MONITORING REPORT AGROCORTEX REDD PROJECT

Document Prepared by Ecologica Assessoria Ltda.

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1. PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Brazil has more than 490 million hectares of forest, covering 59% of its entire territory, putting it in second place for nations with most forest area worldwide[1]. Brazil has at times also been the country with the highest levels of forest loss in the world, for example 53,167,000 ha were deforested from 1990 to 2015 at an average rate of 0.4%/year[2]. The expansion of the agricultural frontier due to cattle ranching, soy farming, timber collection, infrastructure and colonization have contributed to this historically high deforestation rate, which is concentrated in the northern portion of the country, where the Amazon Rainforest lies.

The primary objective of the Agrocortex REDD Project is to avoid the unplanned deforestation (AUD) of the 186,067.04 ha project area, consisting of 100% Amazon rainforest. The project area is located within a private property named "Fazenda Seringal Novo Macapá", which is situated in the municipalities of Manoel Urbano, Pauini and Boca do Acre, in the States of Acre and Amazonas, South-western Amazon.

The project proponent is Agrocortex Madeiras do Acre Agroflorestal Ltda., a Brazilian private company responsible for the operations of Agrocortex Florestas do Brasil S.A – the holding. The latter also holds Agrocortex Florestas Tropicais Ltda., which owns another private company named Batisflor Florestal Ltda. – the landowner of Fazenda Seringal Novo Macapá.

In March/2014, the Agrocortex holding company and Batisflor Florestal Ltda. established an agreement to harvest forest products/by-products and non-timber forest products (NTFPs) in the Project Area, in a manner that is consistent with local ecosystem conservation, granting rights of 1) timber harvesting, 2) NTFPs extraction and 3) carbon credits to Agrocortex Madeiras do Acre Agroflorestal Ltda. (hereafter, "Agrocortex" or "the company").

Agrocortex is a sustainable development company engaged in conserving the environment through sustainable forest and NTFP management, generating greenhouse gases (GHG) emission reductions, and NTFPs. Agrocortex started the sustainable forest management operations in June-2014, which defines the project start date because the activity resulted in reduced GHG emissions. Agrocortex have maintained the Sustainable Forest Management Plan (SFMP) operational and according to planned since the project start

[1] FAO. **Global Forest Resource Assessment 2015**: Desk reference. Rome, 2015. 253 p. Available at: <http://www.fao.org/3/a-i4808e.pdf>. Last visited on: 21-March-2017.

[2] FAO. **Global Forest Resources Assessment 2015 Country Reports**: Brazil. Rome, 2014. 148 p. Available at: <http://www.fao.org/3/a-az172e.pdf>. Last visited on: 21-March-2017.

date. Until the end date of this monitoring report, seven Annual Production Units (APUs) were harvested.

The present REDD project is estimated to avoid a predicted 30,006 ha of deforestation, equating to 14,507,808 tCO2e in emissions reductions over the 30 year project lifetime (01-July-2014 to 30-June-2044).

The project is located in the border between the States of Acre and Amazonas, within the agricultural expansion frontier region, around 25km south of the BR-364, the main highway that crosses the State of Acre. The main deforestation and degradation agents acting within the reference region are: cattle ranching, mainly producing beef cattle; and timber harvesters, acting both legally and illegally. Deforestation in the region involves spatially overlapping activities: firstly, extraction of commercially valuable tree species for sale to timber companies. The final step is the slash-and-burn deforestation of the area above for pasturelands and cattle ranching.

Agrocortex developed a sustainable forest management plan (SFMP) that is certified by the Forest Stewardship Council (FSC), and is considered a tool for forest conservation, maintenance of forest carbon stocks, and decreasing deforestation rates in the project region. These benefits are mainly due to the following:

a) the use of reduced impact logging techniques;

b) reduced social and environmental operational impacts;

c) increased surveillance in the area; and

d) increased economic value from forest resources.

The increased complexity and costs associated with the sustainable operation of the forest as well as other factors such as bureaucratic constraints and price fluctuations of certified timber prices, make sustainable forest management less competitive than illegal logging. Thus, revenue from the sales of the Verified Carbon Units (VCUs) is essential for the project activity to compete with profitable alternative land-use scenarios.

In addition to contributing to the long-term conservation of the region, the Agrocortex REDD Project also establishes a barrier against the advancement of deforestation, making it an important contribution to the conservation of South-western Amazon biodiversity and also to climate regulation in Brazil and South America.

The prevention of unplanned deforestation in the Project Area reduced the emission of 1,179,316 tCO_2e during the monitoring period from 01-January-2017 to 31-December-2019, both days included. This figure of emissions reductions is the net anthropogenic GHG emission reductions after subtractions for project, leakage and buffer emissions. The contribution to sustainability is being monitored applying the SOCIALCARBON® Standard, which is based in six main pointers: Technology; Natural; Financial; Human; Social and Carbon Resources.

1.2 Sectoral Scope and Project Type

14. Agriculture, Forestry, Land Use (AFOLU)

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

This is not a grouped project.

1.3 Project Proponent

Organization name	Agrocortex Madeiras do Acre Agroflorestal Ltda.
Contact person	Marcos Preto
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1.4 Other Entities Involved in the Project

Organization name	Ecológica Assessoria Ltda.
Role in the Project	Project developer. As the authorized contract, Ecológica was given the responsibility of developing the present Project Document.
Contact person	Marcelo Hector Sabbagh Haddad
Title	Technical Coordinator
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Organization name	Uezu Planejamento Ambiental S/S LTDA
Role in the Project	Coordinator
Contact person	Alexandre Uezu
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Telephone	-
Email	-

1.5 Project Start Date

The Project Start Date is 02-June-2014. "Fazenda Seringal Novo Macapá" is a private land owned by Batisflor Florestal Ltda, a Brazilian company owned by Agrocortex Florestas Tropicais Ltda. On 17/March/2014, an agreement was established between the Agrocortex holding company and Batisflor Florestal Ltda., granting rights of timber harvesting, NTFPs extraction and carbon credits to Agrocortex Madeiras do Acre Agroflorestal Ltda. (i.e., the project proponent).

Agrocortex obtained the logging authorization from the Brazilian Environmental Agency[3] for operating the area on 02-June-2014. From this date, the first Annual Production Unit (APU) was harvested through sustainable forest management plan (SFMP) and reduced impact logging techniques. This was the main action of the company in terms of reducing GHG emissions and initiating the present REDD project, and is thus the designated project start date.

Furthermore, the greater presence in the area increased the surveillance, which helps to avoid unplanned deforestation or illegal logging within the project area by external agents.

1.6 Project Crediting Period

The project has a crediting period of 30 years, from 01-July-2014 until 30-June-2044.

1.7 Project Location

The Agrocortex REDD Project is situated in three municipalities within the South-western Amazon region: Manoel Urbano in the State of Acre (AC), and Pauini and Boca do Acre, in the State of Amazonas (AM). The project area is composed of one single property (in Portuguese: Fazenda) covered almost in its totality by native vegetation: Fazenda Seringal Novo Macapá, totaling 190,210 ha.

[3] The responsible environmental agency in this case is the *Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis* - IBAMA.

In accordance with VCS requirements, stipulated in the Approved VCS Methodology VM0015, version 1.1, the project area may only include areas composed of "forest"[4] for a minimum of ten years prior to the project start date. Satellite images from 2003 and 2013 were analyzed and classified. Images from those years were chosen due to the lack of availability of images for the first semester of 2014 (before the Project Start Date).

A portion of land measuring 3,690.22 ha located on the south border of Fazenda Seringal Novo Macapá was excluded from the Project Area, as it is expected that the ownership of this area will be transferred to the local community in the near future. The remaining areas within Fazenda Seringal Novo Macapá that were defined as forest in 2013 and in 2003 were identified and utilized to compose the project area. In addition, some non-forest areas were also excluded, such as rivers, rocks, and non-forest vegetation.

As shown in Figure 1 below, the size of the areas that were considered "non-forest" (i.e. deforested areas, non-forest vegetation, hydrography or rock formations) within the project area at the project start date was 452.74 ha. This was also excluded from the initial area of 190,210 ha, resulting in 186,067.04 ha, which was then defined as project area.

The project geodetic coordinates utilizing Datum WGS84 are provided in Appendix I.

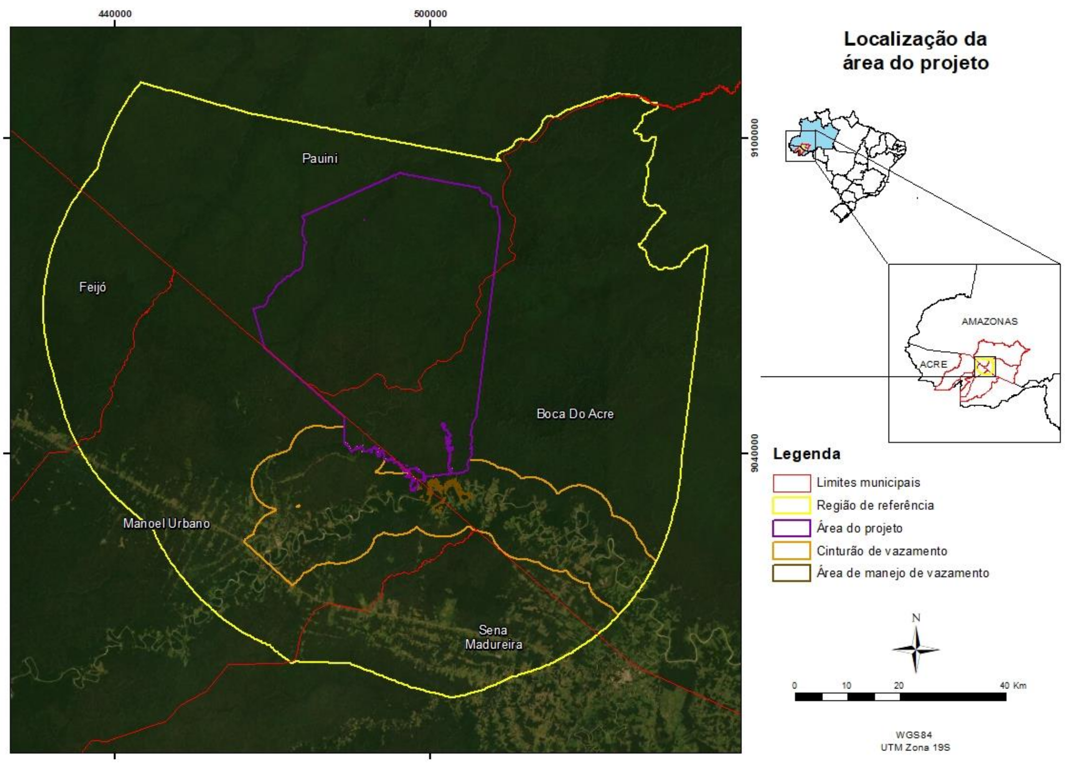

Figure 1. Agrocortex REDD project area

[4] Brazilian Forestry Service. Brazil adopts FAO forest definition: "Land with tree crown cover (or equivalent stocking level) of more than 10 percent and area of more than 0.5 hectares (ha). The trees should be able to reach a minimum height of 5 meters (m) at maturity *in situ*." Available at: <http://www.florestal.gov.br/snif/recursos-florestais/index.php?option=com_k2&view=item&layout=item&catid=14&id=158>. Last visited on: 24-March-2017.

1.8 Title and Reference of Methodology

Approved VCS Methodology VM0015: Methodology for Avoided Unplanned Deforestation, version 1.1, published on 03-December-2012.

In addition, the SOCIALCARBON Methodology[5] is being applied as a sustainability tool in association with VCS Standard.

Furthermore, the following tools were used:

- VT0001 - Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities, v3.0, published on 01-February-2012;
- AFOLU Non-Permanence Risk Tool: VCS Version 4, published on 19-September-2019;
- CDM-approved and VCS-endorsed Tool for testing significance of GHG emissions in A/R CDM project activities, v01.

1.9 Participation under other GHG Programs

The project activity is not included in an emission trading program or any other mechanism that includes GHG allowance trading.

The project area has not created any other form of environmental credit. This project has not been registered in any other credited activity. The project does not intend to generate any other form of GHG-related environmental credit for GHG emission reductions or removals claimed under this VCS project.

This project has not been registered and is not seeking registration under any other GHG Programs.

1.10 Other Forms of Credit

The project activity is not included in an emission trading program or any other mechanism that includes GHG allowance trading.

The project area has not created any other form of environmental credit. This project has not been registered in any other credited activity.

The project does not intend to generate any other form of GHG-related environmental credit for GHG emission reductions or removals claimed under this VCS project.

[5] SOCIALCARBON Methodology was developed by Ecológica Institute (www.ecologica.org.br). It was founded on the principle that transparent assessment and monitoring of the social and environmental performance of projects improves their long-term effectiveness. The methodology uses a set of analytical tools that assess the social, environmental and economic conditions of communities affected by the project and demonstrates through continuous monitoring the project's contribution to sustainable development.

1.11 Sustainable Development

The primary objective of the Agrocortex REDD Project is to avoid the unplanned deforestation (AUD) of the 186,067.04 ha project area, consisting of 100% Amazon rainforest. The Project also has the function of establishing a barrier against the advancement of deforestation, making an important contribution to the conservation of South-western Amazon biodiversity and also to climate regulation in Brazil and South America.

These measures contribute to several nationally stated sustainable development priorities, such as the following objectives from the Brazilian Government related to the Sustainable Development Goals:

- Objective 12: Ensure sustainable production and consumption patterns.
- Objective 13: Take urgent action to combat climate change and its impacts.
- Objective 15: To protect, restore and promote the sustainable use of terrestrial ecosystems, to manage forests sustainably, to combat desertification, to halt and reverse land degradation, and to halt the loss of biodiversity.

Reducing deforestation and promoting sustainable development in the Amazon is also a key component to Brazil's Nationally Determined Contribution (NDC) under the Paris Agreement. According to the Brazilian Government Ministry for the Environment (in Portuguese, Ministério do Meio Ambiente), the implementation of REDD+ activities are an important component to meet the Country's contribution under the United Nations Framework Convention on Climate Change while preserving natural forest resources[6].

The following components of the Brazilian commitments under the Convention are reinforced by the development of the Agrocortex REDD Project:

- Strengthening and enforcing the implementation of the Forest Code, at federal, state and municipal levels;
- Strengthening policies and measures with a view to achieve, in the Brazilian Amazon, zero illegal deforestation by 2030 and compensate for greenhouse gas emissions from legal suppression of vegetation by 2030;
- Enhancing sustainable native forest management systems, through georeferencing and tracking systems applicable to native forest management, with a view to curb illegal and unsustainable practices.

In addition, implementation of REDD and SOCIALCARBON mechanisms together with FSC-certified SFMP promotes sustainable forest use. Beyond the project's ecological and carbon benefits, a proportion of the carbon credits generated will be dedicated to

[6] Brazil's Nationally Determined Contribution towards achieving the objective of the United Nations Framework Convention On Climate Change can be accessed in full at: <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Brazil/1/BRAZIL%20iNDC%20english%20FINAL.pdf>. Last visited on April 10th, 2017.

improving the social and environmental conditions in the project region, specifically contributing to improving deforestation control, and developing environmental education and other social activities.

2. SAFEGUARDS

2.1 No Net Harm

Agrocortex has performed a social and environmental impact assessment of the sustainable forest management performed on the Project Area in May, 2015[7]. This assessment was performed by Agrocortex management team with support from an experienced consultant. The assessment included consultations with local stakeholders, who were asked about their impressions on the expected impacts related to Agrocortex activities.

According to the assessment, there were 95 families living around the Project Area at the time of the study. As part of the surveys performed, all 95 families have been consulted on potential social and environmental impacts resulting from the forest management performed by Agrocortex. In addition, local presentations and meetings were performed for one of the communities where 10 families lived at the time of the survey.

A new assessment of potential environmental and socio-economic risks of the Project was performed on April, 2017 as part of the design of the SOCIALCARBON Indicators for REDD+SFMP Projects, which were developed by Ecológica Assessoria for their application to the Agrocortex REDD Project[8]. This assessment took in consideration the findings of the assessment performed by Agrocortex in 2015 and identified the main risks that should be evaluated as part of SOCIALCARBON certification. Table below provides details on the potential risks identified:

[7] AGROCORTEX, **Identificação dos Impactos do Manejo Florestal Fazenda Seringal Novo Macapá à População do Entorno**. May, 2015.

[8] Indicators available at: <http://www.socialcarbon.org/wp-content/uploads/2012/11/Template_Submission_of_new_indicators_REDD+SFMP_v1.2_EN1.pdf>. Last access on 10/07/2017. These indicators were approved by the Ecológica Institute and can now be applied for similar REDD projects.

Activity	Aspect	Impact	Effect		Comments/ Observation
			Beneficial	Adverse	
Sustainable forest management	Frighten animals	Hunting shortage		X	- Biodiversity resource: Biodiversity monitoring; Impact on remaining flora
Sustainable forest management	Vehicle transport	Air Pollution, Noise and soil erosion		X	- Human resource: Conflict management
Sustainable forest management	Land demarcation processes	Land tenure	X		- Natural resource: Land tenure
Sustainable forest management	Presence of company/workers on local communities	Conflicts between company/workers and local communities		X	- Human resource: Conflict management; Public health - Carbon resource: Stakeholder consultation
REDD carbon project	Conservation of Amazon Rainforest	Avoided deforestation	X		- Carbon resource: Project performance; Buffer reduction
REDD carbon project	Empowerment	Increase independence of communities in the project area.	X		- Social resource: Associations and cooperatives; Women inclusion - Human resource: Community education and training - Financial resource: Alternative income sources

					Biodiversity resource: Non timber forest products (NTFPs)
REDD carbon project	Application of the Social Carbon methodology	Encouragement, monitoring and investment on social, economic and environmental aspects in the project region.	X		- Social resource: Women inclusion; Expansion of community activities - Financial resource: Secure funds; Carbon credit Investments - Natural resource: Social and Environmental Investments; Control and Quality monitoring

Table 1. Potential environmental and socio-economic risks

As available on the table above, three negative impacts were considered for the SOCIALCARBON certification and shall be monitored as part of the indicators created.

The impact of hunting shortage will be monitored through the indicators described on the last column of the above table: biodiversity monitoring and impact on remaining flora. The following measures were planned by Agrocortex to mitigate this risk:

- Restrict the circulation of personnel and equipment on the Project Area to avoid frightening or modifying the behavior of animals;
- Regular meetings with communities living within the leakage management area explaining about the difference between the customary and the predatory hunting and fishing[9];
- Timber harvesting should be performed on annual plots and not at several locations simultaneously;
- Establish procedures to monitor fauna on traditional hunting spots inside each APU.

Air pollution, noise and soil erosion will be monitored through the conflict management indicator. The following measures were planned by Agrocortex to mitigate this risk:

- Monitor vehicles for their compliance on driving speed;
- Establish speed bumps and spray roads with water near populated areas
- Establish and monitor time limits for harvest transportation to avoid disturbing locals during rest periods.

Finally, the impact related to conflicts between company/workers and local communities will be monitored through the indicators of conflict management, public health and stakeholder consultation. The following measures were planned by Agrocortex to mitigate this risk:

- Establish and monitor a Code of Conduct for employees, including information related to issues such as drugs and alcohol, prostitution, the use of firearms, amongst others;
- Promote lectures and educational campaigns on respecting local culture;
- Establish procedures to ensure employee's health is assessed on a regular basis to prevent the spread of infectious diseases.

[9] It is constantly clarified that the customary activity that communities practice may continue as it has always been; however, the predatory activity is prohibited because it can bring harmful results for the biodiversity and for the community itself, since it may lead to a decrease of animals supply. It is important to note that Agrocortex offers all meals for all employees, thus there is no need of fishing/hunting within the project area.

During this second monitoring period there was no record of significant harms in regards to the risks described above. Agrocortex maintained the established procedures to monitor and report on environmental or socioeconomic impacts from its forest operations throughout the entire monitoring period.

In addition, Agrocortex utilizes the concepts of High Conservation Values (HCV) to manage the Project Area. Agrocortex has established criteria to define HCV and the corresponding areas of significant value or extreme importance at regional or global levels. Definitions on such areas were taken considering 2012 guidelines from the HCV Resource Network, documents from other institutions, internal data and information from the consultation of local communities.

Such definitions allowed Agrocortex to map the locations and boundaries of areas of significant value. On such areas, specific monitoring and maintenance measures are taken to prevent environmental impacts and to ensure their environmental and socioeconomic values are preserved. Measures include applying reduced impact harvesting, supervising worker's operations around these areas, incidents record, and report on the status of HCV areas by the end of each harvest season.

2.2 Local Stakeholder Consultation

The purpose of the local stakeholder consultation is:

- Ensure that all stakeholders are aware and informed about the REDD project and its objectives;
- Assist the project proponent/developer in identifying potential topics for local communities;
- Provide different opportunities to stakeholders for discussion and participation in the validation process.

The main stakeholders considered in this project are:

- The local community surrounding the project area;
- Local community associations and labour unions;
- Agrocortex employees;
- Agrocortex shareholders;
- The Brazilian Environmental Agency (IBAMA);
- The State Environmental Agency of Acre (SEMA-AC);
- The State Environmental Agency of Amazonas (SEMA-AM);
- The Climate Change Institute of Acre (IMC);
- The State System of Incentives for Environmental Services of Acre (SISA);

- The Environmental Institute of Acre (IMAC);
- The Institute of Lands of the State of Acre (ITERACRE);
- The Educational Agency of Manoel Urbano Municipality;
- The Health Agency of Manoel Urbano Municipality;
- The Department of Forest Development, Commerce, Industry and Sustainable Services of Acre (SEDENS);
- The State Department of Agroforestry Extension and Family Production of Acre;
- The State Technology Foundation of Acre (FUNTAC);
- The Chico Mendes Institute for Biodiversity Conservation (ICMBio);
- The Institute of National Historical and Artistic Heritage (IPHAN);
- The Tropical Forest Institute;
- The Forest Stewardship Council (FSC);
- The National Indigenous Foundation (FUNAI);
- Certification bodies;
- Banks;
- The Brazilian Biodiversity Fund (FUNBIO);
- The Brazilian Department of Biodiversity and Forest (SBF);
- Sustainable forest management companies;
- Non-Governmental Organizations (NGOs);
- Universities and Institutes.

Table 2 below shows the number of people/organizations informed about the project, organized by type.

Stakeholder classification	Number of People/ Organizations informed about the Agrocortex REDD Project
Governmental entities	28
Local communities	6
Local community associations and labour unions	3
Agrocortex employees	30
Agrocortex shareholders	4
Certification bodies	5
Banks	2
Sustainable forest management companies	5

NGOs	10
Universities	5
TOTAL	98

Table 2. Stakeholders informed about the Agrocortex REDD Project, organized by type

As part of the validation of this Project, a local stakeholder consultation was performed in 2017. Since such consultation occurred during this second monitoring period, additional consultations were not performed for this monitoring period.

An explanatory letter was sent to all stakeholders asking their opinion about the project. Moreover, they were also invited to attend a local stakeholders' consultation in Manoel Urbano Municipality. The local community was personally invited by one of the project forest engineers who visited them by boat. The invitation letter was sent 30 days before the consultation meeting.

The local stakeholders' consultation was held on 20/06/2017 in the Agrocortex industrial complex located in Manoel Urbano, State of Acre. This presentation detailed a summary of the proposed activities of the REDD project implementation and monitoring, including FSC-certified sustainable forest management operations and potential socioenvironmental activities related to the SOCIALCARBON Methodology and Leakage Management Area involving the local community. An auditor from RINA Services S.p.A. (RINA), who conducted the validation and verification of this project, was also present at this meeting. Pictures of the local stakeholder consultation are available below.

The presentation raised several questions from the participants, which were promptly answered, resulting in great interest in understanding the challenges and benefits of this project. No negative input or comment was received.

Furthermore, all stakeholders were informed that the period for requesting information and comments about the Agrocortex REDD Project was open. The deadline for comments was 30 days from the presentation date, and it could be done by phone or e-mail, both of which were provided in the presentation and explanatory letters. No comments or negative inputs were obtained during the 30 days public consultation period, so it was assumed that stakeholders have no objections to the project activity. Therefore, no modifications to the project were deemed necessary.

Figure 2. Local stakeholders consultation held in Agrocortex industrial complex, 20-June-2017

MADEIRAS DO ACRE

LISTA DE PRESENÇA
AGROCORTEX MADEIRAS DO ACRE AGROFLORESTAL LTDA
CNPJ: 19.848.073/0001-66

MADEIRAS DO ACRE

DATA: 20/06/2017	**HORÁRIO:** 8:40 – 9:30	**TOTAL DE PARTICIPANTES:** 23
DURAÇÃO: 50 min.	**LOCAL:** Refeitório Indústria	

ASSUNTO:
Apresentação do Projeto de REDD Agrocortex (Primeira apresentação)

	NOME	ASSINATURA
1	Ana Beatriz Melo — Agrocortex	Ana Melo
2	Lays Gollovitz Miranda — Agrocortex	Lays Gollovitz Miranda
3	Talita C. Beck — RINA	[illegible]
4	Ítalo Augusto C. Lima - Bco. Amazônia	[illegible]
5	[illegible] Oliveira de Araújo	COOP[illegible]
6	Edson Amaral - ICMBio	[illegible]
7	Avila B. Almeida Dantas - Agrocortex	Avila Dantas
8	Jean Carlos Alves Meneses Agrocortex	Jean Carlos
9	Elza Rodrigues dos Santos Agrocortex	Elza Rodrigues
10	Rafaele Dantas Cardoso Agrocortex	Rafaele Dantas
11	Vanusa Araujo da Cruz - Agrocortex	Vanusa Araujo
12	[illegible]	João Santa [illegible]
13	[illegible]	[illegible]
14	Agnaldo Jesus Galvão de Lima.	[illegible]
15	Antonio [illegible] Silva de Souza - Agrocortex	Antonio [illegible]
16	Edivaldo Gomes dos Santos Agrocortex	Edivaldo Gomes
17	Tarderson de Oliveira Barros Agrocortex	Tarderson Barros
18	Arizio Gonçalves [illegible] Agrocortex	[illegible]
19	[illegible]	Agrocortex [illegible]
20	Jéssica Bispo do Carmo	JBCarmo
21	[illegible] de Fátima Oliveira	[illegible] (Filoc)
22	Armando Luiz Pirovel	[illegible] (Kogitec)
23	Ricardo Cesar Sitta	Ricardo Cesar Sitta
24		
25		

Observações:

Ana Melo
AGROCORTEX MADEIRAS DO ACRE AGROFLORESTAL LTDA
CNPJ: 19.848.073/0001-66

[signature]
INSTRUTOR

Figure 3. Attendance list – Local Stakeholders Consultation

Furthermore, a permanent communication channel with local stakeholders was created in order to receive any comments or suggestions regarding the present REDD project. Furthermore, local communities surrounding the project area will be regularly visited as part of the FSC certification, which requires a social analysis and assessment about the impacts of the SFMP in the local communities. All comments will be received, and outcomes will be documented and stored in digital format. The SOCIALCARBON methodology will also analyze the frequency and methods used for addressing the outcomes of each local stakeholder consultation. The project proponent intends to conduct a stakeholder consultation at each monitoring period.

2.3 AFOLU-Specific Safeguards

Local Stakeholder Identification and Background

Stakeholders were identified through research and previous social activities developed by Agrocortex in the project area. The main stakeholders included representants from communities living outside the project area, Governmental agents, Environmental and Agricultural Agencies, and private sector. The list is available at section Local Stakeholders Consultation above.

According to the social impact studies, there are communities from 9 localities affected by the project. The Sustainable Forest Management Plan includes 95 families. It is important to note that environmental and social activities carried out by the project will try to benefit all communities. This was measured by SOCIALCARBON indicators during the current monitoring period, which analysed the extent of alternative income generation sources and further programs and alternative income sources, besides the applied methods for local stakeholders consultation.

Risks to Local Stakeholders

The main potential environmental and socio-economic risks for stakeholders were evaluated as part of SOCIALCARBON certification at each verification event. The identified risks were described at Section 2.1 above (No Net Harm).

As described above, Agrocortex management team has expertise and prior experience in implementing projects with community engagement within the project region, such as the partnership with the State of Acre's government to reduce bureaucracy and expand the production and generation of income and work. It generates 150 direct jobs, being 600 during high production. Partnership with the government to donate wood residues for the artisan's associations, stimulating the production of handicrafts. The program helps 40 artisans, indirectly benefiting 250 families. In addition, the Sustainable Forest Management Plan with FSC incorporates alternative income into the community. 100% of the activities are developed with the local community.

<u>Respect for Local Stakeholder Resources</u>

The project owner recognizes, respects and supports local stakeholders' customary tenure/access rights to territories and resources. The project will never encroach on private property or relocate people off their lands without consent. In the event there are any ongoing or unresolved conflicts over property rights, usage or resources, the project shall undertake no activity that could exacerbate the conflict or influence the outcome of an unresolved dispute.

Through education activities, Agrocortex offered workplace security, first aid and fire training programs for the community, under the "Jovem Aprendiz" (young apprentice) program and in the SFMP itself. In addition, the company established a partnership to donate wood residues to the Artisans association, stimulating the production of handicrafts, in addition to the creation of job opportunities for the young and adult population under the "Jovem aprendiz".

Any conflict management was monitored by SOCIALCARBON indicators, specifically Stakeholder consultation and support for the project.

In addition, the project did not introduce any invasive species or allow an invasive species to thrive through project implementation. If the project implements any reforestation project with non-native species over native species in the future, the possible risks and adverse effects of exotic species will be justified and explained to communities.

<u>Communication and Consultation</u>

The project took all appropriate measures to communicate and consult with local stakeholders in an ongoing process for the life of the project. As described above, the project conducted a local stakeholders consultation and meetings during the current monitoring period, which were monitored by SOCIALCARBON certification. This consultation communicated:

- The project implementation, including the project results and the importance of forest conservation activities.
- The risks, costs and benefits the project brings to local stakeholders.
- The benefit sharing mechanism.
- Procedures related to resolve eventual conflicts with stakeholders.
- The process of VCS Program validation and verification and the validation/verification body's site visit.

Grievance redress and conflict management procedures, as well as benefit sharing mechanisms, have been discussed with communities through stakeholders consultations. Furthermore, a permanent communication channel with local stakeholders was created in order to receive any comments or suggestions regarding the present REDD project. All comments received were responded. Moreover, in case of any grievances, this will be resolved in a suitable timeframe whenever possible, taking into account culturally-appropriate conflict resolution methods.

3. IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The VCS PD was validated by the Validation and Verification Body (VVB) RINA Services S.p.A. and this present monitoring report is being verified by Designated Operational Entity Earthood Services Private Limited.

Agrocortex has maintained the SFMP and the project activities fully operational since the starting date of the crediting period. The project activities include banning of illegal logging, social education and supervision of deforestation by a management team and through satellite images.

The monitoring data was kept according to the monitoring plan described in the approved VCS PD. This Monitoring Report refers to the second monitoring period of this project and includes data from 01-January-2017 to 31-December-2019.

According to the VCS PD, the main land-uses between the years 1999 to 2013 that promoted or stimulated deforestation in the project region, frequently followed this order of events:

- Highways, access roads, navigable rivers, and infrastructure projects reach remote forested areas;
- Illegal timber logging seeks the most valuable commercial species;
- Deforestation for livestock production.

Usually, deforestation in the region involves spatially overlapping activities: firstly, extraction of commercially valuable tree species for sale to timber companies. The final step is the slash-and-burn deforestation of the area above for pasturelands and cattle ranching.

An analysis of agents and drivers of deforestation revealed that during the second monitoring period (01-January-2017 to 31-December-2019), the primary economic activities in the five municipalities of the reference region continued to be extraction of timber and non-timber forest products (NTFPs) and cattle ranching[10]. The graphs of production of logged timber and cattle ranching in the municipalities of the reference region, according to available data during the monitoring period, are presented in the Figures below.

[10] Instituto Brasileiro de Geografia e Estatística (IBGE). Available at: <https://cidades.ibge.gov.br/>. Last visited on 04/06/2020.

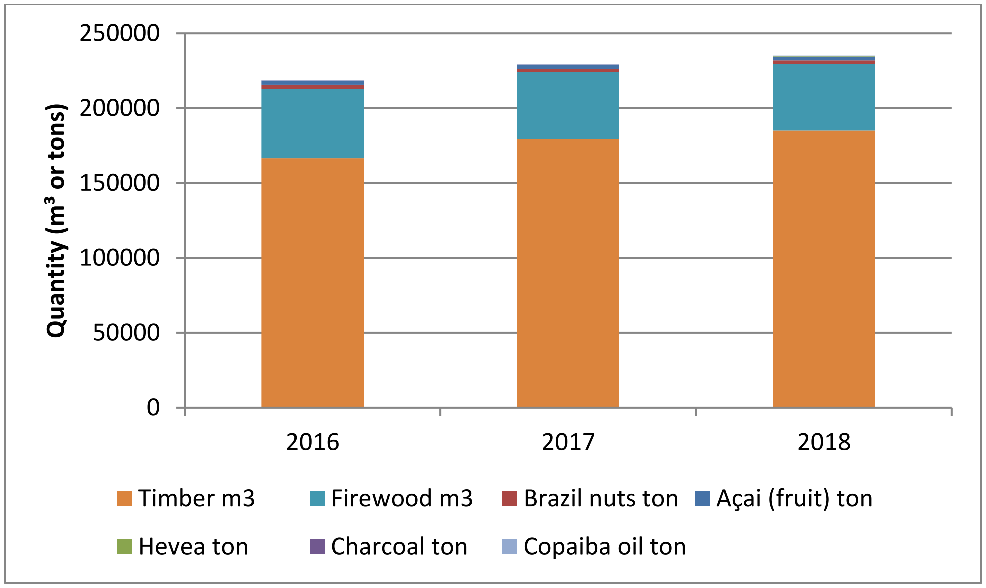

Figure 4. Extractive production in the municipalities where the reference region is located

According to Figure above, timber and firewood continued to be the largest contributors to the total amount of annual production when compared to all extractivism products in the municipalities where the reference region is located. However, NTFPs have showed an increase in the total value of production (R$) during this period for the economic activities within the analyzed municipalities. The main NTFPs were Brazilian nuts and Açaí, which are not considered elements of the deforestation dynamic; on the other hand, production of NTFP has been positively correlated with forest conservation.

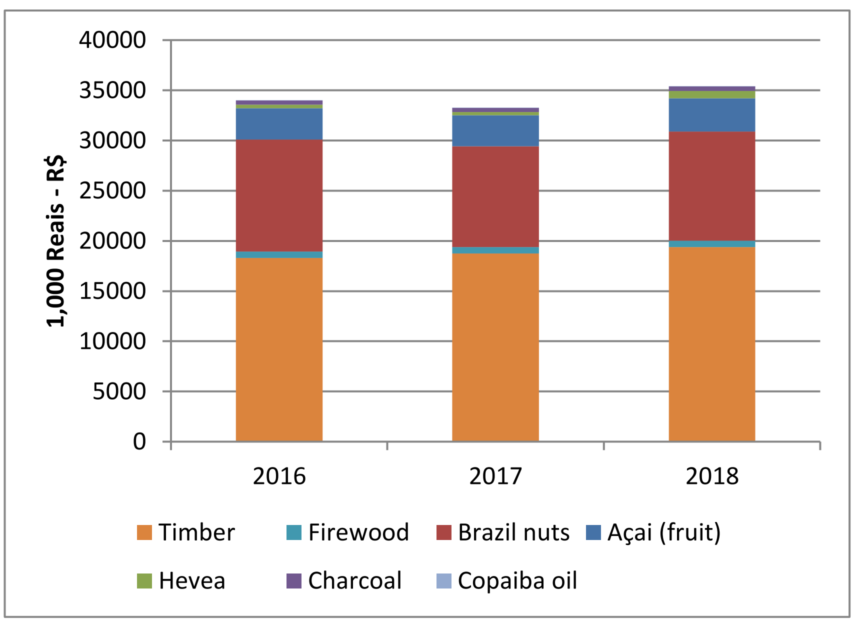

Figure 5. Extraction production values per product in the municipalities of the reference region during the 2016-2018 period

Furthermore, Figure below shows the increase of the cattle herd in the municipalities composing the reference region across the period 2016 - 2018[11]. It is possible to note that this number increased around 5% over these three years, which means almost 32 thousand heads more. The municipality responsible for the largest cattle herd is Sena Madureira (in the State of Acre), which is located in the south of the project area.

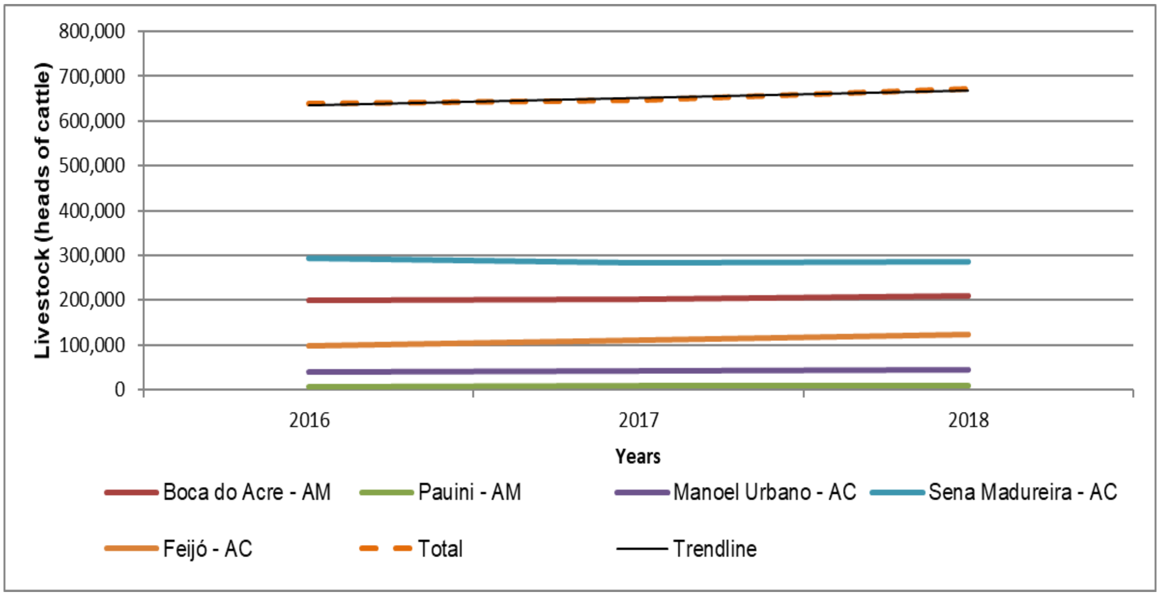

Figure 6. Annual livestock production in the municipalities where the reference region is located
Source: Instituto Brasileiro de Geografia e Estatística (IBGE)

It is expected that agents and drivers of deforestation may increase as a result of a possible population growth in the reference region, which is also influenced by the prices of timber logs and livestock arroba, thus intensifying the demand to convert forested areas to productive areas in the region.

The GIS mapping carried out showed that almost all deforestation that took place during the second monitoring period within the project area resulted from SFMP planned activities. The map with the annual areas of deforestation within the project area during the current monitoring period is showed below. It is possible to analyze that most annual deforested areas correspond to planned access roads and timber yards part of the Sustainable Forest Management Plan (SFMP).

[11] The Brazilian Institute for Geography and Statistics (IBGE): <http://www.ibge.gov.br/home/>.

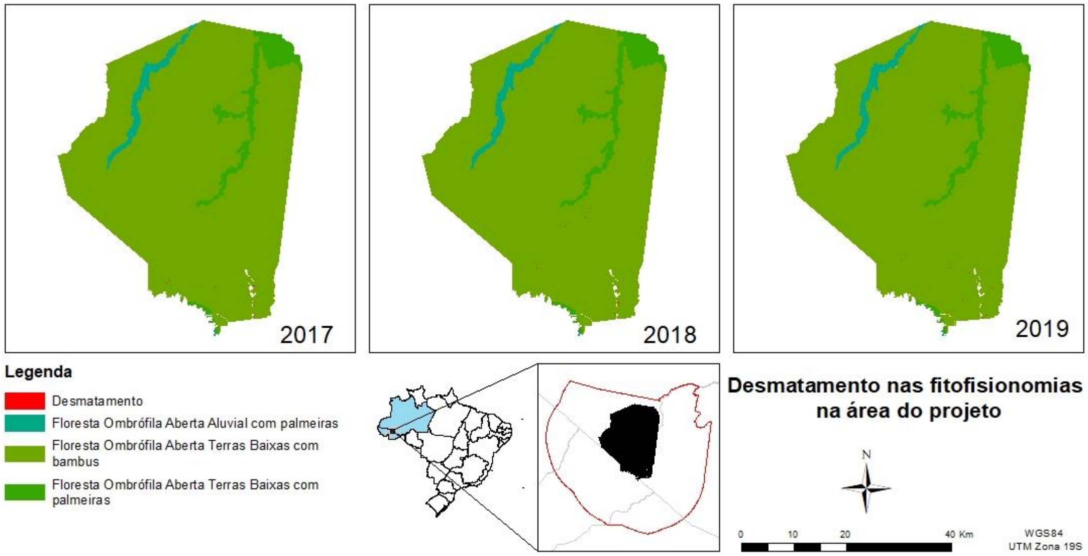

Figure 7. Annual deforestation in the Project Area between 2017 and 2019

However, some unplanned deforestation occurred in the southern border of the project area, corresponding to a total of 67.43 ha during the monitoring period.

Therefore, the annual deforestation values (both planned and unplanned) within the Project Area during the current monitoring period can be seen in the Table 3 below.

Year	Open Tropical Rainforest with bamboo	Open Tropical Rainforest with palm trees	Open Alluvial Rainforest with palm trees	Total forest area (ha)	No forest in PA (ha)	Annual Deforestation (ha)	Cumulative deforestation (ha)	R: annual rate of forest cover change
2017	171,948.54	9,531.80	4,130.77	185,611.12	607.94	134.09	134.09	0.07%
2018	171,805.21	9,530.36	4,128.12	185,463.69	755.36	147.42	281.52	0.08%
2019	171,734.94	9,523.99	4,126.64	185,385.57	833.48	78.12	359.64	0.04%
Initial Forest area (year of 2013) (ha)							186,067.04	
Final Forest area (year of 2019) (ha)							185,385.57	
Total deforestation in the reference region (2017-2019 period) (ha)							359.64	
Average annual deforestation rate (2017-2019 period)							0.06%/year	

Table 3. Annual deforestation, cumulative deforestation and R in the project area during the monitoring period

As can be seen in the table above, the project area displayed an annual average deforestation rate of 0.06% per year during the 2017 – 2019 period (applying R: annual rate of change of forest cover[12]).

[12] Puyravaud, J.-P. (2003), "Standardizing the calculation of the annual rate of deforestation." Forest Ecology and Management, 177: 593-596

According to the baseline scenario, the predicted area that would be deforested within the project area during this monitoring period from 2017 - 2019 would be of 3,487.08 ha, which would mean an annual average deforestation rate of 0.67% per year. Comparing to the actual classified deforestation area during the same analyzed period, as detailed in the Table 3 above, the present REDD project avoided 3,127.44 ha of deforestation, which can be seen in the Table 4 below.

Cumulative deforestation during the 2017 – 2019 period	Area (ha)
Simulated deforestation area (baseline scenario)	3,487.08
Classified deforestation area (project scenario)	359.64
Credit area	**3,127.44**

Table 4. Comparison between the simulated and classified deforestation area within the project area during the 2017-2019 period

The comparison between these two scenarios is displayed in Figure 8 below, showing the conservation of forest areas and the consequent emission reduction provided by the REDD mechanism in the project area. The baseline scenario (solid blue line), which was calculated through the deforestation projected in the VCS PD, was compared to the project scenario (dashed red line). The area between these two lines is exactly the avoided deforestation area by this REDD project over monitored period.

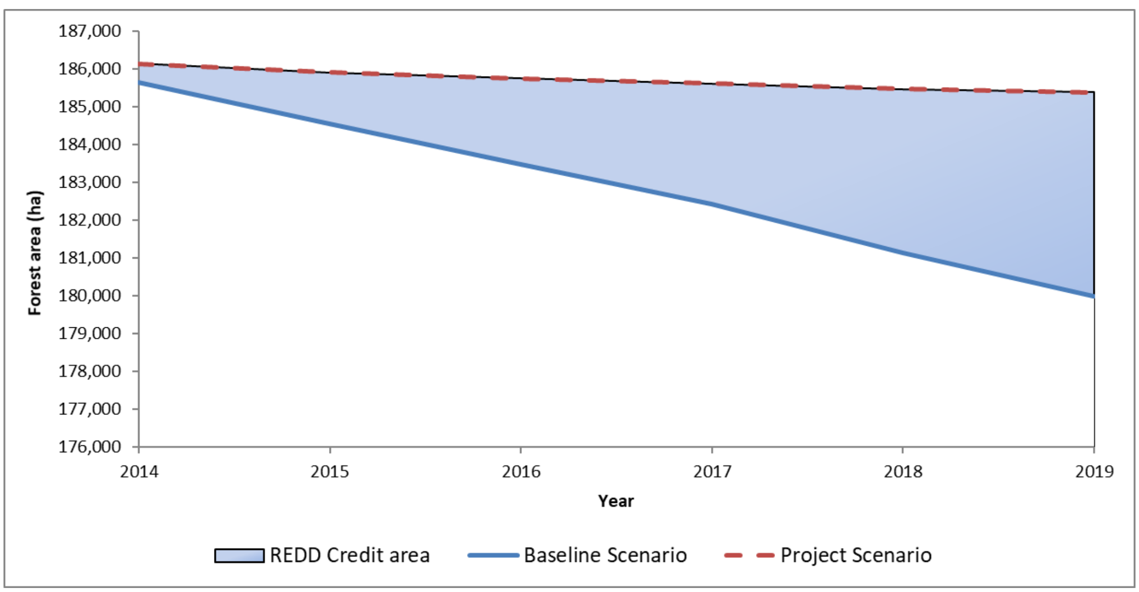

Figure 8. REDD credit area formed by the comparison between the baseline and project scenarios

Looking now at the Reference Region, the actual classified deforestation during the monitoring period was of 16,402.88 ha, which corresponds to around 0.46%/year. Meanwhile, the predicted area in the baseline scenario that would be deforested within the reference region during this monitoring period from 2017 – 2019 would be 29,723.42 ha, meaning an annual average deforestation rate of 0.99% per year.

Comparing to what occurred during the 1999 – 2013 period (historical reference period), when the annual average deforestation rate within the reference region was of 0.25%, the deforestation rate increased around 84%, reaching around 0.46%/year. Therefore, an increase tendency in the deforestation rate in the region could be noted. This figure shows that Agrocortex activities in the region could help reducing the advancement of deforestation towards the project area. In fact, deforestation rate within the Agrocortex project area was 87% lower than what occurred in the reference region. The map with the annual areas of deforestation within the reference region during the current monitoring period is showed below.

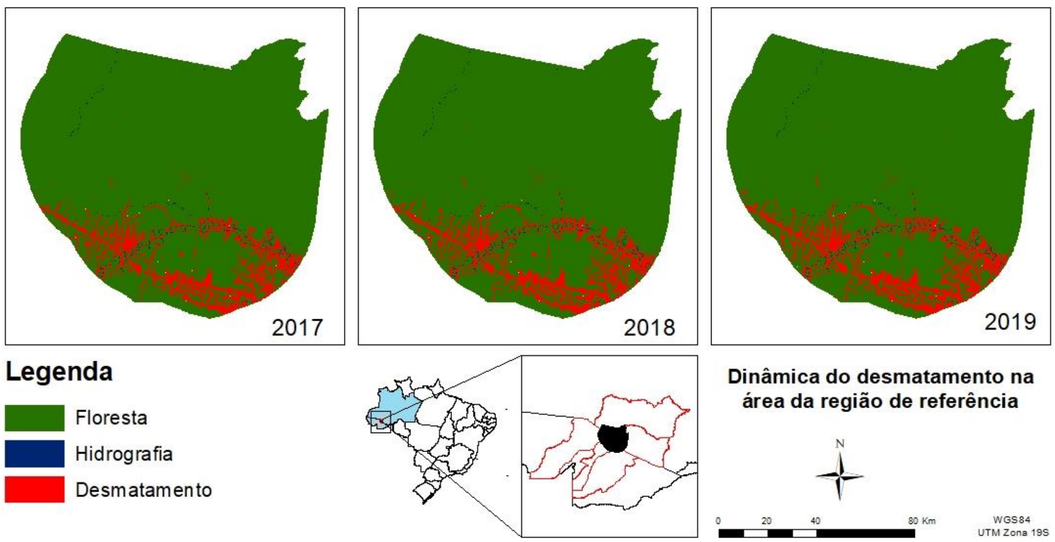

Figure 9. Deforestation in the Reference Region between 2017 and 2019

Meanwhile, the leakage belt (LK) presented the highest deforestation rate during this monitored period. From 2017 to 2019, there was an accumulated deforestation of 5,517.83 ha during this period at an annual rate of 1.59%/year.

Furthermore, the deforestation rate within the leakage belt was around 39.03% lower than predicted in the baseline scenario. However, it is observed that pressure comes from the South of the Reference Region along the BR-364 highway and the Purus River. Furthermore, it appears to originate from outside the latter, influencing the dynamics of land-use change in the Leakage Belt. Figure 10 below shows the annual deforested areas within the leakage belt during the monitoring period.

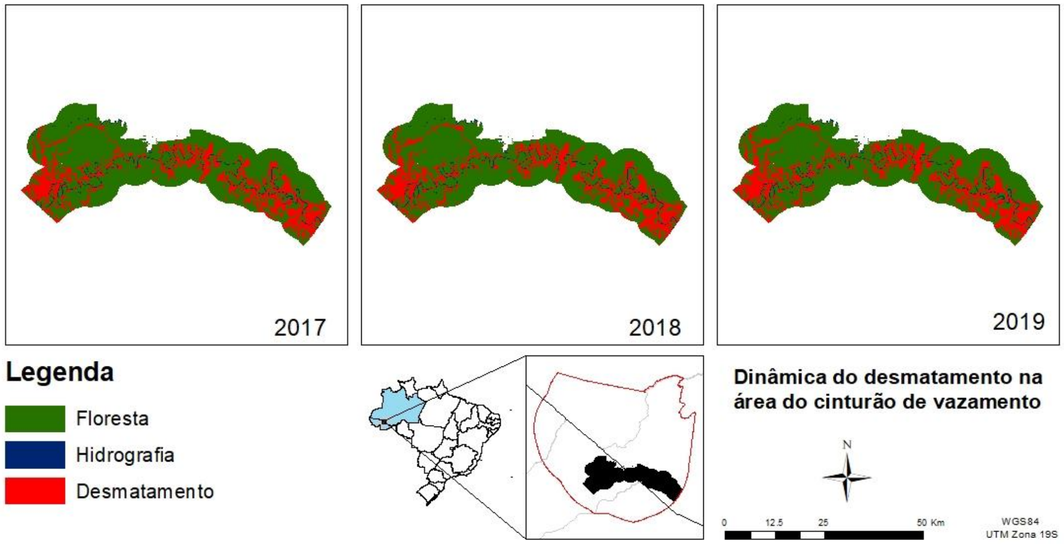

Figure 10. Deforestation in the Leakage Belt between 2017 and 2019

In addition, the increase of the non-forest class occurred at the extreme boundaries of the leakage belt and far from the project area: from one side occurred the expansion of the municipality of Manoel Urbano in the State of Acre, and the increase of roads that connect the city to new opened areas. At the other side, along the Purus River in the state of Amazonas, the increase of the non-forest class resulted from the expansion of the municipality of Sena Madureira, as can be seen in the Figure 11 below. Deforestation was concentrated along the Purus River, according to the historical occupation pattern in the region.

In addition, according to PRODES[13] data, the municipalities of Manoel Urbano and Sena Madureira showed a deforestation rate increase when comparing the historical reference period (2000-2013) and the current monitoring period (2017-2019). Manoel Urbano presented an increase rate of 166%, while in Sena Madureira, the increase was of about 18%.

[13] PRODES Project - Brazilian Amazon Forest Monitoring through Satellite. Instituto Nacional de Pesquisas Espaciais (INPE). Available at: <http://www.obt.inpe.br/prodes/index.php>. Last visited on 10-December-2017.

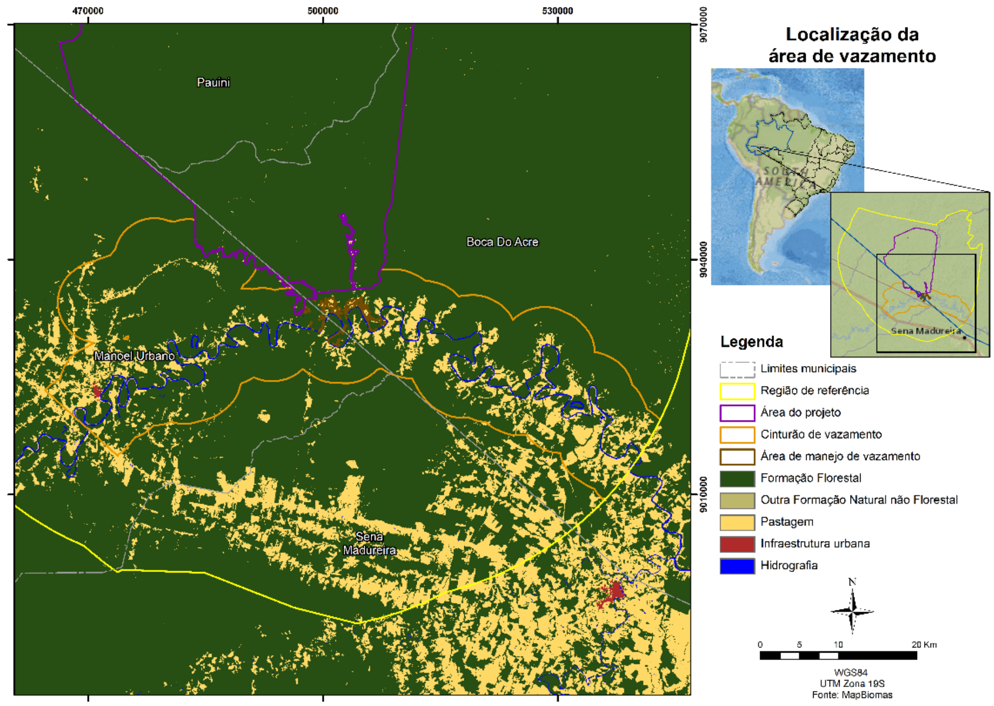

Figure 11. Deforestation within the Leakage Belt between 2017 and 2019, detailing two expansion deforestation regions coming from Manoel Urbano and Sena Madureira municipalities

During the current monitoring period within the leakage belt, there was no deforestation occurred in the project scenario above that predicted in the baseline scenario. However, there were three main focus of deforestation in the leakage belt in 2017, which are showed in the Figure 12 below represented in red color. The western deforestation density represents the deforestation due to the expansion of Manoel Urbano municipality, while the eastern deforestation density (highest one) represents the deforestation due to Sena Madureira municipality. The deforestation occurred in the middle region of the LK presented the lowest density of those three areas, and corresponds to the part that encompasses the community and the leakage management area (LMA), which is the closest region to the Agrocortex project area.

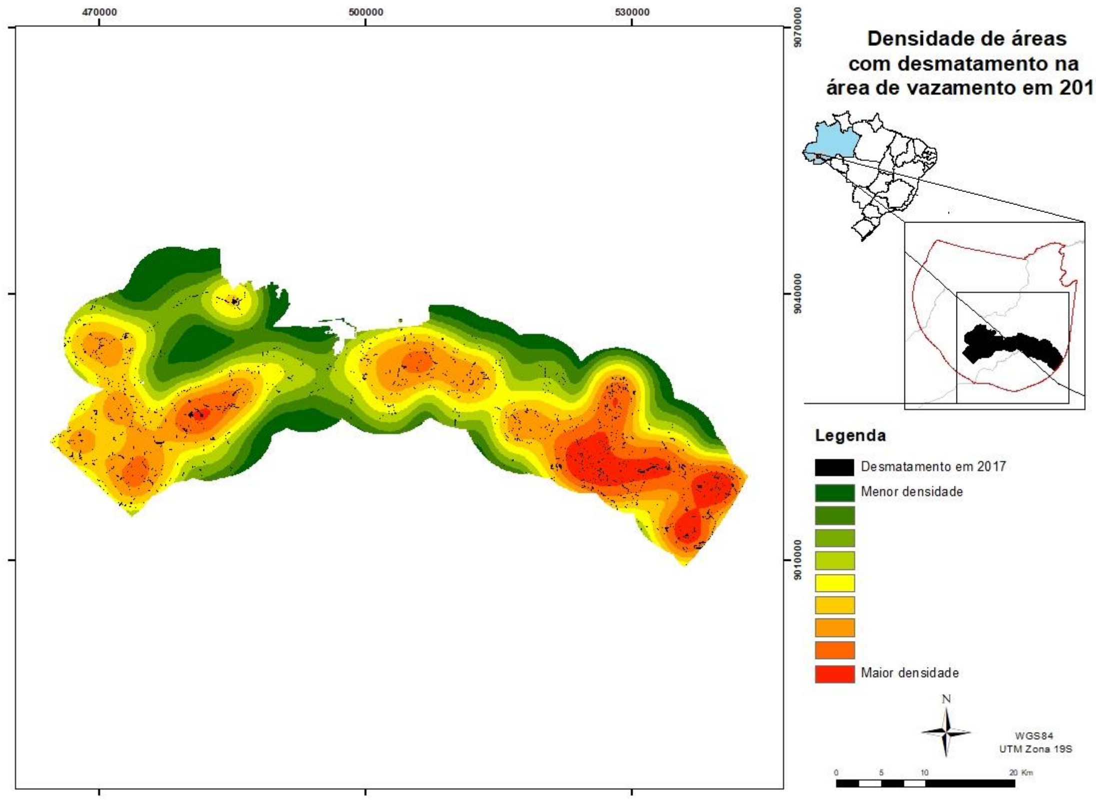

Figure 12. Deforestation within the Leakage Belt in 2017, detailing three expansion deforestation regions coming mainly from Manoel Urbano and Sena Madureira municipalities

According to the GIS analysis, the two focus of deforestation located at the LK extremities – far from the project area and the leakage management area - presented the highest densities of deforestation rates during the monitoring period. This is a positive indication that social activities involving the local community contributed to environmental education and alternative livelihood projects encompassing generation of income from SFMP. Combined with the increased surveillance against deforestation agents in the region, these social activities developed by Agrocortex REDD Project may have contributed in part to reduce the deforestation rate within the middle region of the LK, where the leakage management area is located.

The deforestation within the leakage belt did not occur due to the displacement of deforestation from the project area. In addition to the density map that shows where deforestation predominantly occurred within the leakage belt (Figure 12 above), the Figure 13 below shows the distribution of deforestation in relation to the distance from the project area. This graph shows that a large part of the deforestation in 2017 occurred more than 10km far from the project area.

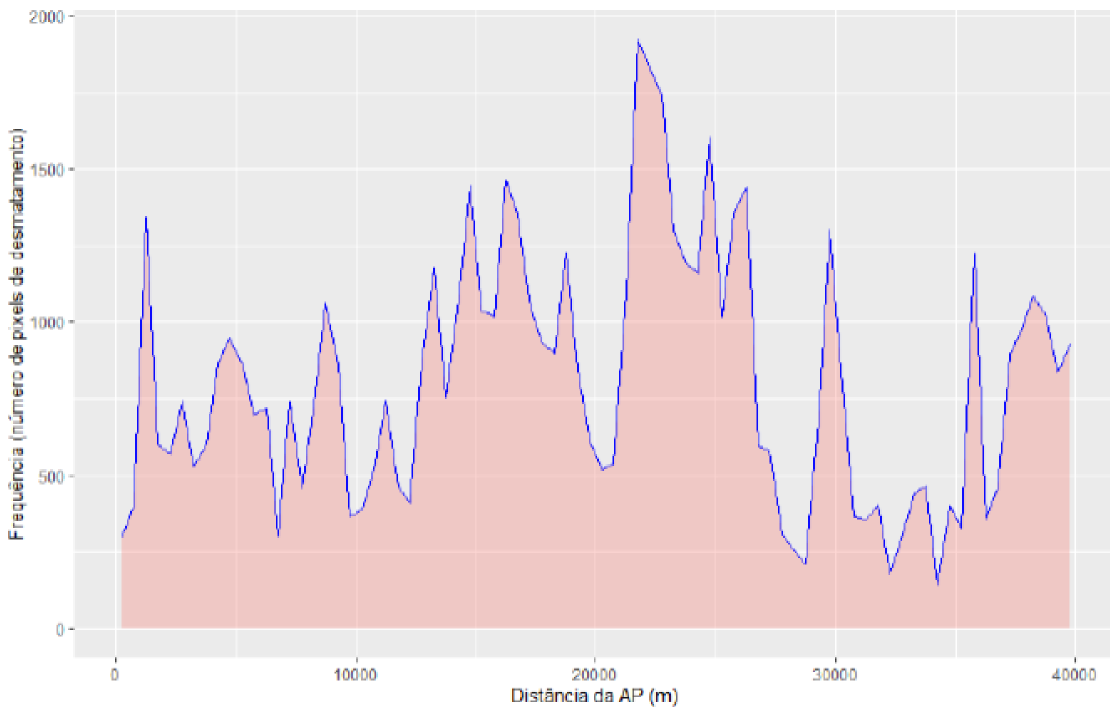

Figure 13. Distribution of deforestation pixels in the leakage belt, considering their distances from the Project Area

Therefore, observing the deforestation patterns in the Leakage Belt, the GIS analysis led to the conclusion that the deforestation in the south of the Leakage Belt is not associated with the project activity; and that there was no relation between the observed patterns of deforestation in the Leakage Belt with the present REDD project.

The map showing the cumulative deforestation during this monitoring period within the Reference Region, Project Area and Leakage Belt is illustrated in the Figure below.

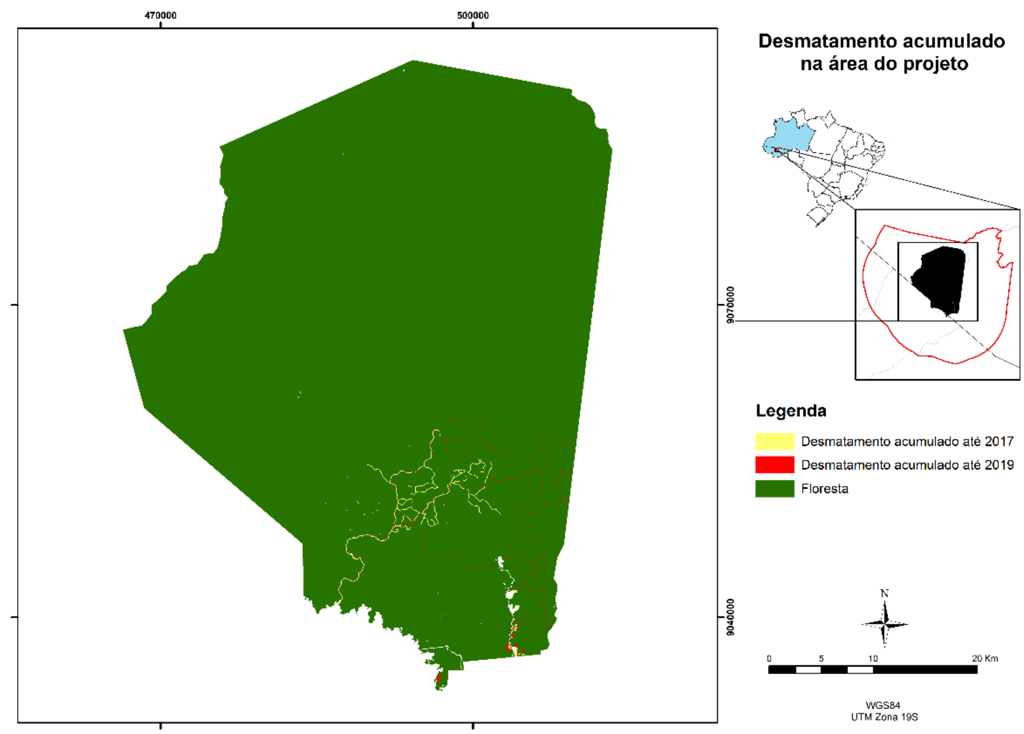

Figure 14. Cumulative deforestation from 2017 to 2019 in the Project Area

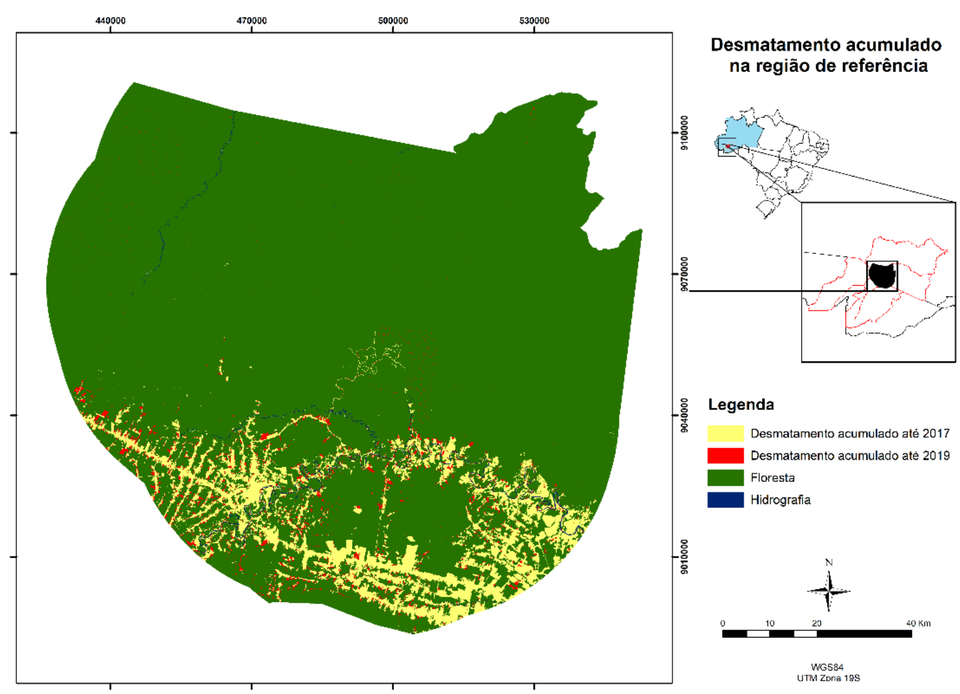

Figure 15. Cumulative deforestation from 2017 to 2019 in the Reference Region

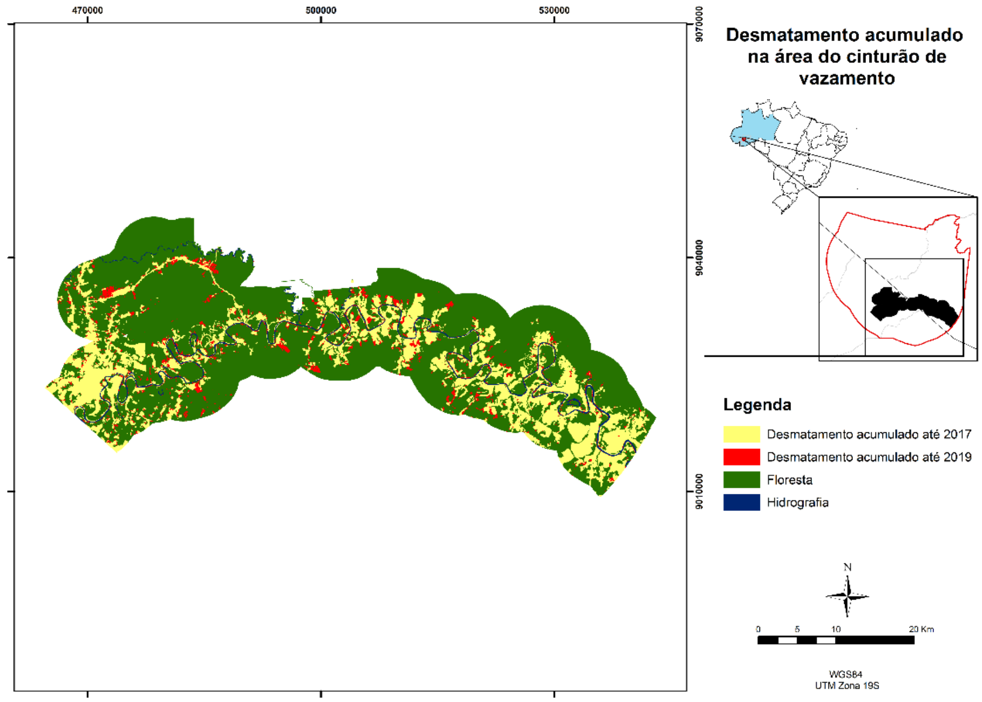

Figure 16. Cumulative deforestation from 2017 to 2019 in the Leakage Belt

Besides forest conservation, the present project aims to improve and quantify its social and environmental benefits through application of the SOCIALCARBON® Methodology, which is being carried out during this second monitoring period. This methodology is an innovative concept developed by the Ecológica Institute to measure the contribution of carbon projects to sustainability. The SOCIALCARBON® Methodology is based on six main indicators: Biodiversity; Natural; Financial; Human; Social and Carbon Resources and aims to deliver high-integrity benefits in each.

The annual deforestation values in the Reference Region, Project Area and Leakage Belt during the monitoring period (2017-2019) can be seen in the Tables 5 – 7 below.

Project year t	Stratum i in the reference region (ha)					Total (ha)	
	ABSLRR 1 Open tropical rainforest with bamboo	ABSLRR 2 Open tropical rainforest with palm trees	ABSLRR 3 open alluvial rainforest with palm trees	ABSLRR 4 Dense tropical rainforest	ABSLRR 5 Secondary Vegetation	annual $ABSLRR_t$	cumulative ABSLRR
2017	3,924.91	379.08	1,353.66	0.00	1,385.09	7,042.74	7,042.74
2018	2,780.62	673.87	669.65	0.00	259.82	4,383.96	11,426.70
2019	3,315.89	608.23	756.23	0.00	295.83	4,976.18	16,402.88

Table 5. Annual areas of deforestation in the reference region across the monitoring period

Project year t	Stratum i in the project area (ha)			Total (ha)	
	ABSLPA 1 Open tropical rainforest with bamboo	ABSLPA 2 Open tropicalrainforest with palm trees	ABSLPA 3 Open alluvial rainforest with palm trees	annual $ABSLPA_t$	cumulative ABSLPA
2017	132.55	0.00	1.54	134.09	134.09
2018	143.33	1.44	2.65	147.42	281.52
2019	70.27	6.37	1.48	78.12	359.64

Table 6. Annual areas of deforestation in the project area across the monitoring period

Project year t	Stratum i in the leakage belt (ha)				Total (ha)	
	ABSLLK 1 Open tropical rainforest with bamboo	ABSLLK 2 Open tropical rainforest with palm trees	ABSLLK 3 Open alluvial rainforest with palm trees	ABSLLK 4 Secondary Vegetation	annual $ABSLLK_t$	cumulative ABSLLK
2017	751.70	19.90	1,000.39	868.44	2,640.43	2,640.43
2018	769.60	17.38	536.01	134.05	1,457.04	4,097.47
2019	677.89	7.14	576.61	158.72	1,420.36	5,517.83

Table 7. Annual areas of deforestation in the leakage belt across the monitoring period

Furthermore, the number of hectares deforested in each forest class, within the reference region, project area and leakage belt are found in Tables 8 – 10 below.

Area deforested per florest class *icl* within the reference region						Total baseline deforestation in the reference region	
IDicl	1	2	3	4	5	annual ABSLRRt (ha)	ABSLRR cumulative (ha)
Name	Open Tropical Rainforest with bamboo	Open Tropical Rainforest with palm trees	Open Alluvial Rainforest with palm trees	Dense Tropical Rainforest	Secondary vegetation		

Project year *t*	ha	ha	ha	ha	ha		
2017	3,924.91	379.08	1,353.66	0.00	1,385.09	7,042.74	7,042.74
2018	2,780.62	673.87	669.65	0.00	259.82	4,383.96	11,426.70
2019	3,315.89	608.23	756.23	0.00	295.83	4,976.18	16,402.88

Table 8. Annual areas deforested per forest class icl within the reference region in the project case

Area deforested per florest class icl within the project area				Total baseline deforestation in the project area	
IDicl	1	2	3	annual ABSLPAt (ha)	ABSLPA cumulative (ha)
Name	Open Tropical Rainforest with bamboo	Open Tropical Rainforest with palm trees	Open Alluvial Rainforest with palm trees		
Project year *t*	ha	ha	ha		
2017	132.55	0.00	1.54	134.09	134.09
2018	143.33	1.44	2.65	147.42	281.52
2019	70.27	6.37	1.48	78.12	359.64

Table 9. Annual areas deforested per forest class icl within the project area in the project case

Leakage Belt						
Area deforested per florest class icl within the leakage belt					Total baseline deforestation in the leakage belt	
IDicl	1	2	3	5	annual ABSLLKt (ha)	ABSLLK cumulative (ha)
Name	Open Tropical Rainforest with bamboo	Open Tropical Rainforest with palm trees	Open Alluvial Rainforest with palm trees	Secondary vegetation		
Project year *t*	ha	ha	ha	ha		
2017	751.70	19.90	1,000.39	868.44	2,640.43	2,640.43
2018	769.60	17.38	536.01	134.05	1,457.04	4,097.47
2019	677.89	7.14	576.61	158.72	1,420.36	5,517.83

Table 10. Annual areas deforested per forest class icl within the leakage belt in the project case

In addition, Tables 11 – 13 depict activity data per post-deforestation forest class in the reference region, project area, and leakage belt, respectively.

Area established after deforestation per zone within the reference region		Total baseline deforestation in the reference region	
ID_{fcl}	1	$ABSLRR_t$	$ABSLRR$
Name	No forest	annual	cumulative
Project year	ha	ha	ha
2017	7,042.74	7,042.74	7,042.74
2018	4,383.96	4,383.96	11,426.70
2019	4,976.18	4,976.18	16,402.88

Table 11. Annual areas deforested in each zone within the reference region in the project case

Area established after deforestation per zone within the project area		Total baseline deforestation in the project area	
ID_{fcl}	1	$ABSLPA_t$	$ABSLPA$
Name	No forest	annual	cumulative
Project year	ha	ha	ha
2017	134.09	134.09	134.09
2018	147.42	147.42	281.52
2019	78.12	78.12	359.64

Table 12. Annual areas deforested in each zone within the project area in the project case

Area established after deforestation per zone within the leakage belt		Total baseline deforestation in the leakage belt	
ID_{fcl}	1	$ABSLLK_t$	$ABSLLK$
Name	Non forest	annual	cumulative
Project year	ha	ha	ha
2017	2,640.43	2,640.43	2,640.43
2018	1,457.04	1,457.04	4,097.47
2019	1,420.36	1,420.36	5,517.83

Table 13. Annual areas deforested in each zone within the leakage belt in the project case

Furthermore, data from the governmental fire monitoring program named *Queimadas*, from INPE[14] was carried out. Between 2017 and 2019, a total of 12,687 fire outbreaks were counted within the limits of the reference region, being: 29, in the project area; 3,808, in the leakage belt;

[14] Queimadas INPE website. Available at: < http://queimadas.dgi.inpe.br/queimadas/portal> Last visited on 18/06/2020

and 8,850, in the rest of the reference region. Therefore, the amount of fires within the project area was insignificant during the monitoring period.

3.2 Deviations

3.2.1 Methodology Deviations

Not applicable. The project has no methodology deviations.

3.2.2 Project Description Deviations

During the current monitoring period, some project description deviations were carried out. According to the applied methodology VM0015 v1.1: "the project area shall include only land qualifying as "forest" for a minimum of 10 years prior to the project start date." However, it was identified that the project area contained some hydrography areas, which were not excluded from the area qualified as forest for a minimum of 10 years prior to the project start date. Nevertheless, it is important to note that these hydrography areas were in fact excluded from the project area during the projection of future deforestation carried out in the VCS PD; and no deforestation occurred on hydrography areas during the first monitoring period. Thus, this situation did not impact baseline or project emissions, as the only modification was the size of the project area. Therefore, this deviation does not impact the applicability of the methodology, the additionality or the appropriateness of the baseline scenario.

Furthermore, it was also identified a little overlap between the project area and the leakage belt. The leakage belt delineation was corrected to exclude from it the project area limits. Similarly, this deviation does not impact the applicability of the methodology, the additionality or the appropriateness of the baseline scenario. The figure 16 below shows the land use map in 2014, detailing the overlap between the project area and the leakage belt.

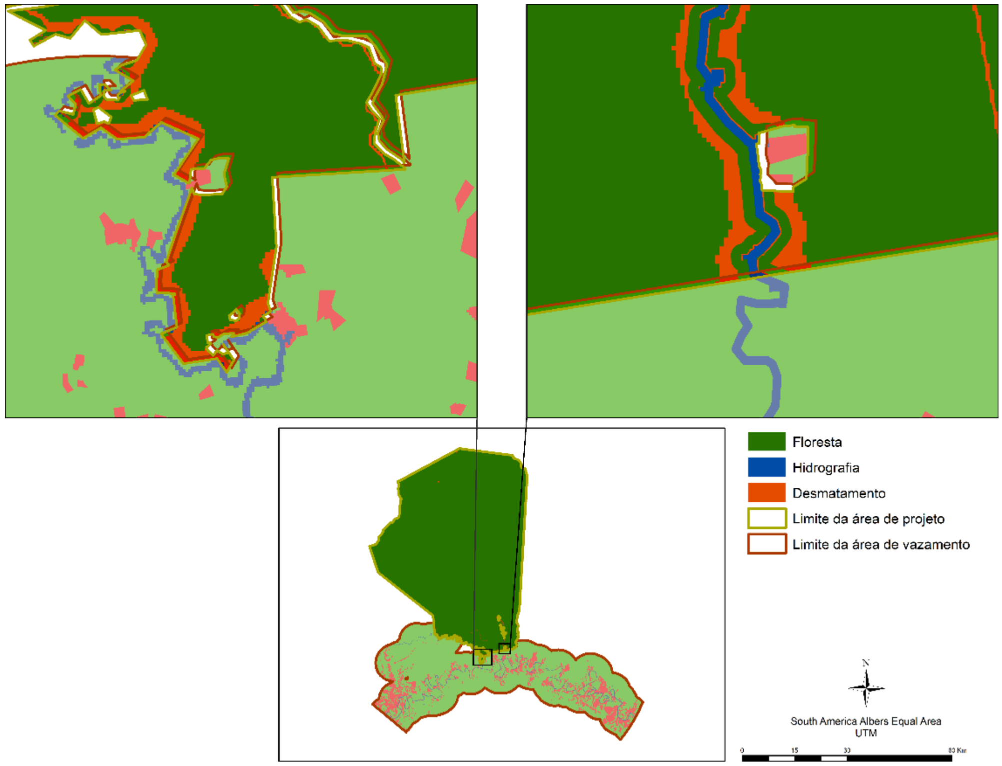

Figure 17 - Overlapping areas between the project area and the leakage belt in 2014. It is also possible to observe that there are hydrography areas within the project area

Therefore, the edition processes followed the procedures detailed below:

- Remove the hydrography areas from the project area (figure 18)
- Remove from the project area the overlapping areas with the leakage belt (figure 19)

Figure 18 – Project area editing

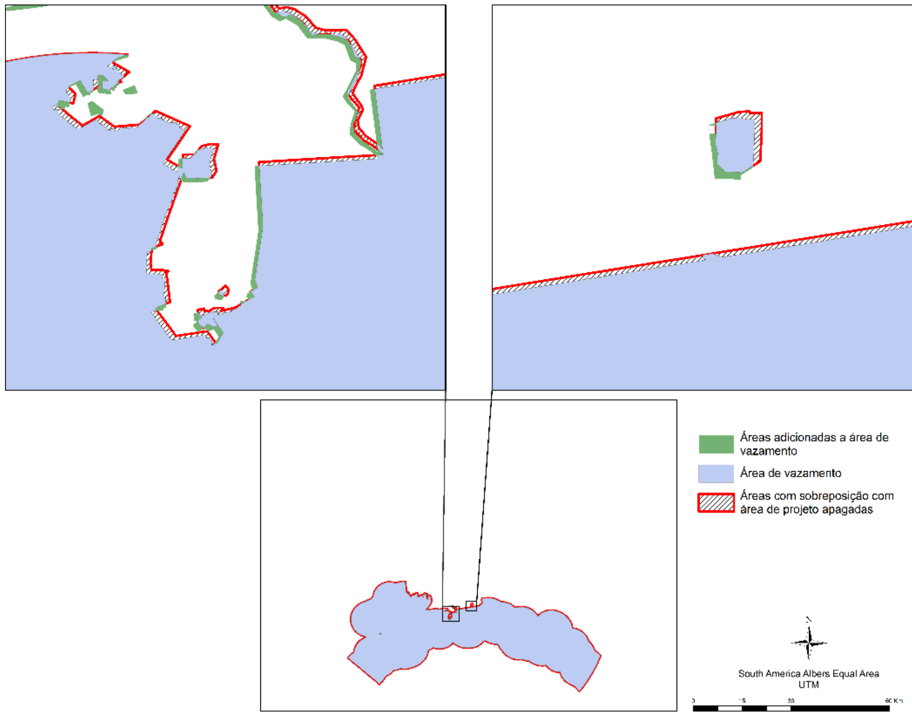

Figure 19– Leakage belt area editing

After these editions in the project area and the leakage belt the new area values were:

- Project area – 186,067.04 ha (instead of 186,219.05).
- Leakage belt area – 127,972.41 ha (instead of 128,115.48 ha)

In addition, land-use change analyses were made through MapBiomas images, which is a new platform that produces maps through a pixel-by-pixel classification from Landsat satellites images. The entire process is done with extensive machine learning algorithms through the Google Earth Engine system that offers more detailed, precise and available information.

The mapping of land use dynamics in the reference region was based on the mapping produced by MapBiomas[15], available in raster format.

MapBiomas is a multi-institutional initiative of the Emissions Estimation System Greenhouse Gases[16] promoted by the Climate Observatory. The co-MapBiomas creation involves NGOs, universities, and technology companies. In MapBiomas, the image classification methodology uses for each year, all Landsat images available in each period (Landsat 5 [L5], Landsat [L7] and Landsat [L8] with a cloud cover less than or equal 50%. Thus, a representative mosaic of each year is generated by selecting cloudless pixels from the available images. For each pixel, metrics are extracted that describe its behavior during the year and can contain up to 105 layers of information. with an artificial intelligence classifier, Random Forest. The acquisition of Landsat images is done via Google Earth Engine, with sources from NASA (American Space Agency) and USGS (US Geological Survey).

The algorithm uses samples obtained by reference maps, generation of stable collections from previous MapBiomas series and direct collection by visual interpretation of Landsat images to classify as a single map per class. This classification then goes through the stages of the spatial filter, applying neighbourhood rules and temporal filters, in particular changes in coverage and use that are impossible or not allowed, to reduce spatial and temporal inconsistencies.

MapBiomas presents a higher temporal frequency than the official data from Prodes, and thus is recommended as image reference for regions with high cloud cover throughout the whole year.

According to the applied methodology, if remotely sensed data have become available from new and higher resolution sources during a monitoring period, these can only be used if the images based on interpretation of the new data overlap the images based on interpretation of the old data by at least 1 year and they cross calibrate to acceptable levels. Therefore, in order to verify the consistency between the different image classification methodologies, two land use maps of the same year (2013) were compared, using the new MapBiomas classification, and the classification supervised by Maximum Likelihood, used during for the baseline projection. The maps were overlapped, and a confusion matrix was generated and calculated in order to quantify

[15] Mapbiomas website – Available at: <http://mapbiomas.org/>. Last visited on: 18/06/2020

[16] SEEG website. Available at: http://seeg.eco.br/en/ Last visited on 18/06/2020

the errors of omission and commission. The MapBiomas resulted in more precise and conservative values for deforestation. The values generated by the confusion matrix are showed below. It is possible to note that deforestation values for 2013 classified by Mapbiomas were more accurate and conservative than the old classification method.

		Maximum Likelihood classification – 2013 (ha)				
		Forest	Hydrography	Deforestation	Total	Accuracy
MapBiomas 2013 (ha)	Forest	1,038,717.13	1,486.85	10,438.87	1,050,642.85	98.86%
	Hydrography	218.60	2,523.08.90	620.53	3,362.21	75.04%
	Deforestation	7,425.09	299.52	47,403.64	55,128.25	85.99%
	Total	1,046,360.82	4,309.45	58,463.04	1,108,920.00	
	Accuracy	99.27%	58.55%	81.08%		

Table 14 – Compatibility of the classification of land use used in the last monitored period with the data used in this current monitoring period.

In addition, the VCS PD, in the Section 2.4 – Baseline Scenario, had a writing error in the description of the projection method for simulating deforestation. It is important to highlight that this writing error did not impact the applicability of the methodology, additionality or the appropriateness of the baseline scenario, because the calculations and projections of future deforestation were not impacted. Moreover, this section of the VCS PD was not enough detailed with all the steps carried out during the mapping analysis, and therefore, this is better summarized below.

In order to simulate the landscape, land use/ land cover (LU/LC) maps from the years 1999 to 2006 were used in the calibration phase. The confirmation year for the model calibration was 2013.

Furthermore, the factor maps used to create the deforestation risk map are presented below.

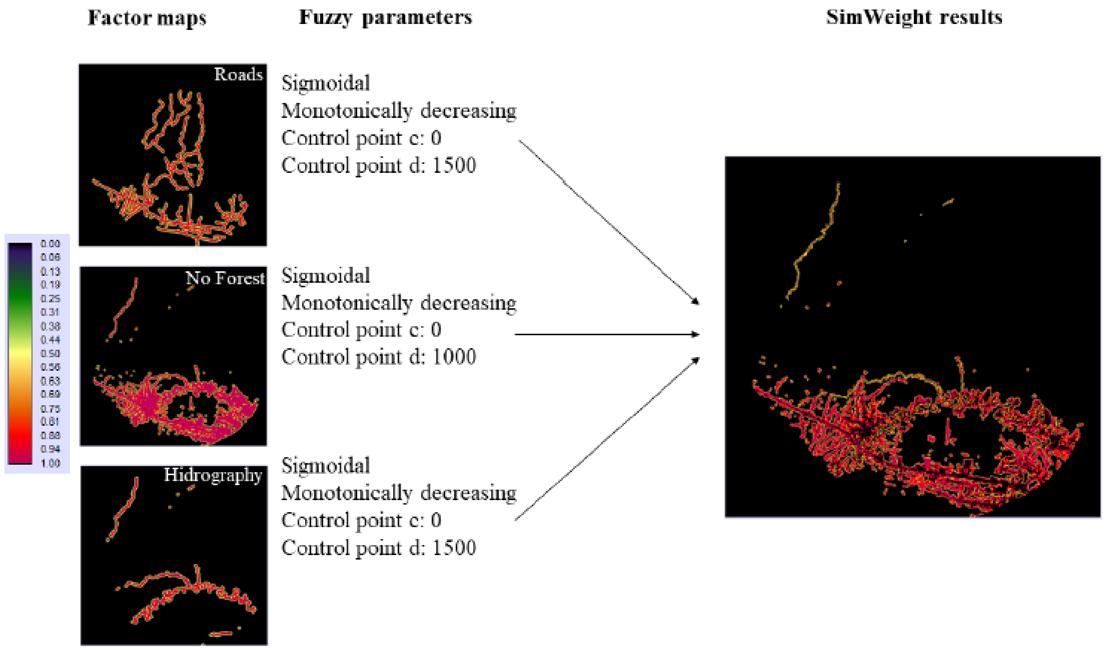

Figure 20. Factor maps utilized to create the deforestation risk map

Several risk maps models were produced for the selection of the most accurate deforestation risk map, based on different combinations of factor maps and modeling assumptions. A total of 10 different risk maps were created using different GIS methods, and the most accurate one – the Test 3 with a kappa index of 0.9672 – was selected to project the future deforestation in the baseline scenario. The tests are shown in the Table below. In addition, the kappa index achieved for the Test 3 was detailed in the Figure below.

Teste ID	Control point:	Factor maps				Kappa for 2013			Note
		C	R	H	NF	Markov chain + automates	LCM/MLP	LCM/SimW	
1	c		500	500	100	0.5325	-	-	MCE (Weight) - Roads (0.2583) / Hidrography (0.6370) / No Forest (0.1047)
	d		3000	3000	1000				
2	c	4000	0	0		0.5974	-	-	MCE (Weight) - Community (0.1047) / Roads (0.2583) / Hidrography (0.6370)
	d	8500	1500	1500					
3	c		0	0	0	-	0.8351	0.9672	Adiitonal LCM input: Elevation model
	d		1500	1500	1000				
4	c		0	0	0	-	0.8346	-	Aditional LCM input: Elevation model+Basis road
	d		1500	1500	1000				
5	c	4000	0	0	0	-	0.7796	-	Aditional LCM input: Elevation model+Basis road
	d	8500	1500	1500	1000				
6	c	0	0	0		-	0.7268	-	Aditional LCM input: Elevation model
	d	500	500	200					
7	c	0	0	0		-	0.9672	*	Aditional LCM input: Elevation model
	d	1000	500	500					
8	c	500	100	100		-	0.748	*	Aditional LCM input: Elevation model
	d	5000	1000	1000					
9	c	1000	500	500		-	0.7199	0.7015	Aditional LCM input: Elevation model
	d	5000	5000	5000					
10	c	1000	500	500		-	0.7191	0.7015	Aditional LCM input: Elevation model
	d	10000	5000	5000					

Table 25. Deforestation projection models tested for the project activity. Each line corresponds to a model and was evaluated by the Kappa index

Using 2013_new (columns) v.s. landcov_predict_2013 (rows)

(Created: 8/16/2020 11:22:31 PM)

Pixel Cross-tabulation

Category	1	2	Total
1	11590674	0	11590674
2	44511	697641	742152
Total	11635185	697641	12332826

Chi-square = 11548808.0000, df = 1, P-Level = 0.0000, Cramer's V = 0.9677

Proportional Cross-tabulation

Category	1	2	Total
1	0.9398	0.0000	0.9398
2	0.0036	0.0566	0.0602
Total	0.9434	0.0566	1.0000

Kappa Index of Agreement (KIA)

1) Using landcov_predict_2013 as the reference image

Category	KIA
1	1.0000
2	0.9364

2) Using 2013_new as the reference image

Category	KIA
1	0.9364
2	1.0000

Overall Kappa: 0.9672

Figure 21. Kappa index achieved for the Model 3, comparing the simulated scenario and the real one for the year of 2013, reaching an overall value of 0.9672

3.2.3 Grouped Projects

Not applicable. This is not a grouped project.

4 DATA AND PARAMETERS

4.1 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.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.html>).
Value applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	The default value was used.
Purpose of Data	This parameter was used to calculate the baseline, project and leakage emissions from deforestation occurred in the baseline and project scenarios. Provides an estimate of the carbon content of the vegetation biomass within the project reference region.
Comments	If new and more accurate carbon fraction data become available, these can be used to estimate the net anthropogenic GHG emission reduction of the subsequent fixed baseline period.

Data / Parameter	ab_{icl}
Data unit	Mg/ha
Description	Average biomass stock per hectare in the above-ground biomass pool of initial forest classes icl in Mg/ha
Source of data	Average values for the above-ground biomass were taken from the following study: SALIMON,C.I; PUTZ, F.E.; MENEZES-FILHO, L.; ANDERSON,A.; SILVEIRA, M.; FOSTER BROWN, I.; OLIVEIRA, L.C. Estimating state-wide biomass carbon stocks for a REDD plan in Acre, Brazil. 2011, **Forest Ecology and Management**, 262, p. 555–560, 2011.
Value applied	See table below

Above-ground biomass ab_{icl} (Mg/ha)			
Vegetation	Reference Region	Project Area	Leakage Belt
Open tropical rainforest with bamboo	257.82	274.20	291.73
Open tropical rainforest with palm trees	245.98	119.16	349.44

	Open alluvial rainforest with palm trees	218.50	193.83	243.17
	Dense tropical rainforest	323.88	-	-
	Secondary vegetation	37.00	-	53.45
Justification of choice of data or description of measurement methods and procedures applied	Following a literature search, the above-ground biomass values of this study was used as they were determined to accurately represent the values of the vegetation within the project reference region. In addition, the results from this study were also compared with Nogueira et al. (2008)[17] and Saatchi et al. (2007)[18], presenting very similar conclusions. The average biomass stock per hectare was calculated for each project boundary (reference region, project area and leakage belt) and for each vegetation group using weighted average, considering discounts for uncertainties.			
Purpose of Data	This parameter was used to calculate the baseline, project and leakage emissions from deforestation occurred in the baseline and project scenarios. Provides an average of the biomass stock per hectare in the above-ground biomass within the project reference region.			
Comments	If new and more accurate biomass stock data become available, these can be used to estimate the net anthropogenic GHG emission reduction of the subsequent fixed baseline period.			

Data / Parameter	bb_{icl}
Data unit	Mg/ha
Description	Average biomass stock per hectare in the below-ground biomass pool of initial forest classes icl in Mg/ha
Source of data	Average values for the below-ground biomass were taken from the applied methodology VM0015 v1.1, which estimates a root-to-shoot ratio of 0.24 for tropical rainforest having above ground biomass values above 125 tons/ha, and 0.20 for values below 125 tons/ha.

[17] NOGUEIRA, E. M. **Densidade de Madeira e Alometria de Árvores em Florestas do 'Arco do Desmatamento':** Implicações para Biomassa e Emissão de Carbono a partir de Mudanças de Uso da Terra na Amazônia Brasileira. 2008. 151 f. Doctor Thesis - Curso de Ciências de Florestas Tropicais, INPA, Manaus, 2008.

[18] SAATCHI, S.S.; HOUGHTON, R.A., ALVALÁ, R.C.S.; SOARES J.V.; YU, Y. Distribution of aboveground live biomass in the amazon basin. **Global Change Biology**, v.13, p. 816-837, 2007

Value applied	**Below-ground biomass** ***bb_{icl}*** **(Mg/ha)** **Vegetation** / **Reference Region** / **Project Area** / **Leakage Belt** Open tropical rainforest with bamboo / 61.88 / 65.81 / 70.01 Open tropical rainforest with palm trees / 59.04 / 28.60 / 83.87 Open alluvial rainforest with palm trees / 52.44 / 37.78 / 49.62 Dense tropical rainforest / 77.73 / - / - Secondary vegetation / 7.40 / - / 10.69
Justification of choice of data or description of measurement methods and procedures applied	Following a literature search, the below-ground biomass values of the applied methodology were used as they were determined to accurately represent the values of the vegetation within the project reference region. The average biomass stock per hectare was calculated for each project boundary (reference region, project area and leakage belt) and for each vegetation group using weighted average, considering discounts for uncertainties.
Purpose of Data	This parameter was used to calculate the baseline, project and leakage emissions from deforestation occurred in the baseline and project scenarios. Provides an average of the biomass stock per hectare in the below-ground biomass within the project reference region.
Comments	If new and more accurate biomass stock data become available, these can be used to estimate the net anthropogenic GHG emission reduction of the subsequent fixed baseline period.

Below-ground biomass bb_{icl} (Mg/ha)			
Vegetation	Reference Region	Project Area	Leakage Belt
Open tropical rainforest with bamboo	61.88	65.81	70.01
Open tropical rainforest with palm trees	59.04	28.60	83.87
Open alluvial rainforest with palm trees	52.44	37.78	49.62
Dense tropical rainforest	77.73	-	-
Secondary vegetation	7.40	-	10.69

Data / Parameter	***$Ctot_{fcl}$***
Data unit	tCO2e/ha
Description	Average carbon stock per hectare in anthropic areas in equilibrium of post-deforestation class fcl in tCO2e/ha

Source of data	Long-term average carbon stocks per hectare of post-deforestation LU/LC classes present in the reference region were taken from the following study: FEARNSIDE, Philip M. Amazonian deforestation and global warming: carbon stocks in vegetation replacing Brazil's Amazon forest. **Forest Ecology And Management,** Manaus, v. 80, p.21-34, 1996.
Value applied	46.93
Justification of choice of data or description of measurement methods and procedures applied	Fearnside (1996) is one of the most recognized studies for the Brazilian Amazon about long term carbon stocks in deforested areas.
Purpose of Data	This parameter was used to calculate the baseline emissions from deforestation occurred in the baseline scenario. Provides an average of the post-deforestation carbon stock per hectare within the project reference region.
Comments	If new and more accurate biomass stock data become available, these can be used to estimate the net anthropogenic GHG emission reduction of the subsequent fixed baseline period.

Data / Parameter	D_m
Data unit	g/cm³
Description	Mean wood density
Source of data	NOGUEIRA, E. M. **Densidade de Madeira e Alometria de Árvores em Florestas do 'Arco do Desmatamento'**: Implicações para Biomassa e Emissão de Carbono a partir de Mudanças de Uso da Terra na Amazônia Brasileira. 2008. 151 f. Doctor Thesis - Curso de Ciências de Florestas Tropicais, INPA, Manaus, 2008.
Value applied	0.583
Justification of choice of data or description of measurement methods and procedures applied	The mean wood density presented in Nogueira (2008) was obtained from southern and southwestern portions of the Brazilian Amazon, where the project region is located.
Purpose of Data	This parameter was used to calculate project emissions from logging activities occurred in the project scenario due to sustainable forest management. Carbon stock decrease due to planned logging activities were calculated through multiplying the harvested volume by the mean wood density. Carbon stock increase due to natural regeneration after periodical harvest cycle can be calculated through multiplying the mean annual increment by the mean wood density.

Comments	Nogueira (2008) defined wood density as "specific gravity" or "basic specific gravity '. This is the ratio between the dry mass and the volume of green wood. If new and more accurate wood density data become available, these can be used to estimate project emissions of the subsequent fixed baseline period.

<table>
<tr><td>Data / Parameter</td><td>D_j</td></tr>
<tr><td>Data unit</td><td>g/cm^3</td></tr>
<tr><td>Description</td><td>Mean wood density of species j</td></tr>
<tr><td>Source of data</td><td>SERVIÇO FLORESTAL BRASILEIRO. Fichas Tecnológicas das Madeiras da FLONA Jamari. Available at: <http://www.florestal.gov.br/documentos/concessoes-florestais/concessoes-florestais-florestas-sob-concessao/flona-do-jamari/edital/192-fichas-tecnologicas/file>. Last visit on: July 14th, 2017.
OLIVEIRA, Luiz Rogério. Plano de Manejo Florestal Sustentado 2ª Revisão - Consolidado: Fazenda Seringal Novo Macapá. Rio Branco: Batisflor Florestal Ltda, 2017. 225 p.</td></tr>
<tr><td>Value applied</td><td>
<table>
<tr><th colspan="3">Commercial Groups</th></tr>
<tr><td>Timber commercial Group</td><td>Characteristics</td><td>Average wood density (g/cm^3)</td></tr>
<tr><td>High density woods and Mahogany</td><td>High density woods, with the potential to become long-lived wood products</td><td>0.77</td></tr>
<tr><td>White woods</td><td>Low density woods, mainly destined for construction (short-lived wood products)</td><td>0.53</td></tr>
</table>
</td></tr>
<tr><td>Justification of choice of data or description of measurement methods and procedures applied</td><td>Agrocortex divides timber production in commercial groups, which have different rates of commercialization and wood densities. These groups were classified in two larger groups, based on their properties and characteristics.
The wood density presented by the cited study was obtained by the Brazilian Forest Service Forest Products Laboratory, which analyzed wood properties from different Brazilian Amazon species, where the project region is located.</td></tr>
</table>

Purpose of Data	This parameter was used to calculate project emissions due to harvested wood products carbon pool in the project scenario. Carbon stock per hectare of extracted biomass by class of wood product were calculated through multiplying the timber volume per product class by the wood density of species belonging to a specific class of wood products.
Comments	If new and more accurate wood density data become available, these can be used to estimate project emissions of the subsequent fixed baseline period.

Data / Parameter	*EI*
Data unit	%
Description	*Ex ante* estimated effectiveness index
Source of data	OLIVEIRA, Luiz Rogério. **Plano de Manejo Florestal Sustentado 2ª Revisão - Consolidado:** Fazenda Seringal Novo Macapá. Rio Branco: Batisflor Florestal Ltda, 2017. 225 p. Forest Stewardship Council (FSC) Certification for Forest Management (FSC-C121950) and Chain of Custody (FSC-C127203) for Agrocortex SFMP activities.
Value applied	95
Justification of choice of data or description of measurement methods and procedures applied	The calculation of the effectiveness index was estimated on the efficiency in reducing deforestation within the project area due to Agrocortex REDD Project activities.
Purpose of Data	This parameter was used to calculate project emissions in the baseline scenario. Provides an *ex ante* estimation of the carbon stock changes due to unavoidable unplanned deforestation within the project area, based on the effectiveness of the proposed project activities to reduce the deforestation.
Comments	*Ex post* monitoring of the project area shall be done to determine deforestation rate and the project emissions. This parameter will be updated at each renewal of fixed baseline period.

Data / Parameter	*DLF*
Data unit	%
Description	Displacement Leakage Factor
Source of data	OLIVEIRA, Luiz Rogério. **Plano de Manejo Florestal Sustentado 2ª Revisão - Consolidado:** Fazenda Seringal Novo Macapá. Rio Branco: Batisflor Florestal Ltda, 2017. 225 p.

	Forest Stewardship Council (FSC) Certification for Forest Management (FSC-C121950) and Chain of Custody (FSC-C127203) for Agrocortex SFMP activities. SOCIALCARBON Indicators for REDD+SFMP Projects
Value applied	5
Justification of choice of data or description of measurement methods and procedures applied	The *DLF* was estimated as 5%, which is considered as a conservative estimate based on the referenced literature and taking into account the project situation, where Agrocortex SFMP+FSC+REDD+SOCIALCARBON project activities are estimated to benefit a large part of the population in the region.
Purpose of Data	This parameter was used to calculate leakage emissions in the baseline scenario due to activity displacement leakage, providing an *ex ante* estimation of the decrease in carbon stocks and increase in GHG emissions. This value was calculated based on the percent of deforestation expected to be displaced outside the project boundary due to the implementation of the AUD project activity.
Comments	*Ex post* monitoring of the leakage belt shall be done to determine deforestation rate outside the project area and consequently, the leakage emissions and carbon stock decrease. This parameter will be updated at each renewal of fixed baseline period.

Data / Parameter	$EBBBSLPA_t$
Data unit	tCO_2e
Description	Sum of (or total) baseline non-CO_2 emissions from forest fire at year *t* in the project area
Source of data	- Remote sensing data and GIS; - Supervisor information.
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	If forest fires occur, these non-CO_2 emissions will be subject to monitoring and accounting, when significant.
Purpose of Data	This parameter was used to calculate *non-CO_2* emissions due to forest fires within the project area in the baseline scenario, providing an *ex ante* estimation.
Comments	Non-CO_2 emissions from fires used to clear forests in the baseline scenario were omitted in this project. Therefore, $EBBBSLPA_t$ equals to zero.

	Ex post monitoring of forest fires and *non-CO_2 emissions* shall be done to determine GHG emissions within the project area (when the forest fire is significant). This parameter will be updated at each renewal of fixed baseline period.

Data / Parameter	$\Delta CBSLLK_t$
Data unit	tCO_2e
Description	Annual carbon stock changes in leakage management areas in the baseline case at year *t*
Source of data	- Planned interventions proposed by Agrocortex REDD Project; - Remote sensing and GIS
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	Leakage prevention activities generating a decrease in carbon stocks should be estimated *ex ante* and accounted. The leakage prevention measures proposed by the present project do not include decrease in carbon stocks due to activities implemented in the leakage management area.
Purpose of Data	This parameter was used to calculate leakage emissions in the baseline scenario due to leakage prevention measures. It provides an *ex ante* estimation of the decrease in carbon stocks due to the activities implemented in the leakage management area.
Comments	*Ex post* monitoring of the leakage management area shall be done to determine the carbon stock decrease and the leakage emissions. This parameter will be updated at each renewal of fixed baseline period.

4.2 Data and Parameters Monitored

Data / Parameter	$ACPA_{icl,t}$
Data unit	Hectare
Description	Annual area of initial forest classes *icl* within the Project Area affected by catastrophic events at year *t*
Source of data	- Remote sensing data and GIS, - Agrocortex management team and other field data.

Description of measurement methods and procedures to be applied	In addition to remote sensing data and GIS, which can identify the area affected by catastrophic events, the measurement of this parameter was also based in the below national database: - INMET[19] - INPE[20] Moreover, periodic reports from local Agrocortex management team, also confirmed the data obtained from remote sensing and GIS measurement.
Frequency of monitoring/recording	At each time a significant catastrophic event occurs
Value monitored	0 (no significant catastrophic event occurred)
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing and GIS. Furthermore, the following sources were also monitored to confirm the data obtained from remote sensing and GIS: - INMET - INPE Periodic reports from Agrocortex management team
Purpose of the data	This parameter was used to calculate project emissions in the project scenario. Provides an *ex post* estimation of initial forest classes (*icl*) areas affected by catastrophic events within the project area.
Calculation method	Remote sensing and GIS
Comments	Decreases in carbon stocks and increases in GHG emissions (e.g. in case of forest fires) due to natural disturbances (such as hurricanes, earthquakes, volcanic eruptions, tsunamis, flooding, drought, fires, tornados or winter storms) or man-made events, including those over which the project proponent has no control (such as acts of terrorism or war), are subject to monitoring and must be accounted under the project scenario, when significant.

Data / Parameter	$AUFPA_{icl,t}$
Data unit	Hectare

[19] INMET. National Meteorology Institute. Automatic Station – Graphics. Available at: <http://www.inmet.gov.br/portal/index.php?r=home/page&page=rede_estacoes_auto_graf>. Last visit on: May 29th, 2017.

[20] INPE. Brazilian National Space Research Institute catalogue. Available at: < http://www.inpe.br/queimadas/risco-de-fogo-meteorologia >. Last visit on: May 29th, 2017.

<table>
<tr><td>Description</td><td>Annual area of initial forest classes icl within the Project Area affected by forest fires at year t</td></tr>
<tr><td>Source of data</td><td>- Remote sensing data and GIS,
- Supervisor information and other field data.</td></tr>
<tr><td>Description of measurement methods and procedures to be applied</td><td>In addition to remote sensing data and GIS, which can identify the area affected by forest fires, the measurement of this parameter was also based in the below national database:
- INMET[21]
- INPE[22]

Moreover, periodic reports from local Agrocortex management team also confirmed the data obtained from remote sensing and GIS measurement.</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>Annually</td></tr>
<tr><td>Value monitored</td><td>
<table>
<tr><th>Year</th><th>Open Tropical Rainforest with bamboo</th><th>Open Tropical Rainforest with palm trees</th><th>Open Alluvial Rainforest with palm trees</th></tr>
<tr><td>2017</td><td>22.33</td><td>0.00</td><td>1.54</td></tr>
<tr><td>2018</td><td>20.69</td><td>1.44</td><td>2.65</td></tr>
<tr><td>2019</td><td>10.93</td><td>6.37</td><td>1.48</td></tr>
<tr><td>Total</td><td>53.95</td><td>7.81</td><td>5.67</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>Remote sensing and GIS</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>Best practices in remote sensing and GIS. Furthermore, the following sources were also monitored to confirm the data obtained from remote sensing and GIS:
- INMET
- INPE

Periodic reports from Agrocortex management team</td></tr>
<tr><td>Purpose of the data</td><td>This parameter was used to calculate project emissions in the project scenario. Provides an ex post estimation of initial forest classes (icl) areas affected by forest fires within the project area.</td></tr>
</table>

[21] INMET. National Meteorology Institute. Automatic Station – Graphics. Available at: <http://www.inmet.gov.br/portal/index.php?r=home/page&page=rede_estacoes_auto_graf>. Last visit on: May 29th, 2017.

[22] INPE. Brazilian National Space Research Institute catalogue. Available at: < http://www.inpe.br/queimadas/risco-de-fogo-meteorologia >. Last visit on: May, 29, 2017.

Calculation method	Remote sensing and GIS
Comments	Decreases in carbon stocks and increases in GHG emissions (e.g. in case of forest fires) due to natural disturbances (such as hurricanes, earthquakes, volcanic eruptions, tsunamis, flooding, drought, fires, tornados or winter storms) or man-made events, including those over which the project proponent has no control (such as acts of terrorism or war), are subject to monitoring and must be accounted under the project scenario, when significant. No forest fire was used by Agrocortex for conducting planned deforestation or timber harvesting activities. However, there were around 67.43 ha of unplanned deforestation within the project area during the monitored period, which conversion of forest to non-forest may have involved fires. The effect of fire on carbon emissions is counted in the estimation of carbon stock changes in the parameter $\Delta CUDdPA_t$; therefore CO_2 emissions from forest fires were ignored to avoid double counting. However, non-CO_2 emissions (CH_4 and N_2O) from forest fires must be counted in the project scenario, when they are significant. In order to be conservative, it was assumed that all unplanned deforestation within the project area involved fire. Therefore, non-CO_2 emissions from forest fires were quantified and deducted from emission reductions

Data / Parameter	$ABSLLK_{icl,t}$
Data unit	Hectare
Description	Annual area of deforestation of initial forest classes *icl* within the leakage belt at year *t*
Source of data	Remote sensing and GIS.
Description of measurement methods and procedures to be applied	Deforestation in the leakage belt area can be considered activity displacement leakage. Activity data for the leakage belt area was determined using the same methods applied to monitoring deforestation activity data in the project area.
Frequency of monitoring/recording	Annually
Value monitored	Annual average deforestation in the leakage belt during the monitoring period per forest class, in hectares:

Year	Open Tropical Rainforest	Open Tropical Rainforest	Open Alluvial Rainforest	Secondary vegetation

		with bamboo	with palm trees	with palm trees	
	2017	751.70	19.90	1,000.39	868.44
	2018	769.60	17.38	536.01	134.05
	2019	677.89	7.14	576.61	134.05
	Total	2,199.19	44.42	2,113.01	1,161.21
Monitoring equipment	Remote sensing and GIS				
QA/QC procedures to be applied	Best practices in remote sensing.				
Purpose of the data	This parameter was used to calculate leakage emissions in the project scenario. Provides the *ex post* value of the deforested area within the leakage belt.				
Calculation method	Analysis of satellite images and maps.				
Comments	Where evidence can be collected that deforestation in the leakage belt is attributable to deforestation agents that are not linked to the project area, the detected deforestation may not be attributed to the project activity and therefore, not considered leakage.				

Data / Parameter	$ABSLPA_{icl,t}$
Data unit	Hectare
Description	Annual area of deforestation of initial forest classes *icl* in the project area at year *t*
Source of data	- Field reports; - Annual post-harvesting report; - Remote sensing and GIS.
Description of measurement methods and procedures to be applied	Forest cover change due to deforestation was monitored through assessment of classified satellite imagery covering the project area.
Frequency of monitoring/recording	Annually
Value monitored	Annual average deforestation in the project area during the monitoring period per forest class, in hectares:

	<table><tr><th>Year</th><th>Open Tropical Rainforest with bamboo</th><th>Open Tropical Rainforest with palm trees</th><th>Open Alluvial Rainforest with palm trees</th></tr><tr><td>2017</td><td>132.55</td><td>0.00</td><td>1.54</td></tr><tr><td>2018</td><td>143.33</td><td>1.44</td><td>2.65</td></tr><tr><td>2019</td><td>70.27</td><td>6.37</td><td>1.48</td></tr><tr><td>Total</td><td>346.16</td><td>7.81</td><td>5.67</td></tr></table>
Monitoring equipment	Remote sensing and GIS.
QA/QC procedures to be applied	Best practices in remote sensing.
Purpose of the data	This parameter was used to calculate baseline emissions and project emissions in the project scenario. Provides the *ex post* value of the deforested area per forest class within the project area.
Calculation method	Analysis of satellite images and maps.
Comments	N/A

Data / Parameter	$ABSLRR_{icl,t}$
Data unit	Hectare
Description	Annual area of deforestation of initial forest classes *icl* in the reference region at year *t*
Source of data	Remote sensing and GIS.
Description of measurement methods and procedures to be applied	Forest cover change due to deforestation was monitored through assessment of classified satellite imagery covering the project area.
Frequency of monitoring/recording	Annually
Value monitored	Annual average deforestation in the reference region during the monitoring period per forest class, in hectares: <table><tr><th>Year</th><th>Open Tropical Rainforest</th><th>Open Tropical Rainforest</th><th>Open Alluvial Rainforest</th><th>Dense Tropical Rainforest</th><th>Secondary Vegetation</th></tr></table>

	with bamboo	with palm trees	with palm trees		
2017	3,924.91	379.08	1,353.66	0.00	1,385.09
2018	2,780.62	673.87	669.65	0.00	259.82
2019	3,315.89	608.23	756.23	0.00	295.83
Total	10,021.42	1,661.18	2,779.54	0.00	1,940.74

Monitoring equipment	Remote sensing and GIS.
QA/QC procedures to be applied	Best practices in remote sensing.
Purpose of the data	This parameter was used to calculate baseline emissions in the project scenario. Provides the *ex post* value of the deforested area per forest class within the reference region.
Calculation method	Analysis of satellite images and maps.
Comments	N/A

Data / Parameter	$APDPA_{icl,t}$
Data unit	Hectare
Description	Areas of planned deforestation in forest class *icl* at year *t* in the project area
Source of data	- Annual operational plan; - Annual post-harvesting report; - Remote sensing and GIS.
Description of measurement methods and procedures to be applied	The planned deforestation activities in the project area that resulted in carbon stock decrease were subject to monitoring. Agrocortex management team records such information according to procedures established in its sustainable forest management plan.
Frequency of monitoring/recording	Annually
Value monitored	

Year	Open Tropical Rainforest with bamboo	Open Tropical Rainforest with palm trees	Open Alluvial Rainforest with palm trees
2017	110.22	0.00	0.00

	2018	122.64	0.00	0.00
	2019	59.34	0.00	0.00
	Total	292.21	0.00	0.00

Monitoring equipment	- Remote sensing and GIS - Agrocortex Management team, based on the Sustainable Forest Management Plan for Fazenda Seringal Novo Macapá
QA/QC procedures to be applied	Best practices in remote sensing. Internal audit of the SFMP.
Purpose of the data	This parameter was used to calculate project emissions in the project scenario. Provides the *ex post* value of the decrease in carbon stocks due to planned deforestation in the project area.
Calculation method	Emissions from deforestation at each forest class are quantified by multiplying the detected area of forest loss by the average forest carbon stock per unit area.
Comments	Values above represent the annual planned deforestation per forest class during this monitoring period. Planned deforestation mainly includes implementation of the forest management infrastructure, such as opening of main and secondary roads, skidding trails, and timber yards in each annual production unit within the project area.

Data / Parameter	$APLPA_{icl,t}$
Data unit	Hectare
Description	Areas of planned logging activities in forest class *icl* at year *t* in the project area
Source of data	- Annual operational plan; - Annual post-harvesting report; - Remote sensing and GIS.
Description of measurement methods and procedures to be applied	The planned logging activities in the project area that resulted in carbon stock increase or decrease shall be subjected to monitoring, when significant.
Frequency of monitoring/recording	Annually

<table>
<tr><td>Value monitored</td><td>
<table>
<tr><th>Year</th><th>Open Tropical Rainforest with bamboo</th><th>Open Tropical Rainforest with palm trees</th><th>Open Alluvial Rainforest with palm trees</th></tr>
<tr><td>2017</td><td>4,513.78</td><td>0.00</td><td>0.00</td></tr>
<tr><td>2018</td><td>7,452.42</td><td>0.00</td><td>0.00</td></tr>
<tr><td>2019</td><td>4,839.93</td><td>0.00</td><td>0.00</td></tr>
<tr><td>Total</td><td>16,806.13</td><td>0.00</td><td>0.00</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>- Remote sensing and GIS
- Agrocortex Management team, based on the Sustainable Forest Management Plan for Fazenda Seringal Novo Macapá</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>Best practices in remote sensing.

Internal audit of the SFMP.</td></tr>
<tr><td>Purpose of the data</td><td>This parameter was used to calculate project emissions in the project scenario. Provides the ex post value of the increase or decrease in carbon stocks due to planned logging activities in the project area.</td></tr>
<tr><td>Calculation method</td><td>Carbon stock decrease from planned logging activities at each forest class are quantified by multiplying the detected area subject to logging by the harvested timber volume intensity, and then by the mean wood density.

Carbon stock increase from planned logging activities at each forest class are quantified by multiplying the detected area subject to logging by the mean annual increment due to natural regeneration of managed forests, and then by the mean wood density.</td></tr>
<tr><td>Comments</td><td>According to the sustainable forest management plan[23], 175,707.55 ha are subject to sustainable forest management plan (SFMP). The adopted rotation cycle is 30 years, thus each annual productive unit (APU) has around 5,856.92 hectares.

The SFMP provides guidance to Agrocortex management team in order to harvest forest products/by-products in a manner consistent with the conservation of the local ecosystem.</td></tr>
</table>

Data / Parameter	$APFPA_{icl,t}$

[23] OLIVEIRA, Luiz Rogério. **Plano de Manejo Florestal Sustentado 2ª Revisão - Consolidado:** Fazenda Seringal Novo Macapá. Rio Branco: Batisflor Florestal Ltda, 2017. 225 p.

Data unit	Hectare
Description	Areas of planned fuel-wood collection and charcoal production activities in forest class *icl* at year *t* in the project area
Source of data	- Annual operational plan; - Annual post-harvesting report; - Remote sensing and GIS; - Other SFMP documents.
Description of measurement methods and procedures to be applied	No production of fuel wood or charcoal occurred within the project area during this monitoring period.
Frequency of monitoring/recording	Annually
Value monitored	0 (no production of fuel wood or charcoal occurred)
Monitoring equipment	- Remote sensing and GIS - Planned interventions proposed by Agrocortex REDD Project
QA/QC procedures to be applied	Best practices in remote sensing. Internal audit of the SFMP.
Purpose of the data	This parameter was used to calculate project emissions in the project scenario. Provides the *ex post* value of the increase or decrease in carbon stocks due to planned fuel-wood collection and charcoal production activities in the project area.
Calculation method	Emissions at each forest class are quantified by multiplying the detected area subject to fuel wood collection or charcoal production by the harvested volume intensity, and then by the mean wood density.
Comments	N/A

Data / Parameter	$\Delta CPAdPA_t$
Data unit	tCO_2e
Description	Total decrease in carbon stock due to all planned activities at year *t* in the project area
Source of data	- Annual operational plan; - Annual post-harvesting report; - Remote sensing and GIS; - Other SFMP documents.

Description of measurement methods and procedures to be applied	The planned activities in the project area that resulted in carbon stock decrease shall be subjected to monitoring, when significant.
Frequency of monitoring/recording	Annually
Value monitored	<table><tr><th>Year</th><th>$\Delta CPAdPA_t$ (tCO_2e)</th></tr><tr><td>2017</td><td>207,449.57</td></tr><tr><td>2018</td><td>175,779.90</td></tr><tr><td>2019</td><td>106,019.30</td></tr><tr><td>Total</td><td>489,248.77</td></tr></table>
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing. Internal audit of the SFMP.
Purpose of the data	This parameter was used to calculate project emissions in the project scenario. Provides the *ex post* value of the decrease in carbon stocks due to planned activities in the project area.
Calculation method	This parameter is the sum of: carbon stock decrease due to planned deforestation, carbon stock decrease due to planned logging activities, and carbon stock decrease due to planned fuel-wood and charcoal activities.
Comments	No production of fuel wood or charcoal occurred within the project area during this monitoring period. Value above represents the annual decrease in carbon stocks due to all planned activities within the project area.

Data / Parameter	$\Delta CPAiPA_t$
Data unit	tCO_2e
Description	Total increase in carbon stock due to all planned activities at year *t* in the project area
Source of data	- Annual operational plan; - Annual post-harvesting report; - Remote sensing and GIS; - Permanent plots monitoring reports; - Other SFMP related documents.
Description of measurement methods	The planned activities in the project area that resulted in carbon stock increase shall be subjected to monitoring, when significant.

and procedures to be applied	
Frequency of monitoring/recording	Annually
Value monitored	<table><tr><th>Year</th><th>ΔCPAiPA$_t$ (tCO_2e)</th></tr><tr><td>2017</td><td>15,192.24</td></tr><tr><td>2018</td><td>19,341.29</td></tr><tr><td>2019</td><td>26,191.53</td></tr><tr><td>Total</td><td>60,725.06</td></tr></table>
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing. Internal audit of the SFMP.
Purpose of the data	This parameter was used to calculate project emissions in the project scenario. Provides the *ex post* value of the increase in carbon stocks due to planned activities in the project area, which could reduce the decrease in carbon stocks in the project area.
Calculation method	Carbon stock increase from planned logging activities at each forest class are quantified by multiplying the detected area subject to logging by the mean annual increment due to natural regeneration of managed forests, and then by the mean wood density. Due to the periodical harvesting, the projected increase in carbon stocks of each forest class in the project scenario is estimated by assuming that the maximum carbon stock is the long term average carbon stock (the average of a production cycle). Therefore, once a class reaches this level of carbon stock, no more carbon stock increase can be attributed to it.
Comments	No production of fuel wood or charcoal occurred within the project area during this monitoring period. In addition, there are no secondary forests or degraded forests within the project area that have the potential to grow and accumulate significant carbon stocks. A sustainable forest management plan (SFMP) was developed for the Project Area, which has been carried out by Agrocortex management team since 2014. Forests that will be subject to planned logging activities under the project scenario have the potential to grow and accumulate significant carbon stocks after the periodical harvest cycle due to natural regeneration.

	Value above represents the annual increase in carbon stocks due to all planned activities within the project area.

Data / Parameter	$\Delta CADLK_t$
Data unit	tCO_2e
Description	Total decrease in carbon stocks due to displaced deforestation at year *t*
Source of data	Remote sensing and GIS.
Description of measurement methods and procedures to be applied	Deforestation in the leakage belt area can 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 monitored	Year / $\Delta CADLK_t$ (tCO_2e): 2017 – 0.00; 2018 – 0.00; 2019 – 0.00; Total – 0.00
Monitoring equipment	Remote sensing and GIS.
QA/QC procedures to be applied	Best practices in remote sensing.
Purpose of the data	This parameter was used to calculate leakage emissions in the project scenario. Provides the *ex post* value of the decrease in carbon stocks due to displaced deforestation in the leakage belt.
Calculation method	Emissions from deforestation at each forest class are quantified by multiplying the detected area of forest loss by the average forest carbon stock per unit area.
Comments	Where evidence can be collected that deforestation in the leakage belt is attributable to deforestation agents that are not linked to the project area, the detected deforestation may not be attributed to the project activity and therefore, not considered leakage. The GIS analysis conducted during this monitoring period led to the conclusion that the increase in deforestation in the south of the Reference Region in 2017 was not associated with the project activity; and that there was no relation between the

Value monitored:

Year	$\Delta CADLK_t$ (tCO_2e)
2017	0.00
2018	0.00
2019	0.00
Total	0.00

	observed patterns of deforestation in the Leakage Belt with the present REDD project.

Data / Parameter	*ΔCPSLK$_t$*
Data unit	tCO_2e
Description	Annual carbon stock change in leakage management areas in the project case at year *t*
Source of data	- Activities report related to leakage prevention measures proposed by Agrocortex REDD Project; - SOCIALCARBON Reports; - Field assessment; Remote sensing and GIS
Description of measurement methods and procedures to be applied	The planned activities in leakage management areas that resulted in carbon stock decrease shall be subjected to monitoring, when significant.
Frequency of monitoring/recording	Annually
Value monitored	(see table below)
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing. FSC annual reports.
Purpose of the data	This parameter was used to calculate leakage emissions in the project scenario. Provides the *ex post* value of the change in carbon stocks due to leakage prevention measures in the leakage management area.
Calculation method	Emissions from deforestation are quantified by multiplying the detected area of forest loss by the average forest carbon stock per unit area.

Value monitored:

Project year	Carbon stock changes in leakage management area in the project case			
	ID_{fcl}	1	annual	cumulative
	APSLKfcl,t	$Ctot_{fcl,t}$	ΔCPSLKt	ΔCPSLK
	ha	tCO_2e/ha	tCO_2e	tCO_2e
2017	8.33	55.00	458.15	458.15
2018	7.54	73.33	552.93	1,011.08
2019	11.52	91.67	1,056.00	2,067.08

Comments	Leakage prevention measures proposed by the present project do not include decrease in carbon stocks due to activities implemented in the leakage management area.

Data / Parameter	*$\Delta CUDdPA_t$*
Data unit	tCO_2e
Description	Total actual carbon stock change due to unavoided unplanned deforestation at year *t* in the project area
Source of data	- Remote sensing and GIS - Supervisor reports.
Description of measurement methods and procedures to be applied	Forest cover change due to unplanned deforestation was monitored through assessment of classified satellite imagery covering the project area.
Frequency of monitoring/recording	Annually
Value monitored	(see table below)
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing.
Purpose of the data	This parameter was used to calculate project emissions in the project scenario. Provides the *ex post* value of the change in carbon stocks due to unavoided unplanned deforestation within the project area.
Calculation method	Emissions from deforestation at each forest class are quantified by multiplying the detected area of forest loss by the average forest carbon stock per unit area.
Comments	N/A

Value monitored:

Year	$\Delta CUDdPA_t$ (tCO_2e)
2017	14,746.01
2018	15,463.47
2019	12,667.92
Total	42,877.40

Data / Parameter	*$EBBPSPA_t$*
Data unit	tCO_2e

Description	Sum of (or total) actual non-CO_2 emissions from forest fire at year *t* in the project area
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-CO_2 emissions are subjected to monitoring and accounting, when significant. In addition to remote sensing data and GIS, which can identify the area affected by forest fire, periodic reports from area supervisors, who live inside the project area, confirmed the data obtained.
Frequency of monitoring/recording	Annually
Value monitored	<table><tr><th>Year</th><th>$EBBPSPA_t$ (tCO_2e)</th></tr><tr><td>2017</td><td>678.64</td></tr><tr><td>2018</td><td>746.12</td></tr><tr><td>2019</td><td>395.38</td></tr><tr><td>Total</td><td>1,820.14</td></tr></table>
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing and GIS.
Purpose of the data	This parameter was used to calculate *non-CO_2* emissions due to forest fires within the project area in the project scenario, providing an *ex post* project emissions value.
Calculation method	If forest fires occur, these non-CO_2 emissions will be subject to monitoring and accounting, when significant.
Comments	No forest fire was used by Agrocortex for carrying out planned deforestation or timber harvesting activities. However, there were around 67.43 ha of unplanned deforestation within the project area during the monitored period, which conversion of forest to non-forest could have involved fires. It was conservatively assumed that all unplanned deforestation within the project area involved fire and all above ground biomass was burnt. Therefore, non-CO_2 emissions from forest fires were quantified and deducted from emission reductions.

Data / Parameter	$EgLK_t$
Data unit	tCO_2e

Description	Emissions from grazing animals in leakage management areas at year *t*.
Source of data	- Activities report related to leakage prevention measures proposed by Agrocortex REDD Project; - SOCIALCARBON Reports; - Field assessment; - Remote sensing data and GIS.
Description of measurement methods and procedures to be applied	GHG emissions from grazing animals in leakage management areas (i.e. enteric fermentation or manure management) were subjected to monitoring, when significant.
Frequency of monitoring/recording	Annually
Value monitored	<table><tr><th>Year</th><th>$EgLK_t$ (tCO_2e)</th></tr><tr><td>2017</td><td>830.87</td></tr><tr><td>2018</td><td>830.87</td></tr><tr><td>2019</td><td>830.87</td></tr><tr><td>Total</td><td>2,492.62</td></tr></table>
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing and GIS. Field assessment data FSC annual reports.
Purpose of the data	This parameter was used to calculate GHG leakage emissions from activities implemented in the leakage management area in the project scenario, providing an *ex post* value.
Calculation method	Described in the methodology (VM0015, v1.1), section 8.1.2: *Ex ante* estimation of CH_4 and N_2O emissions from grazing animals.
Comments	Activities from grazing animals that resulted in GHG emissions occurred in the leakage management area during this monitoring period were carried out.

Data / Parameter	$EADLK_t$
Data unit	tCO_2e
Description	Total *ex post* increase in GHG emissions due to displaced forest fires at year *t*.

Source of data	Remote sensing data and GIS.
Description of measurement methods and procedures to be applied	Forest fires in the leakage belt area can be considered activity displacement leakage. GHG emissions due displaced forest fires shall be subjected to monitoring, when significant.
Frequency of monitoring/recording	Annually
Value monitored	0.00 (no significant forest fires in the leakage belt area occurred during this monitoring period)
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing and GIS.
Purpose of the data	This parameter was used to calculate leakage emissions in the project scenario. Provides the *ex post* value of the increase in GHG emissions due to displaced forest fires in the leakage belt.
Calculation method	Emissions from deforestation at each forest class are estimated by multiplying the detected area of forest loss by the average forest carbon stock per unit area.
Comments	No significant forest fires in the leakage belt area occurred during this monitoring period. Where evidence can be collected that deforestation in the leakage belt is attributable to deforestation agents that are not linked to the project area, the detected deforestation may not be attributed to the project activity and therefore, not considered leakage.

Data / Parameter	$HI_{icl,t}$
Data unit	m³/ha
Description	Harvesting intensity of timber in forest class *icl* at year *t* in the project area due to planned logging activities (i.e., sustainable forest management plan).
Source of data	Sustainable forest management activity reports, such as the annual operational plan and the annual post-harvesting report.
Description of measurement methods and procedures to be applied	Forest inventory and measurements of wood logs by Agrocortex management team. Agrocortex controls all the harvested timber from the forest management area through a software. Harvesting intensity followed procedures described in the Sustainable Forest Management Plan for Fazenda Seringal Novo Macapá.

<table>
<tr><td>Frequency of monitoring/recording</td><td>Annually</td></tr>
<tr><td>Value monitored</td><td>

Year	$HI_{icl,t}$ (m³/ha)
2017	10.34
2018	4.84
2019	5.18
Average	6.42

</td></tr>
<tr><td>Monitoring equipment</td><td>The same equipment applied in the forest inventory. Each harvested timber log is measured by Agrocortex management team and stored in a collector, which is linked to the SFMP software.</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>Control procedures applied to forest inventory.
FSC Certification.
SFMP internal audit.
Logging authorization from the Brazilian Environmental Agency[24].</td></tr>
<tr><td>Purpose of the data</td><td>This parameter was used to calculate project emissions in the project scenario. Provides the ex post value of the harvested timber volume due to planned logging activities in the project area.</td></tr>
<tr><td>Calculation method</td><td>This parameter was calculated through the annual timber inventory, which is carried out before harvesting and contains the timber volume from each APU. After harvesting operations, each harvested timber log is measured (diameter and height) by Agrocortex employees and stored in a collector, which automatically calculate the timber volume through the following equation:
$lnV= -9,41417 + 0,97524 \times ln (D^2 \times H)$
Where,
D = Diameter
H = Height
Carbon stock decrease from planned logging activities at each forest class are quantified by multiplying the detected area subject to logging by the harvested timber volume intensity (added to logging damage factor), and then by the mean wood density.</td></tr>
<tr><td>Comments</td><td>A sustainable forest management plan (SFMP) was developed and has been executed by Agrocortex management team since 2014.</td></tr>
</table>

[24] The responsible environmental agency in this case is the *Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis* - IBAMA.

Data / Parameter	*Logging damage factor (LDF)*
Data unit	m^3/m^3 of harvested timber
Description	The logging damage factor (LDF) is a representation of the quantity of emissions that will ultimately arise per unit of extracted timber (m^3). These emissions arise from the non-commercial portion of the felled trees (the branched and stump) and trees incidentally killed during felling.
Source of data	SFMP related documentation, such as forestry inventory, harvesting management plans and post-harvest assessment reports. Feldpausch et al. When big trees fall: Damage and carbon export by reduced impact logging in southern Amazonia. Forest Ecology and Management 219 (2005) 199–215
Description of measurement methods and procedures to be applied	The emissions resulting directly from logging are calculated by estimating the emissions resulting from dead wood created in each logging gap measured divided by the volume of wood created, adding skidder trails damage. According to Feldpausch et al (2005), Table 6 pag 209, the mean Coarse woody debris returned to the soil as necromass following logging and damage in: (1) tree felling gap formation (trees killed by tree-fall), (2) residual canopy from the felled tree, (3) road, (4) deck construction (whole trees plowed to the ground) and (5) skid maneuvering during logging, is about 6.9 Mg C/ha. According to section 4.3 (pg 212) from this same study, this represents 2.4 times the carbon taken off site in logs. However, the MR already takes into account as planned deforestation the roads and decks constructions, which represent around 16% of the total damage. Therefore, the LDF is 2.4 * (1-0,159) = 2.0174.
Frequency of monitoring/recording	Annually
Value monitored	2.0174
Monitoring equipment	The same equipment applied in the forest inventory.
QA/QC procedures to be applied	Control procedures applied to forest inventory. SFMP internal audit. FSC Reports. Permanent plots monitoring report regarding the APUs harvested within the SFMP
Purpose of the data	This parameter was used to calculate project emissions from logging activities occurred in the project scenario due to sustainable forest management, specifically for the calculation

	of the carbon stock decrease due to planned logging activities in the project area.
Calculation method	This parameter is added to the harvested timber volume intensity in order to calculate carbon stock decrease from planned logging activities at each forest class.
Comments	If no monitoring data is available, SFMP data shall be used. If new and more accurate harvest intensity data become available, these can be used to estimate project emissions

Data / Parameter	LTF_w
Data unit	%
Description	Fraction of wood products that are considered permanent (i.e. carbon is stored for 100 years or more).
Source of data	Sustainable forest management activity reports, such as the annual operational plan and the annual post-harvesting report. Financial reports may also be utilized to calculate this parameter.
Description of measurement methods and procedures to be applied	Forest inventory and measurements of harvested wood logs by Agrocortex management team. Agrocortex controls all the harvested timber from the forest management area through the SFMP software. Agrocortex divides timber production in commercial groups, which have different rates of commercialization. Each group has a specific durability and lifetime, which mainly depends on the quality and density of the wood.
Frequency of monitoring/recording	Annually
Value monitored	0
Monitoring equipment	The same equipment applied in the forest inventory.
QA/QC procedures to be applied	Control procedures applied to forest inventory. SFMP internal audit. FSC Reports.
Purpose of the data	This parameter was used to calculate project emissions in the project scenario, specifically for calculations of harvested wood products carbon pool.
Calculation method	This parameter was calculated through the percentage of final wood products that are considered permanent (long lifetime).

Comments	This value is a conservative estimate based on Agrocortex's operations of the SFMP. Such data indicates long lifetime wood products are not produced as part of forest operations.

Data / Parameter	MAI_{icl}
Data unit	m³/ha/year
Description	Mean annual increment at each forest class due to natural regeneration of managed forests following planned sustainable logging activities
Source of data	- Field measurements in sample plots; - BRASIL. Conselho Nacional do Meio Ambiente (CONAMA). Resolution 406, dated 02/02/2009. **Diário Oficial [da] República Federativa do Brasil**, Brasília, DF, 06 fev. 2009. This Resolution establishes technical parameters to be adopted in the preparation, presentation, technical evaluation and execution of a Sustainable Forest Management Plan - SFMP for logging purposes, for native forests and their succession forms in the Amazon biome.
Description of measurement methods and procedures to be applied	Forests that were subject to planned logging activities under the project scenario have the potential to grow and accumulate significant carbon stocks after the periodical harvest cycle due to natural regeneration. This parameter was calculated through the annual monitoring of permanent plots following planned sustainable logging activities.
Frequency of monitoring/recording	Annually
Value monitored	0.86
Monitoring equipment	The same equipment applied in the forest inventory.
QA/QC procedures to be applied	Control procedures applied to forest inventory. SFMP internal audit. FSC Reports.
Purpose of the data	This parameter was used to calculate project emissions from logging activities occurred in the project scenario due to sustainable forest management, specifically for the calculation of the carbon stock increase due to natural regeneration of managed forests after planned sustainable logging activities.

Calculation method	Carbon stock increase from previously planned logging areas within each forest class is estimated via the increase in DBH assessed in measured trees within permanent plots. It is calculated through the annual measurement of the diameter of all remaining trees located within permanent plots following planned sustainable logging activities. The diameter is a good parameter to estimate the mean annual increment due to natural regeneration.
Comments	A SFMP was developed and is executed by Agrocortex management team since 2014. If new and more accurate harvest intensity data become available, these can be used to estimate project emissions

Data / Parameter	MTF_w
Data unit	%
Description	Fraction of wood products that are retired between 3 and 100 years.
Source of data	Sustainable forest management activity reports, such as the annual operational plan and the annual post-harvesting report. Financial reports may also be utilized to calculate this parameter.
Description of measurement methods and procedures to be applied	Forest inventory and measurements of harvested wood logs by Agrocortex management team. Agrocortex controls all the harvested timber from the forest management area through the SFMP software. Agrocortex divides timber production in commercial groups, which have different rates of commercialization. Each group has a specific durability and lifetime, which mainly depends on the quality and density of the wood.
Frequency of monitoring/recording	Annually
Value monitored	*76*
Monitoring equipment	The same equipment applied in the forest inventory.
QA/QC procedures to be applied	Control procedures applied to forest inventory. SFMP internal audit. FSC Reports.
Purpose of the data	This parameter was used to calculate project emissions in the project scenario, specifically for calculations of harvested wood products carbon pool.

Calculation method	This parameter was calculated through the percentage of final wood products that have an expected lifetime between 3 to 100 years.
Comments	This value was calculated with data on the operation of the SFMP during this monitoring period.

Data / Parameter	RF_t
Data unit	%
Description	Risk factor used to calculate VCS buffer credits
Source of data	- VCS Non-Permanence Risk Report from Agrocortex REDD Project, - Remote sensing data and GIS, - Supervisor information - Literature data.
Description of measurement methods and procedures to be applied	All sources of data from the VCS Non-Permanence Risk Report were used to measure the various risk factors.
Frequency of monitoring/recording	Annually
Value monitored	10
Monitoring equipment	Remote sensing and GIS.
QA/QC procedures to be applied	Best practices in remote sensing and GIS.
Purpose of the data	This parameter represents the non-permanence risk rating of the project during the current monitoring period, which was used to determine the number of buffer credits that shall be deposited into the AFOLU pooled buffer account.
Calculation method	This parameter was calculated using the AFOLU Non-Permanence Risk Tool. All the risk factors described in the VCS Non-Permanence Risk Report were assessed based on the current monitoring period.
Comments	N/A

Data / Parameter	STF_w
Data unit	%

Description	Fraction of wood products and waste that will be emitted to the atmosphere within 3 years.
Source of data	Sustainable forest management activity reports, such as the annual operational plan and the annual post-harvesting report. Financial reports may also be utilized to calculate this parameter.
Description of measurement methods and procedures to be applied	Forest inventory and measurements of harvested wood logs by Agrocortex employees. Agrocortex controls all the harvested timber from the forest management area through the SFMP software. Agrocortex divides timber production in commercial groups, which have different rates of commercialization. Each group has a specific durability and lifetime, which mainly depends on the quality and density of the wood.
Frequency of monitoring/recording	Annually
Value monitored	24
Monitoring equipment	The same equipment applied in the forest inventory.
QA/QC procedures to be applied	Control procedures applied to forest inventory. SFMP internal audit. FSC Reports.
Purpose of the data	This parameter was used to calculate project emissions in the project scenario, specifically for calculations of harvested wood products carbon pool.
Calculation method	This parameter was calculated through the percentage of final wood products that have an expected lifetime below 3 years.
Comments	This value was calculated with data on the operation of the SFMP during this monitoring period.

Data / Parameter	$VEX_{w,j,icl,t}$
Data unit	m^3
Description	Volume of timber for product class *w*, of species *j*, extracted from within forest class *fcl* at time *t*
Source of data	Sustainable forest management activity reports, such as the annual operational plan and the annual post-harvesting report. Financial reports may also be utilized to calculate this parameter.

Description of measurement methods and procedures to be applied	Forest inventory and measurements of wood logs by Agrocortex management team. Agrocortex controls all the harvested timber from the forest management area through a SFMP software. Agrocortex divides timber production in commercial groups, which have different rates of commercialization.
Frequency of monitoring/recording	Annually
Value monitored	(see table below)
Monitoring equipment	The same equipment applied in the forest inventory. Each harvested timber log is measured by Agrocortex employees and stored in a collector, which is linked to the SFMP software.
QA/QC procedures to be applied	Control procedures applied to forest inventory. FSC Certification. SFMP internal audit. Logging authorization from the Brazilian Environmental Agency[25].
Purpose of the data	This parameter was used to calculate project emissions in the project scenario, specifically for calculations of harvested wood products carbon pool. Provides the *ex post* value of the final wood products volume per product class due to planned logging activities in the project area.
Calculation method	This parameter was calculated based on the production of timber per commercial group. A volumetric efficiency coefficient of 40%[26] was utilized to calculate the parameter $VEX_{w,j,fcl,t}$, in order to convert the volume of timber harvested into volume of final wood products.
Comments	This value was calculated with data on the operation of the SFMP during this monitoring period.

Value monitored:

Commercial Groups VEXw,j,icl,t (m³)			
Timber commercial Groups	**2017**	**2018**	**2019**
High density woods and Mahogany	10,177.32	13,473.53	9,345.68
White woods	8,492.04	957.87	691.95
Total	**18,669.36**	**14,431.40**	**10,037.63**

[25] The responsible environmental agency in this case is the *Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis* - IBAMA.

[26] According to Agrocortex internal data.

4.3 Monitoring Plan

The monitoring plan was performed as planned on the VCS PD. Monitoring was performed by the project proponent and outsourced to third parties having sufficient capacities to perform the monitoring tasks.

For all aspects of project monitoring, Agrocortex ensured that data collection, processing, analysis, management and archiving were conducted in accordance with the established monitoring plan. The authority for the registration, monitoring, measurement and reporting is *Mr. Marcos Preto*, the CEO of Agrocortex. The operational and managerial structure used for the monitoring plan is described on the table below:

Variables monitored	Responsible	Frequency
Monitoring Deforestation and Project Emissions	Agrocortex together with Ecológica Assessoria and Uezu Planejamento Ambiental	Prior to verification
Monitoring of non-CO_2 emissions from forest fires	Agrocortex together with Ecológica Assessoria and Uezu Planejamento Ambiental	Prior to verification
Monitoring of Leakage	Agrocortex together with Ecológica Assessoria and Uezu Planejamento Ambiental	Prior to verification
Monitoring of Natural Disturbance and catastrophic events	Agrocortex together with Ecológica Assessoria and Uezu Planejamento Ambiental	When a natural event occurs

Table 16. Type of Monitoring and Party Responsible for Monitoring

Internal auditing and non-conformities were managed according to Agrocortex internal procedures. Agrocortex manages forest resources according to a Sustainable Forest Management Plan developed by third party experts and performed by its management team with significant experience in forest management. Such plan has procedures to identify and assess non-conformities and risks. The plan also establishes procedures for the regular training of Agrocortex staff. Ecológica Assessoria has also supported Agrocortex on the management of this VCS REDD Project.

Carbon stock changes due to planned deforestation were monitored by Agrocortex management team according to procedures set on their sustainable forest management plan, which included information on the amount of wood harvested and the total forest area affected by harvesting operations during the monitoring period.

Deforestation and related project emissions were monitored through periodic assessment of classified satellite imagery covering the project area. Uezu Planejamento Ambiental has supported the Project Proponent for such activity. For the present monitoring period, land-use change analyses were made through MapBiomas images, which is a new platform that produces maps through a pixel-by-pixel classification from Landsat satellites images.

Automatic classification was used for images cropped from the reference area, employing the cluster method from Google Earth Engine software. Automatic classification is necessarily followed by interpretation and refinement by analysts, in order to match the automatic results with the reality of the landscape. Using the same methodology as employed in the VCS PD, the process of accumulating “Non Forest” areas was adopted, in such a way that areas classified as “Non Forest” in one year were necessarily included in the same category in the following year.

Classification was first conducted for the whole Reference Region and subsequently cropped to the Leakage Belt and Project Area.

In order to compare the projection and the classification, GIS software was used to combine the land-use file from the projection of baseline deforestation with the classification obtained from satellite images in the current monitoring phase. In this way, a hybrid file was generated which allowed a “projection x classification” matrix to be created, which indicated the accumulated deforestation dynamics from 2017 – 2019, compared to the scenario stipulated in the VCS PD.

Based on the results obtained, the following matrix was developed for identification of the deforestation dynamics in a given period:

PROJECTION	CLASSIFICATION	WHAT OCCURRED	LABLE APPLIED
Non-Forest	Forest	The deforestation predicted in the VCS PD was avoided	Avoided deforestation
Forest	Forest	The forest was conserved as predicted	Forest
Non-forest	Non-forest	Deforestation occurred where it had been predicted	Predicted deforestation
Forest	Non-forest	Deforestation occurred where it had not been predicted	Non-predicted deforestation

Table 17. Matrix for the identification of LULC change during comparison of projection versus classification

Given the data obtained by combining these files, analysis of two aspects for project monitoring was possible: quantitative aspects relating to the total avoided deforestation area in the monitored period and the consequent generation of Verified Carbon Units (VCUs) credits; and qualitative aspects relating to the spatial distribution of these areas.

The data relating to generation of VCUs in the area during the monitoring period can be inferred from a numerical comparison of the projected and classified deforestation within the Project Area, regardless of spatial distribution.

In fact, the analysis of the spatial distribution of deforestation and the comparison with what was projected is fundamental to evaluating the deforestation patterns during the monitoring period. It allows the identification of concentration of activity in certain regions, construction of roads or possible changes in the dynamics of deforestation agents, drawing attention to necessary project adjustments.

In the case of the Reference Region and the Leakage Belt, the emphasis was put upon spatial analysis in order to understand the dynamics surrounding the Project Area and analyze possible changes in the observed deforestation patterns and possible relationships with the Project Area. Turning to the Project Area, it was analyzed spatially as well as numerically, in order to calculate the avoided deforestation in the period eligible for the generation of VCUs.

5. QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

The total average biomass stock per hectare (Mg ha^{-1}) was converted to tCO_2e using the following equations:

$$Cab_{icl} = ab \times CF \times 44 / 12$$

Where,

Cab_{icl}	Average carbon stock per hectare in the above-ground biomass carbon pool of initial forest class *icl*; $tCO_2e\ ha^{-1}$
ab	Average biomass stock per hectare in the above-ground biomass pool of initial forest class *icl*; Mg ha^{-1}
CF	Default value of carbon fraction in biomass
44/12	Ratio converting C to CO_2e

$$Cbb_{icl} = bb \times CF \times 44 / 12$$

Where,

Cbb_{icl}	Average carbon stock per hectare in the below-ground biomass carbon pool of initial forest class *icl*; $tCO_2e\ ha^{-1}$
bb	Average biomass stock per hectare in the below-ground biomass pool of initial forest class *icl*; Mg ha^{-1}
CF	Default value of carbon fraction in biomass
44/12	Ratio converting C to CO_2e

The total baseline carbon stock change in the project area at year *t* is calculated as follows:

$$\Delta \boldsymbol{CBSLPA_t} = \Delta \boldsymbol{CabBSLPA_{icl,t}} + \Delta \boldsymbol{CbbBSLPA_{icl,t}}$$

Where,

$\Delta CBSLPAt$	Total baseline carbon stock changes in the project area at year *t*; tCO_2e
$\Delta CabBSLPA_{icl,t}$	Total baseline carbon stock change for the above-ground biomass pool in the project area for initial forest class at year *t*; tCO_2e
$\Delta CbbBSLPA_{icl,t}$	Total baseline carbon stock change for the below-ground biomass pool in the project area for initial forest class at year *t*; tCO_2e

$$\Delta \boldsymbol{CabBSLPA_{icl,t}} = \boldsymbol{ABSLPA_{icl,t}} \times \Delta \boldsymbol{Cab_{icl}}$$

Where,

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

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

Where,

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

<u>Carbon stocks</u>

Project carbon stocks were calculated on the basis of biomass values from the study presented in tables below. An average of biomass values (above ground) from Salimon *et al.* (2011)[27] was utilized, which was a study conducted in the State of Acre that covered all the forest types in the State. The cited study obtained these values via inventoried wood volumes and alometric equations, using data from Amazonian regions.

Salimon *et al.* (2011)'s estimates of the above-ground biomass within the Brazilian State of Acre were mainly based on a remote sensing methodology carried out by Saatchi *et al.* (2007) and Nogueira *et al.* (2008), through the utilization of sophisticated methods to estimate biomass through remote sensing. Those three literature estimates of the above-ground biomass presented very similar results for the State of Acre.

The average biomass stock per hectare was calculated for each project boundary (reference region, project area and leakage belt) and for each vegetation group using weighted average. More details and the map of the different forest classes within the reference region, project area and leakage belt can be found in Appendix II.

Below ground biomass values were estimated to be 24% of the above ground biomass, according to the applied methodology VM0015 v1.1 (root-to-shoot ratio of 0.24 for tropical rainforest having above ground biomass values above 125 tons/ha, and 0.20 for values below 125 tons/ha).

REFERENCE REGION			
Vegetation	Above-ground Biomass (Mg/ha)	Below-ground Biomass (Mg/ha)	Total biomass (Mg/ha)
Open tropical rainforest with bamboo	257.82	61.88	319.70
Open tropical rainforest with palm trees	245.98	59.04	305.01
Open alluvial rainforest with palm trees	218.50	52.44	270.94
Dense tropical rainforest	323.88	77.73	401.61
Secondary vegetation	37.00	7.40	44.40

Table 18. Biomass values used for the "forest" classes within the reference region

PROJECT AREA			
Vegetation	Above-ground Biomass (Mg/ha)	Below-ground Biomass (Mg/ha)	Total biomass (Mg/ha)
Open tropical rainforest with bamboo + Lowland dense tropical rainforest	274.20	65.81	340.01
Open tropical rainforest with palm trees + bamboo	234.30	56.23	290.53

[27] SALIMON,C.I; PUTZ, F.E.; MENEZES-FILHO, L.; ANDERSON,A.; SILVEIRA, M.; FOSTER BROWN, I.; OLIVEIRA, L.C. Estimating state-wide biomass carbon stocks for a REDD plan in Acre, Brazil. 2011, **Forest Ecology and Management**, 262, p. 555–560, 2011.

Open alluvial rainforest with palm trees + Dense alluvial tropical rainforest	218.50	52.44	270.94

Table 19. Biomass values used for the “forest” classes within the project area

LEAKAGE BELT			
Vegetation	Above-ground Biomass (Mg/ha)	Below-ground Biomass (Mg/ha)	Total biomass (Mg/ha)
Open tropical rainforest with bamboo	256.59	61.58	318.17
Open tropical rainforest with palm trees	234.30	56.23	290.53
Open alluvial rainforest with palm trees	218.50	52.44	270.94
Secondary vegetation	37.00	7.40	44.40

Table 20. Biomass values used for the “forest” classes within the leakage belt

In order to convert biomass into carbon, and carbon into carbon-dioxide, the conversion factors defined below were used.

Conversion Factors	
Biomass to Carbon	0.5
C to CO_2	44/12

Table 21. Biomass to CO_2 conversion factors[28]

REFERENCE REGION			
Vegetation	Aboveground biomass Cab_{icl} (tCO_2e/ha)	Belowground biomass Cbb_{icl} (tCO_2e/ha)	Total $Ctot_{icl}$ (tCO_2e/ha)
Open tropical rainforest with bamboo	472.67	113.44	586.12
Open tropical rainforest with palm trees	450.96	108.23	559.19
Open alluvial rainforest with palm trees	400.58	80.12	480.70
Dense tropical rainforest	593.79	142.51	736.29
Secondary vegetation	67.83	13.57	81.40

Table 22. Average CO_2 per hectare of initial forest classes *icl* existing in the reference region

PROJECT AREA

[28] IPCC, 2003. Good practice guidance for land use, land-use change and forestry. Kanagawa: IGES, 2003. Available at: http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf.html

Vegetation	Aboveground biomass Cab_{icl} (tCO_2e/ha)	Belowground biomass Cbb_{icl} (tCO_2e/ha)	Total $Ctot_{icl}$ (tCO_2e/ha)
Open tropical rainforest with bamboo + Lowland dense tropical rainforest	502.70	120.65	623.35
Open tropical rainforest with palm trees + bamboo	429.55	103.09	532.64
Open alluvial rainforest with palm trees + Dense alluvial tropical rainforest	400.58	80.12	480.70

Table 23. Average CO_2 per hectare of initial forest classes *icl* existing in the project area

LEAKAGE BELT			
Vegetation	Aboveground biomass Cab_{icl} (tCO_2e/ha)	Belowground biomass Cbb_{icl} (tCO_2e/ha)	Total $Ctot_{icl}$ (tCO_2e/ha)
Open tropical rainforest with bamboo	470.41	112.90	583.31
Open tropical rainforest with palm trees	429.55	103.09	532.64
Open alluvial rainforest with palm trees	400.58	80.12	480.70
Secondary vegetation	67.83	13.57	81.40

Table 24. Average CO_2 per hectare of initial forest classes *icl* existing in the leakage belt

<u>Average carbon stocks of post-deforestation classes</u>

Fearnside (1996)[29] is one of the most recognized studies for the Brazilian Amazon about long term carbon stocks in deforested areas. This study constructed a Markov matrix of annual transition probabilities to estimate landscape composition and to project future changes in the Brazilian Amazon. The average carbon stock value of non-forest vegetation in anthropic areas in equilibrium (post-deforestation class) was defined as 12.8 tC/ha, or 46.93 tCO_2e/ha.

Post deforestation class *fcl*	
Name	Non forest
ID_{fcl}	1
$Ctot_{fcl}$	
tCO_2e/ha	

[29] FEARNSIDE, Philip M.. Amazonian deforestation and global warming: carbon stocks in vegetation replacing Brazil's Amazon forest. **Forest Ecology And Management,** Manaus, v. 80, p.21-34, 1996. Available at: <http://www1.uwindsor.ca/ees/system/files/Reference 4 - Amazonian deforestation and global warming- carbon stocks in.pdf>. Last visit on: April 13th. 2015.

46.93

Table 25. Long-term (20-years) average carbon stocks per hectare of post-deforestation LU/LC classes present in the reference region

Uncertainty assessment

According to the applied methodology, if the uncertainty of the total average carbon stock is less than 10% of the average value, the average carbon stock value can be used. Otherwise, the lower boundary of the 90% confidence interval must be considered in the calculations if the class is an initial forest class in the project area or a final non-forest class in the leakage belt, and the higher boundary of the 90% confidence interval if the class is an initial forest class in the leakage belt or a final non-forest class in the project area.

Salimon *et al.* (2011) present uncertainties as one standard deviation of the mean. Thus, confidence interval of this method was around 68.27%. This was converted to a confidence interval of 90% by multiplying the standard deviation by the value of 1.64[30].

Therefore, Tables 26 and 27 below present carbon stocks per hectare of initial forest classes *icl* existing in the project area and leakage belt, uncertainties at confidence interval of 90%, and final values after discounts for uncertainties.

The resulting changes in carbon stock for initial forest classes for the project area and leakage belt are shown in Tables 28 and 29 below.

[30] SOUZA, A. M. Intervalos de Confiança. Departamento de Estatística - PPGEMQ / PPGEP – UFSM. 2008. Available at: <http://w3.ufsm.br/adriano/aulas/ic/tintconf.pdf>. Last visited on: 12/03/2018.

Boundaries	Initial forest class *icl*																							
	Average carbon stock 90% CI																							
	Name	Open tropical rainforest with bamboo					Name	Open tropical rainforest with palm trees					Name	Open alluvial rainforest with palm trees					Name	Secondary vegetation				
	ID_{icl}	1					ID_{icl}	2					ID_{icl}	3					ID_{icl}	5				
	Cab_{icl}		Cbb_{icl}		$Ctot_{icl}$		Cab_{icl}		Cbb_{icl}		$Ctot_{icl}$		Cab_{icl}		Cbb_{icl}		$Ctot_{icl}$		Cab_{icl}		Cbb_{icl}		$Ctot_{icl}$	
	C stock	±90% CI	C stock	±90% CI	C stock	±90% CI	C stock	±90% CI	C stock	±90% CI	C stock	±90% CI	C stock	±90% CI	C stock	±90% CI	C stock	±90% CI	C stock	±90% CI	C stock	±90% CI	C stock	±90% CI
	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e/ ha	tCO2e/ ha	tCO2e/ ha	tCO2e/ ha	tCO2e/ ha	tCO2e/ ha	tCO2e/ ha	tCO2e/ ha	tCO2e/ ha	tCO2e/ ha	tCO2e/ ha	tCO2e/ ha	tCO2e/ ha	tCO2e/ ha	tCO2e/ ha
Project Area	502.70	45.23	120.65	10.85	623.35	56.08	429.55	211.09	103.09	50.66	532.64	261.75	400.58	45.23	80.12	10.85	480.70	56.08	-	-	-	-	-	-
Leakage Belt	470.41	64.42	112.90	15.46	583.31	79.87	429.55	211.09	103.09	50.66	532.64	261.75	400.58	45.23	80.12	10.85	480.70	56.08	67.83	30.16	13.57	6.03	81.40	36.19

Table 26. Carbon stocks per hectare of initial forest classes *icl* existing in the project area and leakage belt

	Boundaries	Initial forest class *icl*																							
		Average carbon stock 90% CI																							
		Name	Open tropical rainforest with bamboo					Name	Open tropical rainforest with palm trees					Name	Open alluvial rainforest with palm trees					Name	Secondary vegetation				
		ID_{icl}	1					ID_{icl}	2					ID_{icl}	3					ID_{icl}	5				
		Cab_{icl}		Cbb_{icl}		$Ctot_{icl}$		Cab_{icl}		Cbb_{icl}		$Ctot_{icl}$		Cab_{icl}		Cbb_{icl}		$Ctot_{icl}$		Cab_{icl}		Cbb_{icl}		$Ctot_{icl}$	
		C stock	C stock change	C stock	C stock change	C stock	C stock change	C stock	C stock change	C stock	C stock change	C stock	C stock change	C stock	C stock change	C stock	C stock change	C stock	C stock change	C stock	C stock change	C stock	C stock change	C stock	C stock change
		tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha	tCO2e /ha
Initial forest class	Project Area	502.70	502.70	120.65	120.65	623.35	623.35	429.55	218.46	103.09	52.43	532.64	270.89	400.58	355.36	80.12	69.26	480.70	424.62	-	-	-	-	-	-
Final forest class		502.70	502.70	120.65	120.65	623.35	623.35	429.55	640.64	103.09	153.75	532.64	794.39	400.58	445.81	80.12	90.97	480.70	536.78	-	-	-	-	-	-
Initial forest class	Leakage Belt	470.41	534.83	112.90	128.36	583.31	663.19	429.55	640.64	103.09	153.75	532.64	794.39	400.58	445.81	80.12	90.97	480.70	536.78	67.83	97.99	13.57	19.60	81.40	117.59
Final forest class		470.41	406.00	112.90	97.44	583.31	503.44	429.55	218.46	103.09	52.43	532.64	270.89	400.58	355.36	80.12	69.26	480.70	424.62	67.83	37.68	13.57	7.54	81.40	45.21

Table 27. Carbon stocks per hectare of initial forest classes *icl* existing in the project area and leakage belt after discounts for uncertainties

Carbon stock change in the above-ground biomass per initial forest class *icl*				Total carbon stock change in the above-ground biomass of initial forest class in the project area	
ID_{cl}	1	2	3	$\Delta CabBSLPA_{icl,t}$	$\Delta CabBSLPA_{icl}$
Name	Open Tropical Rainforest with bamboo	Open Tropical Rainforest with palm trees	Open Alluvial Rainforest with palm trees	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2017	501,731	12,338	0	514,069	1,815,512
2018	604,871	20,540	0	625,411	2,440,923
2019	534,201	15,859	0	550,060	2,990,983

Carbon stock change in the below-ground biomass per initial forest class *icl*				Total carbon stock change in the below-ground biomass of initial forest class in the project area	
ID_{cl}	1	2	3	$\Delta CbbBSLPA_{icl,t}$	$\Delta CbbBSLPA_{icl}$
Name	Open Tropical Rainforest with bamboo	Open Tropical Rainforest with palm trees	Open Alluvial Rainforest with palm trees	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2017	41,719	1,650	166	43,534	43,534
2018	56,236	2,142	166	58,544	102,078
2019	69,057	2,523	166	71,745	173,823

Carbon stock changes in above-ground biomass per post-deforestation zone z		Total carbon stock change of post deforestation zones in the project area	
ID_{lz}	1	$\Delta CBSLPA_{z,t}$	$\Delta CBSLPA_{z}$
Name	Non-forest	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e
2017	12,868	12,868	12,868
2018	17,818	17,818	30,686
2019	23,906	23,906	54,593

Total net carbon stock change in the project area	
$\Delta CBSLPA_{t}$	$\Delta CBSLPA$
annual	cumulative
tCO_2e	tCO_2e
544,735	544,735
666,137	1,210,872
597,899	1,808,771

Table 28. Baseline carbon stock change in the project area

Carbon stock change in the above-ground biomass per initial forest class *icl*					Total carbon stock change in the above-ground biomass of initial forest class in the leakage belt	
ID_{cl}	1	2	3	5	$\Delta CabBSLLK_{icl,t}$	$\Delta CabBSLLK_{icl}$
Name	Open Tropical Rainforest with bamboo	Open Tropical Rainforest with palm trees	Open Alluvial Rainforest with palm trees	Secondary vegetation	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2017	414,219	228,564	334,974	190	977,948	1,940,868
2018	1,610,234	199,105	356,228	0	2,165,568	4,106,436
2019	3,544,200	312,070	453,977	0	4,310,246	8,416,682

Carbon stock change in the below-ground biomass per initial forest class *icl*					Total carbon stock change in the below-ground biomass of initial forest class in the leakage belt	
ID_{cl}	1	2	3	5	$\Delta CbbBSLLK_{icl,t}$	$\Delta CbbBSLLK_{icl}$
Name	Open Tropical Rainforest with bamboo	Open Tropical Rainforest with palm trees	Open Alluvial Rainforest with palm trees	Secondary vegetation	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2017	15,697	5,858	20,285	974	42,813	42,813
2018	54,342	10,636	27,554	974	93,506	136,320
2019	139,403	18,126	36,818	974	195,321	331,640

Carbon stock changes in above-ground biomass per post-deforestation zone z		Total carbon stock change of post deforestation zones in the leakage belt	
ID_{lz}	1	$\Delta CtotBSLLK_{z,t}$	$\Delta CtotBSLLK_{z}$
Name	Non-forest	annual	cumulative
Project year	tCO_2e	tCO_2e	tCO_2e
2017	11,479	11,479	11,479
2018	20,324	20,324	31,804
2019	39,664	39,664	71,468

Total net carbon stock change in the leakage belt	
$\Delta CtotBSLLK_{t}$	$\Delta CtotBSLLK$
annual	cumulative
tCO_2e	tCO_2e
1,009,281	1,009,281
2,238,750	3,248,031
4,465,903	7,713,934

Table 29. Baseline carbon stock change in the leakage belt

5.2 Project Emissions

The FSC-certified sustainable forest management plan implemented by Agrocortex in 2014 within the project area aims to harvest forest products/by-products in a manner consistent with the conservation of the local ecosystem. This type of economic activity enables the harvesting of an economically feasible volume of forest products, however allowing the regeneration of the natural stock in accordance with the growth and recovery rates of the biome.

Therefore, the present REDD project includes planned deforestation and planned logging activities within the project area. These carbon stock changes are estimated *ex ante* and shall be measured *ex post*.

Planned deforestation mainly includes implementation of infrastructure, such as opening of main and secondary roads, skidding trails[31], and timber yards in each annual production unit – APU (*Unidade de Produção Anual*, in portuguese) within the project area, estimated to be around 1% of each APU. According to the sustainable forest management plan[32], 175,707.55 ha (92.4% of total property area) are subject to SFMP. The adopted rotation cycle is 30 years, thus each annual productive unit (APU) has around 5,856.92 hectares.

The location of areas to be protected and the allocation of infrastructures within each APU are planned based on an aerial survey, such as the Light Detection and Ranging (LIDAR) tool, which has a high-resolution of 1.5m. These data allow generating the Digital Terrain Model and the Digital Drainage Model. From these models, it is possible to generate level curves and to identify PPAs according to legislation. With the aforementioned models and the spatial distribution of the selected trees for cutting, Agrocortex plans the infrastructure construction in each APU within the project area, such as opening of main and secondary roads, skidding trails, and timber yards.

The construction of the infrastructure is carried out in accordance with techniques provided by the Tropical Forest Institute (*Instituto Floresta Tropical* - IFT), an NGO that promotes the adoption of good practices sustainable in forest management plans, contributing to the conservation of natural resources and improving the life quality of the population[33].

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[31] According to the SFMP implemented by Agrocortex, all skidding trails are planned to minimize damages to the forest, extracting trees from the felling site without damaging other trees, only affecting sub-forest areas using low impact techniques. According to Holmes et al. (2002) less than 10% of skidding trails from reduced impact logging (RIL) forest management systems caused soil degradation and consequently clearings in the forest, while 100% of trails in conventional management areas are affected. It is expected that the FSC-certified SFMP implemented by Agrocortex would reduce this damage in a more significant way when compared to simple RIL-forest management.

HOLMES, T.P.; BLATE, G.M.; ZWEEDE, J.C.; PEREIRA JUNIOR, R.L BARRETO, P.; BOLTZ, F. **Custos e benefícios financeiros da exploração de impacto reduzido em comparação à exploração florestal convencional na Amazônia Oriental**. Belém: Fundação Floresta Tropical, 2002, 66p., 2ª edição.

[32] OLIVEIRA, Luiz Rogério. **Plano de Manejo Florestal Sustentado 2ª Revisão - Consolidado:** Fazenda Seringal Novo Macapá. Rio Branco: Batisflor Florestal Ltda, 2017. 225 p.

[33] Available at: <http://ift.org.br/>. Last visited on: April 26th, 2020

The location of each APU and protection areas within the Agrocortex property area, which will be subject to planned deforestation and planned logging activities during the project crediting period, is detailed in the Figure below.

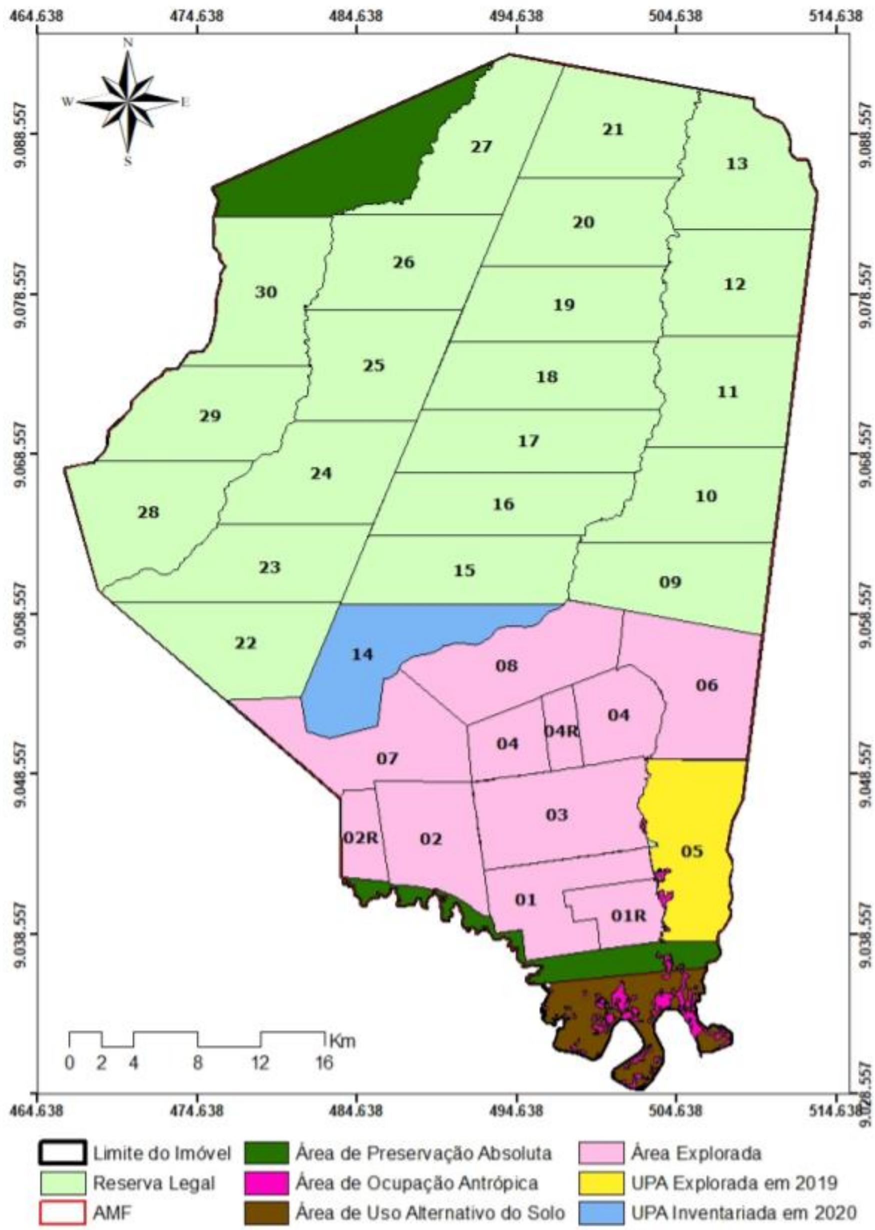

Figure 22. Location of each APU within the Sustainable Forest Management Plan area

As previously described in Section 3.1 above, almost all deforestation occurred within the project area resulted from planned deforestation activities. During the current monitoring period, five APUs were harvested, according to Table below.

Annual Productive Unit (APU)	Year
APU 4R	2017
APU 7	2017
APU 6	2018
APU 8	2018
APU 5	2019

Table 30. Annual Productive Units (APU) harvested at each year of the monitoring period

APU 4 was harvested in 2016. However, the remaining volume that could not be transported in 2016 due to climate conditions from those APUs was transported in 2017.

The *ex post* carbon stock decrease due to planned deforestation in the project area was calculated using the following equation:

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

Where,

$\Delta CPDdPA_t$ Total decrease in carbon stock due to planned deforestation at year *t* in the project area; tCO_2e

$APDPA_{icl,t}$ Areas of planned deforestation in forest class *icl* at year *t* in the project area; ha

$\Delta Ctot_{icl}$ Average carbon stock change of all accounted carbon pools in forest class *icl* at time *t*; tCO_2e/ha

In addition, some unplanned deforestation occurred in the southern border of the project area, corresponding to a total of 67.43 ha during the monitoring period. The *ex post* carbon stock decrease due to unplanned deforestation in the project area was calculated using the following equation:

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

Where,

$\Delta CPUdPA_t$ Total *ex post* actual carbon stock change due to unavoidable unplanned deforestation at year *t* in the project area; tCO_2e

$AUDPA_{icl,t}$ Areas of unplanned deforestation in forest class *icl* at year *t* in the project area; ha

$\Delta Ctot_{icl}$ Average carbon stock change of all accounted carbon pools in forest class *icl* at time *t*; tCO_2e/ha

Therefore, the total carbon stock decreases due to planned and unplanned deforestation in the project area could be calculated, as depicted in Table below.

Project year t	Areas of planned deforestation x Carbon stock change (decrease) in the project area						Total carbon stock decrease due to planned deforestation		Areas of unplanned deforestation x Carbon stock change (decrease) in the project area						Total carbon stock decrease due to unplanned deforestation		Total carbon stock decrease due to planned and unplanned deforestation in the project area	
	ID_{cl} = 1 Open tropical rainforest with bamboo		ID_{cl} = 2 Open tropical rainforest with palm trees		ID_{cl} = 3 Open alluvial rainforest with palm trees		annual	cumulative	ID_{cl} = 1 Open tropical rainforest with bamboo		ID_{cl} = 2 Open tropical rainforest with palm trees		ID_{cl} = 3 Open alluvial rainforest with palm trees		annual	cumulative	annual	cumulative
	$APDPA_{icl,t}$	$Ctot_{icl,t}$	$APDPA_{icl,t}$	$Ctot_{icl,t}$	$APDPA_{icl,t}$	$Ctot_{icl,t}$	$\Delta CPDdPA_t$	$\Delta CPDdPA$	$AUDPA_{icl,t}$	$Ctot_{icl,t}$	$AUDPA_{icl,t}$	$Ctot_{icl,t}$	$AUDPA_{icl,t}$	$Ctot_{icl,t}$	$\Delta CUDdPA_t$	$\Delta CUDdPA$		
	ha	tCO_2e/ha	ha	tCO_2e/ha	ha	tCO_2e/ha	tCO_2e	tCO_2e	ha	tCO_2e/ha	ha	tCO_2e/ha	ha	tCO_2e/ha	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2017	110.22	623.35	0.00	794.39	0.00	536.78	68,706.66	68,706.66	22.33	623.35	0.00	794.39	1.54	536.78	14,746.01	14,746.01	83,452.67	83,452.67
2018	122.64	623.35	0.00	794.39	0.00	536.78	76,449.89	145,156.56	20.69	623.35	1.44	794.39	2.65	536.78	15,463.47	30,209.48	91,913.36	175,366.03
2019	59.34	623.35	0.00	794.39	0.00	536.78	36,990.72	182,147.27	10.93	623.35	6.37	794.39	1.48	536.78	12,667.92	42,877.40	49,658.64	225,024.67

Table 31. *Ex post* carbon stock decrease due to planned and unplanned deforestation in the project area

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

The maximum cutting level adopted by Agrocortex is 25.8 m^3/ha, which is 14% lower than the legal harvesting volume allowed by Law. However, due to conservation measures, the actual logging intensity carried out by Agrocortex during this monitoring period was around 6.42 m^3/ha.

At least 10% of the remaining trees per species in the effective exploration area are guaranteed, respecting the minimum limit of preservation of at least 3 trees per species per 100 ha, in each subdivision of the plot. For vulnerable species, those figures are stricter: 15% of the remaining trees per species in the effective exploration area shall be guaranteed, and at least 4 trees per species per 100 ha shall be preserved. Moreover, at least 20% of the remaining Mahogany trees in the effective exploration area shall be preserved, respecting the minimum limit of preservation of at least 5 trees per 100 ha, in each subdivision of the plot. Moreover, trees shall have minimum diameter of 50cm for felling, and 60cm for Mahogany. Furthermore, according to the Brazilian Forest Code, trees located within permanent preservation areas (PPA), i.e. at the borders of waterways or springs, shall be comprehensively preserved.

In the project scenario, emissions due to planned logging activities results from timber harvesting and also from damages to vegetation during the directional tree felling, which generate forest residues (branches, remains of logs and other damaged trees during the tree felling). According to the Sustainable Forest Management Plan, it is estimated that 1m^3 of forest residues is generated for each m^3 of log harvested through sustainable forest management. Thus, GHG emissions from logging activities include the volume of harvested timber plus the logging damage factor, as follows.

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

Where,

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

In addition, Agrocortex core activity is the sustainable forest management plan, therefore harvested wood products are a significant carbon pool under the project scenario. Carbon stocks in wood products are those stocks that become wood products pool at the time of deforestation. They are divided in three fractions, as follows:

- Short-term wood products: wood products and waste that would decay within 3 years; all carbon shall be assumed to be lost immediately;
- Medium-term wood products: wood products that are retired between 3 and 100 years; for this group of wood products, a 20-year linear decay function shall be applied;
- Long-term wood products: wood products that are considered permanent (i.e. carbon is stored for 100 years or more); it may be assumed that no carbon is released.

Agrocortex divides timber production in four commercial groups. These groups were classified in two larger groups, based on their properties and characteristics, as described on Table below. According to the SFMP, 50% of the Commercial Group 2 category are destined for the production of durable wood products such as decks, tables, doors, etc. (which have potential to become long-lived wood products), and 50% for construction, which are short-lived wood products.

Commercial Groups				
Group	Characteristics	Lifetime category	% of total harvested and commercialized wood	Average wood density (g/cm³)
Group 1, 50% of Group 2, Group 4	High density woods and Mahogany	Medium-term and Long-term	76%	0.77
50% of Group 2, Group 3	White wood (low density wood)	Short-term	24%	0.53

Table 32. Commercial timber groups produced by Agrocortex

Accounting for carbon stocks in wood products was carried out utilizing the Method 1 described in the applied Methodology: Direct Volume Extraction Estimation. This Method was applied because timber harvest plans specifying the harvest intensity per forest class in terms of volume extracted per hectare are available for the Project area. Furthermore, the proportion of carbon stock stored in each fraction of wood products was obtained from specific studies. The Method 1 contains the following steps:

Step 1: Calculate the biomass carbon of the commercial volume extracted since the project start date and in the process of logging activities as follows:

$$CXB_{w,icl,t} = \frac{1}{ABSLPA_{icl,t}} * \left(\sum_{t=1}^{t^*} \sum_{j=1}^{J} (VEX_{w,j,icl,t} * D_j * CF_j * \frac{44}{12}\right)$$

Where,

$CXB_{w,icl,t}$ Mean carbon stock per hectare of extracted biomass carbon by class of wood product *w* from forest class *icl* at time *t*; tCO_2e/ha

icl	1, 2, 3, …*icl* initial pre-deforestation forest classes; dimensionless
w	1, 2, 3 … *w* wood product class (sawn-wood, wood-based panels, other industrial roundwood, paper and paper board, and other); dimensionless
t	1, 2, 3… *t* years, a year of the project crediting period; dimensionless
t*	the year at which the area $ABSLPA_{icl,t}$ is deforested in the baseline case; dimensionless
j	1, 2, 3 … *j* tree species; dimensionless
$ABSLPA_{icl,t}$	Area of forest class *icl* deforested at year *t**; ha
$VEX_{,w,j,fcl,t}$	Volume of timber for product class *w*, of species *j*, extracted from within forest class *fcl* at time *t*; m^3
D_j	Mean wood density of species *j*; t d.m.m^{-3}
CF_j	Carbon fraction of biomass for tree species *j*; tC t^{-1} d.m.
44/12	Ratio of molecular weight of CO_2 to carbon; dimensionless

A volumetric efficiency coefficient of 40%[34] was utilized to calculate the parameter $VEX_{,w,j,fcl,t}$, in order to convert the volume of timber harvested into volume of final wood products.

Step 2: Calculate the carbon stock in the wood products carbon pool extracted from the biomass at time *t*.

$$Cwp_{icl,t} = \sum_{w=1}^{W} CXB_{w,icl,t} * (1 - STF_w)$$

Where,

$Cwp_{icl,t}$	Carbon stock in the wood products carbon pool in initial forest class *icl* at time *t*; tCO_2e/ha
STF_w	Fraction of wood products and waste that will be emitted to the atmosphere within 3 years; all carbon shall be assumed to be lost immediately; dimensionless

Step 3: Calculate the biomass carbon extracted at time *t* that becomes the medium-term wood products at the time of harvesting.

$$Cwp_{mt,icl,t} = Cwp_{icl,t} - (Cwp_{icl,t} * (1 - STF_w) * (1 - LTF_w))$$

[34] According to Agrocortex internal data..

Where,

$Cwp_{mt,icl,t}$	Carbon stock in the medium-term wood products carbon pool at the time of deforestation *t* of the initial forest class *icl*; tCO_2e/ha
LTF_w	Fraction of wood products that are considered permanent (i.e. carbon is stored for 100 years or more); it may be assumed no carbon is released

Step 4: Calculate the biomass carbon extracted at time *t* that becomes the long-term wood products at the time of harvesting.

$$Cwp_{lt,icl,t} = Cwp_{icl,t} - (Cwp_{icl,t} * (1 - STF_w) * (1 - MTF_w))$$

Where,

$Cwp_{lt,icl,t}$	Carbon stock in the long-term wood products carbon pool at the time of deforestation *t* of the initial forest class *icl*; tCO_2e/ha
MTF_w	Fraction of wood products that are retired between 3 and 100 years; for this group of wood products, a 20-year linear decay function shall be applied

Based on calculations above, the average carbon stock factor for harvested wood products carbon pool in the initial forest class icl applicable at time *t* is reported in Table below.

Year after timber harvest		$\Delta Cwp_{cl,t}$ (tCO_2e/ha)		
		Short-lived	Medium-lived	Long-lived
1	2014	0	0.02	1.13
2	2015	0	0.07	2.17
3	2016	0	0.12	2.88
4	2017	0	0.16	2.61
5	2018	0	0.19	2.09
6	2019	0	0.22	2.24

Table 33. Carbon stock factors for initial forest classes (*icl*) for harvested wood products carbon pool (Method 1)

The average carbon stock per hectare in the harvested wood products carbon pool of initial forest class *icl* at time *t* (ΔCwp_t) is calculated as follows:

$$\Delta Cwp_t = \sum_{icl=1}^{icl} (Cwp_{mt,icl,t} + Cwp_{lt,icl,t})$$

Therefore, the *ex post* carbon stock decrease due to planned logging activities in the project area was calculated using the following equation:

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

Where,

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

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

Project year *t*	Areas of planned logging activities x Carbon stock change (decrease) in the project area						Wood products		Total carbon stock decrease due to planned logging activities	
	ID_{cl} = 1 Open tropical rainforest with bamboo		ID_{cl} = 2 Open tropical rainforest with palm trees		ID_{cl} = 3 Open alluvial rainforest with palm trees		annual	cumulative	annual	cumulative
	$APLPA_{icl,t}$	$\Delta CLd_{icl,t}$	$APLPA_{icl,t}$	$\Delta CLd_{icl,t}$	$APLPA_{icl,t}$	$\Delta CLd_{icl,t}$	ΔCwp_t	ΔCwp	$\Delta CPLdPA_t$	$\Delta CPLdPA$
	ha	tCO_2e/ha	ha	tCO_2e/ha	ha	tCO_2e/ha	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2017	4,513.78	33.35	0.00	0.00	0.00	0.00	11,783.40	11,783.40	138,742.91	138,742.91
2018	7,452.42	15.61	0.00	0.00	0.00	0.00	17,026.65	28,810.05	99,330.00	238,072.91
2019	4,839.93	16.72	0.00	0.00	0.00	0.00	11,902.28	40,712.33	69,028.58	307,101.50

Table 34. *Ex post* actual carbon stock decrease due to planned logging activities in the project area

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

No production of fuel wood or charcoal occurred within the project area during the monitoring period.

Thus, Table below presents the total *ex post* carbon stock decrease due to planned activities in the project area.

Project year t	Total carbon stock decrease due to planned deforestation		Total carbon stock decrease due to planned logging activities		Total carbon stock decrease due to planned fuel-wood and charcoal activities		Total carbon stock decrease due to planned activities	
	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	$\Delta CPDdPA_t$	$\Delta CPDdPA$	$\Delta CPLdPA_t$	$\Delta CPLdPA$	$\Delta CPFdPA_t$	$\Delta CPFdPA$	$\Delta CPAdPA_t$	$\Delta CPAdPA$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2017	68,706.66	68,706.66	138,742.91	138,742.91	0.00	0.00	207,449.57	207,449.57
2018	76,449.89	145,156.56	99,330.00	238,072.91	0.00	0.00	175,779.90	383,229.47
2019	36,990.72	182,147.27	69,028.58	307,101.50	0.00	0.00	106,019.30	489,248.77

Table 35. Total *ex post* carbon stock decrease due to planned activities in the project area

Forests that were subject to planned logging activities under the project scenario have the potential to grow and accumulate significant carbon stocks after the periodical harvest cycle due to natural regeneration. The mean annual increment of managed forests in Brazil is estimated to be 0.86 m^3/ha/year[35].

Due to the periodical harvesting, the projected increase in carbon stocks of each forest class in the project case is estimated by assuming that the maximum carbon stock is the long term average carbon stock (the average of a production cycle). Therefore, once a class reaches this level of carbon stock, no more carbon stock increase can be attributed to it.

Table below provides an *ex post* carbon stock increase following planned logging activities in the project area, which is calculated as follows:

$$\Delta CPLiPA_t = \sum_{icl=1}^{icl} (APLPA_{icl,t} \times \Delta CLi_{icl,t})$$

Where,

$\Delta CPLiPA_t$ — Total increase in carbon stock due to planned logging activities at year t in the project area; tCO_2e

$APLPA_{icl,t}$ — Areas of planned logging activities in forest class *icl* at year t in the project area; ha

$\Delta CLi_{icl,t}$ — Average carbon stock increase due to sustainable logging activities in forest class *icl* at time t; tCO_2e/ha

[35] BRASIL. Conselho Nacional do Meio Ambiente (CONAMA). Estabelece parâmetros técnicos a serem adotados na elaboração, apresentação, avaliação técnica e execução de Plano de Manejo Florestal Sustentável - PMFS com fins madeireiros, para florestas nativas e suas formas de sucessão no bioma Amazônia. Resolução nº. 406, de 02 de fevereiro de 2009. **Diário Oficial [da] República Federativa do Brasil**, Brasília, DF, 06 feb. 2009.

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	
	ID_{cl} = 1 Open tropical rainforest with bamboo		ID_{cl} = 2 Open tropical rainforest with palm trees		ID_{cl} = 3 Open alluvial rainforest with palm trees		annual	cumulative
	$APLPA_{icl,t}$	$\Delta CLi_{icl,t}$	$APLPA_{icl,t}$	$\Delta CLi_{icl,t}$	$APLPA_{icl,t}$	$\Delta CLi_{icl,t}$	$\Delta CPLiPA_t$	ΔCPLiPA
	ha	tCO_2e/ha	ha	tCO_2e/ha	ha	tCO_2e/ha	tCO_2e	tCO_2e
2017	4,513.78	0.92	0.00	0.00	0.00	0.00	15,192.24	15,192.24
2018	7,452.42	0.92	0.00	0.00	0.00	0.00	19,341.29	34,533.53
2019	4,839.93	0.92	0.00	0.00	0.00	0.00	26,191.53	60,725.06

Table 36. *Ex post* carbon stock increase following planned logging activities in the project area

Neither planned protection of secondary/degraded forests without harvest nor production of fuel-wood and charcoal are expected to occur within the project area under the project scenario. Thus, carbon stock increase due to growth without harvest or due to planned fuel-wood and charcoal activities were not monitored. However, if any of these activities is implemented in the future, a measurement of the carbon stock changes will be carried out. According to the applied methodology, if the project activity generates a significant change in carbon stocks due to these activities, the carbon stock change shall be measured *ex post*. However, if the decrease is not significant, it shall not be accounted, and *ex post* monitoring is not required.

Therefore, the total *ex post* carbon stock increase due to planned activities in the project area is detailed in Table below.

Project year *t*	Total carbon stock increase due to growth without harvest		Total carbon stock increase due to planned logging activities		Total carbon stock increase due to planned fuel-wood and charcoal activities		Total carbon stock increase due to planned activities	
	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	$\Delta CPNiPA_t$	ΔCPNiPA	$\Delta CPLiPA_t$	ΔCPLiPA	$\Delta CPFiPA_t$	ΔCPFiPA	$\Delta CPAiPA_t$	ΔCPAiPA
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2017	0.00	0.00	15,192.24	15,192.24	0.00	0.00	15,192.24	15,192.24
2018	0.00	0.00	19,341.29	34,533.53	0.00	0.00	19,341.29	34,533.53
2019	0.00	0.00	26,191.53	60,725.06	0.00	0.00	26,191.53	60,725.06

Table 37. Total *ex post* carbon stock increase due to planned activities in the project area

The calculation of the *ex post* net carbon stock change in the project area under the project scenario ($\Delta CPSPA_t$) is described as follows.

$$\Delta CPSPA_t = \Delta CPAdPA_t + \Delta CUDdPA_t - \Delta CPAiPA_t$$

Where,

$\Delta CPSPA_t$	Sum of ex post actual carbon stock changes in the project area at year t; tCO_2e
$\Delta CPAdPA_t$	Total decrease in carbon stock due to all planned activities at year t in the project area; tCO_2e
$\Delta CUDdPA_t$	Total ex post actual carbon stock change due to unavoidable unplanned deforestation at year t in the project area; tCO_2e
$\Delta CPAiPA_t$	Total increase in carbon stock due to all planned activities at year t in the project area; tCO_2e

Ex post carbon stock change in the project area under the project scenario is shown below.

Project year *t*	Total carbon stock decrease due to planned activities		Total carbon stock increase due to planned activities		Total carbon stock decrease due to unavoided unplanned deforestation		Total carbon stock change in the project case	
	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	$\Delta CPAdPA_t$	$\Delta CPAdPA$	$\Delta CPAiPA_t$	$\Delta CPAiPA$	$\Delta CUDdPA_t$	$\Delta CUDdPA$	$\Delta CPSPA_t$	$\Delta CPSPA$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2017	207,449.57	207,449.57	15,192.24	15,192.24	14,746.01	14,746.01	207,003.35	207,003.35
2018	175,779.90	383,229.47	19,341.29	34,533.53	15,463.47	30,209.48	171,902.08	378,905.42
2019	106,019.30	489,248.77	26,191.53	60,725.06	12,667.92	42,877.40	92,495.69	471,401.11

Table 38. *Ex post* net carbon stock change in the project area under the project scenario

No forest fire was used by Agrocortex for carrying out planned deforestation or timber harvesting activities. However, there were around 67.43 ha of unplanned deforestation within the project area during the monitored period, which conversion of forest to non-forest could have involved fires.

The effect of fire on carbon emissions is counted in the estimation of carbon stock changes in the parameter $\Delta CUDdPA_t$; therefore CO_2 emissions from forest fires were ignored to avoid double counting. However, non-CO_2 emissions (CH_4 and N_2O) from forest fires must be counted in the project scenario, when they are significant.

It was conservatively assumed that all unplanned deforestation within the project area involved fire and all above ground biomass was burnt. Therefore, non-CO_2 emissions from forest fires were quantified and deducted from emission reductions, as follows:

$$EBBtot_{icl,t} = EBBN_2O_{icl,t} + EBBCH_{4icl,t}$$

Where,

$EBBtot_{icl,t}$	Total GHG emission from biomass burning in forest class *icl* at year *t*; tCO_2e/ha
$EBBN_2O_{icl,t}$	N_2O emission from biomass burning in forest class *icl* at year *t*; tCO_2e/ha

$EBBCH_{4icl,t}$ — CH_4 emission from biomass burning in forest class *icl* at year *t*; tCO_2e/ha

$$EBBN_2O_{icl,t} = EBBCO_{2icl,t} * 12/44 * NCR * ER_{N2O} * 44/28 * GWP_{N2O}$$

Where,

$EBBCO_{2icl,t}$ — Per hectare CO_2 emission from biomass burning in slash and burn in forest class *icl* at year *t*; tCO_2e/ha

NCR — Nitrogen to Carbon Ratio (IPCC default value = 0.01); dimensionless

ER_{N2O} — Emission ratio for N_2O (IPCC default value = 0.007)

GWP_{N2O} — Global Warming Potential for N_2O[36]

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

Where,

$EBBCO_{2icl,t}$ — Per hectare CO_2 emission from biomass burning in slash and burn in forest class *icl* at year *t*; tCO_2e/ha

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

GWP_{CH4} — Global Warming Potential for CH_4[37]

$$EBBCO_{2icl,t} = Fburnt_{icl} * \sum_{p=1}^{P} (C_{picl,t} * Pburnt_{p,icl} * CE_{p,icl})$$

Where,

$EBBCO_{2icl,t}$ — Per hectare CO_2 emission from biomass burning in the forest class *icl* at year *t*; tCO_2e/ha

$Fburnt_{icl}$ — Proportion of forest area burned during the historical reference period in the forest class *icl*; %

$C_{picl,t}$ — Average carbon stock per hectare in the carbon pool *p* burnt in the forest class *icl* at year *t*; tCO_2e/ha

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[36] According to the VCS Standard v4, the six Kyoto Protocol greenhouse gases and ozone-depleting substances shall be converted using 100 year global warming potentials derived from the IPCC's Fourth Assessment Report. GWP for N_2O = 298. Available at: <https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html>. Last visited on: 18/June/2020.

[37] According to the VCS Standard v4, the six Kyoto Protocol greenhouse gases and ozone-depleting substances shall be converted using 100 year global warming potentials derived from the IPCC's Fourth Assessment Report. GWP for CH_4 = 25. Available at: <https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html>. Last visited on: 18/June/2020.

$Pburnt_{p,icl}$ Average proportion of mass burnt in the carbon pool *p* in the forest class *icl*; % (conservatively assumed as 100%)

$CE_{p,icl}$ Average combustion efficiency of the carbon pool *p* in the forest class *icl*; dimensionless (IPCC default of 0.5 was used)

p Carbon pool that could burn, in the project case, above-ground biomass

Thus, the total actual non-CO_2 emissions from forest fire at year *t* in the project area ($EBBPSPA_t$) are were calculated as follows.

$$EBBPSPA_t = ABSLPA_{icl,t} * EBBtot_{icl,t}$$

Where,

$EBBPSPA_t$ Total actual non-CO_2 emissions from forest fire at year *t* in the project area; tCO_2e/ha

$ABSLPA_{icl,t}$ Annual area of deforestation of initial forest classes *icl* in the project area at year *t*; ha

$EBBtot_{icl,t}$ Total GHG emission from biomass burning in forest class *icl* at year *t*; tCO_2e/ha

Project year *t*	Total ex post estimated actual non-CO_2 emissions from forest fires in the Project area	
	$EBBPSPA_t$	EBBPSPA
	annual	cumulative
	tCO_2e	tCO_2e
2017	678.64	678.64
2018	746.12	1,424.76
2019	395.38	1,820.14

Table 39. Total *ex post* actual non-CO_2 emissions from forest fires in the project area

<u>Total *ex post* project emissions for the project area</u>

The *ex post* carbon stock changes and non-CO_2 emissions in the Project area during the monitoring period is summarized in Table below.

Project year *t*	Total *ex post* carbon stock decrease due to planned activities		Total *ex post* carbon stock increase due to planned activities		Total *ex post* carbon stock decrease due to unavoided unplanned deforestation		Total *ex post* carbon stock change		Total *ex post* estimated actual non-CO_2 emissions from forest fires in the project area	
	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	$\Delta CPAdPA_t$	$\Delta CPAdPA$	$\Delta CPAiPA_t$	$\Delta CPAiPA$	$\Delta CUDdPA_t$	$\Delta CUDdPA$	$\Delta CPSPA_t$	$\Delta CPSPA$	$EBBPSPA_t$	EBBPSPA
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e

2017	207,449.57	207,449.57	15,192.24	15,192.24	14,746.01	14,746.01	207,003.35	207,003.35	678.64	678.64
2018	175,779.90	383,229.47	19,341.29	34,533.53	15,463.47	30,209.48	171,902.08	378,905.42	746.12	1,424.76
2019	106,019.30	489,248.77	26,191.53	60,725.06	12,667.92	42,877.40	92,495.69	471,401.11	395.38	1,820.14

Table 40. Total *ex post* estimated actual net changes in carbon stocks and emissions of GHG gases in the project area

5.3 Leakage

According to the applied methodology, two sources of leakage are considered: a) decrease in carbon stocks and increase in GHG emissions associated with leakage prevention measures; and b) decrease in carbon stocks and increase in GHG emissions associated with activity displacement leakage.

Ex post **estimation of decrease in carbon stocks and increase in GHG emissions due to leakage prevention measures**

To reduce the risk of activity displacement leakage, baseline deforestation agents could participate in activities within the project area and leakage management area that together will replace baseline income, product generation and livelihood of the agents as much as possible, so that deforestation will be reduced and the risk of displacement minimized. As such, a reduction in carbon stocks and/or an increase in GHG emissions may occur compared to the baseline case. If this decrease in carbon stock or increase in GHG emission is significant, it must be accounted and *ex post* monitoring will be required.

In order to calculate the net carbon stock changes that the planned leakage prevention measures are expected to occasion during the monitoring period, the projected carbon stocks shall be estimated in the leakage management area under the baseline case and project scenario.

$$\Delta CLPMLK_t = \Delta CPSLK_t - \Delta CBSLLK_t$$

Where,

$\Delta CLPMLK_t$ Carbon stock decrease due to leakage prevention measures at year t; tCO_2e

$\Delta CBSLLK_t$ Annual carbon stock changes in leakage management areas in the baseline case at year t; tCO_2e

$\Delta CPSLK_t$ Annual carbon stock change in leakage management areas in the project case; tCO_2e

If the net sum of carbon stock changes within a monitoring period is more than zero, leakage prevention measures are not causing any carbon stock decrease. The net increase shall conservatively be ignored in the calculation of net GHG emission reductions of the project activity. Nevertheless, if the net sum is negative, it must be accounted if significant.

According to the planned interventions carried out by Agrocortex REDD Project in the baseline case, no decrease in carbon stocks due to activities implemented in the leakage management area were identified, thus ΔCBSLLK = 0. However, during the current monitoring period, there were carbon stock changes within the leakage management area due to deforestation of regenerated forests. Therefore, the *ex post* carbon stock change in leakage management areas in the project case ($\Delta CPSLK_t$) was calculated as follows. The annual values are detailed in the Table below.

$$\Delta CPSLK_t = APSLK_{fcl,t} * \Delta Ctot_{icl}$$

Where,

$\Delta CPSLK_t$ Annual carbon stock change in leakage management areas in the project case; tCO_2e

$APSLK_{fcl,t}$ Annual area of class fcl with decreasing carbon stock in leakage management areas in the project case at year t; ha

$\Delta Ctot_{icl}$ Average carbon stock change of all accounted carbon pools in forest class icl at time t; tCO_2e/ha

Project year	Carbon stock changes in leakage management area in the project case			
	ID_{fcl}	1	annual	cumulative
	APSLKfcl,t	$Ctot_{fcl,t}$	ΔCPSLKt	ΔCPSLK
	ha	tCO_2e/ha	tCO_2e	tCO_2e
2017	8.33	55.00	458.15	458.15
2018	7.54	73.33	552.93	1,011.08
2019	11.52	91.67	1,056.00	2,067.08

Table 41. *Ex post* carbon stock change in leakage management areas in the project case

The Table below shows that the net sum of carbon stock changes within the leakage management area during the current monitoring period is less than zero, i.e., leakage prevention measures are causing carbon stock decrease and therefore, are included as leakage emissions.

Project year	Total carbon stock change in the baseline case		Total carbon stock change in the project case		Net carbon stock change due to leakage prevention measures	
	annual $\Delta CBSLLK_t$ tCO_2e	cumulatve ΔCBSLLK tCO_2e	annual $\Delta CPSLK_t$ tCO_2e	cumulatve ΔCPSLK tCO_2e	annual $\Delta CLPMLK_t$ tCO_2e	cumulatve ΔCLPMLK tCO_2e
2017	0.00	0.00	458.15	458.15	458.15	458.15
2018	0.00	0.00	552.93	1,011.08	552.93	1,011.08
2019	0.00	0.00	1,056.00	2,067.08	1,056.00	2,067.08

Table 42. *Ex post* estimated net carbon stock change in leakage management areas

Furthermore, leakage prevention measures carried out by the present project during the current monitoring period did not include agricultural intensification, fertilization, fodder production and/or other measures to enhance cropland and grazing land areas. However, the communities living within the leakage management area implement cattle raising activities and therefore, emissions from grazing animals in leakage management areas ($EgLK_t$) should be accounted, which calculation is detailed below.

$$EgLK_t = ECH_4ferm_t + ECH_4man_t + EN_2Oman_t$$

Where,

$EgLK_t$	Emissions from grazing animals in leakage management areas at year *t*; tCO_2e/year
ECH_4ferm_t	CH_4 emissions from enteric fermentation in leakage management areas at year *t*; tCO_2e/year
ECH_4man_t	CH_4 emissions from manure management in leakage management areas year *t*; tCO_2e/year
EN_2Oman_t	N_2O emissions from manure management in leakage management areas at year *t*; tCO_2e/year
t	1, 2, 3, … T years of the project crediting period; dimensionless

The values adopted to calculate the EgLKt parameter are available below:

Parameter	Values used for calculations	Unit	Description
EF1	0.79	kg CH4 head-1 yr-1	Enteric CH4 emission factor for the livestock group
EF2	2	kg CH4 head-1 yr-1	Manure management CH4 emission factor for the livestock group
EF3	0.02	kg N2O-N (kg N-1) head-1 yr-1	Emission factor for N2O emissions from manure management for

			the livestock group
EF4	0.01	kg N2O-N (kg NH3-N and NOx-N emitted)-1 head-1 yr-1	Emission factor for N2O emissions from atmospheric deposition of forage-sourced nitrogen on soils and water surfaces
DBI	-	kg d.m. head-1 day-1	Daily biomass intake
Nex	0.48	kg N head-1 yr-1	Annual average N excretion per livestock head
Fracgas	0.4	kg NH3-N and NOx-N emitted (Kg N)-1	Fraction of managed livestock manure nitrogen that volatilizes as NH3 and NOx in the manure management phase

Table 43 – Parameters used for the ex post estimation of GHG emissions from grazing activities

Project year	annual	annual	annual	annual	annual	annual	annual	annual	annual	cumulative
	Afforage	Pforage	Population	ECH4ferm*t*	ECH4man*t*	EdirN2Oman*t*	EindN2Oman*t*	EN2Oman*t*	EgLk*t*	EgLK*t*
	ha	kgd.m.yr	Nr Heads	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2017	0.00	0.00	11,057.00	218.38	552.85	49.71	9.94	59.65	830.87	830.87
2018	0.00	0.00	11,057.00	218.38	552.85	49.71	9.94	59.65	830.87	1,661.75
2019	0.00	0.00	11,057.00	218.38	552.85	49.71	9.94	59.65	830.87	2,492.62

Table 44. Ex post estimation of leakage emissions above the baseline from grazing animals in leakage management areas

Therefore, the total *ex post* estimated carbon stock changes and increases in GHG emissions due to leakage prevention measures during this monitoring period is calculated as follows.

$$ELPMLK_t = EgLK_t + \Delta CLPMLK_t$$

Where,

$ELPMLK_t$ Annual total increase in GHG emissions due to leakage prevention measures at year *t*; tCO_2e

Project year	Carbon stock decrease due to leakage prevention measures		Total *ex post* GHG emissions from increased grazing activities		Total *ex post* increase in GHG emissions due to leakage prevention measures	
	annual	cumulative	annual	cumulative	annual	cumulative
	$\Delta CLPMLK_t$	$\Delta CLPMLK$	$EgLK_t$	$EgLK$	$ELPMLK_t$	$ELPMLK$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2017	458.15	458.15	830.87	830.87	1,289.02	1,289.02
2018	552.93	1,011.08	830.87	1,661.75	1,383.81	2,672.83
2019	1,056.00	2,067.08	830.87	2,492.62	1,886.87	4,559.71

Table 45. Ex post estimated total emissions above the baseline from leakage prevention activities

Ex post decrease in carbon stocks and increase in GHG emissions due to activity displacement leakage

Activities that cause deforestation within the project area in the baseline case could be displaced outside the project boundary due to the implementation of the AUD project activity. A greater decrease in carbon stocks within the leakage belt during the project scenario than those predicted *ex ante* would indicate displacement of deforestation activities due to the project.

It is important to note that activity data for the leakage belt area was determined using the same methods applied to monitoring deforestation activity data in the project area. Leakage due to displacement activity was monitored by mapping forest cover change in the leakage belt.

As defined in the VCS Methodology VM0015 v1.1, if carbon stocks in the leakage belt area decrease more during project implementation than projected in the baseline case, this will be an indication that leakage due to displacement of baseline activities has occurred. Where strong evidence can be collected that deforestation in the leakage belt is attributable to deforestation agents that are not linked to the project area, the detected deforestation may not be attributed to the project activity and considered leakage.

As previously described in Section 3.1 above, in 2017, deforestation rate within the leakage belt was very similar to the predicted value in the baseline scenario. However, most of deforestation within the leakage belt in 2017 occurred at its extreme boundaries and far from the project area. This was very likely associated to the expansion of two municipalities located at each side of the leakage belt along the Purus River: Manoel Urbano and Sena Madureira, both in the State of Acre. Furthermore, it is observed that this pressure comes from the South of the Reference Region along the Purus River and appears to originate from outside the latter, influencing the dynamics of land-use change in the Leakage Belt. Therefore, the GIS analysis led to the conclusion that the deforestation in the leakage belt is not associated with the project activity; and that there was no relation between the observed patterns of deforestation in the Leakage Belt with the present REDD project.

Thus, leakage emissions due to activity displacement, which is calculated as the difference between the *ex ante* and the *ex post* assessments, was defined as zero, as detailed in the Table 42 below.

Project year	Total ex ante net baseline carbon stock change		Total ex post net actual carbon stock change		Total ex post leakage	
	ΔCBSLLKt annual	ΔCBSLLK cumulative	ΔCBSLLKt annual	ΔCBSLLK cumulative	ΔCBSLLKt annual	ΔCBSLLK cumulative
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2017	1,009,281	1,009,281	1,002,437	1,002,437	0	0
2018	2,238,750	3,248,031	734,298	1,736,736	0	0
2019	4,465,903	7,713,934	706,736	2,443,471	0	0

Table 46. Total net carbon stock change in the leakage belt

However, to reduce the risk of activity displacement leakage, baseline deforestation agents may participate in activities within the project area and leakage management area, so that deforestation will be reduced, and the risk of displacement minimized.

Emissions from forest fires were not included in the baseline scenario; therefore, monitoring of increases in GHG emissions within leakage belt ($EADLK_t$) is not necessary.

***Ex post* estimation of total leakage**

The result of all sources of leakage is calculated as follows:

$$\Delta CLK_t = \Delta CLPMLK_t + \Delta CADLK_t$$

Where:

ΔCLK_t Total decrease in carbon stocks within the leakage belt at year t; tCO_2e

$\Delta CLPMLK_t$ Carbon stock decrease due to leakage prevention measures at year t; tCO_2e

$\Delta CADLK_t$ Total decrease in carbon stocks due to displaced deforestation at year t; tCO_2e

$$ELK_t = EgLK_t + EADLK_t$$

Where:

ELK_t Sum of *ex post* leakage emissions at year t; tCO_2e

$EgLK_t$ Emissions from grazing animals in leakage management areas at year t; tCO_2e

$EADLK_t$ Total *ex post* increase in GHG emissions due to displaced forest fires at year t; tCO_2e

In addition, methane emissions resulting from the decomposition of wood residues that were generated during the timber processing in Agrocortex industry were calculated. A small part of the wood residues is burned in a boiler located inside the industry; however, the largest part has been piled up since 2014, which results in methane emissions from anaerobic decomposition.

Calculations were made according to methodology AMS-III.F.: Avoidance of methane emissions through composting - Version 12.0[38] and the Methodological Tool 04 - Emissions from solid waste disposal sites - Version 08.[39]

The results of all *ex post* estimations of leakage are summarized in the table below. Therefore, such emissions were discounted due to leakage during this monitoring period. The calculated values of ΔCLK_t and ELK_t in the present project are shown in the table below.

Project year	Total ex post GHG emissions from increased grazing activities		Total ex post increase in GHG emissions due to displaced forest fires		Total ex post GHG emissions from decomposition of wood residues in the industry		Total ex post decrease in carbon stocks due to displaced deforestation		Carbon stock decrease due to leakage prevention measures		Total net carbon stock change due to leakage		Total net increase in emissions due to leakage	
	annual $EgLK_t$ tCO_2e	cumulative EgLK tCO_2e	annual $EADLK_t$ tCO_2e	cumulative EADLK tCO_2e	annual tCO2e	cumulative tCO_2e	annual $\Delta CADLK_t$ tCO_2e	cumulative $\Delta CADLK$ tCO_2e	annual $\Delta CLPMLK_t$ tCO_2e	cumulative $\Delta CLPMLK$ tCO_2e	annual ΔCLK_t tCO_2e	cumulative ΔCLK tCO_2e	annual ELK_t tCO_2e	cumulative ELK tCO_2e
2017	830.87	830.87	0.00	0.00	5,215.34	5,215.34	0.00	0.00	458.15	458.15	458.15	458.15	6,046.22	6,046.22
2018	830.87	1,661.75	0.00	0.00	6,086.47	11,301.82	0.00	0.00	552.93	1,011.08	552.93	1,011.08	6,917.35	12,963.57
2019	830.87	2,492.62	0.00	0.00	6,635.06	17,936.87	0.00	0.00	1,056.00	2,067.08	1,056.00	2,067.08	7,465.93	20,429.50

Table 47. Total *ex post* estimated leakage

38 AMS-III.F.: Avoidance of methane emissions throug composting – Version 12.0. Available at: < https://cdm.unfccc.int/methodologies/DB/NZ83KB7YHBIA7HL2U1PCNAOCHPUQYX>

39 Methodological Tool 04 – Emisions from solid waste diposal sites – Version 08. Available at: < https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v8.0.pdf>

5.4 Net GHG Emission Reductions and Removals

The net anthropogenic GHG emission reduction of the proposed AUD project activity is calculated as follows:

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

Where:

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

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

$EBBBSLPA_t$ — Sum of baseline emissions from biomass burning in the project area at year *t*; tCO_2e

$\Delta CPSPA_t$ — Sum of *ex post* estimated actual carbon stock changes in the project area at year *t*; tCO_2e

Note: If $\Delta CPSPA_t$ 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 actual emissions from biomass burning in the project area at year *t*; tCO_2e

ΔCLK_t — Sum of *ex post* estimated leakage net carbon stock changes at year *t*; tCO_2e

Note: If the cumulative sum of ΔCLK_t within a fixed baseline period is > *0*, ΔCLK_t shall be set to zero.

ELK_t — Sum of *ex post* estimated leakage emissions at year *t*; tCO_2e

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

The number of Verified Carbon Units (VCUs) to be generated through the proposed AUD project activity at year *t* is calculated as follows:

$$VCU_t = \Delta REDD_t - VBC_t$$

$$VBC_t = (\Delta CBSLPA_t - \Delta CPSPA_t) \times RF_t$$

Where:

VCU_t	Number of Verified Carbon Units that can be traded at time *t*; tCO_2e **Note:** If $VCU_t < 0$ no credits (VCUs) will be awarded to the proponents of the AUD project activity.
$\Delta REDD_t$	*Ex post* estimated net anthropogenic greenhouse gas emission reduction attributable to the AUD project activity at year *t*; tCO_2e
VBC_t	Number of Buffer Credits deposited in the VCS Buffer at time *t*; tCO_2e
$\Delta CBSLPA_t$	Sum of baseline carbon stock changes in the project area at year *t*; tCO_2e
$\Delta CPSPA_t$	Sum of *ex post* carbon stock changes in the project area at year *t*; $tCO_2e\ ha^{-1}$
RF_t	Risk factor used to calculate VCS buffer credits; %
t	1, 2, 3 … *T,* a year of the proposed project crediting period; dimensionless.

The RF_t was estimated using the most recent version of the *VCS-approved AFOLU Non-Permanence Risk Tool* and the resulting value of RF_t for the present REDD project during the current monitoring period was 10%.

The specific summary of GHG reductions and removals in the Agrocortex REDD project during the current monitoring period is included in Table 48 below. The latter table includes estimates of GHG emissions reduction ($REDD_t$), calculations of buffer and leakage, and the resulting calculation of tradable Verified Carbon Units (VCU_t).

Project year	Baseline carbon stock changes		Baseline GHG emissions from biomass burning		Ex post project carbon stock changes		Ex post project GHG emissions from biomass burning		Ex post leakage carbon stock changes		Ex post leakage GHG emissions		Ex post net anthropogenic GHG emission reductions		Ex post VCUs tradable		Ex post buffer credits	
	annual $\Delta CBSLPA_t$ tCO_2e	cumulative $\Delta CBSLPA$ tCO_2e	annual $EBBBSLPA_t$ tCO_2e	cumulative $EBBBSLPA$ tCO_2e	annual $\Delta CPSPA_t$ tCO_2e	cumulative $\Delta CPSPA$ tCO_2e	annual $EBBPSPA_t$ tCO_2e	cumulative $EBBPSPA$ tCO_2e	annual ΔCLK_t tCO_2e	cumulative ΔCLK tCO_2e	annual ELK_t tCO_2e	cumulative ELK tCO_2e	annual $\Delta REDD_t$ tCO_2e	cumulative $\Delta REDD$ tCO_2e	annual VCU_t tCO_2e	cumulative VCU tCO_2e	annual VBC_t tCO_2e	cumulative VBC tCO_2e
2017	544,735	544,735	0	0	207,003	207,003	679	679	458	458	6,046	6,046	330,549	330,549	296,775	296,775	33,773	33,773
2018	666,137	1,210,872	0	0	171,902	378,905	746	1,425	553	1,011	6,917	12,964	486,019	816,567	436,595	733,370	49,423	83,197
2019	597,899	1,808,771	0	0	92,496	471,401	395	1,820	1,056	2,067	7,466	20,429	496,486	1,313,053	445,946	1,179,316	50,540	133,737

Table 48. Ex post estimated net anthropogenic GHG emissions reductions and VCU

In addition, the net GHG emission reductions and removals in the Agrocortex REDD Project are summarized in the Table 49, which follows.

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO2e)	Buffer pool allocation	VCUs eligible for issuance
2017	544,735	207,682	6,504	330,549	33,773	296,775
2018	666,137	172,648	7,470	486,019	49,423	436,595
2019	597,899	92,891	8,522	496,486	50,540	445,946
Total	**1,808,771**	**473,221**	**22,497**	**1,313,053**	**133,737**	**1,179,316**

Table 49. Net GHG emissions reductions and removals in the Agrocortex REDD Project

APPENDIX I: PROJECT AREA CONTOUR COORDINATES

Project Area Contour Coordinates											
UTM 19L, Datum WGS84											
Point	X	Y	Point	X	Y	Point	X	Y	Point	X	Y
1	497572.79	9036841.97	268	503153.60	9042237.99	535	488400.14	9040803.03	802	503153.14	9042178.05
2	497707.38	9036830.75	269	503153.14	9042229.16	536	488397.91	9040799.64	803	503185.37	9042151.20
3	497813.94	9036836.36	270	503153.14	9042237.99	537	488248.61	9040572.71	804	503237.68	9042107.60
4	497948.53	9036645.68	271	503153.60	9042237.99	538	488232.53	9040548.26	805	503281.24	9042073.72
5	498043.87	9036583.99	272	511826.19	9087206.05	539	488216.26	9040519.49	806	503292.53	9042070.49
6	498116.78	9036612.03	273	512159.68	9086960.66	540	488145.37	9040394.06	807	503292.69	9042065.72
7	498245.76	9036527.91	274	512807.77	9086954.37	541	488108.72	9040407.63	808	503296.70	9042065.72
8	498357.93	9036365.28	275	513018.56	9086293.69	542	487964.34	9040461.10	809	503296.70	9042046.88
9	498543.00	9036365.28	276	512980.81	9086016.83	543	487817.37	9040400.44	810	503288.90	9042037.66
10	498711.24	9036314.80	277	513023.76	9085804.44	544	487610.43	9040315.04	811	503261.88	9042030.16
11	498795.36	9036269.94	278	513094.07	9085456.82	545	487541.96	9040286.78	812	503189.28	9041996.28
12	498851.44	9036090.48	279	513395.36	9084919.63	546	487516.06	9040295.73	813	503165.08	9041947.88
13	498918.74	9036051.22	280	513358.46	9084617.94	547	487173.21	9040414.17	814	503213.48	9041899.48
14	498918.74	9035978.31	281	513240.19	9083651.31	548	487209.75	9040464.41	815	503261.88	9041889.80
15	498789.75	9035759.60	282	508748.87	9047024.50	549	487226.85	9040487.92	816	503309.39	9041896.13
16	498733.67	9035681.08	283	508087.89	9045661.42	550	487297.04	9040537.47	817	503369.01	9041881.46
17	498784.15	9035596.96	284	507759.13	9043731.58	551	487454.80	9040648.83	818	503417.23	9041869.60
18	498868.27	9035501.62	285	508062.27	9043261.92	552	487354.23	9040782.92	819	503417.81	9041869.45
19	498812.19	9035355.81	286	508147.66	9042732.50	553	487246.96	9040776.21	820	503419.69	9041868.88
20	498789.75	9035243.65	287	507964.07	9042083.52	554	487300.60	9040970.65	821	503421.52	9041868.19
21	498896.31	9035120.27	288	507946.99	9041613.87	555	487073.28	9041242.89	822	503423.31	9041867.38
22	499002.86	9035052.97	289	508016.04	9041233.08	556	487244.19	9041402.12	823	503425.04	9041866.46
23	499120.25	9034950.90	290	508005.41	9041233.08	557	487091.36	9041470.89	824	503426.71	9041865.42
24	499121.01	9034940.24	291	508005.41	9041261.79	558	487028.27	9041448.18	825	503428.31	9041864.28
25	497637.57	9034940.24	292	507976.70	9041261.79	559	487007.86	9041457.66	826	503429.82	9041863.04
26	497637.57	9034198.52	293	507976.70	9041204.37	560	486928.19	9041382.12	827	503431.26	9041861.69
27	497504.44	9033589.93	294	508005.41	9041204.37	561	486847.19	9041482.12	828	503432.60	9041860.26
28	497528.53	9033509.65	295	508005.41	9041175.66	562	486744.20	9041452.12	829	503433.85	9041858.75
29	497531.20	9033500.74	296	508026.45	9041175.66	563	486735.16	9041424.21	830	503434.99	9041857.15
30	497524.71	9033499.06	297	508087.89	9040836.81	564	486731.51	9041382.84	831	503436.03	9041855.49
31	497440.18	9033455.29	298	507861.60	9040341.54	565	486742.40	9041301.17	832	503436.95	9041853.76
32	497468.23	9033422.55	299	507895.76	9040145.14	566	486707.01	9041203.16	833	503437.76	9041851.97
33	497468.23	9033394.80	300	508066.54	9039931.66	567	486705.37	9041197.75	834	503438.46	9041850.13
34	497476.80	9033394.80	301	507972.61	9039590.09	568	486709.60	9041175.66	835	503439.03	9041848.26
35	497324.67	9033320.42	302	507712.17	9039239.99	569	486712.20	9041162.12	836	503439.47	9041846.35
36	497300.62	9033308.66	303	507549.92	9038906.96	570	486689.53	9041145.71	837	503439.80	9041844.41
37	497295.96	9033306.39	304	507268.13	9038667.87	571	486687.95	9041140.54	838	503439.99	9041842.46
38	497256.82	9033287.25	305	507144.31	9038240.91	572	486685.23	9041105.15	839	503440.05	9041840.50
39	497247.10	9033285.56	306	507246.78	9037788.34	573	486615.22	9041066.52	840	503440.00	9041838.64
40	497076.97	9033255.97	307	507383.41	9037378.46	574	486606.28	9041061.58	841	503439.33	9041827.72
41	497105.54	9033290.89	308	507122.97	9036934.42	575	486609.53	9041075.08	842	503558.71	9041840.92
42	497020.05	9033294.61	309	506542.31	9036823.41	576	486613.23	9041090.47	843	503615.91	9041819.47
43	496982.87	9033287.17	310	506478.26	9036533.08	577	486577.98	9041064.95	844	503657.31	9041836.03
44	496934.55	9033261.15	311	506485.92	9036467.95	578	486491.20	9041002.12	845	503669.95	9041836.03
45	496880.12	9033267.20	312	506488.74	9036468.23	579	486471.67	9040973.64	846	503669.95	9041841.08
46	496878.36	9033295.29	313	506481.15	9036461.72	580	486395.20	9040862.12	847	503710.94	9041857.48
47	496804.85	9033287.12	314	503843.01	9036204.45	581	486373.68	9040915.92	848	503711.88	9041857.86
48	496810.30	9033205.45	315	503728.38	9036193.28	582	486331.20	9041022.12	849	503716.13	9041858.33
49	496838.86	9033206.51	316	499063.95	9035739.02	583	486174.20	9041062.12	850	503716.40	9041859.34
50	496842.84	9033193.46	317	499116.28	9035006.43	584	486020.20	9041202.12	851	503809.32	9041845.37
51	496792.36	9033158.19	318	499081.38	9035052.97	585	485884.20	9041202.12	852	503823.87	9041988.72
52	496808.93	9033120.76	319	498929.96	9035165.13	586	485883.20	9041052.12	853	503831.02	9042008.77
53	496862.39	9033069.04	320	498851.44	9035260.47	587	486013.20	9040862.12	854	503838.36	9042096.76
54	496905.74	9033118.44	321	498840.23	9035350.20	588	485907.42	9040815.32	855	503841.73	9042137.18
55	496975.44	9033075.30	322	498913.13	9035473.58	589	485900.20	9040812.12	856	503842.20	9042142.93
56	496990.13	9033078.97	323	498890.70	9035529.66	590	485687.00	9040875.76	857	503860.49	9042229.57
57	497034.91	9033090.17	324	498800.97	9035664.26	591	485632.20	9040892.12	858	503892.31	9042266.70
58	497005.18	9033138.49	325	498823.40	9035720.34	592	485417.20	9040782.12	859	503899.64	9042266.70
59	496980.53	9033181.63	326	498918.74	9035866.15	593	485227.20	9040532.12	860	503899.64	9042275.25
60	497061.67	9033050.26	327	498986.04	9036073.65	594	485233.70	9040428.22	861	503899.86	9042275.51
61	497089.21	9033005.66	328	498868.27	9036281.15	595	485237.20	9040372.12	862	503908.71	9042295.41
62	497008.85	9032888.21	329	498772.93	9036398.92	596	485089.41	9040335.41	863	503928.35	9042295.41
63	497002.05	9032878.28	330	498514.95	9036410.14	597	485076.20	9040332.12	864	503928.35	9042324.12
64	496983.51	9032906.70	331	498408.40	9036443.79	598	484944.20	9040402.12	865	503957.07	9042324.12
65	496980.13	9032911.88	332	498301.85	9036578.39	599	484944.20	9040582.12	866	503957.07	9042378.01
66	496927.34	9032992.84	333	498167.25	9036673.72	600	484875.20	9040792.12	867	503960.28	9042381.55
67	496922.71	9032999.93	334	498077.52	9036701.76	601	484802.20	9040842.12	868	503985.78	9042381.55
68	496908.61	9033021.55	335	497982.18	9036690.55	602	484757.21	9040962.12	869	503985.78	9042409.60
69	496901.48	9033032.48	336	497847.59	9036881.23	603	484605.21	9040992.12	870	503986.38	9042410.26
70	496526.03	9032998.96	337	497673.73	9036881.23	604	484607.21	9041182.12	871	504014.49	9042410.26
71	496298.08	9033334.18	338	497572.79	9036926.09	605	484585.21	9041282.12	872	504014.49	9042441.18
72	496319.77	9033341.41	339	497539.14	9036999.00	606	484512.21	9041342.12	873	504020.32	9042447.60
73	496463.32	9033389.27	340	497662.52	9037122.38	607	484540.21	9041582.12	874	504035.06	9042444.32
74	496479.10	9033394.53	341	497701.77	9037189.67	608	484459.21	9041682.12	875	504035.06	9042491.33
75	496463.32	9033633.40	342	497623.26	9037228.93	609	484248.21	9041512.12	876	504010.28	9042511.15
76	496458.22	9033710.63	343	497421.37	9037268.19	610	484179.21	9041562.12	877	503985.78	9042525.15
77	496455.63	9033749.87	344	497247.51	9037200.89	611	484228.21	9041652.12	878	503985.78	9042553.82
78	496418.92	9033764.08	345	497040.01	9037178.46	612	484213.21	9041852.12	879	503870.93	9042553.82
79	496387.58	9033770.39	346	496372.64	9037116.77	613	484020.21	9041862.12	880	503153.14	9042291.63
80	496279.90	9033770.39	347	496076.49	9037080.25	614	483975.21	9041652.12	881	503166.00	9042324.12
81	496274.21	9033854.10	348	495553.85	9037015.82	615	483864.21	9041672.12	882	503153.14	9042324.12
82	496301.03	9034024.36	349	494864.05	9036948.52	616	483815.21	9041802.12	883	503153.14	9042291.63
83	496423.75	9034060.53	350	494757.75	9036920.18	617	483979.21	9041942.12	884	503181.85	9042364.20
84	496430.01	9034069.30	351	494732.57	9036934.52	618	483734.26	9042082.82	885	503200.07	9042410.26
85	496402.00	9034098.50	352	494713.98	9037016.70	619	483637.73	9047072.46	886	503181.85	9042410.26
86	496421.09	9034144.32	353	494814.69	9037112.61	620	468415.62	9060128.09	887	503181.85	9042364.20
87	496536.09	9034420.32	354	494873.27	9037238.13	621	466380.02	9067629.65	888	503223.66	9042465.48
88	496602.44	9034571.98	355	494806.32	9037338.54	622	467456.21	9067898.34	889	503274.62	9042525.11
89	496606.88	9034582.13	356	494698.64	9037414.55	623	468197.88	9068030.90	890	503210.56	9042525.11
90	496615.00	9034600.69	357	494711.54	9037500.57	624	468841.28	9068751.99	891	503210.56	9042436.78

91	496635.59	9034647.76	358	494711.91	9037503.02	625	469115.83	9069165.80	892	503218.57	9042457.03
92	496652.68	9034686.82	359	494720.16	9037557.99	626	469148.93	9070000.39	893	503218.75	9042457.45
93	496664.31	9034713.39	360	494724.46	9037586.70	627	469715.39	9070494.82	894	503219.55	9042459.24
94	496677.81	9034744.25	361	494725.61	9037594.35	628	470523.35	9071341.49	895	503220.48	9042460.97
95	496693.02	9034779.01	362	494735.62	9037661.04	629	470602.70	9071904.52	896	503221.51	9042462.64
96	496735.74	9034876.67	363	494749.33	9037752.47	630	471886.22	9073110.27	897	503222.66	9042464.24
97	496736.81	9034876.88	364	494707.30	9037741.58	631	472442.82	9073441.79	898	503223.66	9042465.48
98	496755.91	9034811.41	365	494568.31	9037705.54	632	472706.88	9073796.40	899	507783.82	9041099.17
99	496841.13	9034794.37	366	494414.10	9037490.99	633	473467.02	9073887.44	900	507740.08	9041035.20
100	496932.03	9034794.37	367	494413.59	9037492.11	634	474211.26	9074911.96	901	507755.34	9040988.85
101	497068.39	9034794.37	368	494373.88	9037578.15	635	475066.51	9074991.57	902	507809.45	9040985.75
102	497125.20	9034868.22	369	494381.62	9037640.07	636	475481.78	9075561.29	903	507868.05	9041055.87
103	497102.48	9035004.58	370	494392.89	9037730.26	637	475737.04	9076637.61	904	507858.41	9041126.01
104	497119.56	9035049.60	371	494400.69	9037792.70	638	475894.76	9077591.94	905	507817.57	9041118.23
105	497164.97	9035169.34	372	494125.81	9037886.56	639	475928.67	9078437.75	906	507783.82	9041099.17
106	497079.75	9035180.70	373	494157.81	9037927.71	640	476158.88	9079438.57	907	504436.79	9041109.91
107	497045.74	9035175.60	374	494172.74	9037946.90	641	476147.02	9079782.60	908	504428.52	9041209.15
108	496966.12	9035163.66	375	494281.24	9037986.88	642	476469.25	9080341.93	909	504337.55	9041200.88
109	496880.90	9035072.76	376	494300.13	9037993.83	643	476108.25	9080741.93	910	504300.58	9041144.00
110	496843.56	9035074.25	377	494276.26	9038091.94	644	476102.86	9081116.85	911	504246.09	9041141.41
111	496768.08	9035083.85	378	494274.77	9038098.06	645	475674.25	9081651.93	912	504153.17	9041152.56
112	496767.67	9035077.29	379	494239.79	9038241.90	646	475773.21	9082842.14	913	504091.32	9041149.47
113	496738.86	9035078.44	380	494194.04	9038257.97	647	475692.62	9083266.28	914	504064.08	9041161.16
114	496716.14	9034947.76	381	494058.98	9038305.43	648	476055.25	9084431.91	915	504058.78	9041074.82
115	496719.40	9034936.58	382	493991.72	9038329.06	649	475644.71	9085235.60	916	504030.50	9040970.42
116	496705.25	9034929.66	383	493917.97	9038436.33	650	491931.83	9092531.60	917	503933.86	9040862.63
117	496546.14	9035030.43	384	493879.27	9038418.39	651	494213.96	9093555.16	918	503926.03	9040848.54
118	496841.14	9035399.18	385	493649.58	9038311.86	652	494251.44	9093548.23	919	503842.86	9040812.90
119	496750.44	9035444.53	386	493633.69	9038304.49	653	494437.34	9093513.84	920	503818.84	9040810.26
120	496658.00	9035490.75	387	493620.87	9038298.55	654	494816.29	9093443.76	921	503762.19	9040907.39
121	496549.46	9035545.02	388	493455.36	9038221.79	655	504521.78	9091650.73	922	503822.42	9040950.41
122	496543.16	9035548.17	389	493234.11	9038228.49	656	509484.11	9090735.41	923	503839.63	9041062.27
123	496492.04	9035573.73	390	493200.94	9038291.75	657	509496.02	9090384.01	924	503813.82	9041242.96
124	496485.73	9035576.88	391	493104.06	9038476.49	658	509460.56	9090271.46	925	503812.16	9041244.02
125	496463.32	9035588.09	392	493089.96	9038503.38	659	509626.35	9090106.16	926	503813.73	9041253.66
126	496438.87	9035600.32	393	493019.89	9038618.78	660	509838.14	9089969.11	927	503801.70	9041250.67
127	496348.48	9035531.74	394	492984.09	9038677.74	661	510021.90	9089744.86	928	503719.17	9041303.20
128	496332.29	9035519.46	395	492903.08	9038811.18	662	510246.16	9089654.53	929	503584.16	9041196.61
129	496319.77	9035509.96	396	492879.50	9038850.01	663	510786.55	9089523.72	930	503511.63	9041178.59
130	496256.59	9035462.04	397	492874.37	9038858.47	664	511247.51	9089202.91	931	503509.99	9041201.63
131	496244.44	9035452.82	398	492862.00	9038878.83	665	511638.40	9088586.21	932	503489.67	9041226.47
132	496061.36	9035448.75	399	492827.59	9038964.86	666	511755.20	9088090.99	933	503457.45	9041202.31
133	495975.23	9035446.83	400	492794.96	9039046.45	667	511712.93	9087558.42	934	503448.82	9041195.83
134	495942.74	9035446.11	401	492473.14	9039033.04	668	511826.19	9087206.05	935	503424.56	9041204.39
135	495922.03	9035462.04	402	492479.45	9039022.28	669	502519.23	9045829.83	936	503448.31	9041166.39
136	495768.42	9035580.20	403	492496.28	9038993.57	670	502498.13	9045783.42	937	503451.39	9041162.54
137	495573.26	9035485.77	404	492501.11	9038985.32	671	502434.99	9045787.05	938	503402.42	9041157.10
138	495560.58	9035479.63	405	492513.11	9038964.86	672	502431.31	9045636.40	939	503323.36	9041148.32
139	495548.04	9035490.75	406	492529.94	9038936.15	673	502427.53	9045628.10	940	503309.68	9041118.23
140	495314.86	9035697.43	407	492587.12	9038838.61	674	502430.19	9045590.88	941	503300.16	9041097.27
141	495288.90	9035720.44	408	492558.54	9038832.59	675	502427.84	9045494.65	942	503280.33	9041053.67
142	495265.58	9035741.11	409	492501.11	9038820.50	676	502439.21	9045494.00	943	503324.52	9041047.35
143	495286.15	9035761.68	410	492357.56	9038790.28	677	502439.44	9045493.98	944	503340.57	9041045.06
144	495312.51	9035788.04	411	492332.35	9038784.97	678	502441.39	9045493.79	945	503374.98	9040993.43
145	495440.29	9035749.15	412	492321.86	9038774.48	679	502443.33	9045493.47	946	503452.43	9040993.43
146	495466.71	9035741.11	413	492164.73	9038617.36	680	502445.24	9045493.03	947	503473.53	9040993.43
147	495500.24	9035848.38	414	492150.33	9038649.03	681	502447.12	9045492.46	948	503490.10	9040980.49
148	495429.70	9035930.67	415	492131.21	9038691.11	682	502447.30	9045492.40	949	503542.01	9040960.39
149	495419.78	9035942.25	416	492151.32	9038818.49	683	502555.91	9045417.20	950	503542.64	9040960.14
150	495429.70	9035946.31	417	491896.55	9039033.04	684	502536.40	9045395.52	951	503544.43	9040959.33
151	495439.07	9035950.14	418	491798.25	9039000.27	685	502431.30	9045434.38	952	503546.16	9040958.41
152	495458.42	9035958.05	419	491695.42	9038965.99	686	502426.37	9045434.66	953	503547.83	9040957.37
153	495567.28	9036002.59	420	491635.08	9038758.15	687	502426.08	9045422.86	954	503549.42	9040956.23
154	495601.97	9035936.10	421	491621.29	9038764.28	688	502441.76	9045239.61	955	503550.94	9040954.99
155	495624.61	9035892.71	422	491582.34	9038781.59	689	502470.87	9045055.59	956	503552.38	9040953.65
156	495630.69	9035881.07	423	491574.73	9038784.97	690	502545.05	9044947.13	957	503553.72	9040952.22
157	495639.59	9035864.00	424	491576.46	9038821.30	691	502660.14	9044821.80	958	503554.96	9040950.70
158	495647.74	9035848.38	425	491577.83	9038850.01	692	502636.76	9044823.15	959	503555.68	9040949.70
159	495676.13	9035864.00	426	491580.57	9038907.44	693	502566.13	9044862.51	960	503555.68	9040912.83
160	495716.82	9035886.38	427	491581.44	9038925.76	694	502451.75	9044784.34	961	503546.49	9040889.59
161	495728.33	9035892.71	428	491553.63	9038931.85	695	502518.49	9044681.65	962	503495.45	9040838.55
162	495745.53	9035902.17	429	491533.97	9038936.15	696	502529.23	9044737.52	963	503495.45	9040778.32
163	495781.83	9035922.13	430	491521.93	9038938.78	697	502597.33	9044775.98	964	503572.89	9040700.88
164	495775.49	9036036.27	431	491383.10	9038969.15	698	502670.99	9044785.87	965	503607.31	9040649.25
165	495775.12	9036042.82	432	491366.89	9038972.70	699	502729.23	9044782.53	966	503608.62	9040646.62
166	495835.46	9036042.82	433	491269.68	9039348.15	700	502730.02	9044795.46	967	503641.72	9040580.42
167	495860.38	9036016.43	434	491383.46	9039575.71	701	502784.81	9044782.23	968	503658.93	9040494.37
168	495868.76	9036007.56	435	491383.66	9039576.10	702	502802.59	9044893.79	969	503712.52	9040429.30
169	495889.09	9035986.03	436	491323.31	9039723.60	703	502802.92	9045035.94	970	503706.53	9040400.10
170	495895.88	9035978.85	437	491323.31	9039891.22	704	502730.13	9045078.48	971	503714.95	9040336.97
171	495899.86	9035974.63	438	491189.22	9039985.08	705	502728.62	9045079.43	972	503756.02	9040341.86
172	495881.92	9035975.91	439	491193.95	9040055.90	706	502727.02	9045080.57	973	503778.54	9040344.54
173	495831.67	9035978.42	440	491201.60	9040170.75	707	502725.50	9045081.81	974	503791.77	9040362.18
174	495831.67	9035978.85	441	491202.63	9040186.22	708	502724.07	9045083.15	975	503788.70	9040371.41
175	495830.93	9035978.85	442	490947.86	9040534.85	709	502722.73	9045084.59	976	503894.98	9040393.70
176	495830.80	9035978.47	443	490760.13	9040528.15	710	502721.48	9045086.10	977	503931.44	9040446.63
177	495827.47	9035978.63	444	490750.30	9040515.29	711	502720.34	9045087.70	978	503951.49	9040451.35
178	495825.35	9035961.72	445	490694.70	9040442.58	712	502719.30	9045089.36	979	503953.29	9040478.34
179	495814.59	9035928.66	446	490676.55	9040418.84	713	502718.75	9045090.36	980	503978.96	9040515.60
180	495820.54	9035923.25	447	490672.97	9040414.17	714	502675.92	9045171.39	981	503959.17	9040566.57
181	495819.30	9035913.29	448	490681.76	9040395.35	715	502675.55	9045172.12	982	503960.06	9040579.96
182	495843.80	9035880.62	449	490706.18	9040343.02	716	502674.73	9045173.91	983	503960.09	9040580.42
183	495900.97	9035872.45	450	490751.34	9040246.25	717	502674.04	9045175.74	984	504080.56	9040666.46
184	495904.53	9035874.75	451	490766.84	9040213.03	718	502673.47	9045177.62	985	504185.95	9040734.22
185	495960.20	9035866.12	452	490741.73	9040203.24	719	502673.32	9045178.26	986	504306.31	9040697.70
186	495978.82	9035865.04	453	490520.01	9040116.71	720	502758.93	9045237.53	987	504353.86	9040824.28
187	495983.16	9035892.71	454	490491.95	9040105.76	721	502766.81	9045242.98	988	504361.32	9040825.46
188	495975.23	9035892.71	455	490490.04	9040055.90	722	502764.88	9045250.68	989	504361.32	9040844.14
189	495975.23	9035918.70	456	490485.33	9039933.55	723	502751.85	9045302.82	990	504363.28	9040849.36
190	495975.54	9035918.88	457	490485.25	9039931.44	724	502746.36	9045324.76	991	504428.52	9040878.35
191	496004.43	9035943.24	458	490585.82	9039777.24	725	503013.62	9045337.01	992	504436.79	9041109.91
192	496056.16	9035956.85	459	490564.62	9039748.98	726	502995.55	9045481.32	993	503893.65	9039811.07
193	496009.04	9035962.51	460	490557.94	9039740.08	727	502809.29	9045512.23	994	503907.54	9039699.96
194	496061.36	9035997.95	461	490525.48	9039696.79	728	502748.47	9045701.46	995	504011.70	9039727.73
195	496157.28	9036062.93	462	490433.88	9039691.96	729	502684.28	9045884.85	996	503990.87	9039852.74

196	496061.36	9036124.71	463	490398.09	9039690.08	730	502519.23	9045829.83	997	503893.65	9039811.07
197	495975.78	9036179.83	464	490397.49	9039682.65	731	502952.16	9043156.76	998	494629.66	9037938.39
198	495959.50	9036190.32	465	490384.68	9039522.47	732	502952.16	9043128.05	999	494636.16	9037736.03
199	496033.25	9036237.25	466	490368.46	9039457.57	733	502980.87	9043128.05	1000	494672.17	9037750.91
200	496207.56	9036277.47	467	490357.86	9039415.19	734	502980.87	9043099.34	1001	494673.96	9037751.58
201	496321.54	9036438.38	468	490334.09	9039421.53	735	503067.00	9043099.34	1002	494675.84	9037752.15
202	496261.20	9036599.29	469	490146.76	9039471.49	736	503067.00	9043128.05	1003	494677.75	9037752.60
203	496147.50	9036593.96	470	490108.58	9039481.67	737	503095.72	9043128.05	1004	494679.69	9037752.92
204	496090.07	9036591.27	471	490056.16	9039495.65	738	503095.72	9043099.34	1005	494681.64	9037753.11
205	495887.89	9036581.79	472	490020.64	9039537.43	739	503124.43	9043099.34	1006	494683.60	9037753.18
206	495832.11	9036579.18	473	489942.18	9039629.74	740	503124.43	9043070.63	1007	494685.56	9037753.12
207	495829.28	9036581.79	474	490062.86	9039897.92	741	503153.14	9043070.63	1008	494687.51	9037752.92
208	495774.24	9036632.59	475	490062.86	9040033.34	742	503153.14	9043128.05	1009	494689.45	9037752.61
209	495767.07	9036639.22	476	490062.86	9040132.58	743	503124.43	9043128.05	1010	494691.36	9037752.16
210	495657.79	9036740.09	477	489955.59	9040213.03	744	503124.43	9043214.19	1011	494693.24	9037751.59
211	495483.48	9036559.06	478	489885.19	9040461.10	745	503101.47	9043214.19	1012	494695.08	9037750.90
212	495322.57	9036612.70	479	489916.55	9040486.58	746	503089.79	9043307.37	1013	494696.86	9037750.09
213	495255.30	9036581.79	480	489917.07	9040487.00	747	502975.40	9043325.48	1014	494698.60	9037749.17
214	495200.01	9036556.39	481	489931.79	9040498.97	748	502934.07	9043300.91	1015	494700.26	9037748.14
215	495192.81	9036553.08	482	489992.47	9040548.26	749	502913.71	9043228.93	1016	494701.86	9037746.99
216	495142.59	9036530.01	483	490000.98	9040551.83	750	502967.39	9043195.05	1017	494703.38	9037745.75
217	495130.32	9036524.37	484	490200.31	9040635.42	751	502980.87	9043173.87	1018	494704.06	9037745.11
218	495085.16	9036503.62	485	490280.76	9040776.21	752	502980.87	9043156.76	1019	494730.10	9037795.33
219	495074.50	9036498.72	486	490220.42	9040963.94	753	502952.16	9043156.76	1020	494707.19	9037955.04
220	495034.27	9036565.77	487	490118.05	9040957.34	754	503187.19	9042962.64	1021	494629.66	9037938.39
221	495065.17	9036581.79	488	490031.91	9040951.78	755	503213.28	9042911.72	1022	495544.55	9037758.97
222	495113.88	9036607.04	489	490012.58	9040950.53	756	503268.76	9042908.53	1023	495544.55	9037701.55
223	495120.55	9036610.50	490	490009.53	9040945.96	757	503271.95	9042915.41	1024	495601.97	9037701.55
224	495171.30	9036636.82	491	490003.20	9040936.46	758	503260.85	9042972.53	1025	495601.97	9037672.84
225	495215.29	9036659.63	492	489990.39	9040917.25	759	503203.91	9042996.99	1026	495659.40	9037672.84
226	495113.88	9036717.38	493	489974.49	9040893.40	760	503187.19	9042962.64	1027	495659.40	9037787.68
227	495099.88	9036725.35	494	489971.25	9040888.54	761	503088.83	9042902.31	1028	495573.26	9037787.68
228	495056.45	9036750.08	495	489917.07	9040807.26	762	503096.30	9042791.33	1029	495573.26	9037758.97
229	495049.46	9036754.06	496	489894.69	9040773.69	763	503163.98	9042822.75	1030	495544.55	9037758.97
230	494970.32	9036799.13	497	489888.35	9040764.19	764	503168.74	9042900.15	1031	504000.16	9037205.83
231	494948.62	9036811.49	498	489876.68	9040746.69	765	503110.93	9042910.53	1032	503833.07	9037169.71
232	494811.10	9036889.80	499	489865.08	9040729.28	766	503088.83	9042902.31	1033	503833.07	9037156.03
233	495217.37	9036914.87	500	489847.97	9040752.09	767	503870.93	9042553.82	1034	503833.07	9037107.19
234	496101.28	9037016.47	501	489824.85	9040782.92	768	503870.93	9042496.39	1035	503832.06	9037098.60
235	496193.18	9037027.04	502	489854.91	9040879.11	769	503899.64	9042496.39	1036	503812.22	9037098.60
236	497124.13	9037127.98	503	489871.23	9040931.34	770	503899.64	9042488.67	1037	503812.36	9037098.01
237	497398.93	9037178.46	504	489891.90	9040997.46	771	503861.60	9042496.28	1038	503812.68	9037096.07
238	497511.10	9037189.67	505	489824.38	9041004.00	772	503813.51	9042498.96	1039	503812.86	9037094.28
239	497628.87	9037150.42	506	489772.33	9041009.04	773	503813.51	9042525.11	1040	503819.93	9036995.48
240	497499.88	9037071.90	507	489684.06	9041017.58	774	503698.66	9042525.11	1041	503818.44	9036982.81
241	497483.06	9036970.96	508	489543.26	9041325.99	775	503698.66	9042553.82	1042	503821.97	9036966.91
242	497572.79	9036841.97	509	489502.57	9041305.64	776	503612.53	9042553.82	1043	503823.15	9036950.46
243	496121.38	9035905.97	510	489391.25	9041249.98	777	503612.53	9042525.11	1044	503823.16	9036950.30
244	496150.40	9035852.22	511	489382.35	9041245.53	778	503583.81	9042525.11	1045	503823.18	9036950.01
245	496301.47	9035853.93	512	489371.54	9041119.43	779	503583.81	9042467.68	1046	503823.94	9036936.56
246	496266.93	9035954.30	513	489362.24	9041010.87	780	503526.39	9042467.68	1047	503828.49	9036937.59
247	496121.38	9035905.97	514	489125.44	9040917.25	781	503497.68	9042467.68	1048	503832.37	9036920.11
248	495692.73	9035774.43	515	489103.17	9040908.45	782	503354.12	9042467.68	1049	503828.96	9036890.49
249	495726.73	9035626.64	516	489073.94	9040896.90	783	503354.12	9042525.11	1050	503826.53	9036890.63
250	495803.23	9035643.07	517	489062.68	9040866.07	784	503353.51	9042525.11	1051	503827.33	9036876.44
251	495855.67	9035619.21	518	489058.87	9040855.65	785	503272.50	9042430.31	1052	503823.55	9036843.67
252	495887.20	9035688.80	519	488983.10	9040648.27	786	503268.40	9042419.94	1053	503829.58	9036836.68
253	495748.38	9035802.47	520	488946.56	9040548.26	787	503242.98	9042415.70	1054	503832.34	9036787.78
254	495692.73	9035774.43	521	488940.59	9040493.69	788	503220.10	9042301.32	1055	503832.38	9036786.90
255	496441.58	9033759.51	522	488923.09	9040333.72	789	503220.96	9042300.03	1056	503832.50	9036782.28
256	496478.15	9033746.16	523	488986.90	9040200.78	790	503218.91	9042294.84	1057	504049.78	9036760.63
257	496478.02	9033752.18	524	489003.55	9040166.10	791	503176.59	9042279.73	1058	504051.71	9036791.92
258	496441.58	9033759.51	525	488894.38	9040212.89	792	503155.40	9042272.16	1059	504147.34	9036842.55
259	497120.17	9033430.83	526	488878.85	9040219.54	793	503154.04	9042246.27	1060	504166.42	9037014.30
260	497147.89	9033427.63	527	488862.75	9040226.44	794	503149.50	9042266.70	1061	504170.94	9037015.33
261	497172.39	9033446.69	528	488862.12	9040227.39	795	503124.43	9042266.70	1062	504169.39	9037041.08
262	497186.01	9033498.41	529	488842.46	9040256.88	796	503124.43	9042237.99	1063	504172.15	9037065.84
263	497158.82	9033533.97	530	488826.02	9040281.54	797	503095.72	9042237.99	1064	504180.42	9037189.89
264	497150.61	9033544.70	531	488823.32	9040285.60	798	503095.72	9042180.57	1065	504089.15	9037195.60
265	497066.21	9033482.08	532	488768.60	9040367.67	799	503124.43	9042180.57	1066	504086.39	9037208.61
266	497077.11	9033435.80	533	488742.07	9040407.47	800	503124.43	9042151.85	1067	504000.16	9037205.83
267	497120.17	9033430.83	534	488668.32	9040843.26	801	503153.14	9042151.85			

APPENDIX II: DEFINITION OF BIOMASS STOCKS

A total of 14 different forest phytophysiognomies were identified in the reference region, while 3 of them are present in the project area and 8 in the leakage belt.

These forest phytophysiognomies were grouped in accordance to their presence in each project spatial boundary (reference region, project area and leakage belt), according to the predominant category of each phytophysiognomy, following instructions from the Brazilian Institute for Geography and Statistics - IBGE.

Afterwards, biomass stocks were calculated through the weighted average between above ground biomass values for each phytophysiognomy, which were obtained from Salimon *et al.* (2011)[40], and the presence of each phytophysiognomy within each project boundary.

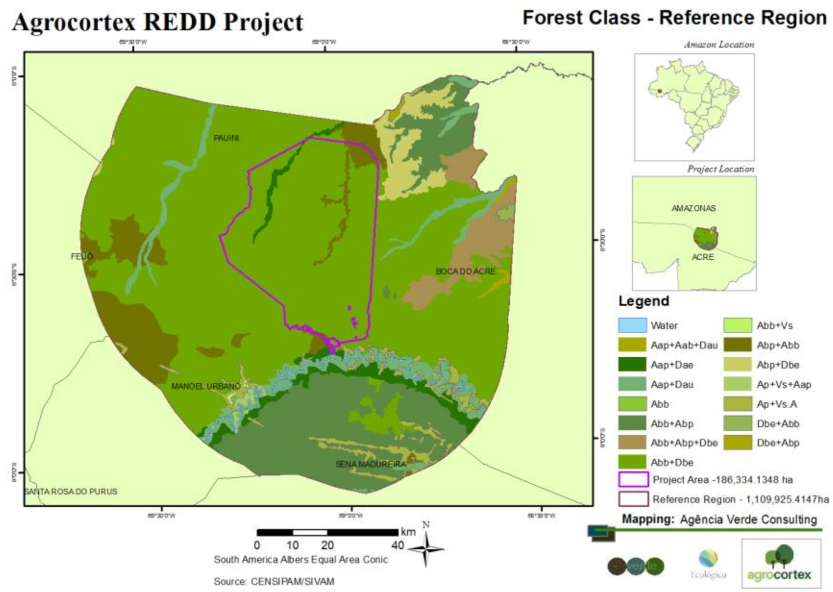
Table 50 below details the presence of each phytophysiognomy within each project spatial boundary and the grouping method adopted according to the predominant forest class. These data were used to calculate the weighted average of biomass stocks in each grouped forest class. In addition, the figure 23 presents the forest classes existing at each project boundary, RR, LB and PA.

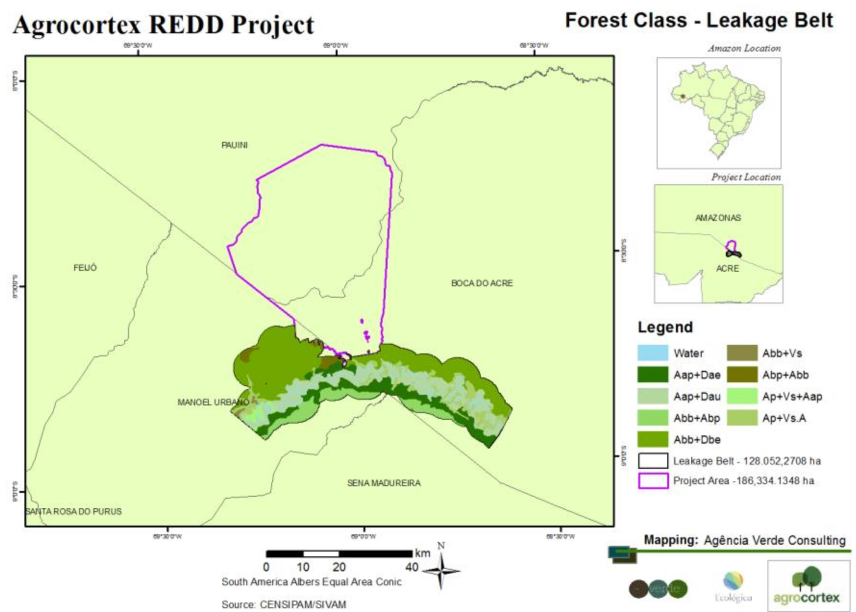
[40] SALIMON,C.I; PUTZ, F.E.; MENEZES-FILHO, L.; ANDERSON,A.; SILVEIRA, M.; FOSTER BROWN, I.; OLIVEIRA, L.C. Estimating state-wide biomass carbon stocks for a REDD plan in Acre, Brazil. 2011, **Forest Ecology and Management**, 262, p. 555–560, 2011.

				REFERENCE REGION			PROJECT AREA			LEAKAGE BELT		
Acronym	Vegetation classes (IBGE)	Grouped classes	Average above ground biomass (Mg ha^{-1})	Area of the vegetation class in the RR (ha)	% of the class in the grouped vegetation type	% of the class in the RR	Area of the vegetation class in the PA (ha)	% of the class in the grouped vegetation type	% of the vegetation class in the PA	Area of the vegetation class in the LK (ha)	% of the class in the grouped vegetation type	% of the vegetation class in the Leakage Belt
Abb	Floresta Ombrófila Aberta Terras Baixas com Bambu	Abb	192.80	362.16	0.04%	0.03%						
Abb+Abp	Floresta Ombrófila Aberta Terras Baixas com Bambu + Palmeiras		186.50	163,377.76	18.55%	14.72%				11,537.28	19%	9%
Abb+Abp+Dbe	Floresta Ombrófila Aberta Terras Baixas com Bambu + Palmeiras + Floresta Ombrófila Densa de terras Baixas com Dossel Emergente		274.90	41,426.30	4.70%	3.73%						
Abb+Dbe	Floresta Ombrófila Aberta Terras Baixas com Bambu + Floresta Ombrófila Densa de terras Baixas com Dossel Emergente		274.20	675,167.73	76.64%	60.83%	172,554.03	100%	93%	50,159.25	81%	39%
Abb+Vs	Floresta Ombrófila Aberta Terras Baixas com Bambu + Vegetação Secundária		114.90	625.84	0.07%	0.06%				526.94	1%	
Dbe	Floresta Ombrófila Densa de Terras Baixas com Dossel Emergente	Dbe	328.80	1,709.61	61.88%	0.15%						
Dbe+Abp	Floresta Ombrófila Densa de Terras Baixas com Dossel Emergente + Floresta Ombrófila Aberta Terras Baixas com Palmeiras		315.90	1,053.01	38.12%	0.09%						
Aap+Aab+Dau	Floresta Ombrófila Aberta Aluvial com	Aap	218.50	2,589.03	3.03%	0.23%						

	Palmeiras + Bambu + Floresta Ombrófila Densa Aluvial com Dossel Uniforme											
Aap+Dae	Floresta Ombrófila Aberta Aluvial com Palmeiras + Floresta Ombrófila Densa Aluvial com Dossel Emergente		218.50	27,683.70	32.36%	2.49%	4,133.22	100%	2%	18,796.21	41%	15%
Aap+Dau	Floresta Ombrófila Aberta Aluvial com Palmeiras + Floresta Ombrófila Densa Aluvial com Dossel Uniforme		218.50	55,264.26	64.61%	4.98%				27,023.56	59%	21%
Abp+Abb	Floresta Ombrófila Aberta Terras Baixas com Palmeiras + Bambu	Abp	234.30	74,968.58	71.23%	6.75%	9,531.80	100%	5%	2,694.49	100%	2%
Abp+Dbe+Abb	Floresta Ombrófila Aberta Terras Baixas com Palmeiras + Floresta Ombrófila Densa de terras Baixas com Dossel Emergente + Bambu		274.90	30,275.41	28.77%	2.73%						
Ap+Vs.A	Pecuária + Vegetação Secundária	Ap	37.00	27,709.95	91.78%	2.50%				12,645.19	87%	10%
Ap+Vs+ Aap	Pecuária + Vegetação Secundária + Floresta Ombrófila Aberta Aluvial com Palmeiras		37.00	2,481.65	8.22%	0.22%				1,818.77	13%	1%

Table 50. Presence of each phytophysiognomy within each project spatial boundary and the grouping method adopted according to the predominant forest class


Agrocortex REDD Project
Forest Class - Reference Region
Amazon Location
Project Location
AMAZONAS
ACRE
PAUINI
FEIJÓ
BOCA DO ACRE
MANOEL URBANO
SENA MADUREIRA
SANTA ROSA DO PURUS
Legend
Water
Aap+Aab+Dau
Aap+Dae
Aap+Dau
Abb
Abb+Abp
Abb+Abp+Dbe
Abb+Dbe
Abb+Vs
Abp+Abb
Abp+Dbe
Ap+Vs+Aap
Ap+Vs.A
Dbe+Abb
Dbe+Abp
Project Area -186,334.1348 ha
Reference Region - 1,109,925.4147ha
Mapping: Agência Verde Consulting
km
0 10 20 40
South America Albers Equal Area Conic
Source: CENSIPAM/SIVAM
agrocortex


Agrocortex REDD Project
Forest Class - Leakage Belt
Amazon Location
Project Location
AMAZONAS
ACRE
PAUINI
FEIJÓ
BOCA DO ACRE
MANOEL URBANO
SENA MADUREIRA
SANTA ROSA DO PURUS
Legend
Water
Aap+Dae
Aap+Dau
Abb+Abp
Abb+Dbe
Abb+Vs
Abp+Abb
Ap+Vs+Aap
Ap+Vs.A
Leakage Belt - 128.052,2708 ha
Project Area -186,334.1348 ha
Mapping: Agência Verde Consulting
km
0 10 20 40
South America Albers Equal Area Conic
Source: CENSIPAM/SIVAM
agrocortex

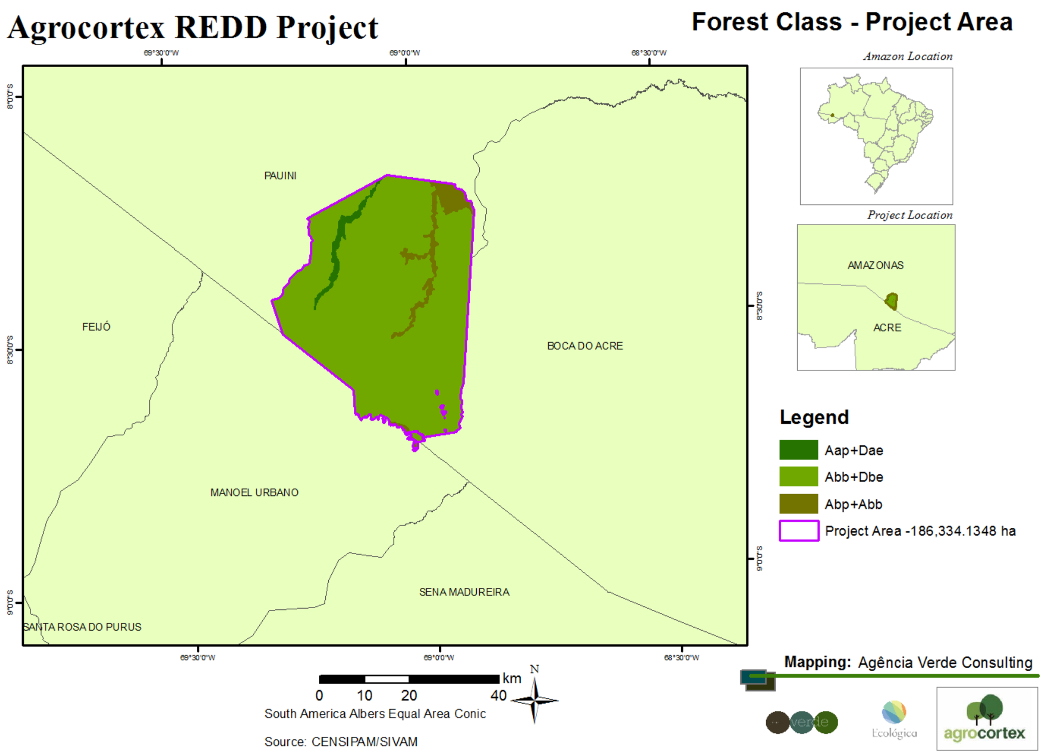


Figure 23. Forest classes existing at each project boundary, RR, LB and PA

APPENDIX III: METHODOLOGICAL PROCEDURES FOR LU/LC-CHANGE ANALYSIS

According to the applied methodology, in order to achieve a consistent time-series of LU/LC-change data over the crediting period, the detailed methodological procedures used in pre-processing, classification, post classification processing, and accuracy assessment of the remotely sensed data shall be carefully documented in the VCS PD. Therefore, the information below describes the methodological procedures applied during the current monitored period.

Data sources and pre-processing

The historic deforestation of the reference region should be analyzed through maps from MapBiomas (version 5.0, which was the last available version), available in raster format, which can be downloaded from the http://mapbiomas.org/ website. MapBiomas is a multi-institutional initiative of the Greenhouse Gas Emissions Estimation System (SEEG - http://seeg.eco.br/en/) promoted by the Climate Observatory. MapBiomas co-creation involves NGO's, universities and technology companies.

Furthermore, at least two Landsat scenes per year should be necessary to compose the entire reference region (orbit/point: 002/066 and 003/66). The final mapping resolution should be 30m.

Vector	Sensor	Resolution		Coverage	Acquisition date	Scene	
		Spatial (m)	Spectral (µm)	(Km²)	DD/MM/YY	Path	Row
Satellite	Landsat TM	30	0.45 – 2.35	34,225	2017-2019	3	66
Satellite	Landsat TM	30	0.45 – 2.35	34,225	2017-2019	2	66

Table 51. Source of the remotely sense data used for historical reference period

The forest dynamics data, the deforestation vectors and other base data from the studied region, which were used for the project's baseline construction, should be organized in a spatialized database. For this purpose, the software used in this baseline reassessment was the File Geodatabase format from ArcGIS 10.6. The files are stored in vector and matrix format (raster). In order to standardize spatial references, all data has been projected for the UTM and Datum WGS84, Zone 22S projection.

The MapBiomas methodology for land use classification uses 105 input variables, including the original Landsat bands, indexes, fractional and textural information derived from these bands, which are detailed in the table below.

			Reducer						
	band or index name	formula	median	median_dry	median_wet	amplitude	std Dev	min	Reference
bands	blue	B1 (L5 e L7); B2 (L8)							
	green	B2 (L5 e L7); B3 (L8)							
	red	B3 (L5 e L7); B4 (L8)							
	nir	B4 (L5 e L7); B5 (L8)							
	swir1	B5 (L5 e L7); B6 (L8)							
	swir2	B7 (L5); B8 (L7); B7 (L8)							
	temp	B6 (L5 e L7); B10 (L8)							
index	ndvi	(nir - red)/(nir + red)							
	evi2	(2.5 * (nir - red)/(nir + 2.4 * red + 1)							
	cai	(swir2 / swir1)							
	ndwi	(nir - swir1)/(nir + swir1)							
	gcvi	(nir / green - 1)							
	hall_cover	(-red*0.017 - nir*0.007 - swir2*0.079 + 5.22)							
	pri	(blue - green)/(blue + green)							
	savi	(1 + L) * (nir - red)/(nir + red + 0,5)							
	textG	('median_green') .entropy(ee.Kernel .square({radius: 5}))							
fraction	gv	fractional abundance of green vegetation within the pixel							
	npv	fractional abundance of non-photosynthetic vegetation within the pixel							
	soil	fractional abundance of soil within the pixel							
	cloud	fractional abundance of cloud within the pixel							
	shade	100 - (gv + npv + soil + cloud)							
MEM index	gvs	gv / (gv + npv + soil + cloud)							
	ndfi	(gvs - (npv + soil))/(gvs + (npv + soil))							
	sefi	(gv+npv_s - soil)/(gv+npv_s + soil)							
	wefi	((gv+npv) - (soil+shade)) /((gv+npv) + (soil+shade))							
	fns	((gv+shade) - soil) / ((gv+shade) + soil)							
slope		ALOS DSM: Global 30m							

Table 52. List, description and reference of bands, fractions and indexes available in the feature space[41]

[41] Source: MapBiomas. Description of each column below.

Where,

Median - Median of the pixel values of the best mapping period defined by each biome.

Median_dry = median of the quartile of the lowest pixel NDVI values.

Median_wet = median of the quartile of the highest pixel NDVI values.

Amplitude = amplitude of variation of the index considering all the images of each year.

stdDev = standard deviation of all pixel values of all images of each year.

Min = lower annual value of the pixels of each band.

In addition, Landsat Images used in MapBiomas were accessible via Google Earth Engine, and most of them are composed by the Collection 1 Tier 1 from USGS. This is the highest quality Level-1 products suitable for pixel-level time series analysis. These images are radiometrically calibrated and orthorectified using ground control points (GCPs) and digital elevation model (DEM) data to correct for relief displacement.

Data classification and post-processing

The LU/LC classes defined for this project activity were: Forest, Non-Forest and Hydrography. In addition, the established LU/LC-change categories were:

a) Forested areas that remains as forested areas (Conservation);

b) Forest that are converted to non-forested areas (Deforestation); or

c) Non-forested areas that remains as non-forested areas.

The image classification methodology for each year involves all Landsat images available for each period (Landsat 5 [L5], Landsat 7 [L7] and Landsat 8 [L8]) or other sensor available) with a cloud cover less than or equal to 50%. Thus, a representative mosaic of each year could be generated, selecting cloud free pixels from the available images. Metrics should be extracted for each pixel that describes its behavior during the year and could contain up to 105 layers of information. The mapping should be done with an artificial intelligence classifier, such as the Randon Forest. The Landsite images acquisition could be made through Google Earth Engine, with data from NASA and USGS (U.S. Geological Survey).

The algorithm may use samples obtained by reference maps, stable collections from previous MapBiomas series and/or direct collection by visual interpretation of Landsat images in order to classify a single map per class. This classification should then go through spatial filter, applying neighborhood rules and temporal filters to reduce spatial and temporal inconsistencies. The software used in this baseline reassessment was the ArcGIS 10.6. In addition, high resolution images from Google Earth software (https://earth.google.com/) were also utilized to perform some LU/LC-change analysis.

Due to the pixel-based classification method and the long temporal series, the MapBiomas applies a chain of post-classification filters. The first post-classification action involves the application of temporal filters. Then, a spatial filter was applied followed by a gap fill filter. The application of these filters removes classification noises. These post-classification procedures were implemented in the Google Earth Engine platform and are described below:

Gap Fill

The Gap fill is a temporal filter used to fill possible no-data values. In a long time series of severely cloud-affected regions, it is expected that no-data values may populate some of the resultant median composite pixels. In this filter, no-data values (“gaps”) are theoretically not allowed and are replaced by the temporally nearest valid classification

Spatial Filter

Spatial filter was applied to avoid unwanted modifications to the edges of the pixel groups (blobs), a spatial filter was built based on the “connectedPixelCount” function. This function locates connected components (neighbours) that share the same pixel value.

Temporal Filter

The temporal filter uses sequential classifications in a three-to-five-years unidirectional moving window to identify temporally non-permitted transitions. Based on generic rules (GR), the temporal filter inspects the central positions of three to five consecutive years, and if the extremities of the consecutive years are identical but the centre position is not, then the central pixels are reclassified to match its temporal neighbour class.

Frequency Filter

This filter takes into consideration the occurrence frequency throughout the entire time series. Thus, all class occurrence with less than given percentage of temporal persistence (eg. 3 years or fewer out of 33) are filtered out. This mechanism decreasing the number of false positives and preserving consolidated trajectories.

Incident Filter

An incident filter was applied to remove pixels that changed too many times in the 34 years of time spam. All pixels that changed more than eight times and are connected to less than 6 pixels were replaced by the MODE value of that given pixel position in the stack of years.

Classification accuracy assessment

The MapBiomas results go through an accuracy evaluation, which remains in 95% for the entire Amazon Biome. However, to meet the particularities of the project’s region, an independent evaluation was carried out for the reference region.

Thus, in order to assess the accuracy of the maps produced by the MapBiomas methodology, a confusion matrix was generated calculating the percentages of user and producer correctness, as well as omission and commission errors.

A total of 210 random points was drawn on the reference region (70 points for each land use class – Forest, Non-Forest and Hydrography) and the degree of correctness of the classification was verified. High resolution images from Google Earth should also be used as reference, in which land use was visually possible at the drawn points.

The table below shows the final accuracy analysis carried out for each year and each land use class during the analyzed monitoring period.

	Producer accuracy			User accuracy		
Year	Forest	Hydrography	Deforestation	Forest	Hydrography	Deforestation
2017	100.00%	98.55%	93.24%	95.71%	97.14%	98.57%
2018	100.00%	97.18%	93.24%	92.86%	98.57%	98.57%
2019	100.00%	98.57%	95.83%	97.14%	98.57%	98.57%

Table 53. Summary of confusion matrices from the evaluation of MapBiomas from 2017 to 2019