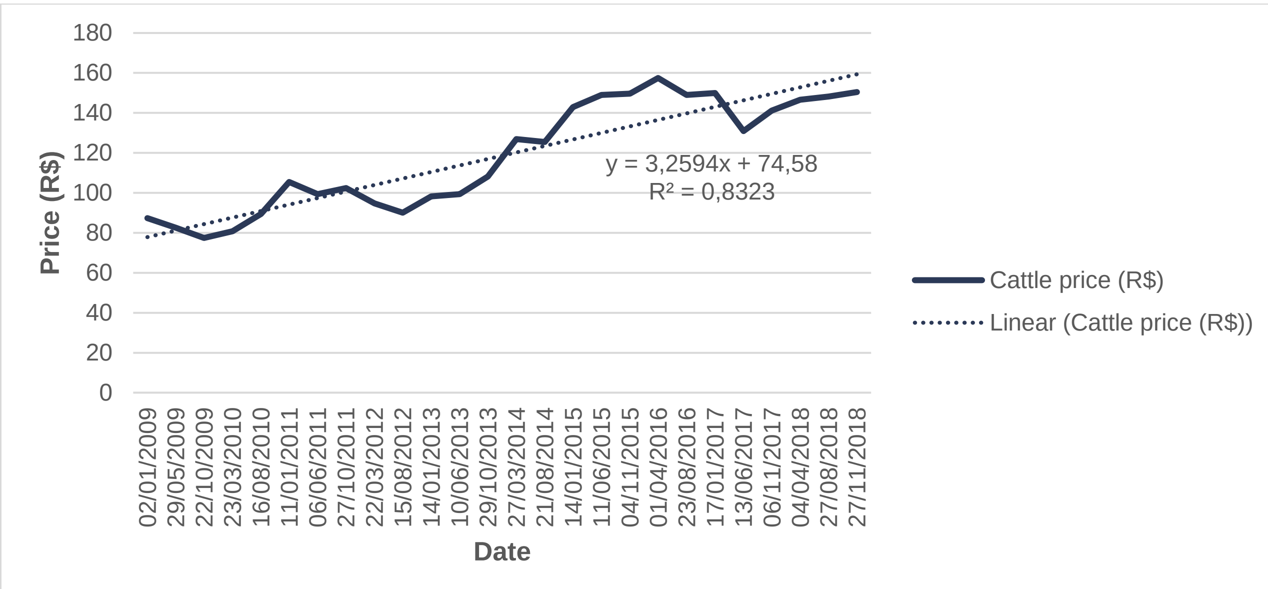


Figure 26. Cattle prices in Brazil (CEPEA, 2019)

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.

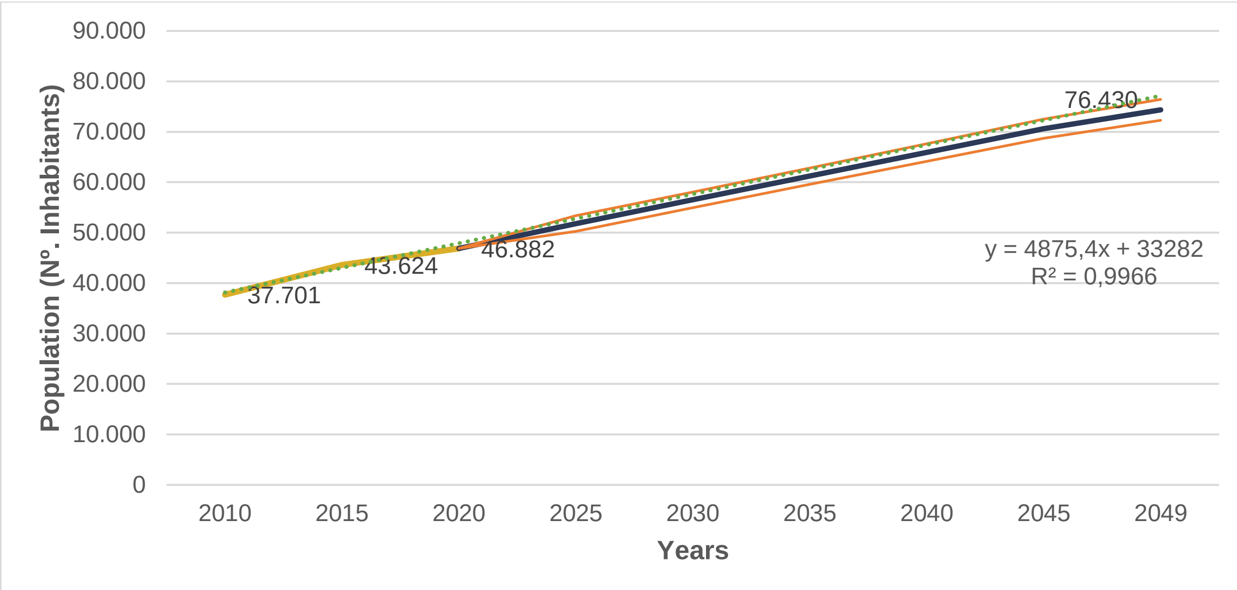


Figure 27. Projected population growth in the municipality of Lábrea, Amazonas, Brazil

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, 2021[44]);

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

[44] Source (accessed 16/03/21): Imazon, https://imazongeo.org.br/

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 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 159,148.7 hectares, equivalent to more than 23% 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:

- 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.

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 13. 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 MapBiomas professionals[45]: 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 was estimated as 163,254.1 hectares over the 30-year project lifetime, corresponding to an estimated average annual rate of deforestation is 5,441.80 hectares for the Reference Region.

[45] Source Mapbiomas (accessed 24/03/2021): https://mapbiomas.org/atbd---entenda-cada-etapa

Table 14. 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	0.0	159,148.7
2019	1	15,387.3	174,536.1
2020	2	14,004.4	188,540.5
2021	3	14,016.7	202,557.2
2022	4	12,262.1	214,819.2
2023	5	11,988.5	226,807.7
2024	6	11,715.3	238,523.0
2025	7	11,726.4	250,249.4
2026	8	11,046.5	261,295.9
2027	9	10,800.2	272,096.1
2028	10	10,553.9	282,650.0
2029	11	2,112.8	284,762.8
2030	12	2,112.8	286,875.6
2031	13	2,112.8	288,988.5
2032	14	2,112.8	291,101.3
2033	15	2,112.8	293,214.1
2034	16	1,990.3	295,204.4
2035	17	1,990.3	297,194.7
2036	18	1,990.3	299,184.9
2037	19	1,990.3	301,175.2
2038	20	1,990.3	303,165.5
2039	21	1,945.9	305,111.5
2040	22	1,945.9	307,057.4
2041	23	1,945.9	309,003.3
2042	24	1,945.9	310,949.2
2043	25	1,945.9	312,895.2
2044	26	1,901.5	314,796.7
2045	27	1,901.5	316,698.2
2046	28	1,901.5	318,599.8
2047	29	1,901.5	320,501.3
2048	30	1,901.5	322,402.9
TOTAL		**163,254.1**	

The accumulated baseline deforestation projected to occur within the Project Area over the 30-year project lifetime was estimated at 24,031.3 hectares. The estimated average annual rate of deforestation is 775.20 hectares for the Project Area.

Table 15. 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	-	1,174.1
2019	1	1,386.73	2,560.9
2020	2	1,700.25	4,261.1
2021	3	1,750.05	6,011.2
2022	4	1,736.86	7,748.0
2023	5	1,005.81	8,753.8
2024	6	838.90	9,592.7
2025	7	1,590.44	11,183.2
2026	8	848.95	12,032.1
2027	9	1,594.29	13,626.4
2028	10	952.36	14,578.8
2029	11	885.67	15,464.4
2030	12	885.67	16,350.1
2031	13	885.67	17,235.8
2032	14	885.67	18,121.4
2033	15	885.67	19,007.1
2034	16	420.81	19,427.9
2035	17	420.81	19,848.7
2036	18	420.81	20,269.5
2037	19	420.81	20,690.4
2038	20	420.81	21,111.2
2039	21	406.03	21,517.2
2040	22	406.03	21,923.2
2041	23	406.03	22,329.3
2042	24	406.03	22,735.3
2043	25	406.03	23,141.3
2044	26	412.83	23,554.1
2045	27	412.83	23,967.0
2046	28	412.83	24,379.8
2047	29	412.83	24,792.6
2048	30	412.83	25,205.5
TOTAL		**24,031.3**	

Table 16. 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	0.0	0.0
2019	1	13,433.1	152,370.0
2020	2	12,253.8	164,623.8
2021	3	12,292.6	176,916.5
2022	4	10,778.3	187,694.8
2023	5	10,561.9	198,256.7
2024	6	10,344.6	208,601.3
2025	7	10,377.8	218,979.2
2026	8	9,798.3	228,777.4
2027	9	9,601.4	238,378.8
2028	10	9,403.6	247,782.3
2029	11	2,870.2	250,652.5
2030	12	2,870.2	253,522.7
2031	13	2,870.2	256,393.0
2032	14	2,870.2	259,263.2
2033	15	2,870.2	262,133.4
2034	16	2,021.9	264,155.2
2035	17	2,021.9	266,177.1
2036	18	2,021.9	268,198.9
2037	19	2,021.9	270,220.8
2038	20	2,021.9	272,242.7
2039	21	2,060.3	274,303.0
2040	22	2,060.3	276,363.3
2041	23	2,060.3	278,423.7
2042	24	2,060.3	280,484.0
2043	25	2,060.3	282,544.3
2044	26	2,104.0	284,648.3
2045	27	2,104.0	286,752.3
2046	28	2,104.0	288,856.3
2047	29	2,104.0	290,960.2
2048	30	2,104.0	293,064.2
TOTAL		**154,127.3**	

4.1.4.1 Location of future deforestation: Conclusion

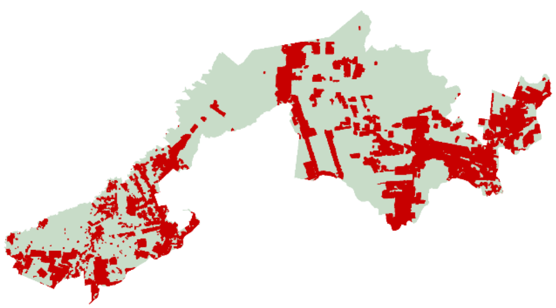
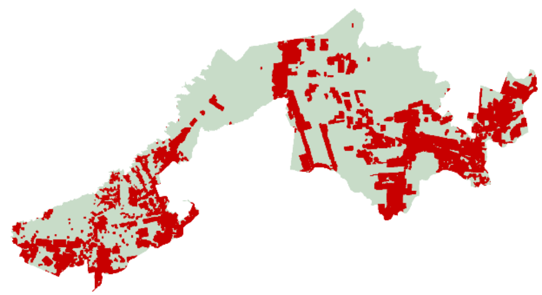
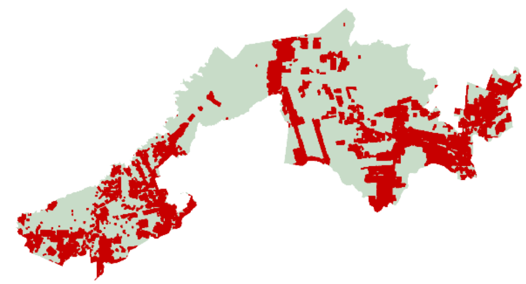
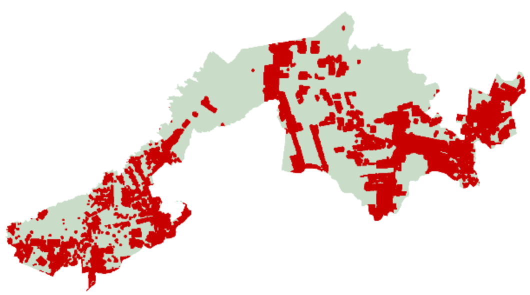
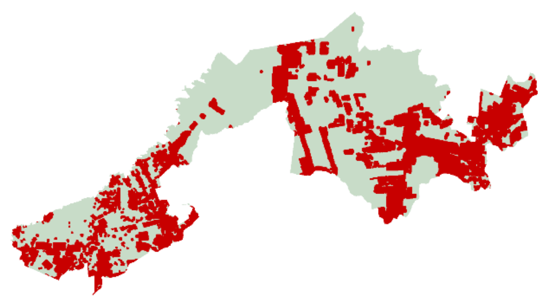
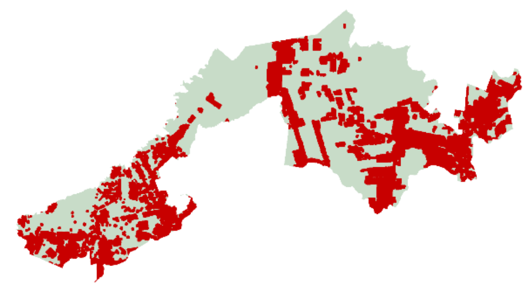
The location of deforestation in the Reference Region was strongly influenced by the factor of accessibility of forests, contributing to the expansion and clearing of new areas in the region as a whole, mainly as extensions from the BR-364 along its length in the states of Acre and Rondônia into the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

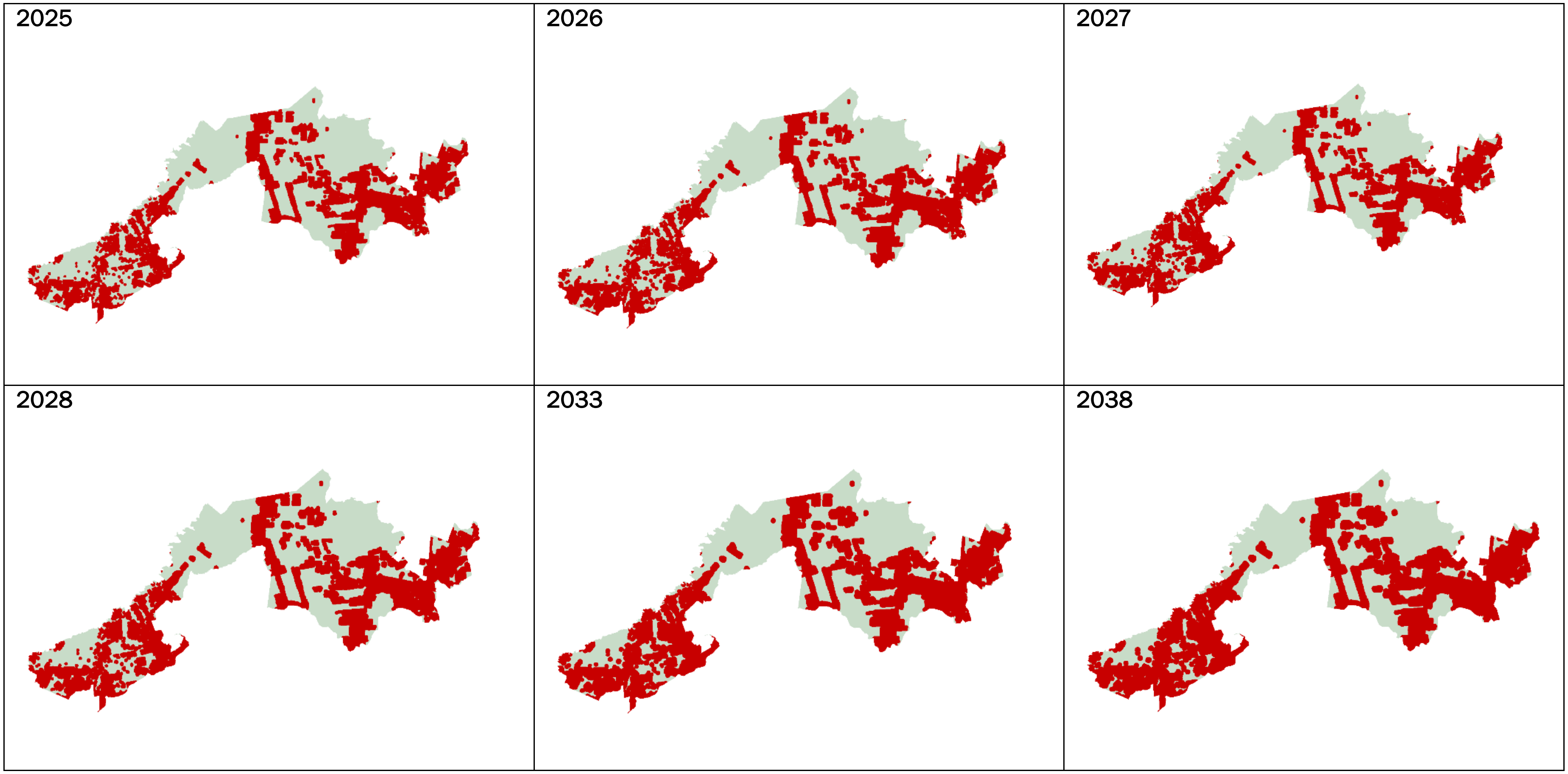
The Reference Region has a vast and dense network of primary, secondary and tertiary roads, as well as navigable rivers. Rivers have also been considered as paths to facilitate deforestation: the maps of projection of deforestation location indicate a consistent occurrence of future deforestation in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

2019	2020	2021
		
2022	2023	2024
		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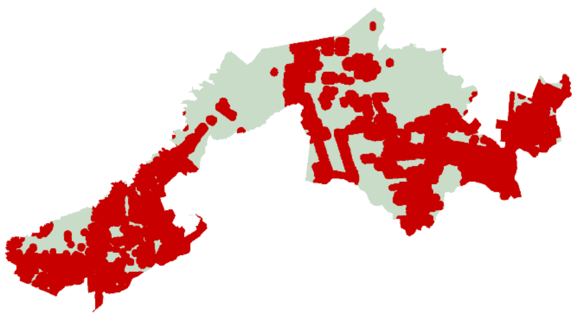
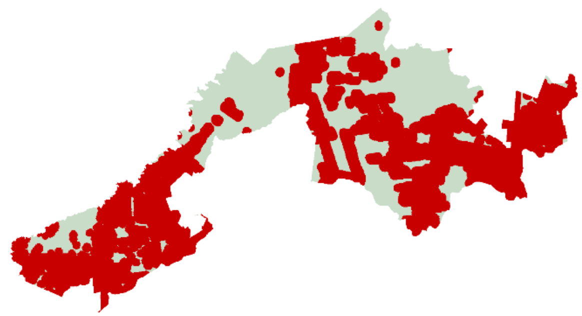
2043	2048	
		

Figure 28. 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.

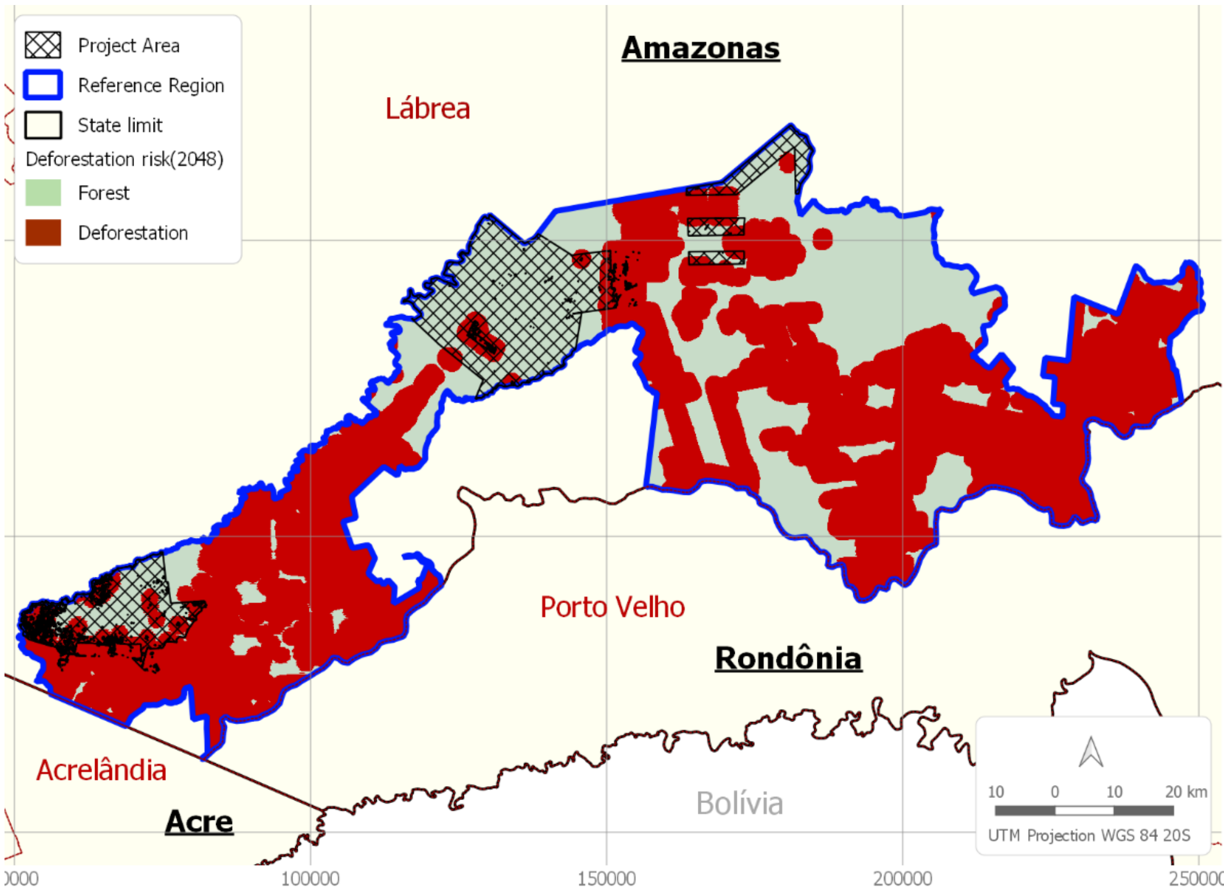


Figure 29. Mapping of cumulative deforestation projected to 2048, in the Project Area.

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% are submontane dense ombrophylous forest (“Ds”). 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 17. 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} >	1	Total baseline deforestation in the project area	
	Name >	Submontane open ombrophylous forest (As)		
	Project year *t*	ha	annual $ABSLPA_t$ ha	cummulative ABSLPA ha
2018	0	0.0	0.0	1,174.1
2019	1	1,386.7	1,386.7	2,560.9
2020	2	1,700.3	1,700.3	4,261.1
2021	3	1,750.1	1,750.1	6,011.2
2022	4	1,736.9	1,736.9	7,748.0
2023	5	1,005.8	1,005.8	8,753.8
2024	6	838.9	838.9	9,592.7
2025	7	1,590.4	1,590.4	11,183.2
2026	8	849.0	849.0	12,032.1
2027	9	1,594.3	1,594.3	13,626.4
2028	10	952.4	952.4	14,578.8
2029	11	885.7	885.7	15,464.4
2030	12	885.7	885.7	16,350.1
2031	13	885.7	885.7	17,235.8
2032	14	885.7	885.7	18,121.4
2033	15	885.7	885.7	19,007.1
2034	16	420.8	420.8	19,427.9
2035	17	420.8	420.8	19,848.7
2036	18	420.8	420.8	20,269.5
2037	19	420.8	420.8	20,690.4
2038	20	420.8	420.8	21,111.2
2039	21	406.0	406.0	21,517.2
2040	22	406.0	406.0	21,923.2
2041	23	406.0	406.0	22,329.3
2042	24	406.0	406.0	22,735.3

2043	25	406.0	406.0	23,141.3
2044	26	412.8	412.8	23,554.1
2045	27	412.8	412.8	23,967.0
2046	28	412.8	412.8	24,379.8
2047	29	412.8	412.8	24,792.6
2048	30	412.8	412.8	25,205.5
TOTAL			**24,031.3**	

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

Table 18. 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)

	ID_{icl} >	1	Total baseline deforestation in the leakage belt	
	Name >	Submontane open ombrophylous forest (As)		
Year	Project year *t*	ha	annual $ABSLLK_t$ ha	cummulative ABSLLK ha
2018	0	0.0	0.0	0.0
2019	1	13,433.1	13,433.1	152,370.0
2020	2	12,253.8	12,253.8	164,623.8
2021	3	12,292.6	12,292.6	176,916.5
2022	4	10,778.3	10,778.3	187,694.8
2023	5	10,561.9	10,561.9	198,256.7
2024	6	10,344.6	10,344.6	208,601.3
2025	7	10,377.8	10,377.8	218,979.2
2026	8	9,798.3	9,798.3	228,777.4
2027	9	9,601.4	9,601.4	238,378.8
2028	10	9,403.6	9,403.6	247,782.3
2029	11	2,870.2	2,870.2	2,870.2
2030	12	2,870.2	2,870.2	253,522.7
2031	13	2,870.2	2,870.2	256,393.0
2032	14	2,870.2	2,870.2	259,263.2
2033	15	2,870.2	2,870.2	262,133.4
2034	16	2,021.9	2,021.9	264,155.2
2035	17	2,021.9	2,021.9	266,177.1
2036	18	2,021.9	2,021.9	268,198.9
2037	19	2,021.9	2,021.9	270,220.8
2038	20	2,021.9	2,021.9	272,242.7
2039	21	2,060.3	2,060.3	274,303.0
2040	22	2,060.3	2,060.3	276,363.3

2041	23	2,060.3	2,060.3	278,423.7
2042	24	2,060.3	2,060.3	280,484.0
2043	25	2,060.3	2,060.3	282,544.3
2044	26	2,104.0	2,104.0	284,648.3
2045	27	2,104.0	2,104.0	286,752.3
2046	28	2,104.0	2,104.0	288,856.3
2047	29	2,104.0	2,104.0	290,960.2
2048	30	2,104.0	2,104.0	293,064.2
TOTAL			**154,127.3**	

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” has been chosen, since historical LU/LC-changes are assumed to be representative for 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 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. Thus, the post deforestation class is considered as “pasture”.

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

Table 19. Annual areas deforested in each zone within the project area in the baseline case (baseline activity data zone) (Table 13.b of VM0015)

	ID_z >	1	Total baseline deforestation in the project area	
	Name >	Pasture		
Year	Project year *t*	ha	annual $ABSLPA_t$ ha	cummulative ABSLPA ha
2019	0	0.0	0.0	1,174.1
2020	1	1,386.7	1,386.7	2,560.9
2021	2	1,700.3	1,700.3	4,261.1
2022	3	1,750.1	1,750.1	6,011.2
2023	4	1,736.9	1,736.9	7,748.0
2024	5	1,005.8	1,005.8	8,753.8
2025	6	838.9	838.9	9,592.7
2026	7	1,590.4	1,590.4	11,183.2
2027	8	849.0	849.0	12,032.1

2028	9	1,594.3	1,594.3	13,626.4
2029	10	952.4	952.4	14,578.8
2030	11	885.7	885.7	15,464.4
2031	12	885.7	885.7	16,350.1
2032	13	885.7	885.7	17,235.8
2033	14	885.7	885.7	18,121.4
2034	15	885.7	885.7	19,007.1
2035	16	420.8	420.8	19,427.9
2036	17	420.8	420.8	19,848.7
2037	18	420.8	420.8	20,269.5
2038	19	420.8	420.8	20,690.4
2039	20	420.8	420.8	21,111.2
2040	21	406.0	406.0	21,517.2
2041	22	406.0	406.0	21,923.2
2042	23	406.0	406.0	22,329.3
2043	24	406.0	406.0	22,735.3
2044	25	406.0	406.0	23,141.3
2045	26	412.8	412.8	23,554.1
2046	27	412.8	412.8	23,967.0
2047	28	412.8	412.8	24,379.8
2048	29	412.8	412.8	24,792.6
2049	30	412.8	412.8	25,205.5
TOTAL			**24,031.3**	

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

Table 20. 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)

	ID_z >	1	Total baseline deforestation in the leakage belt	
	Name >	Pasture		
Year	Project year *t*	ha	annual $ABSLLK_t$ ha	cummulative ABSLLK ha
2013	0	0.0	0.0	0.0
2014	1	13,433.1	13,433.1	152,370.0
2015	2	12,253.8	12,253.8	164,623.8
2016	3	12,292.6	12,292.6	176,916.5
2017	4	10,778.3	10,778.3	187,694.8
2018	5	10,561.9	10,561.9	198,256.7
2019	6	10,344.6	10,344.6	208,601.3

2020	7	10,377.8	10,377.8	218,979.2
2021	8	9,798.3	9,798.3	228,777.4
2022	9	9,601.4	9,601.4	238,378.8
2023	10	9,403.6	9,403.6	247,782.3
2024	11	2,870.2	2,870.2	2,870.2
2025	12	2,870.2	2,870.2	253,522.7
2026	13	2,870.2	2,870.2	256,393.0
2027	14	2,870.2	2,870.2	259,263.2
2028	15	2,870.2	2,870.2	262,133.4
2029	16	2,021.9	2,021.9	264,155.2
2030	17	2,021.9	2,021.9	266,177.1
2031	18	2,021.9	2,021.9	268,198.9
2032	19	2,021.9	2,021.9	270,220.8
2033	20	2,021.9	2,021.9	272,242.7
2034	21	2,060.3	2,060.3	274,303.0
2035	22	2,060.3	2,060.3	276,363.3
2036	23	2,060.3	2,060.3	278,423.7
2037	24	2,060.3	2,060.3	280,484.0
2038	25	2,060.3	2,060.3	282,544.3
2039	26	2,104.0	2,104.0	284,648.3
2040	27	2,104.0	2,104.0	286,752.3
2041	28	2,104.0	2,104.0	288,856.3
2042	29	2,104.0	2,104.0	290,960.2
2043	30	2,104.0	2,104.0	293,064.2
TOTAL			**154,127.3**	

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 Project. Data presented in the next table were calculated from this field study, as well as superior and inferior limits of the 90% Confidence Intervals.

Table 21. 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 *icl* Name: Submontane open ombrophylous forest (As) ID icl 1 Average carbon stock per hectare ± 90% CI											
		Cab *icl*		Cbb *icl*		Cwp *icl*						Ctot *icl*	
						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_2e ha^{-1}	t CO_2e ha^{-1}	t CO_2e ha^{-1}	t CO_2e ha^{-1}	t CO_2e ha^{-1}	t CO_2e ha^{-1}	t CO_2e ha^{-1}	t CO_2e ha^{-1}	t CO_2e ha^{-1}	t CO_2e ha^{-1}	t CO_2e ha^{-1}	t CO_2e ha^{-1}
2018	0												
2019	1		559		170		0		0		25		704
2020	2	577		176		0		0		30		723	
...	...		596		182		0		0		35		742
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 22. 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)

<table>
<tr><th rowspan="5">Year</th><th rowspan="5">Project year t</th><th colspan="10">Initial forest class icl
Name: Submontane open ombrophylous forest (As)
ID icl 1
Average carbon stock per hectare ± 90% CI</th><th colspan="2"></th></tr>
<tr><th colspan="2" rowspan="2">Cab icl</th><th colspan="2" rowspan="2">Cbb icl</th><th colspan="6">Cwp icl</th><th colspan="2">Ctot icl</th></tr>
<tr><th colspan="2">short lived</th><th colspan="2">medium lived</th><th colspan="2">long lived</th><th colspan="2"></th></tr>
<tr><th>C stock</th><th>C stock change</th><th>C stock</th><th>C stock change</th><th>C stock</th><th>C stock change</th><th>C stock</th><th>C stock change</th><th>C stock</th><th>C stock change</th><th>C stock</th><th>C stock change</th></tr>
<tr><th>t CO_2e ha^{-1}</th><th>t CO_2e ha^{-1}</th><th>t CO_2e ha^{-1}</th><th>t CO_2e ha^{-1}</th><th>t CO_2e ha^{-1}</th><th>t CO_2e ha^{-1}</th><th>t CO_2e ha^{-1}</th><th>t CO_2e ha^{-1}</th><th>t CO_2e ha^{-1}</th><th>t CO_2e ha^{-1}</th><th>t CO_2e ha^{-1}</th><th>t CO_2e ha^{-1}</th></tr>
<tr><td>2018</td><td>0</td><td rowspan="5">577</td><td rowspan="5">0</td><td rowspan="5">176</td><td rowspan="5">0</td><td rowspan="5">0</td><td rowspan="5">0</td><td rowspan="5">0</td><td rowspan="5">0</td><td rowspan="5">35</td><td rowspan="5">5</td><td rowspan="5">718</td><td rowspan="5">-5</td></tr>
<tr><td>2019</td><td>1</td></tr>
<tr><td>2020</td><td>2</td></tr>
<tr><td>...</td><td>...</td></tr>
<tr><td>2048</td><td>30</td></tr>
</table>

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 23. 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 *fcl* Name: Pasture ID $_{fcl}$ 1 Average carbon stock per hectare ± 90% CI											
		Cab $_{fcl}$		Cbb $_{fcl}$		Cwp $_{fcl}$ *short lived*		*medium lived*		*long lived*		Ctot $_{fcl}$	
		average stock t CO_2e ha^{-1}	± 90% CI t CO_2e ha^{-1}	*average stock* t CO_2e ha^{-1}	± 90% CI t CO_2e ha^{-1}	*average stock* t CO_2e ha^{-1}	± 90% CI t CO_2e ha^{-1}	*average stock* t CO_2e ha^{-1}	± 90% CI t CO_2e ha^{-1}	*average stock* t CO_2e ha^{-1}	± 90% CI t CO_2e ha^{-1}	*average stock* t CO_2e ha^{-1}	± 90% CI t CO_2e ha^{-1}
2018	0												
2019	1		5.9		9.4		0		0		0		15.3
2020	2	11.37		18.15		0		0		0		29.52	
...	...		16.8		26.9		0		0		0		43.7
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 24. Long-term (20-year) area weighted average carbon stock per zone (Table 17 of VM0015)

Zone		Post -deforestation LU/LC-class *fcl* Name: Pasture ID $_{fcl}$ 1			Area weighted long-term (20 years) average carbon stocks per zone *z*			
		Cab $_{fcl}$ *C stock*	Cbb $_{fcl}$ *C stock*	Cwp $_{fcl}$ *C stock*	Cab $_z$ *C stock*	Cbb $_z$ *C stock*	Cwp $_z$ *C stock*	Ctot $_z$ *C stock*
IDz	Name	t CO_2e ha^{-1}	t CO_2e ha^{-1}	t CO_2e ha^{-1}	t CO_2e ha^{-1}	t CO_2e ha^{-1}	t CO_2e ha^{-1}	t CO_2e 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 25. Carbon stock change factors for land-use change categories (ct or ctz) (Method 2) (Table 20.c of VM0015)

Year after deforestation		$\Delta Cab_{ctz,t}$	$\Delta Cbb_{ctz,t}$	$\Delta Cwp_{ctz,t}$ long-lived
0	2018	-577	-17.60	0
1	2019	1.68	-14.91	0
2	2020	1.68	-14.91	0
3	2021	1.68	-14.91	0
4	2022	1.68	-14.91	0
5	2023	1.68	-14.91	0
6	2024	1.68	-14.91	0
7	2025	1.68	-14.91	0
8	2026	1.68	-14.91	0
9	2027	1.68	-14.91	0
10	2028	1.68	2.69	0
11	2029	0	0.00	0
12	2030	0	0.00	0
13	2031	0	0.00	0
14	2032	0	0.00	0
15	2033	0	0.00	0
16	2034	0	0.00	0
17	2035	0	0.00	0
18	2036	0	0.00	0
19	2037	0	0.00	0
20	2038	0	0.00	0
21	2039	0	0.00	0
22	2040	0	0.00	0
23	2041	0	0.00	0
24	2042	0	0.00	0
25	2043	0	0.00	0
26	2044	0	0.00	0
27	2045	0	0.00	0
28	2046	0	0.00	0
29	2047	0	0.00	0
30	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 immediately above.

Table 26. Baseline carbon stock change in the above-ground biomass in the project area (Table 22.b.1 of VM0015)

		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
		$ABSLPA_{ct,t}$	$\Delta Cab_{ct,t}$	$\Delta CabBSLPA_t$	$\Delta CabBSLPA$
Year	Project year t	ha	tCO_2-e ha^{-1}	tCO_2-e	tCO_2-e
2018	0	0.0	0	0	0
2019	1	1,386.7	-577	-800,197	-800,197
2020	2	1,700.3	-317	-978,775	-1,778,972
2021	3	1,750.1	-208	-1,004,647	-2,783,619
2022	4	1,736.9	-151	-994,088	-3,777,707
2023	5	1,005.8	-75	-569,318	-4,347,024
2024	6	838.9	-56	-471,310	-4,818,334
2025	7	1,590.4	-90	-903,564	-5,721,898
2026	8	849.0	-44	-473,017	-6,194,915
2027	9	1,594.3	-72	-901,677	-7,096,592
2028	10	952.4	-39	-528,572	-7,625,164
2029	11	885.7	-38	-488,484	-8,113,648
2030	12	885.7	-40	-489,328	-8,602,977
2031	13	885.7	-44	-490,701	-9,093,677
2032	14	885.7	-47	-492,157	-9,585,834
2033	15	885.7	-48	-493,591	-10,079,425
2034	16	420.8	-23	-225,553	-10,304,977
2035	17	420.8	-26	-226,257	-10,531,234
2036	18	420.8	-28	-228,227	-10,759,462
2037	19	420.8	-32	-228,949	-10,988,411
2038	20	420.8	-35	-230,925	-11,219,336
2039	21	406.0	-37	-223,290	-11,442,626
2040	22	406.0	-40	-224,098	-11,666,724
2041	23	406.0	-44	-224,906	-11,891,630
2042	24	406.0	-49	-225,714	-12,117,343
2043	25	406.0	-55	-226,522	-12,343,865
2044	26	412.8	-56	-231,255	-12,575,120
2045	27	412.8	-56	-231,268	-12,806,388
2046	28	412.8	-56	-231,282	-13,037,670
2047	29	412.8	-56	-231,295	-13,268,965
2048	30	412.8	-56	-231,309	-13,500,273

Table 27. 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
		$BBSLPA_{ct,t}$	$\Delta Cbb_{ct,t}$	$\Delta CbbBSLPA_t$	$\Delta CbbBSLPA$
		ha	tCO_2-e ha^{-1}	tCO_2-e	tCO_2-e
2018	0	0.0	0.00	0	0
2019	1	1,386.7	-17.60	-24,406	-24,406
2020	2	1,700.3	-16.39	-50,600	-75,006
2021	3	1,750.1	-15.88	-76,827	-151,833
2022	4	1,736.9	-15.62	-102,688	-254,520
2023	5	1,005.8	-15.27	-115,718	-370,238
2024	6	838.9	-15.18	-127,777	-498,014
2025	7	1,590.4	-15.34	-153,511	-651,526
2026	8	849.0	-15.12	-164,175	-815,700
2027	9	1,594.3	-15.25	-189,950	-1,005,650
2028	10	952.4	-15.10	-202,423	-1,208,073
2029	11	885.7	-16.70	-215,449	-1,423,522
2030	12	885.7	-17.20	-207,978	-1,631,500
2031	13	885.7	-17.45	-195,833	-1,827,333
2032	14	885.7	-17.64	-182,945	-2,010,277
2033	15	885.7	-16.60	-170,254	-2,180,531
2034	16	420.8	-16.30	-160,281	-2,340,812
2035	17	420.8	-17.78	-154,047	-2,494,860
2036	18	420.8	-16.58	-136,608	-2,631,468
2037	19	420.8	-18.44	-130,225	-2,761,693
2038	20	420.8	-17.26	-112,729	-2,874,422
2039	21	406.0	-17.27	-104,543	-2,978,965
2040	22	406.0	-17.48	-97,392	-3,076,357
2041	23	406.0	-17.72	-90,240	-3,166,597
2042	24	406.0	-18.01	-83,089	-3,249,686
2043	25	406.0	-18.37	-75,938	-3,325,624
2044	26	412.8	-16.70	-68,906	-3,394,530
2045	27	412.8	-16.70	-68,787	-3,463,317
2046	28	412.8	-16.71	-68,668	-3,531,985
2047	29	412.8	-16.71	-68,549	-3,600,533
2048	30	412.8	-16.71	-68,430	-3,668,963

Table 28. 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
		$WPSLPA_{ct,t}$	$\Delta Cwp_{ct,t}$	$\Delta CwpBSLPA_t$	$\Delta CwpBSLPA$
		ha	tCO_2-e ha^{-1}	tCO_2-e	tCO_2-e
2018	0	0.0	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	885.7	0.00	0	0
2030	12	885.7	0.00	0	0
2031	13	885.7	0.00	0	0
2032	14	885.7	0.00	0	0
2033	15	885.7	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	412.8	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 25.

Table 29. 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
		$ABSLLK_{ct,t}$	$\Delta Cab_{ct,t}$	$\Delta CabBSLLK_t$	$\Delta CabBSLLK$
		ha	tCO_2-e ha^{-1}	tCO_2-e	tCO_2-e
2018	0	0	0	0	0
2019	1	13,433	-577	-7,751,450	-7,751,450
2020	2	12,254	-274	-7,048,306	-14,799,756
2021	3	12,293	-186	-7,050,065	-21,849,821
2022	4	10,778	-126	-6,155,545	-28,005,367
2023	5	10,562	-101	-6,012,496	-34,017,862
2024	6	10,345	-84	-5,869,317	-39,887,179
2025	7	10,378	-73	-5,871,064	-45,758,243
2026	8	9,798	-61	-5,519,140	-51,277,384
2027	9	9,601	-54	-5,389,019	-56,666,402
2028	10	9,404	-48	-5,258,707	-61,925,109
2029	11	2,870	-15	-1,472,866	-63,397,976
2030	12	2,870	-17	-1,490,660	-64,888,636
2031	13	2,870	-19	-1,506,467	-66,395,103
2032	14	2,870	-21	-1,522,340	-67,917,443
2033	15	2,870	-24	-1,535,661	-69,453,104
2034	16	2,022	-19	-1,059,087	-70,512,191
2035	17	2,022	-23	-1,073,107	-71,585,299
2036	18	2,022	-28	-1,087,183	-72,672,482
2037	19	2,022	-35	-1,100,283	-73,772,765
2038	20	2,022	-46	-1,113,051	-74,885,816
2039	21	2,060	-49	-1,147,690	-76,033,507
2040	22	2,060	-50	-1,149,054	-77,182,561
2041	23	2,060	-52	-1,150,419	-78,332,980
2042	24	2,060	-54	-1,151,783	-79,484,763
2043	25	2,060	-56	-1,153,147	-80,637,910
2044	26	2,104	-58	-1,179,691	-81,817,601
2045	27	2,104	-57	-1,179,553	-82,997,153
2046	28	2,104	-57	-1,179,414	-84,176,568
2047	29	2,104	-57	-1,179,276	-85,355,844
2048	30	2,104	-57	-1,179,138	-86,534,981

Table 30. 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
		$BBSLLK_{ct,t}$	$\Delta Cbb_{ct,t}$	$\Delta CbbBSLLK_t$	$\Delta CbbBSLLK$
		ha	tCO_2-e ha^{-1}	tCO_2-e	tCO_2-e
2018	0	0	0.00	0	0
2019	1	13,433	-17.60	-236,419	-236,419
2020	2	12,254	-16.19	-415,950	-652,369
2021	3	12,293	-15.78	-599,336	-1,251,705
2022	4	10,778	-15.50	-755,966	-2,007,671
2023	5	10,562	-15.39	-912,860	-2,920,531
2024	6	10,345	-15.31	-1,066,512	-3,987,043
2025	7	10,378	-15.26	-1,221,334	-5,208,377
2026	8	9,798	-15.20	-1,365,865	-6,574,243
2027	9	9,601	-15.17	-1,508,491	-8,082,733
2028	10	9,404	-15.14	-1,648,164	-9,730,898
2029	11	2,870	-17.03	-1,673,385	-11,404,283
2030	12	2,870	-17.05	-1,515,893	-12,920,176
2031	13	2,870	-17.31	-1,375,985	-14,296,160
2032	14	2,870	-17.26	-1,235,498	-15,531,658
2033	15	2,870	-17.50	-1,117,588	-16,649,246
2034	16	2,022	-17.78	-987,976	-17,637,222
2035	17	2,022	-18.30	-863,885	-18,501,107
2036	18	2,022	-18.75	-739,298	-19,240,405
2037	19	2,022	-19.58	-623,353	-19,863,758
2038	20	2,022	-20.86	-510,344	-20,374,102
2039	21	2,060	-16.95	-400,961	-20,775,063
2040	22	2,060	-17.03	-388,886	-21,163,949
2041	23	2,060	-17.10	-376,811	-21,540,760
2042	24	2,060	-17.19	-364,736	-21,905,496
2043	25	2,060	-17.28	-352,661	-22,258,157
2044	26	2,104	-16.66	-341,354	-22,599,511
2045	27	2,104	-16.65	-342,578	-22,942,089
2046	28	2,104	-16.64	-343,802	-23,285,892
2047	29	2,104	-16.64	-345,027	-23,630,918
2048	30	2,104	-16.63	-346,251	-23,977,169

Table 31. 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
		$WPSLLK_{ct,t}$	$\Delta Cwp_{ct,t}$	$\Delta CwpBSLLK_t$	$\Delta CwpBSLLK$
		ha	tCO_2-e ha^{-1}	tCO_2-e	tCO_2-e
2018	0	0.0	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	2,870.2	0.00	0	0
2030	12	2,870.2	0.00	0	0
2031	13	2,870.2	0.00	0	0
2032	14	2,870.2	0.00	0	0
2033	15	2,870.2	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	2,104.0	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-CO_2 gases (CH_4 and N_2O). Sufficient data on such forest fires are available from the historical reference period and the project proponent considers that these emissions are an important component of the baseline. Thus, CH_4 emissions from biomass burning were estimated.

The effect of fire on carbon emissions is counted in the estimation of carbon stock changes; therefore, CO_2 emissions from forest fires were ignored to avoid double counting.

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 (Pburnt,p), and the average combustion efficiency of each pool (CEp) 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.

$$EBBtot_{icl,t} = EBBN20_{icl,t} + EBBCH4_{icl,t} \quad (11)$$

Where:

$EBBtot_{icl,t}$ Total GHG emission from biomass burning in forest class *icl* at year *t*; tCO_2-e ha^{-1}

$EBBN20_{icl,t}$ Total GHG emission from biomass burning in forest class *icl* at year *t*; tCO2-e ha^{-1}

$EBBCH4_{icl,t}$ CH_4 emission from biomass burning in forest class *icl* at year *t*; tCO2-e ha^{-1}

$$EBBN20_{icl,t} = EBBCO2_{icl,t} *12/44 * \mathrm{NCR} * \mathrm{ER}_{N20} * 44/28 * \mathrm{GWP}_{N20}$$

$$EBBCH4_{icl,t} = EBBCO2_{icl,t} *12/44 * \mathrm{ER}_{CH4} * 16/12 * \mathrm{GWP}_{CH4}$$

Where:

$EBBCO2_{icl,t}$ Per hectare CO_2 emission from biomass burning in slash and burn in forest class *icl* at year *t*; tCO_2-e ha^{-1}

$EBBN20_{icl,t}$ Per hectare N_2O emission from biomass burning in slash and burn in forest class *icl* at year *t*; tCO_2-e ha^{-1}

$EBBCH4_{icl,t}$ Per hectare CH_4 emission from biomass burning in slash and burn in forest class *icl* at year *t*; tCO_2-e ha^{-1}

NCR Nitrogen to carbon ratio (IPCC default value = 0.01); dimensionless

ER_{N20} Emission ratio for N_2O (IPCC default value = 0.007)

ER_{CH4} Emission ratio for CH_4 (IPCC default value = 0.012)

GWP_{N20} Global Warming Potential for N_2O (IPCC default value = 310 for the first commitment period)

GWP_{CH4} Global Warming Potential for CH_4 (IPCC default value = 21 for the first commitment $BBCO2_{icl,t} = Fburnt_{icl} *(x + a)^n = \sum_{p=1}^{p}(C_{p,icl,t} * Pburnt_{p,icl} * CE_{p,icl})$

(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; tCO_2-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 … Icl (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 32. Parameters used to calculate non-CO2 emissions from forest fires (Table 23 of VM0015)

Initial Forest Class		Parameters								
		$Fburnt_{icl}$	Cab	$Pburnt_{ab,icl}$	$CEab,icl$	$ECO2\text{-}ab$	$EBBCO2\text{-}tot$	$EBBN2O_{icl}$	$EBBCH4_{icl}$	$EBBtot_{icl}$
IDcl	Name	N/A	$tCO_2e\ ha^{-1}$	N/A	N/A	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$
1	Submontane open ombrophylous forest (As)	1.0	577	0.86	0.5	248	248	2.31	22.7	25.1

Table 33. 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	
		IDcl = 1		annual	cumulative
		$ABSLPA_{icl,t}$	$EBBBSLtot_{icl}$	$EBBBSLPA_t$	EBBBSLPA
		ha	$tCO_2\text{-}e\ ha^{-1}$	$tCO_2\text{-}e$	$tCO_2\text{-}e$
2018	0	0.0	25.05	0	0
2019	1	1,386.7	25.05	34,739	34,739
2020	2	1,700.3	25.05	42,593	77,333
2021	3	1,750.1	25.05	43,841	121,174
2022	4	1,736.9	25.05	43,510	164,684
2023	5	1,005.8	25.05	25,197	189,881
2024	6	838.9	25.05	21,015	210,896
2025	7	1,590.4	25.05	39,842	250,739
2026	8	849.0	25.05	21,267	272,006
2027	9	1,594.3	25.05	39,939	311,945
2028	10	952.4	25.05	23,858	335,803
2029	11	885.7	25.05	22,187	357,990
2030	12	885.7	25.05	22,187	380,177
2031	13	885.7	25.05	22,187	402,364
2032	14	885.7	25.05	22,187	424,551

2033	15	885.7	25.05	22,187	446,738
2034	16	420.8	25.05	10,542	457,280
2035	17	420.8	25.05	10,542	467,822
2036	18	420.8	25.05	10,542	478,364
2037	19	420.8	25.05	10,542	488,906
2038	20	420.8	25.05	10,542	499,447
2039	21	406.0	25.05	10,172	509,619
2040	22	406.0	25.05	10,172	519,790
2041	23	406.0	25.05	10,172	529,962
2042	24	406.0	25.05	10,172	540,133
2043	25	406.0	25.05	10,172	550,305
2044	26	412.8	25.05	10,342	560,647
2045	27	412.8	25.05	10,342	570,989
2046	28	412.8	25.05	10,342	581,331
2047	29	412.8	25.05	10,342	591,673
2048	30	412.8	25.05	10,342	602,014

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 16 years of 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 has also been 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 34. 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	
		IDcl = 1		annual	cumulative
		$APLPA_{icl,t}$	$\Delta Ctot_{icl,t}$	$\Delta CPLdPA_t$	$\Delta CPLdPA$
		ha	tCO_2-e ha^{-1}	tCO_2-e	tCO_2-e
2018	0	0.0	37.73	0	0
2019	1	3,430.1	37.73	129,402	129,402
2020	2	4,395.0	37.73	165,805	295,207
2021	3	3,286.6	37.73	123,990	419,197
2022	4	4,775.5	37.73	180,159	599,356
2023	5	4,786.1	37.73	180,560	779,916
2024	6	3,976.6	37.73	150,020	929,936
2025	7	3,980.1	37.73	150,151	1,080,087
2026	8	3,980.1	37.73	150,151	1,230,237
2027	9	3,971.7	37.73	149,836	1,380,073
2028	10	3,971.7	37.73	149,836	1,529,909
2029	11	2,694.3	37.73	101,644	1,631,554
2030	12	0.0	37.73	0	1,631,554
2031	13	0.0	37.73	0	1,631,554
2032	14	0.0	37.73	0	1,631,554
2033	15	0.0	37.73	0	1,631,554
2034	16	0.0	37.73	0	1,631,554
2035	17	0.0	37.73	0	1,631,554
2036	18	0.0	37.73	0	1,631,554
2037	19	0.0	37.73	0	1,631,554
2038	20	0.0	37.73	0	1,631,554
2039	21	0.0	37.73	0	1,631,554
2040	22	0.0	37.73	0	1,631,554
2041	23	0.0	37.73	0	1,631,554
2042	24	0.0	37.73	0	1,631,554
2043	25	0.0	37.73	0	1,631,554
2044	26	0.0	37.73	0	1,631,554

2045	27	3,430.1	37.73	129,402	1,760,956
2046	28	4,395.0	37.73	165,805	1,926,761
2047	29	3,286.6	37.73	123,990	2,050,750
2048	30	4,775.5	37.73	180,159	2,230,910

Table 35. 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
		$APLPA_{icl,t}$	$\Delta Ctot_{icl,t}$	$\Delta CPLiPA_t$	$\Delta CPLiPA$
		ha	$tCO_2\text{-e ha}^{-1}$	tCO_2-e	tCO_2-e
2018	0	0.0	0.00	0	0
2019	1	3,430.1	3.03	10,376	10,376
2020	2	4,395.0	3.03	23,671	34,047
2021	3	3,286.6	3.03	33,613	67,660
2022	4	4,775.5	3.03	48,059	115,719
2023	5	4,786.1	3.03	62,537	178,255
2024	6	3,976.6	3.03	74,566	252,821
2025	7	3,980.1	3.03	86,606	339,427
2026	8	3,980.1	3.03	98,645	438,073
2027	9	3,971.7	3.03	110,660	548,732
2028	10	3,971.7	3.03	122,674	671,407
2029	11	2,694.3	3.03	130,825	802,231
2030	12	0.0	3.03	130,825	933,056
2031	13	0.0	3.03	130,825	1,063,880
2032	14	0.0	3.03	130,825	1,194,705
2033	15	0.0	3.03	130,825	1,325,530
2034	16	0.0	3.03	130,825	1,456,354
2035	17	0.0	3.03	130,825	1,587,179
2036	18	0.0	3.03	130,825	1,718,003
2037	19	0.0	3.03	130,825	1,848,828
2038	20	0.0	3.03	130,825	1,979,652
2039	21	0.0	3.03	130,825	2,110,477
2040	22	0.0	3.03	130,825	2,241,301
2041	23	0.0	3.03	130,825	2,372,126
2042	24	0.0	3.03	130,825	2,502,950
2043	25	0.0	3.03	130,825	2,633,775
2044	26	0.0	3.03	130,825	2,764,600
2045	27	3,430.1	3.03	141,201	2,905,800
2046	28	4,395.0	2.82	144,119	3,049,920
2047	29	3,286.6	2.59	140,767	3,190,686
2048	30	4,775.5	2.46	145,270	3,335,957

Some unplanned deforestation may happen in the project area despite the AUD project activity. The level at which deforestation will actually be reduced in the project case depends on the effectiveness of the proposed activities, which cannot be measured *ex ante*.

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.

$$\Delta CUDdPA_t = \Delta CBSL_t \; *(1 - EI)$$

Where:

$\Delta CUDdPA_t$ Total *ex ante* actual carbon stock change due to unavoided unplanned deforestation at year t in the project area; tCO_2-e GHG emission from biomass burning in forest class *icl* at year *t*; tCO_2-e ha^{-1}

$\Delta CBSL_t$ Total baseline carbon stock change at year t in the project area; tCO_2-e

EI Ex ante estimated Effectiveness Index; %

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

Table 36. 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
		$\Delta CPLdPA_t$	$\Delta CPLdPA$	$\Delta CPLiPA_t$	$\Delta CPLiPA$	$\Delta CUDdPA_t$	$\Delta CUDdPA$	$\Delta CPSPA_t$	$\Delta CPSPA$
		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	0	0	0	0	0	0	0	0
2019	1	129,402	129,402	10,376	10,376	-82,460	-82,460	-201,487	-201,487
2020	2	165,805	295,207	23,671	34,047	-102,937	-185,398	-245,071	-446,558
2021	3	123,990	419,197	33,613	67,660	-108,147	-293,545	-198,524	-645,082
2022	4	180,159	599,356	48,059	115,719	-109,678	-403,223	-241,778	-886,860
2023	5	180,560	779,916	62,537	178,255	-68,504	-471,726	-186,527	-1,073,387
2024	6	150,020	929,936	74,566	252,821	-59,909	-531,635	-135,362	-1,208,749
2025	7	150,151	1,080,087	86,606	339,427	-105,708	-637,342	-169,253	-1,378,002

2026	8	150,151	1,230,237	98,645	438,073	-63,719	-701,062	-115,224	-1,493,226
2027	9	149,836	1,380,073	110,660	548,732	-109,163	-810,224	-148,339	-1,641,565
2028	10	149,836	1,529,909	122,674	671,407	-73,100	-883,324	-100,261	-1,741,826
2029	11	101,644	1,631,554	130,825	802,231	-70,393	-953,717	-41,213	-1,783,039
2030	12	0	1,631,554	130,825	933,056	-69,731	-1,023,448	61,094	-1,721,945
2031	13	0	1,631,554	130,825	1,063,880	-68,653	-1,092,101	62,171	-1,659,774
2032	14	0	1,631,554	130,825	1,194,705	-67,510	-1,159,611	63,314	-1,596,460
2033	15	0	1,631,554	130,825	1,325,530	-66,384	-1,225,996	64,440	-1,532,020
2034	16	0	1,631,554	130,825	1,456,354	-38,583	-1,264,579	92,241	-1,439,778
2035	17	0	1,631,554	130,825	1,587,179	-38,030	-1,302,609	92,794	-1,346,984
2036	18	0	1,631,554	130,825	1,718,003	-36,484	-1,339,093	94,341	-1,252,643
2037	19	0	1,631,554	130,825	1,848,828	-35,917	-1,375,010	94,907	-1,157,736
2038	20	0	1,631,554	130,825	1,979,652	-34,365	-1,409,376	96,459	-1,061,277
2039	21	0	1,631,554	130,825	2,110,477	-32,783	-1,442,159	98,041	-963,236
2040	22	0	1,631,554	130,825	2,241,301	-32,149	-1,474,308	98,676	-864,560
2041	23	0	1,631,554	130,825	2,372,126	-31,515	-1,505,823	99,310	-765,250
2042	24	0	1,631,554	130,825	2,502,950	-30,880	-1,536,703	99,944	-665,306
2043	25	0	1,631,554	130,825	2,633,775	-30,246	-1,566,949	100,579	-564,727
2044	26	0	1,631,554	130,825	2,764,600	-18,075	-1,585,024	112,749	-451,978
2045	27	129,402	1,760,956	141,201	2,905,800	-17,799	-1,602,823	-6,001	-457,979
2046	28	165,805	1,926,761	144,119	3,049,920	-17,523	-1,620,346	-39,208	-497,187
2047	29	123,990	2,050,750	140,767	3,190,686	-17,247	-1,637,593	-470	-497,657
2048	30	180,159	2,230,910	145,270	3,335,957	-16,971	-1,654,563	-51,859	-549,516

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-CO_2 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-CO_2 emissions from forest fires due to unavoided unplanned deforestation at year *t* in the project area; tCO_2-e

$EBBBSPA_t$ Total non-CO_2 emissions from forest fires at year t in the project area; tCO_2-e

EI *Ex ante* estimated Effectiveness Index; %

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

Table 37. Total *ex ante* estimated actual emissions of non-CO_2 gases due to forest fires in the project area (Table 28 of VM0015)

Year	Project year t	Total ex ante estimated actual non-CO_2 emissions from forest fires in the Project area	
		annual	cumulative
		$EBBPSPA_t$	EBBPSPA
		tCO_2-e	tCO_2-e
2018	0	0	0
2019	1	3,474	3,474
2020	2	4,259	7,733
2021	3	4,384	12,117
2022	4	4,351	16,468
2023	5	2,520	18,988
2024	6	2,102	21,090
2025	7	3,984	25,074
2026	8	2,127	27,201
2027	9	3,994	31,194
2028	10	2,386	33,580
2029	11	2,219	35,799
2030	12	2,219	38,018
2031	13	2,219	40,236
2032	14	2,219	42,455
2033	15	2,219	44,674
2034	16	1,054	45,728
2035	17	1,054	46,782
2036	18	1,054	47,836
2037	19	1,054	48,891
2038	20	1,054	49,945
2039	21	1,017	50,962
2040	22	1,017	51,979
2041	23	1,017	52,996
2042	24	1,017	54,013
2043	25	1,017	55,030
2044	26	531	55,562
2045	27	531	56,093
2046	28	531	56,624
2047	29	531	57,155
2048	30	531	57,686

4.2.3 Ex ante estimation of actual carbon stock changes

Table 38. Total ex ante estimated actual net carbon stock changes and emissions of non-CO2 gases in the project area (Table 29 of VM0015)

		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
	Project	$\Delta CPAdPA_t$	$\Delta CPAdPA$	$\Delta CPAiPA_t$	$\Delta CPAiPA$	$\Delta CUDdPA_t$	$\Delta CUDdPA$	$\Delta CPSPA_t$	$\Delta CPSPA$	$EBBPSPA_t$	$EBBPSPA$
Year	year t	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	0	0	0	0	0	0	0	0	0	0
2019	1	129,402	129,402	10,376	10,376	-82,460	-82,460	-201,487	-201,487	3,474	3,474
2020	2	165,805	295,207	23,671	34,047	-102,937	-185,398	-245,071	-446,558	4,259	7,733
2021	3	123,990	419,197	33,613	67,660	-108,147	-293,545	-198,524	-645,082	4,384	12,117
2022	4	180,159	599,356	48,059	115,719	-109,678	-403,223	-241,778	-886,860	4,351	16,468
2023	5	180,560	779,916	62,537	178,255	-68,504	-471,726	-186,527	-1,073,387	2,520	18,988
2024	6	150,020	929,936	74,566	252,821	-59,909	-531,635	-135,362	-1,208,749	2,102	21,090
2025	7	150,151	1,080,087	86,606	339,427	-105,708	-637,342	-169,253	-1,378,002	3,984	25,074
2026	8	150,151	1,230,237	98,645	438,073	-63,719	-701,062	-115,224	-1,493,226	2,127	27,201
2027	9	149,836	1,380,073	110,660	548,732	-109,163	-810,224	-148,339	-1,641,565	3,994	31,194
2028	10	149,836	1,529,909	122,674	671,407	-73,100	-883,324	-100,261	-1,741,826	2,386	33,580
2029	11	101,644	1,631,554	130,825	802,231	-70,393	-953,717	-41,213	-1,783,039	2,219	35,799
2030	12	0	1,631,554	130,825	933,056	-69,731	-1,023,448	61,094	-1,721,945	2,219	38,018
2031	13	0	1,631,554	130,825	1,063,880	-68,653	-1,092,101	62,171	-1,659,774	2,219	40,236
2032	14	0	1,631,554	130,825	1,194,705	-67,510	-1,159,611	63,314	-1,596,460	2,219	42,455
2033	15	0	1,631,554	130,825	1,325,530	-66,384	-1,225,996	64,440	-1,532,020	2,219	44,674
2034	16	0	1,631,554	130,825	1,456,354	-38,583	-1,264,579	92,241	-1,439,778	1,054	45,728
2035	17	0	1,631,554	130,825	1,587,179	-38,030	-1,302,609	92,794	-1,346,984	1,054	46,782
2036	18	0	1,631,554	130,825	1,718,003	-36,484	-1,339,093	94,341	-1,252,643	1,054	47,836

2037	19	0	1,631,554	130,825	1,848,828	-35,917	-1,375,010	94,907	-1,157,736	1,054	48,891
2038	20	0	1,631,554	130,825	1,979,652	-34,365	-1,409,376	96,459	-1,061,277	1,054	49,945
2039	21	0	1,631,554	130,825	2,110,477	-32,783	-1,442,159	98,041	-963,236	1,017	50,962
2040	22	0	1,631,554	130,825	2,241,301	-32,149	-1,474,308	98,676	-864,560	1,017	51,979
2041	23	0	1,631,554	130,825	2,372,126	-31,515	-1,505,823	99,310	-765,250	1,017	52,996
2042	24	0	1,631,554	130,825	2,502,950	-30,880	-1,536,703	99,944	-665,306	1,017	54,013
2043	25	0	1,631,554	130,825	2,633,775	-30,246	-1,566,949	100,579	-564,727	1,017	55,030
2044	26	0	1,631,554	130,825	2,764,600	-18,075	-1,585,024	112,749	-451,978	531	55,562
2045	27	129,402	1,760,956	141,201	2,905,800	-17,799	-1,602,823	-6,001	-457,979	531	56,093
2046	28	165,805	1,926,761	144,119	3,049,920	-17,523	-1,620,346	-39,208	-497,187	531	56,624
2047	29	123,990	2,050,750	140,767	3,190,686	-17,247	-1,637,593	-470	-497,657	531	57,155
2048	30	180,159	2,230,910	145,270	3,335,957	-16,971	-1,654,563	-51,859	-549,516	531	57,686

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 (CH_4) and nitrous oxide (N_2O) 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 39. 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	cumulative	annual	cumulative
		$\Delta CADLK_t$	$\Delta CADLK$	$EADLK_t$	$EADLK$
		tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e
2018	0	0	0	0	0
2019	1	-41,230	-41,230	1,737	1,737
2020	2	-51,469	-92,699	2,130	3,867
2021	3	-54,074	-146,773	2,192	6,059
2022	4	-54,839	-201,611	2,176	8,234
2023	5	-34,252	-235,863	1,260	9,494
2024	6	-29,954	-265,817	1,051	10,545
2025	7	-52,854	-318,671	1,992	12,537
2026	8	-31,860	-350,531	1,063	13,600
2027	9	-54,581	-405,112	1,997	15,597
2028	10	-36,550	-441,662	1,193	16,790
2029	11	-35,197	-476,859	1,109	17,899
2030	12	-34,865	-511,724	1,109	19,009
2031	13	-34,327	-546,051	1,109	20,118
2032	14	-33,755	-579,806	1,109	21,228
2033	15	-33,192	-612,998	1,109	22,337
2034	16	-19,292	-632,289	527	22,864
2035	17	-19,015	-651,305	527	23,391
2036	18	-18,242	-669,547	527	23,918
2037	19	-17,959	-687,505	527	24,445
2038	20	-17,183	-704,688	527	24,972
2039	21	-16,392	-721,080	509	25,481
2040	22	-16,074	-737,154	509	25,990
2041	23	-15,757	-752,911	509	26,498
2042	24	-15,440	-768,351	509	27,007
2043	25	-15,123	-783,474	509	27,515
2044	26	-9,038	-792,512	266	27,781
2045	27	-8,900	-801,412	266	28,046
2046	28	-8,761	-810,173	266	28,312
2047	29	-8,623	-818,796	266	28,578

4.3.3 Ex ante estimation of total leakage

Table 40. 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	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
		$EADLK_t$	EADLK	$\Delta CADLK_t$	$\Delta CADLK$	ΔCLK_t	ΔCLK	ELK_t	ELK
		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	0	0	0	0	0	0	0	0
2019	1	1,737	1,737	-41,230	-41,230	-41,230	-41,230	1,737	1,737
2020	2	2,130	3,867	-51,469	-92,699	-51,469	-92,699	2,130	3,867
2021	3	2,192	6,059	-54,074	-146,773	-54,074	-146,773	2,192	6,059
2022	4	2,176	8,234	-54,839	-201,611	-54,839	-201,611	2,176	8,234
2023	5	1,260	9,494	-34,252	-235,863	-34,252	-235,863	1,260	9,494
2024	6	1,051	10,545	-29,954	-265,817	-29,954	-265,817	1,051	10,545
2025	7	1,992	12,537	-52,854	-318,671	-52,854	-318,671	1,992	12,537
2026	8	1,063	13,600	-31,860	-350,531	-31,860	-350,531	1,063	13,600
2027	9	1,997	15,597	-54,581	-405,112	-54,581	-405,112	1,997	15,597
2028	10	1,193	16,790	-36,550	-441,662	-36,550	-441,662	1,193	16,790
2029	11	1,109	17,899	-35,197	-476,859	-35,197	-476,859	1,109	17,899
2030	12	1,109	19,009	-34,865	-511,724	-34,865	-511,724	1,109	19,009
2031	13	1,109	20,118	-34,327	-546,051	-34,327	-546,051	1,109	20,118
2032	14	1,109	21,228	-33,755	-579,806	-33,755	-579,806	1,109	21,228
2033	15	1,109	22,337	-33,192	-612,998	-33,192	-612,998	1,109	22,337
2034	16	527	22,864	-19,292	-632,289	-19,292	-632,289	527	22,864
2035	17	527	23,391	-19,015	-651,305	-19,015	-651,305	527	23,391
2036	18	527	23,918	-18,242	-669,547	-18,242	-669,547	527	23,918
2037	19	527	24,445	-17,959	-687,505	-17,959	-687,505	527	24,445

2038	20	527	24,972	-17,183	-704,688	-17,183	-704,688	527	24,972
2039	21	509	25,481	-16,392	-721,080	-16,392	-721,080	509	25,481
2040	22	509	25,990	-16,074	-737,154	-16,074	-737,154	509	25,990
2041	23	509	26,498	-15,757	-752,911	-15,757	-752,911	509	26,498
2042	24	509	27,007	-15,440	-768,351	-15,440	-768,351	509	27,007
2043	25	509	27,515	-15,123	-783,474	-15,123	-783,474	509	27,515
2044	26	266	27,781	-9,038	-792,512	-9,038	-792,512	266	27,781
2045	27	266	28,046	-8,900	-801,412	-8,900	-801,412	266	28,046
2046	28	266	28,312	-8,761	-810,173	-8,761	-810,173	266	28,312
2047	29	266	28,578	-8,623	-818,796	-8,623	-818,796	266	28,578
2048	30	266	28,843	-8,485	-827,282	-8,485	-827,282	266	28,843

4.4 Net GHG Emission Reductions and Removals

The determination of which GHG emissions by sources, decreases in carbon pools, and leakage emissions are significant for this Project Activity has been carried out using the “Tool for testing significance of GHG emissions in A/R CDM project activities (Version 01)”. According to the tool, the GHG emissions by sources, decreases in carbon pools and leakage emissions are all considered significant, as their sums represent more than 5% of net emission reductions.

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:

$$\Delta REDD_t = (\Delta CBSLPA_t + EBBBSLPA_t) - (\Delta CPSPA_t + EBBPSPA_t) - (\Delta CLK + \Delta ELK_t)$$

Where:

$\Delta REDD_t$ *Ex ante* estimated net anthropogenic greenhouse gas emission reduction attributable to the AUD project activity at year t; tCO_2e

$\Delta CBSLPA_t$ Sum of baseline carbon stock changes in the project area at year t; tCO_2e

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; tCO_2-e

$REDD_t$ *Ex-ante* estimated net anthropogenic greenhouse gas emission reductions attributable to the AUD project activity at year t; tCO_2-e ha^{-1}

VBC_t Number of Buffer Credits deposited in the VCS Buffer at time t; tCO_2-e

$CBSLPA_t$ Sum of baseline carbon stock changes in the project area at year t; tCO_2e

$CPSPA_t$ Sum of ex ante estimated actual carbon stock changes in the project area at year t; tCO_2-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

Table 41. Ex ante estimated net anthropogenic GHG emission reductions ($\Delta REDD_t$) and Voluntary Carbon Units (VCU_t) (Table 36 of VM0015)[46]

		Baseline GHG emissions		Ex ante project GHG emissions		Ex ante leakage GHG emissions		Ex ante net anthropogenic GHG emission reductions	
		annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	Project year t	$EBBBSLPA_t$	EBBBSLPA	EBBPSPAt	EBBPSPA	ELKt	ELK	$\Delta REDD_t$	ΔREDD
Year		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	0	0	0	0	0	0	0	0
2019	1	34,739	34,739	3,474	3,474	1,737	1,737	611,415	611,415
2020	2	42,593	77,333	4,259	7,733	2,130	3,867	769,039	1,380,453
2021	3	43,841	121,174	4,384	12,117	2,192	6,059	866,141	2,246,594
2022	4	43,510	164,684	4,351	16,468	2,176	8,234	837,143	3,083,737
2023	5	25,197	189,881	2,520	18,988	1,260	9,494	485,674	3,569,411
2024	6	21,015	210,896	2,102	21,090	1,051	10,545	451,633	4,021,044
2025	7	39,842	250,739	3,984	25,074	1,992	12,537	868,836	4,889,879
2026	8	21,267	272,006	2,127	27,201	1,063	13,600	508,184	5,398,063
2027	9	39,939	311,945	3,994	31,194	1,997	15,597	922,655	6,320,718
2028	10	23,858	335,803	2,386	33,580	1,193	16,790	614,463	6,935,182
2029	11	22,187	357,990	2,219	35,799	1,109	17,899	646,382	7,581,564
2030	12	22,187	380,177	2,219	38,018	1,109	19,009	742,394	8,323,958
2031	13	22,187	402,364	2,219	40,236	1,109	20,118	733,237	9,057,195
2032	14	22,187	424,551	2,219	42,455	1,109	21,228	723,520	9,780,715
2033	15	22,187	446,738	2,219	44,674	1,109	22,337	713,951	10,494,666
2034	16	10,542	457,280	1,054	45,728	527	22,864	467,744	10,962,410
2035	17	10,542	467,822	1,054	46,782	527	23,391	463,044	11,425,454
2036	18	10,542	478,364	1,054	47,836	527	23,918	449,896	11,875,349
2037	19	10,542	488,906	1,054	48,891	527	24,445	445,083	12,320,432
2038	20	10,542	499,447	1,054	49,945	527	24,972	431,891	12,752,323
2039	21	10,172	509,619	1,017	50,962	509	25,481	418,128	13,170,451
2040	22	10,172	519,790	1,017	51,979	509	25,990	412,736	13,583,188
2041	23	10,172	529,962	1,017	52,996	509	26,498	407,345	13,990,532
2042	24	10,172	540,133	1,017	54,013	509	27,007	401,953	14,392,485
2043	25	10,172	550,305	1,017	55,030	509	27,515	396,561	14,789,046
2044	26	5,311	555,616	531	55,562	266	27,781	288,978	15,078,024
2045	27	5,311	560,928	531	56,093	266	28,046	167,604	15,245,628
2046	28	5,311	566,239	531	56,624	266	28,312	131,774	15,377,402
2047	29	5,311	571,550	531	57,155	266	28,578	167,889	15,545,291
2048	30	5,311	576,862	531	57,686	266	28,843	113,876	15,659,167

[46] Note: for remaining columns of this table, see Appendix 2: Calculation of Total VCUs

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 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 CO2e 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 measurement methods and procedures applied	Conversion from C to CO2 based on molecular weights
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	• *Calculation of baseline emissions* • *Calculation of project emissions* • *Calculation of leakage*
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	tCO2/ha
Description	Average carbon stock per hectare in the aboveground biomass pool of initial forest class icl
Source of data	Average of public literature data from the project region. Further details are provided in “1.13 Conditions Prior to Project Initiation” of this VCS-PD.
Value applied	575
Justification of choice of data or description of measurement methods and procedures applied	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). 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).

	0.589 t/m3 wood density was applied, according to Nogueira (2008).
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.

Data / Parameter	Cbb_{icl}
Data unit	tCO2/ha
Description	Average carbon stock per hectare in the belowground biomass pool of initial forest class icl
Source of data	Average of public literature data from the project region. Further details are provided in “1.13 Conditions Prior to Project Initiation” of this VCS-PD.
Value applied	174
Justification of choice of data or description of measurement methods and procedures applied	Justify the choice of data source, providing references where applicable. Where values are based on measurement, include a description of the measurement methods and procedures applied (e.g., what standards or protocols have been followed), indicate the responsible person/entity that undertook the measurement, the date of the measurement and the measurement results. More detailed information may be provided in an appendix.
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.

Data / Parameter	Cabfcl
Data unit	tCO2/ha
Description	Average carbon stock per hectare in the aboveground biomass pool of post-deforestation class fcl
Source of data	Weighted average (by area obtained in Terra Class database): 2006 IPCC Guidelines for National Greenhouse Gas Inventories, V. 4, Chapter 6: Grassland, pg. 6.27, Table 6.4 (for Pasture: 76.1% of area) 2006 IPCC Guidelines for National Greenhouse Gas Inventories, V. 4, Chapter 4: Forest Land, pg. 4.63, Table

	4.12 (for Pasture with regeneration: 23.9% of area) Value applied: 61.1
Value applied	61.1
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	tCO2/ha
Description	Average carbon stock per hectare in the belowground biomass pool of post-deforestation class fcl
Source of data	Weighted average (by area obtained in Terra Class database): 2006 IPCC Guidelines for National Greenhouse Gas Inventories, V. 4, Chapter 6: Grassland, pg. 6.27, Table 6.4 (for Pasture: 76.1% of area) 2006 IPCC Guidelines for National Greenhouse Gas Inventories, V. 4, Chapter 4: Forest Land, pg. 4.63, Table 4.12 (for Pasture with regeneration: 23.9% of area)
Value applied	40.5
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	EI
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.
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	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. Thus, the "Displacement Leakage Factor" (DLF) was conservatively defined as 0.05.
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
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.
Purpose of Data	• Calculation of baseline emissions
Comments	N/A

5.2 Data and Parameters Monitored

Data / Parameter	ACPAt
Data unit	Ha
Description	Annual area within the Project Area affected by catastrophic events at year t
Source of data	- Remote sensing data and GIS, - Supervisor reports
Description of measurement methods and procedures to be applied	The following sources will be monitored: - INMET (INMET. Instituto Nacional de Meteorologia. http://www.inmet.gov.br/portal/index.php?r=home/page&page=rede_estacoes_conv_graf) - Periodic reports from area supervisor - INPE (INPE. Instituto Nacional de Pesquisas Espaciais. http://www.inpe.br/queimadas/abasFogo.php)
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	Identify equipment used to monitor the data/parameter including type, accuracy class, and serial number of equipment, as appropriate.
QA/QC procedures to be applied	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	Remote sensing and GIS
Comments	N/A

Data / Parameter	**ABSLLKt**
Data unit	ha
Description	Annual area of 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	Values projected annually
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 Any comment: 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.
Comments	Where strong evidence can be collected that deforestation in the leakage belt is attributable to deforestation agents that are not linked to the project area, the detected deforestation will not be attributed to the project activity, thus not considered leakage.

Data / Parameter	ABSLPAt
Data unit	ha
Description	Annual area of deforestation in the project area at year t
Source of data	Remote sensing 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	Annual average deforestation in the project area during the project crediting period
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
Comments	N/A

Data / Parameter	ΔCADLKt
Data unit	tCO2e
Description	Total decrease in carbon stocks due to displaced deforestation at year t Source of data:
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	Annual average decrease in carbon stocks due to displaced deforestation during the project crediting period
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 leakage
Calculation method	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	**ΔCPAdPAt**
Data unit	tCO2e
Description	Total decrease in carbon stock due to all planned activities at year t in the project area.
Source of data	Documents, remote sensing and GIS.
Description of measurement methods and procedures to be applied	The planned activities in the project area that result in carbon stock decrease will be subject to monitoring, when significant.

Frequency of monitoring/recording	Annually.
Value applied	0
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 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	**ΔCPSLKt**
Data unit	tCO2e
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 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	**ΔCUDdPAt**
Data unit	tCO2e
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	Annual average decrease in carbon stocks due to unavoided unplanned deforestation during the project crediting period
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 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	Areas burnt will be monitored every 5 years or if verification occurs on a frequency of less than every 5 years, examination will occur prior to any verification event
Value applied	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 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 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	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	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	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 project emissions
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
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	Frequency of monitoring/recording: Annually
Value applied	Value applied: N/A
Monitoring equipment	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	ΔCabBSLLKt
Data unit	tCO_2e
Description	Total carbon stock changes in the leakage belt area
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.

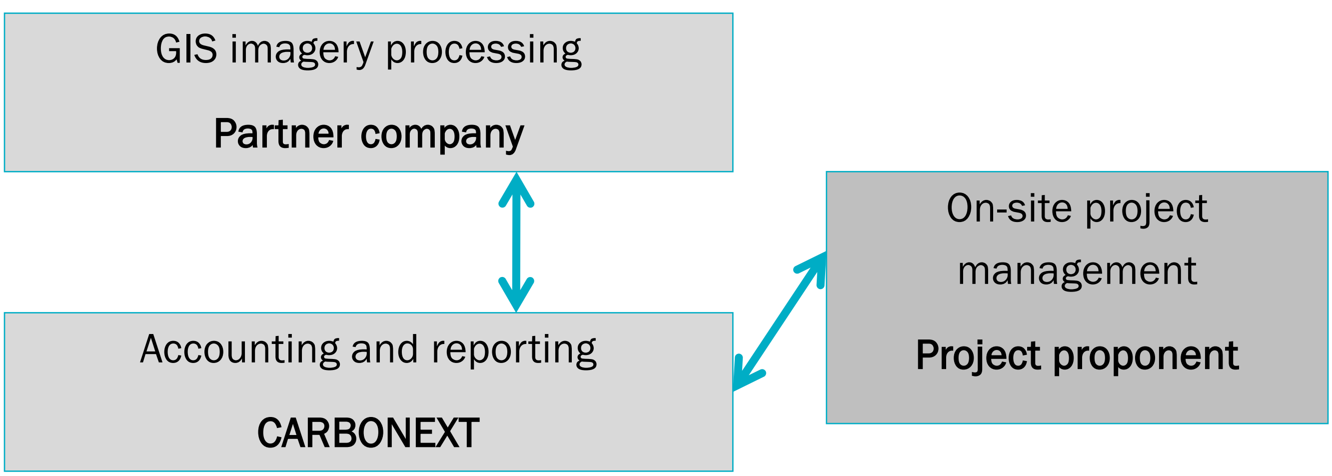


Figure 30. General overview of parties involved in monitoring activities.

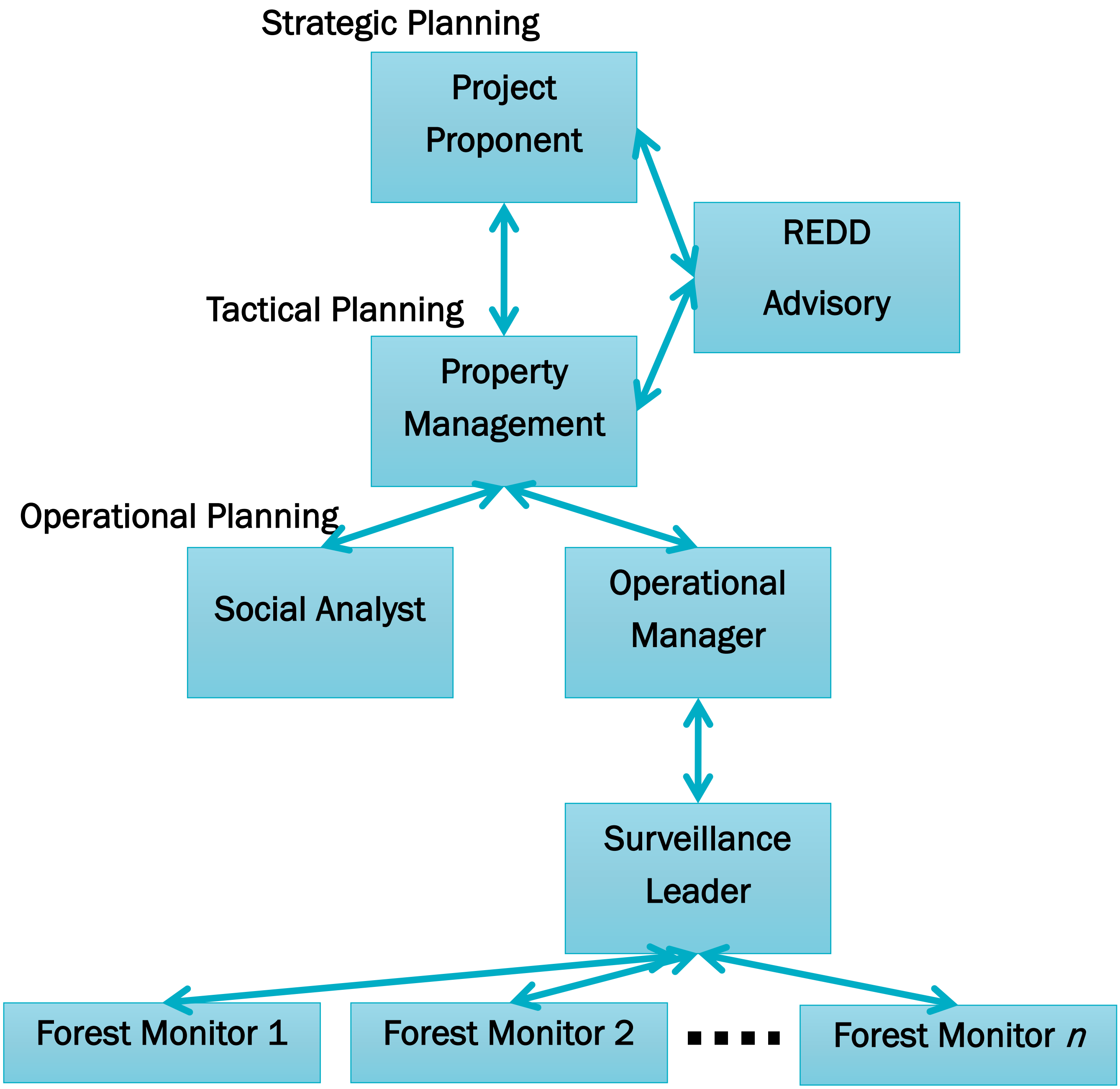


Figure 31. General overview of staff in the Project Area

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 Tables 40 and 41, 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 (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 1.1.3 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. See section 1.1.4 below for more detailed guidance.

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-CO_2 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-CO_2 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 VCUs.

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 Initial plan for selecting 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 (both in terms of wood products and in terms of the sustainable exploitation of non-timber forest products (NTFPs)).

b) Data to be collected.

i) Complementary monitoring of labour conditions (monthly internal audits for health and security assessments, nutrition aspects, personal care and hygiene etc.);

ii) Number of workers trained for sustainable cattle ranching techniques;

iii) Number of workers trained for fire brigades;

iv) Number of attendees in training on forest management;

v) Number of people impacted through forest conservation practices.

Table 42. Social parameters to be monitored: activities, scope, indicators, units, monitoring frequencies, goals, corrective actions after critical analyses.

Activities dependent on the completion of the Validation process

Activity	Scope	Indicator	Unit	Monitoring Frequency	Goal	Corrective Actions after Critical Analyses
Training of fire brigades	Project Area	Attendance	Number of Attendees	5 years	All employees and 15 neighbors	Enhance partnership with teaching institutions; Improve dissemination and communication means; Revise conditions of local and time of sessions
Health and security internal audits	Project Area	Coverage	% of Employees per Year	yearly	100	Improve supervisor attendance in the field; Increase the number of supervisors in the field
Advice on nutritional aspects	Project Area	Attendance	% of Employees per Year	yearly	100	Improve dissemination and communication means; Consult employees about conditions of local and time of sessions

Activities dependent on carbon credits sales

Activity	Scope	Indicator	Unit	Monitoring Frequency	Goal	Corrective Actions after Critical Analyses
Training on sustainable cattle raising	Regional	Attendance	Number of Attendees	3 years	15	Enhance partnership with teaching institutions; Improve dissemination and communication means; Revise conditions of local and time of sessions
Training on forest management	Regional	Attendance	Number of Attendees	3 years	15	Enhance partnership with teaching institutions; Improve dissemination and communication means; Revise conditions of local and time of sessions

c) Overview of data collection procedures.

Data collection procedures will consist of monthly internal audits involving field visits in operation sites, as well as interviews with workers and their families.

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 the social aspects and labour conditions inside the Project Area.

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 (see table below).

Table 43. Biodiversity parameters to be monitored: activities, scope, indicators, units, monitoring frequencies, goals, corrective actions after critical analyses.

Activities dependent on the completion of the Validation process

Activity	Scope	Indicator	Unit	Monitoring Frequency	Goal	Corrective Actions after Critical Analyses
Training of fire brigades	Project Area	Attendance	Number of Attendees	5 years	All employees and 15 neighbors	Enhance partnership with teaching institutions; Improve dissemination and communication means; Revise conditions of local and time of sessions
Dissemination of forest conservation practices	Project Area	Attendance	% of Employees per Year	Yearly	100	Improve supervisor attendance in the field; Increase the number of supervisors in the field

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: NON-PERMANENCE RISK REPORT UNITOR REDD+ PROJECT

1 INTERNAL RISK

Project Management			
a)	Species planted (where applicable) associated with more than 25% of the stocks on which GHG credits have previously been issued are not native or proven to be adapted to the same or similar agro-ecological zone(s) in which the project is located. **Not applicable: the project does not involve plantations**		0
b)	Ongoing enforcement to prevent encroachment by outside actors is required to protect more than 50% of stocks on which GHG credits have previously been issued. **Not applicable: GHG credits have not been previously issued.**		0
c)	Management team does not include individuals with significant experience in all skills necessary to successfully undertake all project activities (i.e., any area of required experience is not covered by at least one individual with at least 5 years experience in the area). **Management team includes individuals with significant experience in all skills necessary to successfully undertake all project activities.**		0
d)	Management team does not maintain a presence in the country or is located more than a day of travel from the project site, considering all parcels or polygons in the project area. **Management team maintains a presence in the country and is located less than a day of travel from the project site, considering all parcels or polygons in the project area.**		0
e)	**Mitigation:** Management team includes individuals with significant experience Management team includes individuals with significant experience in AFOLU project design and implementation, carbon accounting and reporting (e.g., individuals who have successfully managed projects through validation, verification and issuance of GHG credits) under the VCS Program or other approved GHG programs. The technical aspects of the Project Activity will be supported by the following team: Janaina Dallan MBA. - Carbon markets specialist. Working in the coordination of projects related to sustainability strategy and projects to the Clean Development Mechanism. Part of the UNFCCC Registration and Issuance Team as an Expert. Has a bachelor's degree in Forestry Engineering and a Master's in business of the environment. Carbon markets specialist based in São Paulo working specifically in the carbon credit development department being responsible of managing the Brazilian projects and participating as a reviewer of projects in		-2

	other countries, was part of the international Carbon Assets Team of Ecofys. Working with Carbon Market issues since 2002 when she worked with the Center for Advanced Studies on Applied Economics at the University of São Paulo while participating in two projects directed by the Ministry of the Environment. Ms. Dallan later managed CDM projects and Carbon market activities at the company Golder Associates São Paulo and provided support to other Golder offices throughout Latin American countries and North America. She has also worked as a Carbon Markets consultant for an Energy company being responsible for the implementation of the CDM department including staff training, project advisor and staff coordination. Luiz Fernando de Moura. – Forestry Engineer, M.Sc. and Ph.D. in Wood technology by the Université Laval (Quebec, Canada). He is responsible to coordinate the technical group at PLANT Environmental Intelligence, working with projects for the Carbon Markets including Forestry projects. Dr. de Moura had participation in the preparation of "Energia Verde Carbonization Project - Mitigation of Methane Emissions in the Charcoal Production of Grupo Queiroz Galvão, Maranhão, Brazil", registered on March 21, 2011. David Swallow holds an undergraduate degree in Anthropology from Edinburgh University and a Masters in Ecology, Evolution and Conservation from Imperial College London. Based in São Paulo, he focuses on forest carbon, certified supply chains, and impact investment, with nine years' experience developing carbon and social aspects of REDD+ projects on the Brazilian market. Complete CVs are available to auditors. Based on team expertise, the Project Proponent and Project Developers have the unconditional, undisputed and unencumbered ability to claim that the project can generate climate, community and biodiversity benefits.	
f)	**Mitigation:** Adaptive management plan in place	-2
Total Project Management [a + b + c + d + e + f]		-4
Note: When a risk factor does not apply to the project, the score shall be zero for such factor		

Financial Viability		
Q	How many years does it take for the cumulative cashflow to break even?	d)
Q	What percentage of funding is needed to cover the total cash out before the project breaks even has been secured?	h)
d)	Project cash flow breakeven point is less than 4 years from the current risk assessment. As shown in the "Financial viability" spreadsheet, which has been made available to auditors, the project cashflow does not achieve breakeven (i.e., net revenue becomes positive, and stays positive) in the first ten years of the project in scenarios with credit prices ranging from USD2.00 – USD5.00/ VCU.	0

	The Project Proponent, and all of the entities involved in the project, have disclosed evidence as part of this project, that they are not involved, or complicit, in any form of corruption, including bribery, embezzlement, fraud, favoritism, cronyism, nepotism, extortion, and collusion. Official documentation on Project Proponent and Project Developers' suitability is available to the auditors (e.g., Certificates of absence of Legal Disputes and Debts).	
h)	Project has secured 80% or more of funding needed to cover the total cash out before the project reaches breakeven. The proponents have independent wealth and alternative means to generate income from their properties. This will provide a buffer if the carbon market performs poorly. As shown in the "Financial viability" spreadsheet, a conservative estimate of funding needed is of R$13,483,033 (NPV of Year 0 without VCUs), and the project proponents have this sum available on call. The risk of technical failure is very low, as the project has limited technical requirements: No advancement in technologies or maintenance of technical systems are required for the project's success.	0
i)	**Mitigation:** Project has available as callable financial resources at least 50% of total cash out before project reaches breakeven	**-2**
Total Financial Viability [(a, b, c or d) + (e, f, g or h) + i]		0
Note: When a risk factor does not apply to the project, the score shall be zero for such factor		

Opportunity Cost		
Q	What is the NPV from the most profitable alternative land use activity compared to NPV of project activity?	**f)**
a)	NPV from the most profitable alternative land use activity is expected to be at least 100% more than that associated with project activities; or where baseline activities are subsistence-driven, net positive community impacts are not demonstrated	0
b)	NPV from the most profitable alternative land use activity is expected to be between 50% and up to100% more than from project activities	0
c)	NPV from the most profitable alternative land use activity is expected to be between 20% and up to 50% more than from project activities	0
d)	NPV from the most profitable alternative land use activity is expected to be between 20% more than and up to 20% less than from project activities; or where baseline activities are subsistence-driven, net positive community impacts are demonstrated	0
e)	NPV from project activities is expected to be between 20% and up to 50% more profitable than the most profitable alternative land use activity	0
f)	NPV from project activities is expected to be at least 50% more profitable than the most profitable alternative land use activity	-4

	The NPV calculated for the project area is R$15.26/hectare/year, at a realistic VCU price of USD5.00, being slightly above average market prices reported in literature for 2019 (USD4.30)[47], which is justified by Carbonext's sales history. Meanwhile the NPV for the business-as-usual scenario (BAU) of cattle farming is calculated at -R$6.01/ha, based on cattle farming data from the local area, and this is in line with values reported in scientific studies, which also report a negative NPV.[48] Thus, the project NPV is 139% higher than that observed for the BAU activity. These NPVs are based on a discount rate of 12%.	
g)	**Mitigation:** Project proponent is a non-profit organization	0
h)	**Mitigation:** Project is protected by legally binding commitment to continue management practices that protect the credited carbon stocks over the length of the project crediting period (see project longevity)	0
i)	**Mitigation:** Project is protected by legally binding commitment to continue management practices that protect the credited carbon stocks over at least 100 years (see project longevity)	0
Total Opportunity Cost [(a, b, c, d, e or f) + (g + h or i)]		-4
Note: When a risk factor does not apply to the project, the score shall be zero for such factor		
Total may be less than zero		

Project Longevity			
Q	Does the project have a legally binding agreement that covers at least a 100 year period from the project start date?		No
Q	What is the project Longevity in years?		30
Q	Legal Agreement or requirement to continue management practice?		Yes
a)	Without legal agreement or requirement to continue the management practice	0	
b)	With legal agreement or requirement to continue the management practice As demonstrated in the PD, the project proponents hold sustainable timber Operations Licenses approved by the State of Amazonas. These licenses allow the landowner to harvest wood logs. This constitutes a legal agreement to continue the management practice. Additionally, the Legal Reserve (LR) (at least 80% of the property) is	15	

[47] Forest Trends: State of Voluntary Carbon Markets 2020

[48] SCHNEIDER et al. Amazônia Sustentável: limitantes e oportunidades para o desenvolvimento rural. Brasília: World Bank; Belém: Imazon, 2000. 58 pp

	registered in property deeds at the Real Estate Registry Office: its location is publicly known. Brazilian Forest Code determines that, once allocated, LRs may not be changed even in cases of real estate transfer, land dismembering or area rectification.		
Total Project Longevity			15
Note: Total may not be less than zero. Any project with a legally binding agreement that covers at least a 100 year period from the project start date will be assigned a score of zero. Any project with a project longevity of less than 30 years fails the risk assessment			

Total Internal Risk (PM + FV + OC + PL)	**7**
Note: Total may not be less than zero	

2 EXTERNAL RISK

Q	Are the ownership and resource access/use rights held by the same of different entities?	Same
a)	Ownership and resource access/use rights are held by same entity(s)	0
b)	Ownership and resource access/use rights are held by different entity(s) (e.g., land is government owned and the project proponent holds a lease or concession)	0
c)	In more than 5% of the project area, there exist disputes over land tenure or ownership	0
d)	There exist disputes over access/use rights (or overlapping rights)	0
e)	WRC projects unable to demonstrate that potential upstream and sea impacts that could undermine issued credits in the next 10 years are irrelevant or expected to be insignificant, or that there is a plan in place for effectively mitigating such impacts	0
f)	**Mitigation:** Project area is protected by legally binding commitment (e.g., a conservation easement or protected area) to continue management practices that protect carbon stocks over the length of the project crediting period	0
g)	**Mitigation:** Where disputes over land tenure, ownership or access/use rights exist, documented evidence is provided that projects have implemented activities to resolve the disputes or clarify overlapping claims	0
Total Land Tenure [(a or b) + c + d + e + f +g)]		**0**
Note: When a risk factor does not apply to the project, the score shall be zero for such factor		

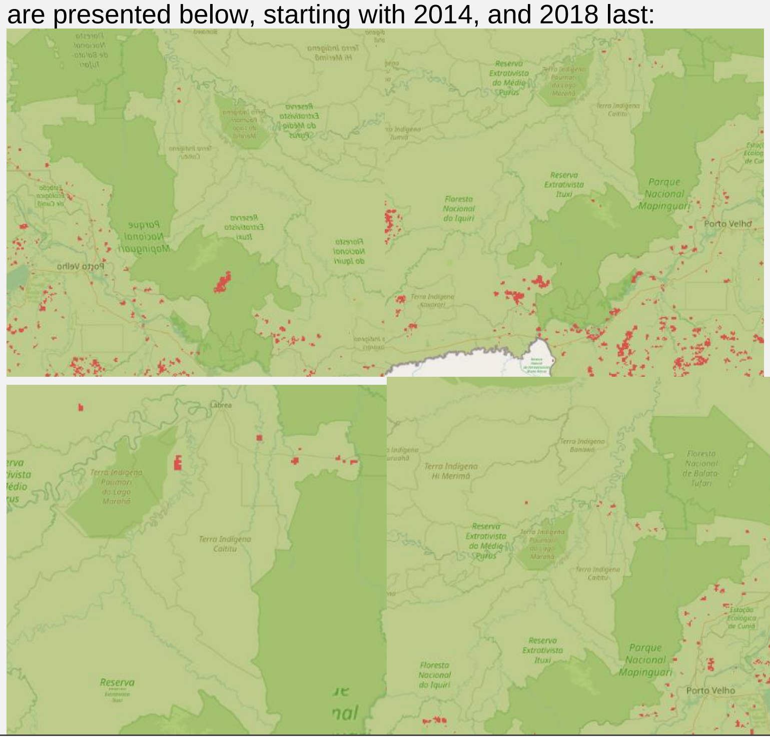
Total may not be less than zero

a)	Less than 50 percent of households living within the project area who are reliant on the project area, have been consulted	0
b)	Less than 20 percent of households living within 20 km of the project boundary outside the project area, and who are reliant on the project area, have been consulted.	0
c)	**Mitigation:** The project generates net positive impacts on the social and economic well- being of the local communities who derive livelihoods from the project area.	-5
Total Community Engagement [a + b + c]		**-5**
Note: When a risk factor does not apply to the project, the score shall be zero for such factor		
Total may be less than zero		

Q	What is the country's calculated Governance score?	0.054
a)	Governance score of less than -0.79	0
b)	Governance score of -0.79 to less than -0.32	0
c)	Governance score of -0.32 to less than 0.19	2
d)	Governance score of 0.19 to less than 0.82	0
e)	Governance score of 0.82 or higher	
f)	**Mitigation:** Country implementing REDD+ Readiness or other activities such as: a) The country is receiving REDD+ Readiness funding from the FCPF, UN-REDD or other bilateral or multilateral donors b) The country is participating in the CCBA/CARE REDD+ Social and Environmental Standards Initiative c) The jurisdiction in which the project is located is participating in the Governors' Climate and Forest Taskforce d) The country has an established national FSC or PEFC standards body e) The country has an established DNA under the CDM and has at least one registered CDM A/R project c) Governor Lima of Amazonas State, Brazil is an active member of the Governors' Climate and Forest Taskforce https://www.gcftf.org/who-we-are/member-states/ https://www.gcftf.org/amazonas-continues-at-war-against-covid-19/ Moreover, Brazil has historically been a leader in the establishment of the REDD framework at international level.	-2
Total Political [(a, b, c, d or e) + f)]		**0**
Note: When a risk factor does not apply to the project, the score shall be zero for such factor		
Total may not be less than zero		

Total External Risk (LT + CE +PC)	0
Note: Total may not be less than zero	

3 NATURAL RISK

Risk Category Factors		LS	M	Risk Rating
a)	Fire (F) The CPTEC/INPE database[49] was used to assess forest fire occurrence in the region for years 2014 – 2018. It was observed that August - September are the months with the highest incidence of forest fires in all these years. Fire incidence in the years mentioned are presented below, starting with 2014, and 2018 last: 	2	0.25	0. 5

[49] Source: http://queimadas.dgi.inpe.br/queimadas/bdqueimadas#exportar (last visited on 04/02/2021).

	 Possible fire points were observed surrounding and within the Project Area in all years from 2014 – 2018: within a 1 km range of the Project Area, and also within it. This was confirmed by interviews with the project owners, who also related that they have had success in controlling these points of fire outbreak, and containing them to avoid them becoming full forest fires, which was confirmed by GIS analysis to determine the project area. **Likelihood and Significance (LS)**: The likelihood of fire in the project area is less than every 10 years, and the loss in carbon stock based on satellite analyses is classed as: minor (5% ≤ 25% loss of carbon stocks) or transient (full recovery of lost carbon stocks expected within 10 years of any event). **Mitigation**: The adaptative management plan is in place, and includes strategic bases equipped with mobile phones and motorcycles. The plan is aimed at restricting invasions and risks of fire. (File: “Proced_Unitor_Controle Patrimonial e Combate a Incendio”) Fire brigades will be organized from local labour forces. Those in favour of the objectives put forward by the project (preservation of natural resources and the continuation of forest management) will be included in training courses, which aims to become a source of income for the local community. The Project budget provides for investments in vehicles and monitoring agreements of park frontiers nearby farm limits. All neighbours will be invited to participate in these training sessions promoted by the Project; and all costs will be covered by the project proponent.			
b)	**Pest and Disease Outbreaks (PD)** This risk is not applicable to the project area. There is no record of Pest or Disease outbreaks in the area, since the area is a natural forest in a state of equilibrium, where it is understood to have virtually zero pest or disease outbreaks. Regarding disease and pest outbreaks in tropical humid forests, due to the high species diversity and resilience, these ecosystems have a strong capacity to adapt and react to any specific single pathogen, insect, or pest (in general terms) that could develop cause widespread damage to vegetation, with consequent carbon loss. There is no scientific evidence on this sort of outbreak in highly diverse tropical humid forests vegetation in the Amazon, which would be different in monoculture tropical plantations.	0	1.00	0.00

	Likelihood and Significance (LS): 0 **Mitigation**: none.			
c)	**Extreme Weather (W)** According to Lewis et al. (2011): "The 2005 and 2010 droughts both coincided with higher-than-normal tropical North Atlantic sea surface temperatures (SST), which have been linked to the 2005 Amazon drought and are suspected in the 2010 drought. The 2010 drought also coincided with a La Niña event, associated with cooler than normal sea surface temperatures in the equatorial Pacific. While La Niña events are generally associated with wetter than normal weather over the northern parts of the Amazon Basin, including some areas impacted by the 2010 drought, it has also been associated with drying over much of the southern half of the basin. It seems likely that the 2010 drought was influenced by both Pacific and Atlantic SSTs. Furthermore, both droughts are consistent with climate modelling that projects drying of the Amazon, although researchers concede that significant uncertainty still remains in these linkages". **Likelihood and Significance (LS)**: Insignificant (less than 5% loss of carbon stocks) or transient (full recovery of lost carbon stocks expected within 10 years of any event) **Mitigation**: none.	2	1.00	2.00
d)	**Geological Risk (G)** Not applicable to the project area. The project area is located in a stable geological area with no faults. The risks of carbon losses related to geological phenomena are more prone to occur in steeply sloped landscapes, which is not the case in the project area (predominantly flat landscape). In steeply sloping areas, biomass loss can occur through earthquake-induced landslides. Even in these cases, previous studies (ALLEN et al. 1999) show that much of an earthquake's immediate impact is low intensity damage to forests. ALLEN et al. (1999) quantified the immediate impact of an earthquake (magnitude index MW 6.7 in 1994). Brazil has a mild seismic activity: earthquakes are predominantly of low intensity varying between 2- and 4-degrees Richter. The highest earthquake recorded in the country occurred in 1955 in the State of Mato Grosso (6.6 degrees Richter) (TOMINAGA et al. 2009). Thus, the earthquake intensity and frequency in Brazil are not likely to produce significant losses of forest biomass. Moreover, according to REN et al. (2009), the occurrence an earthquake-induced landslide must comply with the combination of a series of factors, comprising soil mechanics, vegetation transpiration and root mechanical reinforcement, and hydrological processes. In this context, there are strong reasons to reject the possibility of any significant vegetation damage caused by earthquakes in the project region. **Likelihood and Significance (LS)**: 0 **Mitigation:** none.	0	1.00	0.00

e)	**Other natural risk (ON1)** No further risk factors to the project were identified.	0	1.00	0.00
f)	**Other natural risk (ON2)** No further risk factors to the project were identified.	0	1.00	0.00
g)	**Other natural risk (ON3)** No further risk factors to the project were identified.	0	1.00	0.00
Total Natural Risk [F + PD + W + G + ON]				2.50
Note: When a risk factor does not apply to the project, the score shall be zero for such factor Risk rating is determined by [LS x M]				

Total Natural Risk (F + PD + W + G + ON)	**2.50**
Note: Total may not be less than zero	
If the Total Natural Risk is above 35 then the project fails the entire risk analysis	

Risk Category		**Rating**
a)	Internal risk	7.00
b)	External risk	0.00
c)	Natural Risk	2.50
Overall risk rating (a + b + c)		**10.00**
Note: Overall risk rating shall be rounded up to the nearest whole percentage		
The minimum risk rating shall be 10, regardless of the risk rating calculated		
If the overall risk rating is over 60 then the project fails the entire risk analysis		
Total Risk Assessment		
Net change in the project's carbon stocks		
TOTAL NUMBER OF CREDITS TO BE DEPOSITED IN THE AFOLU POOLED BUFFER ACCOUNT		**1,655,736**

APPENDIX 2: CALCULATION OF TOTAL VCUS

Year	Project year t	Ex ante net anthropogenic GHG emission reductions		Ex ante VCUs tradable		Ex ante buffer credits	
		annual $\Delta REDD_t$ tCO_2-e	cumulative $\Delta REDD$ tCO_2-e	annual VCU_t tCO_2-e	cumulative VCU tCO_2-e	annual VBC_t tCO_2-e	cumulative VBC tCO_2-e
2018	0	0	0	0	0	0	0
2019	1	611,415	611,415	549,103	549,103	62,312	62,312
2020	2	769,039	1,380,453	690,608	1,239,711	78,430	140,742
2021	3	866,141	2,246,594	777,846	2,017,557	88,295	229,037
2022	4	837,143	3,083,737	751,643	2,769,200	85,500	314,537
2023	5	485,674	3,569,411	435,823	3,205,023	49,851	364,388
2024	6	451,633	4,021,044	405,260	3,610,284	46,372	410,760
2025	7	868,836	4,889,879	780,053	4,390,337	88,782	499,542
2026	8	508,184	5,398,063	455,988	4,846,325	52,197	551,739
2027	9	922,655	6,320,718	828,326	5,674,650	94,329	646,068
2028	10	614,463	6,935,182	551,390	6,226,040	63,073	709,141
2029	11	646,382	7,581,564	580,110	6,806,151	66,272	775,413
2030	12	742,394	8,323,958	666,554	7,472,705	75,840	851,253
2031	13	733,237	9,057,195	658,366	8,131,071	74,870	926,124
2032	14	723,520	9,780,715	649,678	8,780,749	73,842	999,965
2033	15	713,951	10,494,666	641,123	9,421,872	72,828	1,072,794
2034	16	467,744	10,962,410	419,936	9,841,809	47,808	1,120,601
2035	17	463,044	11,425,454	415,734	10,257,543	47,310	1,167,911
2036	18	449,896	11,875,349	403,978	10,661,521	45,918	1,213,829
2037	19	445,083	12,320,432	399,675	11,061,195	45,408	1,259,237
2038	20	431,891	12,752,323	387,880	11,449,075	44,011	1,303,248
2039	21	418,128	13,170,451	375,541	11,824,616	42,587	1,345,835
2040	22	412,736	13,583,188	370,720	12,195,336	42,017	1,387,852
2041	23	407,345	13,990,532	365,899	12,561,235	41,446	1,429,298
2042	24	401,953	14,392,485	361,078	12,922,313	40,875	1,470,172
2043	25	396,561	14,789,046	356,257	13,278,570	40,304	1,510,476
2044	26	394,752	15,183,798	354,655	13,633,225	40,097	1,550,573
2045	27	275,636	15,459,434	247,451	13,880,676	28,185	1,578,758
2046	28	242,062	15,701,496	217,235	14,097,911	24,827	1,603,585
2047	29	280,435	15,981,931	251,771	14,349,682	28,664	1,632,248
2048	30	228,680	16,210,610	205,192	14,554,874	23,488	1,655,736

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