



**Verified Carbon  
Standard**

## MONITORING REPORT

# ECOMAPUÁ AMAZON REDD PROJECT



SUSTAINABLE  
**CARBON**

Document Prepared by Sustainable Carbon – Projetos Ambientais Ltda.

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<b>Prepared By</b>	Sustainable Carbon – Projetos Ambientais Ltda.
<b>Contact</b>	Rua Dr. Bacelar, 368 - Conjunto 23, Vila Clementino, São Paulo/SP, Brazil Postal code: 04026-001 Telephone: +55 11 2649.0036 Email: marcelo@sustainablecarbon.com Website: <a href="http://www.sustainablecarbon.com/">http://www.sustainablecarbon.com/</a>

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# 1 PROJECT DETAILS

## 1.1 Summary Description of the Implementation Status of the Project

The Ecomapuá Amazon REDD Project is located on Marajó Island, Pará State, in the Eastern Amazon region of Brazil. The island lies at the mouth of the Amazon River, which has been called the rainforest's "super highway", being the principal means of transportation as well as a strong driver of deforestation. Marajó is Brazil's richest region in terms of waterways<sup>1</sup>, and it has a long history of colonization especially by small-scale subsistence farmers, beginning early in the history of Amazon exploration during the rubber-tapping era. The Marajó várzea is a critically valuable ecosystem for many species, but especially noted for its avifauna<sup>2</sup>, adding to the importance of the present project.

The primary objective of the Ecomapuá Amazon REDD Project is to avoid the unplanned deforestation (AUD) of a subsection of the 97,007.22 ha project area, which is within a private property on Marajó Island, owned by Ecomapuá Conservação Ltda. (hereafter, "the company"). The company is a private Brazilian sustainable development firm engaged in renewable energy and carbon finance projects, with the mission of conserving the environment and improving living standards of isolated communities on the island. Ecomapuá Ltda. was created on 19-July-2001, with the following goal described in their Social Contract<sup>3</sup>: "development of sustainable development projects, clean development mechanisms, carbon sequestration". The diagnostic study of the project area, published on 01-September-2002, was the first action of the company in terms of initiating the present REDD project, and is thus the designated project start date.

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

During the current monitoring period from 01-January-2013 to 31-December-2017, the present REDD project avoided around 164.05 ha of deforestation, resulting in 174,939 tCO<sub>2e</sub> in emissions reductions. This figure of emissions reductions is after subtractions for buffer and

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<sup>1</sup> Grupo Executivo do Estado do Pará para o Plano Marajó (GEPLAM) (2007), "Plano De Desenvolvimento Territorial Sustentável Do Arquipélago Do Marajó."

<sup>2</sup> Antonio A. F. Rodrigues, (June 2007) "Priority Areas for Conservation of Migratory and Resident Waterbirds on the Coast of Brazilian Amazonia". *Revista Brasileira de Ornitologia* 15 (2) 209-218.

<sup>3</sup> São Paulo, 19.07.01 - "Instrumento particular de Alteração de Contrato Social, Santana Madeiras Ltda.".

project emissions. Revenue from the sale of VCU is essential for the project activity to compete with profitable alternative land-use scenarios, namely unplanned timber production.

## 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

<b>Organization name</b>	Ecomapuá Conservação Ltda.
<b>Contact person</b>	Lap Tak Chan
<b>Title</b>	Managing Partner
<b>Address</b>	Avenida Gentil Bittencourt, n° 1390, Loja B-4, Bairro Nazaré Postal Code: 66040-000, Belém, Pará, Brazil
<b>Telephone</b>	+55 11 3034 4408
<b>Email</b>	lap@ecomapua.com.br

<b>Organization name</b>	Sustainable Carbon – Projetos Ambientais Ltda.: Project developer, Project participant and Project conceiver. As the authorized project contact, Sustainable Carbon was given the responsibility of developing the present Monitoring Report.
<b>Contact person</b>	Marcelo H. S. Haddad
<b>Title</b>	Technical Coordinator
<b>Address</b>	R. Doutor Bacelar, 368 – Conj. 23 – Vila Clementino Postal Code: 04026-001 São Paulo – SP, Brazil
<b>Telephone</b>	+55 11 2649 0036
<b>Email</b>	marcelo@sustainablecarbon.com

## 1.4 Other Entities Involved in the Project

<b>Organization name</b>	Uezu Planejamento Ambiental S/S LTDA
<b>Role in the Project</b>	Coordinator
<b>Contact person</b>	Alexandre Uezu
<b>Title</b>	CEO
<b>Address</b>	Rod. D. Pedro I KM 47, SN, Nazaré Paulista – SP
<b>Telephone</b>	-
<b>Email</b>	-

## 1.5 Project Start Date

The project start date is 01-September-2002 because an initial diagnostic study of the area, commissioned by Ecomapuá Ltda., was published on this date, analyzing the risk of deforestation over the next 30 years<sup>4</sup>. The deforestation rate identified in the aforementioned study was 0.685% per year – an estimated baseline which justified the probable viability of a future REDD project. To clarify, this deforestation rate is not the one utilized in the present REDD project, merely a preliminary estimate.

Ecomapuá Ltda. was created on 19-July-2001, with the following goal described in their Social Contract<sup>5</sup>: “development of sustainable development projects, clean development mechanisms, carbon sequestration”. Therefore, the diagnostic study mentioned above was the first action of the company in terms of initiating the present REDD project, and is thus the designated project start date.

## 1.6 Project Crediting Period

The Ecomapuá Amazon REDD Project has a crediting period of 30 years, from 01-January-2003 until 31-December-2032.

The present monitoring report, covering the period from 01-January-2013 to 31-December-2017, is within the second baseline period of this project activity, from 01-January-2013 to 31-December-2022.

<sup>4</sup> P. G. Martorano (September 2002), “Caracterização da vegetação e uso do solo das terras pertencentes à empresa Ecomapuá Conservação Ltda No Município de Breves, Pará”.

<sup>5</sup> São Paulo, 19.07.01 - “Instrumento particular de Alteração de Contrato Social, Santana Madeiras Ltda.”.

## 1.7 Project Location

The Ecomapuá Amazon REDD Project is situated on Marajó Island (Ilha de Marajó) in Pará State in the far north of Brazil, which is the lower Amazon Basin. The island forms the mouth of the Amazon River, the Amazon and Tocantins rivers being the western and the eastern boundaries of Marajó Island, respectively. Marajó is considered the largest river/sea island in the world, being almost the size of Switzerland and spanning over 48,000 km<sup>2</sup> <sup>6</sup>.

There are 16 municipalities in the Marajó archipelago, divided into three micro-regions: Portel, Furos de Breves and Ararí. The areas belonging to Ecomapuá Ltda. are located in the Furos de Breves micro-region, in the western part of Marajó Island, and fall into three municipalities: Breves, Curralinho and São Sebastião da Boa Vista. In terms of transport, the project is only reachable by a 12-hour boat journey or a 45-minute flight from the city of Belem.

The project area comprehensively belongs to Ecomapuá Ltda., and is split into five properties (Portuguese: Fazendas): Bom Jesus, Brasileiro, Lago do Jacaré, São Domingos and Vila Amélia. In accordance with the approved VCS Methodology VM0015, version 1.1, they are areas which 'include only "forest"<sup>7</sup> for a minimum of ten years prior to the project start date'. As shown in the figure below, the size of the areas that were considered as "non-forest" within the project area was 1,414.25 ha. This was excluded from the initial area of 98,421.47 ha, resulting in 97,007.22 ha, which was then defined as project area.

The Ecomapuá properties are located on either side of the Mapuá River, and span three municipalities: the four smaller properties are located in Breves municipality, while the largest property, "Lago do Jacaré", extends into the municipalities of Curralinho and São Sebastião da Boa Vista. The full contour coordinates of the project area are found in Appendix I. The northern boundary of the property is constituted by the delta of the Aramã and Mapuá rivers, and to the east by the municipality of São Sebastião da Boa Vista, to the west by the delta of the Mapua-Mirim and Furo dos Macacos, and to the South by the municipality of Curralinho.

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<sup>6</sup> LIMA, C. M. **Dinâmica da vegetação e inferências climáticas no Quaternário Tardio na região da Ilha de Marajó (PA), empregando os isótopos do carbono (12C, 13C, 14C) da matéria orgânica de solos e sedimentos**. 183 p. Dissertação (Master) - Energia Nuclear na Agricultura e no Ambiente, Universidade de São Paulo (USP), Piracicaba, 2008.

<sup>7</sup> The applied definition of forest is from the FAO: "Land with tree crown cover (or equivalent stocking level) of more than 10 percent and area of more than 0.5 hectares (ha). The trees should be able to reach a minimum height of 5 meters (m) at maturity *in situ*." Available at: <<http://www.fao.org/docrep/006/ad665e/ad665e06.htm>>. Last visited on: March 21<sup>st</sup>, 2018.

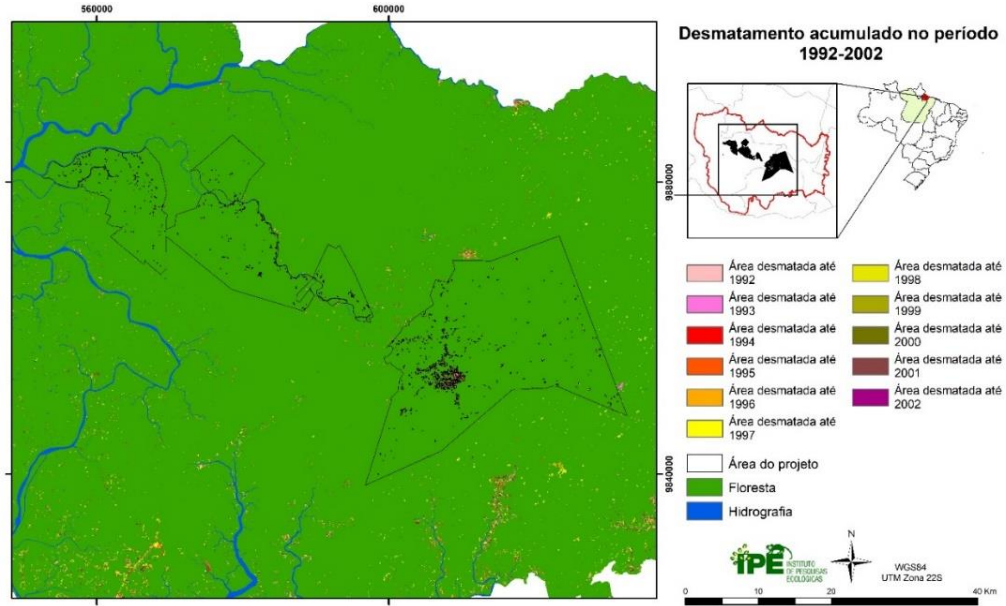


Figure 1. REDD area, showing in orange the areas to be excluded, not being defined as forest 10 years prior to the project start date

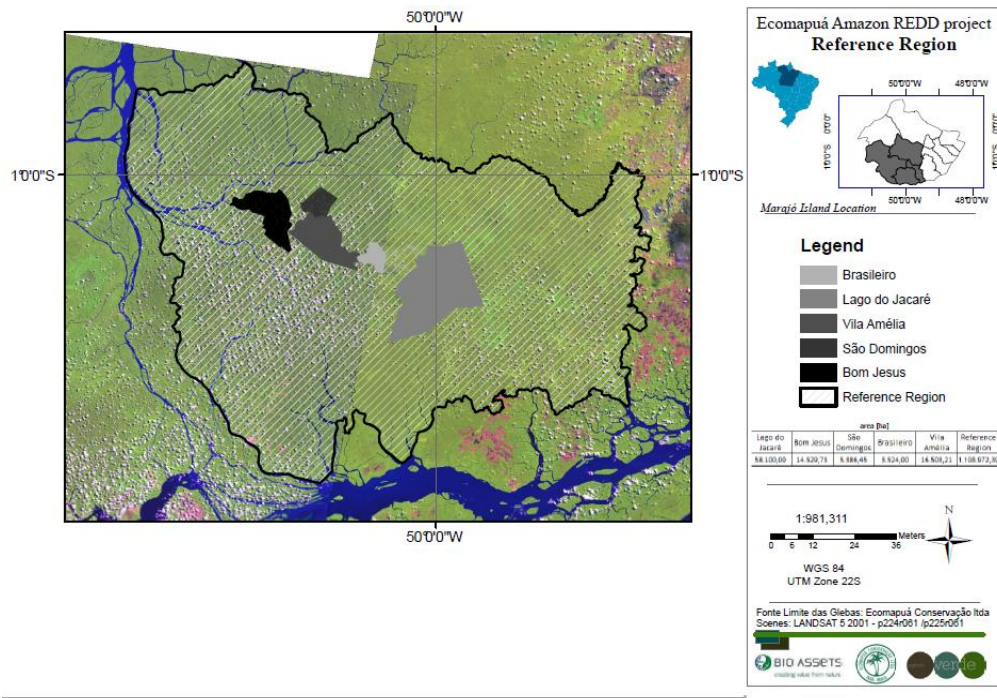


Figure 2. Ecomapuá REDD project's five properties and reference region

## 1.8 Title and Reference of Methodology

The project applies a methodology approved under the Verified Carbon Standard: VCS Methodology VM0015 - Methodology for Avoided Unplanned Deforestation, version 1.1, published on 03-December-2012.

In addition, the SOCIALCARBON Methodology<sup>8</sup> is being applied as a sustainability tool in association with VCS Standard.

Furthermore, the following tools were used:

- AFOLU Non-Permanence Risk Tool v4.0, 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.

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<sup>8</sup> SOCIALCARBON Methodology was developed by Ecológica Institute ([www.ecologica.org.br](http://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 Ecomapuá Amazon REDD Project is to avoid the unplanned deforestation (AUD) of the project area, consisting of 100% Amazon rainforest.

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

- SDG 1: No poverty.
- SDG 4: Quality education.
- SDG 8: Decent work and economic growing.
- SDG 12: Ensure sustainable production and consumption patterns.
- SDG 13: Take urgent action to combat climate change and its impacts.
- SDG 15: To protect, restore and promote the sustainable use of terrestrial ecosystems, to manage forests sustainably, to combat desertification, to halt and reverse land degradation, and to halt the loss of biodiversity.

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<sup>9</sup>.

The following components of the Brazilian commitments under the Convention are reinforced by the development of the Ecomapuá Amazon 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.

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<sup>9</sup> Brazil's Nationally Determined Contribution towards achieving the objective of the United Nations Framework Convention on Climate Change can be accessed in full at: <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Brazil/1/BRAZIL%20iNDC%20english%20FINAL.pdf>. Last visited on December 10<sup>th</sup>, 2019.

In addition, beyond the project's ecological and carbon benefits, the implementation of REDD and SOCIALCARBON mechanisms promotes benefit sharing: a proportion of the carbon credits generated will be dedicated to 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

Ecomapuá has conducted a social and environmental impact assessment within the Project Area in 2002<sup>10</sup>. According to this assessment, there were 99 families in the project area, and an estimated 187 families in the reference region at the time of the study.

During the research, various meetings and consultations were held with the local residents of Ecomapuá Ltda.'s area to explain the company's proposition and enquire about their opinions. It became apparent that the local families were motivated to attend the meetings in order to be informed about the company's plans and proposals, while they clearly sought to demonstrate dissatisfaction at the loss of income because of the ban on wood extraction in the area.

During the research, a huge disparity between the beautiful natural landscape in the Ecomapuá area and the poor living conditions of the residents was observed. There is a large concentration of people in homes on the banks of the river, especially children.

In the project area there are elementary schools. However, the majority of the schools are inside the houses of the local residents. Normally, the teacher works alone, and receives help from the local community with food, and cleaning supplies, among other items. As observed by the research, 90% of the heads of families are illiterate. During the research, there were 267 students in the Ecomapuá area. High levels of illiteracy and low levels of education among youth and adults were observed.

The research showed that 93% of the interviewed families had not worked outside the project area in the last two years, highlighting that the community's livelihoods depend on local activities. The production system consists of agriculture (78.58%) and extraction activities (12.24%) based on family labor, which corresponds to 79,6% of the community population. The agriculture activities are for local consumption, example, 87,76% of the producers transform the manioc into flour which is the main food ingredient in the Ecomapuá communities. The extractivism activities are pursued for external sales to gain profit.

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<sup>10</sup> Fundação de Amparo e Desenvolvimento da Pesquisa (FADESP) (2002), 'Comunidades Agroextrativistas do Rio Mapuá - Breves/PA, Diagnóstico Socio-Econômico'.

A demographic research verified the following characteristics of communities living within the project area, which was conducted in 2002:

- Total population: 1,193 residents.
- Family average: 6.38 members/family.
- 100% of the population was born in Pará state.
- More than 93% of the population have lived in the project area for more than 10 years, and 93% of them have only ever worked inside the project area, showing that the population live from subsistence activities.
- Low life expectancy.

Furthermore, the following courses were provided to Ecomapuá communities:

Nº	Course	Participants	Communities	Date
1	Gardening course	43	Santo Amaro and Mapuá	2003
2	Animal protein production course	-	Santo Amaro	2003
3	Poultry raising course	6	Bom Jesus and Vila Amélia	2007
4	Gardening course	15	Bom Jesus and Santo Amaro	2007
5	Fish farming course	12	Bom Jesus and Santo Amaro	2007
6	Apiculture course	12	Bom Jesus	2006
7	Permaculture, Design & Consulting course	1	Bom Jesus	2007
8	Community involvement in Development of " Program for Natural Resource Education on Ilha Marajó, Pará, Brazil"	20	Bom Jesus and Santo Amaro	2010
9	Technological Training of Solidarity Enterprises	01	Bom Jesus	2013
10	Technical course in Forests	80	Bom Jesus	2014
11	Organic production and certification	22	Bom Jesus	2015 - 2017

**Table 1.** Courses provided by Ecomapuá company to the local community

The main social activities developed by Ecomapuá within the project area during the current monitoring period (2013 – 2017) are listed below. More detailed information can be found in the respective SOCIALCARBON Report – Point One.

During the first monitoring period, it was observed that the projects undertaken generated alternative income sources; however, most of the activities were not continued. Despite that, on the second monitoring period, with the aim of promoting a real income source for the local community, the project proponent invested on Açaí organic production and certification together with COAMA Cooperative (“Cooperativa de agricultores do Rio Mapuá e Aramã”).

During the current monitoring period, the COAMA cooperative was created to foster peace and inclusion within the community and to promote sustainable development. It has 23 members, and its main members are: Mr. Janari (president), Mr. Galo (manager), Mr. Aluisio (coordinator) and Ms. Micheli Marques (organic production process manager).

Furthermore, courses were provided to the local community about the procedures of organic production and certification of Açaí, with lectures about the organic practices, sustainability, and health and security on the process. The project proponent is responsible for the organic certification of COAMA, which occurs twice a year with site visits and stakeholders consultation.

Moreover, Ecomapuá company built a new tree nursery for the local community, which was a request from the community itself during a stakeholders consultation in 2014. The community is responsible for the production of seedlings, focusing on native species with high commercial value. These seedlings are planted in degraded areas, which in addition to promoting environmental recovery, contributes to alternative income generation to the community.

Furthermore, the project proponent was responsible for the creation of Amzn's, which is an online store to sell communities' products from the project area (<https://amzns.myshopify.com/>), helping the promotion and marketing of those products.

A new project was also developed during this monitoring period, named "Projeto Virola" with the objective of promoting the sustainable harvest of Virola seeds, which are utilized to obtain an oil with medicinal properties. The species *Virola surinamensis* (Roll) Warb. is classified as 'Endangered' in the IUCN Red List of Threatened Species. Furthermore, seedlings from this tree and other commercially valuable species were produced in the tree nursery by the local community, who collected seeds within the region and started planting together with their production. In partnership with Beraca, the project proponent constructed a seed dryer for the community in 2016.

In addition, the project supports the Rural Family House (*Casa da Família Rural - CFR*, in portuguese) of the region with monthly donations essential for its operation. The project also funds scholarships at the University for two community members.

It is important to mention that several meetings to consult stakeholders' opinions were held during this monitoring period, which did not raise any negative inputs about the project.

The main potential environmental and socio-economic risks that are evaluated as part of SOCIALCARBON certification are detailed in the table below:

Activity	Aspect	Impact	Effect		Comments/ Observation
			Beneficial	Adverse	
REDD: Carbon credit project	Conservation of Amazon Rainforest	Greenhouse Gas Emissions Reductions	X		Monitored by the Carbon resource: <ul style="list-style-type: none"> <li>Project performance</li> </ul>

					Monitored by the Natural resource: <ul style="list-style-type: none"> <li>• Efficiency of project in countering agents of deforestation/ degradation</li> </ul>
REDD: Carbon credit project	Conservation of Amazon Rainforest	Monitoring and supervision to avoid deforestation of forest within the project area.	X		Monitored by the Biodiversity resource: <ul style="list-style-type: none"> <li>• Biodiversity conservation</li> </ul> Monitored by the Natural resource: <ul style="list-style-type: none"> <li>• Monitoring Methods</li> </ul>
REDD: Carbon credit project	Conservation of Amazon Rainforest	Conflict management with communities in the project area, due to banning of timber product extraction.		X	Monitored by the Carbon resource: <ul style="list-style-type: none"> <li>• Stakeholder consultation and support for the project</li> </ul>
REDD: Carbon credit project	Empowerment	Increased independence of the communities in the project area.	X		Monitored by the Social resource: <ul style="list-style-type: none"> <li>• Associations and cooperatives</li> <li>• Alternative income sources</li> <li>• Extent of alternative income generation sources and further programs</li> </ul> Monitored by the Human resource: <ul style="list-style-type: none"> <li>• Community education and training</li> </ul> Monitored by the Financial resource: <ul style="list-style-type: none"> <li>• Employment opportunities</li> </ul>

					Monitored by the Natural resource: <ul style="list-style-type: none"> <li>• Tree nursery and maintenance of planted trees.</li> </ul> Monitored by the Biodiversity resource: <ul style="list-style-type: none"> <li>• Non timber forest products (NTFPs)</li> </ul>
REDD: Carbon credit project	Application of the Social Carbon methodology	Encouragement and investment in research on social, economic and environmental aspects in the project region.	X		Monitored by the Social resource: <ul style="list-style-type: none"> <li>• Social research</li> </ul> Monitored by the Human resource: <ul style="list-style-type: none"> <li>• Health</li> <li>• Leisure, culture and sport</li> <li>• Equipment and infrastructure</li> </ul> Monitored by the Financial resource: <ul style="list-style-type: none"> <li>• Securing of funds</li> <li>• Carbon credit Investments</li> </ul> Monitored by the Biodiversity resource: <ul style="list-style-type: none"> <li>• Biodiversity research</li> </ul>

**Table 2.** Main social, economic and environmental impacts of the Ecomapuá Amazon REDD Project

The identified impacts were monitored through the indicators described on the last column of the table above.

In addition to the risks described above, another risk that could affect the project activity, which is described by the SOCIALCARBON indicators and depicted on Table below:

Activity	Aspect	Risk	SOCIALCARBON Indicators that will monitor the identified potential risks
REDD carbon project	Uncertainties relating to standing forest in the future.	Non permanence of carbon: Time which carbon will remain stocked in live biomass, without being emitted into the atmosphere. Due to the uncertainties related to what will happen to the forest in future, there is a risk of non-permanence of forest carbon.	Monitored by the Carbon resource: <ul style="list-style-type: none"> <li>• Buffer reduction</li> </ul>

**Table 3.** Significant risks to the Project

This risk will be monitored as part of the present monitoring report and also as part of the monitoring of the non-permanence risk, which is evaluated at each verification event. Nevertheless, this risk was also assessed by the SOCIALCARBON Indicators described on the last column of the Table above.

As available on tables above, one negative impact was considered for the SOCIALCARBON certification and shall be monitored as part of the indicators created.

The impact of “conflict management with communities in the project area, due to banning of timber product extraction” will be monitored through the indicator described on the last column of the above table: Stakeholder consultation and support for the project. The following measures were implemented by Ecomapuá to mitigate this risk:

- Stakeholders consultation with local communities and cooperatives;
- Creation of alternative income generation sources for the local community, such as Non-Timber Forest Products (NTPF), construction of tree nurseries, sustainable courses, among others;
- Organic certification of the açaí and production by the local community;
- Creation of the COAMA cooperative.

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

## 2.2 Local Stakeholder Consultation

During the FADESP research in 2002, multiple meetings and consultations were carried out with the residents of the Ecomapuá area. It became apparent that the motivation of the local families to attend the meetings was to get informed about the company's plans and proposals, while they also clearly sought to demonstrate dissatisfaction on the ban of wood extraction in the area.

Protests have been held in the early 2000s because residents could no longer harvest timber within the project area due to the prohibition, which had been their primary source of income. To change this situation, Ecomapuá company founded an NGO called the Sustainable Amazon Institute – IAS. The NGO procures funds to invest in the sustainable development of the Ecomapuá area.

Through the IAS NGO, the Ecomapuá was able to raise funds to the project area, and held several meetings with the local residents during the Fome Zero Project. It was possible to identify the main difficulties of the communities and future projects to develop the region were discussed with the families. Also, a forestry engineer visited various families in Bom Jesus community aiming to identify the company's image, represented by Mr. Lap Tak Chan.

As part of the validation of this Project, a local stakeholder consultation was performed. The main stakeholders considered in this project are:

- The local community living inside the project area;
- The local community surrounding the project area;
- The Municipalities of Breves, Currálinho and São Sebastião da Boa Vista;
- The Environmental Agencies of Breves and São Sebastião da Boa Vista Municipalities;
- The Agriculture Agency of Breves Municipality;
- The Educational Agency of Breves Municipality;
- The Chico Mendes Institute for Biodiversity Conservation (ICMBio);
- Amazon Oil (chemical-oil industry that operates in the area of extraction of Amazon oilseeds);

An explanatory letter was sent to the stakeholders asking their opinion about the project. Moreover, they were also invited to attend a local stakeholders' consultation in Breves Municipality. The local community was invited by one of the project supervisors who lives in the Bom Jesus community of the project area.

The local stakeholders' consultation was held on 07-February-2013 in the Environmental Agency of Breves Municipality (SEMMA). This presentation detailed a summary of the proposed activities of the project implementation and monitoring, including potential activities related to production of Amazon seed oils involving the local community. The auditor from TÜV Rheinland, who conducted the validation of this project, was also present at this meeting.

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. In addition, the following materials were distributed: Sustainable Carbon Folder and the Project Idea Note (PIN), both in Portuguese. Furthermore, a preliminary version of the VCS PD was available for local consultation.

Furthermore, the participants were informed that the period for requesting information and comments about the Ecomapuá Amazon 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. As no answer was obtained within 30 days, it was assumed that stakeholders have no objections to the project activity.

In addition, a permanent communication channel with local stakeholders was created in order to receive any comments or suggestions regarding the present REDD project. 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.

During the monitoring period (2013 – 2017) various meetings and stakeholder consultations were held with the local residents of the Ecomapuá area in order to explain the proposal of the company and enquire their opinion. A frequency of more than one stakeholder consultation per year was observed, once stakeholders consultations were made in several moments of the monitoring period:

- As mentioned above, a formal stakeholder consultation was held in Secretaria Municipal do Meio Ambiente (Municipal Secretary of the Environment), with the presence of community members, AMOREMA, SEMAGRI, SEMA, SEMMA, Ecomapuá Conservação, Sustainable Carbon, Nativa Florestal and TUV Rheinland (2013).
- Consultation about the community opinion concerning the REDD project (2013);
- A lecture at UNOPAR – North of Pará University in the municipality of Breves was carried out to expose the project activity to students (2014);
- A formal stakeholder consultation was held in Fazenda Bom Jesus, with the presence of community members, AMOREMA, UFRA-Belém, GIZ, Ecomapuá Conservação, Sustainable Carbon and RINA. It was carried to know the community necessities and try to find a way to meet them. As a consensus, the entities involved agreed to have a closer relationship and formalize a partnership with the aims of providing more benefits to the community (2014);
- In the meetings with the community for the Açaí organic certifications, which happened twice a year (between 2015 and 2017) there was a consultation about the community's opinion about the project;

These local stakeholders consultations had the main objective of communicating the following information:

- 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.

A continuous means of communication with stakeholders was also implemented in Rural Family House (CFR). The CFR is an educational institution created to seek a personalized education and an integral formation of the farmer, from his own reality.

During these consultations, there were two requests from the community that were attempted: the construction of a new tree nursery and the provision of two scholarships for community members. In these moments, all the comments were recorded and no negative comment was made.

## 2.3 AFOLU-Specific Safeguards

### **Local Stakeholder Identification and Background**

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

Communities have customary tenure/access rights to territories and resources. Therefore, since the beginning of Ecomapuá's activities within the project area, the company's main intention was to carry out environmental activities that brings possibilities of generation of alternative income sources to local communities, without affecting in anyway the ownership of the land or right to use natural resources by local communities. However, it should also be noted that Ecomapuá has never supported illegal logging activities, which is not a legal practice. This inference is reinforced by report conducted by FADESP (2002)<sup>11</sup>, who collected interviews in which residents stated that they could no longer harvest timber within the project area, and also from the protests and complaints observed in certain communities due to the prohibition.

According to the aforementioned social study, the residents' agricultural activities rely on slash-and-burn practices to clear land for plantation; as such subsistence agriculture is an important component of the dynamic of deforestation in the project area and reference region. The communities have a lower HDI than the average for the region, and the main production activity is the extraction of wood, palm heart and manioc flour for own consumption. Therefore, Ecomapuá's main activities are to provide alternative income sources to communities, potentially the açai.

The main impacted communities by the project are located along the Mapuá River, i.e., within the five properties composing the project area, as well as in areas in the border of the project area. 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

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<sup>11</sup> Fundação de Amparo e Desenvolvimento da Pesquisa (FADESP) (2002), 'Comunidades Agroextrativistas do Rio Mapuá - Breves/PA, Diagnóstico Socio-Econômico'.

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, Ecomapuá management team has expertise and prior experience in implementing projects with community engagement within the project region, such as the Fome Zero Project (2005 / 2006), which made it possible to identify the main difficulties of the communities and future projects to be developed in the region.

### **Respect for Local Stakeholder Resources**

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.

After the acquisition of the properties where the project area is located, in 2001, Ecomapuá's main intention was to carry out environmental and social activities that brings possibilities of generation of alternative income sources to local communities, as detailed in the company's Social Contract objectives. The company has never questioned the community or raised any concerns about land tenure and natural resources access issues.

No community member has been removed from their land, on the contrary, communities have been supported through programs and incentives the project proponent has instigated. Several social and environmental projects have been developed within the project area since the beginning of activities in 2001, however all these activities did not affect in anyway the ownership of the land or right to use natural resources by local communities. Ecomapuá always tried to reach the maximum communities as possible in the region, which were directly involved in these project activities.

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.

### Communication and Consultation

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 several local stakeholders consultations and meeting 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

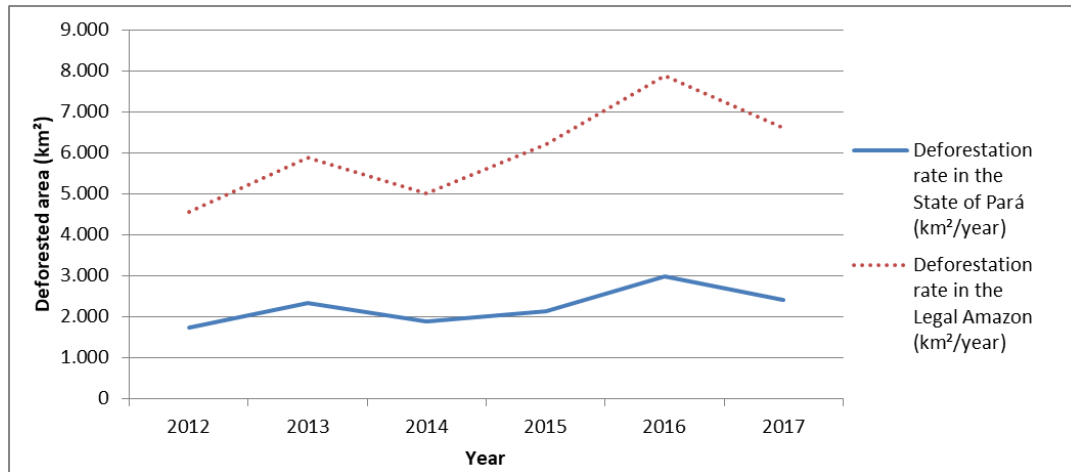
### 3.1 Implementation Status of the Project Activity

The VCS PD was validated by the Designated Operational Entity TÜV Rheinland (China) Ltd., and the 1<sup>st</sup> monitoring period was verified by the Designated Operational Entity RINA Services S.p.A. The verification of this 2<sup>nd</sup> monitoring period is conducted at the same time of the reassessment of the 2<sup>nd</sup> baseline period, which are being verified by the Designated Operational Entity Earthood Services Private Limited.

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-2013 to 31-December-2017.

The project has been fully operational since the starting date of the crediting period. The project activities include banning of logging, social education, generation of alternative income sources, and supervision of deforestation by supervisors from within the project area communities.

The general picture of deforestation pressure in the State of Pará, where the project is located, is that it has increased 39% since 2012, reaching an average of 2,358 km<sup>2</sup>/year in the 2013-2017 period. The annual deforestation areas from 2012 to 2017 in the State of Pará and in the Legal Amazon can be seen in the Figure below. The State of Pará has an average participation of around 37% in the deforestation of the Amazon Biome in the 2012-2017 period, making it the primary deforester of all Legal Amazon States since 2006<sup>12</sup>.



**Figure 3.** Comparison between the annual deforestation rate in the State of Pará and in the Legal Amazon from 2012 to 2017

Source: PRODES (INPE)

According to the VCS PD, local residents are expected to carry out unplanned deforestation in the project region, converting forest into non-forest. Usually, deforestation in the region involves three spatially overlapping activities: firstly, extraction of commercially valuable tree species for sale to timber companies. This is accompanied by palm-heart extraction, which is both for commercial ends and for consumption or trade in kind by the harvesters themselves. The former two activities may not result in conversion of forest to non-forest, however they are integral parts of the deforestation process. Finally, slash-and-burn deforestation of the area above for subsistence agriculture, and the planting of crops<sup>13,14,15</sup>. Resident families feed the supply chain for all the

<sup>12</sup> PRODES Project - Brazilian Amazon Forest Monitoring through Satellite. Instituto Nacional de Pesquisas Espaciais (INPE). Available at: <<http://www.obt.inpe.br/prodes/dashboard/prodes-rates.html>>. Last visited on 21-March-2018.

<sup>13</sup> Fundação de Amparo e Desenvolvimento da Pesquisa (FADESP), “Comunidades Agroextrativistas do Rio Mapuá – Breves/PA, Diagnóstico Socio-Econômico”. 2002.

<sup>14</sup> CASARIM, F. et al. (WINROCK International). “Assessing the potential for generating carbon offsets in the EcoMapuá Conservação properties in the Marajó Island, Brazil”. 2010.

<sup>15</sup> Martorano, P.G, “Caracterização da vegetação e uso do solo das terras pertencentes à empresa Ecomapuá conservação LTDA no município de Breves, PA.” Convênio N° 518 Nova Amafruta/ FADESP / Empresa Ecomapuá Conservação Ltda. 2002

products concerned – being primarily manioc used to produce flour, meaning that subsistence agriculture is an important component of the composite deforestation agent<sup>16</sup>.

During the second monitoring period, the principal products harvested and extracted in the project region were Açaí berries; Palm-heart; and Wood (firewood and timber). However, compared to the initial assessment of the first monitoring period, lower values for timber extraction are encountered for the second monitoring period, probably due to the activities implemented in the project area since the project's initiation, which reduced deforestation. Palm-heart, being an illegal activity as well, similarly decreased<sup>17</sup>.

Meanwhile the values for açaí collection are increasing, given that this is a legal activity which is encouraged in the project area. It is important to note that açaí-related activities are not a deforestation agent as they do not cause trees to be cut down. On the other hand, açaí production has been positively correlated with forest conservation in a study of Pará state<sup>18</sup>.

The main achievement obtained by Ecomapuá during this monitoring period was the organic certification of the Açaí produced by communities living within the project area. The project owner provided courses to the local community about the procedures of organic production and certification of Açaí, with lectures about the organic practices, sustainability, and health and security on the process. An independent certification is responsible for the inspection of organic production twice a year, conducting site visits and also performing stakeholder's consultation.

The graphs of production of the main products in the main municipalities of the reference region are presented in the Figures below<sup>19</sup>.

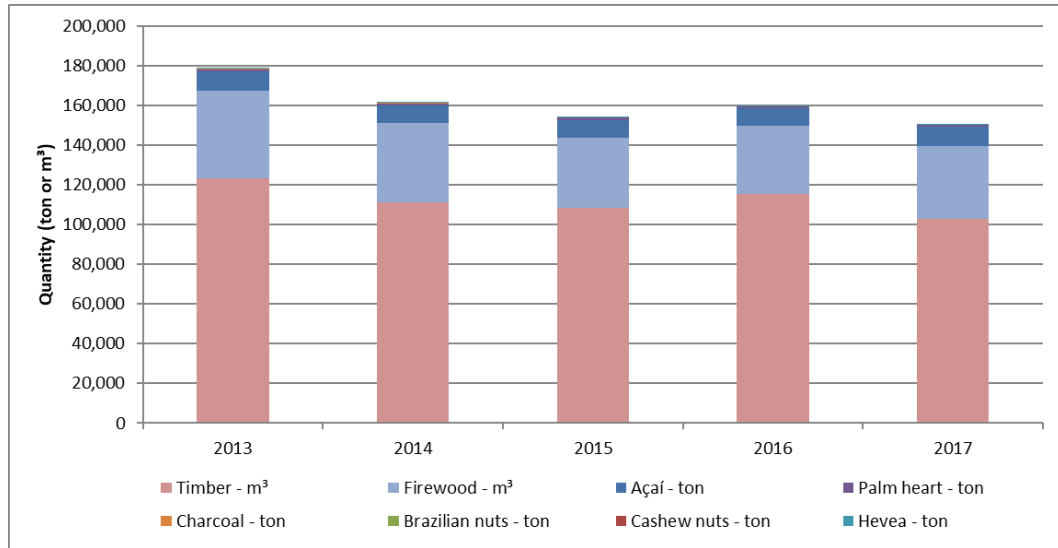
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<sup>16</sup> Herrera, J. A. (2003), "Dinâmica e desenvolvimento da agricultura familiar: o caso de Vila Amélia – Breves, PA." Dissertação de mestrado. Universidade Federal do Pará.

<sup>17</sup> Instituto Brasileiro de Geografia e Estatística (IBGE). Available at: <<https://cidades.ibge.gov.br/>>. Last visited on 21-March-2018.

<sup>18</sup> Almeida et al. (2010), "Potencial para conservação do açaí: uma análise da produção de açaí e desmatamento no estado do Pará." In: 62 Reunião Anual da SBPC, 2010, Natal. Ciência do Mar: herança para o futuro. Natal: SBPC.

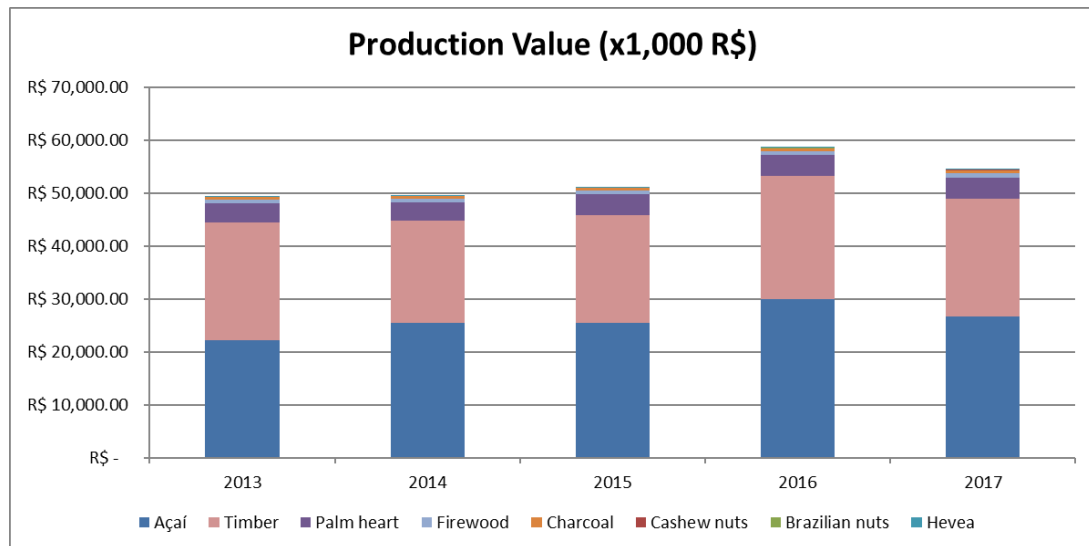
<sup>19</sup> Municipalities of Anajás, Breves, Currealinho, and São Sebastião da Boa Vista, which compose 96.97% of the reference region. Instituto Brasileiro de Geografia e Estatística (IBGE). Available at: <<https://cidades.ibge.gov.br/>>. Last visited on 21-March-2018.



**Figure 4.** Extractive production in the main municipalities where the reference region is located during the 2013-2016 period

According to the 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 main municipalities where the reference region is located. However, a 16.5% reduction in wood production (both firewood and timber) in the project reference region occurred during the analyzed period. Similarly, palm-heart production reduced around 28% over the observed period. These trends are in accordance with the observed reduction in deforestation in the project area

Nevertheless, non-timber forest products (NTFPs) have showed a significant increase in the total value of production (R\$) during this period for the economic activities within the analyzed municipalities.



**Figure 5.** Extraction production values per product in the main municipalities of the reference region during the 2013-2016 period

As can be seen in Figure 5 above, the main increase verified in the economic activities in the region was from açai berries, which is a NTFP. Açai is produced mainly for subsistence, being an integral and traditional part of the daily diet<sup>20</sup>. However, the commercialization of açai has been expanding over the region, which is incentivized by Ecomapuá Project activities. It is important to note that açai is not considered a significant element of the deforestation dynamic; on the other hand, production of NTFP has been positively correlated with forest conservation.

In 2013, açai represented around 45% of the total production value in the main municipalities of the reference region. In 2017, açai represented almost 50% of the total value, which is equivalent to an increase of more than 2%/year. On the other hand, timber, firewood and charcoal represented together 47% of the total production value in 2013, and 43% in 2017, showing a gradually less dependent wood economy in the region.

The local community who lives within the project area adopts the *coivara* practice for agriculture plantations. The main crops planted are manioc and corn. Usually, the agricultural cycle involves the clearing of an approximately 4 hectare plot of land per family to be used for 2.5 years, followed by a fallow period, and subsequent re-use of the same area. The total length of the production/fallow cycle is 10 years.<sup>21,22</sup>.

Thus, non-CO<sub>2</sub> emissions from the burning cycle of regenerated forests due to the *coivara* practice was considered as project emissions. Moreover, the usual deforestation process in the region involves fire to clean the area, therefore non-CO<sub>2</sub> emissions resulting from deforestation and fire within the project area were also included as project emissions.

The GIS mapping analysis was conducted through maps from MapBiomias (version 4.0), during the period of 2013 to 2017, downloaded from the <http://mapbiomas.org/> website, according to the monitoring plan established by the VCS PD – 2<sup>nd</sup> baseline reassessment.

In order to assess the accuracy of the maps produced by the MapBiomias methodology, a confusion matrix was generated calculating the percentages of user and producer correctness, omission errors and commission. 210 random points were 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 and Landsat images were used as reference, in which land use was visually possible at the drawn points. The table below shows the accuracy analysis carried out for each land use class and each year during the monitoring period.

<sup>20</sup> Fundação de Amparo e Desenvolvimento da Pesquisa (FADESP), ‘Comunidades Agroextrativistas do Rio Mapuá – Breves/PA, Diagnóstico Socio-Econômico’. 2002.

<sup>21</sup> CASARIM, F. et al. (WINROCK International) (2010), “Assessing the potential for generating carbon offsets in the EcoMapuá Conservação properties in the Marajó Island, Brazil”.

<sup>22</sup> P. G. Martorano (September 2002) “Caracterização da vegetação e uso do solo das terras pertencentes à empresa Ecomapuá Conservação Ltda No Município de Breves, Pará”

Year	Producer accuracy			User accuracy		
	Forest	Hydrography	Deforestation	Forest	Hydrography	Deforestation
2013	84.75%	93.06%	78.48%	71.43%	95.71%	88.57%
2014	78.67%	95.77%	85.94%	84.29%	97.14%	78.57%
2015	78.38%	91.67%	87.50%	82.86%	94.29%	80.00%
2016	78.08%	98.55%	80.88%	81.43%	97.14%	78.57%
2017	87.88%	94.52%	85.92%	82.86%	98.57%	87.14%

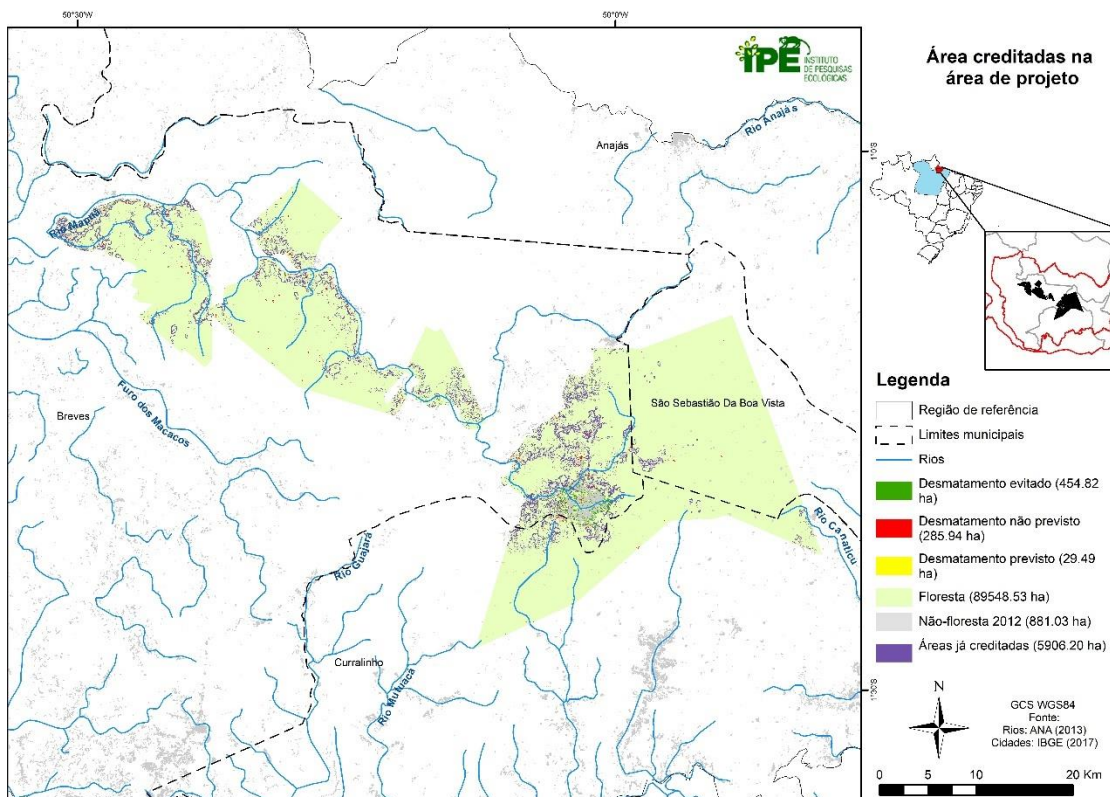
**Table 4.** Summary of confusion matrices from the evaluation of MapBiomass from 2013 to 2017

According to VM0015 v1.1 methodology, cumulative credited areas cannot generate additional VCUs in future periods. Due to changes in the project area during the second baseline reassessment, better described in the section project description deviations, the projection and classification of forest/non-forest areas within the project area also changed.

Therefore, the analysis of credited areas during the 1<sup>st</sup> monitoring period (2003-2012) revealed that some projected areas to be deforested during the 2<sup>nd</sup> monitoring period have already been credited in the past. Therefore, these areas had to be discounted from the baseline deforestation in order to avoid double counting of credited areas.

Furthermore, this analysis of credited areas during the 1<sup>st</sup> monitoring period (2003-2012) also revealed that some classified deforested areas during the 2<sup>nd</sup> monitoring period have already been accounted as deforestation in the 1<sup>st</sup> monitoring period. Therefore, these areas also had to be discounted from the classified deforestation in the 2013-2017 period in order to avoid double counting of deforestation areas in the project scenario.

The map showing the cumulative deforestation during both the last and the current monitoring periods within the project area is illustrated in the Figure below. This Figure also shows the cumulative areas credited within the project area to guarantee that these areas do not generate additional VCUs in future periods.



**Figure 6.** Cumulative deforestation from 2003 to 2017 in the Project Area

Therefore, after the discounts described above, the GIS analysis showed that 315.43 ha of accumulated deforestation took place during the second monitoring period within the project area. The deforestation activities caused the transformation from the initial land use/ land cover (LULC) class of riparian dense tropical rainforest to the final class of non-forest. The annual deforestation values in the Project Area during the current monitoring period can be seen in the Table below.

Year	Annual deforestation in the Project Area (ha)	Cumulative deforestation (ha)
2013	111.92	111.92
2014	58.71	170.63
2015	25.14	195.77
2016	51.82	247.59
2017	67.84	315.43

**Table 5.** Annual deforestation and cumulative deforestation 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 63.09 ha per year during the 2013 – 2017 period. Comparing to what occurred during the 1993 – 2001 period (historical reference period), when the annual average deforestation rate

was about 908.90 ha/year, the deforestation rate in the project area decreased around 90%. Therefore, a decrease tendency in the deforestation rate could be noted, which probably represents the results from the Ecomapuá activities in the project area.

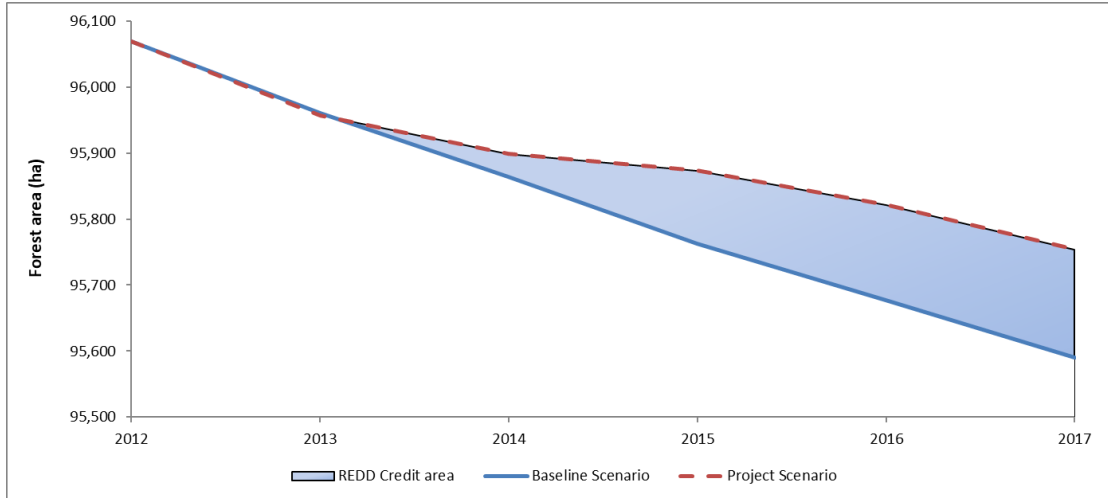
Social activities involving the local community contributed to environmental education, reforestation and alternative livelihood projects encompassing generation of income and production of food. Combined with Government's actions, these social activities developed by Ecomapuá may have contributed in part to reduce the deforestation rate within the project area, when comparing to the 90s' rate (historical reference period). More detailed information on socioenvironmental activities carried out by Ecomapuá during the current monitoring period can be found in the respective SOCIALCARBON Report – Point One.

According to the baseline scenario, the predicted area that would be deforested within the project area during this monitoring period from 2013 - 2017 would be of 479.48 ha. The latter figure is after discounts from already credited areas in the past monitoring period. Comparing to the actual classified deforestation area during the same analyzed period, as detailed in the Table 5 above, the present REDD project avoided 164.05 ha of deforestation, which can be seen in the Table below.

Cumulative deforestation during the 2013 - 2017 period	Area (ha)
Simulated deforestation area (baseline scenario)	479.48
Classified deforestation area (project scenario)	315.43
<b>Credit area</b>	<b>164.05</b>

**Table 6.** Comparison between the simulated and classified deforestation area within the project area during the 2013-2017 period

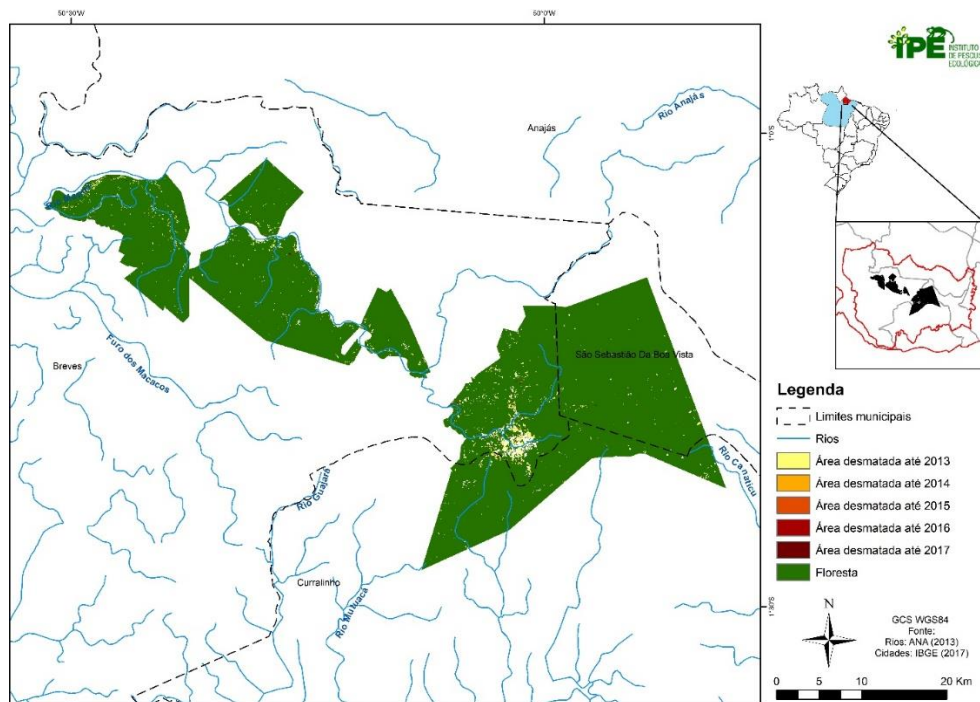
The comparison between these two scenarios is displayed in the Figure below, showing the conservation of forest areas and the consequent emission reduction provided by the REDD mechanism in the project area. The baseline scenario (solid blue line), which was calculated through the deforestation projected 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 7.** REDD credit area formed by the comparison between the baseline and project scenarios

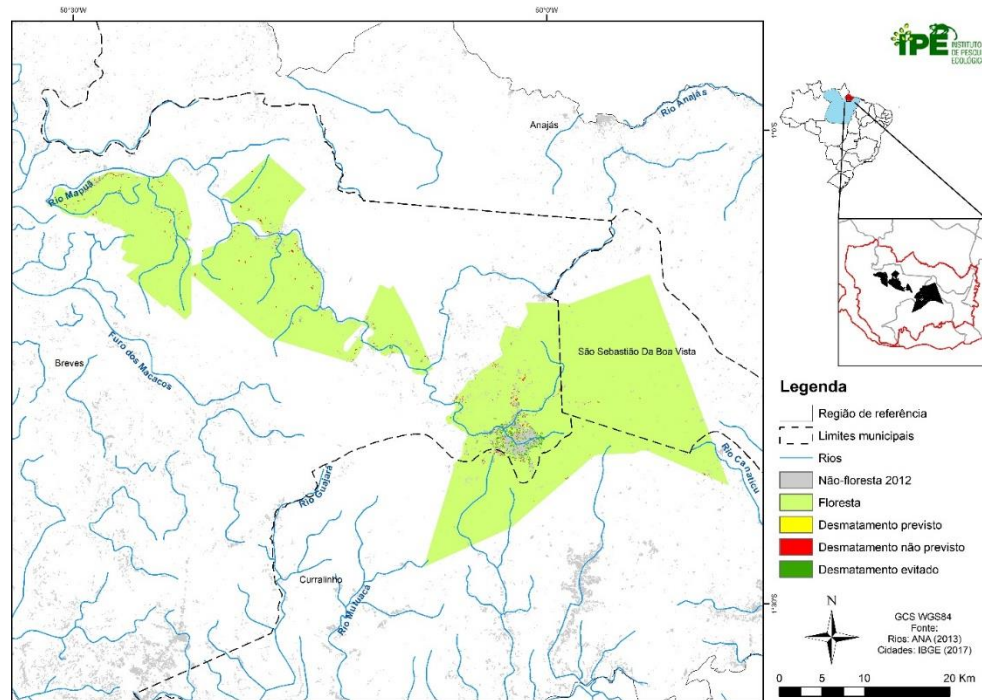
Deforestation in the Project Area is concentrated along the rivers, as predicted in the baseline scenario. However, a focus of non-predicted deforestation was noted in the eastern property of Ecomapuá, Lago do Jacaré, which shows deforestation advancement from the east border.

The annual evolution of the deforestation in the Project Area can be seen at the Figure below. From 2013 to 2017, the forested areas within the project area decreased by around 63.09 ha per year, which corresponds to an accumulated deforestation of 1,253.50 ha since the project start date. In 2017, the forested areas still corresponded to more than 98% of the original project area at the time of the project start date, summing up to 95,753.72 ha.



**Figure 8.** Evolution of the deforestation within the project area between 2013 and 2017

The cumulative deforestation within the project area is showed below. This figure also shows the comparison to the projected deforestation during the reassessment of the second baseline period. The maps below shows the locations of the avoided deforestation areas (green), predicted deforestation areas (yellow) and non-predicted deforestation areas (red) within the project area during the 2013-2017 period.



**Figure 9.** Cumulative deforestation within the project area between 2013 and 2017

In comparison to the reference region and the leakage belt, the project area presented the lowest deforestation rate during the current monitoring period, around 62% and 48% lower, respectively. This could be an indicative to demonstrate the effectiveness of the REDD project in the region.

Looking now at the Reference Region, during the 2013 – 2017 period, areas classified as “non-forest” are of greater concentration and larger in the eastern portion of the latter, which illustrates that the deforestation pressure mainly comes from outside the Project Area and Leakage Belt.

From 2013 to 2017, the forested areas within the reference region decreased by around 1,803.26 ha per year, which corresponds to an accumulated deforestation of 9,016.29 ha during the monitoring period and 48,396.69 ha of total cumulative deforestation.

Furthermore, the annual evolution of the deforestation and cumulative deforestation in the Reference Region during the 2013-2017 period can be seen at the Figures below. In addition, it is also possible to compare the real and projected deforestation occurred during the monitoring period within the reference region (Figure 11).

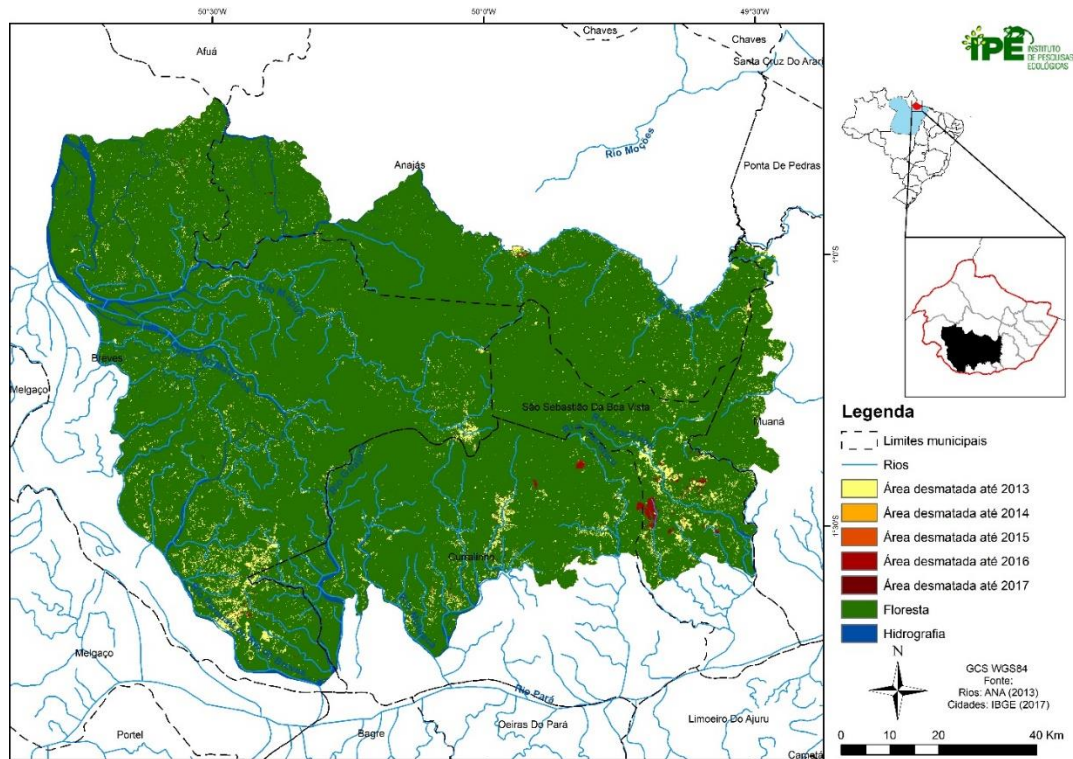


Figure 10. Evolution of the deforestation within the reference region between 2013 and 2017

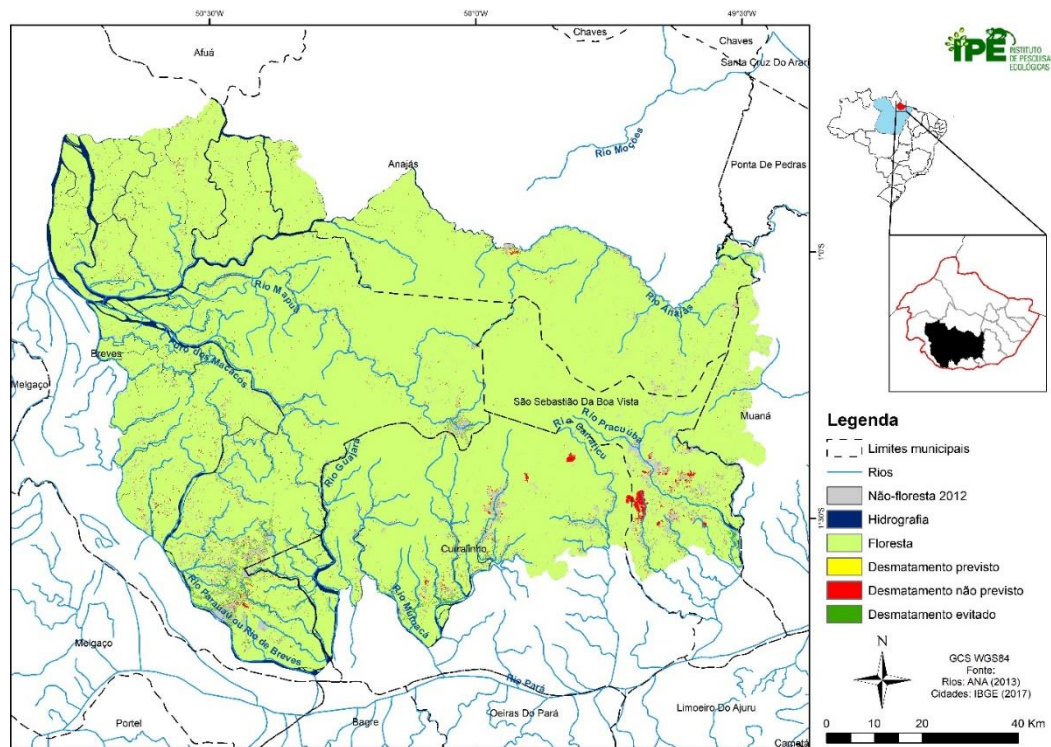


Figure 11. Cumulative deforestation within the reference region between 2013 and 2017

Meanwhile, the leakage belt presented an accumulated deforestation of 1,174.86 ha during the 2013 - 2017 period, at an annual rate of 234.97 ha/year. The figures below show the cumulative and annual deforestation within the leakage belt.

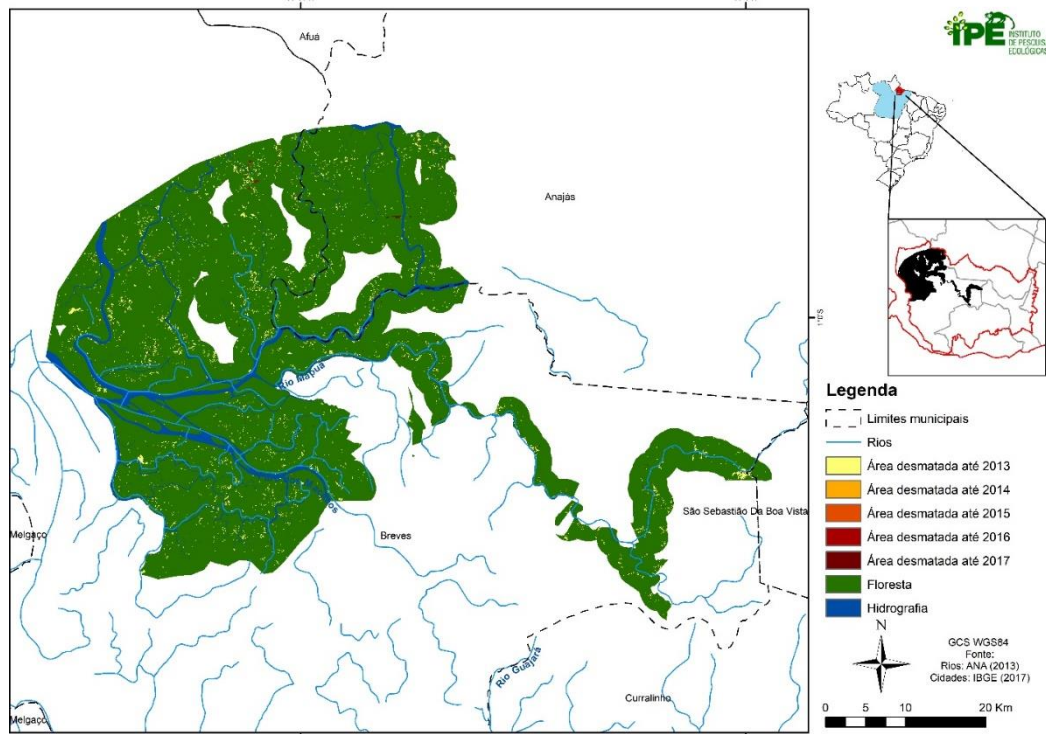


Figure 12. Annual deforestation in the Leakage Belt between 2013 and 2017

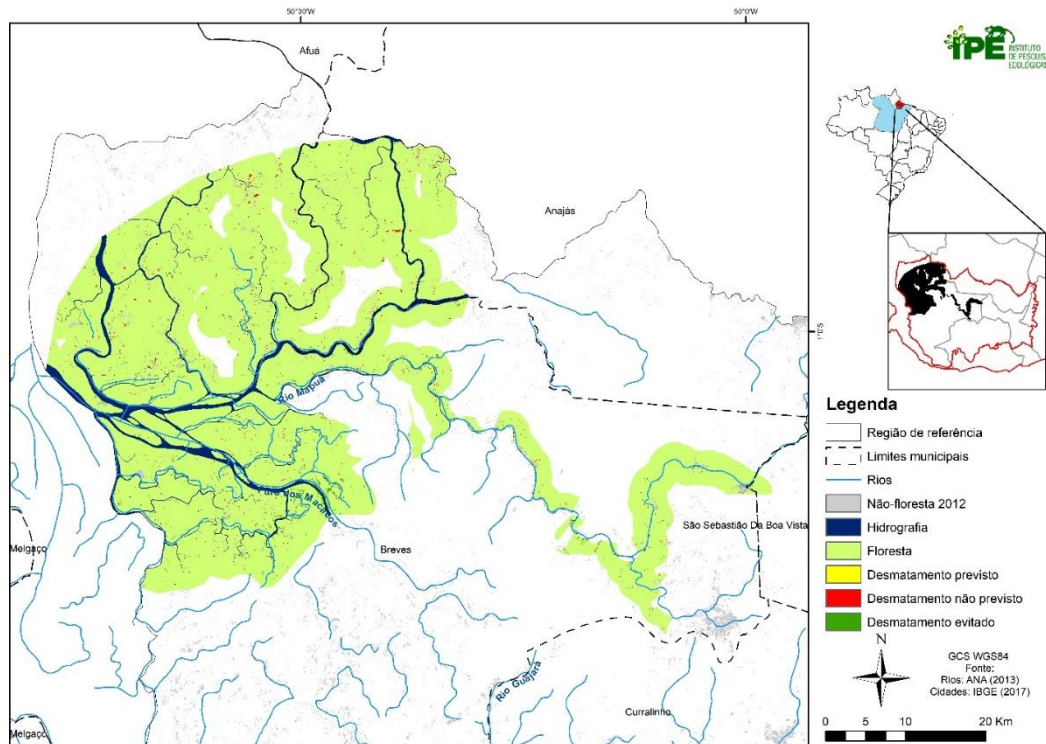


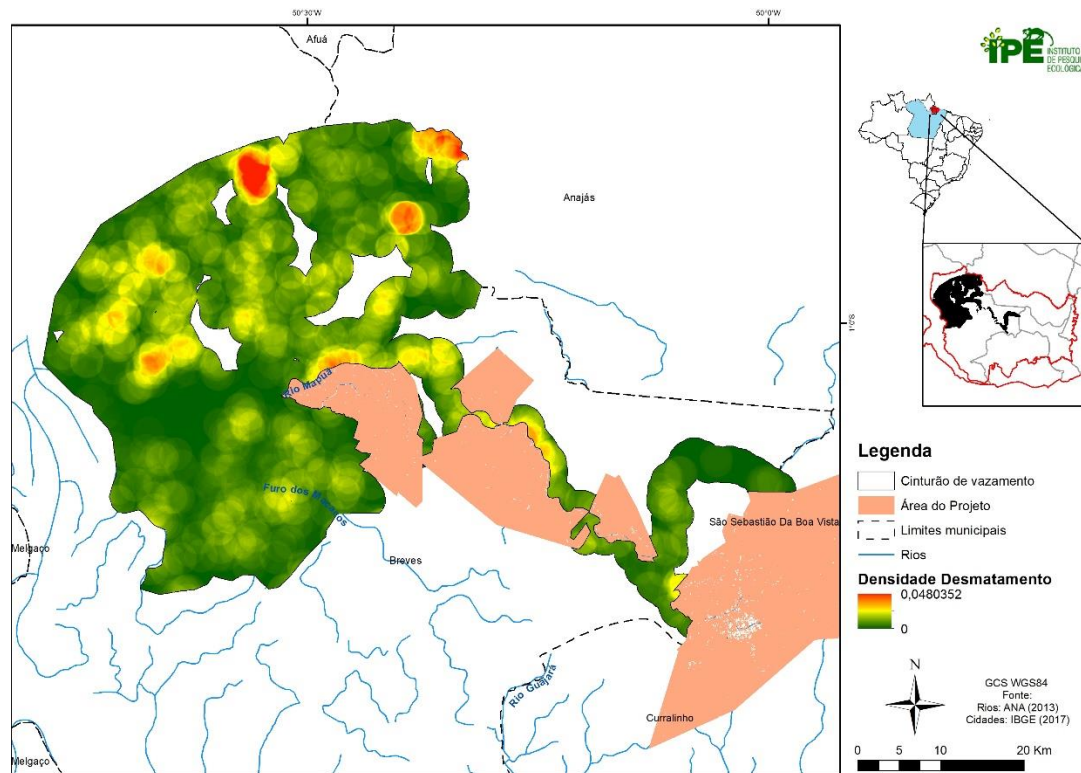
Figure 13. Cumulative deforestation in the Leakage Belt between 2013 and 2017

Observing the deforestation patterns in the Leakage Belt, it is noted a greater intensity in deforestation in its north-western portion, nearer to the main watercourses, at the most distant point of the project area.

This observation reinforces the importance of rivers in impacting land-use changes. According to the VCS PD, timber harvesting was the main deforestation agent considered possible for leakage to occur, due to the following considerations:

- Implementation of the present project in 2002 led to the banning of timber activities in the areas belonging to Ecomapuá Ltda. Given that subsistence agriculture was not prohibited by the project proponent, other activities are not considered to be susceptible to leakage.
- Wood production is one of the most lucrative activities<sup>23</sup>.

Deforestation within the leakage belt during the current monitoring period was 25% higher than predicted in the baseline scenario. However, as shown in the Figure below, the analysis of the main locations of deforestation during the 2013-2017 within the leakage belt are of greater concentration in its northern-western portion, and more than 20km far from the project area, close to the Anajás municipality.

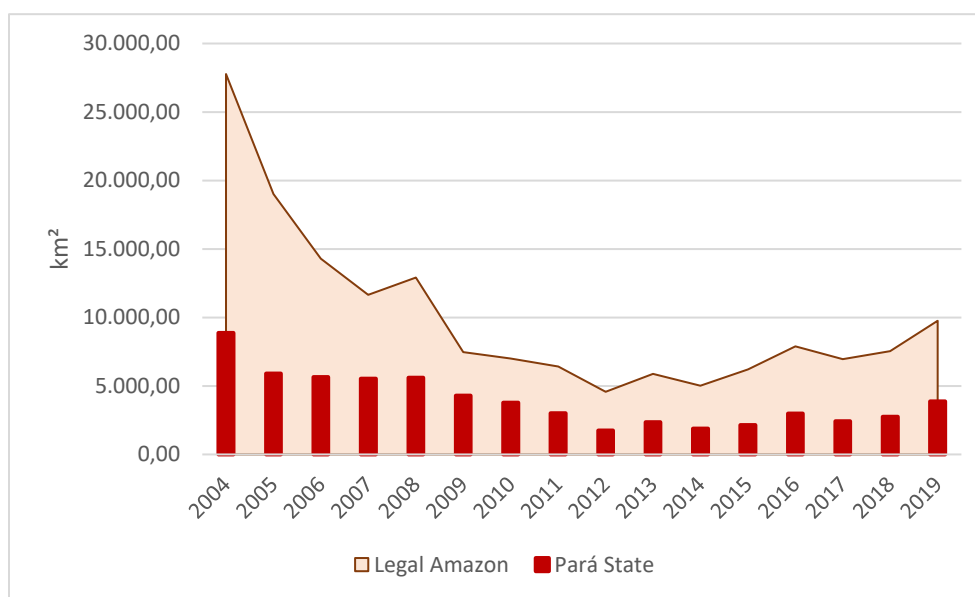


**Figure 14.** Density of deforestation in the Leakage Belt between 2013 and 2017

<sup>23</sup> Instituto Brasileiro de Geografia e Estatística (IBGE). Available at: <<https://cidades.ibge.gov.br/>>. Last visited on 21-March-2018.

Furthermore, as previously mentioned, deforestation in the State of Pará, as well as in the Amazon biome presented a high increase after 2012, when deforestation reached the lowest level ever recorded. Not by coincidence, the year of 2012 was marked by the greatest setback in the socio-environmental agenda since the end of the military dictatorship<sup>24</sup>, reversing a trend towards improving the sustainable development agenda that had been implemented throughout all governments since 1988, which could not be predicted at the time of projection of future deforestation during the second baseline reassessment.

The figure below shows, for both the State of Pará and the Amazon Biome, the decrease of deforestation during the 2004-2012 period and the turnaround after 2012, where it is possible to note the new increase of deforestation. After 2012, deforestation more than doubled in the State of Pará and as in the entire Amazon Biome, reaching an increase of 122% and 114%, respectively. The State of Pará is the largest contributor to the deforestation of the Amazon Biome, with an average participation of 34%<sup>25</sup>.



**Figure 15.** Evolution of deforestation between 2004 and 2019 in the State of Pará and Legal Amazon, noting the increase of deforestation after 2012

Some events that occurred in 2012 that could have influenced deforestation dynamics in the region were: the 90% reduction in Governmental resources applied in the Action Plan for Prevention and Control of Deforestation in the Legal Amazon (PPCDAm); the flexibilization of the forest code legislation and amnesty to deforesters; the interruption of the creation of protected areas, even reaching the unprecedented reduction of several of these protected areas in the Amazon; the interruption of the processes of recognition of indigenous lands; the cessation of

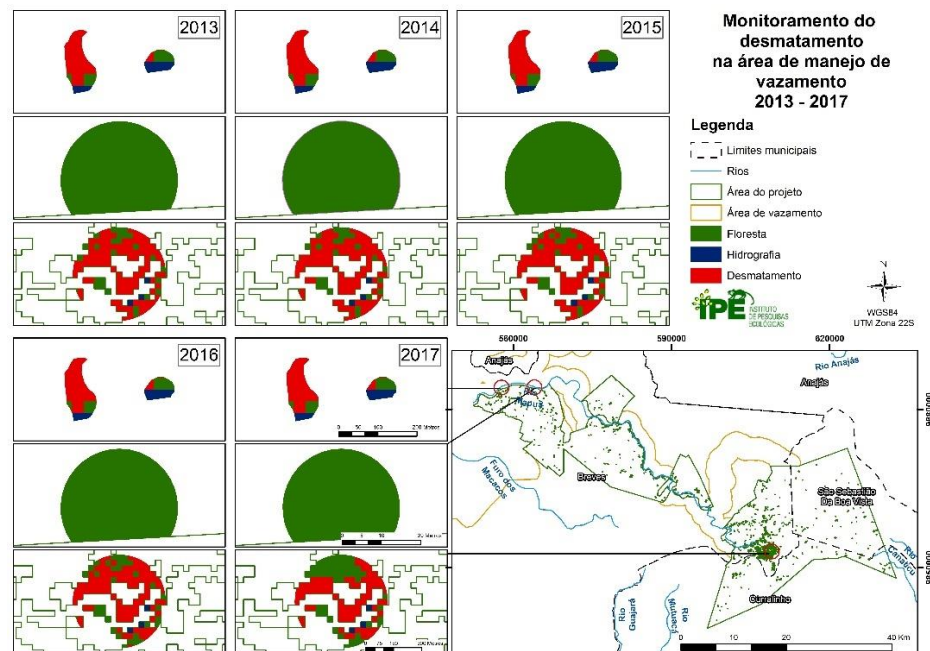
<sup>24</sup> WWF. Financiamento Público em Meio Ambiente: Um Balanço da Década e Perspectivas.2018. Available at: <[https://d3nehc6yl9qzo4.cloudfront.net/downloads/financiamentomma\\_final2\\_web.pdf](https://d3nehc6yl9qzo4.cloudfront.net/downloads/financiamentomma_final2_web.pdf)>

<sup>25</sup> According to PRODES: <[http://terrabrazilis.dpi.inpe.br/app/dashboard/deforestation/biomes/legal\\_amazon/rates](http://terrabrazilis.dpi.inpe.br/app/dashboard/deforestation/biomes/legal_amazon/rates)>.

the climate change agenda; the reduction of the Ibama's control and power, which is the Governmental body responsible for deforestation control in Brazil; and the largest decrease ever noticed in the approved budget for the Ministry of the Environment and its bodies<sup>26</sup>. Those several setbacks in the Brazilian environmental agenda contributed to the increase of deforestation after 2012, as verified by Prodes in the Brazilian Amazon<sup>27</sup>.

Therefore, observing the deforestation patterns in the Leakage Belt, 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.

Meanwhile, some parts of the leakage management area (i.e. the CFR school and main community centers within Bom Jesus and Lago do Jacaré Farms) presented forest regeneration and a little deforestation (0.18 ha) during the current monitoring period. Deforestation was accounted as carbon stock changes in leakage management area in the project case. The figure below shows the annual distribution of regeneration and deforestation within the leakage management area during the 2013-2017 period.



**Figure 16.** Regeneration of forests and deforestation within the leakage management area during the monitoring period

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

<sup>26</sup> Castelo, 2018. Governos e mudanças nas políticas de combate ao desmatamento na Amazônia. Revista Iberoamericana de Economía Ecológica Vol. 28, No. 1: 111-134. Available at: <<https://redibec.org/ojs>>.

<sup>27</sup> According to PRODES: <[http://terrabrazilis.dpi.inpe.br/app/dashboard/deforestation/biomes/legal\\_amazon/rates](http://terrabrazilis.dpi.inpe.br/app/dashboard/deforestation/biomes/legal_amazon/rates)>.

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 (2013 – 2017) are detailed in the Tables below.

Project year t	Stratum i in the reference region (ha)	Total (ha)	
	ABSLRR <sub>i,t</sub>	annual ABSLRR <sub>t</sub>	cumulative ABSLRR
2013	2,249.91	2,249.91	2,249.91
2014	921.15	921.15	3,171.06
2015	809.28	809.28	3,980.34
2016	3,476.43	3,476.43	7,456.77
2017	1,559.52	1,559.52	9,016.29

**Table 7.** Annual areas of deforestation in the reference region across the monitoring period

Project year t	Stratum i in project area (ha)	Total (ha)	
	ABSLPA <sub>i,t</sub>	annual ABSLPA <sub>t</sub>	cumulative ABSLPA
2013	111.92	111.92	111.92
2014	58.71	58.71	170.63
2015	25.14	25.14	195.77
2016	51.82	51.82	247.59
2017	67.84	67.84	315.43

**Table 8.** Annual areas of deforestation in the project area across the monitoring period

Project year t	Stratum i in the leakage belt (ha)	Total (ha)	
	ABSLK <sub>i,t</sub>	annual ABSLK <sub>t</sub>	cumulative ABSLK
2013	599.67	599.67	599.67
2014	102.69	102.69	702.36
2015	75.15	75.15	777.51
2016	174.60	174.60	952.11
2017	222.75	222.75	1,174.86

**Table 9.** 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 below.

Area deforested per forest class <i>icl</i> within the reference region		Total deforestation in the reference region	
<i>IDicl</i>	1	annual ABSLRR <sub>t</sub> (ha)	ABSLRR cumulative (ha)
Name	Riparian (Aluvial) Dense Tropical Rainforest		
Project year <i>t</i>	ha		
2013	2,249.91	2,249.91	2,249.91
2014	921.15	921.15	3,171.06
2015	809.28	809.28	3,980.34
2016	3,476.43	3,476.43	7,456.77
2017	1,559.52	1,559.52	9,016.29

**Table 10.** Annual areas deforested per forest class *icl* within the reference region in the project case

Area deforested per forest class <i>icl</i> within the project area		Total deforestation in the project area	
<i>IDicl</i>	1	annual ABSLPA <sub>t</sub> (ha)	ABSLPA cumulative (ha)
Name	Riparian (Aluvial) Dense Tropical Rainforest		
Project year <i>t</i>	ha		
2013	111.92	111.92	111.92
2014	58.71	58.71	170.63
2015	25.14	25.14	195.77
2016	51.82	51.82	247.59
2017	67.84	67.84	315.43

**Table 11.** Annual areas deforested per forest class *icl* within the project area in the project case

Area deforested per forest class <i>icl</i> within the leakage belt		Total deforestation in the leakage belt	
<i>IDicl</i>	1	annual ABSLLK <sub>t</sub> (ha)	ABSLLK cumulative (ha)
Name	Riparian (Aluvial) Dense Tropical Rainforest		
Project year <i>t</i>	ha		
2013	599.67	599.67	599.67
2014	102.69	102.69	702.36
2015	75.15	75.15	777.51
2016	174.60	174.60	952.11
2017	222.75	222.75	1,174.86

**Table 12.** Annual areas deforested per forest class *icl* within the leakage belt in the project case

In addition, Tables below 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 deforestation in the reference region	
ID <sub>fcl</sub> Name Project year	2 Non forest ha	ABSLRR <sub>t</sub> annual ha	ABSLRR cumulative ha
2013	2,249.91	2,249.91	2,249.91
2014	921.15	921.15	3,171.06
2015	809.28	809.28	3,980.34
2016	3,476.43	3,476.43	7,456.77
2017	1,559.52	1,559.52	9,016.29

**Table 13.** 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 deforestation in the project area	
ID <sub>fcl</sub> Name Project year	2 Non forest ha	ABSLPA <sub>t</sub> annual ha	ABSLPA cumulative ha
2013	111.92	111.92	111.92
2014	58.71	58.71	170.63
2015	25.14	25.14	195.77
2016	51.82	51.82	247.59
2017	67.84	67.84	315.43

**Table 14.** 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 deforestation in the leakage belt	
ID <sub>fcl</sub> Name Project year	2 Non forest ha	ABSLLK <sub>t</sub> annual ha	ABSLLK cumulative ha
2013	599.67	599.67	599.67
2014	102.69	102.69	702.36
2015	75.15	75.15	777.51
2016	174.60	174.60	952.11
2017	222.75	222.75	1,174.86

**Table 15.** Annual areas deforested in each zone within the leakage belt in the project case

## 3.2 Deviations

### 3.2.1 Methodology Deviations

The present 2<sup>nd</sup> Monitoring Report has no methodology deviations from the applied methodology VM0015 v1.1 or from the VCS PD - 2<sup>nd</sup> baseline period.

According to VCS rules, methodology deviations shall be reported in all subsequent verification reports. Therefore, this section describes all Methodology Deviations verified in the 1<sup>st</sup> monitoring report, which comprised the 2003 – 2012 period.

As described in the 1<sup>st</sup> Monitoring Report, Section Methodology Deviations, an adaptation of the annual deforestation calculation was deemed to be necessary, as there were no good-quality images for the years 2002 and 2012. The Landsat images from 2002 had cloud cover obstructing over 80% of the scene, making classification impossible. Therefore, the classification of the images as of the year 2001 was carried out. Given this situation, the deforestation values were quantified based on the deforestation in the 2001 – 2003 period. In order to be conservative, the deforestation in 2002 was assumed to be zero and the deforestation value in the year 2003 was considered as being the accumulated in the 2001-2003 period.

In addition, a similar situation applied to the year 2012. During this year, an error with the Landsat satellite sensor occurred, resulting in images also being unavailable for this year. The deforestation values in 2012 were quantified based on the average deforestation in the 2011 – 2013 period, noting that satellite images from Landsat 8 were available for the year 2013, which is a more recent satellite. Thus, the procedure applied was to divide the deforestation in the 2011 – 2013 period into equal parts in order to distribute it equally among the years 2012 and 2013.

### 3.2.2 Project Description Deviations

According to the VCS PD containing the reassessment of the 2<sup>nd</sup> baseline period, section 1.11, some corrections from the original VCS PD (1<sup>st</sup> baseline period) have been carried out, which are described below.

Land-use change analyses were made through MapBiomias 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 use of MapBiomias as image reference was made because the region has a high cloud cover throughout the whole year, and thus, the official data from Prodes were highly impacted by this condition.

However, changing the land use data during the second baseline reassessment resulted in different polygons of forest/non-forest areas within the project area at the project start date, showing either deforested areas inside the project area and forested areas outside the project area. According to the applied VM0015 methodology, the project area shall include only forest land at the project start date. Thus, a comparison between 1992 and 2002 has been conducted

to include only land qualifying as “forest” for a minimum of 10 years prior to the project start date, in accordance to the methodology.

Therefore, the project area was corrected and has in fact an area of 97,007.22 ha instead of 86,269.84 ha, which was defined in the previous VCS PD corresponding to the first baseline period. The old classification method utilized in the previous VCS PD was conservative because a smaller project area resulted in a lower GHG emission reductions generation during the first baseline period.

In addition, the correction of the boundaries of forested and non-forested lands within Ecomapuá properties at the project start date also resulted in the rectification of the leakage management area. According to the applied methodology, the leakage management area shall be located outside the project area and contain only non-forested lands. Thus, a new delineation of the leakage management area had to be carried out. The previous one was located in Fazenda Bom Jesus and presented an area of 817.17 ha. The corrected leakage management area has 12.74 ha and is now split into two properties: Fazenda Bom Jesus and Fazenda Lago do Jacaré. This way, leakage management areas are now more distributed along the project area and more accessible to communities, as most of them live within Fazenda Lago do Jacaré.

Furthermore, during the reassessment of the second baseline period, carbon stock data had to be updated. The old carbon stock data utilized in the VCS PD covering the first baseline period has more than 10 years old, thus not in accordance with methodology requirements. Thus, above ground biomass carbon stocks from the doctorate thesis of Cunha (2018)<sup>28</sup> have been considered after a literature search revealed that this study had the most accurate biomass values for the vegetation-cover of the Project’s reference region (riparian dense tropical rainforest). Moreover, this literature is consistent with the requirements established by the applied methodology VM0015 v1.1. Therefore, carbon stocks were updated based on above ground biomass values from this study.

In addition, according to VCS rules, project description deviations shall be reported in all subsequent verification reports. Therefore, this section also describes below all Project Description Deviations verified in the 1<sup>st</sup> monitoring report, which comprised the 2003 – 2012 period.

During development of the 1<sup>st</sup> Monitoring Report, while comparing the classification and projections in the VCS PD, a discrepancy was noted between the areas represented in the tables in the VCS PD and those found in the final shapefiles of the baseline referring to the Project Area, used for comparison purposes in the monitoring phase. Following exhaustive checking of all the files used to generate data used in the VCS PD, it was realized that the shapefile from which the projected areas were derived did not exclude areas considered to be “non-forest” in 2001, but

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<sup>28</sup> CUNHA, Denise de Andrade. **Dinâmica e produtividade em florestas de igapó e várzea na Amazônia Oriental**. 2018. 144 f. Tese (Doutorado) - Curso de Doutorado do Programa de Pós-graduação em Biodiversidade e Biotecnologia, Rede Bionorte, Museu Paraense Emílio Goeldi, Belém, 2018.

only those from 1993, having a different border from the final file. In this way, the numerical data presented in the tables in the VCS PD differed from the official spatial file, and the VCS PD made an error in projecting a lower figure than it should have for future deforestation. The source of the discrepancy having been identified, it was necessary to update the values for “forest” and “non-forest” for each simulated year, in accordance with the perimeters of the official shapefile.

In order to correct the previously validated VCS PD, it was deemed necessary to revise the process regarding the year 2002. As mentioned above, there were no good-quality images for the year 2002, making classification impossible. After a great many analyses, the conclusion was reached that the most conservative and realistic way to project the deforestation in the 1<sup>st</sup> baseline period would be to exactly replicate the map from 2001 in order to represent 2002, in other words, the deforestation from 2001 to 2002 was considered to be 0 (zero). Thus, the starting year of the projection was altered in the 1<sup>st</sup> monitoring process, starting from the year of 2003 instead of 2002. This decision was judged to be more conservative than projecting the year 2002, because it decreased the deforestation rate during the historical reference period, which was then utilized to project the deforestation in the 2003 – 2012 period.

Given this, it was felt necessary to repeat the entire simulation process referring to the VCS PD, from which the maps were simulated based on Markov chains coupled with cellular automata, and in which the input maps were 1993 and 2002, thus forming a nine-year interval between them. After the entire historical series was re-generated, the Kappa index was applied, from which the effective similarity value was found, with a high similarity index between the simulated and mapped results. These are values which, according to the literature, represent the reality of the landscape.

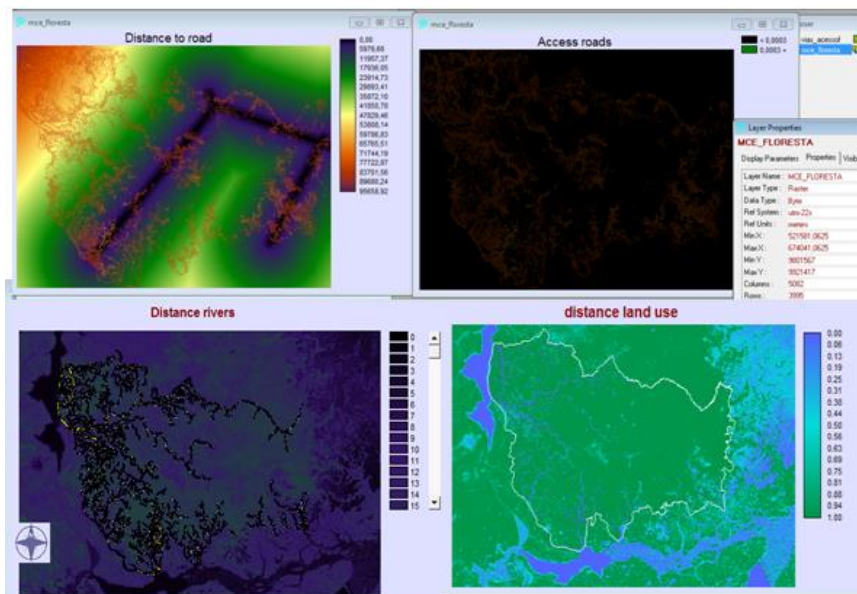
However, in order to be conservative, a correction factor was applied to the new simulated deforestation values obtained for the 2003 – 2012 period. The accuracy assessment was carried out using Kappa statistics, through comparison of the real map from 2001 with the projection of the same year. As mentioned above, there were no good-quality images for the year 2002, thus the year 2001 was considered as the final year of this analysis. The Kappa index achieved between these two figures was of 0.7105.

Therefore, the correction factor was calculated by considering the 28.95% error resulted from the Kappa index analysis (100%-71.05%), which was applied to the simulated deforestation values obtained for the 2003 – 2012 period, resulting in a total predicted deforestation of 4,929.03 ha. These updated values were used to calculate the cumulative areas for carbon credit generation in the 1<sup>st</sup> monitoring period.

Moreover, the creation of Table 10 (VM0015 v1.1) was judged not to be necessary as the data utilized to formulate the deforestation scenarios included the area history. However, at the time of the VCS PD development, the spatial variables that most likely represent the patterns of baseline deforestation in the reference region were identified, and the digital maps representing the spatial features of each variable were created. Therefore, the Table 10 of VM0015 v1.1 and the digital maps are presented below.

Factor Map		Source	Variable represented		Meaning of the categories or pixel value		Other Maps and Variables used to create the Factor Map		Source	Algorithm or equation used	Comments
ID	File Name		Unit	Description	Range	Meaning	ID	File Name			
1	Deforested land 1993	Satellite image - Landsat 1993	Pixel	Classification	0-256	According to satellite image categories	6	Road Network	DNIT, 2010	LCM (Idrisi) – identifying drivers: Transition Potentials - distance	Paved and deployed road
2	Deforested land 1994	Satellite image – Landsat 1994	Pixel	Classification	0-256		7	Hydrography	ANA, 2010	LCM (Idrisi) – identifying drivers: Transition Potentials - distance	Hydrography navigable
3	Deforested land 1995	Satellite image - Landsat 1995	Pixel	Classification	0-256		8	Exploration wood/land use - distance	Terraclas, 2010	LCM (Idrisi) – identifying drivers: Transition Potentials - distance	Potential logging according to land use
4	Deforested land 1999	Satellite image – Landsat 1999	Pixel	Classification	0-256		9	MCE – Multi-criteria: forest and no forest	Classification	MCE	evaluation classes
5	Deforested land 2001	Satellite image – Landsat 2001	Pixel	Classification	0-256		10	MDET	SRTM	MDET	Model digital elevation
							11	Slope	SRTM	slope	slope which favors LU/LC

Table 16. List of variables, maps and factor maps



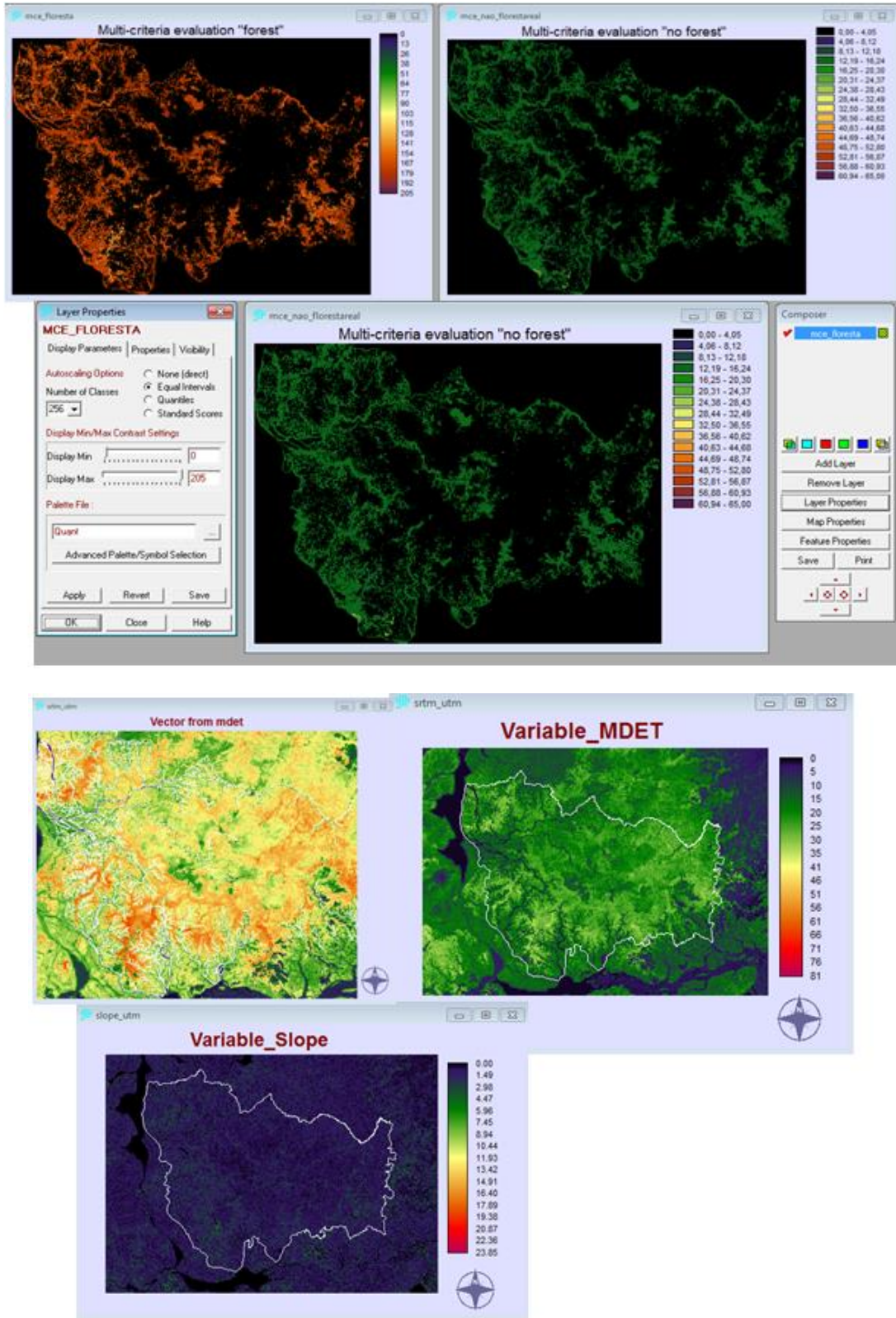


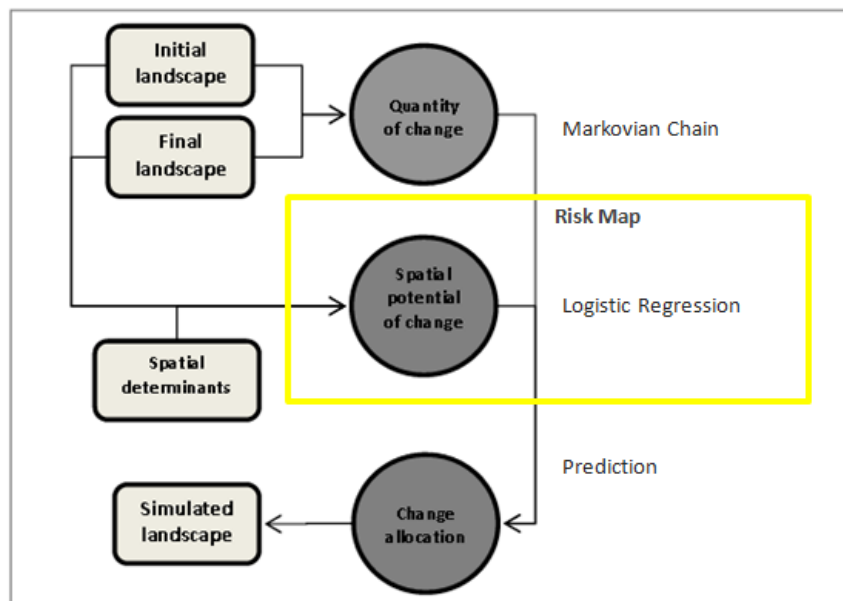
Figure 17. Maps representing the spatial features of each variable within the reference region

The variables and deforestation patterns presented above were analyzed together to produce the risk map. It is important to note that the deforestation risk map illustrates the probability of a forest area becoming a non-forest area. This map was generated through the analysis of all the variables and deforestation patterns measured over the years during the baseline period, which were obtained through the satellite image classification. For this purpose, the IDRISI software and the Land-Use Change Modeler software – LCM were utilized, which analyzed all the variables and deforestation patterns together to produce the risk map.

The transition probability matrix was generated using the LCM software, using logistic regression to calculate the potential transition, which is an algorithm capable of estimating the environmental implications according to the chosen variable and its distance. This algorithm evaluates the probability of a given pixel belonging to a most likely category based on the proximity to other pixels from the listed category. Therefore, this algorithm determines the probability of a pixel from the forest class becoming non-forest within the reference region.

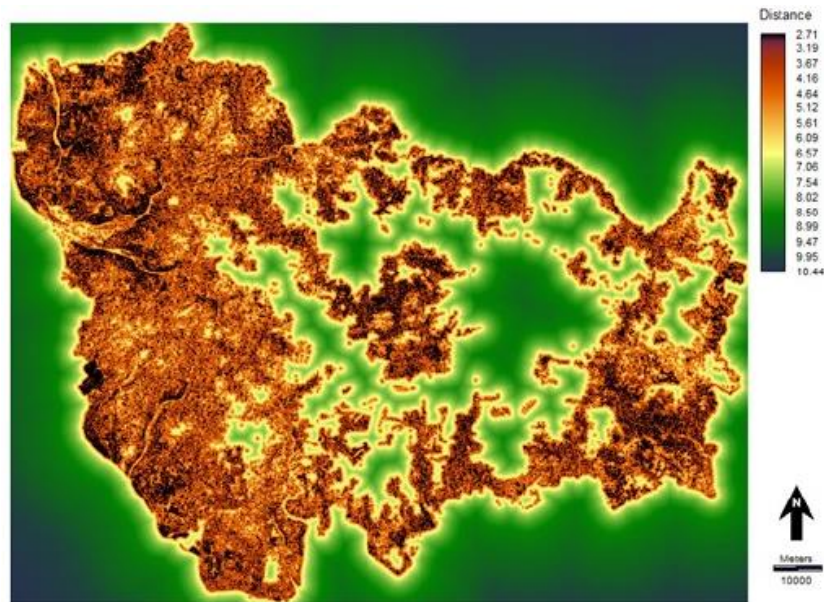
The LCM software generated distance maps based on the deforestation likelihood, which was estimated through the percentage of pixels that were deforested during the historical reference period (based on the presence of forest and non-forest). Thus, the deforestation likelihood is the probability of a forest area becoming a non-forest area based on the distance from non-forest areas. After the generation of distance maps, the LCM identified land use and land cover transitions according to the deforestation drivers. For example, the presence and distance from roads is very often a potential indicator of deforestation, in the same way as the proximity to markets or municipal centers contributes to the timber commercialization.

The flowchart below illustrates the LCM modelling steps, showing how the risk map was generated.



**Figure 18.** LCM modeling steps focusing on the creation of the deforestation risk map

Therefore, all the variables and deforestation patterns were analyzed together to produce the risk map. Table 10 of VM0015 describing the list of variables, maps and factor maps was filled and presented above. In addition, the maps representing the spatial features of each variable were also presented. Thus, the deforestation risk map available in the VCS PD - 1<sup>st</sup> baseline period, Section 2.4 – Baseline Scenario (Figure 25) was produced based on the information above, in accordance with the steps required by the methodology VM0015 v1.1. The deforestation risk map is presented below, which is the same map available at the VCS PD.



**Figure 19.** Deforestation risk map of the reference region

### 3.3 Grouped Projects

Not applicable. This is not a grouped project.

## 4 DATA AND PARAMETERS

### 4.1 Data and Parameters Available at Validation

<b>Data / Parameter</b>	CF
<b>Data unit</b>	tC/tdm
<b>Description</b>	Default value of carbon fraction in biomass.
<b>Source of data</b>	Values from the literature (e.g. IPCC 2003. Good practice guidance for land use, land-use change and forestry. Kanagawa: IGES, 2003. Available at: < <a href="http://www.ipcc-nggip.iges.or.jp/public/gpplulucf/gpplulucf.html">http://www.ipcc-nggip.iges.or.jp/public/gpplulucf/gpplulucf.html</a> >.)

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

Data / Parameter	ab
Data unit	Mg/ha
Description	Average biomass stock per hectare in the above-ground biomass pool of initial forest class icl in Mg/ha.
Source of data	Average values for the above-ground biomass in Riparian dense tropical rainforest were taken from the following study: CUNHA, Denise de Andrade. <b>Dinâmica e produtividade em florestas de igapó e várzea na Amazônia Oriental</b> . 2018. 144 f. Tese (Doutorado) - Curso de Doutorado do Programa de Pós-graduação em Biodiversidade e Biotecnologia, Rede Bionorte, Museu Paraense Emílio Goeldi, Belém, 2018.
Value applied	359.80
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 were used as they were determined to accurately represent the values of the vegetation within the Project reference region.
Purpose of Data	This parameter is used to calculate the baseline, project and leakage emissions from deforestation occurred in the baseline and project scenarios. Provides an 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
Data unit	Mg/ha
Description	Average biomass stock per hectare in the below-ground biomass pool of initial forest class icl in Mg/ha.
Source of data	Average values for the below-ground biomass were taken from the applied methodology VM0015 v1.1, which estimates a root-to-shoot ratio of 0.24 for tropical rainforest having above ground biomass values above 125 tons/ha, and 0.20 for values below 125 tons/ha.
Value applied	86.35
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.
Purpose of Data	This parameter is used to calculate the baseline, project and leakage emissions from deforestation occurred in the baseline and project scenarios. Provides an 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.

Data / Parameter	Ctot <sub>fcl</sub>
Data unit	tCO <sub>2</sub> e/ha
Description	Average carbon stock per hectare in anthropic areas in equilibrium of post-deforestation class fcl in tCO <sub>2</sub> e/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. <b>Forest Ecology And Management</b> , Manaus, v. 80, p.21-34, 1996.
Value applied	46.93

<b>Justification of choice of data or description of measurement methods and procedures applied</b>	Fearnside (1996) is one of the most recognized studies for the Brazilian Amazon about long term carbon stocks in deforested areas.
<b>Purpose of Data</b>	This parameter is used to calculate the baseline emissions from deforestation occurred in the baseline scenario. Provides an average of the post-deforestation carbon stock per hectare within the project reference region.
<b>Comments</b>	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.

<b>Data / Parameter</b>	EI
<b>Data unit</b>	%
<b>Description</b>	<i>Ex ante</i> estimated effectiveness index
<b>Source of data</b>	First monitoring report from Ecomapuá Amazon REDD Project covering the first baseline period (2003-2012).
<b>Value applied</b>	67.95%
<b>Justification of choice of data or description of measurement methods and procedures applied</b>	The calculation of the effectiveness index was based on the estimated deforestation activity during the first monitoring period in the baseline case compared to that in the project case within the project area.
<b>Purpose of Data</b>	This parameter is used to calculate project emissions in the baseline scenario. Provides an <i>ex ante</i> 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.
<b>Comments</b>	<i>Ex post</i> monitoring of the project area is necessary to determine deforestation rate and the project emissions.  This parameter will be updated at each renewal of fixed baseline period.

<b>Data / Parameter</b>	DLF
<b>Data unit</b>	%
<b>Description</b>	Displacement Leakage Factor

Source of data	First monitoring report from Ecomapuá Amazon REDD Project covering the first baseline period (2003-2012).
Value applied	0%
Justification of choice of data or description of measurement methods and procedures applied	The DLF was calculated based on the estimated deforestation activity during the first monitoring period within the leakage belt, comparing the baseline case to the project case.
Purpose of Data	This parameter is used to calculate leakage emissions in the baseline scenario due to activity displacement leakage, providing an <i>ex ante</i> 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	<p><i>Ex post</i> monitoring of the leakage belt is necessary to determine deforestation rate outside the project area and the leakage emissions and carbon stock decrease.</p> <p>This parameter will be updated at each renewal of fixed baseline period.</p>

Data / Parameter	$\Delta CBSLLK_t$
Data unit	tCO <sub>2e</sub>
Description	Annual carbon stock changes in leakage management areas in the baseline case at year t
Source of data	Planned interventions proposed by the project proponent; Remote sensing and GIS.
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	<p>Leakage prevention activities generating a decrease in carbon stocks should be estimated <i>ex ante</i> and accounted.</p> <p>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.</p>
Purpose of Data	This parameter was used to calculate leakage emissions in the baseline scenario due to leakage prevention measures implemented in the leakage management area. It provides an <i>ex ante</i> estimation of the decrease in carbon stocks due to the activities implemented.

<b>Comments</b>	<p><i>Ex post</i> monitoring of the leakage management area is necessary to determine the carbon stock decrease and the leakage emissions.</p> <p>This parameter will be updated at each renewal of fixed baseline period.</p>
<b>Data / Parameter</b>	EBBtot <sub>icl,t</sub>
<b>Data unit</b>	tCO <sub>2</sub> e/ha
<b>Description</b>	Total GHG emission from biomass burning in forest class icl at year t
<b>Source of data</b>	<p>Calculated according to methodology VM0015 v1.1.</p> <p>GWP for CH<sub>4</sub> and N<sub>2</sub>O were extracted from the applied methodology VM0015 v1.1.</p>
<b>Value applied</b>	33.29
<b>Justification of choice of data or description of measurement methods and procedures applied</b>	<p>This parameter was calculated according to requirements and default values established by the VM0015 v1.1 methodology. In order to estimate non-CO<sub>2</sub> emissions from forest fires, the average percentage of the deforested area in which fire was used (Fburnt), and the average proportion of mass burnt in each carbon pool (Pburnt,<sub>p</sub>) were estimated to be 100% either for the baseline and project case. These average percentage values are assumed to remain the same in the future, according to the applied methodology.</p>
<b>Purpose of Data</b>	This parameter is used to calculate the baseline, project and leakage non-CO <sub>2</sub> emissions from biomass burning occurred in the baseline and project scenarios
<b>Comments</b>	<p>The only considered carbon pool in this parameter was the above ground biomass.</p> <p>According to the VCS Standard v4.0, the six Kyoto Protocol greenhouse gases and ozone-depleting substances shall be converted using 100-year global warming potentials (GWP) derived from the IPCC's Fourth Assessment Report (GWP for CH<sub>4</sub> = 25 and for N<sub>2</sub>O = 298). However, default values from the applied methodology were used (GWP for CH<sub>4</sub> = 21 and for N<sub>2</sub>O = 310) because a lower value of EBBtot<sub>icl,t</sub> was achieved (33.29 tCO<sub>2</sub>e/ha instead of 38.93 tCO<sub>2</sub>e/ha), which consequently resulted in more conservative GHG emission reductions.</p>

## 4.2 Data and Parameters Monitored

<b>Data / Parameter</b>	ACPA <sub>t</sub>
<b>Data unit</b>	Ha
<b>Description</b>	Annual area within the Project Area affected by catastrophic events at year t.
<b>Source of data</b>	<ul style="list-style-type: none"> <li>- Remote sensing data and GIS,</li> <li>- Supervisor reports.</li> </ul>
<b>Description of measurement methods and procedures to be applied</b>	<p>The following sources will be monitored:</p> <ul style="list-style-type: none"> <li>- INMET<sup>29</sup></li> <li>- Periodic reports from area supervisor</li> <li>- INPE<sup>30</sup></li> </ul>
<b>Frequency of monitoring/recording</b>	At each time a catastrophic event occurs.
<b>Value applied</b>	0
<b>Monitoring equipment</b>	Remote sensing and GIS
<b>QA/QC procedures to be applied</b>	<p>Best practices in remote sensing and GIS. Furthermore, the following sources will be also monitored to confirm the data obtained from remote sensing and GIS:</p> <ul style="list-style-type: none"> <li>- INMET</li> <li>- INPE</li> <li>- Periodic reports from area supervisor</li> </ul>
<b>Purpose of data</b>	This parameter was used to calculate project emissions in the project scenario. Provides an <i>ex post</i> estimation of the area affected by catastrophic events within the project area
<b>Calculation method</b>	Remote sensing and GIS
<b>Comments</b>	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

<sup>29</sup> INMET. Instituto Nacional de Meteorologia. Available at: [http://www.inmet.gov.br/portal/index.php?r=home/page&page=rede\\_estacoes\\_conv\\_graf](http://www.inmet.gov.br/portal/index.php?r=home/page&page=rede_estacoes_conv_graf).

<sup>30</sup> INPE. Instituto Nacional de Pesquisas Espaciais. Available at: [http://sigma.cptec.inpe.br/queimadas/index\\_old.php](http://sigma.cptec.inpe.br/queimadas/index_old.php).

	(such as acts of terrorism or war), are subject to monitoring and must be accounted under the project scenario, when significant.															
<b>Data / Parameter</b>	ABSLLK <sub>t</sub>															
<b>Data unit</b>	Ha															
<b>Description</b>	Annual area of deforestation within the leakage belt at year t.															
<b>Source of data</b>	Remote sensing and GIS.															
<b>Description of measurement methods and procedures to be applied</b>	Deforestation in the leakage belt area may 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.															
<b>Frequency of monitoring/recording</b>	Annually															
<b>Value applied</b>	<table border="1"> <thead> <tr> <th>Year</th> <th>ABSLLK<sub>t</sub> (ha)</th> </tr> </thead> <tbody> <tr> <td>2013</td> <td>599.67</td> </tr> <tr> <td>2014</td> <td>102.69</td> </tr> <tr> <td>2015</td> <td>75.15</td> </tr> <tr> <td>2016</td> <td>174.60</td> </tr> <tr> <td>2017</td> <td>222.75</td> </tr> <tr> <td>Total</td> <td>1,174.86</td> </tr> </tbody> </table>		Year	ABSLLK <sub>t</sub> (ha)	2013	599.67	2014	102.69	2015	75.15	2016	174.60	2017	222.75	Total	1,174.86
Year	ABSLLK <sub>t</sub> (ha)															
2013	599.67															
2014	102.69															
2015	75.15															
2016	174.60															
2017	222.75															
Total	1,174.86															
<b>Monitoring equipment</b>	Remote sensing and GIS															
<b>QA/QC procedures to be applied</b>	Best practices in remote sensing.															
<b>Purpose of data</b>	This parameter was used to calculate leakage emissions in the project scenario. Provides the <i>ex post</i> value of the deforested area within the leakage belt.															
<b>Calculation method</b>	Analysis of satellite images and maps.															
<b>Comments</b>	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 is attributed to the project activity, thus not considered leakage.															

<b>Data / Parameter</b>	ABSLPA <sub>t</sub>															
<b>Data unit</b>	Ha															
<b>Description</b>	Annual area of deforestation in the project area at year t															
<b>Source of data</b>	Remote sensing and GIS.															
<b>Description of measurement methods and procedures to be applied</b>	Forest cover change due to deforestation is monitored through periodic assessment of classified satellite imagery covering the project area.															
<b>Frequency of monitoring/recording</b>	Annually															
<b>Value applied</b>	<table border="1"> <thead> <tr> <th>Year</th> <th>ABSLPA<sub>t</sub> (ha)</th> </tr> </thead> <tbody> <tr> <td>2013</td> <td>111.92</td> </tr> <tr> <td>2014</td> <td>58.71</td> </tr> <tr> <td>2015</td> <td>25.14</td> </tr> <tr> <td>2016</td> <td>51.82</td> </tr> <tr> <td>2017</td> <td>67.84</td> </tr> <tr> <td>Total</td> <td>315.43</td> </tr> </tbody> </table>	Year	ABSLPA <sub>t</sub> (ha)	2013	111.92	2014	58.71	2015	25.14	2016	51.82	2017	67.84	Total	315.43	
Year	ABSLPA <sub>t</sub> (ha)															
2013	111.92															
2014	58.71															
2015	25.14															
2016	51.82															
2017	67.84															
Total	315.43															
<b>Monitoring equipment</b>	Remote sensing and GIS															
<b>QA/QC procedures to be applied</b>	Best practices in remote sensing.															
<b>Purpose of data</b>	This parameter was used to calculate baseline emissions and project emissions in the project scenario. Provides the <i>ex ante</i> and <i>ex post</i> values of the deforested area per forest class within the project area.															
<b>Calculation method</b>	Analysis of satellite images and maps.															
<b>Comments</b>	N/A															

<b>Data / Parameter</b>	ΔCADLK <sub>t</sub>
<b>Data unit</b>	tCO <sub>2e</sub>
<b>Description</b>	Total decrease in carbon stocks due to displaced deforestation at year t

Source of data	Remote sensing and GIS.
Description of measurement methods and procedures to be applied	Deforestation in the leakage belt area may be considered activity displacement leakage. Activity data for the leakage belt area was determined using the same methods applied to monitoring deforestation activity data in the project area.
Frequency of monitoring/recording	Annually
Value applied	0
Monitoring equipment	Remote sensing and GIS.
QA/QC procedures to be applied	Best practices in remote sensing.
Purpose of data	This parameter was used to calculate leakage emissions in the project scenario. Provides the <i>ex post</i> value of the decrease in carbon stocks due to displaced deforestation in the leakage belt.
Calculation method	Emissions from deforestation are estimated by multiplying the detected area of forest loss by the average forest carbon stock per unit area.
Comments	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. During the current monitoring period, some years presented a deforestation higher than predicted in the baseline scenario within the leakage. However, as shown in the section 3.1 above, the analysis of the main locations of deforestation during the 2013-2017 within the leakage belt are of greater concentration in its northern-western portion, and more than 20km far from the project area. Furthermore, other external events caused the deforestation to rise after 2012 in the entire Amazon biome. Therefore, it could be concluded that this increase in deforestation is not linked to the project activity.

Data / Parameter	$\Delta\text{CPAdPA}_t$
Data unit	tCO <sub>2e</sub>
Description	Total decrease in carbon stock due to all planned activities at year t in the project area
Source of data	Documents, remote sensing and GIS.

Description of measurement methods and procedures to be applied	The planned activities in the project area that result in carbon stock decrease will be subject to monitoring, when significant.
Frequency of monitoring/recording	Annually
Value applied	0
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing.
Purpose of data	This parameter was used to calculate project emissions in the project scenario. Provides the <i>ex post</i> value of the decrease in carbon stocks due to planned activities in the project area.
Calculation method	This parameter is the sum of: carbon stock decrease due to planned deforestation, carbon stock decrease due to planned logging activities, and carbon stock decrease due to planned fuel-wood and charcoal activities.
Comments	N/A

Data / Parameter	$\Delta\text{CPAiPA}_t$
Data unit	tCO <sub>2e</sub>
Description	Total increase in carbon stock due to all planned activities at year t in the project area
Source of data	Documents, remote sensing and GIS.
Description of measurement methods and procedures to be applied	The planned activities in the project area that result in carbon stock increase will be subject to monitoring, when significant.
Frequency of monitoring/recording	Annually
Value applied	0
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing.

<b>Purpose of data</b>	This parameter was used to calculate project emissions in the project scenario. Provides the <i>ex post</i> 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.
<b>Calculation method</b>	Depends on the planned activity.
<b>Comments</b>	N/A

<b>Data / Parameter</b>	$\Delta\text{CPSLK}_t$														
<b>Data unit</b>	tCO <sub>2e</sub>														
<b>Description</b>	Total annual carbon stock change in leakage management areas in the project case														
<b>Source of data</b>	<ul style="list-style-type: none"> <li>- Activities report related to leakage prevention measures.</li> <li>- Field assessment.</li> <li>- Remote sensing and GIS.</li> </ul>														
<b>Description of measurement methods and procedures to be applied</b>	The planned activities in leakage management areas that result in carbon stock decrease will be subject to monitoring, when significant.														
<b>Frequency of monitoring/recording</b>	Annually														
<b>Value applied</b>	<table border="1"> <thead> <tr> <th>Year</th> <th><math>\Delta\text{CPSLK}_t</math> (tCO<sub>2e</sub>)</th> </tr> </thead> <tbody> <tr> <td>2013</td> <td>0.00</td> </tr> <tr> <td>2014</td> <td>18.15</td> </tr> <tr> <td>2015</td> <td>0.00</td> </tr> <tr> <td>2016</td> <td>0.00</td> </tr> <tr> <td>2017</td> <td>23.10</td> </tr> <tr> <td>Total</td> <td>41.25</td> </tr> </tbody> </table>	Year	$\Delta\text{CPSLK}_t$ (tCO <sub>2e</sub> )	2013	0.00	2014	18.15	2015	0.00	2016	0.00	2017	23.10	Total	41.25
Year	$\Delta\text{CPSLK}_t$ (tCO <sub>2e</sub> )														
2013	0.00														
2014	18.15														
2015	0.00														
2016	0.00														
2017	23.10														
Total	41.25														
<b>Monitoring equipment</b>	Remote sensing and GIS														
<b>QA/QC procedures to be applied</b>	Best practices in remote sensing.														
<b>Purpose of data</b>	This parameter was used to calculate leakage emissions in the project scenario. Provides the <i>ex post</i> value of the change in														

	carbon stocks due to leakage prevention measures in the leakage management area.
Calculation method	Emissions from deforestation are estimated by multiplying the detected area of forest loss by the average forest carbon stock per unit area.
Comments	The leakage prevention measures proposed by the present project do not include decrease in carbon stocks due to activities implemented in the leakage management area.

Data / Parameter	$\Delta\text{CUDdPA}_t$														
Data unit	tCO <sub>2e</sub>														
Description	Total actual carbon stock change due to unavoided unplanned deforestation at year t in the project area														
Source of data	<ul style="list-style-type: none"> <li>- Remote sensing and GIS.</li> <li>- Supervisors reports.</li> <li>- Field data obtained from local community and forest engineer with experience in the region.</li> </ul>														
Description of measurement methods and procedures to be applied	Forest cover change due to unplanned deforestation was monitored through periodic assessment of classified satellite imagery covering the project area.														
Frequency of monitoring/recording	Annually														
Value applied	<table border="1"> <thead> <tr> <th>Year</th> <th><math>\Delta\text{CUDdPA}_t</math> (tCO<sub>2e</sub>)</th> </tr> </thead> <tbody> <tr> <td>2013</td> <td>85,442.01</td> </tr> <tr> <td>2014</td> <td>50,006.71</td> </tr> <tr> <td>2015</td> <td>27,717.16</td> </tr> <tr> <td>2016</td> <td>45,303.22</td> </tr> <tr> <td>2017</td> <td>53,231.65</td> </tr> <tr> <td>Total</td> <td>261,700.76</td> </tr> </tbody> </table>	Year	$\Delta\text{CUDdPA}_t$ (tCO <sub>2e</sub> )	2013	85,442.01	2014	50,006.71	2015	27,717.16	2016	45,303.22	2017	53,231.65	Total	261,700.76
Year	$\Delta\text{CUDdPA}_t$ (tCO <sub>2e</sub> )														
2013	85,442.01														
2014	50,006.71														
2015	27,717.16														
2016	45,303.22														
2017	53,231.65														
Total	261,700.76														
Monitoring equipment	Remote sensing and GIS														
QA/QC procedures to be applied	Best practices in remote sensing.														

<b>Purpose of data</b>	This parameter was used to calculate project emissions in the project scenario. Provides the <i>ex post</i> value of the change in carbon stocks due to unavoided unplanned deforestation within the project area.
<b>Calculation method</b>	Emissions from deforestation were estimated by multiplying the detected area of forest loss by the average forest carbon stock per unit area.
<b>Comments</b>	According to the VCS PD, unplanned logging was not considered in the baseline scenario of the present REDD project. Excluding degradation from this project activity in the project scenario is conservative, as timber harvesting has been decreasing within the reference region over the monitoring period, so it is expected that project emissions due to illegal harvesting be lower than baseline emissions (if they had been considered).

<b>Data / Parameter</b>	EBBBSLPA <sub>t</sub>															
<b>Data unit</b>	tCO <sub>2e</sub>															
<b>Description</b>	Sum of (or total) baseline non-CO <sub>2</sub> emissions from forest fire at year t in the project area															
<b>Source of data</b>	<ul style="list-style-type: none"> <li>- Remote sensing data and GIS,</li> <li>- Supervisor reports.</li> </ul>															
<b>Description of measurement methods and procedures to be applied</b>	Slash-and-burn deforestation to clear the area is carried out for subsistence agriculture, which is the main cause of deforestation within the project area. Therefore, baseline deforestation in the project area involves fire and all above ground biomass is burnt.															
<b>Frequency of monitoring/recording</b>	Annually															
<b>Value applied</b>	<table border="1"> <thead> <tr> <th>Year</th> <th>EBBBSLPA<sub>t</sub> (tCO<sub>2e</sub>)</th> </tr> </thead> <tbody> <tr> <td>2013</td> <td>3.620,74</td> </tr> <tr> <td>2014</td> <td>3.227,01</td> </tr> <tr> <td>2015</td> <td>3.373,33</td> </tr> <tr> <td>2016</td> <td>2.819,97</td> </tr> <tr> <td>2017</td> <td>2.921,07</td> </tr> <tr> <td>Total</td> <td>15,962.11</td> </tr> </tbody> </table>	Year	EBBBSLPA <sub>t</sub> (tCO <sub>2e</sub> )	2013	3.620,74	2014	3.227,01	2015	3.373,33	2016	2.819,97	2017	2.921,07	Total	15,962.11	
Year	EBBBSLPA <sub>t</sub> (tCO <sub>2e</sub> )															
2013	3.620,74															
2014	3.227,01															
2015	3.373,33															
2016	2.819,97															
2017	2.921,07															
Total	15,962.11															
<b>Monitoring equipment</b>	Remote sensing and GIS															
<b>QA/QC procedures to be applied</b>	Best practices in remote sensing.															

<b>Purpose of data</b>	This parameter was used to calculate non-CO <sub>2</sub> emissions due to forest fires within the project area in the baseline scenario, providing an <i>ex ante</i> estimation.
<b>Calculation method</b>	Non-CO <sub>2</sub> emissions from biomass burning are calculated according to requirements of methodology VM0015 v1.1. Baseline deforestation in the project area involves fire and all above ground biomass is burnt to clear the area to subsistence agriculture. Therefore, this parameter is estimated as the multiplication of the annual area of deforestation of initial forest classes in the project area in the baseline scenario ( $ABSLPA_{icl,t}$ ) times the total GHG emission from biomass burning in initial forest classes ( $EBBtot_{icl,t}$ ).
<b>Comments</b>	<i>Ex post</i> monitoring of forest fires and non-CO <sub>2</sub> emissions ( $EBBPSPA_t$ ) is necessary to determine GHG emissions within the project area (when the forest fire was significant).

<b>Data / Parameter</b>	$EBBPSPA_t$
<b>Data unit</b>	tCO <sub>2</sub> e
<b>Description</b>	Sum of (or total) actual non-CO <sub>2</sub> emissions from forest fire at year t in the project area
<b>Source of data</b>	<ul style="list-style-type: none"> <li>- Remote sensing data and GIS,</li> <li>- Supervisor reports,</li> <li>- Field assessment.</li> </ul>
<b>Description of measurement methods and procedures to be applied</b>	<p>The usual deforestation process in the region involves fire to clean the area. It was conservatively assumed that all unplanned deforestation and catastrophic events within the project area involved fire and all above ground biomass was burnt. Therefore, non-CO<sub>2</sub> emissions from forest fires were quantified and deducted from emission reductions. Moreover, the local community who lives within the project area adopts the <i>coivara</i> practice for agriculture plantations. Thus, non-CO<sub>2</sub> emissions from the burning cycle was also calculated by this parameter.</p> <p>In addition to remote sensing data and GIS, which can identify the area affected by forest fire, periodic reports from area supervisor, a community member who lives inside the project area, could also confirm the data obtained.</p>
<b>Frequency of monitoring/recording</b>	Annually

Value applied	Year	EBBPSPA <sub>t</sub> (tCO <sub>2</sub> e)
	2013	7.889,67
	2014	6.118,08
	2015	5.000,53
	2016	5.888,91
	2017	6.421,93
	Total	31,319.12
Monitoring equipment	Remote sensing and GIS	
QA/QC procedures to be applied	Best practices in remote sensing.	
Purpose of data	This parameter was used to calculate non-CO <sub>2</sub> emissions due to forest fires within the project area in the project scenario, providing an ex post project emissions value.	
Calculation method	Non-CO <sub>2</sub> emissions from biomass burning are calculated according to requirements of methodology VM0015 v1.1. The clearance of the area to subsistence agriculture involved forest fires and these non-CO <sub>2</sub> emissions will be subject to monitoring and accounting, considering that all above ground biomass will be burnt. Therefore, this parameter is calculated as the multiplication of the annual area of deforestation of initial forest classes in the project area in the project scenario times the total GHG emission from biomass burning ( $EBB_{tot_{ic,t}}$ ).	
Comments	N/A	
Data / Parameter	EgLK <sub>t</sub>	
Data unit	tCO <sub>2</sub> e	
Description	Emissions from grazing animals in leakage management areas at year t.	
Source of data	<ul style="list-style-type: none"> <li>- Activities report related to leakage prevention measures.</li> <li>- Field assessment.</li> <li>- Remote sensing data and GIS.</li> </ul>	
Description of measurement methods and procedures to be applied	GHG emissions from grazing animals in the leakage management area (i.e. enteric fermentation or manure management) were subjected to monitoring, when significant.	

Frequency of monitoring/recording	Annually
Value applied	0
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing and GIS.
Purpose of data	This parameter was used to calculate GHG leakage emissions from activities implemented in the leakage management area in the project scenario, providing an <i>ex post</i> value.
Calculation method	Described in the methodology VM0015 v1.1, section 8.1.2: <i>Ex ante</i> estimation of CH <sub>4</sub> and N <sub>2</sub> O emissions from grazing animals.
Comments	No activities from grazing animals that resulted in GHG emissions occurred in the leakage management area during this second monitoring period.

Data / Parameter	EADLK <sub>t</sub>
Data unit	tCO <sub>2e</sub>
Description	Total <i>ex ante</i> and <i>ex post</i> increase in GHG emissions due to displaced forest fires at year t.
Source of data	Remote sensing data and GIS.
Description of measurement methods and procedures to be applied	Forest fires in the leakage belt area may be considered activity displacement leakage. GHG emissions due displaced forest fires will be subjected to monitoring, when significant.
Frequency of monitoring/recording	Annually
Value applied	0
Monitoring equipment	Remote sensing and GIS
QA/QC procedures to be applied	Best practices in remote sensing and GIS.
Purpose of data	This parameter was used to calculate leakage emissions in the baseline and project scenarios. Provides the <i>ex ante</i> and <i>ex post</i> value of the increase in GHG emissions due to displaced forest fires in the leakage belt.

<b>Calculation method</b>	GHG emissions from biomass burning are estimated by multiplying the detected area of forest loss in the leakage belt times the total GHG emission from biomass burning in initial forest classes. This is done separately for the baseline and project scenarios.
<b>Comments</b>	<p>No significant forest fires in the leakage belt area occurred during this second monitoring period.</p> <p>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.</p>

<b>Data / Parameter</b>	$RF_t$
<b>Data unit</b>	%
<b>Description</b>	Risk factor used to calculate VCS buffer credits
<b>Source of data</b>	<ul style="list-style-type: none"> <li>- VCS Non-Permanence Risk Report - Ecomapuá Amazon REDD Project;</li> <li>- Remote sensing data and GIS;</li> <li>- Supervisor report;</li> <li>- Literature data.</li> </ul>
<b>Description of measurement methods and procedures to be applied</b>	All sources of data from the VCS Non-Permanence Risk Report were used to measure the various risk factors.
<b>Frequency of monitoring/recording</b>	Annually
<b>Value applied</b>	10
<b>Monitoring equipment</b>	Remote sensing and GIS.
<b>QA/QC procedures to be applied</b>	Best practices in remote sensing and GIS.
<b>Purpose of data</b>	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.
<b>Calculation method</b>	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

### 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.

All data sources and processing, classification and change detection procedures were documented and stored in a dedicated long-term electronic archive maintained by Ecomapuá Conservação Ltda.'s parent company: Bio Assets, at its office in São Paulo, Brazil.

For all aspects of project monitoring, Ecomapuá and Bio Assets 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. Lap Tak Chan*. 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	Ecomapuá Conservação Ltda. together with Sustainable Carbon and Uezu Planejamento Ambiental	Prior to verification
Monitoring of non-CO <sub>2</sub> emissions from forest fires	Ecomapuá Conservação Ltda. together with Sustainable Carbon and Uezu Planejamento Ambiental	Prior to verification
Monitoring of Leakage	Ecomapuá Conservação Ltda. together with Sustainable Carbon and Uezu Planejamento Ambiental	Prior to verification
Monitoring of Natural Disturbance and catastrophic events	Ecomapuá Conservação Ltda. together with Sustainable Carbon and Uezu Planejamento Ambiental	When a natural event occurs

**Table 17.** Type of Monitoring and Party Responsible for Monitoring

Deforestation and related project/leakage 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 MapBiomass images, which is a new platform that produces maps through a pixel-by-pixel classification from Landsat satellites images. It is important to note that the classification method was the same used in the VCS PD for the 2<sup>nd</sup> baseline reassessment, in order to maintain coherency of methods and results.

In addition, the process of accumulating “Non Forest” areas was adopted using the same method employed in the VCS PD, 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 2013 – 2017, 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 18.** 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, analyses were performed both 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 ( $\text{Mg ha}^{-1}$ ) was converted to  $\text{tCO}_2\text{e}$  using the following equations:

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

Where,

$Cab_{icl}$	Average carbon stock per hectare in the above-ground biomass carbon pool of initial forest class $icl$ ; $\text{tCO}_2\text{e ha}^{-1}$
$ab$	Average biomass stock per hectare in the above-ground biomass pool of initial forest class $icl$ ; $\text{Mg ha}^{-1}$
$CF$	Default value of carbon fraction in biomass
$44/12$	Ratio converting C to $\text{CO}_2\text{e}$

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

Where,

$Cbb_{icl}$	Average carbon stock per hectare in the below-ground biomass carbon pool of initial forest class $icl$ ; $\text{tCO}_2\text{e ha}^{-1}$
$bb$	Average biomass stock per hectare in the below-ground biomass pool of initial forest class $icl$ ; $\text{Mg ha}^{-1}$
$CF$	Default value of carbon fraction in biomass
$44/12$	Ratio converting C to $\text{CO}_2\text{e}$

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

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

Where,

$\Delta CBSLPA_t$  Total baseline carbon stock changes in the project area at year t; tCO<sub>2e</sub>

$\Delta CabBSLPA_{icl,t}$  Total baseline carbon stock change for the above-ground biomass pool in the project area for initial forest class at year t; tCO<sub>2e</sub>

$\Delta CbbBSLPA_{icl,t}$  Total baseline carbon stock change for the below-ground biomass pool in the project area for initial forest class at year t; tCO<sub>2e</sub>

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

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<sub>2e</sub>

$ABSLPA_{icl,t}$  Area of initial forest class icl deforested at time t within the project area in the baseline case; ha

$\Delta Cab_{icl}$  Average carbon stock change factor per hectare in the above-ground biomass carbon pool of initial forest class icl; tCO<sub>2e</sub> ha<sup>-1</sup>

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

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<sub>2e</sub>

$ABSLPA_{icl,t}$  Area of initial forest class icl deforested at time t within the project area in the baseline case; ha

$\Delta Cbb_{icl}$  Average carbon stock change factor per hectare in the below-ground biomass carbon pool of category icl; tCO<sub>2e</sub> ha<sup>-1</sup>

### Estimation of the average carbon stocks

According to the VCS PD for the 2<sup>nd</sup> baseline reassessment, the utilized carbon stocks in the Project were calculated on the basis of above ground biomass values from the study presented in Cunha (2018)<sup>31</sup> for riparian dense tropical rainforest.

This study analyzed the patterns of productivity and dynamics of igapó (black-water) forest in the National Forest of Caxiuanã, Eastern Amazonia, which is located close to the south-western portion of Marajó Island (where the reference region is located) and contains the same forest type of the project area (riparian dense tropical rainforest).

Forest inventory was conducted on a six-year follow-up basis between 2012 and 2017. Results were analyzed in terms of growth, mortality and recruitment of tree species with Diameter at Breast Height (DBH)  $\geq 10$  cm. Two long-term plots of 1 ha each were installed, which were subdivided into five plots of 20 x 100 m each. In each plot, all trees, lianas and palm trees with a DBH  $\geq 10$  cm were identified and analyzed in terms of above ground biomass.

The above-ground biomass estimates per plot were obtained from the sum of the individuals biomass using the allometric equation developed by Chambers et al. (2001) and modified by Baker et al. (2004) for above-ground biomass estimation in flooded forests:

$$\text{Biomass} = \sum n \text{ DEN} / 0.67 * \exp(0.33 (\ln (\text{DAP})) + 0.933 (\ln (\text{DAP}^2)) - 0.122 (\ln (\text{DAP}^3)) - 0.37)^{32}$$

The igapó forests analyzed presented biomass equivalent to  $359.8 \pm 10.8 \text{ Mg ha}^{-1}$  and a mean increase of  $6.3 \pm 3.7 \text{ Mg ha}^{-1} \text{ y}^{-1}$  indicating that these forests during the analyzed period acted as a carbon sink.

This value was chosen after a literature search revealed that this study had the most accurate biomass values for the vegetation-cover of the Project's reference region.

In addition, average values for the below-ground biomass were taken from the applied methodology VM0015 v1.1, which estimates a root-to-shoot ratio of 0.24 for tropical rainforest having above ground biomass values above 125 tons/ha.

Vegetation	Aboveground Biomass (Mg ha <sup>-1</sup> )	Belowground Biomass (Mg ha <sup>-1</sup> )	Total biomass (Mg ha <sup>-1</sup> )
Riparian Dense Tropical Rainforest	359.80	86.35	446.15

**Table 19.** Biomass values used for the class “forest”

According to the applied methodology, as the uncertainty of the total average carbon stock is less than 10% of the average value, the average carbon stock value can be used.

<sup>31</sup> CUNHA, Denise de Andrade. **Dinâmica e produtividade em florestas de igapó e várzea na Amazônia Oriental**. 2018. 144 f. Tese (Doutorado) - Curso de Doutorado do Programa de Pós-graduação em Biodiversidade e Biotecnologia, Rede Bionorte, Museu Paraense Emílio Goeldi, Belém, 2018.

<sup>32</sup> Where 'n' the number of trees per plot and 'DEN' the specific density of wood for each species.

In order to convert biomass into carbon, and carbon into carbon-dioxide, the conversion factors<sup>33</sup> defined in table below were used.

Conversion Factors	
Biomass to Carbon	0.5
C to CO <sub>2</sub>	44/12

**Table 20.** Biomass to CO<sub>2</sub> conversion factors

Therefore, the table below depicts the average above and below ground CO<sub>2</sub> stock values for riparian dense tropical rainforest present in the project region.

Vegetation	Aboveground CO <sub>2</sub> - C <sub>abicl</sub> (tCO <sub>2</sub> ha <sup>-1</sup> )	Belowground CO <sub>2</sub> - C <sub>bbicl</sub> (tCO <sub>2</sub> ha <sup>-1</sup> )	Total CO <sub>2</sub> - C <sub>totict</sub> (tCO <sub>2</sub> ha <sup>-1</sup> )
Riparian Dense Tropical Rainforest	659.63	158.31	817.95

**Table 21.** Carbon stocks per hectare of initial forest classes icl existing in the project area and leakage belt

#### Average carbon stocks of post-deforestation classes

Fearnside (1996)<sup>34</sup> 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<sub>2e</sub>/ha.

Post deforestation class <i>fcl</i>	
Name	Non forest
ID <sub>fcl</sub>	1
<i>C<sub>totfcl</sub></i>	
tCO <sub>2e</sub> /ha	
46.93	

**Table 22.** Long-term (20-years) average carbon stocks per hectare of post-deforestation LU/LC classes present in the reference region

#### Calculation of baseline carbon stock changes

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

<sup>33</sup> 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>>.

<sup>34</sup> 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: <<https://www.sciencedirect.com/science/article/abs/pii/0378112795036474>>.

Carbon stock change in the above-ground biomass per initial forest class <i>icl</i>		Total carbon stock change in the above-ground biomass of initial forest class in the project area		Carbon stock change in the below-ground biomass per initial forest class <i>icl</i>		Total carbon stock change in the below-ground biomass of initial forest class in the project area		Carbon stock changes in above-ground biomass per post-deforestation zone <i>z</i>		Total carbon stock change of post deforestation zones in the project area		Total net carbon stock change in the project area	
ID <sub>icl</sub>	1	$\Delta C_{abBSLPA_{icl,t}}$	$\Delta C_{abBSLPA_{icl}}$	ID <sub>icl</sub>	1	$\Delta C_{bbBSLPA_{icl,t}}$	$\Delta C_{bbBSLPA_{icl}}$	ID <sub>iz</sub>	1	$\Delta C_{BSLPA_{z,t}}$	$\Delta C_{BSLPA_z}$	$\Delta C_{BSLPA_t}$	$\Delta C_{BSLPA}$
Name	Riparian (Aluvial) Dense Tropical Rainforest	annual	cumulative	Name	Riparian (Aluvial) Dense Tropical Rainforest	annual	cumulative	Name	Non-forest	annual	cumulat	annual	cumulat
Project year	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	Project year	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	Project year	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>
2013	71,743	71,743	71,743	2013	61,548	61,548	61,548	2013	23,134	23,134	23,134	110,157	110,157
2014	63,941	63,941	135,684	2014	54,064	54,064	115,612	2014	18,247	18,247	41,380	99,758	209,916
2015	66,841	66,841	202,525	2015	46,558	46,558	162,170	2015	16,028	16,028	57,408	97,371	307,287
2016	55,876	55,876	258,401	2016	41,104	41,104	203,274	2016	13,803	13,803	71,211	83,177	390,465
2017	57,879	57,879	316,281	2017	37,031	37,031	240,305	2017	12,186	12,186	83,396	82,724	473,189

**Table 23.** Baseline carbon stock change in the project area

Carbon stock change in the above-ground biomass per initial forest class <i>icl</i>		Total carbon stock change in the above-ground biomass of initial forest class in the leakage belt		Carbon stock change in the below-ground biomass per initial forest class <i>icl</i>		Total carbon stock change in the below-ground biomass of initial forest class in the leakage belt		Carbon stock changes in above-ground biomass per post-deforestation zone <i>z</i>		Total carbon stock change of post deforestation zones in the leakage belt		Total net carbon stock change in the leakage belt	
ID <sub>icl</sub>	1	$\Delta\text{CabBSLLK}_{icl,t}$	$\Delta\text{CabBSLLK}_{icl}$	ID <sub>icl</sub>	1	$\Delta\text{CbbBSL LK}_{icl,t}$	$\Delta\text{CbbBSL LK}_{icl}$	ID <sub>iz</sub>	1	$\Delta\text{CBSL LK}_{z,t}$	$\Delta\text{CBSLLK}_z$	$\Delta\text{CBSLLK}_t$	$\Delta\text{CBSLLK}$
Name	Riparian (Aluvial) Dense Tropical Rainforest	annual	cumulative	Name	Riparian (Aluvial) Dense Tropical Rainforest	annual	cumulative	Name	Non-forest	annual	cumulative	annual	cumulative
Project year	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	Project year	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	Project year	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>
2013	121,049	121,049	121,049	2013	306,470	306,470	306,470	2013	114,202	114,202	114,202	313,318	313,318
2014	119,387	119,387	240,436	2014	236,238	236,238	542,708	2014	90,856	90,856	205,058	264,769	578,086
2015	122,355	122,355	362,792	2015	203,279	203,279	745,988	2015	70,035	70,035	275,094	255,600	833,686
2016	122,474	122,474	485,266	2016	165,811	165,811	911,799	2016	60,264	60,264	335,358	228,021	1,061,707
2017	130,964	130,964	616,229	2017	141,276	141,276	1,053,074	2017	49,156	49,156	384,514	223,083	1,284,790

**Table 24.** Baseline carbon stock change in the leakage belt

**Baseline non-CO<sub>2</sub> emissions from forest fires**

As described in the baseline scenario of the VCS PD, slash-and-burn deforestation to clear the area is carried out for subsistence agriculture, which is the main cause of deforestation within the project area. Therefore, baseline deforestation in the project area involves fire and all above ground biomass is burnt. It is worth mentioning that the effect of fire on CO<sub>2</sub> emissions is counted in the estimation of carbon stock changes; therefore, CO<sub>2</sub> emissions from biomass burning were ignored to avoid double counting. However, non-CO<sub>2</sub> emissions (CH<sub>4</sub> and N<sub>2</sub>O) from forest fires (EBBBSLPA<sub>t</sub>) were quantified and included as baseline emissions, as follows.

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

Where,

- EBBtot<sub>icl,t</sub> Total GHG emission from biomass burning in forest class icl at year t; tCO<sub>2</sub>e/ha
- EBBN<sub>2</sub>O<sub>icl,t</sub> N<sub>2</sub>O emission from biomass burning in forest class icl at year t; tCO<sub>2</sub>e/ha
- EBBCH<sub>4</sub><sub>icl,t</sub> CH<sub>4</sub> emission from biomass burning in forest class icl at year t; tCO<sub>2</sub>e/ha

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

Where,

- EBBCO<sub>2</sub><sub>icl,t</sub> Per hectare CO<sub>2</sub> emission from biomass burning in slash and burn in forest class icl at year t; tCO<sub>2</sub>e/ha
- NCR Nitrogen to Carbon Ratio (IPCC default value = 0.01); dimensionless
- ER<sub>N<sub>2</sub>O</sub> Emission ratio for N<sub>2</sub>O (IPCC default value = 0.007)
- GWP<sub>N<sub>2</sub>O</sub> Global Warming Potential for N<sub>2</sub>O (IPCC default value = 310 for the first commitment period)<sup>35</sup>

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

Where,

- EBBCO<sub>2</sub><sub>icl,t</sub> Per hectare CO<sub>2</sub> emission from biomass burning in slash and burn in forest class icl at year t; tCO<sub>2</sub>e/ha

<sup>35</sup> According to the VCS Standard 4.0, 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<sub>2</sub>O = 298). However, the default value from the applied methodology was used (GWP for N<sub>2</sub>O = 310) because it resulted in lower values of EBBtot<sub>icl,t</sub> (33.29 tCO<sub>2</sub>e/ha instead of 38.93 tCO<sub>2</sub>e/ha) and consequently, more conservative values of GHG emission reductions.

ER <sub>CH4</sub>	Emission ratio for CH <sub>4</sub> (IPCC default value = 0.012)
GWP <sub>CH4</sub>	Global Warming Potential for CH <sub>4</sub> (IPCC default value = 21 for the first commitment period) <sup>36</sup>

$$EBBCO_{2icl,t} = F_{burnt_{icl}} * \sum_{p=1}^P (C_{p,icl,t} * P_{burnt_{p,icl}} * CE_{p,icl})$$

Where,

EBBCO <sub>2icl,t</sub>	Per hectare CO <sub>2</sub> emission from biomass burning in the forest class icl at year t; tCO <sub>2</sub> e/ha
F <sub>burnt<sub>icl</sub></sub>	Proportion of forest area burned during the historical reference period in the forest class icl; %
C <sub>p,icl,t</sub>	Average carbon stock per hectare in the carbon pool p burnt in the forest class icl at year t; tCO <sub>2</sub> e/ha
P <sub>burnt<sub>p,icl</sub></sub>	Average proportion of mass burnt in the carbon pool p in the forest class icl; %
CE <sub>p,icl</sub>	Average combustion efficiency of the carbon pool p in the forest class icl; dimensionless (IPCC default of 0.5)
p	Carbon pool that could burn, above-ground biomass

Thus, the total actual non-CO<sub>2</sub> emissions from forest fire at year t in the project area at the baseline scenario (EBBBSLPA<sub>t</sub>) were calculated as follows.

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

Where,

EBBBSLPA <sub>t</sub>	Total actual non-CO <sub>2</sub> emissions from forest fire at year t in the project area in the baseline scenario; tCO <sub>2</sub> e/ha
ABSLPA <sub>icl,t</sub>	Annual area of deforestation of initial forest classes icl in the project area at year t; ha
EBBtot <sub>icl,t</sub>	Total GHG emission from biomass burning in forest class icl at year t; tCO <sub>2</sub> e/ha

Values of all estimated parameters are reported in the following table.

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<sup>36</sup> According to the VCS Standard v4.0, 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<sub>4</sub> = 25). However, the default value from the applied methodology was used (GWP for CH<sub>4</sub> = 21) because it resulted in lower values of EBBtot<sub>icl,t</sub> (33.29 tCO<sub>2</sub>e/ha instead of 38.93 tCO<sub>2</sub>e/ha) and consequently, more conservative values of GHG emission reductions.

Initial Forest Class		Parameters								
		Fburnt <sub>icl</sub>	Cab	Pburnt <sub>ab,icl</sub>	CE <sub>ab,icl</sub>	ECO2-ab	EBBCO2-tot	EBBN2O <sub>icl</sub>	EBBCH4 <sub>icl</sub>	EBBtot <sub>icl</sub>
IDcl	Name	%	tCO2e/ha	%	%	tCO2e/ha	tCO2e/ha	tCO2e/ha	tCO2e/ha	tCO2e/ha
1	Riparian (Aluvial) Dense Tropical Rainforest	100%	659.63	100%	100%	329.82	329.82	3.07	30.22	33.29

**Table 25.** Parameters used to calculate non-CO<sub>2</sub> emissions from forest fires

The projected total non-CO<sub>2</sub> emissions from biomass burning are displayed in table below.

Project year t	Emissions of non-CO <sub>2</sub> gasses from baseline forest fires		Total baseline non-CO <sub>2</sub> emissions from forest fires in the project area	
	ID <sub>icl</sub> = 1 Riparian (Aluvial) Dense Tropical Rainforest		annual	cumulative
	ABSLPA <sub>icl,t</sub>	EBBBSL <sub>tot,icl</sub>	EBBBSLPA <sub>t</sub>	EBBBSLPA
	ha	tCO <sub>2</sub> e/ha	tCO <sub>2</sub> e	tCO <sub>2</sub> e
2013	108.76	33.29	3,620.74	3,620.74
2014	96.93	33.29	3,227.01	6,847.75
2015	101.33	33.29	3,373.33	10,221.07
2016	84.71	33.29	2,819.97	13,041.05
2017	87.74	33.29	2,921.07	15,962.11

**Table 26.** Baseline non-CO<sub>2</sub> emissions from forest fires in the project area

## 5.2 Project Emissions

During this monitoring period, there was no planned deforestation within the project area. However, unplanned deforestation occurred in the project area during the monitoring period. The *ex post* carbon stock decrease due to unplanned deforestation in the project area was calculated using the following equation:

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

Where,

$\Delta CUDdPA_t$  Total *ex post* actual carbon stock change due to unavioded unplanned deforestation at year t in the project area; tCO<sub>2</sub>e

- AUDPA<sub>icl,t</sub> Areas of unplanned deforestation in forest class icl at year t in the project area; ha
- ΔCtot<sub>icl</sub> Average carbon stock change of all accounted carbon pools in forest class icl at time t; tCO<sub>2</sub>e/ha
- t 1, 2, 3 ... T, a year of the proposed project crediting period; dimensionless

Therefore, the total carbon stock decrease due to 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	Total carbon stock decrease due to unplanned deforestation		Total carbon stock decrease due to planned and unplanned deforestation in the project area	
	ID <sub>cl</sub> = 1 Riparian (Aluvial) Dense Tropical Rainforest		annual	cumulative	ID <sub>cl</sub> = 1 Riparian (Aluvial) Dense Tropical Rainforest	annual	cumulative	annual	cumulative
	APDPA <sub>icl,t</sub>	Ctot <sub>icl,t</sub>	ΔCPDdPA <sub>t</sub>	ΔCPDdPA	AUDPA <sub>icl,t</sub>	ΔCUDdPA <sub>t</sub>	ΔCUDdPA		
	ha	tCO <sub>2</sub> e/ha	tCO <sub>2</sub> e	tCO <sub>2</sub> e	ha	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e
2013	0.00	817.95	0.00	0.00	111.92	85,442.01	85,442.01	85,442.01	85,442.01
2014	0.00	817.95	0.00	0.00	58.71	50,006.71	135,448.73	50,006.71	135,448.73
2015	0.00	817.95	0.00	0.00	25.14	27,717.16	163,165.88	27,717.16	163,165.88
2016	0.00	817.95	0.00	0.00	51.82	45,303.22	208,469.10	45,303.22	208,469.10
2017	0.00	817.95	0.00	0.00	67.84	53,231.65	261,700.76	53,231.65	261,700.76

**Table 27.** Ex post carbon stock decrease due to planned and unplanned deforestation in the project area

Fossil fuel emissions from REDD project activities are likely to be less than 5% of the total GHG emissions reductions benefits generated by the present project. In addition, according to VCS Standard Requirements, fossil fuel emissions from transport and machinery use in REDD project activities can be considered de minimis.

No planned production of logged timber, fuel wood or charcoal occurred within the project area during the monitoring period. Furthermore, there were no planned activities that resulted in carbon stock increase during this monitoring period.

The calculation of the ex post net carbon stock change in the project area under the project scenario (ΔCPSPA<sub>t</sub>) is described as follows.

$$\Delta CPSPA_t = \Delta CPA_dPA_t + \Delta CUDdPA_t - \Delta CPA_iPA_t$$

Where,

$\Delta\text{CPSPA}_t$	Sum of ex ante estimated actual carbon stock changes in the project area at year t; tCO <sub>2e</sub>
$\Delta\text{CPAdPA}_t$	Total decrease in carbon stock due to all planned activities at year t in the project area; tCO <sub>2e</sub>
$\Delta\text{CUDdPA}_t$	Total ex ante actual carbon stock change due to unavoided unplanned deforestation at year t in the project area; tCO <sub>2e</sub>
$\Delta\text{CPAiPA}_t$	Total increase in carbon stock due to all planned activities at year t in the project area; tCO <sub>2e</sub>

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

Project year	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	
	$\Delta\text{CPAdPA}_t$	$\Delta\text{CPAdPA}$	$\Delta\text{CPAiPA}_t$	$\Delta\text{CPAiPA}$	$\Delta\text{CUDdPA}_t$	$\Delta\text{CUDdPA}$	$\Delta\text{CPSPA}_t$	$\Delta\text{CPSPA}$
	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>
2013	0	0	0	0	85,442.01	85,442.01	85,442.01	85,442.01
2014	0	0	0	0	50,006.71	135,448.73	50,006.71	135,448.73
2015	0	0	0	0	27,717.16	163,165.88	27,717.16	163,165.88
2016	0	0	0	0	45,303.22	208,469.10	45,303.22	208,469.10
2017	0	0	0	0	53,231.65	261,700.76	53,231.65	261,700.76

**Table 28.** Ex post net carbon stock change in the project area under the project scenario

Furthermore, it was conservatively assumed that all unplanned deforestation and catastrophic events within the project area involved fire and all above ground biomass was burnt. It is worth mentioning that the effect of fire on CO<sub>2</sub> emissions is counted in the estimation of carbon stock changes in the parameter  $\Delta\text{CUDdPA}_t$ ; therefore, CO<sub>2</sub> emissions from forest fires were ignored to avoid double counting. However, non-CO<sub>2</sub> emissions (CH<sub>4</sub> and N<sub>2</sub>O) from forest fires ( $\text{EBBPSPA}_t$ ) were quantified and included as project emissions.

In addition, the local community who lives within the project area adopts the *coivara* practice for agriculture plantations, involving the deforestation and burning of an approximately 4 hectare plot of land per family to be used for 2.5 years, followed by a fallow period, and subsequent re-use of the same area. The total length of the production/fallow cycle is 10 years.<sup>37,38</sup> Thus, non-CO<sub>2</sub> emissions from the burning cycle of regenerated forests due to the *coivara* practice was also considered as project emissions.

<sup>37</sup> CASARIM, F. et al. (WINROCK International) (2010), "Assessing the potential for generating carbon offsets in the EcoMapuá Conservação properties in the Marajó Island, Brazil".

<sup>38</sup> P. G. Martorano (September 2002) "Caracterização da vegetação e uso do solo das terras pertencentes à empresa Ecomapuá Conservação Ltda No Município de Breves, Pará"

According to an interview conducted with the community in 2018, there were around 800 families living in the project region, and around 60% of them (480 families) live within the project area. According to VCS PD, the average population growth rate in the project region is around 4.2%/year, thus the approximate number of families living within the project area during the monitoring period could be calculated. Furthermore, carbon stocks of regenerated forests were calculated based on the average mean annual increment of tropical forests under natural regeneration in America, which was obtained from IPCC (2003)<sup>39</sup>.

$$EBB_{tot,icl,t} = EBB_{N_2O,icl,t} + EBB_{CH_4,icl,t}$$

Where,

$EBB_{tot,icl,t}$  Total GHG emission from biomass burning in forest class icl at year t; tCO<sub>2</sub>e/ha

$EBB_{N_2O,icl,t}$  N<sub>2</sub>O emission from biomass burning in forest class icl at year t; tCO<sub>2</sub>e/ha

$EBB_{CH_4,icl,t}$  CH<sub>4</sub> emission from biomass burning in forest class icl at year t; tCO<sub>2</sub>e/ha

$$EBB_{N_2O,icl,t} = EBBCO_{2,icl,t} * 12/44 * NCR * ER_{N_2O} * 44/28 * GWP_{N_2O}$$

Where,

$EBBCO_{2,icl,t}$  Per hectare CO<sub>2</sub> emission from biomass burning in slash and burn in forest class icl at year t; tCO<sub>2</sub>e/ha

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

$ER_{N_2O}$  Emission ratio for N<sub>2</sub>O (IPCC default value = 0.007)

$GWP_{N_2O}$  Global Warming Potential for N<sub>2</sub>O (IPCC default value = 310 for the first commitment period)<sup>40</sup>

$$EBB_{CH_4,icl,t} = EBBCO_{2,icl,t} * 12/44 * ER_{CH_4} * 16/12 * GWP_{CH_4}$$

Where,

$EBBCO_{2,icl,t}$  Per hectare CO<sub>2</sub> emission from biomass burning in slash and burn in forest class icl at year t; tCO<sub>2</sub>e/ha

<sup>39</sup> IPCC. Good Practice Guidance for Land Use, Land-Use Change and Forestry (GPG-LULUCF). 2003. Available at: <[https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf\\_files/GPG\\_LULUCF\\_FULL.pdf](https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/GPG_LULUCF_FULL.pdf)>. Last visited on: 09/April/2020.

<sup>40</sup> According to the VCS Standard 4.0, 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<sub>2</sub>O = 298). However, the default value from the applied methodology was used (GWP for N<sub>2</sub>O = 310) because it resulted in lower values of  $EBB_{tot,icl,t}$  (33.29 tCO<sub>2</sub>e/ha instead of 38.93 tCO<sub>2</sub>e/ha) and consequently, more conservative values of GHG emission reductions.

ER <sub>CH4</sub>	Emission ratio for CH <sub>4</sub> (IPCC default value = 0.012)
GWP <sub>CH4</sub>	Global Warming Potential for CH <sub>4</sub> (IPCC default value = 21 for the first commitment period) <sup>42</sup>

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

Where,

EBBCO <sub>2icl,t</sub>	Per hectare CO <sub>2</sub> emission from biomass burning in the forest class icl at year t; tCO <sub>2</sub> e/ha
F <sub>burnt<sub>icl</sub></sub>	Proportion of forest area burned during the historical reference period in the forest class icl; %
C <sub>picl,t</sub>	Average carbon stock per hectare in the carbon pool p burnt in the forest class icl at year t; tCO <sub>2</sub> e/ha
P <sub>burnt<sub>p,icl</sub></sub>	Average proportion of mass burnt in the carbon pool p in the forest class icl; % (conservatively assumed as 100%)
CE <sub>p,icl</sub>	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

Regarding unplanned deforestation areas (AUDPA<sub>icl,t</sub>), the same parameters used to calculate non-CO<sub>2</sub> emissions from forest fires in the baseline scenario (Table 25) have been considered for the calculation of EBB<sub>tot<sub>icl,t</sub></sub>.

Now regarding the slash and burn practice under *coivara* agriculture that occurred during the monitoring period, the average carbon stock burnt (C<sub>picl,t</sub>) was calculated based on the natural regeneration during a 7.5 years fallow period, which corresponds to around 137.50 tCO<sub>2</sub>e/ha. Therefore, the EBB<sub>tot<sub>icl,t</sub></sub> for *coivara* areas was 6.94 tCO<sub>2</sub>e/ha.

Thus, the total actual non-CO<sub>2</sub> emissions from forest fire at year t in the project area (EBB<sub>PSPA<sub>t</sub></sub>) were calculated as follows.

$$EBB_{PSPA_t} = ABSLPA_{icl,t} * EBB_{tot_{icl,t}}$$

Where,

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<sup>42</sup> According to the VCS Standard v4.0, 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<sub>4</sub> = 25). However, the default value from the applied methodology was used (GWP for CH<sub>4</sub> = 21) because it resulted in lower values of EBB<sub>tot<sub>icl,t</sub></sub> (33.29 tCO<sub>2</sub>e/ha instead of 38.93 tCO<sub>2</sub>e/ha) and consequently, more conservative values of GHG emission reductions.

EBBPSPA<sub>t</sub> Total actual non-CO<sub>2</sub> emissions from forest fire at year t in the project area; tCO<sub>2</sub>e/ha

ABSLPA<sub>icl,t</sub> Annual area of deforestation of initial forest classes icl in the project area at year t; ha

EBBtot<sub>icl,t</sub> Total GHG emission from biomass burning in forest class icl at year t; tCO<sub>2</sub>e/ha

Project year t	Emissions of non-CO <sub>2</sub> gases from forest fires in the project scenario				Total ex post actual non-CO <sub>2</sub> emissions from forest fires in the Project area	
	IDcl = 1 Riparian (Aluvial) Dense Tropical Rainforest		IDcl = 2 Regenerated Riparian (Aluvial) Dense Tropical Rainforest under coivara		EBBPSPA <sub>t</sub>	EBBPSPA
	ABSLPA <sub>icl,t</sub>	EBBPSPA <sub>t</sub>	ABSLPA <sub>icl,t</sub>	EBBPSPA <sub>t</sub>	annual	cumulative
	ha	tCO <sub>2</sub> e/ha	ha	tCO <sub>2</sub> e/ha	tCO <sub>2</sub> e	tCO <sub>2</sub> e
2013	111.92	3,726.01	600.01	4,163.66	7,889.67	7,889.67
2014	58.71	1,954.42	600.01	4,163.66	6,118.08	14,007.75
2015	25.14	836.87	600.01	4,163.66	5,000.53	19,008.29
2016	51.82	1,725.25	600.01	4,163.66	5,888.91	24,897.19
2017	67.84	2,258.27	600.01	4,163.66	6,421.93	31,319.12

**Table 29.** Total ex post actual non-CO<sub>2</sub> emissions from forest fires in the project area

**Total ex post project emissions for the project area**

The results of all ex post carbon stock changes and non-CO<sub>2</sub> emissions in the Project area during the monitoring period are summarized in the Table below. As detailed in this Table, the major cause of project emissions within the project area during this monitoring period was the carbon stock decrease due to unavoided unplanned deforestation.

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 <sub>2</sub> emissions from forest fires in the project area	
	annual	cumulat	annual	cumul	annual	cumul	annual	cumulat	annual	cumul
	ΔCPAd PA <sub>t</sub>	ΔCPAd PA	ΔCPAi PA <sub>t</sub>	ΔCPAi PA	ΔCUDd PA <sub>t</sub>	ΔCUDdPA	ΔCPSPA <sub>t</sub>	ΔCPSPA	EBBPS PA <sub>t</sub>	EBBPS PA
	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e
2013	0	0	0	0	85,442	85,442	85,442	85,442	7,890	7,890
2014	0	0	0	0	50,007	135,449	50,007	135,449	6,118	14,008
2015	0	0	0	0	27,717	163,166	27,717	163,166	5,001	19,008
2016	0	0	0	0	45,303	208,469	45,303	208,469	5,889	24,897
2017	0	0	0	0	53,232	261,701	53,232	261,701	6,422	31,319

**Table 30.** 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. However, 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 is 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, as follows.

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

Where,

$\Delta CLPMLK_t$	Carbon stock decrease due to leakage prevention measures at year t; tCO <sub>2e</sub>
$\Delta CBSLLK_t$	Annual carbon stock changes in leakage management areas in the baseline case at year t; tCO <sub>2e</sub>
$\Delta CPSLK_t$	Annual carbon stock change in leakage management areas in the project case; tCO <sub>2e</sub>

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 Ecomapuá Amazon REDD Project in the baseline case, no decrease in carbon stocks due to activities implemented in the leakage management area were identified, thus  $\Delta CBSLLK = 0$ . However, during the current monitoring period, there were carbon stock changes within the leakage management area due to deforestation of regenerated forests. Therefore, the *ex post* carbon stock change in leakage

management areas in the project case ( $\Delta\text{CPSLK}_t$ ) was calculated as follows. The annual values are detailed in the Table below.

$$\Delta\text{CPSLK}_t = \text{APSLK}_{fcl,t} * \Delta\text{Ctot}_{icl}$$

Where,

$\Delta\text{CPSLK}_t$  Annual carbon stock change in leakage management areas in the project case; tCO<sub>2</sub>e

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

$\Delta\text{Ctot}_{icl}$  Average carbon stock change of all accounted carbon pools in forest class icl at time t; tCO<sub>2</sub>e/ha

Project year	Carbon stock changes in leakage management area in the project case			
	ID <sub>fcl</sub>	1	annual	cumulative
	APSLK <sub>fcl,t</sub>	Ctot <sub>fcl,t</sub>	ΔCPSLK <sub>t</sub>	ΔCPSLK
	ha	tCO <sub>2</sub> e/ha	tCO <sub>2</sub> e	tCO <sub>2</sub> e
2013	0.00	183.33	0.00	0.00
2014	0.09	201.67	18.15	18.15
2015	0.00	220.00	0.00	18.15
2016	0.00	238.33	0.00	18.15
2017	0.09	256.67	23.10	41.25

**Table 31.** 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 stock change in the baseline case		Total carbon stock change in the project case		Net carbon stock change due to leakage prevention measures	
	annual	cumulative	annual	cumulative	annual	cumulative
	ΔCBSLLK <sub>t</sub>	ΔCBSLLK	ΔCPSLK <sub>t</sub>	ΔCPSLK	ΔCLPMLK <sub>t</sub>	ΔCLPMLK
	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e
2013	0.00	0.00	0.00	0.00	0.00	0.00
2014	0.00	0.00	18.15	18.15	18.15	18.15
2015	0.00	0.00	0.00	18.15	0.00	18.15
2016	0.00	0.00	0.00	18.15	0.00	18.15
2017	0.00	0.00	23.10	41.25	23.10	41.25

**Table 32.** 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. Therefore, emissions from grazing animals in leakage management areas (EgLK<sub>t</sub>), which calculation is detailed below, equals to zero.

$$EgLK_t = ECH_4ferm_t + ECH_4man_t + EN_2Oman_t$$

Where,

- EgLK<sub>t</sub> Emissions from grazing animals in leakage management areas at year t; tCO<sub>2</sub>e/year
- ECH<sub>4</sub>ferm<sub>t</sub> CH<sub>4</sub> emissions from enteric fermentation in leakage management areas at year t; tCO<sub>2</sub>e/year
- ECH<sub>4</sub>man<sub>t</sub> CH<sub>4</sub> emissions from manure management in leakage management areas year t; tCO<sub>2</sub>e/year
- EN<sub>2</sub>Oman<sub>t</sub> N<sub>2</sub>O emissions from manure management in leakage management areas at year t; tCO<sub>2</sub>e/year
- t 1, 2, 3, ... T years of the project crediting period; dimensionless

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. Besides carbon stock changes, no increase in GHG emissions due to activities implemented in the leakage management area, such as emissions from grazing animals, fertilizer, or fuel use, were identified.

$$ELPMLK_t = EgLK_t + \Delta CLPMLK_t$$

Where,

- ELPMLK<sub>t</sub> Annual total increase in GHG emissions due to leakage prevention measures at year t; tCO<sub>2</sub>e

Project year	Carbon stock decrease due to leakage prevention measures		Total <i>ex post</i> GHG emissions from increased grazing activities		Total <i>ex post</i> increase in GHG emissions due to leakage prevention measures	
	annual $\Delta CLPMLK_t$ tCO <sub>2</sub> e	cumulative $\Delta CLPMLK$ tCO <sub>2</sub> e	annual EgLK <sub>t</sub> tCO <sub>2</sub> e	cumulative EgLK tCO <sub>2</sub> e	annual ELPMLK <sub>t</sub> tCO <sub>2</sub> e	cumulative ELPMLK tCO <sub>2</sub> e
2013	0.00	0.00	0.00	0.00	0.00	0.00
2014	18.15	18.15	0.00	0.00	18.15	18.15
2015	0.00	18.15	0.00	0.00	0.00	18.15
2016	0.00	18.15	0.00	0.00	0.00	18.15
2017	23.10	41.25	0.00	0.00	23.10	41.25

**Table 33.** *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, the GIS analysis led to the conclusion that the deforestation in the leakage belt is not associated with the initiation of the project; 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 is calculated as the difference between the *ex ante* and the *ex post* assessments, as detailed in the Table below.

Project year	Total <i>ex ante</i> net baseline carbon stock change		Total <i>ex post</i> net actual carbon stock change		Total <i>ex post</i> leakage	
	$\Delta\text{CBSLLK}_t$ annual	$\Delta\text{CBSLLK}$ cumulative	$\Delta\text{CBSLLK}_t$ annual	$\Delta\text{CBSLLK}$ cumulative	$\Delta\text{CBSLLK}_t$ annual	$\Delta\text{CBSLLK}$ cumulative
	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>
2013	313,317.84	313,317.84	420,238.08	420,238.08	0.00	0.00
2014	264,768.55	578,086.38	89,946.68	510,184.75	0.00	0.00
2015	255,599.50	833,685.89	72,036.23	582,220.98	0.00	0.00
2016	228,020.67	1,061,706.56	139,867.73	722,088.71	0.00	0.00
2017	223,082.95	1,284,789.51	168,056.13	890,144.84	0.00	0.00

**Table 34.** Total net carbon stock change in the leakage belt

Furthermore, the monitoring of increases in GHG emissions within leakage belt ( $\text{EADLK}_t$ ) was also carried out. However, as could be observed in the table above, no increase in GHG emissions within the leakage belt happened, thus non-CO<sub>2</sub> emissions from biomass burning in the leakage belt were not associated with the project activity. The table below shows the *ex post* non-CO<sub>2</sub> emissions from forest fires in the leakage belt area.

Project year t	Emissions of non-CO <sub>2</sub> gases from displaced forest fires in the leakage belt		Total ex post non-CO <sub>2</sub> emissions from forest fires in the leakage belt	
	ID <sub>cl</sub> = 1 Riparian (Aluvial) Dense Tropical Rainforest		annual	cumulative
	ABSLLK <sub>t</sub>	EBBtot <sub>cl</sub>	EADLK <sub>t</sub>	EADLK
	ha	tCO <sub>2</sub> e/ha	tCO <sub>2</sub> e	tCO <sub>2</sub> e
2013	0.00	33.29	0.00	0.00
2014	0.00	33.29	0.00	0.00
2015	0.00	33.29	0.00	0.00
2016	0.00	33.29	0.00	0.00
2017	0.00	33.29	0.00	0.00

**Table 35.** Ex post estimated non-CO<sub>2</sub> emissions from forest fires in the leakage belt area

**Ex post estimation of total leakage**

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

$$\Delta\text{CLK}_t = \Delta\text{CLPMLK}_t + \Delta\text{CADLK}_t$$

Where:

- $\Delta\text{CLK}_t$  Total decrease in carbon stocks within the leakage belt at year t; tCO<sub>2</sub>e
- $\Delta\text{CLPMLK}_t$  Carbon stock decrease due to leakage prevention measures at year t; tCO<sub>2</sub>e
- $\Delta\text{CADLK}_t$  Total decrease in carbon stocks due to displaced deforestation at year t; tCO<sub>2</sub>e

$$\text{ELK}_t = \text{EgLK}_t + \text{EADLK}_t$$

Where:

- $\text{ELK}_t$  Sum of ex post leakage emissions at year t; tCO<sub>2</sub>e
- $\text{EgLK}_t$  Emissions from grazing animals in leakage management areas at year t; tCO<sub>2</sub>e
- $\text{EADLK}_t$  Total ex post increase in GHG emissions due to displaced forest fires at year t; tCO<sub>2</sub>e

The results of all ex post estimations of leakage are summarized in the table below. As can be seen, during the current monitoring period, there was leakage due to decrease in carbon stocks within the leakage management area. Therefore, such emissions were discounted due to leakage during this monitoring period. The calculated values of  $\Delta\text{CLK}_t$  and  $\text{ELK}_t$  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 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	cumul	annual	cumulat	annual	cumulat	annual	cumul	annual	cumul	annual	cumulat
	EgLK <sub>t</sub>	EgLK	EADLK <sub>t</sub>	EADLK	ΔCADLK <sub>t</sub>	ΔCADLK	annual ΔCLPM LK <sub>t</sub>	cumul ΔCLPM LK	ΔCLK <sub>t</sub>	ΔCLK	ELK <sub>t</sub>	ELK
	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>	tCO <sub>2e</sub>
2013	0	0	0	0	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	18	18	18	18	0	0
2015	0	0	0	0	0	0	0	18	0	18	0	0
2016	0	0	0	0	0	0	0	18	0	18	0	0
2017	0	0	0	0	0	0	23	41	23	41	0	0

**Table 36.** Total ex post estimated leakage

## 5.4 Net GHG Emission Reductions and Removals

The ex post 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 estimated net anthropogenic greenhouse gas emission reduction attributable to the AUD project activity at year t; tCO<sub>2e</sub>

$\Delta CBSLPA_t$  Sum of baseline carbon stock changes in the project area at year t; tCO<sub>2e</sub>

$EBBBSLPA_t$  Sum of baseline emissions from biomass burning in the project area at year t; tCO<sub>2e</sub>

$\Delta CPSPA_t$  Sum of ex post estimated actual carbon stock changes in the project area at year t; tCO<sub>2e</sub>

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<sub>2e</sub>

$\Delta CLK_t$  Sum of ex post estimated leakage net carbon stock changes at year t; tCO<sub>2e</sub>

Note: If the cumulative sum of  $\Delta CLK_t$  within a fixed baseline period is > 0,  $\Delta CLK_t$  shall be set to zero.

$ELK_t$  Sum of ex post estimated leakage emissions at year t; tCO<sub>2e</sub>

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

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

$$VCU_t = \Delta REDD_t - VBC_t$$

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

Where:

VCU <sub>t</sub>	Number of Verified Carbon Units that can be traded at time t; t CO <sub>2</sub> e
ΔREDD <sub>t</sub>	<i>Ex post</i> estimated net anthropogenic greenhouse gas emission reduction attributable to the AUD project activity at year t; tCO <sub>2</sub> e
VBC <sub>t</sub>	Number of Buffer Credits deposited in the VCS Buffer at time t; t CO <sub>2</sub> e
ΔCBSLPA <sub>t</sub>	Sum of baseline carbon stock changes in the project area at year t; tCO <sub>2</sub> e
ΔCPSPA <sub>t</sub>	Sum of <i>ex post</i> estimated actual carbon stock changes in the project area at year t; tCO <sub>2</sub> e ha <sup>-1</sup>
RF <sub>t</sub>	Risk factor used to calculate VCS buffer credits; %

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

The RF<sub>t</sub> was estimated using the most recent version of the VCS-approved AFOLU Non-Permanence Risk Tool and the resulting value of RF<sub>t</sub> for the present REDD project during the current monitoring period was 10%.

The specific summary of GHG reductions and removals from the Ecomapuá Amazon REDD project during the current monitoring period is included in the Table below. The latter table includes estimates of GHG emissions reduction (REDD<sub>t</sub>), calculations of buffer and leakage, and the resulting calculation of tradable Verified Carbon Units (VCU<sub>t</sub>).

Project year	Baseline carbon stock changes		Baseline GHG emissions from biomass burning		Ex post project carbon stock changes		Ex post project GHG emissions from biomass burning		Ex post leakage carbon stock changes		Ex post leakage GHG emissions		Ex post net anthropogenic GHG emission reductions		Ex post VCUs tradable		Ex post buffer credits	
	annual	cumulative	annual	cumulat	annual	cumulat	annual	cumulat	annual	cumulat.	annual	cumul.	annual	cumulat.	annual	cumulat.	annual	cumulat.
	$\Delta\text{CBSL PA}_t$	$\Delta\text{CBSLPA}$	EBBBSL $\text{PA}_t$	EBBBSL PA	$\Delta\text{CPSPA}_t$	$\Delta\text{CPSPA}$	EBBPS $\text{PA}_t$	EBBPS PA	$\Delta\text{CLK}_t$	$\Delta\text{CLK}$	$\text{ELK}_t$	ELK	$\Delta\text{REDD}_t$	$\Delta\text{REDD}$	$\text{VCU}_t$	VCU	$\text{VBC}_t$	VBC
tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	tCO <sub>2</sub> e	
2013	110,157	110,157	3,621	3,621	85,442	85,442	7,890	7,890	0	0	0	0	20,446	20,446	17,975	17,975	2,472	2,472
2014	99,758	209,916	3,227	6,848	50,007	135,449	6,118	14,008	18	18	0	0	46,843	67,289	41,867	59,842	4,975	7,447
2015	97,371	307,287	3,373	10,221	27,717	163,166	5,001	19,008	0	18	0	0	68,027	135,316	61,061	120,903	6,965	14,412
2016	83,177	390,465	2,820	13,041	45,303	208,469	5,889	24,897	0	18	0	0	34,805	170,121	31,017	151,920	3,787	18,200
2017	82,724	473,189	2,921	15,962	53,232	261,701	6,422	31,319	23	41	0	0	25,969	196,090	23,019	174,939	2,949	21,149

**Table 37.** Ex post estimated net anthropogenic GHG emission reductions and VCU

The net GHG emission reductions and removals in the Ecomapuá Amazon REDD Project are summarized in the Table below.

Year	Baseline emissions or removals (tCO <sub>2</sub> e)	Project emissions or removals (tCO <sub>2</sub> e)	Leakage emissions (tCO <sub>2</sub> e)	Net GHG emission reductions or removals (tCO <sub>2</sub> e)	Buffer pool allocation	VCUs eligible for issuance
2013	113,778	93,332	0	20,446	2,472	17,975
2014	102,985	56,125	18	46,843	4,975	41,867
2015	100,745	32,718	0	68,027	6,965	61,061
2016	85,997	51,192	0	34,805	3,787	31,017
2017	85,646	59,654	23	25,969	2,949	23,019
<b>Total</b>	<b>489,151</b>	<b>293,020</b>	<b>41</b>	<b>196,090</b>	<b>21,149</b>	<b>174,939</b>

**Table 38.** Net GHG emission reductions and removals in the Ecomapuá Amazon REDD Project

# APPENDIX I: PROJECT AREA CONTOUR COORDINATES

Project Area Contour Coordinates																							
UTM 22S, Datum WGS84																							
#	X	Y	#	X	Y	#	X	Y	#	X	Y	#	X	Y	#	X	Y						
1	566667	988487	249	578345	9876903	497	584105	9873243	745	586569	9867183	993	594666	9863308	1241	589055	9865233	1489	554255	9882753	1737	578915	9877413
2	566842	9884680	250	578345	9876933	498	584105	9873183	746	586618	9867117	994	594365	9863361	1242	589085	9865233	1490	554315	9882753	1738	578885	9877413
3	567335	9884073	251	578405	9876933	499	584165	9873183	747	586625	9867113	995	594365	9863373	1243	589085	9865263	1491	554315	9882723	1739	578885	9877383
4	567335	9884073	252	578405	9876963	500	584165	9873153	748	586625	9867093	996	594335	9863373	1244	589145	9865263	1492	554375	9882723	1740	578825	9877383
5	567345	9884073	253	578465	9876963	501	584195	9873153	749	586655	9867093	997	594335	9863403	1245	589145	9865293	1493	554375	9882693	1741	578825	9877353
6	567365	9884048	254	578465	9876993	502	584195	9873123	750	586655	9867093	998	594305	9863403	1246	589097	9865293	1494	554465	9882693	1742	578795	9877353
7	567365	9884043	255	578495	9876993	503	584225	9873123	751	586655	9867033	999	594305	9863371	1247	589246	9865489	1495	554465	9882663	1743	578795	9877323
8	567369	9884043	256	578495	9877023	504	584225	9873093	752	586685	9867033	1000	594228	9863384	1248	589265	9865508	1496	554495	9882663	1744	578765	9877323
9	568557	9882608	257	578555	9877023	505	584255	9873093	753	586685	9867003	1001	593586	9863435	1249	589265	9865413	1497	554495	9882633	1745	578765	9877293
10	568819	9881740	258	578555	9877053	506	584255	9873063	754	586715	9867003	1002	593282	9863454	1250	589295	9865413	1498	554525	9882633	1746	578735	9877293
11	569597	9878457	259	578585	9877053	507	584285	9873063	755	586715	9866973	1003	593255	9863456	1251	589295	9865293	1499	554525	9882603	1747	578735	9877275
12	569105	9876858	260	578585	9877083	508	584285	9873033	756	586775	9866973	1004	593255	9863493	1252	589265	9865293	1500	554585	9882603	1748	578668	9877280
13	569105	9876933	261	578615	9877083	509	584405	9873033	757	586775	9866943	1005	593225	9863493	1253	589265	9865263	1501	554585	9882573	1749	578909	9877551
14	569045	9876933	262	578615	9877113	510	584405	9873003	758	586835	9866943	1006	593225	9863458	1254	589295	9865263	1502	554615	9882573	1750	577997	9877690
15	569045	9876903	263	578675	9877113	511	584435	9873003	759	586835	9866913	1007	593165	9863462	1255	589295	9865173	1503	554615	9882543	1751	577749	9877961
16	569015	9876903	264	578675	9877143	512	584435	9872973	760	586925	9866913	1008	593165	9863523	1256	589325	9865173	1504	554645	9882543	1752	577577	9878358
17	569015	9876873	265	578705	9877143	513	584495	9872973	761	586942	9866901	1009	593225	9863523	1257	589325	9865143	1505	554645	9882513	1753	577431	9878576
18	568985	9876873	266	578705	9877173	514	584495	9872943	762	587323	9866889	1010	593225	9863553	1258	589355	9865143	1506	554705	9882513	1754	577325	9878659
19	568985	9876813	267	578735	9877173	515	584525	9872943	763	587458	9867003	1011	593255	9863553	1259	589385	9865143	1507	554705	9882483	1755	577325	9878673
20	569091	9876813	268	578735	9877190	516	584525	9872913	764	587465	9867003	1012	593255	9863583	1260	589385	9865083	1508	554735	9882483	1756	577325	9878673
21	569045	9876662	269	578762	9877203	517	584585	9872913	765	587465	9866943	1013	593225	9863583	1261	589415	9865083	1509	554735	9882453	1757	577355	9878703
22	569045	9876663	270	578765	9877203	518	584585	9872883	766	587435	9866943	1014	593225	9863613	1262	589415	9865023	1510	554795	9882453	1758	577269	9878703
23	569015	9876663	271	578765	9877204	519	584615	9872883	767	587435	9866913	1015	593195	9863613	1263	589355	9865023	1511	554795	9882423	1759	577100	9878834
24	569015	9876693	272	578823	9877233	520	584615	9872853	768	587465	9866913	1016	593195	9863643	1264	589355	9864993	1512	554825	9882423	1760	576584	9878967
25	568985	9876693	273	578825	9877233	521	584645	9872853	769	587465	9866943	1017	593165	9863643	1265	589385	9864993	1513	554825	9882393	1761	576062	9878980
26	568985	9876663	274	578825	9877234	522	584645	9872793	770	587555	9866943	1018	593165	9863673	1266	589385	9864963	1514	554885	9882393	1762	575817	9878814
27	568925	9876663	275	578885	9877266	523	584675	9872793	771	587555	9867003	1019	593105	9863673	1267	589445	9864963	1515	554885	9882363	1763	575480	9878662
28	568925	9876693	276	578885	9877266	524	584675	9872763	772	587525	9867003	1020	593105	9863613	1268	589475	9864963	1516	554915	9882363	1764	575162	9878861
29	568955	9876693	277	578885	9877293	525	584705	9872763	773	587525	9866973	1021	593075	9863613	1269	589475	9864933	1517	554915	9882333	1765	574765	9879297
30	568955	9876753	278	578885	9877293	526	584705	9872733	774	587495	9866973	1022	593075	9863583	1270	589505	9864933	1518	554945	9882333	1766	574296	9879240
31	568835	9876753	279	578885	9877323	527	584735	9872733	775	587495	9867003	1023	593105	9863583	1271	589505	9864873	1519	554945	9882303	1767	574183	9880137
32	568835	9876723	280	578945	9877323	528	584735	9872553	776	587465	9867003	1024	593105	9863466	1272	589535	9864873	1520	555005	9882303	1768	574144	9880481
33	568865	9876723	281	578945	9877353	529	584765	9872553	777	587465	9867003	1025	592913	9863480	1273	589535	9864843	1521	555005	9882273	1769	574150	9880845
34	568865	9876693	282	578975	9877353	530	584765	9872523	778	587526	9867060	1026	592723	9863372	1274	589565	9864843	1522	555065	9882273	1770	574091	9881096
35	568895	9876693	283	578975	9877383	531	584779	9872523	779	587691	9867244	1027	592450	9863137	1275	589565	9864783	1523	555065	9882243	1771	574038	9881440
36	568895	9876663	284	579005	9877383	532	584780	9872493	780	587784	9867363	1028	592234	9863111	1276	589595	9864783	1524	555125	9882243	1772	573813	9881632
37	568925	9876663	285	579005	9877413	533	584735	9872493	781	587795	9867363	1029	592043	9863149	1277	589595	9864781	1525	555125	9882213	1773	573724	9881697
38	568925	9876573	286	579095	9877413	534	584735	9872313	782	587795	9867377	1030	591978	9863175	1278	589595	9864723	1526	555185	9882213	1774	573729	9881716
39	568955	9876573	287	579095	9877443	535	584765	9872313	783	587806	9867390	1031	591978	9863185	1279	589622	9864723	1527	555185	9882183	1775	573705	9881710
40	568955	9876543	288	579215	9877443	536	584765	9872103	784	588091	9867384	1032	591805	9863361	1280	589625	9864719	1528	555245	9882183	1776	573591	9881684
41	568985	9876543	289	579215	9877413	537	584795	9872103	785	588498	9867358	1033	591632	9863376	1281	589625	9864693	1529	555245	9882153	1777	572870	9881521
42	568985	9876573	290	579245	9877413	538	584795	9871953	786	588755	9867353	1034	591479	9863693	1282	589647	9864693	1530	555365	9882153	1778	573288	9881883
43	569015	9876573	291	579242	9877396	539	584825	9871953	787	588755	9867333	1035	591425	9863711	1283	589655	9864683	1531	555365	9882123	1779	573369	9881953
44	569015	9876603	292	579487	9877334	540	584825	9871833	788	588839	9867333	1036	591425	9863733	1284	589655	9864633	1532	555365	9882123	1780	573369	9881953
45	569027	9876603	293	579785	9877244	541	584855	9871833	789	588875	9867317	1037	591415	9863733	1285	589685	9864633	1533	555635	9882153	1781	573255	9882223
46	568895	9876155	294	579785	9877233	542	584855	9871623	790	588875	9867303	1038	591515	9863763	1286	589685	9864603	1534	555755	9882153	1782	573255	9882223
47	569712	9875488	295	579823	9877233	543	584885	9871623	791	588906	9867303	1039	591665	9863763	1287	589715	9864603	1535	555755	9882178	1783	573255	9884193
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88	574835	9878343	336	581795	9877473	584	584595	9869613	832	590015	9866673	1080	594155	9863763	1328	566645	9869163	1576	558424	9884027	1824	619135	9851652
89	574865	9878343	337	581825	9877473	585	584585	9869613	833	590045	9866673	1081	594185	9863763	1329	566645	9869253	1577	558475	9884043	1825	617346	9851588
90	574865	9878343	338	581825	9877443	586	584585	9869597	834	590045	9866643	1082	594185	9863733	1330	566675	9869253	1578	558485	9884043	1826	616774	9851445
91	574835	9878343	339	581855	9877443	587	584548	9869536	835	590075	9866643	1083	594215	9863733	1331	566675	9869223	1579	558485	9884046	1827	607129	9843120
92	574835	9878347	340	581855	9877413	588	584541	9869433	836	590075	9866703	1084	594215	9863703	1332	566705	9869223	1580	558735	9884122	1828	605465	9842371
93	574972	9878503	341	581885	9877413	589	584525	9869433	837	590045	9866703	1085	594245	9863703	1333	566705	9869253	1581	559205	9884332	1829	605465	9842371
94	575220	9878541	342	581885	9877383	590	584525	9869433	838	590045	9866733	1086	594245	9863673	1334	566675	9869253	1582	559542	9884503	1830	605435	9842373
95	575391	9878547	343	581915	9877383	591	584495	9869433	839	590015	9866733	1087	594275	9863673	1335	566675	9869283	1583	559764	9884618	1831	605435	9842373
96	575594	9878534	344	581915	9877353	592	584465	9869433	840	590015	9866763	1088	594275	9863583	1336	566615	9869283	1584	560291	9884662	1832	605375	9842403
97	575615	9878529	345	581945	9877353	593	584465	9869433	841	589985	9866763	1089	594305	9863583	1337	566615	9869183	1585	560615	9884644	1833	605375	9842373
98	575615	9878523	346	581945	9877293	594	584495	9869433	842	589985	9866823	1090	594305	9863433	1338	566585	9869209	1586	560615	9884643	1834	605315	9842373
99	575635	9878523	347	581975	9877293	595	584495	9869433	843	589925	9866823	1091	594335	9863433	1339	566454	9868727	1587	560637	9884643	1835	605315	9842313
100	575705	9878503	348	581975	9877263	596	584465	9869433	844	589925	9866853	1092	594335	9863523	1340	562505	9871999	1588	561241	9884599	1836	605335	9842313
101	575705	9878493	349	582005	9877263	597	584465	9869523	845	589865	9866853	1093	594365	9863523	1341	562505	9872043	1589	561635	9884583	1837	605788	9838466
102	575739	9878493	350	582005	9877173	598	584405	9869523	846	589865	9866883	1094	594365	9863553	1342	562535	9872043	1590	561635	9884583	1838	600263	9849783
103	575825	9878468	351	582035	9877173	599	584405	9869553	847	589805	9866883	1095	594335	9863553	1343	562535	9872073	1591	561642	9884583	1839	600275	9849783
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